State of the Environment Report for Malta 1998

Submitted to the

Environment Protection Department

Through

The Malta Council for Science and Technology

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April 1999

CONTINUE

DISCLAIMER

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This STATE OF THE ENVIRONMENT REPORT - 1998 is a comprehensive report about the local environment and has been commissioned by the ENVIRONMENT PROTECTION DEPARTMENT, through the MALTA COUNCIL FOR SCIENCE AND TECHNOLOGY (MCST). In their turn, the MCST commissioned a panel of independent experts who, in their individual capacity contributed on specific subject areas.

The panel of experts was composed as follows:-

Victor Axiak - The Coast and Frechwater Resources, Liquid Waste and Panel Co-ordinator)
Vincent Gauci – Solid Waste, Environmental Policy and Education
Adrian Mallia – Population, Tourism, Landuse and Non-renewable Resources
Edward Mallia - Energy
Patrick J. Schembri – Living Resources, Fisheries and Agriculture
Alfred J. Vella – Air Quality

Other experts contributed on particular sections of the report.

This report is intended to be one of a series of such periodic reports which will enable the general public to evaluate the state of the environment in the Maltese Islands.

Although the report was financed from public funds, the report does not necessarily reflect official views. Moreover, the Environment Protection Department is not responsible for any use or misuse of the information included in this report.

The Environment Protection Department would appreciate receiving copies of all articles and publications where the State of the Environment Report is referred to.

V. Gauci
A/Director
Environment Protection Department

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PREFACE

All activities of Man have an impact on the local and global environment. It has become increasingly important to gauge these impacts, both because these impacts are becoming more and more significant and also because Man's expectations have increased more than ever before in the last ten years.

Moreover, the aspect of sustainability, that is whether what we are doing today to satisfy our needs will have an impact on future generations, has become an over-riding concern. It is therefore important that all decisions are taken with an informed mind.

For this to be possible, there must be accurate and accessible information about the state of our environment. Indeed, in signing the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters in December 1998, Malta has pledged amongst other things to keep the public informed about the state of the environment.

This is precisely the scope of this report, which intends to be one of a series of regular snap-shots of the state of the local environment. Such reports will facilitate a co-ordinated response to be made and eventually will enable trends to be discerned.

While the report shows that there is considerable work still to be done in the environmental field, it is nevertheless a milestone towards achieving sustainable development.

The Hon. F. Zammit Dimech LLD, MP
Minister for the Environment

The Hon. F. Zammit Dimech
Minister for the Environment
12th August, 1999

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1. INTRODUCTION

Background and Past Initiatives

Environmental issues are becoming so complex that very often the policy-maker is forced either into an approach of management by crises, or to deal with such issues in an '*ad hoc*' manner.

On the other hand it is self evident that corrective, or pro-active action in environmental protection and management may only be based on correct information about the state of the environment. The fact that very often much of the information may be lacking (as is the case in Malta) makes it even more important to present the limited information which may be available, directly to the policy maker in a format which is easily understood and upon which concrete action may be taken.

Reporting on the state of the environment (SoE) was first developed in the early 1970s in USA, Japan and other countries. Since their inception, such SoE reports were always intended to present information to different audiences (ranging from policy makers, to the general public) in order to facilitate decision making ranging from setting environmental policies to voting choices.

The adoption of Agenda 21 at the 1992 United Nations Conference on Environment and Development served as an added impetus to the regular publication of such SoE reports in various countries. Chapter 40 of Agenda 21 specifically calls for improved environmental information for decision-making. In fact, a National Committee prepared a Malta's National Report in 1992 as required by the UN of member states, which participated in the Rio Conference. This report was a significant attempt in the right direction, though it generally lacked the necessary technical level of information, which is usually found in such reports. In any case, as often happen, the 1992 Report was prepared solely to fulfil Malta's obligation to the UN. It was a one-of initiative, and it had not been reviewed since then.

In 1993, the Environment Protection Department commissioned (through EU LIFE funds) the consultancy firms OMI (Malta) Ltd., and Montgomery Watson to prepare an internal environmental audit for governmental bodies and a SoE. Such reports were concluded in 1994. More recently, in 1997 the Department of Health Policy and Planning with the co-operation of the Environment Protection Department prepared a National Environmental Health Action Plan for Malta. Though such an Action Plan had several elements of a SoE report, it was focused on environmental health and was more action oriented. In 1997, we also witnessed a non-governmental initiative in SoE reporting when a discussion paper entitled Towards Sustainable Europe, Sustainable Malta was published by Moviment ghall-Ambjent – Friends of the Earth. This discussion paper included synoptic reviews of various aspects of our environment.

The Present Project

In 1998, the Environment Protection Department recognized the need for a more coherent and regular programme of reporting on the SoE. Subsequently it commissioned the Malta Council for Science and Technology to prepare a SoE Report, which would serve as a tool for environmental management. It would seek to translate a scientific assessment and evaluation of the current state of the environment into a format, which could be intelligently used by policy and decision-makers. It was also to include **a** non-technical synopsis addressed to the general public. This synopsis could serve as a useful tool in the current initiatives being undertaken for environmental education and sensitization programmes.

The original objectives of this SoE Report were to:

a) Review and validate the available information on environmental quality;
b) Identify the desired national environmental quality objectives for air, water, soil, and sea;
c) Identify the criteria and indices to be used to assess environmental quality of Malta and Gozo;
d) Apply such criteria and indices to the to available data so as to assess the present state of quality of the environment, and to identify trends;
e) Identify in order of priority, the corrective and pro -active action that needs to be taken in order to protect and enhance such quality.

The actual compilation and preparation of this report was entrusted to a Panel of Experts including the following members:

Prof. Victor Axiak (Co-ordinator)
Mr. Vincent Gauci
Mr Adrian Mallia
Prof. Edward Mallia
Prof. Patrick J. Schembri
Prof. Alfred Vella.

The Panel held a number of meetings and each panel member was assigned the responsibility of preparing one or more sections of the report. In turn, each panel member formed a team of collaborators who assisted in the identification and compilation of the data on specific themes. In the meantime, all governmental entities were officially requested by the Minister of responsible for the Environment to assist the Panel in such an initiative, by providing the requested information and data.

Every member of the Panel contributed to the present initiative, in his personal capacity. Any views and opinions expressed in this report do not necessary represent the official views of any of the employers of the Panel members or of their collaborators. The responsibilities for the contents of the individual sections of this report lie solely with the respective Team Leaders.

As the work progressed, it became evident that in order to produce a product of the required level and relevance, the Panel could only address its efforts to some of the stated objectives. This report therefore focuses on:

a) reviewing the information available up till 1997;
b) assessing the reliability of such information and data;
c) assessing the present status and identify trends;
d) make general recommendations and identify priorities.

The first findings of the Panel were presented to the Minister for the Environment in a special seminar held on the 2nd March 1998. The present report represents the technical findings as addressed to our policy and decision-makers. It fulfils the objectives as revised above. It is being submitted to the Environment Protection Department through the Malta Council for Science and Technology.

The Report includes a brief overview of the findings and recommendations on future SoE reporting for Malta, in its concluding section.

We now await the Minister’s instructions on how to proceed with the Synoptic Report, which is to be addressed to the general public.

Professor Victor Axiak,

STATE OF THE ENVIRONMENT REPORT,
Panel Co-ordinator, 5 April 1999

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2. POPULATION, TOURISM, LAND-USE AND NON-RENEWABLE RESOURCES

Team Leader: Adrian Mallia

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Saviour Formosa (Population)

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2. POPULATION, TOURISM, LAND-USE AND NON-RENEWABLE RESOURCES

Introduction

In April 1998, the above team was given the responsibility for the section concerning land-use and landscape. This was later widened to include population, tourism and non-renewable resources (quarrying and salt extraction).

After the change in the national administration in late 1998, the new Ministry for the Environment confirmed its intention to carry on with this project.

Under the heading *"Population, Tourism, Land-Use and Non-Renewable Resources"*, the following will be considered: population change, household sizes, migration, housing, the built environment, the historic environment, urban conservation areas, archaeology, scheduling, tourism, the coastal environment, land and sea use, geology, quarrying, landscape and seascape, environmental impact assessment and enforcement action.

As the work progressed it became very obvious that it would not be possible to meet all the original objectives of the State of the Environment Report (as stated in Part 1) for a number of reasons, principally in view of a lack of information in a number of cases. Hence it was decided that in view of these difficulties and the short time frame within which the report had to be prepared, this part of the report would therefore focus on reviewing available information, assessing the present status and as far as possible identifying trends. In the absence of stated national environmental objectives it is difficult to make detailed recommendations to meet such objectives, therefore only general recommendations are made. The information provided here can be used both as a baseline account with which to compare future State of the Environment reports as well as a basis for formulating indices for assessing environmental quality and national environmental quality objectives.

2.1 The Maltese Islands

The Maltese Islands have a total land area of c. 316 km^2, a coastline of 190 km and a resident population of 376,335 (in 1995[1]). These statistics make Malta one of the smallest countries in the world with one of the highest population densities.

Table 2.1.1 - Land Areas for the Maltese Archipelago

Mainland Malta	245,728 km^2
Gozo	67,078 km^2
Comino	2,784 km^2
Filfla	0.020 km^2
Selmunett Islands	0.101 km^2
Fungus Rock	0.007 km^2
Total	315,718 km^2

Source: Malta Structure Plan (1990); Report of Survey Vol. 2 Part N

The first signs of human presence on the islands date back to over 7000 years BP. The exploitation of the land over the years, for a variety of uses from hunting and agricultural activity to industrial

[1] *1995 was the year the last population census was carried out.*

development to spiritual and recreational activities, has resulted in significant changes to the landscape in order to satisfy the existing and emerging needs of the population. When the islands were opened to tourism in the latter half of this century, the associated development of new facilities and infrastructure lead to further pressures on the limited resources of the country.

With an expanding population, an ever increasing tourist arrivals figure and diminishing unbuilt land area, land availability is possibly one of the most pressing environmental concerns in the Maltese Islands. This does not only result in increased pressures for "virgin" land to be used up but also in periodic "suggestions" in the press for sea reclamation to increase the "territory" of the Maltese Islands. If such a "suggestion" is taken up, it may result in extensive impacts on the marine environment in terms of water quality, loss of biodiversity, impacts on fisheries, and so on. This not to mention the fact that reclamation would have to be effected with construction and demolition waste or quarried rock that is, in itself, an important natural resource.

Hence, an efficient use of the limited land and its resource is of paramount importance to a country like Malta. The following is an overview of the major land-uses in the Maltese Islands.

2.2. Population

2.2.1 Introduction

A brief overview of factors affecting population characteristics, shows that the Maltese population is undergoing a relatively high net-migration balance coupled by a slowdown in the natural population growth, an increase in the number of households, continuous internal migration, a growing ageing population and varying cohort changes in the school age and working age populations.

2.2.2 Population Change

The population structure of the Maltese Islands can be stated to be in a continuous state of flux, one that is rapidly emulating the situation experienced by western countries where birth rates stabilised or decreased, death rates decreased, and an ageing population emerged. In addition to these factors, Malta has experienced fluctuating changes in the international migration component, with the latest movement indicating an increased rate of immigration, decreasing emigration, and naturalisation of foreign persons.

The Maltese population currently stands at around 379000 with an annual growth rate of 1% for the inter-census period 1985-1995. This is twice the amount registered between 1967 and 1985 where an increase of 0.5% per year was registered. In real terms, over the period 1985 to 1995 the Maltese population experienced an increase of over 3000 persons or an increase of 10%, whereas over the 28 year period from 1967 - 1995 the population grew by 19%. The figures indicate a numeric growth from 314000 in 1967 to 345000 in 1985 in turn to 379000 in 1995.

This growth can be considered to be similar to what is happening in western countries, with the added effect that while low mortality rates and incoming international migrants are keeping the population in a state of growth, the long-term impacts on the working and social service scenarios are deemed to be considerable. This is mainly due to the fact that the larger part of incoming international migrants are composed of returned Maltese migrants who in their totality can be termed to be in the higher age cohorts. While some of these components are looked into in other sections of this paper, this issue calls for further research, which is beyond the scope of this report. Table 2.2.2.1 summarises the above.

Table 2.2.2.1 - Total Population Data Summary

Year	Population (Year End)	Annual Natural Increase (for specified year)	Annual Migration Balance (for specified year)	Annual Total Change (for specified year)	Annual % Change (for specified year)
1990	355,910	2,623	857	3,480	0.99%
1995	372,135	2,174	839	3,013	0.82%

Source: Population Estimates - Strategic Planning Unit, Planning Authority

2.2.3 Population Density

Considering the fact that the land area of the Maltese Islands totals 316km^2 and that some of its smaller islands are uninhabitable, the current population density tops that of most densely populated countries. The Islands have a population density of 1200 persons per square kilometer. In fact, Malta stands third in the world list of most dense countries and first in Europe, internationally surpassed only by Macau and Singapore. Following the proposed re-integration of Macau with China, Malta's position as to nearly topping the world's density charts will be undisputed.

This situation is even more acute when one considers the fact that Malta has a population density of over 1400 pers/km^2 and Gozo has over 420 pers/km^2, the latter figure comparing to that of the highest European country.

Appendix 1 gives an outlines of the population densities for all the Local Councils in the Maltese Islands.

2.2.4 Decreasing Household Size

The average household size of the Maltese Islands has been decreasing steadily over the last years and is projected to continue decreasing over the coming years. Such a situation leads to the need for increased provision of services, amenities, housing, transport and other needs which directly and indirectly affect the natural and social environment.

The decrease in household size is mainly based on the increasing number of elderly persons living alone where few would opt to move into smaller residences, thus continuing to live in over-sized dwellings which would otherwise be utilised by younger and larger families. This issue brings to the fore a related issue that impinges on household mobility. A person who moves into a new house generally lives there till that same person dies. The dwelling size does not reflect household size creating stress on house hunters since very often the only option would be to build on new virgin land. In addition an increase in single-person households is expected to occur. Thus the decrease in household size without a parallel increase in household mobility will further stress the diminishing and precious land resources.

Projected forecasts[2] show that by 2010, (as indicated in Table 2.2.4.1) an estimated 29,000 additional households would be created. This figure includes potential migrants as well as foreign residents living in Malta.

Table 2.2.4.1 - Household Data

Household Data - Key Figures	
Households 1990	111,572
Households 2010	140,871
Total Increase 1990-2010	+26%
HH head in the 15-59 age group	+23%
HH head in the 60+ age group	+53%

Source: Population Estimates - SPU, Planning Authority

Table 2.2.4.2 indicates the population and household changes envisaged for 1985, 1995 and 2010. It can be seen that both population and households are set to increase faster than estimated, mainly due to longevity, net migration and household size.

Household size has decreased from 3.25 in 1985 to 3.17 in 1995. This substantial decrease confirms the above. Table 2.2.4.2 gives a brief description of population and household changes from 1985 to 2010. The data projections indicate a further decrease in household size, together with a corresponding increase in the number of projected households.

Table 2.2.4.2 - Population and Household Changes (1985-2010)

	Total Population in Private HH		**Households**		**Mean Household Size**	
Yr. End	Revised forecasts by the PA	SP estimates	Revised forecasts by the PA	SP estimates	Revised forecasts by the PA	SP estimates
1985	340,909	340,559	104,751	104,751	3.25	3.25
1995	379,000		120,000		3.17	
2010	398,694	393,984	143,329	136,814	2.78	2.88

Source: Population Estimates - Strategic Planning Unit, Planning Authority

When these figures are considered against the need to develop more land needed for housing, studies carried out at the Planning Authority indicate that[3] a demand exists for a requirement for 34,670 units for the period 1990-2010, incorporating the projected acceleration in population growth. Table 2.2.4.3 gives a graphic description of the number of dwellings which would be required over the period 1990-2010 by category.

Table 2.2.4.3: Additional dwellings needed (1990-2010)

[2] *Forecasts carried out by the Strategic Planning Unit, Planning Authority, Malta, 1997*
[3] *Structure Plan Monitoring Report 1990 -1995. Planning Authority, Malta, March 1997*

New Dwellings	Reason
28,395	New Maltese households formed, 1990-2010 (excluding the proportion sharing a dwelling)
5,580	Additional second homes and holiday homes required by 2010. These are mostly second homes, since very few additional tourist units are being licensed
690	Balance of additional vacant dwellings ‘required’, after an allowance for additional ‘slack’, to permit the smooth functioning of the enlarged housing market , and a modest reduction in the number of other vacant units
34,670	TOTAL new dwellings required, central scenario

Source: Structure Plan Monitoring Report (1990-95), Planning Authority

2.2.5 Population Aged Less Than 15 Years

The Maltese population aged less than 15 years is expected to change from approximately 82,000 in 1990 to 78,000 in 2010, implying a decrease of 5%. Such a situation, where the size of the population in the reproductive age groups declines, indicates a continuing long-term decrease in the natural growth rate of the Maltese population. In turn, the size of the future labour force available to sustain continued economic growth will be curtailed, stressing the economy even further. This situation is further elaborated in the section below.

2.2.6 Working Population

The population sector within the 15-59 age groups is seen as the demographic fulcrum around which the economic system revolves. With a rapidly ageing population, there is a felt need for an increase in the level of in-migration in the form of workers.

One must note that the population aged between 15-59 is likely to stabilise around the year 2000, then start declining, implying the demand for the availability of the labour force which is one leading factor in order to sustain a healthy local economy, particularly in terms of overcoming skill shortages which were expected to emanate from sustained economic growth in the Maltese Islands.

In the last few years this projected influx has been realised by returning migrants as well as naturalised/registered persons with their diverse skills. While the former group has declined in number, the latter has sustained a level which has kept the situation going. This however, may be difficult to sustain in the near future.

Overall, the labour force numbered 145,654 in September 1997 as shown in Table 2.2.6.1. Unemployment has increased between 1995-1997 with figures moving up from 4,951 in September 1995 to 6,901 in September 1997. Over the same period, the proportion of females in the workforce has remained constant.

Table 2.2.6.1 - Employment Between 1995-97

INDICATOR	1995 Sep	1996 Sep	1997 Sep

Labour Supply	141,822	144,016	145,654
Gainfully Occupied	136,871	138,530	138,753
Total Private Sector	81,143	81,890	82,475
Total Public (Inc. Temp.)	55,728	56,640	56,278
Registered Unemployed	4,951	5,486	6,901
Percentage Unemployed	3.5%	3.8%	4.7%
Self-Employed	15,930	15,768	15,472
Private Sector Share	59.3%	59.1%	59.4%
Public Sector Share	36.6%	36.6%	36.1%
Temp Empl. Share	4.1%	4.3%	4.4%
Total Public Share	40.7%	40.9%	40.6%

Source: Economic Survey January - September 1997

2.2.7 The Elderly

One of the population components which is of major concern enough to merit urgent study, regards the number of elderly which is projected to increase at a phenomenal rate.

This is due to a decline in mortality rates and a relatively high age profile amongst returned migrants. It is assumed that the 60+ population will reach 80,338 in 2010, an increase of 51% over the period 1990-2010 (Table 2.2.7.1), whereas the Old-Old (75+ years) population are likely to experience an even more rapid increase of 55% between 1990 and 2010, reaching a total of 23,457.

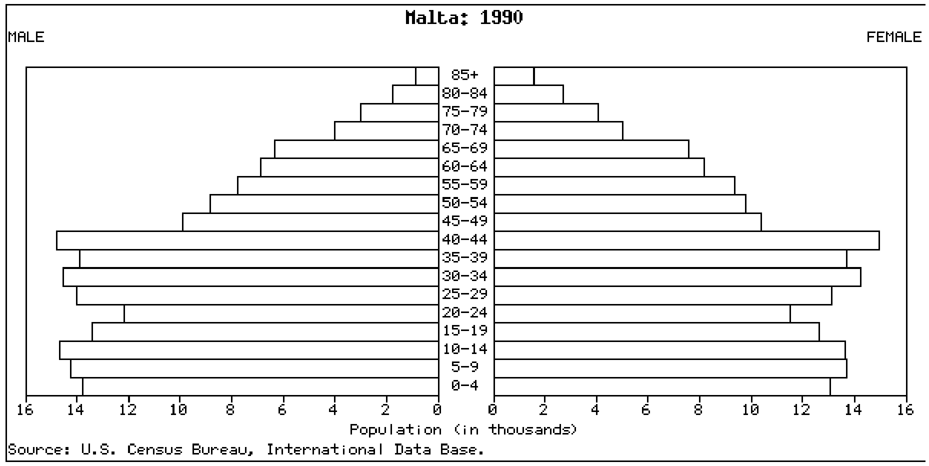
Table 2.2.7.1: State of the elderly population 1990-2010

Elderly Persons (60+ yrs) - Key Figures		
1990-2010 increase (60+)	27,082	51% increase in 60+ persons
1990-2010 increase (75+)	8,369	56% increase in 75+ persons

Source: Population Estimates - Strategic Planning Unit, Planning Authority

Figures 2.1 to 2.3 give a graphic description of the Maltese population scenarios should current rate of change continue at current trends. The population pyramid of 1990 shows a population with relatively large young-aged and middle-aged cohorts. Figure 2.2 points at a growing middle-aged to elderly cohort situation in 2025 which situation poses dangers for the current welfare system. Figure 2.3 shows an unsustainable situation in 2050 with prominence being given to the elderly cohorts. Such a situation indicates a slow dying out of the Maltese population with the resultant need for importation of labour; a situation which would already be realised by the year 2015.

Figure 2.1: Maltese Population 1990

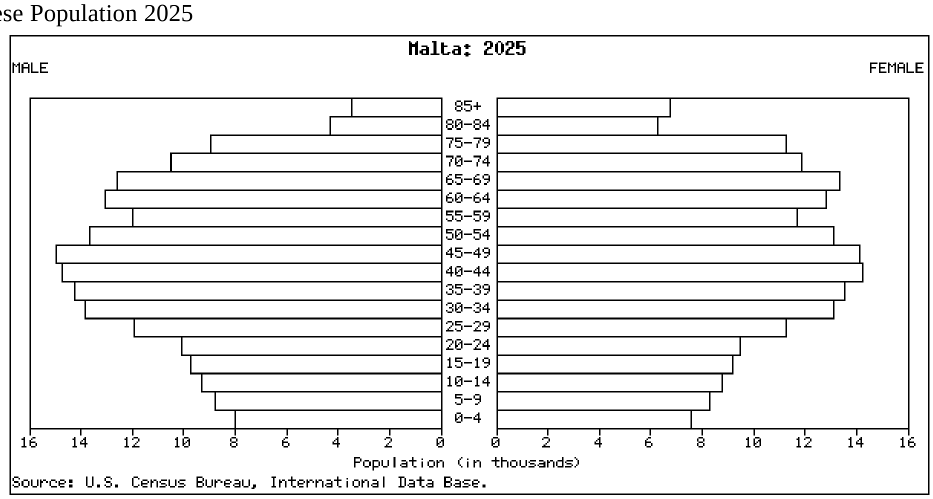


Source: US Bureau of Census, 1998 - http://www.census.gov/cgi- in/ipc/idbpyrs.pl

The main environmental impact that the elderly may have on the Maltese is linked to the perceived reluctance by elderly persons who live in large houses to move into smaller dwelling units. This lack of household mobility continuously puts pressure on housing need.

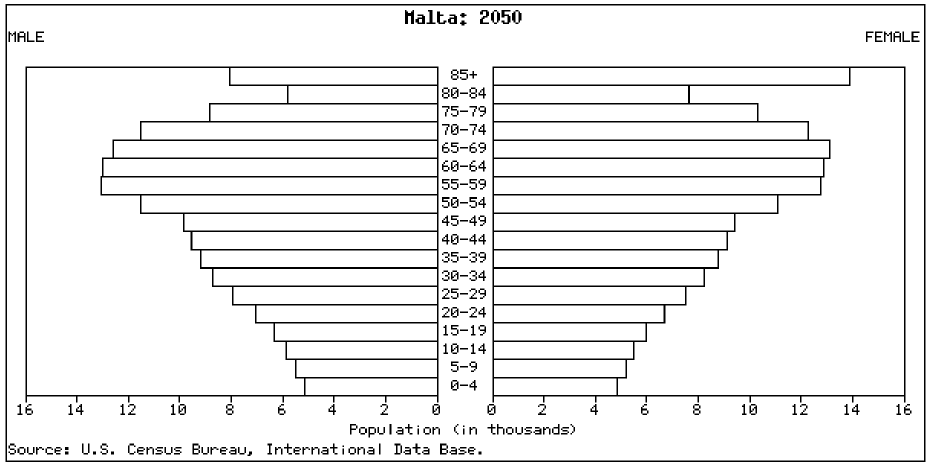
One should not, however, ignore the fact that the Mediterranean south coasts of Europe are experiencing a migration of elderly to their shores, where whole villages are being bought as permanent residences by the elderly, giving rise to the Costa Geriatrica occurrence. Services, special housing, hospitals and other needs move in together with the same people indicating a shift in emphasis of provision by policy makers. This occurrence should not be excluded from happening locally.

Figure 2.2: Maltese Population 2025



Source: US Bureau of Census, 1998 - http://www.census.gov/cgi-bin/ipc/idbpyrs.pl

Figure 2.3: Maltese Population 2050



Source: US Bureau of Census, 1998 - http://www.census.gov/cgi-bin/ipc/idbpyrs.pl

In view of the above, the need is felt for studies to be carried out on the following:

- ?? policies to encourage people to move house according to family size
- ?? national policy on ageing
- ?? policy on retirement age changes
- ?? the ageing of populations in Urban Conservation Areas
- ?? provision of housing units within government projects for the elderly
- ?? the growing number of elderly cases in general hospitals and their impact on the economic running of these institutions
- ?? access / pedestrian utilities
- ?? elderly living alone
- ?? returned migrants - in general are in the old-age cohorts
- ?? industry/work categories by age - are certain activities such as agriculture and quarrying dying out because workers are ageing?

2.2.8 Migration

Migration has been a contentious issue in the Maltese Islands over the last few years, especially regarding the impact that immigration has on the environment. Immigrants and returning migrants tend to look out for styles of housing which would reflect that which they were used to abroad. The stress on land use, infrastructure services, amenities and social services is expected to increase at a rapid rate.

The balance of international migration, particularly with regards to emigration, would remain at a low level, broadly similar to the emigration rate. Recent trends show that the number of immigrants was much higher than the number of emigrants contributing to a positive balance. In fact, there was an upsurge in immigration over the period 1990-1996, with a net average of 600 to 700 persons arriving in Malta per year (Table 2.2.8.1).

In addition, one needs to point out the increasing number of new citizens[4]. The number has increased substantially over the last few years, even more than accounted for in the assumptions: in 1995, 260 persons changed their citizenship to Maltese and in 1996 this increased to 301, while in 1997, 228 persons were registered.

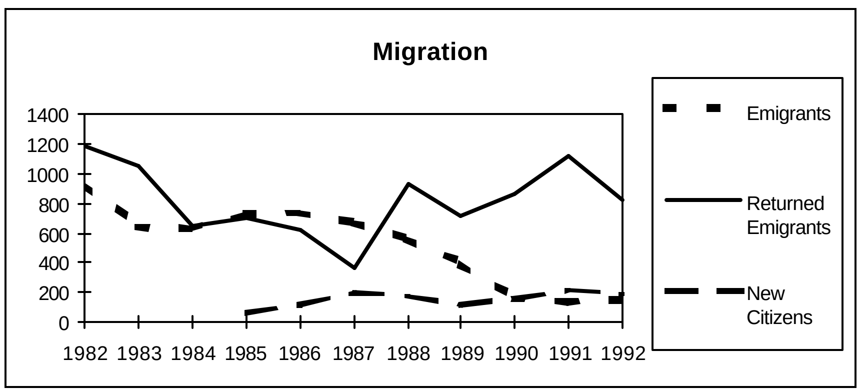
An analysis of recent data suggests that the rate of return migration has now passed its peak[5]. Figure 2.4 gives a graphic depiction of migration trends prior to the peak registered in 1991.

Table 2.8.1: Migration in the 1990s

Net migration 1990s	average of 600-700 persons per year
Emigration	average of 100 persons per year
Peak In-Migration -1991	1124 return migrants 222 registered/naturalised
Average Annual In-Migration	500 return migrants 300 registered/naturalised

Source: Central Office of Statistics

Figure 2.4: Migration Trends 1982-1992



As regards to future migration trends, these are still uncertain, being dependent on immigration policies, EU membership situation and political gu idance.

2.2.9 Internal Migration

Another factor, which needs to be brought to the attention of researchers and policy makers as regards to population studies, concerns the impact of internal migration. Detailed analysis of internal migration show that there are considerable amounts of movements within the Maltese towns and villages, each of which asserts pressure for the allocation of new land for development in particular localities.

An analysis of 1996 internal migration between and within Local Plans as outlined by the Malta Planning Authority shows a marked pattern of preference. Movements of people are registered mainly

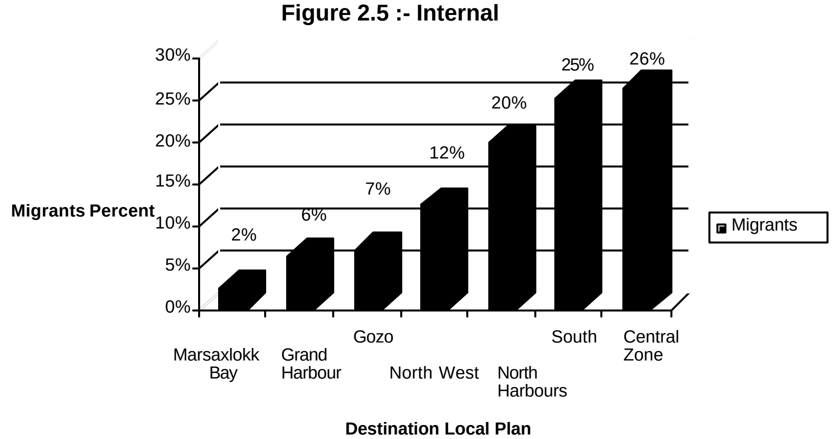
[4] Foreign persons acquiring Maltese citizenship.
[5] Demographic Reviews, 1982 - 1996, Central Office of Statistics, Malta

within an area rather than out to another area. Table 2.2.9.1 and Figures 2.5 to 2.7 indicate that all Local Plans except Grand Harbour LP registered more than 50% of all movements as being in the Within category: (Central Zone 57%, Gozo 91%, Grand Harbour 38%, Marsaxlokk Bay 55%, North Harbours 63%, North West 71%, South 70%). Therefore, except for migrants from the Grand Harbour Local Plan, most migrants perform short movements by restricting themselves to movements within their own Local Plan.

Table 2.2.9.1 : Internal Migration

	Moved INTO Local Plan Area	Moved OUT of Local Plan Area	Moved WITHIN Local Plan Area	Moved OUT of Local Plan Area (%)	Moved WITHIN Local Plan Area (%)
Central Zone	455	474	618	43%	57%
Gozo	18	24	229	9%	91%
Grand Harbour	95	277	167	62%	38%
Marsaxlokk Bay	69	36	44	45%	55%
North Harbours	295	316	544	37%	63%
North West	265	123	294	29%	71%
South	364	311	724	30%	70%

Figure 2.5 :- Internal



Figures 2.6 and 2.7 depict 1996 internal movements between all Local Plan Areas. Movements, whether intra-LPA or inter-LPA are described in colour coding. Figure 2.6 gives a brief description of how the figures are to be analysed.

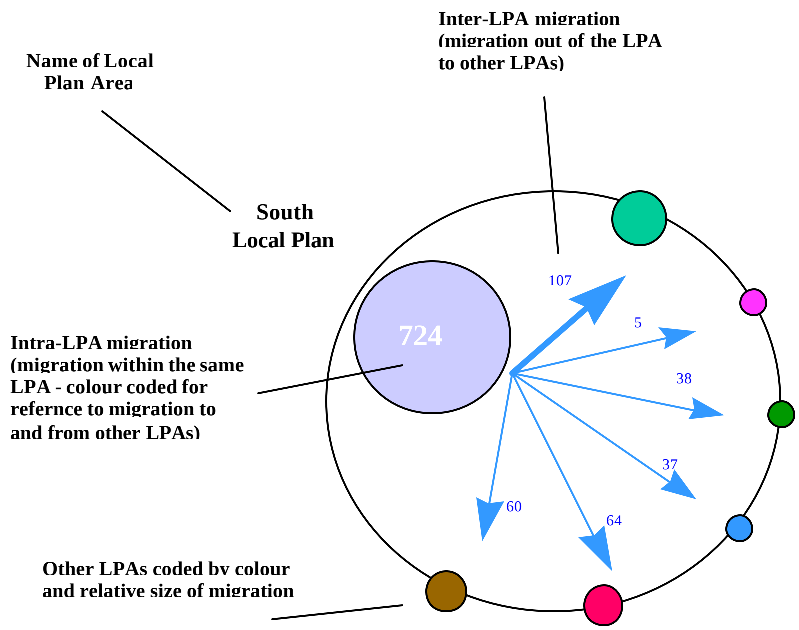


Figure 2.6 - Code Key for Figure 2.7

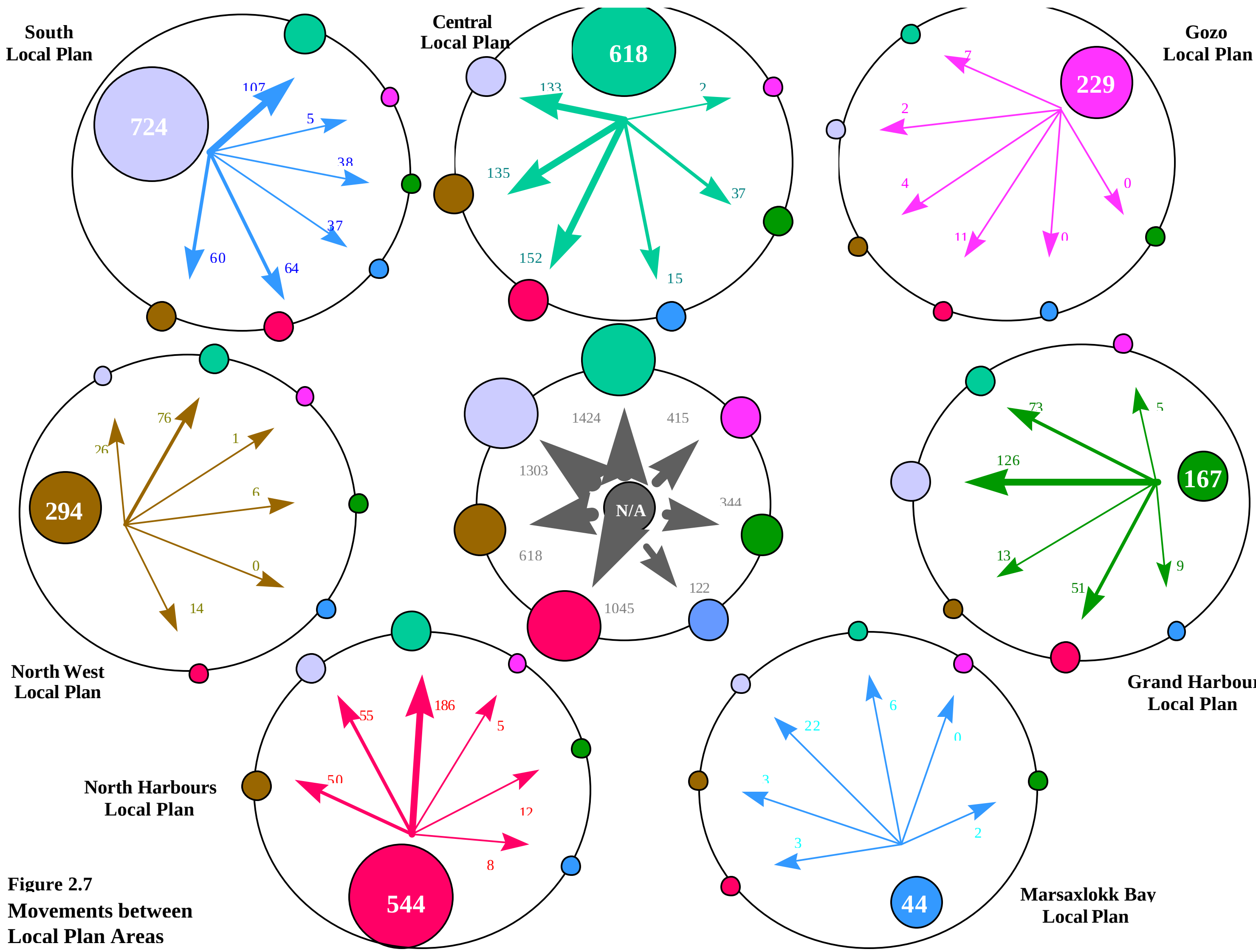


Figure 2.7
Movements between Local Plan Areas

2.2.10 Conclusion

In summary, Maltese population trends are characterised by a high net-migration balance, a slowing natural population growth, an ageing population and a decreasing household size.

This state of affairs highlights the fact that there is an urgent need for the formulation of a population policy wherein all social partners would analyse the respective factors and advise on the changes to policies and legislation required to cater for the potential future scenarios as depicted above. Each factor has its own impacts on both economic and social changes which imply an overall need for policies and action on the ageing structure of the population, the need for the importation of labour on a long-term basis, as well as the provision of adequate measures to further analyse internal-migration.

These issues should reflect the incidence of decreasing household sizes and the resultant need for more dwellings, the potential for the elderly to move into smaller dwelling units, the decreasing younger aged cohorts and their collective impact on education, pension systems, health services and the environment.

Without a concrete framework to which all social partners would link their proposals for change any research aimed at analysing one of these factors in isolation would be superfluous.

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2.3 Tourism

2.3.1 Background to tourism development

Tourism is considered to be a key sector in the economic development of the Maltese Islands. Since 1959 tourist arrivals have grown from a mere 12,500 to 1,182,240 in 1998. Receipts for the period 1959 - 1997, grew from around Lm 750,000 to over Lm249 million. Tourism in 1997 contributed around 22.9% to the export of goods and services and employs a total of 9445 or 6.9% of the total gainfully occupied in hotels and catering establishments.

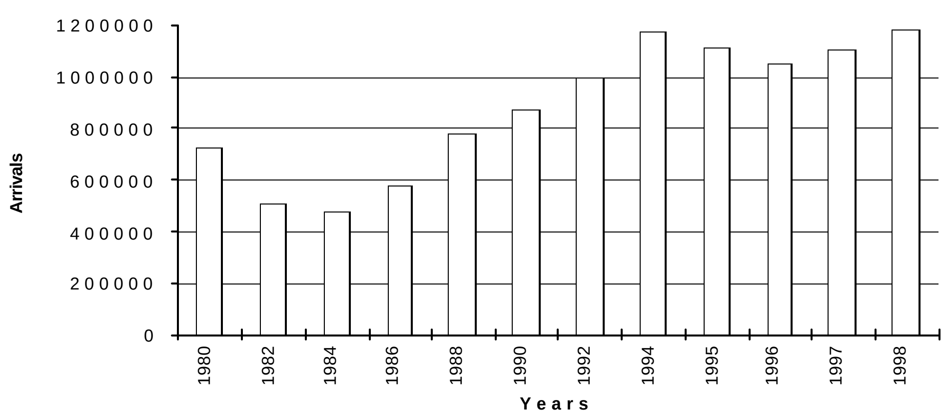
Tourism activity brings income and jobs, increased understanding of other cultures, preservation of cultural and natural heritage and investment in infrastructure, which in turn brings social and cultural benefits. However, the unplanned development of tourism facilities has led to considerable damage to and degradation of the physical, natural and social environment. Some tourism developments have led to degradation of landscapes, destruction of habitats, pollution of bathing water and in some cases, hostility by the local residents.

Tourist development, particularly in the form of tourist accommodation developments, has been heavily concentrated in specific localities and, although the pattern of tourist arrivals has spread into the shoulder months (i.e. March - June & October), nonetheless tourist arrivals still peak during the summer months (July - September). The development of tourism and the future success of this sector depends particularly on the level of attractiveness of a destination. If this attractiveness is lost then the destination is likely to suffer and tourists will no longer be attracted to that destination. Therefore, tourism depends on the quality of the natural and cultural environment for its continued success.

The term tourism as used by the World Tourism Organisation (WTO) includes all travel by people to destinations outside their normal place of residence, for any purpose (including pleasure, professional, educational, health) for a period of not less than 24 hours.

Tourist arrivals in the Maltese Islands experienced annual growth up to 1980. The following year tourist arrivals experienced the first major downward trend. Between 1980 and 1984 tourist arrivals decreased from 728,732 to 479,747. This trend was reversed in 1985. Tourist arrivals kept increasing up to 1994, reaching a figure of 1,176,200. In the following two years arrivals decreased to 1,053,800 by 1996. This downward trend was then reversed in 1997 and 1998.

Fig. 1 - Annual tourist arrivals for selected years between 1980 - 1998



Source: National Tourism Organisation of Malta

Over the last 10 years the tourism authorities have managed to improve the patterns of tourist arrivals both with regard to diversification and seasonality. This was in line with the strategy set out in the Tourism Development Plan for the Maltese Islands (Horwath and Horwath, 1989). For a number of years tourism depended strongly on the British market. This specific market constituted 76% of total tourist arrivals in 1980. Emphasis was placed on marketing and promoting the Maltese Islands in other countries, especially on the continent to reverse this over-dependency.

Table 2.3.1.1 - Percentage Market Share for Main Countries for selected years

Country	1980	1989	1994	1997
UK	76.5	60.79	45.09	39.3
Germany	2.65	11.07	17.02	17.37
Italy	3.75	6.42	8.39	8.1
France	1.67	3.35	5.84	5.6
Belgium	0.5	1.03	1.52	2.3
Netherlands	1.0	2.09	3.85	4.7
Libya	2.25	3.76	3.45	3.5
USA	0.96	1.18	1.01	1.34
Scandinavia	2.78	3.24	2.92	3.53
Others[1]	7.94	7.07	10.91	14.26

Source: National Tourism Organisation of Malta

The monthly pattern of tourist arrivals was such that most of the tourists were coming to the Islands during the summer period i.e. July to September. Although recent years have seen a gradual spread of arrivals into the shoulder months, nonetheless, the seasonality pattern has shown minimal changes over the last ten years.

Table 2.3.1.2 - Percentage Share of tourist arrivals for each season

Season	1989	1992	1994	1996	1998
Winter (Nov-Dec-Jan-Feb)	18.2	19.1	18.7	19.4	19.0
Shoulder (Mar-Apl-May-Jun-Oct)	44.4	44.6	45.4	44.6	44.6
Summer (Jul-Aug-Sep)	37.3	36.3	36.0	36.0	36.4

Source: National Tourism Organisation of Malta

2.3.2 Sustainable Tourism Development

Sustainable tourism development has been recognised as being the sole option for the development of a long term tourism industry. The term has been constantly used and abused. Unfortunately, in some quarters there has been a misunderstanding of this term and some are referring to economic sustainability of tourism or sustained growth. This is only part of the definition, which incorporates a number of key elements:

?? A longer-term perspective on policy making, as sustainable tourism is a goal which cannot be reached immediately;
?? A recognition of the interdependence of economic and environmental and social systems;
?? A concern with biological limits within which human activities need to stay (carrying capacities).

To achieve sustainable tourism it is necessary to balance five elements, without anyone becoming dominant: economic, environmental, social, tourist satisfaction and cultural.

[1] The 'Others' category includes other countries not mentioned specifically particularly countries in Eastern Europe, Middle and Far East, Africa, Australia, South America, Canada and Asia.

Over the last years a number of declarations have been drawn up to ensure that tourism development is in line with the principles of Sustainable Development. These include, amongst others, the Lanzarote declaration, the Hyeres declaration, the Council of Europe's recommendations on sustainable tourism development and the World Tourism Organisation's Agenda 21.

2.3.3 Land developed for tourism

Tourism development requires land for the construction of tourism related facilities. Very often such developments are sited in areas of high landscape value to capitalise on the aesthetic qualities of the area. However, in the process the development usually creates more harm than good to the area as a result of degradation of pristine and sensitive environments, particularly scenic localities, coastal areas and rural areas.

Tourism development in the Maltese Islands has been characterised mainly by the development of tourist accommodation facilities. Around 94% of the tourist accommodation supply in terms of beds are found in coastal areas and some developments have facilities occupying stretches of foreshore in terms of hotel developments and beach concessions. There are also a number of developments that have been constructed in rural areas and outside the development zone boundaries. Very often such intrusive developments have resulted in a negative visual impact on the rural landscape.

From a physical survey carried out by the Planning Authority, hotels and complexes take up 0.3% of the total land cover. This figure does not include holiday flats, and, therefore, the amount of land taken up for tourism development would be somewhat higher. Most of the tourism development is concentrated along coastal stretches particularly in the areas of St. Paul's Bay, Sliema, St. Julians/Paceville and Marsascala in Malta and Marsalforn and Xlendi in Gozo. Table 2.3.3.1 presents the changes in the bed supply in the main tourist areas over the last ten years.

Table 2.3.3.1 - Change in share of tourist accommodation by the main tourist localities between 1989 and 1998 (incl. self-catering)

Locality	No. of Beds (1998)	% share	% share (1989)
St Paul's Bay	1980	4.4	6.0
Bugibba/Qawra	14714	32.4	24.4
Mellieha	5142	11.3	12.2
St Julians	7254	15.9	16.6
Sliema	7086	15.6	15.2
Marsascala	1249	2.7	3.0
Gozo	2732	6.0	4.0
Other	5293	11.6	18.6
TOTAL	**45450**	**100**	**100**

Source: HCEB

The Structure Plan for the Maltese Islands had designated specific areas for the consideration of tourist accommodation projects. These are specified in policy TOU 4 which states that:

> **The Planning Authority will give favourable consideration to the development of further tourist accommodation within the built up areas and Temporary Provisions areas as amended by the relevant Local Plans at Mellieha, St. Paul's Bay/Bugibba, St. Julian's/Paceville, Sliema, Marsascala, Marsaxlokk, and Birzebbuga; and Marsalforn, Xlendi, and Mgarr in Gozo. Within these areas development will comply with the Secretariat for Tourism's Accommodation Projects Policy Guidelines in respect of new provisions, and upgrading and extensions to existing premises.**

Between 1993 and 1997 the Planning Authority had approved various tourist accommodation projects and these are indicated in Table 2.3.3.2. These figures have been published in the Planning Authority's two Monitoring reports [2]

Table 2.3.3.2 - Number of approved tourist accommodation projects between 1993 and 1997

	1993	**1994**	**1995**	**1996**	**1997**
New projects	4	1	4	1	2
Extensions/refurbishment	7	13	10	6	7
Beds approved	1008	1630	2219	226	454
Floorspace (sq. m)	15,000	10,941	410,235	15,939	46,056

Source: Planning Authority

2.3.4 Heritage sites

The Maltese Islands are richly endowed with historical and cultural heritage resources. These are a prime selling and marketing element in the overall tourism product. Tours or individual visits to such sites are common throughout each season. The most visited historic/urban localities are Valletta and Mdina. No exact statistics are available to calculate the number of tourists who visit such localities, however, a study carried out by the Department of Tourism in 1992 identified that approximately 73% of the tourists visiting the Islands visit Valletta and Mdina. Therefore, in 1998 the number of tourists that may have visited these two cities may have been around 863,000. This excludes the number of cruise passengers that are very likely to visit the capital city and possibly even Mdina. A Cruise Passenger Survey carried out by the Planning Authority shows that 67%, 49% and 75% of the respondents in the summer, shoulder and winter months, respectively, visited St. John's co-cathedral. If these figures are an indication of the number of cruise passengers visiting Valletta than it can be estimated that in 1998 over 90,000 cruise passengers may have visited the capital city.

The Three Cities is not as popular as the previous two localities. It is estimated that only 20% of tourists visit this area.

The Tourist Survey indicated that around 56%, 49.2%, and 54.4 % of tourists coming in the summer, winter and shoulder months, respectively, visit Gozo and hence the Citadel which is an important stopover whilst on tour in Gozo. Hence, in 1998 it is estimated that 638,399 international tourists visited the Island. To this figure one needs to add the number of domestic tourists that visit Gozo during specific periods of the year particularly in summer. The Tourism and Recreation Community Survey carried out by the Planning Authority in 1996-1997 states that 77% of the respondents stated that they had a short break in Gozo. This means that domestic tourism to Gozo is likely to be in the region of 291,060 domestic tourists.

Visits to museums and archaeological sites are also another important tourist activity. Such sites are mainly visited by tourists in groups as part of a tour itinerary as well as on an individual basis. Visits to the main sites managed by the Department of Museums for selected years between 1988 and 1998 are given in Table 2.3.4.1.

[2] Structure Plan Monitoring Report 1990 - 1995 and Structure Plan Monitoring Report 1996 - 1997.

Table 2.3.4.1 - Number of visitors (both tourists and locals) to museums and archaeological sites for selected years between 1988 and 1998.

	1988	1994	1998
MALTA			
National Museum of Archaeology	22495	113888	55931
National Museum of Fine Arts	14798	23649	38941
Palace Armoury	52957	101863	112652
Museum of Roman Antiquities	29035	65144	62099
St. Paul's Catacombs	48793	74031	90416
Museum of Natural History	32658	24863	17337
Hal-Saflieni Hypogeum	34266	closed	closed
Tarxien Megalithic Temples	38719	118229	123410
Ghar Dalam	24846	97805	91757
San Pawl Milqi	-------	1513	881
Inquisitors' Palace	5535	25619	41822
Hagar Qim	25247	103999	132263
State Rooms and Tapestry Chamber	24236	116209	137472
War Museum	77119	67552	49343
Maritime Museum	-------	23165	45031
GOZO			
Museum of Archaeology	-------	21702	20761
Ggantija	39388	157581	163595
Museum of Natural Science	-------	4997	8599
Museum of Folklore	8666	18688	16693
Windmill	-------	12334	37962
Visitors in Groups	491655	-------	-------

Source: Department of Museums

Although from the above figures it is noticeable that some sites have decreased their visitors, nonetheless over the last 10 years the number of visitors going to such sites has increased substantially. Therefore, it is important for such sites to have the appropriate management structures to ensure that visitor flow through these sites is adequately managed to avoid any degradation to such sites. Management also involves monitoring of the state of certain structures e.g. the megalithic temples, which have been not only vandalised but have also suffered damage following heavy rainfall.

2.3.5 Tourism and the infrastructure

A good and adequate infrastructural capacity is imperative for a thriving tourism industry. Tourism places demand on water supply, electricity supply and the sewerage systems, as well as the road infrastructure and public transport.

The Sewerage Master Plan for Malta and Gozo[3] estimated that each tourist uses on average 235 lts of water each day. Using this estimate the annual demand for water supply in 1998 was around 2.66 million m^3. It is important to note that the figure used is an average and therefore it is very likely that the daily demand during summer is much higher, and, therefore, since most tourists come during the summer months the demand for water for tourism use may be somewhat higher, possibly even close to 3 million m^3. In 1998

[3] Sewerage Master Plan, Cowiconsult, 1992

the total amount of water consumed was 36,838,109.7m^3 (Water Services Corporation). Therefore, water consumption for tourism purposes constituted 7.2% of total water consumed. During the summer months, as indicated, the percentage would be higher.

Most of the water used for tourism purposes is disposed untreated into the sea through the main sewage outfalls. It is estimated that 80% of water used is disposed of as sewage, according to the Sewage Master Plan. Therefore, total amount of sewage produced as a result of tourist activity is estimated at around 2.13 million m^3.

The results from the Tourist Survey show that 50%, 42.4% and 48.7% of the respondents coming in the summer, winter and shoulder months, respectively, make use of public transport. In 1998, therefore, the following number of tourists made use of such services:

?? Summer	215,000
?? Winter	95,000
?? Shoulder months	257,000

Note: figures are given to the nearest '000.

No figures are available to translate these estimates into number of trips.

Car rental is also another service which tourists avail themselves of. The Tourist Survey results show that 30%, 30.2% and 25% of the respondents coming in the summer, winter and shoulder months, respectively, make use of hired cars. Therefore, using these estimates in 1998, the following number of tourists made use of car hire vehicles during each season.

?? Summer	129,000
?? Winter	68,000
?? Shoulder months	132,000

Note: figures are given to the nearest '000.

The following estimates by month may give an indication of the increased level of traffic resulting from tourism in terms of daily number of cars on the road as a result of tourist activity.

January	1712
February	3371
March	2660
April	3864
May	2611
June	2866
July	4866
August	5629
September	4400
October	2813
November	2947
December	2723

Note: Figures indicate approximate number of cars on the road as a result of tourism.

The impact of tourism on waste generation is not so easy to quantify since no exact records are kept on the amount of waste generated by tourists. For this purpose an estimate from other research carried out will be used to give an indication of the amount of waste generated as a result of tourism. The report "Measuring the Carrying Capacity of a major Cultural Tourism Destination: the case of Venice " by Paolo Costa which was presented at the European Workshop on "Cultural Tourism in Mediterranean Islands " (October 1988), has estimated that tourists using some form of accommodation in Venice produce 2.3 kg of waste per day. With total guest-nights in 1998 at 10,665,000, therefore, the estimated amount of waste generated in 1998 as a result of tourist activity may be in the region of 24.5 million kg.

2.3.6 Social issues and Tourism

The local residents have always been considered very hospitable and this remark has been stated by many tourists. The Maltese and Gozitans are still relatively very hospitable and helpful to tourists, however, this hospitality may change if it is felt that tourist activity and development is adversely affecting the local residents' way of life. The Tourism and Recreation Community Survey sought to identify the attitudes and perceptions of the local residents towards tourism. 90% of the respondents indicated that tourism has been of benefit to them whilst only 6% stated that it has not been of benefit to them. 26.5% of the respondents stated that they often come in contact with tourists, whilst 29% do so only occasionally. 27.5% stated that they rarely come in contact with tourists and 17% stated that they never do. Most of the respondents who live in the main tourist localities stated that the development has brought improvements to their locality. The majority of respondents stated that they would not like to see further development of new hotels in their locality.

Table 2.3.6.1 - Estimated daily number of international tourists at each tourist locality for each season.

Locality	Winter '97	Shoulder '97	Summer '97	Population
St Paul's Bay	3370	3791	12440	7332
Mellieha	640	2720	6122	6220
St Julians	3105	5527	7835	7205
Sliema	5258	8016	9217	12768
Marsascala	625	897	1382	4792
Birzebbuga	148	87	461	7295
Comino	----	87	461	-----
Gozo	394	463	3687	29073
Valletta/Floriana	575	1245	922	9831
Rabat/Mdina	115	260	-----(*)	13291
Attard	148	324	-----(*)	9162
Others	2054	5500	3226	269366
TOTAL	16432	28917	45753	376335

Source: Tourism Statistics, NTOM, Planning Authority, Central Office of Statistics

(*) Although no figures have been indicated for these localities, this does not mean that no tourists stay in these localities. The results obtained from the survey, through a random sample of tourists, simply did not pick any tourist staying in these localities.

Note: The population figures are based on the 1995 census.

Social research indicated that local residents do not think that tourists create major impacts. Nonetheless, during specific periods of the year, especially during summer, parking and crowded beaches have been identified by the local residents as being the most pressured facilities as a result of tourist activity. In addition specific studies on Mdina indicated that the residents of this historic city showed some level of irritation with the number of tourists visiting the city. In some cases it was also indicated that tourists open the front doors of some houses and enter. [4]

[4] Boissevain J., Problems with Cultural Tourism in Malta in Sustainable Tourism in Mediterranean Islands and Small Cities, Fsadni C & Selwyn T., 1997.

2.3.7 Conclusion

The above analysis provides some information on the state of the environment with respect to specific tourism issues. Naturally, the above is not exhaustive. However, other important data needs to be collected to determine, for example, the impact on ecological and marine resources particularly as a result of safari tours or diving activity. This will require specific studies and monitoring of specific areas (e.g. impact on historical sites). It is also important to distinguish between impacts resulting from tourist activity and impacts as a result of locally generated activity particularly from recreational activity. A Carrying Capacity Study which is to be finalised shortly will provide some further insight into the impacts of tourist activity on the economic, social and environmental fabric.

BACK TO CONTENTS

2.4 The Built Environment

2.4.1 The Structure Plan

The Structure Plan for the Maltese Islands is a strategic long term plan for the islands covering the twenty year period to 2010[1]. Although it is concerned with all aspects of social, economic and physical structure, its basic concern is with land: what should be developed, where, when and how. It is essentially a co-ordinating plan that seeks to accommodate, manage and integrate the development requirements of all Government departments and agencies, the private sector and the community as a whole.

The territory of the Maltese Islands is also divided into seven Local Plan areas and the Planning Authority is in the process of preparing these various Local Plans that will guide and control future development and the use of land. To date, two plans have been finalised (one awaiting Government approval), and two others are in an advanced stage and should be finalised in the coming months. In the meantime the Planning Authority has also finalised two action plans – one for Pembroke and one for Ta' Qali and is finalising a third (L-Ahrax tal-Mellieha Action Plan) as part of the North West Local Plan.

The Structure Plan includes a wide range of policies designed to channel, encourage and co-ordinate social and economic development. These include:

1. initiatives to encourage social and economic development
2. provisions to ensure that land and infrastructure can accommodate the required growth, and
3. measures to improve the management of financial and land resources.

The 1990 Structure Plan, and the Temporary Provisions Scheme before that, sought to contain the urban sprawl of the 1980s and concentrate development in and around existing urban areas. Outside these areas, development is only allowed for uses that, due to their nature, cause bad neighbourliness and should be located away from built-up areas (e.g. quarries, farms, obnoxious industries, etc.)

2.4.2 Housing

The Structure Plan includes forecasts of the growth of the population, households and jobs up to 2010. The Plan predicted an increase in the total population living in private households of 11% from 355,000 in 1990 to 394,000 in 2010. However, the population growth is running ahead of the Structure Plan predictions and current forecasts suggest the figure would be closer to 399,000 [source: Structure Plan Monitoring Report 1996-1997 – Planning Authority].

The Structure Plan also estimated that an additional 22,000 new households would be formed by 2010. Again, forecasts now indicate that this figure would be of around 29,000 additional households. This is a total increase of 26% over the period 1990-2010. This increase is partly due to the increase in the number of migrants and foreign residents living in Malta.

As regards housing supply, the Structure Plan estimated a dwelling capacity of 50,000 units in the approved Temporary Provision Schemes. In 1995 this was revised to 60,810 units taking into consideration that the appeal of terraced houses was diminishing and plots of land earmarked as terraced housing were actually being developed into a two-unit building per plot. The figure of 60,810 is based on the assumption that the semi-detached/villa plots identified in the schemes would each provide one dwelling whereas 50% of those identified as terraced houses would be developed to provide one dwelling and the remainder would provide two units per plot.

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[1] The Planning Authority is currently reviewing the Structure Plan. It is expected that the new plan will be finalised by 2001.

Figures for the number of applications approved by dwelling type over the period 1993 to 1997 show a clear trend towards an increase in the number of apartment/maisonette buildings and a decrease in terraced houses.

Table 2.4.2.1 – Dwelling approval by type (1993 – 1997)

Property type	**1993**	**%**	**1994**	**%**	**1995**	**%**	**1996**	**%**	**1997**	**%**
Apartments	1192	40	1742	42	2146	47	1862	44	1687	48
Maisonettes	651	22	1219	30	1114	24	1399	33	1091	31
Terraced Houses	1016	34	1014	25	1160	25	748	18	581	17
Semi/Detached	109	4	142	3	195	4	218	5	123	4
Totals	***2968***	***100***	***4117***	***100***	***5615***	***100***	***4227***	***100***	***3482***	***100***

Source: Dwellings Database, Strategic Planning Unit, Planning Authority

In terms of land availability and housing rate of development, latest figures show that over the four-year period from 1994 to 1998, the rate of housing development amounted to 15.65 ha per year. Obviously, this was not uniform throughout the Islands and in fact the highest housing development occurred in the South of Malta (24 ha or 5.7 ha/year) and the lowest was, as expected, in the Grand Harbour Local Plan Area (0.8ha or 0.2 ha/year). Table 2.4.2.2 below shows a breakdown of the housing land development organised by Local Plan area.

Although the construction industry is an important contributor to the local economy, the scarcity of land on which to build and where to accommodate the various activities which lead to a better quality of life must be taken into consideration in the larger scheme of things. Pressures to release more land for development should therefore be viewed with great caution. This is not only because the release of “virgin” land has an environmental impact but also because it decreases possibilities of recreation, it impacts other vital sectors such as food production, and also diminishes the tourist’s experience of the country.

Table 2.4.2.2 – Housing development rates by Local Plan

Local Plan Area	Housing land developed between 1994-98 (ha)	% of the Total	Housing Development Rate (ha/yr) (1994-1998)
Marsaxlokk Bay	2.9757	4.4	0.7
North West	8.0381	12.1	1.9
Grand Harbour	0.8261	1.2	0.2
North Harbours	4.9788	7.5	1.2
Gozo	5.6902	8.5	1.3
South	24.3531	36.7	5.7
Central	19.662	29.6	4.6
Total	66.52	100	15.65

Source: Land Availability Database, Strategic Planning Unit, Planning Authority

Current population and housing estimates coupled with the growing tendency to build at higher densities and a sustained decline in the natural population growth rate, indicate that whilst the current housing land supply (within the existing schemes) can accommodate about 61,000 units, demand would probably not exceed 34,700 dwelling units. In fact, this has been emphasised in the Structure Plan Monitoring Reports issued by the Planning Authority for the periods 1990-1995 and 1996-1997 which further states that current land allocations for housing are likely to suffice for at least the next thirty years.

Hence a special effort needs to be done to diversify the construction industry and to encourage the rehabilitation of the historic urban centres that have experienced a decline in their population. This decline has resulted in an increase in the number of vacant dwellings and a concomitant decay in the urban fabric of a number of historic buildings, the re-use and rehabilitation of which should be encouraged.

2.4.3 The Historic Environment

2.4.3.1 Conservation Areas

It is widely recognised that it is desirable to preserve and enhance areas of special architectural and historical interest. The Development Planning Act and the Structure Plan empower the Planning Authority to designate Urban Conservation Areas. Urban Conservation Areas (UCAs) are areas of special architectural or historic interest, the character or appearance of which it is desirable to preserve or enhance. The purpose of a UCA is to protect whole areas, such as historic centres as well as individual buildings. The areas between buildings and the surroundings of the buildings are equally important for conservation as the buildings themselves.

UCAs are needed to ensure that an area's uniqueness can be protected now and in the future. This can be achieved by ensuring that new buildings or alterations to existing structures fit in with the area's character. It is important that evidence of Malta's history is not lost for future generations and that places where people live are not spoilt by buildings which do not respect the area's history. The need for policies to preserve and enhance urban areas is all too obvious when one looks at the many areas in Malta that have been allowed to develop without proper conservation guidance, often replacing buildings that were full of character, as along the Sliema and Gzira waterfronts. There are in fact very few areas of Malta where unsuitable building has not taken place. Through the designation of UCAs, the further deterioration of such areas is decreased if not completely arrested.

The Structure Plan strategy for urban conservation rests on particularly strict control of development coupled with an injection of public and private funds for rehabilitation. The Plan identifies urban areas for immediate protection and also gives provisional UCA status to the village core boundaries identified in the Temporary Provision Schemes until an updated boundary is identified for designation purposes. The areas identified in the Structure Plan are as follows:

?? Valletta and Floriana
?? The Three Cities: Birgu, Bormla and Isla
?? Mdina
?? The Cittadella and its environs (Gozo)
?? The central area of Sliema
?? The central area of Hamrun
?? Village Core areas

The first UCAs were approved by the Planning Authority in 1995. To date, 22 UCAs have been approved, a further 22 are being reviewed following public consultation, and 2 have been finalised pending PA approval. Table 2.4.3.1.1 shows the Urban Conservation Areas designated and/or pending and the area protected per year.

Although slow in taking root locally, there are signs that conservation is being recognised as a key factor in promoting economic prosperity since it does not only provide residents with an attractive living and working environment but it can also help to attract inward investment to an area.

Historic buildings and high quality built environments are valuable assets and provided they are maintained, can be extremely important for the tourism and leisure industry as well. It is also good practice in terms of sustainable development to find appropriate uses for old buildings and thus prolong their useful life without needing to use limited resources in new construction.

Table 2.4.3.1.1 – Urban Conservation Areas designated per year and area of land protected.

Year	UCAs approved	Area protected (ha)
1995	Birzebbuga, Cittadella, Floriana, Marsaxlokk, Mdina, Valletta.	236
1996	Attard-Balzan-Lija, Birgu, Bormla, Dingli, Kalkara, Isla, Mellieha, Mgarr, Rabat, San Pawl il-Bahar.	356
1997	Paola-Tarxien, San Giljan, Sliema, Marsa. Subject to public consultation: Fontana-Rabat, Ghajnsielem, Ghammar, Gharb, Ghasri, Kercem, Mgarr (Gozo), Munxar, Nadur, Qala, San Lawrenz, Sannat, Sannat – Triq Ta' Cenc, San Pietru, Santa Lucia, Xaghra village, Xaghra – Triq is-Srug, Xaghra – Triq Marsalforn, Xaghra – Triq Mannar, Xewkija, Zebbug.	159 315
1998	Subject to PA approval: Siggiewi, Haz Zebbug.	 91

Source: Environmental Management Unit, Planning Authority

Over the period 1993-1997, 5% of all the floorspace approved and included in the Planning Authority's Strategic Projects Monitoring Database[2] were located in the approved Urban Conservation Areas[3].

Table 2.4.3.1.2 – Floorspace within UCAs as approved by the Planning Authority between 1990 and 1997.

	Floorspace (square metre)			
Development type	**1990-1995**	**1996**	**1997**	**Total**
Dwellings	22,930	12,365	13,094	48,389
Offices	16,020	1,345	388	17,753
Retail	2,340	2,623	5,929	10,892
Tourism	14,950	0	3,283	18,233
Recreational	1,530	228	240	12,890
Agricultural	N/a	0	828	(828)
Social & community	17,650	3,899	770	22,319
Manufacturing	N/a	80	152	(232)
Warehousing	1,420	655	1,218	3,293
Parking	13,230	5,721	4,976	23,927
Total	90,070	26,916	30,878	147,864

Source: Strategic Projects Monitoring Database, PA

(Dwellings floorspace figures only include dwelling applications with 3 or more units)

[2] The Strategic Projects Monitoring Database (SPMD) contains information on all medium and major development approved by the Planning Authority.

[3] Results are only indicative as many village core areas have not yet been formally defined as UCAs and are therefore omitted from this analysis. These figures include all approved UCAs and those formally defined but still subject to public consultation.

Although not based on complete data, the figures above give a good indication of current trends. The higher figures in the various categories (except for dwellings) are normally due to a few large projects rather than to several smaller projects, hence the overall impact is limited in terms of urban regeneration.

The increasing trend for dwellings in UCAs reflects one of the objectives of the Structure Plan which seeks to encourage growth in the number of residences in UCAs. It also indicates investment in UCAs, another Structure Plan objective. The dwelling floorspace shown only includes medium and major developments with three or more units. Data from the dwellings database of the Planning Authority, which include information on all dwelling applications approved by the PA, also shows an increasing trend in the residential development in UCAs, with 222 dwellings approved in 1996 and 264 in 1997.

Successful rehabilitation and redevelopment projects within UCAs, to date, have largely been concentrated in Sliema and Floriana. Sliema has an exceptional ability to attract significant private sector investment for a wide range of development types, whilst public sector investment in Floriana has been mainly linked to the provision of government or parastatal offices.

However, these numbers must be read with caution as the quality of the development taking place in UCAs is not always in keeping with Structure Plan objectives. Furthermore, a large proportion of the projects in UCAs are for new developments rather than conversions, which may not be achieving the objectives of enhancement. In fact, achievement of the broader rehabilitation objectives set in the Structure Plan are likely to require a number of additional incentives and initiatives in order to stimulate both public and private sector investment within the various UCAs.

2.4.3.2 Rehabilitation Initiatives

The key agency responsible for developing and implementing policies on the historic environment is the Planning Authority. Other agencies involved especially in implementing rehabilitation projects include the Restoration Unit of the Works Division, the Valletta and Cottonera Rehabilitation Projects, the Local Councils, and voluntary organisations such as Din l-Art Helwa and Fondazzjoni Wirt Artna who have undertaken restoration and rehabilitation works on a number of public buildings.

The Structure Plan provides for the setting up of a Land Tribunal and Heritage Trust that would facilitate joint public/private sector projects aimed at the rehabilitation of Malta's many historic buildings. Although there exists some government sponsorship of NGOs for specific restoration projects, the idea of a National Trust never took off. Sporadic initiatives have however been registered, such as the Bank of Valletta International trust which has been set up to promote the conservation of national built heritage, and two schemes launched by the Planning Authority – the Historic Buildings Grant Scheme (HBGS) and the Urban Environmental Improvement Partnership Scheme (UEIPS).

The HBGS was launched in 1996 and up to 1998 has provided Lm 17,689[4] to the public for the restoration of timber balconies in Cottonera. A further Lm 15,000 have been budgeted by the Planning Authority for a second scheme to be launched in 1999.

The UEIPS aims to improve public open spaces by assisting Local Councils to undertake high quality urban renewal projects to benefit the local community and the local environment. A sum of Lm 100,000 was made available by the Planning Authority under agreement entered into with the Department of Finance in 1996. Funding of any one scheme was set at a maximum of 50% of the total cost of the works. Seven projects including a pedestrianisation scheme in Mosta and a regional garden in Zabbar were sponsored. The majority of these projects were for improvements to town centres.

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[4] Of these funds, Lm 15,000 have been provided by the Planning Authority and Lm 2,689 by the Cottonera Rehabilitation Project.

Local Councils have also become a major source of investment in urban upgrading projects. Projects have included traffic calming and re-routing away from urban cores, provision of paving and street furniture, landscaping, restoration of town squares, monuments, listed buildings and churches. Table 2.4.3.2.1 below shows the urban upgrading projects (1996-1997) of a number of Local Councils and estimated expenditure for each project.

Table 2.4.3.2.1 – Local Council Upgrading projects (1996 – 1997)

Local Council	Project Name	Estimated Expenses (Lm)	Area (sq. m.)
Attard	Village square conservation, new pavements at Triq Nutar Zarb	75,000	2,200
Birkirkara	Embellishment of urban environment	85,000	N/a
Floriana	Restoration of pavements and the Wignacourt Tower façade. Landscaping and the storm water catchment project	N/a	N/a
Ghajnsielem	Regeneration of paving and landscaping	28,886	2,711
Hamrun	Restoration of square, landscaping, pavements	374,000	6,933
Luqa	Heritage conservation	9,100	N/a
Marsa	Urban upgrading	72,000	N/a
Mosta	Upgrading of Triq il-Kurat Calleja	38,038	1,396
Munxar	Embellishing of site at 12th December Street	4,208	125
Qormi	Upgrading of paving in Main Street, restoration of "Kristu Rxoxt" niche, restoration of "San Gwakkin" niche	60,000	12,200
Rabat (Gozo)	Upgrading of streets and landscaping, opening of war shelter	51,745	1,994
San Pawl il-Bahar	Paving of street near Wignacourt Tower	3,500	828
San Gwann	Restoration of flour mill, Roman Tower: Ta' Cieda, Chapel of San Gwann ta; łGharghar, Cart Ruts, Chapel of San Filippu and San Gakbu, Ta' Indri Garrison	N/a	N/a
San Lawrenz	Restoration of Triq il-Qadima	2,000	N/a
Swieqi	Restoration of pavements, new pavements and public garden	53,757	N/a
Tarxien	Upgrading of landscaping	20,200	N/a
Xaghra	Restoration of cross monument at Pjazza Vittorja and paving	11,000	N/a
Xewkija	Restoration of farmhouse, historic windmill	N/a	N/a
Xghajra	Restoration and rehabilitation of the batteries, heritage trail and upgrading of landscaping	25,500	2,103
Zabbar	Upgrading of public garden, playing field	152,000	6,755
Balzan	Restoration of village core	16,426	1,550
Senglea	Rehabilitation of village core	N/a	N/a
Mqabba	Rehabilitation of village core, signs, the old hospital, restoration of the "Municipju", commemorative plaques	300,000	11,100
Santa Lucija	Santa Lucija Hypogeum	N/a	N/a

Source: Planning Authority survey of local councils, 1998

Central Government is also a major source of funding of urban conservation initiatives and a number of rehabilitation projects are undertaken by Government each year, even if most are more directed towards maintenance of Government premises such as schools and offices.

Table 2.4.3.2.2 – Government Rehabilitation Projects (1993 – 1995).

		1993	1994	1995
Ministry for Gozo	Restoration works at the Cittadella	39,585	31,004	15,000
Estates Management	Enhancement of Public Areas	185,947	245,289	60,000
	VRP	354,968	323,353	250,000
	Personal emoluments	220,500	220,500	220,500
	CRP	254,703	232,305	200,00
	Personal emoluments	0	0	35,000
TOTAL		1,055,703	1,052,451	780,000

Source: Structure Plan Monitoring Report (1990 – 1995) – Planning Authority

Table 2.4.3.2.3 – Government Rehabilitation Projects (1996 – 1997).

Ministry	**Vote**	**Expenditure**	
		1996	**1997**
Office of the Prime Minister	Rehabilitation of Historical Sites and OAI Centre	33,000	20,000
Ministry of Foreign Affairs and the Env.	Rehabilitation of Palazzo Parisio	40,000	-
Ministry of Education and National Culture	Refurbishment of Detail Office, Maintenance of Government Schools and Restoration of Studies Centre	150,000	630,000
Ministry of Justice and Local Councils	Rehabilitation of House of Catalunya, Municipal Centres and other refurbishment works	160,000	30,000
Ministry of Public Works and Construction	Rehabilitation of Forts, Fortifications and Historical Places, including VRP and CRP	700,000	1,200,000
Ministry of Health, Care of the Elderly and Family Affairs	Refurbishment Works	120,000	25,000
Ministry for Social Security	Refurbishment Works	120,000	25,000
Ministry for Housing	Refurbishment Works	50,000	40,000
TOTAL		1,373,000	1,970,000

Source: Estimates 1997, 1998

2.4.3.3 Listed Buildings

Historic Buildings can be scheduled under the Development Planning Act. The Structure Plan calls for the designation of items listed in the National Protective Inventory (NPI) and continued research to add more items to the list. The NPI, which was launched in 1988, is a detailed survey of the village core areas documenting every building and space in each street. These buildings are assessed by qualified personnel and assigned appropriate grades where the buildings merit so. The Planning Authority has been reviewing the NPI process in order to make it more cost-effective and relevant to the wider planning process.

The NPI has still to cover substantial parts of the Maltese Islands as can be seen from Table 2.4.3.3.1 below. The surveys have generally aimed to cover the areas where Local Plans were being prepared. However, the NPI survey work has lagged behind policy formulation so that the NPI information is mainly being used for Development Control purposes.

Table 2.4.3.3.1 – Localities surveyed as part of the National Protective Inventory and number of properties included in each.

Town/Village	Number of properties in NPI
Marsaxlokk	301
Birzebbuga	909
Rabat	848
Sliema	1052
Mosta	138
Bormla	341
Kalkara	366
Paola	1288
Tarxien	487
Zejtun	1398
Selmun	90
Victoria Lines	358
Ghammar	38
Hamrun	32
Attard	188
Misrah Strejnu	127
Zejtun/Marsaxlokk/Marsascala (outlying district)	105
Qormi	1158
Il-Bidni	109
Marsascala	475
Mqabba	129

Source: Environmental Management Unit, Planning Authority

Information from the NPI is subsequently used to schedule buildings of architectural, cultural, vernacular or historic interest. The scheduling process, which is run by the Planning Authority, was launched in 1994 and to date has afforded protection to around 1000 properties. The scheduling process is not only concerned with buildings but provides for the protection of all heritage items.

Buildings identified for scheduling are assigned grades according to the provisions of Structure Plan policy UCO 7, as follows:

Grade 1 Buildings of outstanding architectural or historical interest that shall be preserved in their entirety. Demolition or alterations that impair the setting or change the external or internal appearance, including anything within the curtilage of the building, will not be allowed. Any interventions allowed must be directed to their scientific restoration and rehabilitation. Internal structural alterations will not be allowed in exceptional circumstances where this is paramount for reasons of keeping the building in active use.

Grade 2 Buildings of some architectural or historical interest or which contribute to the visual image of an Urban Conservation Area. Permission to demolish such buildings will not normally be given. Alterations to the interior will be allowed if proposed to be carried out sensitively and causing the least detriment to the character and architectural homogeneity of the building.

Grade 3 Buildings which have no historical importance and are of relatively minor architectural interest. Demolition may be permitted provided the replacement building is in harmony with its surroundings.

Source: Structure Plan for the Maltese Islands

Of the around 10,000 buildings included to date in the NPI, around 20% are recommended for scheduling at Grade 1 or 2.

Table 2.4.3.3.2 summarises the distribution and number of scheduled buildings (up to 1997) across the country, divided into the seven local plan areas.

Table 2.4.3.3.2 – Number of scheduled buildings per locality (as at 1997)

Local Plan Area	Locality	Number of Scheduled Buildings
Marsaxlokk Bay	Marsaxlokk	28
	Birzebbuga	101
Grand Harbour	Valletta	52
	Floriana	1
	Marsa	0
	Bormla	1
	Isla	0
	Birgu	0
	Kalkara	3
North West	Mellieha	14
	San Pawl il-Bahar	10
	Rabat	2
	Mdina	0
	Mgarr	4
	Dingli	2
North Harbours	Sliema	62
	San Giljan	107
	Ta' Xbiex	0
	San Gwann	7
	Gzira	0
	Msida	1
	Swieqi	0
	Pembroke	69
	Pieta'	3
Central	Naxxar	11
	Mosta	2
	Birkirkara	2
	Attard	2
	Qormi	1
	Sta Venera	3
	Balzan	2
	Lija	1
	Hamrun	1
	Iklin	
	Gharghur	
South	Paola	0
	Tarxien	96
	Fgura	4
	Zabbar	2
	Zejtun	100

	Ghaxaq	1
	Gudja	0
	Luqa	0
	Kirkop	0
	Safi	0
	Qrendi	5
	Zurrieq	8
	Mqabba	14
	Siggiewi	11
	Marsascala	7
	Xghajra	1
	Haz Zebbug	2
	Santa Lucija	
Gozo & Comino	Ghasri	1
	Gharb	2
	Zebbug	1
	San Lawrenz	1
	Kercem	1
	Munxar	1
	Qala	3
	Nadur	1
	Sannat	2
	Rabat (incl. Cittadella)	51
	Xaghra	9
	Xewkija	1
	Fontana	0
	Ghajnsielem	4
	Comino	2
Malta & Gozo	Total	823

Source: Environmental Management Unit, Planning Authority

The Planning Authority maintains information on listed buildings through its in-house heritage management system that is currently being upgraded. This includes information on buildings under threat from neglect or pressure from new development.

Monitoring of scheduled buildings is undertaken by the Planning Authority's Environmental Management and Enforcement Units. Government Departments (especially the Environment Protection Department, the Restoration Unit and the Museums Department), Local Councils, NGOs and private citizens also often lend a hand with reports being forwarded to the PA when properties are in danger. This partnership needs to be further strengthened as the list of scheduled property increases as the PA does not have enough staff to monitor these properties regularly. The introduction of local wardens responsible to the various Local Councils could be a way of forging such a partnership between the PA and the Local Councils.

2.4.3.4 Archaeology

The Maltese Islands are particularly rich in archaeological sites due to their varied and chequered history including occupation by various forces and cultures over the years. The archaeological remains that can be found today are a historical record of thousands of years of human activity on the Islands. Malta's cultural heritage is one of the most important in the Mediterranean region and the remains are of local, national and international importance. The Islands also boast two archaeological World Heritage Sites – the Hypogeum and the Megalithic temples of the Maltese Islands (Ggantija, Hagar Qim, Imnajdra, Tarxien, Skorba and Ta' Hagrat).

Apart from the temples, archaeological sites include a wide range of features including stone circles, burial grounds, catacombs, tombs, cart ruts, sanctuaries, walls, defensive structures, rock-cut features and troglodytic dwellings, and so on.

Responsibility with this sector lies primarily with the Museums Department but the Planning Authority also holds responsibility for protecting the country's archaeological heritage from damage caused by development and for compiling and maintaining an inventory of archaeological sites and affording protection to these features through the scheduling process.

The Structure Plan's strategy for archaeological conservation is the identification of Sites and Areas of Archaeological Importance (SAIs and AAIs) in order to avoid further dilapidation or destruction of our archaeological resource.

The Structure Plan defines SAIs and AAIs as follows:

SAIs	Individual and/or isolated archaeological sites
AAIs	Concentrations of valuable archaeological sites

Archaeological remains are a finite non-renewable resource whose preservation is extremely important. In order to safeguard archaeological remains for future generations and to ensure that the current generation can understand and learn about the past requires the management of the resource. Archaeological remains are a valuable learning medium and can, with appropriate management, form popular leisure and tourism destinations. Unfortunately, very few of our archaeological sites are blessed with some form of management and most of those that are have unfortunately been subjected to inappropriate management practices over the years. However, there are encouraging signs that concrete steps are being taken to change this state of affairs. Archaeological sites also often indirectly provide protection to important natural areas and the promotion of both aspects and the establishment of heritage parks needs further encouragement and support.

In recent years there has also been a drive, mainly spearheaded by the Planning Authority and a few NGOs, to consider archaeology in its widest sense and context. Hence, attention has started being given to a different sort of archaeology from a more recent past, the so-called industrial archaeology. This includes features such as railway tracks, bakeries, power stations, distillation plants, harbour installations, etc. Another aspect that has been given importance is landscape archaeology that aims to protect not only the archaeological remains but also their context when this still exists. This approach therefore would not simply aim to protect the singular sites but would rather protect a complex such as the Ggantija temples, Ghar t' Ghejzu, Xaghra circle and Santa Verna temples. It may also preserve the setting of places like in-Nuffara and Il-Qlejgha Bronze Age settlements, Mdina, the Cittadella and the Hagar Qim-Mnajdra temple complex. The establishment of Areas of Archaeological Importance is a first step in this direction.

Archaeological remains can be protected through the Antiquities Act (1925), through the Environment Protection Act (1991) and the Development Planning Act (1992). The Antiquities Act although not repealed, has become largely ineffective with the latest update of the Antiquities List taking place in 1977. No cultural property (whether buildings or archaeological remains) have been protected under the EPA whereas scheduling of archaeological remains under the DPA has been increasing steadily since the launch of the scheduling process in 1994.

Archaeological remains can be classified from Class A to Class D according to the provisions of Structure Plan policy ARC 2.

Table 2.4.3.4.1 – Protective classification of Archaeological sites (Structure Plan policy Arc 2).

Class A Top priority conservation. No development to be allowed which would adversely affect the natural setting of these monuments or sites. A minimum buffer zone of at least 100m around the periphery of the site will be established in which no development will be allowed.

Class B Very important to be preserved at all costs. Adequate measures to be taken to preclude any damage from immediate development.

Class C Every effort must be made for preservation but may be covered up after proper investigation, documentation and cataloguing. Provision for subsequent access shall be provided.

Class D Belonging to a type known from numerous other examples. To be properly recorded and catalogued before covering or destroying.

Source: Structure Plan for the Maltese Islands

Table 2.4.3.4.2 - Sites of Archaeological Importance (SAIs) scheduled between 1994 and 1997.

Year	Class A	Class B	Class C	Class D	Total
1994	14	4	0	0	18
1995	1	1	1	0	3
1996	0	2	0	0	2
1997	14	3	0	0	17
1998	14	30	0	0	44
Total	43	40	1	0	84

Source: Environmental Management Unit, Planning Authority

Table 2.4.3.4.3 - Areas of Archaeological Importance (AAIs) scheduled (1997 – 1998).

Year	AAI	No. of Archaeological sites and features	No. of cultural properties	Area protected (Km^2)
1997	Hagar Qim/Mnajdra	8	2	0.62
1998	Il-Qlejgha Ghar il-Kbir/Clapham Junction Ghar Dalam/Borg in-Nadur Bingemma Xaghra plateau Rabat/Mdina Cittadella/Victoria	15 8 8 6 5	2 1 1 1 1	1.76 0.69 0.61 0.2 0.3 1.32 4.5

Source: Environmental Management Unit, Planning Authority

Although the various scheduled sites are of extreme importance, this could give a false impression that these are the only archaeologically important sites. The Islands' long settlement history and position in the centre of the Mediterranean is such that the whole territory has archaeological potential and it is important that this widespread value and potential be recognised and integrated into land use planning and management strategy.

2.4.3.5 Archaeological Inventory

The Planning Authority has, over the years, been collating an inventory of the archaeological sites on the Islands. The Planning Services Division with the help of the University of Malta commenced this exercise in 1990. It was subsequently revamped and archaeological surveys have been a common feature of Local Plan environmental resources surveys. Information on the various sites mentioned in the original survey has been updated and additional information gathered. Data has also been gathered from ad hoc site visits, applications for development, Museums Department sites, ancient and historical texts and NGOs. The inventory contains information on the precise location of the archaeological remains, existing and potential threats confronting them and also delineates a protective buffer zone. Most of the sites have now also been entered into a geographical information system in the form of a constraints map and are therefore subject to a certain degree of protection from development. GIS entry is continuing with the aim of having all of the information on the various sites in one comprehensive database.

The amount of archaeological sites recorded in the inventory at present is close to 500. These also include 12 underwater sites. However, this number is expected to increase considerably once the archaeological surveys for the Gozo & Comino, the South and the Central Local Plans are carried out. Table 2.4.3.5.1 below shows the distribution of these sites by the various local plan areas.

Table 2.4.3.5.1 – Distribution of archaeological sites and features recorded in the Planning Authority's Archaeological Inventory.

Local Plan Area	Class A[5]	Class B	Class C	Class D	Class E[6]	Total
Marsaxlokk	10 (2)	9	-	-	8	27 (2)
North West	40 (9)	138 (2)	23 (1)	3	100	304 (12)
Grand Harbour	2	2	-	-	16	20 (0)
North Harbours	1 (1)	5 (2)	-	-	8	14 (3)
Gozo & Comino	17 (7)	12 (2)	6	1	11	47 (9)
Central	3 (1)	7	1	-	4	15 (1)
South	6 (5)	23 (3)	2	-	19	50 (8)
Underwater		12 (1)				12 (1)
Total	79 (25)	208 (10)	32 (1)	4	166	489 (36)

Source: Environmental Management Unit, PA

Scheduling criteria for archaeological sites have also been updated to international standards. These include:

?? Justification for scheduling on the merits of a site's or area's local, national or international significance;
?? Justification for the extent of buffer zones around the sites on the merits of the value of the surrounding landscape in relation to the monument;
?? Current and probable development implications within the area, where possible compromise is sought to avoid future conflicts.

2.4.3.6 Future Issues Concerning Archaeology

In view of the rich archaeological heritage of the islands, the issues involved are also varied and several. These include:

[5] Numbers in brackets indicate scheduled sites.
[6] The Class E grading is not catered for in the Structure Plan but it is being used in the inventory for sites that are known to have existed but are currently untraced. Although most of these sites have been covered by large scale buildings in the post-war construction phase, they are not considered lost since the disturbed remains could probably contain significant information.

?? the urgent need to take protective measures at the various World Heritage megalithic temples, in order that these remains can be preserved for future generations.;
?? the need for policies that effectively protect valuable sites and encourages the reporting of finds. Current measures are considered to be too restrictive leading to destruction of remains unearthed during construction works.
?? issues related to the rich and yet unexplored underwater archaeological remains in various parts of the islands;
?? the need to recognise the value of the country's non-scheduled archaeological heritage which is equally important;
?? the resolution of conflicts between archaeological conservation and development (including agriculture, afforestation and nature conservation);
?? the need to train further personnel in heritage management and rescue archaeology
?? the need for management of the major archaeological sites to include control of visitor pressure;
?? the provision of interpretation facilities at the various archaeological sites.

2.4.4 Industry

The industrial sector is Malta's largest productive sector accounting for around 66% of the total gross output. Of the 2,323 enterprises in Malta[7], 75% are small/micro industries employing less than 5 people. Only 19 enterprises employ more than 250 people. Most of Malta's industry is located in dedicated industrial estates. Most estates are privately owned but a number are owned and run by the Malta Development Corporation (MDC).

Table 2.4.4.1 – Workshop space and number of employees in industrial estates.

Name	**Workshop Area (sq. m)**	**No. employed**
Attard	156,587	3,180
Bulebel	297,646	6,731
Corradino	N/a	Na
Gozo Industrial Zone	361,999	7,592
Hal Far	499,076	8,185
Kordin	565,942	9,529
Luqa	14,793+	Na
Marsa	140,419	3,080
Mosta Technopark	335,654	6,926
Mriehel	608,050	11,021
Mriehel Units	722,550	13,656
Ricasoli	769,050	14,067
San Gwann	881,566	16,482
Ta' Qali	Na	Na
Xewkija	Na	Na
TOTAL	10,446,842	100,446

Source: MDC (May 1994)

Land available in MDC industrial estates (Nov. 1997) is shown in Table 2.4.4.2 below.

[7] This is 1994 data.

Table 2.4.4.2 – Land availability on MDC-owned industrial estates (as at November 1997).

Industrial Estate	Plot Size
Hal Far	368244
Kordin	6500
San Gwann	c. 40000
Xewkija	20000
Luqa	To be decided
Kirkop	To be decided

Source: Commerce & Industry Subject Study, PA

Over the past years, MDC have made efforts to maximise development potential within their existing estates. Extensions to industrial estates over the period 1994-1997 have included 4 ha at San Gwann and 6 ha at Xewkija.

Around 47 ha of industrial land lie outside the established government industrial estates. Out of these 47 ha, around 30ha remained vacant as of Summer 1997.

Unfortunately, most of the sites zoned for industry that are in private ownership are rarely used for this purpose as MDC offers subsidised rates for industrial floorspace which is difficult for the private sector to match. Consequently, land zoned for industrial purposes (particularly at Mriehel) is often utilised for other commercial purposes, mainly showrooms, warehousing and offices.

Current estimates indicate that the overall supply of available industrial land on existing industrial estates, including planned extensions, can comfortably accommodate the anticipated net growth in industrial employment. However, incentives must be put in place for private owners to release land zoned for such uses.

One industry sector that has been given greater attention in recent years is the small and medium sized enterprises (SMEs). A number of sites have been earmarked for such development, mostly within existing industrial sites. The Institute for the Promotion of Small Enterprise (IPSE) has also been set up by government to support this sector of industry and to enable the industry's restructuring.

2.4.5 Waste Dumps

All the waste generated on the Maltese Islands today ends up at the only official dumping sites - at Maghtab in Malta or at Il-Qortin ta' Ghajn Damma in Gozo. Another dump at Ta' Wied Fulija, l/o Zurrieq, has been closed down in the past years. However, a number of unofficial dumps exist around the islands, all of which serve to degrade the landscape and cause all sorts of environmental problems associated with odours, fires, noxious fumes, vermin, dust. Such dumps occur at Ic-Cumnija, Anchor Bay, Ahrax Point, between Xwejni bay and Ghasri, and at Tal-Balal[8] among others.

Based on disposal information from the Maghtab landfill, estimates of waste per capita deposited per week has been calculated to amount to 7.2kg. When comparing this to the UK, the figures of waste arisings by social class range from 3.75 kg/person/week for professional workers and 6.72 kk/person/week for retired people.

However, one of the biggest problems locally is the dumping of construction and demolition (C&D) waste. Recent efforts to channel this waste to quarries for recycling or for rehabilitation of the quarries themselves has been largely unsuccessful. Today, around 80% of the waste reaching the Maghtab landfill is inert C&D

[8] This dump has recently (1999) been cleared.

waste which does not have to be landfilled and instead should as much as possible be re-used. Urgent action to divert this resource from the Maghtab dump needs to be taken.

One possible way to tackle this problem is to encourage recycling initiatives. This could take the form of changes to building regulations and introduction of threshold levels for the re-use of recycled stone, for example by instituting regulations requiring the use of a percentage amount of “recycled stone”[9] in each building.

Other measures required include:

?? changes to existing and outdated technologies such as the “incinerators” at St Luke’s Hospital, Kordin and the abbatoir;
?? the preparation of adequate and up to date policy documents such as a Waste Management Strategy which would set out a vision for tackling the waste problem in the Maltese Islands and a Waste Management Subject Plan that would look into the land-use implications of waste management;
?? the use of tools such as Waste Management Plans; and
?? the formulation of EU-standard Waste Management legislation.

Table 2.4.5.1 below shows the approximate area of land occupied by the various dump sites as at 1993.

Table 2.4.5.1 – Areas occupied by dumps (1993).

Dump Site	Area (sq. m)
Maghtab	210,000
Il-Qortin ta’ Ghajn Damma, Xaghra	80,000
Wied Fulija (closed)	70,000
Luqa (closed)	90,000
Ic-Cumnija (unauthorised)	23,000
Ahrax Point (unauthorised)	30,000
Anchor Bay (unauthorised)	20,000

Source: Mapping Unit, Planning Authority

Further information on waste management is available in other sections of the State of the Environment Report.

2.4.6 Coastal Uses

The latest complete coastal zone survey of the Maltese Islands was carried out in 1989 by the University of Malta and the University of Durham on behalf of the Planning Services Division. This survey mapped all the coastal uses but then used a linear value so that comparisons could be made with the total coastline length of the islands. Summaries of the findings are shown in Table 2.4.6.1 and Table 2.4.6.2 below.

Table 2.4.6.1 – Percentage of coastline dominated by the major geomorphological units (1989).

	Mainland Malta	Gozo & Comino
Obscured by buildings (not accurately classifiable)	30.5	7.5
Rdum	17.0	14.5
Bare cliff	22.0	62.0

[9] By recycled stone we mean either dimension blocks from old buildings re-used in new buildings or else new stone elements made of reconstituted stone.

Low rock coastline	30.5	16.0

Source: Coastal Zone Survey, 1989

Table 2.4.6.2 – Land-use statistics for the coastal area of the Maltese Islands (1989).

	Land Use	Mainland Malta	Gozo & Comino	Malta Total
1	Coastline obscured by development	30.5%	7.5%	38.0%
2	Lowland unobscured coastline	30.5%	16.0%	46.5%
3	Accessible coastline	50.0%	26.0%	76.0%
4	Tourism dominated coastline	35.0%	19.0%	54.0%
5	Industry dominated coastline	8.0%	4.5%	12.5%
6	Coastline frontage with maritime activities	16.5%	4.5%	21.0%
7	Coastal zone agriculture	23.0%	57.0%	80.0%
8	Coastal zone vegetation (green all year)	9.0%	8.5%	17.5%
9	Pollution dominated coastline	3.0%	2.5%	5.5%
10	Coastline of international scientific importance	0.0%	2.5% [10]	2.5%
11	Coastline of national scientific importance	6.0%	6.0%	12.0%
12	Coastline of international importance	5.0% [11]	2.5% [12]	7.5%
13	Coastline of national importance	13.5%	14.0%	27.5%
14	Coastal watch towers beyond worthwhile repair	3	1	4
15	Coastal zone black spot requiring immediate attention (dumping and quarrying activities)	6	2	8
16	Tourist foci in which local Maltese tourism is dominant	7	0	7
17	Hotel development spoiling the coastal environment	5	1	6

Source: Coastal Zone Survey, 1989

This survey estimated that around 8% of the coastline of Malta and 4.5% of the coastline of Gozo and Comino are industry-dominated. These industries include a variety of manufacturing and heavy industries such as dry-docking, etc., in Grand Harbour and Kalafrana, Salt production and desalination of water and quarrying. Table 2.4.6.3 below identifies the various uses.

Table 2.4.6.3 – Percentage of coastline dominated by industry (1989).

Mainland Malta	
8% of total coastline comprising:	
Miscellaneous (manufacturing and other industries)	71%
Salt Production	25%
Desalination Plants	2%
Quarrying	2%
Gozo and Comino	
4.5% of total coastline comprising:	
Salt production	8.8%
Quarrying	12%

Source: Coastal Zone Survey (1989)

[10] Refers to Inland Sea and Dwejra Bay (Gozo).
[11] Refers to Fortifications in Grand Harbour and Marsamxett (Malta).
[12] Refers to Inland Sea and Dwejra Bay (Gozo).

In terms of coastal accessibility, the 1989 survey estimated that 50% and 74% of the coast of mainland Malta and of Gozo and Comino respectively, were inaccessible. On Malta this was due to physical features (75%), industrial development (19.5%), tourism-related development (3.5%) and military areas (2%). On Gozo and Comino it was basically all due to physical features. With regards to tourism development, 35% of the coastal zone of Malta and 19% of Gozo and Comino are tourism dominated. Other coastal uses include agricultural land. Coastal agriculture is more evident on Gozo and although not very important from an economic point of view, coastal agriculture is important for sustaining aspects of the natural environment.

The three major uses affecting coastal areas are tourism, agriculture (including aquaculture) and infrastructure. Tourism has been considered to be a major culprit of the destruction of the local coastal environment, both through direct development on the coast (including hotels, beach concessions, promenades, car parks, etc.) and through the pressure exerted by tourists on the coast, especially the limited sandy shoreline. Recent developments associated with coastal/marine uses have included kiosks (some in totally inappropriate areas like sand dunes), campsites, boathouses and beachrooms, slipways, yacht marinas, beach replenishment and artificial wrecks.

Occasionally, letters to the press also call for other damaging activities such as dumping of rubble at sea, concreting or smoothening of rocky shores, land reclamation and creation of new beaches where none ever existed.

With regards to Agriculture and aquaculture, developments on the coast have included farm stores, reservoirs, boathouses, farmhouses, aquaculture units, greenhouses and animal farms. Although the majority of these are considered to be legitimate uses outside development zone, better guidance on some of these developments, especially in scenic areas, are required.

Infrastructure activity is possible the most damaging on coastal areas. Most of the coastal developments require an environmental impact assessment so that their environmental impact is assessed prior to approval of the development proposal. A number of major coastal developments have been identified for the coming years. These include: the Cirkewwa and Mgarr ferry terminal improvements (the former includes a breakwater extension, land reclamation and coastal defences); the Manoel Island and Tigne' Point development (which includes a yacht marina and other coastal development), A yacht marina at Dockyard Creek; the Cruise Passenger Terminal in Valletta, and tuna penning projects.

2.4.6.1 Coastal Access

Possibly one of the most pressing needs with regards to the coastal environment is the need to ensure public access to and along the coast. The Structure Plan, through policy CZM 3, was very categorical with regards to this issue, providing for a virtual complete public ownership of the coast (except for areas where due to security considerations this was not possible). This policy required that all the coastline be brought into public ownership within a specified period. Although at the time it did not specify what this period would be, there exists a general feeling that this policy has largely failed, even though it has been used successfully to prevent further take-up of public shoreline and the building of more developments along the coast. In a few cases, it has also been used to secure public access to privately owned shoreline as a condition to development permission close to but not on the shore.

It is now felt that this policy needs further elaboration together with an exact definition of what the coastal zone is and how far it extends (at least in planning terms). This issue is to be tackled in depth through the coastal zone management subject plan currently being prepared by the Planning Authority.

CONTINUE

2.5 The Natural Environment

2.5.1 Habitat Data

The exact extent of the various habitat types in the Maltese Islands is still not known. This is because a complete habitat survey has not been carried out. However approximate areas occupied by the various habitat types have been calculated and are available in other sections of the State of the Environment Report.

Since 1992, the Planning Authority has been commissioning ecological surveys as part of the environmental resources surveys for the various local plans and to date around half of the land area of the Maltese Islands has been mapped. It is expected that a full and accurate habitats map be available by 2001.

2.5.2 Rural Conservation Areas

The Structure Plan's strategy on rural conservation hinges on the designation of Rural Conservation Areas (RCAs) which include a blanket prohibition of urbanisation outside existing and planned urban areas except for structures or activities that are legitimate and natural to rural areas.

The designation of RCAs aimed at providing the context and institutional means of channelling effort and investment into the enhancement of the natural resources found in these areas.

The major agencies involved in the protection of the environment are the Environment Protection Department and the Planning Authority. The former as the Government Agency legally responsible for environmental matters and the latter through its land-use planning and development control function, which of necessity has a very significant environmental role. Other agencies of Government with a role in environmental matters include the Agriculture Department, the Water Services Corporation, the Local Councils, the Police, the Civil Protection Department, the Tourism Authority and the Works Division. Non-governmental organisations are also active in the environmental field.

2.5.3 Protected Areas

2.5.3.1 Nature reserves

Natural Areas can be protected either as Nature Reserves under the Environment protection Act (EPA) or as Scheduled Property (Areas of Ecological Importance and Sites of Scientific Importance) under the Development Planning Act (DPA).

Since 1991, a number of Nature Reserves have been declared under the EPA. Three of these – Filfla, Fungus Rock and Selmunett Islands - have been declared under specific legislation whereas the rest were set up under the Birds and Wild Rabbit (Declaration of Protected Species and Nature Reserves). Table 2.5.3.1.1 shows the various nature reserves and the area they occupy.

Table 2.5.3.1.1 – Nature Reserves declared under the Environment Protection Act and the area occupied by each.

Nature Reserve	Date of Declaration	Legal Notice	Area (sq. m)
Filfla			62,879
Fungus Rock	1992	LN 22 of 1992	6,022

Selmunett Islands Ta' Qali	1993 29 October 1993	LN 25 of 1993 LN 144 of 1993	104,400 958,900
Manoel Island	29 October 1993	LN 144 of 1993	307,400
Addolorata Cemetery	29 October 1993	LN 144 of 1993	468,900
Ghadira	29 October 1993	LN 144 of 1993	1,153,000
Xrobb l-Ghagin	29 October 1993[1]	LN 144 of 1993	234,000
Kennedy Grove & Salina	29 October 1993	LN 144 of 1993	252,000
Marsa Sports Ground	29 October 1993	LN 144 of 1993	691,300
San Anton Gardens	29 October 1993	LN 144 of 1993	65,030
Portes-des-Bombes	29 October 1993	LN 144 of 1993	138,000
Comino	29 October 1993	LN 144 of 1993	2,870,719
Buskett Gardens & Verdala Palace	29 October 1993	LN 144 of 1993	1,142,000
Ta' Cenc	29 October 1993	LN 144 of 1993	178,900
Simar, St Paul's Bay	29 October 1993	LN 144 of 1993	68,420
Filfla	29 October 1993	LN 144 of 1993	62,879
Il-Ballut, Marsaxlokk	29 October 1993	LN 144 of 1993	232,800
Selmunett	29 October 1993	LN 144 of 1993	104,400
Girgenti	29 October 1993	LN 144 of 1993	136,100
Wied Ghollieqa	29 October 1993	LN 144 of 1993	112,600
Il-Qawra, Gozo	29 October 1993	LN 144 of 1993	262,600
Ghammar Hill	29 October 1993[2]	LN 144 of 1993	128,300

Source: Various legal notices; Mapping Unit, Planning Authority

Apart from those shown above, LN 144 of 1993 also includes the following with the list of Nature Reserves:

- All public gardens in Malta and Gozo
- Area within 200m of the Luqa Airport and within 50m of the approach lights indicating the runways
- Within 50 metres of the Radio Stations operated by the Department of Civil Aviation at:
  - Benghajsa, l/o Birzebbuga
  - Dingli Heights, l/o Dingli
  - Tas-Silg Fortress, l/o Delimara
  - Wied Rini, l/o Rabat
  - Non-directional beacon, Fort St Rocco, l/o Rinella
  - VOR station, it-Tafal, l/o Kercem, Gozo

2.5.3.2 Scheduled property

Scheduling was launched in 1994 and the very first natural area to be afforded protection under this process was part of the watercourse of Wied Musa in Mellieha. Other natural areas protected since then were saline marshlands and coastal wetlands, sand dunes and beaches, valleys, garigue, maquis, forest remnants and woodlands, coastal cliffs and clay slopes.

Natural areas can be designated as Areas of Ecological Importance, as Sites of Scientific Importance and as Areas of Agricultural Value. Areas of Ecological Importance (AEIs) are relatively large areas

[1] Nature Reserve Status revoked in 1997 after the Deutsche Welle radio station was closed down.
[2] Nature Reserve Status revoked by Authority of Review on 20 December 1995.

designated to protect typical and rare habitats. In order for an area to qualify as an AEI, it must have one or more of the following rare or typical habitat types:

?? Permanent springs
?? Saline marshlands
?? Sand dunes
?? Forest remnants
?? Semi natural woodland
?? Natural freshwater pools and transitional coastal wetlands
?? Deep natural caves
?? Coastal cliffs (including the *rdum* system)
?? Garigue
?? Maquis
?? Valley sides
?? Watercourses
?? Gently sloping rocky coasts

Sites of Scientific Importance (SSIs), on the other hand, are sites containing individual species, groups of species, and geological features of particular scientific value. SSIs are designated when one or more of the following features is present:

?? the only known locality in the Maltese Islands where certain endemic and/or non-endemic species are found;
?? a locality where certain endemic and/or non-endemic species with a restricted distribution in the Maltese Islands occur (where "restricted distribution" means the species is found in five localities or less);
?? the type locality of an endemic species;
?? an important bird nesting site or site is of some other major ornithological interest;
?? a locality of special palaeontological interest;
?? a lithostratigraphical type section;
?? a locality of particular geomorphological interest;
?? some other specific feature of scientific importance.

Areas of Agricultural Value (AAVs) are areas comprising high grade agricultural land including irrigated and partially irrigated land.. AEIs and SSIs are classified according to set protection levels ranging fromLevel 1 to Level 4.

Table 2.5.3.2.1 – Level of protection for Areas of Ecological Importance and Sites of Scientific Importance (Structure Plan Policy RCO 12).

Level 1	Important habitat types present only in small areas and/or sites with unique species or features.
Level 2	Important habitat types present in relatively large areas and/or sites with rare species or features.
Level 3	Areas where control is necessary to preserve habitats/species/features in adjacent sites.
Level 4	Habitats and/or features of general interest.

Source: Structure Plan for the Maltese Islands, 1990

Table 2.5.3.2.2 – Number of natural areas protected through scheduling (1994 – 1997).

Level	1994	1995	1996	1997	Total

Level 1	1	24	10	1	36
Level 2	0	8	10	0	18
Level 3	1	15	15	3	34
Level 4	0	1	3	4	8
Total	2	48	38	8	96

Source: Environmental Management Unit, Planning Authority

AAVs, on the other hand are not classified into separate levels although designation of an area as of agricultural value should ideally be based on an Agricultural Land Classification System which unfortunately does not yet exist for the Maltese Islands.

Other designations used in the Structure Plan is that of "National Parks". This designation is used for relatively large areas of national significance not materially altered by human use, with managed visitor access and amenities. No such areas have as yet been designated in the Maltese Islands[3]. Obviously, very few areas would qualify for such a status although Dwejra/Qawra, Ta' Cenc and San Dimitri point in Gozo and Bahrija, Ras il-Pellegrin and Il-Qammieh in Malta could be good candidates.

Apart from Areas of Ecological Importance, Sites of Scientific Importance and Areas of Agricultural Value, the Development Planning Act also provides for the protection of trees, groups of trees and woodlands. These "scheduled trees" are given the same protection as other scheduled property but in addition the DPA regulates certain activities such as lopping, topping, felling, (apart from prohibiting wilful damage) so as to protect valuable trees. To date, a number of trees have been scheduled as outlined below.

Table 2.5.3.2.3 – Scheduled trees (1994 – 1998).

Year	**Tree Scheduled**	**Number/Area (sq. m.)**
1994	Nil	0
1995	Nil	0
1996	Kennedy Grove, Trees along Kennedy Drive, Buskett	439,200 sq m
1997	Nil	0
1998	One Canary Island Palm One Norfolk Island Pine Tree at St Paul's Bay	2

Source: Environmental Management Unit, Planning Authority

Although these only show figures for trees/woodland areas scheduled specifically under Section 48 of the Development Planning Act, several other trees and groups of trees have been afforded protection by virtue of their being present within Areas of Ecological Value, such as the coastal cliffs, valleys, maquis areas, etc.

2.5.4 Marine Conservation Areas

As with the terrestrial areas, the Structure Plan also provides for the protection of valuable areas of sea as Marine Conservation Areas.

[3] The so-called Ta' Qali National Park does not fit this definition and should more appropriately be termed National Country Park or National Recreation Centre.

Coastal zones, especially in small island states as is Malta, are areas of high resource conflict. In Malta, the problem is exacerbated with the high population density and the restricted extent of accessible coastline.

The waters around the Maltese Islands support an interesting array of habitat types and geomorphological features that, coupled with the historical and archaeological remains, make them ideal candidates for protection as marine protected areas.

Unfortunately, the data needed to precisely identify and delineate Marine Conservation Areas is very limited and expensive to collect. Hence, in 1990 the Structure Plan identified a number of candidate sites that could potentially be designated as Marine Conservation Areas. Of these 14 areas, only two have been surveyed to date.

Still, the designation of MCAs requires the establishment of a management authority and availability of equipment for monitoring and enforcement. Unfortunately, such equipment and the personnel to manage the site is either unavailable or constrained by other work.

2.5.5 Agriculture

Agriculture as a sector contributes less than 4% to the GDP however it is a major land user and a key economic production centre with a role in the nation's long-term security through food-provision. Subject to appropriate environmental management, the agricultural industry can also function as a protector of the countryside and natural heritage of the Islands.

Last official data for registered agricultural land shows that there has been a major decline in agricultural land during the last half-century, with 42% (approx. 8,500 ha) of the total agricultural land being lost between 1956 and 1991[4].

The rate of decline has now decelerated largely due to a success of the relevant Structure Plan policies constraining development to urban areas.

Table 2.5.5.1 – Trends in agricultural land (1983 – 1991).

Type	1983			1986			1991		
	Malta	Gozo	Total	Malta	Gozo	Total	Malta	Gozo	Total
Dry	8778	2133	10911	7958	1920	9878	8454	1544	9998
Irrigated	546	34	580	627	37	664	681	42	723
Waste	1358	168	1526	1282	162	1444	1030	151	1181
Total Land	10682	2335	13017	9867	2119	11986	10165	1737	11902

Source: Central Office of Statistics, Census of Agriculture 1990-1991

Despite the fact that agricultural land has been declining, agricultural production has increased over the last years mainly as a result of more and better irrigation. The main increases were recorded in vegetable production.

The major challenges faced by the agricultural sector today include land fragmentation (especially due to inheritance), scarcity of water resources (although this is being addressed through drip irrigation), and an ageing labour force.

[4] More recent data is not available.

In terms of environmental impact, possibly the most important issues relate to the proliferation of greenhouses (56 such developments approved between 1993 and 1997) and farm stores (252 approvals between 1993 and 1997).

Table 2.5.5.2 shows the number of applications approved by the Planning Authority between 1993 and 1997 for various agriculturally related developments.

Table 2.5.5.2 – Agriculture-related application by type approved by the Planning Authority between 1993 and 1997.

Development Type	Decision Year					Total
Description	**1993**	**1994**	**1995**	**1996**	**1997**	
Access Roads	1	0	0	1	2	4
Apiary	0	0	0	1	0	1
Bird Room	0	1	0	0	1	2
Demolition of rubble walls	0	0	1	0	0	1
Farm Building	6	6	10	14	9	45
Farm House	5	6	11	25	21	68
Farm Store	16	42	56	78	60	252
Greenhouses	2	10	10	18	16	56
Husbandry – Cattle	3	1	2	2	0	8
Husbandry – Chickens	4	3	14	5	6	32
Husbandry – Pigs	2	3	6	10	3	24
Husbandry – Rabbits	2	0	4	3	1	10
Husbandry – Sheep	0	0	1	1	1	3
Husbandry – Stables	3	2	8	2	2	17
Husbandry – Turkey	0	0	1	1	0	2
Land Reclamation	1	0	0	1	2	4
Mushroom Farm	0	0	0	1	1	2
Pump Room	0	3	2	1	4	10
Reservoir	2	15	18	21	16	72
Rubble Wall	0	0	4	1	4	9
Total	47	92	148	186	149	622

Source: Structure Plan Monitoring Report 1996-1997, PA

Further information on Agriculture is available in other Chapters of the State of the Environment Report.

2.5.6 Woodland

Although evidence exists that the Maltese Islands had an extensive tree cover in ancient times, only small pockets of this natural woodland still exist. These are restricted to Il-Ballut tal-Wardija, Il-Ballut ta' l-Imgiebah and Il-Bosk. Another small grove at Ta' Baldu/Wied Hazrun has been all but decimated in recent years. Other ancient groves include Olives at Il-Bidnija, Sandarac Gum trees at Mellieha and Maqluba and a few stands of other types of trees in very restricted places, often containing only a few specimens. All other wooded areas are due to afforestation projects carried out over the years, which have had mixed successes. Unfortunately, some afforestation projects have also been carried out using inappropriate and alien trees which have interfered with the local ecology.

Information on the extent of wooded land is unavailable although a guesstimate would be close to 0.5% of the land area of the Maltese Islands.

2.5.7 Geology, Geomorphology and Palaeontology

2.5.7.1 Geology of the Maltese Islands

The Maltese Islands are almost entirely made up of sedimentary rock deposited in a marine environment over millions of years during the Oligo-Miocene period. These limestones and clays form a series of stratigraphic layers of varying composition and hardness. In a few localised places, these are unconformably overlain by sparse Quaternary terrestrial and raised beach deposits, most of which are of high palaeontological importance. Igneous, intrusive, extrusive or metamorphic rocks do not exist anywhere on the islands.

The exposed rock sequence has been classified into five formations as shown in Table 2.5.7.1.1 below.

Table 2.5.7.1.1 – Stratigraphy of the Maltese Islands.

Rock Layer	**Maximum Thickness**	**Rock members**	**Age**	**Thickness**
Upper Coralline Limestone	175 m	Gebel Imbark	Miocene, Early Messinian	4-25m
		Tal-Pitkal	Miocene, Late Tortonian to Early Messinian	30-50m
		Mtarfa	Miocene, Late Tortonian	12-16m
		Ghajn Melel	Miocene, Late Tortonian	0-16m
Greensand	16 m	-	Miocene, Early Tortonian	0-16m
Blue Clay	75 m	-	Miocene, Serravallian to Early Tortonian	15-75m
Globigerina Limestone	227 m	Upper Globigerina	Miocene, Langhian	2-26m
		Middle Globigerina	Miocene, Aquitanian to Burdigalian	15-38m
		Lower Globigerina	Miocene, Aquitanian	0-80m
Lower Coralline Limestone	120 m (AMSL)	Il-Mara	Oligocene, Chattian	0-20m
		Xlendi	Oligocene, Chattian	0-22m
		Attard	Oligocene, Chattian	10-15m
		Maghlaq	Oligocene, Chattian	>38m

2.5.7.1.1 Upper Coralline Limestone Formation

This formation is largely crystalline or semi-crystalline in nature. It is the youngest of the rock layers and it characteristically forms the mesa-type plateaus and boulder screes.

It is predominantly found in the North West part of Malta and on the higher plateaus in Gozo occupying around 25% of the total area of Gozo and Malta. Due to extensive faulting the islands of Filfla, Cominotto and Comino are entirely made up of Upper Coralline Limestone and at the latter locality it reaches its maximum thickness.

The Upper Coralline Limestone Formation is subdivided into four members as follows:

2.5.7.1.1.1 Gebel Imbark member

The Gebel Imbark member consists of hard, pale gray, recrystallised limestones containing sparse faunas. These deposits are now restricted to erosional outliers and synclinal cores. This member yields high quality rock and has a thickness ranging between 4 and 20 m.

2.5.7.1.1.2 Tal-Pitkal member

The Tal-Pitkal member yiedls the highest quality hard rock aggregate. It consists of pale grey and brownish-grey coarse grained wackestones[5] and packstones containing significant bioclasts of coralline algae, molluscs and echinoids. The Depiru beds of this member contain patch reefs and biostromes dominated by pelloidal and molluscan carbonate mudstones, crustose coralline algae and corals. These reefs are best developed on Gozo close to Dahlet Qorrot and on Comino.

The Rabat Plateau beds of this same member terminate the Maltese stratigraphic sequence. They extend over most of the Rabat/Dingli Plateau reaching an exposed thickness of around 25m. The Rabat Plateau beds are also quarried, both for dimension stone and for aggregate.

2.5.7.1.1.3 Mtarfa member

The Mtarfa member of the UCL consists of massive, pale yellow marly limestone which becomes white and chalky towards the top. This member has a high clay content and as a result it is friable and weathers easily. This high percentage of clay makes this member unsuitable for the construction industry.

2.5.7.1.1.4 Ghajn Melel member

The Ghajn Melel member is the oldest of the four UCL members and consists of massive bedded, pale brown, foraminiferal limestones. This member contains mollusc and echinoid fauna as well as foraminferan bioclasts and, in some places, corals.

2.5.7.1.2 Greensand Formation

This formation is a very thin layer with a maximum thickness of 12m in Malta and 16m in Gozo, but often as little as 30cm. In places it is also completely absent. It occurs at the base of the Mtarfa member of the Upper Coralline Limestone and its exposures are often buried under the talus deposits of the UCL. It is often found as large detached boulders on the clay slopes beneath it.

The unit consists of thickly bedded, friable greyish green, brown or black marly limestone. The dark colour is imparted by an iron silicate (glauconite) which due to oxidation imparts a pale yellow colour or speckled appearance. The major fossils are *Heterostegina, Terebratula terebratula, Schizaster eurinotus,* sharks' teeth, vertebrae of cetaceans, benthonic foraminifera and bryozoans.

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[5] Rock facies whose texture is characterised by grains supported by mud.

2.5.7.1.3 Blue Clay Formation

This formation represents the only significant terrigenous sediment of the Maltese rock succession. It is composed of a bluish-grey colour banded marls and clays or olive-green marls and clays with no apparent banding. The colour banding derives from the varying concentrations of calcium carbonate in the form of fossil tests of planktonic and benthonic foraminifera. The colour variations depend on the calcium carbonate content with the light coloured layers correspond to a higher calcium carbonate content (normally in the range of 20 – 40%) whereas the darker-coloured clays have a 90 to 94% clay content. The purer clay bands have been used as raw material for local pottery manufacture from prehistoric times. Depending on the exact clay content, these sediments can be described as marly clays, clayey marls or marls.

The blue clay contains a rich assemblage of macrofauna represented by molluscs, echinoids, corals, fish remains and marine mammals although most of the larger fossils have been crushed during consolidation under the weight of the overlying sediment

The clays form an impervious base (called aquiclude) to the water-bearing Greensand and Upper Coralline Limestone (aquifers) above them. They hold all the rain water which manages to percolate through the rock layers thereby forming so-called "perched aquifers". Where the interface between the Blue Clay formation and the greensand/UCL formation is exposed, high level springs can form. These springs pour their contents into watercourses and are widely exploited for irrigation purposes.

2.5.7.1.4 Globigerina Limestone Formation

The Globigerina Limestone formation is characterised by a predominantly massive, soft, yellow, cream or white, intensely burrowed limestone with few interbeds of phosphate pebbles mainly at the interface between the sub-component members of the formation. This formation is also very rich in the planktonic foraminiferan *Globigerina* from which it derives its name.

This formation outcrops widely in the south-eastern part of Malta extending over two-thirds of the island's surface area. Topographically, it forms a gently rolling landscape with shallow valleys and low ridges.

This formation is divided into three members – the Upper, Middle and Lower Globigerina Limestones.

2.5.7.1.4.1 Upper Globigerina Limestone member

This member is similar in appearance to the lower globigerina but of a much inferior quality. Some of the beds of this member are resistant to heat and the rocks were extensively used for building small cooking stoves ("kwiener", sing. "Kenur") hence the local name "Gebla tal-kwiener" applied to this member.

This member is subdivided into a basal Upper Main Phosphate Conglomerate bed and two yellow Foraminiferid Wackestone beds separated by an intervening bluish grey to greyish green, marly Foram-Coccolith Mudstone bed.

2.5.7.1.4.2 Middle Globigerina Limestone member

This member consists mainly of white-weathering grey marly limestones and is useless as a building stone. It occasionally contains numerous nodules and layers of chert[6] which form through the replacement of the limestone with quartz. It is made up of two beds, a thin Lower Main Phosphate Conglomerate bed and an overlying thick Foramcoccolith Mudstone bed.

[6] Chert is a siliceous limestone which is hard but brittle. It was used for the manufacture of stone implements by the prehistoric inhabitants of the islands.

2.5.7.1.4.3 Lower Globigerina Limestone member

This member consists of massive, distinctly yellow, medium- to fine-grained, soft calcarenite with thalassinoidean burrows. This member is extensively quarried in both Malta and Gozo for the production of building stone.

This member is subdivided into a Scutella Wackestone bed, a Globigerinid Mudstone/Wackestone bed and the Terminal Lower Globigerina Hard Ground at the top.

2.5.7.1.5 Lower Coralline Limestone

The lower coralline limestone formation is the oldest formation exposed at the surface of the Maltese Islands. It is especially exposed along the North West, West and South West coasts of the islands where it forms massive cliffs in view of the north-easterly tilt of the archipelago.

Lower Coralline Limestone is generally semi-crystalline or crystalline in nature. It is characterised by thick to very thick, massive or cross-bedded, white-grey limestones of shallow marine origin. They generally contain a very rich and diverse fossil remains composed mainly of calcareous algae, corals, bryozoa, brachio pods, foraminifera, serpulids and molluscs.

Any particular horizon within this formation may vary from hard, compact and well-cemented (also refered to as Zonqor/Qawwi) to a soft rubbly chalk (referred to as Qawwi Sekonda).

The formation is sub-divided into four members as follows:

2.5.7.1.5.1 Il-Mara member

This is usually thinly developed and its exposures very limited. This limestone is yellow, coarse to fine grained calcarenite with a mudstone[7] or wackestone texture visible under the microscope. Macrofossils characteristic of this member are tests of macroforaminifera and spines of cidarid echinoids.

2.5.7.1.5.2 Xlendi member

This member consists of cross-laminated, light-yellow, brown or pale-grey wedge-shaped beds between 30 cm and 50 cm in thickness. The major components are algae, *Scutella* fragments and giant foraminifera. This member is found sandwiched between the Il-Mara member above it and the Attard member below it. The transitional zones are respectively marked by the highest bed containing specimens or fragments of *Scutella* and the bed overlying the highest rhodolith horizon of the Attard member. This member is very hard and is quarried from a number of quarries for use as aggregate.

2.5.7.1.5.3 Attard member

This member is light coloured – white to pale gray. It consists of massive, very hard, intraclastic biocalcirudite beds rich in algal rhodoliths (*Archaeolithothamnium*). In thin section this member can be described as an algal packstone rich in migliolids and large foraminifera. Being very hard, this member too is extensively quarried in the Maltese Islands for use as aggregate.

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[7] A clastic sedimentary rock made up of clay-sized clasts (a particle of detrital sediment or sedimentary rock produced by the disintegration of a larger mass); the rock breaks into large boulders.

2.5.7.1.5.4 Maghlaq member

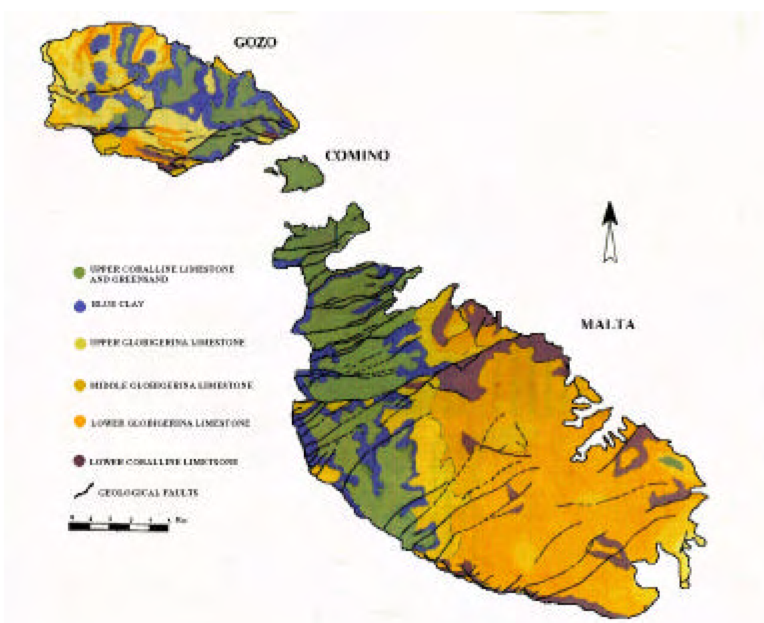
This member constitutes the lowest exposed beds of the Lower Coralline Limestone. It is composed of massive white or grey calcarenites with a mudstone or wackestone texture. Miliolids, especially *Austrotrillina* are the only fossils present and may constitute up to 30-40% of the rock.

2.5.7.1.6 Quaternary deposits

Apart from the normal rock layers, particular locations in the Maltese Islands also have deposits of a terrestrial Quaternary (Pleistocene) nature. These deposits are normally found scattered in the form of isolated patches of brown-yellow to brick-red terra rossa, loams and conglomerates, often lying near the present day coast at the mouth of a valley (e.g. at Benghajsa, Armier, Munxar, Maghlaq, Marsaxlokk) or in deep caves or other cavities (e.g. Ghar Dalam, Ghar Hasan).

These deposits are generally the product of erosion of valleys during fluvial Quaternary climates and are predominantly composed of rounded clasts immersed in a terra rossa matrix although some, such as those found along the Sliema terraces and at Dwejra, are the remains of cave material. Others still are aeolian in nature.

The Quaternary deposits of the Maltese Islands lie unconformably on older strata of Oligo-Miocene age. The average thickness of these deposits is in the range of two and three metres. The major importance of these deposits is not in mineral extraction but in the vast number of fossilised remains that they have brought to light. These have included flora and fauna that are now extinct from the Islands (including mammals) and that indicate that the climate of the Maltese Islands was much different to what it is today.



2.5.7.2 Geomorphology

The geomorphology of the Maltese Islands is largely determined by tectonism, drainage, doline features, drowned valleys and drowned doline strcutures.

The five main rock layers making up the Maltese Islands have an undulating tilt towards the northeast thus producing two types of coastline, a gently sloping rocky coast on the northeastern side and a steep cliff-dominated coastline on the southwest and west side of the Islands.

Superimposed on this general dip are the effects of faulting and differential erosion.

Faulting, especially that brought about by the Great Fault system, resulted in the formation of broad valleys (as at Pwales, Simar, Burmarrad), which slope gradually to sea level forming relatively broad sandy bays like Mellieha Bay, Xemxija Bay or saline marshlands as at Salina. Other valleys developed along the zones of weakness formed by the fault lines and result in steep sided gorge-like valleys known as *widien* (as at Mgarr ix-Xini, Wied Anglu, Wied il-Ghasel and Wied iz-Zurrieq.

The second factor that influences geomorphological patterns, especially near the coast is erosion. Due to the structural properties of the various rock layers, these do not erode uniformly under the action of wind, waves and rain. This has several effects, amongst which are:

- ?? the formation of wave cut notches or wave cut platforms at the base of the Lower Coralline Limestone cliffs (often extending to below sea level);
- ?? the formation of smooth gently sloping coastal platforms on Globigerina limestone shores;
- ?? the formation of bays where clays and marls have been eroded away at a fast rate (as at Xrobb l-Ghagin and Peter's Pool);
- ?? the formation of boulder screes (both on land and in the sea) where erosion of the blue clay undermines the upper coralline limestone cap above it forming the typical *rdum* coastline (as at Ghajn Tuffieha, Qammieh, San Blas, Golden Bay and Fomm ir-Rih);
- ?? the formation of karstland (whether coastal or inland).

Case study 2.5.7.2.1: - The Qawra/Dwejr a area of Gozo

The Qawra/Dwejra area on the western coast of Gozo is arguably the most geomorphologically important site on the Maltese Islands. The site has been shaped into the interesting, rich and varied landscape by a combination of elements. The most noteworthy of the geomorphological features are, in order of importance, the four massive subsidence structure, the *widien*, the inland sea, the high coastal cliffs, a sea stack (Fungus Rock) and submarine caves.

Other geomorphological units include a tunnel, arch and offshore reef, a coastal platform, gently sloping rock shores and a shingle beach. The underwater geomorphology is also interesting with the presence of steep drop-offs (a continuation of the exposed cliffs), submarine caves, arches and tunnels, boulder fields, sunken solution subsidence structures and offshore reefs.

The solution subsidence structures at Qawra/Dwejra could qualify as sites of "outstanding universal value" from a scientific, conservation or scenic point of view. These structures fulfil the conditions set out in para 44 (a) I and iii of Annex A of UNESCO's World Heritage Committee's Doc WHC/2 since they:

a) are outstanding examples of an on-going geological process in the development of landform and geomorphic and physiographic features;
b) contain most of the key interrelated and interdependent elements in their natural relationships;
c) are represented by a complete stratigraphic section preserved in two of the structures; and
d) contain a set of faults representing a complete age span and having both vertical and horizontal displacements

e) have outstanding aesthetic value

2.5.7.3 Palaeontology

Palaeontological studies of local fossils has been carried out by various researchers since the 19th century. More recent studies included those of Trenchman (1938), Felix (1973), Rose (1974) and Pedley (1988). These studies have revealed that most of the important classes and genera of the animal and plant kingdoms are represented in the Maltese strata.

Fossils that have been singled out for their particular scientific importance are:

Macroforaminifera	Occur in the Il-Mara member of the Lower Coralline Limestone Formation. They are of particular scientific importance for their giganticism and for their good state of preservation
Echinoids	Echinoids are particularly common in the Lower Globigerina member while cidarid echinoid spines are found in Il-Mara member of the LCL immediately beneath it. Their importance lies in their palaeoclimatic significance and their endemicity
Brachiopods	These are basically represented by the important Pectinid pavements that characterise the transitional zone between the Lower Coralline Limestone and the Globigerina Limestone overlying it. These pavements are made up of a condensed sequence of shells of the genus *Pecten* and are of biostratigraphic importance. These fossils often have a particularly well-preserved internal structure
Ittiodonts	These are mainly found in the phosphate pebble beds of the Globigerina Limestone Formation. Within these beds a particularly varied collection of Ittiodont fauna and fish teeth (especially sharks) are found. These fossils are particularly important for their rich variety, size and state of preservation.
Fish Horizons	These are mainly found in scattered form in the Lower Globigerina Limestone Formation and are often exposed through quarrying activity. Their importance is due to their exceptional occurrence and scientific interest.
Quaternary fauna and flora	These are obviously associated with the Quaternary fluvial conglomerates and terra rossa found scattered around the Islands. These deposits have yielded remains of Quaternary mammals of palaeontologic, palaeoclimatic and palaeogeographic importance.

Source: North Harbours Geology Survey Report - MUS Ltd, 1996

2.5.7.4 Geological Conservation

The Structure Plan for the Maltese Islands provides for the protection of important geological sites as Sites of Scientific Importance. This importance could be due to a variety of aspects including geomorphology, palaeontology, lithostratigraphy, palaeogeography, etc. The various sites are afforded protection according to a classification ranging from Level 1 to Level 4 as per the Ecological and Scientific designations described elsewhere in this report.

Although this classification is adequate enough to provide protection to the various sites, a complimentary system based on the Earth Conservation Strategy of the UK Nature Conservancy Council has been used by the Planning Authority for Maltese sites during geological surveys carried out for the various Local Plan areas.

In this conservation model, sites of geological importance are classified into two groups – “Exposure” sites and “Integrity” sites and the conservation of the two groups is subsequently approached in a different manner.

Exposure sites usually are the more widespread. The deposit itself is normally quite extensive underground and is almost certain to contain similar scientific value to that observed at the study site but in practical and economic terms the deposit is not readily available for study except at the exposed site. Integrity sites, on the other hand, are normally of limited lateral extent.

Table 2.5.7.4.1 – Geological Conservation Model.

Category	**Description**	**Examples**
Exposure Sites	Sites whose scientific or educational importance lies in providing exposures of a deposit that is extensive or plentiful underground but which is otherwise accessible only by remote sampling.	Outcrops, stream ands foreshore sections, stratigraphic type sections, exposures in quarries, pits, cuttings, cliffs, ditches, mines and tunnels
Integrity Sites	Sites whose scientific or educational importance lies in the fact that they contain finite and limited deposits or landform that are irreplaceable if destroyed.	Caves, karsts, glacial and fluvial deposits, unique mineral, fossil, stratigraphic, structural or other geological deposits and features.

Source: NCC Strategy, 1991

The conservation approach for the two site categories is different. Conservation of exposure sites aims at the preservation of the actual exposure and the exposed material need not be conserved provided that equivalent material can be exposed to form equally good, if not better, exposures. On the contrary, the conservation of integrity sites is more rigid and aims to maintain the integrity of the site as it is by restricting man-made changes.

Table 2.5.7.4.2 below shows the classification of the various Sites of Geological Importance and the applicable conservation strategy as applied to the Maltese Islands by Debono & Scerri, 1996.

Table 2.5.7.4.2 – Classification of Sites of Geological Importance and the conservation strategy applicable to each.

Site Category	Type	Conservation Strategy
	Active Geomorphological Site	Minimise changes and preserve integrity of site
	Cave and Karst Site	
INTEGRITY	Static Geomorphological Site	
	Unique Mineral and Fossil Site	
	Depleted Mineral Resource	
	Inland Outcrop or Stream Section	
	Exposure in disused quarry	
EXPOSURE	Stratigraphic Type Section	
	Exposure in Active Quarry	
	Shafts, Tunnels and Galleries	

	Aquifer Discharge	Preserve exposure, judging changes on their merit in terms of exposure and, where required enhance sites.

Source: North Harbours Geology Survey Report – MUS Ltd, 1996

The sub-classifications of the Integrity and Exposure sites outlined in Table 2.5.7.4.2 above are affected in different ways by various activities and the potential for damage for each site is outlined in Table 2.5.7.4.1.1 below.

The conservation model outlined in these tables constitute the basis for a framework of a Geological Conservation policy and model for the Maltese Islands through which the conservation of local geological sites could be effected. Such models are to be used as practical guides to the resolution of problems affecting or threatening the conservation of geological sites.

2.5.7.4.1 Issues concerning Geological Conservation

Unfortunately, local geological conservation has not been given the same importance as other designations (architectural, archaeological, ecological) over the past years and a number of sites could have been destroyed through development activities (especially quarrying) without ever being recorded. A reversal of this trend is required and the first steps have already been taken by the Planning Authority through a systematic recording of the geological resource through the various Local Plan surveys and scheduling of particular geological sites. These initiatives could be supplemented by the following recommendations (adapted from MUS, 1996):

a) the drawing up of a Geological Conservation Policy (possibly as part of the Structure Plan Review)
b) setting up of a geological conservation body (possibly affiliated with International geological societies)
c) an increase in public awareness of geological conservation
d) further standardisation of site documentation (possibly using the Local Plan data as a baseline)
e) data collection prior to an inevitable destruction of a site (as is done through EIAs).

Table 2.5.7.4.1.1 – Sub-classification of Integrity and Exposure Sites in the Maltese Islands and potential for damage from typical operations.

		Potential for Damage		
Category	**Type of Site**	**Highly damaging**	**Can be damaged if work is not sensitively planned and executed**	**Damaging in exceptional circumstances**
Integrity	Static geomorphological site	Major excavation/levelling Dumping and infilling Major afforestation First time ploughing Coastal reclamation Industrial developments Housing developments	Pits or trenches Small plantations Fencing	Sites generally vulnerable and no specific operation is indicated
	Active geomorphological site	As for static ge omorph sites Stream management Sand fencing Slope stabilisation Dredging in coastal areas Introduction of vegetation	Minor examples of operations to left may avoid damage	Sites generally vulnerable and no specific operation is indicated
	Caves and karst	Effluent disposal Dumping Quarrying Entrance closure Collecting	Changes in agricultural practice Water extraction from boreholes Entrance control Recreatonal caving	Minor developments above cave passages
	Unique minerals and fossil site	Industrial develop ment Housing development Waste disposal and infilling Removal of material	Research and small scale collection Stabilisation of faces	Sites generally vulnerable and no specific operation is indicated

		Collection		
	Site built of depleted Mineral Resource	Demolition Major restoration Collection	Minor restoration	Sites generally vulnerable and no specific operation is indicated
Exposure	Disused quarries, pits and cuttings	Major excavation/levelling Dumping and infilling Major afforestation First time ploughing Coastal reclamation Industrial developments Housing developments	Pits or trenches Small plantations Fencing	Sites generally vulnerable and no specific operation is indicated
	Active quarries and pits	As for static geomorph sites Stream management Sand fencing Slope stabilisation Dredging in coastal areas Introduction of vegetation	Minor examples of operations to left may avoid damage	Sites generally vulnerable and no specific operation is indicated
	Stratigraphic type section, coastal and river cliffs Foreshore exposures	Effluent disposal Dumping Quarrying Entrance closure Collecting Industrial development Housing development Waste disposal and infilling Removal of material Collection	Changes in agricultural practice Water extraction from boreholes Entrance control Recreatonal caving Research and small scale collection Stabilisation of faces	Minor developments above cave passages Sites generally vulnerable and no specific operation is indicated
	Inland outcrops and	Demolition	Minor restoration	Sites generally vulnerable and no specific

	stream sections	Major restoration Collection		operation is indicated
	Shafts, tunnels and galleries	Infilling Surface subsidence Effluent or waste disposal	Show tunnel/gallery developments	Demolition above shaft etc. Normal agricultural practice
	Aquifer discharge	Infilling Effluent or waste disposal Excavations	Groundwater extraction exceeding safe limit	Demolition or restoration of erection above discharge

Source: North Harbours Geology Survey Report – MUS Ltd 1996 (adapted from NCC Strategy 1991)

2.5.8 Landscape.

Since the beginning of time human beings have responded to their environment in different ways, normally seeking to adapt it to their respective needs as they changed over the centuries. This interaction with nature has often been haphazard and unbalanced but where people have worked in harmony with nature, environments of outstanding beauty have resulted. These valued landscapes survive either because they remain economically viable or because of specific and targeted intervention. The situation in the Maltese Islands is no different.

The landscape of Malta has a timelessness about it, partly brought about by the traditional architecture and the continuing use of local materials. Nonetheless, very little, if any, of the landscape of the Maltese Islands is unaffected by man's activities, chief among which are development, agriculture and hunting/trapping.

Bird trapping activities have an important land-use component that has resulted in a negative impact on the amenity value of the Maltese landscape. Apart from the actual trapping activity that affects the bird population (this is treated elsewhere in the State of the Environment Report), the building of trapping hides and lots, often with completely alien material, results in an overall degradation of the natural landscape. These hides are often built from all sorts of available material from masonry to wood to corrugated iron sheets and old 45-gallon oil drums. Apart from the hide itself, considerable patches of land are also stripped of vegetation and levelled for the laying of nets used for trapping. This denudation of vegetation, which is often carried out through the use of herbicides (with the consequent ecological and environmental problems), results in incongruous rectangular brown patches.

Agricultural activity has shaped several of the rural areas of the Maltese Islands that we now take for granted. These include the innumerable terraced hillsides and patchwork fields with their characteristic dry-stone walling and dirt tracks occasionally punctuated by farmhouses or other rural buildings. The result is a very distinctive landscape which adapts itself to the existing environmental constraints and which often provides continuity with the historic fabric of many villages and other urban centres.

This traditional man-made landscape is strongly shaped by the natural environmental factors operating in the Maltese Islands, namely scarcity of water, highly seasonal rainfall patterns and the amount and quality of soils available that are, because of the geology, calcareous in nature. Cultivation is mainly rain-fed dry farming, with only around 6% of the registered cultivated area being irrigated, although irrigated fields have been showing a general increase, especially through the recently introduced drip-irrigation technology.

The overall quality of the Maltese landscape has undergone a significant and serious decline over the past few decades especially as a result of the decline in agricultural activity and an increase in urbanisation. This was especially brought about by a lack of planning in the late 70's and early 80's. At the time, development schemes were implemented outside the much required framework of a planning legislation resulting in massive and uncontrolled development. The effect was that large tracts of previously cultivated land started to be abandoned since its monetary value increased overnight.

The total agricultural land decreased by 42% over the period 1957-1991. Provisional information shows that this decline has been arrested however, only around 38% of the total land area of the Maltese Islands are still arable.

The increase in urbanisation and the decline in agricultural land, though governed by different economic and social dynamics, are linked to the deterioration of the landscape. This is easily visible in the increase of abandoned agricultural land, the decrease of vegetation and tree cover, the lack of maintenance of rubble walls and other rural structures, the diversion of agricultural land to other uses such as dumps for building waste and scrap metal, and the proliferation of trapping hides in areas that were previously good agricultural land.

Areas affected over the years by intense urban sprawl showed even more widespread landscape deterioration with development no longer following field tracks and natural contours. The transition between the built up and the rural environments was often broken and spatial connection made impossible by new road layouts and new developments which were often built with complete disregard to the topographic and landscape features. Urban sprawl has negatively affected the overall visual balance between the rural and urban areas with many urban centres losing their identity, either through a massive lateral expansion or through coalescence with neighbouring centres. There have also been several examples of local landmarks such as windmills, churches, crosses, towers and urban skylines being completely engulfed or hidden by haphazard developments and by new and visually intrusive elements.

Nonetheless, the opportunity exists to conserve and enhance the landscape of the Maltese Islands and to raise its quality and retain its character. This can be achieved through advice, influence, control and direct action.

Modern landscape planning hinges on the measures taken to conserve the character and identity of the local landscape together with the features and elements that contribute to it. Only by taking care of landscape features and elements will the quality of the landscape improve.

Local legislation also provides for the protection of landscape elements. Policy RCO 1 of the Structure Plan includes a designation for the protection of Areas of High Landscape Value (AHLVs). There is some confusion between the Structure Plan and the Development Planning Act, as they refer to AHLVs, areas of natural beauty and areas of scenic beauty. Nonetheless, protection of the landscape is possible through the scheduling process in much the same way that architectural, cultural, archaeological, ecological and scientific heritage can be protected.

Up to 1997, the Planning Authority had designated all of the coastal cliffs of Malta and the woodland area of Buskett as Areas of High Landscape Value.

The North West Local Plan landscape study also suggests a number of new designations such as Coastal Scenic Areas, Cultural Scenic Areas (such as Bingemma Gap and the HagarQim/Imnajdra area), Rural Scenic Areas, and National Landmarks (such as Mdina, Ras il-Wahx, Blue Grotto).

Case Study 2.5.8.1: Landscape Assessment of north west Malta
[based on North West Malta – An exploration and celebration of the landscape by The Landscape Group, County Planning Department, East Sussex County Council, UK, 1994]

It would be difficult to find any area of the world as small as that of the North West of Malta, which contains such a variety of landscape distinction and environmental and cultural value.

In Malta, very little if any of the landscape can be considered to be "natural" as most of it is clearly affected by man's several interventions over the centuries. The closest that one gets to a natural landscape is undoubtedly the Western coast which, together with most of Gozo justifies international recognition.

The landscape is one of the nation's primary natural resources and provides the backdrop for a number of important activities. Unfortunately, this rich landscape is often allowed to degrade through abuse or neglect.

The landscape of the North West region of Malta contains several elements of importance, most of which are still in place, albeit often in a poor state. A number of these landscape elements are also of international importance.

In 1994, the Planning Authority commissioned a comprehensive landscape assessment study of the North West area as part of the North West Malta Local Plan. This study was carried out by the Landscape Group of the County Planning Department of East Sussex County Council.

The assessment identified six areas with definable regional landscape character. These six areas were then sub-divided into "local character areas" and "landscape tracts" where local characteristics and issues can be addressed.

Regional Landscape Character Areas identified:

?? Western Coast (*coastal cliffs from Cirkewwa to Zurrieq*)
?? North East Coast (*coast from Marfa to Salina*)
?? Ridge & Valley (*between Mizieb and Victoria Lines*)
?? Dingli-Nadur plateau (*Nadur, Fiddien, Rabat & Dingli up to Gebel Ciantar*)
?? Eastern Escarpment (*from Chadwick Lakes/Mtarfa to Salib ta' l-Gholja*)
?? Eastern Foreland (*areas around Mosta Fort, Ta' Qali & Rabat/Siggiewi*)

The assessment also identifies specific landmarks that are either of national significance, that is landmarks that add value to the national identity, and those of a more local importance.

Landscape features of national significance identified:

- ?? Hagar Qim & Mnajdra temples (Qrendi)
- ?? Clapham Junction cart ruts complex (Dingli)
- ?? Various towers and features along coast
- ?? Ras il-Pellegrin (Mgarr)
- ?? Ras il-Qammieh (Mellieha)
- ?? Ras il-Wahx (Mellieha)
- ?? Il-Qlejgha (Bahrija)
- ?? Il-Kullana (Siggiewi)
- ?? Blue Grotto & Il-Hnejja
- ?? Mtahleb & Migra l-Ferha
- ?? Dingli Cliffs
- ?? Selmunett Islands
- ?? Mgiebah (Mellieha)
- ?? L-Ahrax tal-Madonna
- ?? Salina salt pans
- ?? Selmun Palace (Mellieha)
- ?? Terraced slopes (Mellieha, Wardija, Victoria Lines)
- ?? Victoria Lines, Dwejra Lines
- ?? Caves at Bingemma Gap
- ?? Skorba & Ta' Hagrat temples (Mgarr)
- ?? Roman Baths (Ghajn Tuffieha)
- ?? Verdala Palace & Buskett
- ?? Ghemieri Palace (Rabat)
- ?? Dingli Church
- ?? Salib ta' l-Gholja (Siggiewi)
- ?? Chadwick Lakes
- ?? Mosta Fort

The north west of the country however also has several problems especially linked to recreational pursuits that are causing landscape and environmental degradation. These include the paraphernalia of shooting and trapping hides, shooting ranges (legal and illegal), and the increasing pursuit of off-roading with the serious consequences they bring about.

The opportunities for other "greener" pursuits such as walking, cycling and horse-riding, should be actively considered for this and other regions. The facilitation of such pastimes would also have a positive impact on the tourism industry.

As regards development, a strict enforcement of planning policy, especially Structure Plan policy RCO 4, is an urgent requirement so as to preserve what is left of the landscape character and to ward off any threats to the integrity of the landscape. This should be coupled with an effort to seek opportunities to remove incongruous development from the countryside.

Possible the most pressing issues relate to:

?? fly-tipping,
?? the need to better manage the urban fringe,
?? the need for a strategy for afforestation and planting in the countryside,
?? problems associated with the quarrying industry and its impact on the landscape; and
?? landscape renewal of the coastal and rural areas.

This can only happen through a change in attitude linked to legislation, planning and management.

2.5.8.1 Seascapes[8]

The interaction of geomorphological features and habitat types to create characteristic assemblages also occurs in the seas around us.

Up to a few years ago, few attempts had been made to characterise and classify the major marine benthic biotopes[9] occurring around the Maltese coastline. A study carried out by Pirotta and Schembri (1997) described and characterised the main marine biotopes of the Maltese Islands. A classification scheme, which can be applied locally for tasks such as habitat mapping, impact assessment studies, the formulation of environmental management plans, and for the identification and establishment of conservation areas and nature reserves, was devised. The study classified seascapes into two – those found in areas with a hard bottom type and those found in areas with a mobile bottom.

Each biotope was characterised in terms of the major geophysical, topographic and biotic features present as well as a number of other habitat specific biotic parameters, including the major macroalgal species and sessile macrofauna present, and their distribution (zonation) and relative abundance.

Eight biotopes have been identified, some of which were further sub-divided into different sub-types. Table 2.5.8.1.1 gives a summary of this classification.

[8] The term here is taken to mean the underwater scenery as opposed to a panoramic / landscape view that has the sea as its backdrop.
[9] A biotope is a place where an animal or plant normally lives, often characterised by a dominant growth form or physical characteristic.

Table 2.5.8.1.1 - Marine biotope classification scheme for the Maltese Islands.

Biotope	Description	Sub-division	Description	Sub-type	Description
Caves	Submerged large hollows in cliff faces, slopes, or horizontal bedrock.				
Slopes	A stretch of bedrock which extends for a considerable distance out to sea and inclines gradually.	**Gentle slopes.**	Gradient 5 - 10º.	**Shallow gentle slopes**	From 0 to 20m depth.
				Deep gentle slopes	From 20 to 60m depth.
		Steep slopes	Gradient 10 - 40º.	**Shallow steep slopes**	From 0 to 20m depth.
				Deep steep slopes	From 20 to 60m depth.
Drop-offs	A submerged cliff-face characterised by very steep gradients of more than 75°.	**Continuous drop-offs**	Vertical cliff-face which extends to the seabed without any major topographical variations such as ledges and platforms.		
		Stepped (non-continuous) drop-offs	Vertical cliff-face with extensive ledges or platforms running horizontally across the vertical wall.		
Boulder fields	A stretch of bedrock that extends for a considerable distance and which is covered with boulders.	**Fields with large boulders**	Fields with boulders 3-6m high.		
		Fields with small boulders	Fields with boulders 0.5-3m high.		
Bare sand	Extensive areas of sandy sediment that				

	is devoid of attached vegetation. The sediment may range from fine sand to sandy gravel.				
Posidonia oceanica meadows	Extensive regions of sea-bed with beds of the sea-grass *Posidonis oceanica.*	**Continuous Posidonia oceanica meadows**	Plain meadows, consisting of continuous, homogeneous beds of sea-grass (the *herbier de plaine* of Molinier & Picard, 1952).		
		Reticulate Posidonia oceanica meadows	Meadows composed of extensive patches of sea-grass and mounds of matte which are, however, interspersed by areas of seabed devoid of sea-grass (similar to the *herbier de colline* of Boudouresque *et al.*, 1985).		
Posidonia oceanica reefs	Masses of rhizomes which grow vertically trapping sediment thus forming a solid structure with live shoots at the top (the *plateau récilfal* of Boudouresque *et al.*, 1985).	**Posidonia oceanica reef originating out at sea**			
		Posidonia oceanica reef originating from the shoreline			

BACK TO CONTENTS

2.6. Non-Renewable Resources

The only mineral resources utilised in the Maltese Islands are limestone and, to a much smaller extent, sea salt.

2.6.1 Quarrying

2.6.1.1 Introduction

This chapter is concerned with limestone - the principal non-renewable resource in the Maltese Islands. It examines the following aspects: classification of limestone resources, current and future supply of limestone resources, current and future demand for limestone resources, the environmental implications associated with the extraction, use and disposal of limestone resources, and the sustainability implications for the construction industry in the Maltese Islands.

2.6.1.2 Classification

The nature of limestone results in its being grouped into two types "Softstone", derived from the Lower Globigerina Limestone layer and "Hardstone", derived from the Upper and Lower Coralline Limestone layers.

2.6.1.2.1 Softstone

Typically this stone is fine-grained and homogenous, workable yet strong enough to build with. The Maltese softstone industry commonly identifies three categories of stone, namely best quality (typically used for churches, facades, etc.), second quality (typically used as dimension stone for houses) and poor quality (typically used in foundations etc.). Judgement is typically undertaken by the quarry operator on the basis of appearance, colour and sonority.

2.6.1.2.2 Hardstone

Hardstone tends to be extremely variable in nature, with single quarries often exhibiting considerable variation in the nature of the exploited limestones. Hardstone may be classified as first quality (being hard and nonporous) and second quality (being soft, more porous and less resistant to weathering). The physical and mechanical properties or limestone, do not compare favourably with British Standards for aggregates and with examples of limestones used in construction in other countries. In fact, there is a noticeable lack of road surfacing material in Malta and Maltese limestone is especially prone to polishing.

2.6.1.3 Supply

2.6.1.3.1 Number of Quarries

The chart below shows the number of licensed quarries in Malta and Gozo in 1997 and compares this to the number in 1993. Whilst the number of softstone quarries has declined from 70 to 60 over the period, and the number of hardstone quarries has increased from 26 to 30. The proportion of area occupied by the two different classes of quarries has also changed markedly, with hardstone quarries occupying an ever increasing proportion of the total quarrying footprint.

This change has been brought about by a number of factors, chiefly a slowdown in demand for softstone and decreasing levels of profitability (prices have been relatively stable, whilst costs have increased) on the one hand, and increasing levels of demand for hardstone on the other hand.

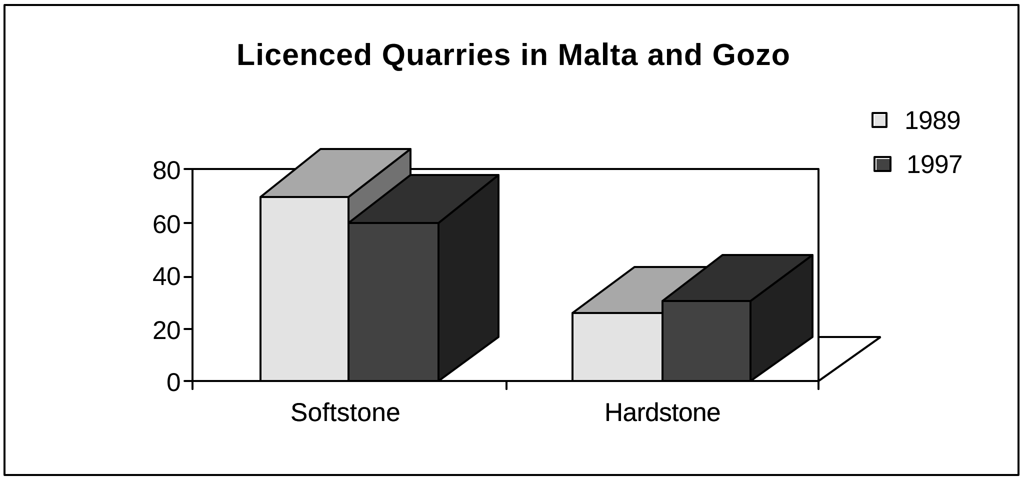


Table 2.6.1.3.1.1 gives further details on the number unlicensed or suspended quarries in Malta and Gozo in 1997. Data is also provided on the numbers of disused quarries in Gozo, based on a pilot exercise carried out in 1997 by the Planning Directorate. Whilst there is quite a large number of disused softstone quarries, the number of disused hardstone quarries is small, mainly owing to the fact that the industry is relatively young and exhibiting an expansionary trend.

Table 2.6.1.3.1.1 - Status of existing quarries in Malta and Gozo, 1997

	Licensed and Active Quarries		Unlicensed or Suspended Quarries		Disused Quarries	
	Malta	**Gozo**	**Malta**	**Gozo**	**Malta**	**Gozo**
Softstone	51	9[1]	7	/	n.a.	11
Hardstone	26	4	3	1	n.a.	1

Sources: Planning Authority Records, Structure Plan Monitoring Report 1996-1997

2.6.1.3.2 Production

2.6.1.3.2.1 Softstone

Softstone quarries are typically part-privately owned and operated. They generally employ an average of some 5 part-time employees (quite often family members), and operate using a system of vertical and horizontal automated saws which shape ready-made building blocks to a pre-determined size. Expansion of quarries is generally accomplished by increasing the area of tenure subject to licensing and planning permission. There seems to be a degree of over-capacity within existing quarries, with quarries having a potential to produce far more per quarry per year than the estimated annual average.

[1] This includes 8 quarries which are working beyond their permitted boundaries.

Softstone production is traditionally measured according to the number of truckloads leaving the quarry. A truckload typically corresponds to approximately $0.75m^3$. Table 2.6.1.3.2.2.1 gives an indication of the output of softstone during the last years. Production rates of softstone are difficult to ascertain. The data listed is based on the Industrial Statistics, which quotes only 24 establishments producing limestone in 1994. There is a clear discrepancy between this and the data housed at the Planning Authority. Unfortunately, although the Planning Authority houses up-to-date information on the number of establishments, there is no equivalent up-to-date information on production. The Planning Authority estimated a figure of some $860{,}000m^3$ of softstone production in 1995. [2]

2.6.1.3.2.2 Hardstone

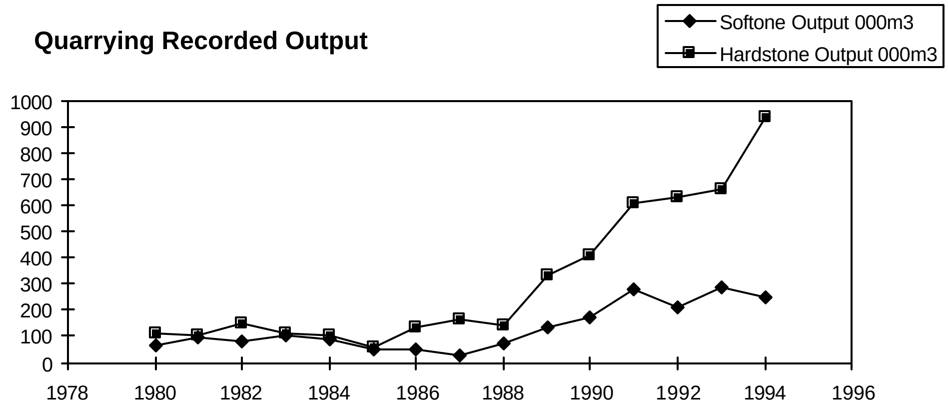
Hardstone quarry operations differ substantially from those of softstone. Hardstone quarries are typically privately owned and operated. Quarry expansion is generally accomplished by increasing the area of tenure being subject to licensing and planning permission. Stone is extracted by drilling and blasting. This is followed by crushing and grading to prescribed particle sizes. Unfortunately, hardstone production is as difficult to ascertain as softstone production. The data listed in Table 2.6.1.3.2.2.1 is based on the Industrial Statistics which assumes only 14 establishment produced coralline spalls and sand in 1994. The Structure Plan Monitoring Report estimated a figure of some 1.4 million m^3 of hardstone.

Table 2.6.1.3.2.2.1 - Quarrying Recorded Output

Year	Softstone Output $000m^3$	Hardstone Output $000m^3$
1980	65	111
1981	93	100
1982	83	148
1983	106	110
1984	88	106
1985	50	60
1986	53	132
1987	27	167
1988	76	139
1989	136	335
1990	170	413
1991	281	610
1992	213	628
1993	286	663
1994	252	939

Source: Mineral Resources Assessment, Planning Authority

[2] Structure Plan Review: Monitoring Report 1995



2.6.1.3.3 Location

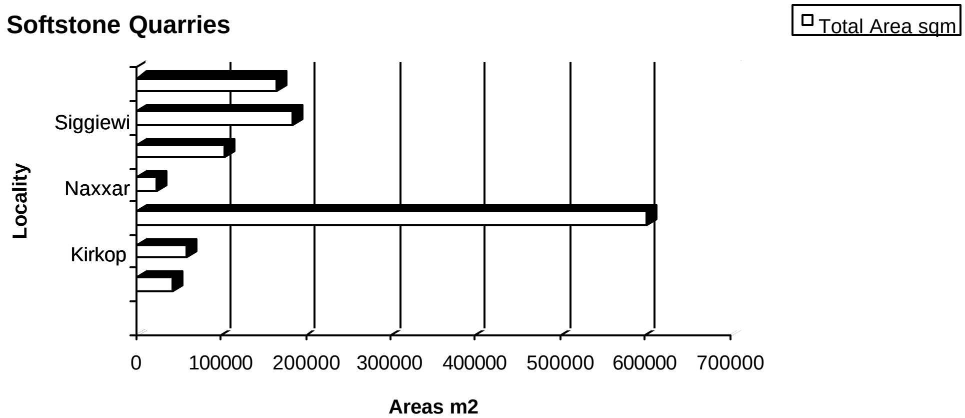
2.6.1.3.3.1 Softstone quarries

The softstone industry is mainly located in the central and eastern areas of Malta, whilst in Gozo the small number of quarries are located in San Lawrenz and Kercem. In 1999, the overall surface area occupied by licensed softstone quarries, was approximated 1.1km^2 with an additional 0.1km^2 taken up by illegal quarrying.

Table 2.6.1.3.3.1.1 - Softstone Quarries by Locality in 1999

Locality	Total Area m^2
Gharghur	43,750
Kirkop	59,980
Mqabba	602,609
Naxxar	23,693
Qrendi	104,819
Siggiewi	183,911
Gozo	166,494
TOTAL	**1,185,256**

Source: Planning Authority Records



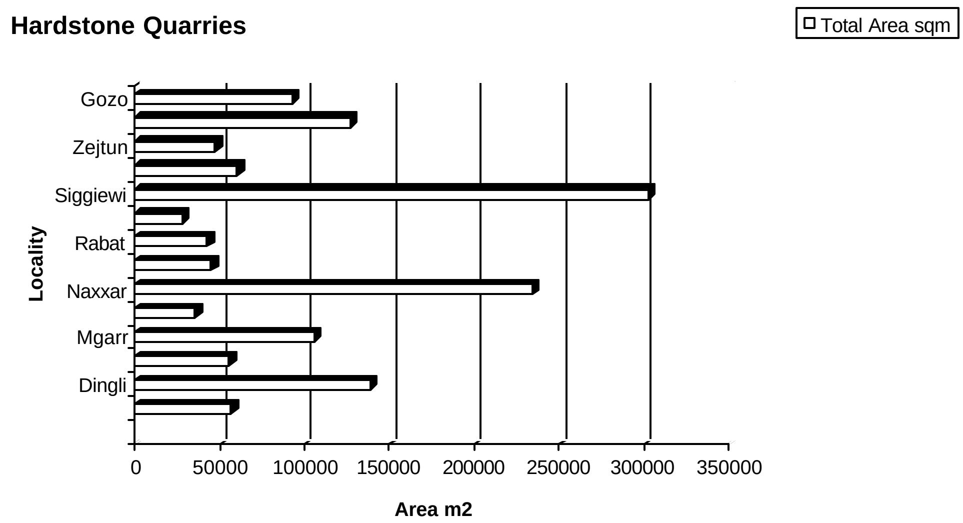
2.6.1.3.3.2 Hardstone quarries

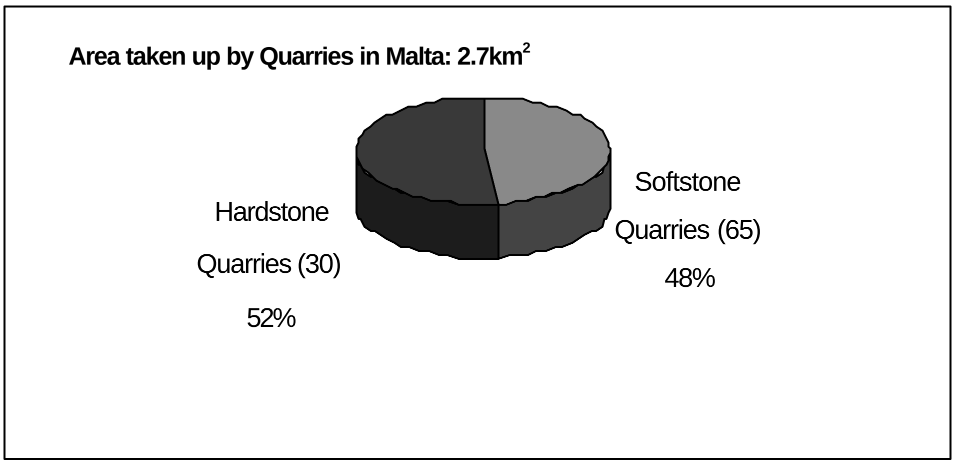
Hardstone quarries tend to be more widely distributed in Malta, with limited activity taking place in Gozo. The overall surface area occupied by hardstone quarries is estimated to be some 1.4km^2 of which almost 0.2km^2 is taken up by suspended quarries.

Table 2.6.1.3.3.2.1 - Hardstone Quarries by Locality in 1999

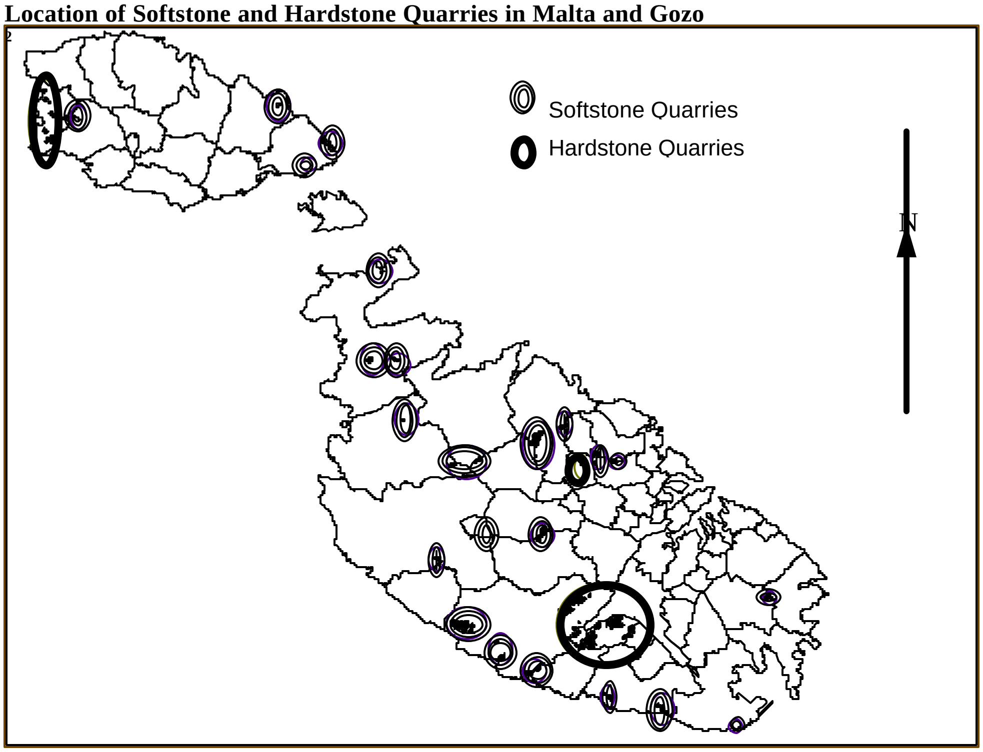
Locality	Total Area m^2
Attard	56,760
Dingli	139,140
Mellieha	55,570
Mgarr	105,460
Mosta	35,540
Naxxar	234,663
Qrendi	44,950
Rabat	42,770
San Gwann	27,350
Siggiewi	302,850
Zebbug	60,180
Zejtun	47,150
Zurrieq	127,280
Gozo	92,534
TOTAL	**1,372,197**

Source: Planning Authority Records


Hardstone Quarries
Total Area sqm
Gozo
Zejtun
Siggiewi
Rabat
Naxxar
Mgarr
Dingli
Locality
0
50000
100000
150000
200000
250000
300000
350000
Area m2


Area taken up by Quarries in Malta: 2.7km2
Hardstone
Quarries (30)
52%
Softstone
Quarries (65)
48%

Location of Softstone and Hardstone Quarries in Malta and Gozo



Source: Planning Authority Records

2.6.1.3.4 Future Supply

During the period 1993 - 1997, the Planning Authority granted development permission for 9 developments consisting in extensions to existing quarries or new quarries. This, together with the large number of quarries currently in operation, may be taken as a crude indication of the fact that the supply is guaranteed for a number of years in the future. The amount of years that permitted reserves are expected to last however, cannot be determined at the time of writing this report, owing to the fact that data on the volume of permitted reserves is not available. Neither is it possible to make realistic forecasts of expected future extraction rates, given the inaccuracy of the data on current production rates.

Table 2.6.1.3.4.1 - Applications Granted for New Quarries or Quarry Extensions

	Malta		Gozo	
	Softstone	**Hardstone**	**Softstone**	**Hardstone**
1993	-	1	-	-
1994	-	-	-	-
1995	1	1	-	-
1996	1	3	-	-
1997	-	1	1	-

Source: Planning Authority Records

In addition to reserves which are currently being exploited (i.e. operational quarries), the Mineral Resources Assessment, commissioned by the Planning Directorate identifies 26 search areas for future extraction where minerals development is considered to be potentially viable and gives estimates of indicated volumes.

Table 2.6.1.3.4.2 - Reserves

	Malta and Gozo	
	Softstone	**Hardstone**
Proved	9.36 million tonnes	31.2 million tonnes
Inferred	20.9 million tonnes	6.24 million tonnes
Indicated	428 million tonnes	421 million tonnes

Source: Minerals Resources Assessment

Given that environmental considerations have not yet been incorporated into the assessment, the amount actually feasible from a Planning perspective is likely to be lower than that predicted by the report. At current estimated rates of production as estimated by the Planning Directorate, these reserves are expected to provide supply for the number of years indicated in Table 2.6.1.3.4.3.

Table 2.6.1.3.4.3 - Expected years to depletion

	Malta and Gozo	
	Softstone[3]	**Hardstone**[4]
Proved	6 years	9 years
Inferred	13 years	2 years
Estimated	264 years	123 years

2.6.1.4 Demand

2.6.1.4.1 Sources of Demand

Demand for limestone emanates exclusively from domestic sources, chiefly by the construction industry. Moreover, local resources provide the main raw material for the construction industry with little imports to compete with the produce. Table 2.6.1.4.1.1 gives an indication of the level of construction activity taking place in the Maltese economy of the past 9 years. Other sources of demand for quarried material are also identified in Table 2.6.1.4.1.2, whilst the chart below provides some more detail on one of the chief components of demand: applications for new dwellings.

[3] At assumed rate of 0.9 million m3 per annum or 1.62 million tonnes per annum.

[4] At assumed rate of 1.4 million m3 per annum or 2.6 million tonnes per annum.

Table 2.6.1.4.1.1 - Construction Activity

Year	Construction Activity Lm million
1989	22.3
1990	22.9
1991	26.5
1992	25.3
1993	26.2
1994	32.5
1995	33.7
1996	36.0
1997	37.9

Source: Minerals Resources Assessment

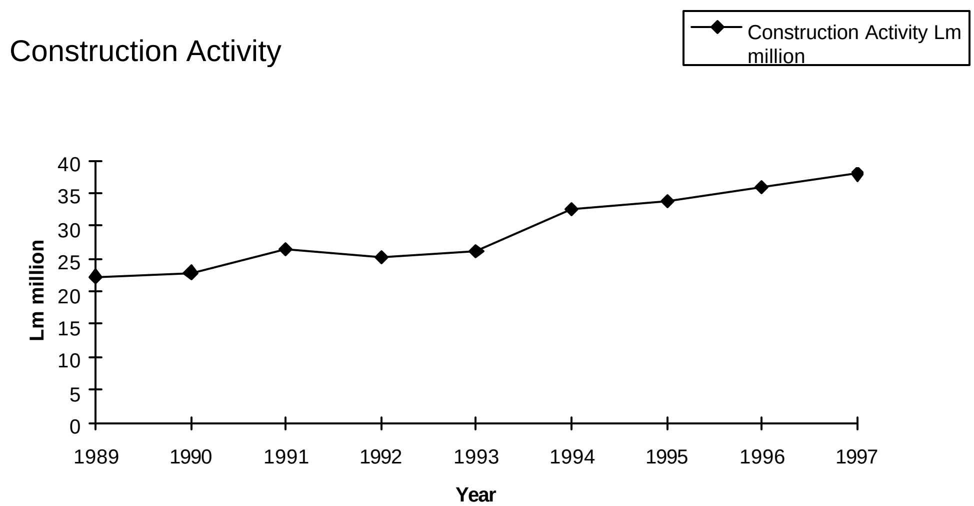
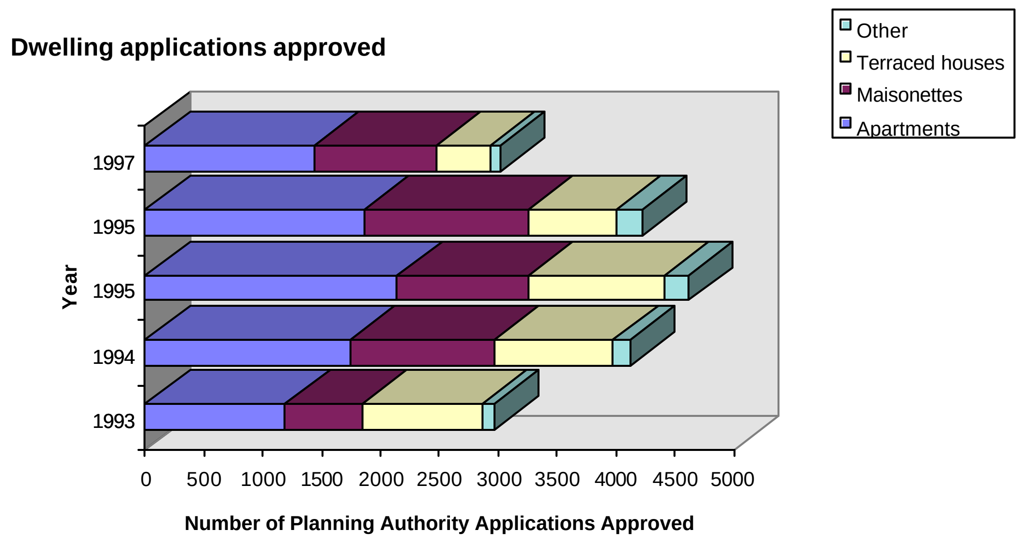


Table 2.6.1.4.1.2 - Sources of demand for limestone

Upper Coralline Limestone "Hardstone"	Tarmac Concrete Facing of buildings
Upper Coralline Limestone "Marble" Globigerina Limestone "Softstone"	Decorative purposes Buildings Structures Facing of buildings Restoration works Monuments Limestone fill Paving slabs Animal feed
Lower Coralline Limestone "Hardstone"	Plastering material

	Tarmac Concrete
Blue Clay	Pottery
Cliff fall boulders	Sea defences.

Source: Minerals Resources Assessment



2.6.1.4.2 Future Demand

Unfortunately it is not possible to compute future demand owing to lack of reliable past data on production/consumption of minerals, and waste levels. However, it may be assumed that demand is mainly derived from the amount and type of construction activity taking place.

2.6.1.5 Environmental Impact

2.6.1.5.1 Negative Impacts

Given that minerals can only be worked where they are found, the natural distribution of rock types has significantly influenced the location of quarries. This has resulted in a number of environmental impacts which are explored in Table 2.6.1.5.1.1. The table also gives an indication of the response to date.

Table 2.6.1.5.1.1 - Environmental Impacts of quarrying activity and response to date

Type	Description	Response to date
Natural Resource Depletion	Limestone is a non-renewable natural resource. Current rates of production, consumption, and waste cannot be sustained indefinitely into the future, even with discoveries of new resources. There is reason to assume that rates of depletion are higher than optimal owing to economic factors which work against keeping the resource in situ. In addition, there have been instances (e.g. Quarries at Tad-Dawl and ta' Kandja, limits of Mqabba and Tal-Balal) where quarries were abandoned prematurely or quarrying areas built upon (e.g. l-Iklin).	All applications for new quarry development require an Environmental Impact Assessment including requirements to explain need for the resource. Areas identified as priorities by the Minerals Resources Assessment are being considered as constraints on development by the Planning Authority to avoid further sterilisation of good resources. In addition major projects are assessed by the Planning Authority against this possibility. A Minerals Subject Plan is being prepared by the Planning Authority, to regulate the industry. Efforts to regulate waste generated also have a direct bearing on sustainability (see below).
Landscape Damage	Softstone quarries with sheer, almost vertical sides and hardstone quarries developed through blasting mechanisms, result in the scaring and breaching of hillsides, valleys, coastal cliffs, and faults. Unsightly stock piles of stone and unusable rubble, mechanical plants, buildings and vehicles serve to generate considerable landscape damage.	All applications for new quarry development require an Environmental Impact Assessment including consideration landscape damage. New quarries or quarry extensions now require landscaping as part of planning consent. Some disused quarries have also been crudely restored or rehabilitated to agricultural use. Others are partly in-filled with variety of materials including inert quarry and construction waste, scarp and domestic refuse. The height of stock piles is regulated and there is generally a request to demolish buildings and structures after completion of work.
Damage to Ecological Areas	The quarry itself has often led to a complete destruction of habitats and species. This coupled with the building of roads and the generation of traffic through the countryside, creates substantial damage to ecological areas.	All applications for new quarry development require an Environmental Impact Assessment including consideration ecological damage and traffic impact assessment. Further more the protection of areas of ecological importance through the Planning Authority's scheduling mechanism has served as a buffer against damage to such sites.
Damage to Archaeological	The quarry itself has sometimes led to the complete destruction of archeological sites. The use of drilling and blasting in hardstone	All applications for new quarry development require an Environmental Impact Assessment including consideration of damage to archaeological sites. In

Sites	quarry operations can cause further damage to archaeological sites when the quarry is in operation.	addition, blasting activities are closely monitored by the Planning Authority. Furthermore the protection of areas of archaeological importance through the Planning Authority's scheduling mechanism, and through the National Protective Inventory has served as a buffer against damage to such sites.
Damage to Buildings and Infrastructure	In addition to the risk of damage to buildings and infrastructure through vibrations caused by drilling and blasting, quarries can also cause deterioration to roads around quarry area by heavy trucks.	All applications for new quarry development require an Environmental Impact Assessment including consideration of damage to buildings and structures, and traffic impact. In addition, blasting activities are closely monitored by the Planning Authority. Further more the designation of urban conservation areas, and the conservation of buildings through the Planning Authority's scheduling mechanism, and through the National Protective Inventory has served as a buffer against damage to particular areas and buildings.
Impact on other economic activities	Negative environmental impacts caused by quarrying can generate secondary impacts on other economic activities such as agriculture (good quality soil and areas of high agricultural land may be damaged as a spill-over effect) and tourism (in areas of conflict, tourism activity suffers a negative spill over effect from unsightly and polluting activities).	All applications for new quarry development require an Environmental Impact Assessment including consideration of damage to other economic activities.
Noise Generation Air Pollution and dust generation	Use of mechanical equipment (particularly drilling and blasting in hardstone quarries) together with the generation of traffic often create noise. The use of mechanical equipment, vehicles for transportation, as well as the nature of the activity itself generates both local air pollution problems as well as contributing to wider ranging air pollution.	All applications for new quarry development require an Environmental Impact Assessment including consideration of noise impacts. In addition, blasting activities are closely monitored by the Planning Authority. All applications for new quarry development require an Environmental Impact Assessment including consideration of impacts on air quality. In addition, mitigation measures against the dispersal of dust during transport is regulated.
Damage to ground water and water courses	Blasting, storage of fuel, oil chemicals and other potential contaminants, septic tanks, the deposit of refuse and oils in quarries pose a threat to groundwater and water courses.	All applications for new quarry development require an Environmental Impact Assessment including consideration of impacts on ground water.
Generation of	It is estimated that almost half the material extracted from softstone	The generation of waste is being discouraged through the application of the

Waste	quarries is discarded. There is also substantial waste generation in use and demolition of buildings. The construction sector generates the largest qualities of waste, presently averaging about 45,460 tonnes per week. This in turn has often created landscape, ecological, and dust generation problems, as well as having important repercussions on the sustainability of the quarrying industry.	Polluter Pays Principle, and the dumping of inert waste is now only legally possible against payment of a fee. Discussion on the re-use of quarries as landfill sites has commenced and partial infilling of disused quarries with inert quarry and construction waste, is being encouraged.
Safety	Adjacent properties and roads often directly overlook softstone quarry voids with virtually no safety stand off.	New quarries or extensions to existing quarries require Planning Consent which regulates the distance of quarry from road, and requires the erection of boundary walls enclosing quarry sites, among other considerations.

2.6.1.5.2 Positive Impacts

The built environment of Malta is very much shaped by Franka for use in buildings, structures, as facing stone, decorative purposes and restoration of historic monuments and buildings. Indeed the requirement to use Franka for building facades is a Planning requirement. Another indirect positive impact which merits further effort could be the re-use of quarries for mono-landfills or as recycling depots.

2.6.1.6 Sustainable Development

Mineral resources constitute an important input to the Maltese economy. They provide the main raw material for the construction industry which employed 6191 persons in 1997 (almost 16% of total employment)[5], and generated value added of some Lm36.6 million in 1996 (some 3.6 % if total Gross Domestic Product at Factor Cost)[6]. Although the proportion of GDP generated by the sector is relatively low in comparison to other sectors in the economy (such as Manufacturing 22.2%), however it has important linkages with other domestic sub-sectors (such as furniture, and self-employed service providers). The quarrying industry by itself is estimated to employ some 500 persons. It is estimated to generate a value added of some Lm 4 - 5 million per year[7].

The extraction, use and subsequent disposal of minerals, generates considerable environmental impacts, not all of which can be effectively mitigated. Moreover, the fact that limestone is a non-renewable natural resource constitutes an important consideration in the futurity of the quarrying and construction industry as it stands. As long as the construction sector continues to base itself on the extraction of a limited resource, it can not be said to be on a sustainable development path.

Headway has been made in regulating the industry through the planning regulation, including environmental impact assessment, and through the protection of particular areas. However it is worth noting that this response would be far more effective if more effort were to be focused on enforcing conditions laid out by planning consent. Furthermore there are a number of other options for steering the industry along a more sustainable path, which have not yet been explored.

These are chiefly directed at the possibility of using virgin material more sparingly, hence generating less waste, and less environmental impacts. Such recommendations include: the possibility of grading and differentially pricing stone to reduce waste, storing stone from demolished buildings, re-using second-hand stone, charging a virgin material premium, re-using existing property to reduce demand for virgin material, encouraging technical research on the recycling and reuse of construction materials, and diversifying the industry.

It is also evident that more data is required on this sector. The most important gap is data on the volume of permitted reserves (survey), as well as rates of production and waste.

The Planning Authority's upcoming Minerals Subject Study is expected to address the information requirements as well as provide policy guidance to better regulate the land-use aspects of the industry.

2.6.1.7 Issues related to the quarrying industry

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[5] This figure includes a number of persons employed in oil drilling. Economic Survey January - September 1997.

[6] Economic Survey January - September 1997.

[7] This estimate is based upon a simple proportion calculation, although there is reason to assume that the incomes generated in the quarrying sector are proportionately less than those generated by the construction industry.

Although quarrying arouses wide and disparate feelings, the economic importance of the construction industry and the need for the raw material is a reality we have to contend with. Nonetheless, a number of issues connected with quarrying are becoming urgent and need tackling in the short to medium term. These include:

?? Safeguarding mineral reserves from other development;
?? Utilising as much of the resource as possible through encouragement of recycling depots;
?? Consideration of alternative quarrying techniques, such as mining, possibly through the establishment of appropriate incentives;
?? Revision of the price orders for stone and stone products to encourage the classification of first class and second class rock;
?? Consideration of alternative building techniques and materials;
?? Re-use of quarry rejects and off-cuts and processing into reconstituted stone products;
?? Environmental management of quarry operations, including dust generation, noise and blasting/vibration effects;
?? Enforcement of quarry restoration and after-use
?? Better landscaping around quarry sites

2.6.2 Salt Production

The only other mineral that is harvested locally is sea salt. This is a centuries old industry whereby seawater is collected in shallow, normally rock-cut depressions or pans, where it is kept until the water evaporates leaving behind the salt. The salt is eventually collected and stored in sheds until it is packed and sold.

Salt pan complexes of varying age and complexity can be found on a number of rocky shores around the islands. Some date from Roman times and others from the time of the Knights of St John. Others are more recent or have been modified over the years. The major complexes are those at Salina (which owes its name to this very same industry), Bugibba, Bahar ic-Caghaq, Qbajjar (Gozo) and Marsascala. Other salt pans are found at Dwejra (Gozo), Tal-Blata, Xghajra and Delimara. Apart from the complex at Salina which is still in active use, most of the others have long been abandoned and the pans are often used as a convenient flat resting place for sun-bathers and barbecuers during the summer months.

Today, only around 2% of the Islands' coastline is dominated by the salt production industry.

BACK TO CONTENTS

2.7. Planning and Environmental Control

2.7.1 Environmental Impact Assessment

Environmental Impact Assessment procedures were introduced in Malta in 1993 after about four years of attempts and *ad hoc* arrangements for studies to be carried out for large developments. In 1993, the Planning Services Division and the Secretariat for the Environment commissioned UN consultant Dr Jonathan Wager to set out a framework for the local EIA process.

The EIA procedures for the Maltese Islands were followed by a detailed planning and policy guidance on EIA in Malta issued by the Planning Authority in May 1994. This document has been used as the major guidance on EIA ever since.

In 1994, the Planning Authority also started work on Environmental Impact Assessment Regulations, which aim to give a legal standing to the procedures making up the EIA process. These draft Regulations were finalised in 1997 and agreed to by the Environment Protection Department. It is hoped that these Regulations be finally approved in the coming months.

The proposed EIA regulations include proposals for:

?? a register of consultants;
?? wider socio-economic impact assessment, including impact of environmental change on human society;
?? clarification that if no EIA is submitted by the developer the project will be refused;
?? consideration of economic feasibility
?? more powers for the enforcement of monitoring conditions;
?? specification for time frames for public consultation;
?? necessity for the Environment protection Department to certify that the EIA is complete and finalised;
?? availability of the EIA document for sale to interested parties at cost of printing;
?? changes of use or extensions to projects can be subject to EIA;
?? cumulative effects of other projects on site should also be considered;
?? new methods and production processes might require EIA after a specified period; and
?? clarification of the roles of the Planning Authority, the Environment Protection Department, the developer, the consultants, the Local Councils, NGOs and the general public in the EIA process.

Locally, projects requiring EIA fall within two categories. Category I projects require a full Environmental Impact Assessment with the preparation of an Environmental Impact Statement (EIS) and a formal public hearing at the end. Category II projects require a limited Environmental Impact Assessment with the preparation of an Environmental Planning Statement (EPS) which would deal with fewer topics and is required when details of the application are not enough to assess the development and its environmental implications.

For certain projects that would generate a considerable amount of traffic, Traffic Impact Statements (TISs) may also be required. A TIS may also be requested independently of the EIA process in cases where the proposed development may not have a high environmental impact but could cause traffic problems in view of its nature or location.

Since 1993, a number of EIAs and TISs have been commissioned in support of development projects that could have environmental or traffic impacts. Table 2.7.1.1 below lists projects for which an EIA or TIS has been completed up to 1997. Several other projects are still subject to EIA proceedings but a formal document has not been submitted yet.

Although the process for requesting and performing EIAs is slowly reaching maturity, there are areas that need attention. This is especially so as regards the quality of the statements submitted which is extremely variable. Although there has been substantial improvement over the years, not all sections of the terms of reference prepared by the Planning Authority and the Environment Protection Department are given equal importance. Of particular concern is the fact that consideration of social and economic impacts, impacts on other land uses, and the overall co-ordinated assessment which is meant to tie together the EIA, are generally inadequate. The Planning Authority is cautious of these limitations and is currently engaged in trying to find ways to overcome this problem.

Table 2.7.1.1 – Environmental Assessments completed up to 1997

Sector	EIS	EPS	TIS
Agriculture and Fisheries	Fish farm (Comino Channel)	Fish Hatchery (Hondoq ir-Rummien)	
	Fish Farm (Munxar Reef)	Fish Farm (Qormi)	
		Poultry Farm (Bahrija) Fish Farm (Il-Hofra iz-Zghira)	
		Poultry Farm (Maghtab)	
Residential/ Retail			Residential Complex (Sliema)
			Block of 60 apartments, 162 garages and 17 retail outlets (Bugibba)
			Extension to commercial complex (Rabat)
Infrastructure	Desalinaton Plant (Zonqor)	Telecommunications Training Centre (Swatar)	Telecommunications Training Centre (Swatar) Maltacom Development (Paceville)

Commerce and Industry		Factory Extension (Haz Zebbug)	Commercial Development (B'Kara)
		Factory (Hal Far)	
		Tarmac plant (Ta' Kandja)	
		Batching Plant (Ta' Zuta)	
Social and Community Facilities	Private School (Mselliet)	Hospital (Sta Venera)	Private School (Msida)
	Hospital (Tal-Qroqq)		Hospital (Tal-Qroqq)
			Hospital (Sliema)
Quarrying	Hardstone Quarry (Qrendi)	Softstone Quarry (Mqabba)	
		Softstone Quarry (Tal-Balal)	
		Hardstone Quarry (Gebel Ciantar)	

		Softstone Quarry (Mqabba)	
		Softstone Quarry (Ta’ Slima, San Lawrenz)	
		Softstone Quarry (Tal-Ponta, San Lawrenz)	
		Hard Stone Quarry (Naxxar)	
		Hard Stone Quarry (Siggiewi)	
		Hard stone Quarry (Nadur)	
Tourism	Hotel (San Lawrenz)	Hotel (St Julians)	Hotel (St Julians)
	Tourist Complex (Fort Chambray)	Visitor Center (Qrendi)	Hotel (St Julians)
	Hotel (Spinola)	Artificial Wreck (Gozo)	Tourism complex (Fort Chambray)
		Artificial Wreck (Marsascala)	Extension to Hotel (Bugibba)
		Artificial Wreck (Qawra)	Hotel (Tigne’)

			Hotel (Sliema)
			Family Theme Park (Paceville)
Transport	Yacht Marina (Salina)	Heliport Building (Gozo)	Car Park (Sliema)
		Freeport Terminal Two (B'Buga)	Grade Separated Junction (Msida)
		Dredging Works (Cirkewwa)	
Waste		Sorting Yard (Maghtab)	
		Waste Oil Recycling Plant (Marsa)	
		Waste Transfer Station (Gozo)	
		Inert Waste landfill (Gharb)	
Other			Mixed Used development (Gzira)
			Ex-Pax Flour Mills (Victoria)

Source: Environmental Management Unit, PA

2.7.2 Enforcement

Enforcement of illegal developments has always been a problem in the Maltese Islands. The Structure Plan sought to over-turn the deeply entrenched culture of permissive development and to replace it with a regulated strategic and local-planning approach to development. However, this requires a very determined enforcement that has to hit at the grass roots in order to effect a much needed culture change. Such a change can only occur through political and organisational determination to protect the environment and cannot realistically be expected to happen overnight.

Between 1993 and 1996, the number of enforcement notices issued by the Planning Authority doubled (from 840 in 1993 to 1680 in 1996). Although *prima facie* this shows that the PA's enforcement officers were being more effective, it could also mean that the number of infringements was increasing. In the earlier years, most of the enforcement notices related to completely illegal development, that is, development that was attempted without first seeking to obtain development permission. Since 1995, the vast majority of cases were about developments that, although permitted, where not carried out according to the approved plans.

The number of enforcement notices issued in 1997 (1400) was also less than those issued in 1996. This decline way be interpreted as a positive sign that the public has become more conscious of the law. Although there is some truth in this, these figures could also be a sign of the ineffectiveness of the Authority in monitoring developments and detecting breaches of planning control.

In recent years the Planning Authority has set up a Major Projects Team within the Enforcement Unit so as to improve the monitoring of large-scale developments and the conditions set in their permits. This team meets regularly and has established effective links with developers. There is still however need to make this monitoring more effective as deviations in plans of major projects can have a significant impact on the environment.

Direct action by the Planning Authority since 1993 has involved demolition of a number of structures around Malta and Gozo. The threat of direct action (and the expenses related to that which are passed on to the owner of the illegal development) has also resulted in the removal of the infringement by the owner himself in a significant number of cases.

Table 2.7.2.1 – Direct action effected by the Planning Authority's enforcement section between 1993 and 1997.

Year	Enforcement Action
1993	Demolition of a number of unauthorised structures as a result of court orders
1994	Removal of an extensive, incomplete development of terraced houses at Attard; Destruction of several unauthorised garages and shed in a number of localities (including San Gwann, Mosta, Bormla, Zejtun) Removal of over 500 billboards
1995	26 actions involving removal of illegal structures. Significant structures removed included: Batching plant (Birzebbuga); farmhouse (Pembroke); boathouses and other structures (Armier); poultry farm (Kercem); agricultural stores (Xaghra); boundary walls, rooms, garages and other structures (Kercem, Ghasri, Zebbug, Munxar, Xlendi, Victoria, Qala, Mosta, Floriana, Haz Zebbug, Zejtun)
1996/1997	139 cases, including: Boathouses (Armier); scrapyard (Birzebbuga); Greenhouse and boundary wall (Zurrieq); concrete platform (Bahar ic-Caghaq); several illegal advertisements (Malta and Gozo)

	148 infringements were removed by the owners, including: garages, rooms, advertisements, scrap yards/dumping sites, kiosks, caravans, canopies, structures in front gardens, boathouses.

Source: Planning Authority

Another encouraging sign over these past five years has been the increasing number of complaints received and investigated by the enforcement section of the Planning Authority (between October 1996 and September 1997, the PA received 1972 complaints from the public). This all shows a greater public involvement in enforcing development control. Prompted by such a growing public awareness, in 1996 the Planning Authority introduced a 24-hour telephone "hot line" service, an enforcement page on the internet and an emergency weekend service for lodging complaints.

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2.8. Recommendations

The following are general recommendations concerning the issues tackled in this report.

Population

1.1. Changes in population and household sizes should be monitored closely and the emerging trends used as the basis of national policy especially with regards to work force supply, housing units, the elderly, retiring ages and pensions.

1.2. A national study on the rate of growth of the elderly population should be undertaken urgently in order to identify the requirements of the nation on a shirt-, medium- and long-term basis. This study should lead to a national policy on ageing.

1.3. A study should be undertaken to explore possible schemes that would encourage greater household mobility so as to alleviate development pressure on unbuilt areas and encourage people to move house according to family size.

1.4. There is an urgent need for the formulation of a population policy wherein all social partners would analyse the respective factors and advise on the changes to policies and legislation required to cater for the potential future scenarios.

1.5. Internal migration patterns should be given equal importance to other population parameters as the trends show that the high number of movements between towns and villages exert pressure for the allocation of new land for development.

Tourism

2.1. Further efforts should be made to encourage off-peak tourism to the islands.

2.2. Action for the rehabilitation/restoration of the natural and cultural environment should be encouraged and funded and the same assets promoted as tourism attractions.

2.3. A study should be undertaken to assess the impact of certain types of tourist activities on the environment, such as safari tours, scuba diving, visits to vulnerable archaeological sites.

2.4. The NTOM, Museums Department, MHRA, Environment Protection Department, Planning Authority, Non-governmental Organizations and other agencies should work together to steer the tourism industry towards sustainable development parameters, namely:

?? establishing a long-term policy-making perspective;

?? recognition of the interdependence of economic, environmental and social systems;

?? establishing environmental carrying capacities.

2.5 Tourism development should only be encouraged in existing built-up areas with the refurbishment of existing establishments being given priorities.

2.6 A national study establishing the maximum number of hotel beds that could be sustained locally taking into account economic, environmental and social parameters is urgently required, and developments exceeding these numbers should be refused automatically.

2.7 Tourism to the three cities should be encouraged further.

2.8 The Museums Department should be adequately funded to undertake the much needed upgrade of existing museums and to establish new ones. The private sector should also be encouraged to open theme museums.

2.9 The Museums Department should focus its energies at upgrading existing museums to European standards and to provide management and interpretative facilities at the several archaeological sites.

2.10 Special efforts should be made in places such as Mdina and the Cittadella so as not to encourage the “Disney Land” syndrome. Facilities should be provided but not at the expense of the heritage and character of the place. In the case of Mdina, in particular, the development of new commercial outlets should be immediately prohibited.

Housing

3.1. The current trend for smaller dwelling units registered over the past 4 years should be encourages and pressure to release more land for development should be resisted.

3.2. The current trends whereby the number of new housing applications approved by the PA significantly exceed the number of new households formed needs further analysis and action to ensure sustainability measures are safeguarded.

3.3. A special effort needs to be made to diversify the construction industry and to encourage the rehabilitation of the historic urban centres that have experienced a decline in their populations.

3.4. The re-use and rehabilitation of buildings in the urban conservation areas of towns and villages should be encouraged both as good sustainable development practice and to minimise the need for using limited resources in new constructions.

The Historic Environment

4.1. The areas and open spaces between buildings and the surroundings of the buildings (including gardens) are equally important for conservation as the buildings themselves and should be afforded the same type of protection.

4.2. Visual links between important historic buildings, such as coastal towers, the fortifications across Grand Harbour and Marsamxett Harbour, and similar buildings should be protected against insensitive development that blocks views or important heritage buildings.

4.3. Developments that block vistas of the many fortifications around Marsamxett and Grand Harbour should not be allowed.

4.4. The Planning Authority should be encouraged to develop policies to preserve and enhance urban areas and to guide development in UCAs

4.5. The Planning Authority, the NTOM and NGOs should work together to promote historic buildings and high quality built environments as valuable tourist assets.

4.6. The private sector and financial institutions should be encouraged to support or initiate schemes aimed at the preservation of the historic heritage in UCAs, especially through re-use and rehabilitation of old buildings.

4.7. The various agencies and departments involved in implementing rehabilitation projects (the Restoration Unit, VRP, CRP, local Councils, NGOs) should collaborate with regulator agencies such as the Planning Authority and the Museums Department to ensure pooling of resources and more effective action towards rehabilitation initiatives.

4.8. The recommendation of the 1990 Structure Plan for the Maltese Islands for the setting up of a Land Tribunal and Heritage Trust should be actively considered and funded by Government.

4.9. The PA should be encouraged to progress the National Protective Inventory project and the successful scheduling process which has afforded protection to over 1000 properties in 5 years.

4.10. The PA and the local councils should work more closely in the interest of local heritage. In particular, they should explore possibilities of partnerships in this area through the councils’ local wardens.

Archaeology

5.1. The Museums Department and the PA should work more closely in the interests of the local archaeological heritage. In particular, their respective resources should be pooled whenever possible to ensure more effective protection of this important and finite resource.

5.2. Landscape archaeology and the context of individual monuments should be given the same importance as the monuments themselves.

5.3. Streamlining of the various legislation affording protection to cultural heritage is urgently required. In this respect, designation of heritage sites is largely a land-use exercise and should be intimately tied to the Structure Plan for the Maltese Islands and the scheduling exercise of the Development Planning Act.

5.4. Other forms of non-traditional archaeology , e.g. industrial archaeology, maritime archaeology, etc., should be given equal importance to other, more traditional, types of archaeology.

5.5. The PA should be encouraged, and the necessary funds made available to it, to continue with its programme of inventorying the archaeological heritage of the country.

5.6. Archaeological sites that are known to have existed but are currently untraced or covered should be afforded the same type of protection as visible ones and all measures should be taken to ensure their survival.

5.7. Urgent measures should be taken to protect the various World Heritage megalithic temples in the islands.

5.8. A review of current policy with regards to archaeological finds is urgently required to encourage the reporting of finds and protection of valuable heritage.

5.9. The rich underwater archaeology of the islands should be given urgent attention and coastal/marine developments should not be allowed unless they ensure that this heritage is protected and/or the necessary explorations/excavations are undertaken.

5.10. There is a need to recognise the value of the country's non-scheduled archaeological heritage as being equally important.

5.11. Training in heritage management at the University of Malta should be established as matter of priority.

5.12. There exists a need to train further personnel in heritage management and rescue archaeology.

5.13. The Museums Department should be requested to prepare, as matter of priority, a management plan for all major archaeological sites and top provide interpretation pf the same heritage for visitors to the sites.

Industry

6.1. Malta Development Corporation should be further encouraged to maximize the re/development potential of the industrial estates under their management.

6.2. Private owners of industrial estates should be encouraged to make land in their ownership available for development through Government sponsored incentives.

Coastal

7.1. Further development of coastal areas should be prohibited forthwith in accordance with Structure Plan policy.

7.2. Coastal areas in private ownership should be taken into public ownership as per Structure Plan policy within a specified period of time.

7.3. Illegal coastal developments (including boathouses, beach rooms, berths, slipways, etc.) should be removed and the area rehabilitated for public use.

7.4. All coastal development projects should be subject to an Environmental Impact Assessment complete with the necessary modelling to determine the potential impacts on the natural event and nearby development.

7.5. Activities that damage the marine and coastal environment such as dumping of rubble in the sea, concreting/smoothing of rocky shores, land reclamation, creation of new beaches where none ever existed should not be allowed.

7.6. Artificial Beach Nourishment projects should only be allowed after the necessary studies are undertaken and the Planning Authority and the Environment Protection Department are satisfied that no negative impact will occur on the environment. Such projects should be undertaken by knowledgeable individuals and be based on accurate data.

7.7. The Planning Authority should, as a matter of priority, establish the extent of the coastal zone in the various localities.

The Natural Environment

8.1. The Environment Protection Act and the Development Planning Act should be harmonized insofar as the protection of natural areas is concerned. In this regard, since the designation of areas is largely a land-use exercise, this should be reconciled with the provisions of the Structure Plan for the Maltese Islands and the Development Planning Act.

8.2. The designate of areas of ecological importance and sites of scientific importance should be promoted.

8.3. The Environment Protection Department should be encouraged to provide management at the various natural sites protected through scheduling including the process of interpretative facilities and the training of personnel.

8.4. The establishment of environmental wardens should be actively considered as a matter of priority.

8.5. Areas of good grade agricultural land should be identified and designated as AAVs to ensure their continued viability.

8.6. Valuable trees should be identified and afforded protection through legislation.

Marine Conservation

9.1. A national study into the feasibility of establishing Marine Conservation Areas should be undertaken by the Planning Authority, Environment Protection Department and the University of Malta and the first such area identified, designated and managed together with local interest groups.

9.2. The Government should strive to fund (or attract necessary funding) for main research and establishment of Marine Conservation Areas.

Agriculture

10.1. The Agriculture Industry should be actively supported and encouraged both as a food provider and a protection of the countryside.

10.2. The impact of greenhouse development on the landscape should be assessed urgently and the necessary mitigation measures identified in partnership with farmers and their cooperation.

10.3. The issue of agricultural land fragmentation needs to be addressed as a matter of priority.

10.4. The Agricultural Department, the Environment Protection Department and the Planning Authority should undertake a study to identify abandoned fields and to channel reclamation activities into these areas rather than natural areas.

Geology

11.1. Quaternary deposits in the Maltese Islands should be recognized as important heritage items and given the required protection.

11.2. Development on areas of geological risk and/or areas prone to erosion should be actively and expressively prohibited and derelict buildings in such areas should be pulled down and the area rehabilitated.

11.3. Local geological conservation should be given the same importance as other designations.

11.4. The Planning Authority should be further encouraged to continue recording the geological resources of the islands.

11.5. Measures should be taken for the drawing up of a Geological Conservation Policy as part of the Structure Plan Review.

11.6. The setting up of a local geological conservation policy, possibly affiliated with International geological societies should be supported and actively considered.

11.7. Measures aimed at increasing the public's appreciation of the local geological resource and geological conservation in general should be encouraged.

11.8. Site documentation data should be further standardized, possibly using Planning Authority data as a baseline.

11.9. Data collection prior to an inevitable destruction of a site should be an uncompromisable requirement.

Landscape

12.1. The Planning Authority should continue to identify areas of high landscape value and to protect them through the scheduling process.

12.2. Activities/developments having a negative impact on the landscape should be controlled and/or reviewed. Alien materials should be replaced by more compatible constructions.

Quarrying

13.1. A national study on the environmental impact of quarrying and on the state of the local quarrying industry is urgently required.

13.2. A study into the demand and supply of all active quarry sites on the islands is urgently required so as to set the quarrying industry on a sustainable footing whereby the finite resources are only quarried when really required.

13.3. An accurate assessment of existing permitted resources and the amount of years these are expected to last should be urgently undertaken. New quarry sites should only be permitted of existing resources are not adequate.

13.4. The Planning Authority, the GRTU and the Quarry Owners Association should work more closely to ensure that environmental conditions around existing quarries are upgraded and the necessary measures taken. These include landscaping, dust control, noise and vibration mitigation and reclamation of disused quarry areas.

13.5. The Planning Authority should urgently undertake a survey of all quarry sites to determine what environmental controls are necessary what after-use would be acceptable at each quarry.

13.6. Re-use and recycling of stone blocks and inert waste should be actively promoted and encouraged as a matter of urgent priority. The Water Services Corporation, the Planning Authority, the Environment Protection Department, the GRTU and the Quarry Owners Association should establish a working group with a clear deadline by when this urgent problem is to be tackled.

13.7. Softstone quarry owners should be given incentives to waste less of the virgin material being extracted.

13.8. Government should consider recurring the current price control on virgin rock and to institute grading for rock types thereby identifying first and second class rock.

13.9. The Planning Authority should ensure that areas containing significant and valuable mineral resources are safeguarded from other development.

13.10. Alternative quarrying techniques, such as mining, should be actively considered and promoted through appropriate incentives.

13.11. Alternative building techniques and materials should be further considered, including the possibility of introducing minimum thresholds for the use of recycled stone materials in all new development.

13.12. Possibilities of encouraging salt production in old salt pans as a vernacular industry should be considered, possibly in collaboration with the Museums Department and the NTOM.

Waste

14.1. Old waste dumps such as those at Luqa and Wied Fulija should be assessed for the presence of gas and rehabilitated for re-use (e.g. for major impact sports, industrial estates, recreational facilities, etc.).

14.2. Illegal dumps such as those at l-Ahrax, ic-Cumnija and Anchor Bay should be cleared and the areas rehabilitated as a matter of priority.

14.3. Existing outdated technologies (such as the incinerators at S.L.H Kordin and the abattoir) should be phased out and replaced by modern, environmentally-friendly technologies.

14.4. Waste Management should be put higher on the country's agenda and all agencies, whether procedures (e.g. Health, Agriculture, Ports, Airports, Drydocks, etc.) or regulators (Environment Protection Department, Waste Management Department, Planning Authority) should work together to tackle this problem.

14.5. National policies on Waste Management (including a Waste Management Strategy and a Waste Management Subject Plan) should be immediately undertaken and a Waste Management Act formulated.

Environmental Impact Assessment

15.1. The Planning Authority and the Environment Protection Department should as a matter of priority finalize the draft EIA Regulations.

15.2. The Planning Authority and the Environment Protection Department should undertake a study assessing the quality of EIAs prepared locally and provide the necessary training to new consultants.

15.3. The Planning Authority and the Environment Protection Department should ensure that social and economic impacts of development are considered in EIAs.

Enforcement

16.1. The Planning Authority should be given all the necessary support and equipment to ensure that its enforcement actions are timely and effective.

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APPENDIX 1

Population Density

Locality	**Persons/Km. Sq.**
MALTESE ISLANDS	1194
MALTA	1409
GOZO & COMINO	423
Attard	1390
Balzan	5708
Birgu (Vittoriosa)	5790
Birkirkara	7561
Birzebbugia	796
Bormla (Cospicua)	6568
Dingli	477
Fgura	9558
Floriana	2570
Fontana	2100
Ghajnsielem & Comino	300
Gharb	224
Gharghur	979
Ghasri	79
Ghaxaq	1060
Gudja	1286
Gzira	7704
Hamrun	10413
Iklin	1796
Isla	21902
Kalkara	1591
Kercem	282
Kirkop	1902
Lija	2314
Luqa	911
Marsa	1965
Marsaskala	891
Marsaxlokk	607
Mdina	418
Mellieha	272
Mgarr (Malta)	166
Mosta	3062

Mqabba	991
Msida	4111
Munxar Nadur	271 551
Naxxar	848
Paola	3733
Pembroke	957
Pieta`	9502
Qala	255
Qormi	3500
Qrendi Rabat (Malta)	514 474
Rabat (Victoria) (Gozo)	2258
Safi	890
San Giljan	4448
San Gwann	4574
San Lawrenz	155
San Pawl il-Bahar	468
Sannat Santa Lucia	417 5008
Santa Venera	7196
Siggiewi	349
Sliema	9822
Swieqi	2193
Ta` Xbiex	5962
Tarxien	8724
Valletta Xaghra	8552 555
Xewkija	685
Xghajra	1155
Zabbar	2450
Zebbug (Gozo)	163
Zebbug (Malta)	1197
Zejtun	2101
Zurrieq	988

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3. LIVING RESOURCES, FISHERIES & AGRICULTURE

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3. LIVING RESOURCES, FISHERIES & AGRICULTURE

Introduction

Under the heading '*Living resources, fisheries and agriculture*', the following will be considered: biota, habitats and biocoenoses, exploitation of wildlife, fisheries, aquaculture, and agriculture including soil.

As the work progressed it became very obvious to the Team responsible for this part of the Report that it would not be possible to meet all objectives of this project (as stated in Part 1) for a variety of reasons, principally having to do with the availability of information. In particular it has not been possible to address objectives 1 and 2 within the timeframe given for completion of this report. This report therefore focuses on reviewing available information, assessing present status and identifying trends. In the absence of stated national environment objectives it is difficult to make detailed recommendations to meet such objectives, therefore only general recommendations are made. The information provided here can be used both as a baseline account with which to compare future State of the Environment reports as well as a basis for formulating indices for assessing environmental quality and national environmental quality objectives.

3.1 Biota

3.1.1 Characteristics

3.1.1.1 Total Number Of Species

The Maltese Islands harbour a very diverse array of non-marine plants and animals, especially when considering the relatively small land area, the limited number of habitat types and the intense human pressure.

Tables 3.1.1 and 3.1.2 give estimates of the number of species of selected groups of plants and animals that occur in the Maltese Islands and their territorial waters.

Table 3.1.1
The number of terrestrial and freshwater species of representative groups of plants and animals in the Maltese Islands. In some cases the numbers given are only estimates, as the groups concerned have not been adequately studied.

PLANTS	
Algae	ca.150
Myxomycota (slime moulds)	ca.71
Large Fungi	ca.150
Lichenes (lichens)	ca.300
Bryophyta (mosses and relatives)	ca.130
Pteridophyta (ferns and relatives)	11
Gymnospermae (conifers)	2 indigenous species
Angiospermae (flowering plants)	ca.900 indigenous species
ANIMALS	
Hydrozoa (hydras)	1 species recorded
Turbellaria (flatworms)	at least 10 species
Nematoda (roundworms)	ca.27 plant parasitic species recorded; probably 1-2 hundred free-living and other species occur
Nematomorpha (horsehair worms)	1 species
Annelida (earthworms and leeches)	at least 15 species
Mollusca (snails and slugs)	69
Scorpiones (scorpions)	1
Pseudoscorpiones (false scorpions)	ca.24
Opiliones (harvestmen)	ca.6
Araneae (spiders)	ca.83 recorded; at least 200+ species occur
Palpigradi (microwhipscorpions)	1
Acari (ticks and mites)	a few species recorded; many more occur
Branchiopoda (fairy shrimps, water-fleas and relatives)	at least 10 species
Ostracoda (seed shrimps)	at least 7 species
Amphipoda (sandhoppers and beach-hoppers)	ca.9 recorded
Isopoda (woodlice)	ca.49
Decapoda (crabs)	1 freshwater species

Apterygote orders	ca.20 species recorded; many more occur
Odonata (dragonflies and damselflies)	ca.10 recorded
Dictyoptera (mantises and cockroaches)	ca.11
Orthoptera (grasshoppers and relatives)	ca.48
Dermaptera (earwigs)	5
Isoptera (termites)	2
Coleoptera (beetles)	ca.600 recorded; probably 2000+ occur
Homoptera (aphids, leafhoppers, scale insects and relatives)	a few species recorded; many more occur
Heteroptera (true bugs)	113 recorded; more occur
Lepidoptera (butterflies and moths)	ca.590
Neuroptera (lacewings)	ca.30 recorded
Diptera (flies)	ca.200 recorded; probably 500+ occur
Hymenoptera (bees, wasps and ants)	ca.150 recorded; probably 500+ occur
Diplopoda (millipedes)	ca.14
Chilopoda (centipedes)	ca.15
Amphibia (frogs)	1
Reptilia (reptiles)	9
Aves (birds)	ca.13 resident (ca.57 regular visitors and c.112 regular migrants)
Mammalia (mammals)	c.20

Table 3.1.2
The number of marine species of representative groups of plants and animals in Maltese territorial waters. In some cases the numbers given are only estimates, as the groups concerned have not been adequately studied.

Macroscopic algae (seaweeds)	ca.220 recorded; more occur
Microscopic algae	ca.160 recorded; more occur
Marine angiosperms (sea-grasses)	3 confirmed species
Porifera (sponges)	33 species recorded; more occur
Hydrozoa (hydroids),	ca.34 recorded; many more occur
Scyphozoa (jellyfish)	ca.5 recorded; more occur
Anthozoa (sea-anemones and corals)	ca.20 recorded; many more occur
Ctenophora (comb-jellies)	2 species recorded; more occur
Platyhelminthes (marine flatworms)	occur not studied
Nemertina (ribbon worms)	ca.4 species recorded; more occur
Nematoda (thread worms)	occur but not studied
Gastrotricha	occur but not studied
Rotifera (wheel animals)	occur but not studied
Kinorhyncha	occur but not studied
Bryozoa (moss animals)	ca.20 species recorded; many more occur
Brachiopoda (lamp shells)	6
Phoronida	occur but not studied
Caudofoveata	2; more may occur
Solenogastres	2; more may occur
Polyplacophora (chitons)	19
Scaphopoda (tusk shells)	10
Gastropoda (marine snails and slugs)	ca.600 recorded; more occur
Bivalvia (marine bivalves)	ca.230 recorded; more occur
Cephalopoda (squid, cuttlefish and octopuses)	20 recorded; more occur
Priapulida	probably occur

Sipuncula (peanut worms)	ca.3 recorded; more occur
Echiura (spoon worms)	1 species recorded; more may occur
Polychaeta (ragworms and relatives)	ca.83 recorded; more occur
Oligochaeta (marine oligochaetes)	occur but not studied
Hirudinea (marine leeches)	1 species recorded
Tardigrada (water bears)	occur but not studied
Pycnogonida (sea spiders)	occur but not studied
Branchiopoda	1 species recorded; more occur
Ostracoda (marine seed shrimps)	2 species recorded; more occur
Copepoda (oar shrimps)	ca.54 recorded; more occur
Cirripedia (barnacles)	19 species recorded; more occur
Isopoda (sea slaters and fishlice)	ca.12 species recorded; more occur
Amphipoda (beachhoppers and relatives)	ca.21 recorded; many more occur
Mysidacea (mysid shrimps)	2 recorded; more probably occur
Euphausiacea (krill)	3 recorded; more probably occur
Stomatopoda (mantis shrimps)	3 recorded; more probably occur
Decapoda (shrimps, hermit crabs and crabs)	ca.85 recorded; more occur
Crinoidea (sea lilies)	1 species recorded
Asteroidea (starfish)	ca.14 recorded; more occur
Ophiuroidea (brittle stars)	ca.5 recorded; more occur
Echinoidea (sea urchins)	ca.17 recorded; more occur
Holothuroidea (sea cucumbers)	3 recorded; more occur
Chaetognatha (arrow worms)	4 recorded; more probably occur
Hemichordata (hemichordates)	may occur
Urochordata (tunicates)	ca.16 recorded; many more occur
Cephalochordata (lancelets)	1
Agnatha (jawless fishes)	1
Chondrichthyes (cartilaginous fishes)	51; more may occur
Osteichthyes (bony fish)	234; more may occur
Reptilia (marine turtles)	3
Mammalia (seals, dolphins and whales)	1 seal and ca.9 cetaceans

3.1.1.2 State Of Knowledge Of The Various Groups

Although a large amount of work on the biota of the Maltese Islands has been carried out, our knowledge of the terrestrial, freshwater and marine biota of the Maltese Islands is still quite poor. Most attention has been focus on 'popular' groups such as flowering plants, fish, butterflies and birds, however, there are whole groups about which next to nothing is know, even if some of these are of economic importance. Table 3.1.3 summarises our state of knowledge of locally occurring biota.

Table 3.1.3

The state of knowledge of the terrestrial, freshwater and marine biota of the Maltese Islands and their territorial waters, based on the number and quality of published taxonomic works on the groups concerned and on personal communications from workers on the various groups.

Key:	unknown	– occur but not studied
	poor	– some knowledge but not adequately studied
	good	– moderately well studied
	very good	– well studied, the bulk of the species which occur are known

Group	**State of knowledge**
Prokaryota (bacteria and relatives)	Unknown
Protoctista – protozoan phyla	Unknown to poor
Protoctista – algal phyla	good to very good
Protoctista – Myxomycota (slime moulds)	Good
Fungi – smaller fungi	Poor
Fungi – larger fungi	Good
Lichenes (lichens)	poor
Bryophyta (mosses and liverworts)	good
Pteridophyte groups (ferns and relatives)	very good
Gymnospermae (conifers)	very good
Angiospermae (flowering plants)	very good
Mesozoa	unknown
Porifera (sponges)	poor to good
Cnidaria (hydroids, jellyfish, sea-anemones, corals)	unknown to poor
Ctenophora (comb-jellies)	unknown
Platyhelminthes (flatworms, flukes, tapeworms)	unknown
Nemertina (ribbon worms)	unknown
Gnathostomulida (jaw worms)	unknown
Aschelminth phyla	unknown except for plant parasitic nematodes which are poorly known
Bryozoa (moss animals)	poor
Brachiopoda (lamp shells)	very good
Phoronida	unknown
Mollusca	Lesser groups – poor Polyplacophora (chitons) – very good Scaphopoda (tusk shells) – good Bivalvia (bivalves) – good to very good Gastropoda (slugs and snails) – good to very good Cephalopoda (squid and octopuses) – good
Priapulida (priapulid worms)	unknown
Sipuncula (peanut worms)	poor
Echiura (spoon worms)	good
Annelida (polychaetes, oligochaetes and leeches)	poor
Tardigrada (water bears)	unknown
Pentastomida (tongue worms)	unknown
Chelicerata – Pycnogonida (sea spiders)	unknown
Chelicerata – Arachnida	Scorpiones (scorpions) – very good Pseudoscorpiones (false scorpions – very good Opiliones (harvestmen) – poor Araneae (spiders) – poor to good Acari (mites and ticks) – poor
Crustacea – Branchiopoda	phyllopod groups (fairy and clam shrimps) -- good Cladocera (water fleas) -- poor
Crustacea – Ostracoda (seed shrimps)	poor
Crustacea – Copepoda (oar shrimps)	poor
Crustacea – Cirripedia (barnacles)	good
Crustacea – Isopoda (sea slaters and woodlice)	very good for terrestrial forms, otherwise poor
Crustacea – Amphipoda (hoppers)	poor to good
Crustacea – Euphausiacea (krill)	unknown
Crustacea – Decapoda (shrimps and crabs)	very good

Uniramia – Pauropoda and Symphyla	unknown
Uniramia – Diplopoda (millipedes)	very good
Uniramia – Chilopoda (centipedes)	good
Uniramia – Insecta	Protura Diplura (japygids) -- unknown Collembola (springtails) – unknown to poor Thysanura (silverfish) – poor to good Ephemeroptera (mayflies) – poor Odonata (dragonflies) – very good Orthoptera and Dictyoptera (grasshoppers, mantids, cockroaches) – good to very good Dermaptera (earwigs) – very good Isoptera (termites) – very good Embioptera (webspinners) – unknown Psocoptera (book lice) -- unknown Mallophaga (biting lice) -- unknown Anoplura (sucking lice) -- unknown Thysanoptera (thrips) -- good Hemiptera (bugs) – good Homoptera (aphids, scale insects, leafhoppers) – poor to good Neuroptera (antlions, lacewings) -- good Coleoptera (beetles) -- good Strepsiptera (stylops) -- poor Lepidoptera (moths, butterflies) – very good Diptera (flies) -- good Trichoptera (caddisflies) – poor to good Siphonaptera (fleas) – poor Hymenoptera (bees, wasps, ants) – good
Pogonophora (beardworms)	unknown
Echinodermata	Crinoidea (sea lilies) – good Asteroidea (starfish) – good Ophiuroidea (brittle stars) – poor Echinoidea (sea urchins) – good Holothuroidea (sea cucumbers) – poor
Chaetognatha (arrowworms)	unknown
Hemichordata (hemichordates)	unknown
Chordata	lower chordates -- unknown to poor fish groups -- good to very good Amphibia (amphibians) – very good Reptilia (reptiles) -- very good Aves (birds) -- very good Mammalia (mammals) -- very good

3.1.1.3 Endemic Species

The main affinities of the Maltese biota are with Sicily, however, the Maltese Islands support a number of species of plants and animals which are found only here and nowhere else in the world.

Endemic species are of great cultural and scientific importance. Culturally they are important because such species are unique to the Maltese Islands and therefore a valuable part of the national heritage.

Scientifically they are important because of their intrinsic interest with respect to phylogeny, biogeography and evolution of their group, and for the wider evolutionary processes they demonstrate.

The number and taxonomic distribution of endemic terrestrial, freshwater and marine species from those groups that have been adequately studied are given in the Table 3.1.4.

Table 3.1.4
The number of endemic species and subspecies occurring in the Maltese Islands. Only those groups which have been adequately studied taxonomically are included. All species are terrestrial, freshwater or brackish water unless otherwise stated.

Group	**Number of endemic species/subspecies**
Tracheophyta (higher plants)	21 (at least another 5 are under study)
Bryophyta (mosses and relatives)	2
Mollusca (snails and slugs)	7 (including one marine species)
Pseudoscorpiones (false scorpions)	3
Palpigradi (micro-whipscorpions)	1
Araneae (spiders)	7
Isopoda (woodlice)	5
Decapoda (crabs)	1
Thysanura (silverfish)	1
Orthoptera (grasshoppers and relatives)	1
Heteroptera (true bugs)	1
Coleoptera: Staphylinidae (rove beetles)	4
Coleoptera: Elateridae (click beetles)	1
Coleoptera: Tenebrionidae (darkling beetles)	5
Coleoptera: Curculionidae (weevils)	2
Lepidoptera: (butterflies and moths)	17
Diptera (flies)	5
Hymenoptera: Formicidae (ants)	2
Hymenoptera: Mutillidae (velvet ants)	1
Reptilia (reptiles)	1 (*Podarcis filfolensis* which occurs also on Linosa and Lampione; at least 4 races of this species occur in the Maltese Islands)
Mammalia (mammals)	1

Maltese endemics
Case-study: The Maltese Wall Lizard

The Maltese Wall Lizard (*Podarcis filfolensis*) is a neoendemic species found only on the Maltese Islands and on the nearby Pelagian Islands of Linosa and Lampione. The Maltese Wall Lizard is most closely related to *Podarcis wagleriana*, a wall-lizard endemic to Sicily, and is most probably derived from populations of this species which became cut off when the various islands of the Maltese and Pelagian archipelagos finally became separated from the Sicilian mainland. The populations of the various islands show some differences from each other. These are often regarded as distinct races and formally named as subspecies: *P.f.filfolensis* on the island of Filfla, *P.f.maltensis* on Malta, Gozo and Comino, *P.f.generalensis* on Il-Gebla tal-General (= Fungus Rock), *P.f.kieselbachi* on Selmunett (= St. Paul's Islands), and *P.f.laurentiimuelleri* on Linosa and Lampione. The population on Kemmunett also presents some differences and may be another race. A study of these island forms would be of great interest from the point of view of understanding micro-evolutionary processes and how these are affected by differences in the environment between the various islands.

3.1.1.4 International Importance Of The Maltese Biota

Apart from their local importance, some elements of the Maltese biota have a wider regional importance:

- ?? Numerous endemic species and subspecies of plants and animals have been described from the Maltese Islands and these are of evolutionary and biogeographical interest.
- ?? A number of Maltese endemic (i.e. found only in a particular region and nowhere else) plants and animals are relics from the pre-glacial Mediterranean flora and fauna and some have no close relatives anywhere else in the world.
- ?? Numerous species of Maltese flora and fauna have a restricted Mediterranean distribution. Some species that are locally relatively common are endangered on a European scale.
- ?? Some taxa with a restricted distribution were first described from Maltese material, and for these the Maltese Islands are the type locality.
- ?? The island of Filfla supports one of the largest known breeding colonies of the Storm Petrel (Il-Kangu ta' Filfla, *Hydrobates pelagicus*) in the Mediterranean.
- ?? The Mediterranean is divided into two major subregions, the East Basin and the West Basin, each with its own characteristic species, while there are also differences in species diversity between the northern (European) shores and the southern (North African) shores of the Mediterranean. Being situated in the centre of the Mediterranean, the Maltese Islands are at the meeting point of these four regions, and therefore the marine biota of the islands is of biogeographical interest.

Biogeographical importance of the Maltese biota
Case-study: The flowering plants

The main affinities of the Maltese biota are with Sicily, the closest sizeable landmass. However, the Maltese biota is not merely an appendage to that of Sicily. This is well illustrated by the vascular plants (Tracheophyta) which are much better known than any other group. The bulk of Maltese vascular plants also occur in Sicily, and indeed some species are Siculo-Maltese endemics, i.e. they are found only in Sicily and Malta, for example: Sicilian Iris (*Iris sicula*), Pygmy Groundsel (*Senecio pygmaeus*), Pignatti's Fern-grass (*Desmazeria pignattii*), Crescent Orchid (*Ophrys lunulata*) and Late Spider-orchid (*Ophrys oxyrrhyncos*). Nevertheless, several Maltese species are absent from Sicily, for example: Aleppo Spurge (*Euphorbia aleppica*), Olive-leaved Bindweed (*Convolvulus oleifolius*) and African Wolfbane (*Periploca angustifolia*). The Maltese Islands' position in the centre of the Mediterranean results in the presence both of western elements such as Mediterranean Willow (*Salix pedicellata*), and African Tamarisk (*Tamarix africana*, and of eastern elements such as Thorny Burnet (*Sarcopoterium spinosum*), Yellow Kidney-Vetch (*Anthyllis hermanniae)* and Olive-leaved Bindweed (*Convolvulus oleifolius*). There is also a fairly strong North African element represented by such species as Egyptian St. John's Wort (*Hypericum aegypticum*), Rock Crosswort (*Crucianella rupestris*), Clustered Carline-

Thistle (*Carlina involucrata*), African Wolfbane (*Periploca angustifolia*), *Pteranthus dichotomus* and perhaps such Pelago-Maltese endemics (i.e. found only in Malta and the neighbouring Pelagian Islands) as Lampedusa Carrot (*Daucus lopadusanus*), Maltese Toadflax (*Linaria pseudolaxiflora*) and Maltese Dwarf Spurge (*Euphorbia exigua* var. *pycnophylla*).

3.1.2 Threatened Species

3.1.2.1 Red Data Book (RDB) Status By Taxonomic Group

An assessment of the conservation status of locally occurring terrestrial, freshwater and marine species was made in 1989 when the first Red Data list for the Maltese Islands was prepared, following the criteria established by the IUCN – the World Conservation Union, and modelled on national and international Red Data lists. Table 3.1.5 gives a summary of the information contained in the *Red Data Book for the Maltese Islands* (RDB) with minor modifications (see notes at end of table).

Table 3.1.5
The number of extinct and threatened species of the Maltese Islands. Only those groups included in the *Red Data Book for the Maltese Islands* are given. Adapted from Schembri & Sultana (1989).
Key: X: Extinct; E: Endangered; V: Vulnerable; R: Rare; I: Indeterminate.

Group	X	E	V	R	I	TOTAL
Cyanobacteria (blue-green algae)	0	0	0	0	1	1
Chlorophyta (green algae)	1	0	1	2	0	4
Phaeophyta (brown algae)	0	0	3	2	0	5
Rhodophyta (red algae)	1	0	0	3	0	4
Macrofungi ("higher" fungi)	0	1	0	16	1	18
Bryophyta (mosses and relatives)	0	1	0	33	3	37
Lycophyta (club-mosses and rel.)	1	0	0	1	0	2
Filicophyta (fernsand relatives)	3	2	0	0	0	5
Pinophyta (conifers)	1	1	0	0	0	2
Gnetophyta (gnetads)	1	0	0	0	0	1
Magnoliophyta (flowering plants)	103	71	44	136	34	388
Cnidaria (cnidarians)	0	0	0	4	0	4
Hirudinea (leeches)	0	0	1	0	0	1
Chelicerata (spiders and relatives)	0	1	0	4	4	9
Crustacea (crustaceans)	0	2	2	8	2	14
Mollusca (snails and relatives)	5	11	10	19	7	52
Odonata (dragonflies and rel.)	0	0	1	1	0	2
Dictyoptera (mantises and rel.)	0	0	0	2	0	2
Orthoptera (grasshoppers and rel.)	1	0	2	5	0	8
Dermaptera (earwigs)	0	0	1	0	0	1
Hemiptera (bugs)	0	0	0	1	4	5
Homoptera (scale insects and aphids)	0	0	0	0	2	2
Trichoptera (caddisflies)	0	0	0	2	0	2
Hymenoptera (bees, wasps and ants)	0	1	7	4	0	12
Lepidoptera (butterflies and moths)	7	1	11	9	4	32
Coleoptera (beetles)	11	0	38	66	48	163
“Pisces” (fish)	0	0	1	0	0	1

Amphibia (amphibians)	0	0	1	0	0	1
Reptilia (reptiles)	0	1	12	1	1	15
Aves (birds)	3	4	13	0	0	20
Mammalia (mammals)	0	0	13	8	3	24

Notes on Table 3.1.5

Phaeophyta:	*Sargassum* spp. listed as vulnerablen in RDB should be a total of 3 species.
Chlorophyta:	Here includes charophytes, listed as Charophyta in RDB.
Rhodophyta:	*Lithophyllum lichenoides* added as very rare.
Bryophyta:	*Riella helicophylla* added as endangered.
Cnidaria:	*Antipathes* spp. counted as 2 species.
Mollusca:	Data given is for taxa *not* species; for species only the figures should read: it should read: X - 5, E – 7, V – 9, R – 19, I – 7, Total - 47; All data for non-marine Mollusca were updated from Giusti *et al.* (1995)
Aves:	Amended based on personal communications from A.E. Baldacchino & S. Gatt; another 11species that are occasional breeders may be included as 'Indeterminate'.
Mammalia:	*Tadarida teniotis* (V) and *Stenella coeruleoalba* (V) were added to the list; *Crocidura suaveolens* and *C. russula* were removed and replaced by *Crocidura sicula calypso* (I)

3.1.2.2 Trends Since Publication Of The 1989 RDB

Since the *Red Data Book for the Maltese Islands* was published in 1989, there have been many developments. Our knowledge of certain groups has improved considerably with the result that many new records have been added to the Maltese list, while the taxonomic status of several taxa has been revised. Better exploration of the islands has resulted in the re-discovery of a number of species previously thought to have become extinct while conversely, some previously occurring species have not been recorded for many years and may be extinct. The Maltese landscape has undergone huge changes since 1989, mainly as a result of development, with the result that some habitats have become scarcer (especially natural ones) while others have become more widespread (mainly anthropogenic ones). As a consequence, the species that these habitats support have likewise become rarer or commoner and less widespread or more widespread as the case may be. It is clear that the conservation status of many species reported in the RDB needs revision.

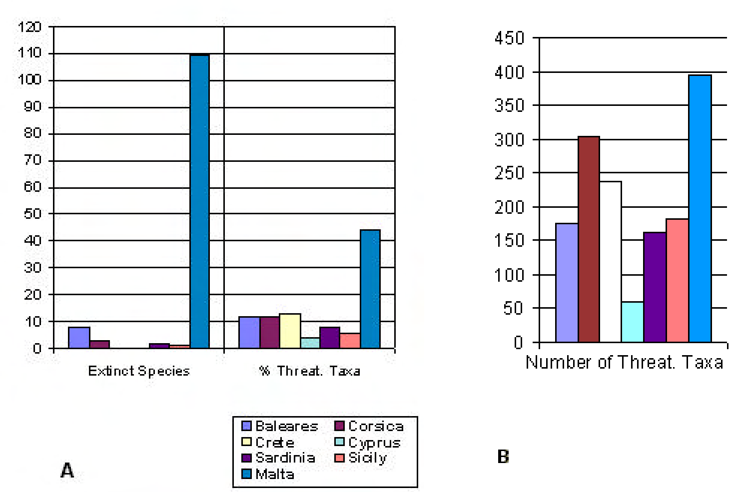
Another important development is that the IUCN has re-defined the criteria for its threat categories. These changes are fundamental and it is not possible to simply translate the old threat ratings to the new ones; each species needs to be re-evaluated from scratch.

Given these important changes, it is not possible to give an updated account of the conservation status for most groups and this would require a huge effort on the part of many specialists and a great deal of time. However, to illustrate trends, a case study for a relatively well known group is presented, although even here the information is far from complete. In particular, it should be noted that the threat criteria employed are not the revised IUCN ones but the ones used in the original RDB.

Trends in conservation status of Maltese species
Case study: The vascular flora (Darrin T. Stevens, unpublished)

About 900 taxa of vascular plants are considered as native, possibly native, or archaeophytic to the Maltese Islands. This is a large number, especially when compared to continental Europe, for example, the British Isles have some 2000 native species of vascular plants, which is only double the number found in the Maltese Islands, which are orders of magnitude smaller.

However, despite such a high species richness, this value is rapidly declining, and as much as 44% of the native flora is rare, threatened or a lready extinct. This value is the highest for Mediterranean Islands:



<u>Fig 1.1</u>

A. Graph showing number of extinct species and percentage of locally threatened taxa in different Mediterranean Islands.

B. Graph showing the number of locally threatened taxa in different Mediterranean Islands.

Percentage of locally threatened taxa is represented as the percentage of the total number of the island taxa; threat. is an abbreviation for threatened; data for Mediterranean Islands other than Malta obtained from Delanoë *et al*. (1996).

As seen from Fig.1.1, the Maltese Islands have the highest number of extinct species (109 taxa); the second-highest value of extinct taxa is of only 8 taxa for the Balearic Islands!

Similarly, the Maltese Is lands also have the highest number of threatened taxa: 396; the second-highest value is of 305 for Corsica. Nonetheless, the percentage of threatened taxa in the Maltese Islands is much higher than for Corsica (i.e. 44% vs 12%).

This decline has been quite rapid as can seen from comparison with situation in 1989 as given in the *Red Data Book for the Maltese Islands* (Lanfranco,1989):

?? Lanfranco (1989) lists 9% of the native vascular flora as extinct; recent investigation reveals that this has arisen to 12%. However, this value is misleading since a number of taxa upon which the new estimate is based were not included in the *Red Data Book*. On the other hand, other taxa however disappeared since 1989, as for example the Sawfly Orchid, *Ophrys tenthredinifera*; a nd an undescribed endemic species of *Limonium*.

?? About 140 taxa are not listed in Lanfranco (1989). This increases the number of rare, threatened and/or extinct taxa by 15%. Again, some of the taxa included as threatened in the new estimate were not include d in the *Red Data Book*.

In general, threatened plants have declined in numbers and distribution ranges, and some have became much rarer (e.g. Maltese Toadflax *Linaria pseudolaxiflora*; Maltese Waterwort *Elatine gussonei*; Pheasant's Eye *Adonis microcarpa*). On the other hand, 10 species presumed to be extinct in 1989 have been rediscovered.

3.1.2.3 Species Listed In International Red Data Lists

A good indicator of the international importance of local species is their inclusion in international treaties and other instruments protecting wildlife. Table 3.1.6 provides a summary of such species.

Table 3.1.6 lists 153 species of which 85 are not legally protected by local legislation giving the number of species of international importance protected by Maltese legislation as 68 (44.4% of the species on international lists).

However, 37 species on the international list have been proposed by the Environment Protection Department for protection under the Environment Protection Act 1991 and are presently awaiting ministerial approval. If these species become protected species, then the number of species of international importance protected by Maltese legislation will rise to 105 (70% of the species on international lists).

Table 3.1.6

Locally occurring species of international importance. Only species listed in international treaties, red data lists, and lists of species of conservation importance are included, and only locally breeding species are considered. Cetaceans, the Mediterranean monk seal, sea turtles, and migratory birds are excluded. Extinct, irregularly and/or doubtfully breeding species are also excluded.

Key to column headings:

Bern:	Bern Convention
Bonn:	Bonn Convention
ACCOBAMS:	Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area
EuroBats:	Agreement on the Conservation of Bats in Europe
Vert RDB:	Draft European Vertebrate Red Data Book
IUCN RDB	For animals: 1996 IUCN Red List Of Threatened Animals For plants: 1997 IUCN Red List Of Threatened Plants
IUCN-MIPSG:	Proposed for inclusion in the IUCN Mediterranean Islands Plant Specialist Group's list of the top 50 threatened Mediterranean plants.
Euro RDB:	European Red List of Globally Threatened Animals and Plants
Birds Directive	(European Union)
Habitats Directive	(European Union)

Key to abbreviations:

App:	Appendix [followed by appendix number]
Ann:	Ann [followed by annex number]
Prop:	Proposed for inclusion into [followed by appendix/annex number]
SC:	Special Concern for Europe
GT	Globally threatened
LR	Lower risk
VU	Vulnerable
DD	Data deficient
CR	Critically Endangered
EN	Endangered
Ind	Indeterminate
X	Extinct

SPECIES	Bern	Bonn	SPA-BIM	ACCO-BAMS	Euro Bats	Vert RDB	IUCN RDB	IUCN MIPSG	Euro RDB	Birds Directive	Habitats Directive	Additional Comments
MAMMALS												
CETACEA												
Balaenoptera acutorostrata	App II		Ann I	Ann I							Ann IV	
Balaenoptera borealis	App II		Ann I	Ann I		EN					Ann IV	
Balaenoptera physalus	App II		Ann I	Ann I		EN					Ann IV	
Delphinus delphis	App II	App II[1]	Ann I	Ann I							Ann IV	
Eubalaena glacialis		App I	Ann I	Ann I		EN					Ann IV	
Globicephala melas	App II		Ann I	Ann I							Ann IV	
Grampus griseus	App II		Ann I	Ann I							Ann IV	
Kogia simus	App II		Ann I	Ann I							Ann IV	
Megaptera novaeangliae	App II	App I	Ann I	Ann I		VU					Ann IV	
Mesoplodon densirostris	App II		Ann I	Ann I							Ann IV	
Orcinus orca	App II		Ann I	Ann I							Ann IV	
Phocoena phocoena	App II		Ann I	Ann I		VU					Ann II & Ann IV	
Physeter macrocephalus	App II		Ann I	Ann I		VU					Ann IV	
Pseudorca crassidens	App II		Ann I	Ann I							Ann IV	
Sousa chinensis		App II									Ann IV	
Stenella coeruleoalba	App II	App II[2]	Ann I	Ann I							Ann IV	
Steno bredanensis	App II		Ann I	Ann I							Ann IV	
Tursiops truncatus	App II	App II[3]	Ann I	Ann I							Ann II & IV	
Ziphius cavirostris	App II		Ann I	Ann I							Ann IV	
CARNIVORA												

[1] Western Mediterranean populations
[2] Western Mediterranean populations
[3] Western Mediterranean populations

Mustela nivalis	App III										Ann IV	
Monachus monachus	App II	App II	Ann I								Ann II & IV	
											Ann IV	
CHIROPTERA											Ann IV	
Eptesicus serotinus	App II	App II			Yes						Ann IV	
Miniopterus schreibersi	App II	App II			Yes	SC	LR				Ann II & Ann IV	
Myotis blythi	App II	App II			Yes						Ann II & Ann IV	The local subspecies, *punicus*; is of biogeographical importance
Myotis capaccini	App II	App II			Yes						Ann II & Ann IV	
Myotis daubentonii	App II	App II			Yes						Ann IV	
Myotis myotis	App II	App II			Yes						Ann II & Ann IV	
Nyctalus noctula	App II	App II			Yes						Ann IV	
Pipistrellus kuhli	App II	App II			Yes	SC					Ann IV	
Pipistrellus pipistrellus	App III	App II			Yes						Ann IV	
Plecotus auritus	App II	App II			Yes						Ann IV	
Rhinolophus blasii	App II	App II			Yes	SC					Ann II & Ann IV	
Rhinolophus ferrumequinum	App II	App II			Yes	SC-VU	LR				Ann II & Ann IV	
Rhinolophus hipposideros	App II	App II			Yes	GT-VU	VU				Ann II & Ann IV	
Tadarida teniotis	App II								Rare		Ann IV	
Vespertilio murinus	App II	App II			Yes						Ann IV	

INSECTIVORA												
Atelerix algirus	App II										Ann IV	
Crocidura sicula	App III											
Suncus etruscus	App III											

<u>BIRDS</u>												
Calonectris diomedea	App II		Ann I			SC				Ann I		Good breeding stations at Ta' Cenc (Gozo) [800-1000 pairs] and Filfla, but also Rdum tal-Madonna [where it started breeding recently]. Breeding success seemingly declining
Hydrobates pelagicus	App II		Ann I			SC				Ann I		Filfla has one of the largest breeding colonies in the Mediterranean [5000-10000 pairs, but population is probably declining].
Monticola solitarius	App II					SC						Malta's National Bird
Muscicapa striata						SC						
Puffinus yelkouan	App II		Ann I									Mediterranean endemic; occurs locally as the subspecies *yelkouan*. Good breeding station at Rdum tal-Madonna (Ahrax) [c. 500 pairs] and at Ta' Cenc (Gozo).
Falco peregrinus						SC				Ann I		
Falco tinnunculus						SC						
Tyto alba						SC						

<u>REPTILES</u>												
Caretta caretta	App II	App I&II	Ann I			EN					Ann II & IV	
Chelonia mydas	App II	App	Ann I			EN					Ann IV	

		I&II										
Dermochelys coriacea	App II	App I&II	Ann I			EN					Ann IV	
Eretmochelys imbricata	App III	App I&II				CR					Ann IV	
Lepidochelys kempii	App III	App I&II	Ann I			CR					Ann IV	
Coluber algirus	App III					SC						Malta is the only European station
Coluber viridiflavus	App II										Ann IV	
Elaphe situla	App II										Ann II & IV	Occurs locally as the subspecies *leopardina*; which is of biogeographical interest.
Telescopus fallax	App II										Ann IV	Of biogeographical interest
Chamaeleo chamaeleon	App II					SC					Ann IV	
Chalcides ocellatus	App II										Ann IV	
Hemidactylus turcicus	App III											
Podarcis filfolensis	App II						NE (Rare in 1994 edition)		Rare		Ann IV	Sub-endemic; of biogeographic importance
Tarentola mauritanica	App III											
AMPHIBIANS												
Discoglossus pictus	App II										Ann IV	Sub-endemic; of biogeographical importance
<u>FISH</u>												
Alosa fallax	App III		Ann II								Ann II & V	
Anguilla anguilla	Prop App III		Ann II									
Aphanius fasciatus	App II		Ann I				DD				Ann II	Local populations appear to belong to a

												distinct race.
Cethorinus maximus	App II		Ann I									
Carcharodon carcharias	App II		Ann I									
Epinephelus marginatus	App III		Ann II									
Hippocampus hippocampus	App II		Ann I									
Hippocampus ramulosus	App II		Ann I									
Isurus oxyrinchus	App III		Ann II									
Lamna nasus	App III		Ann II									
Mobula mobular	App II		Ann II									
Petromyzon marinus	App III		Ann II								Ann IV	
Prionace glauca	App III		Ann II									
Raja alba	App III		Ann II									
Sciaena umbra	App III		Ann II									
Squatina squatina	App III		Ann II									
Thunnus thynnus	Prop App III		Ann II									
Umbrina cirrosa	App III		Ann II									
Xiphias gladius	Prop App III		Ann II									

PORIFERA												
Petrobiona massiliana	App II		Ann I								Ann V	

CNIDARIA												
Antipathes spp	App III		Ann II									
Astroides calycularis	App II		Ann I									
Corallium rubrum	App III		Ann II								Ann V	

CRUSTACEA												
Homarus gammarus	App III		Ann II									

Maja squinado	App III		Ann II									
Palinurus elephas	App III		Ann II									
Scyllarides latus	App III		Ann II								Ann V	
Scyllarides pygmaeus	App III		Ann II									
Scyllarus arctus	App III		Ann II									
<u>INSECTA</u>												
Cerambyx cerdo	App II						VU				Ann II & IV	
<u>ARACHNIDA</u>												
Nemesia arboricola	Prop App II											
<u>MOLLUSCA</u>												
Charonia rubicunda	App II		Ann I									
Charonia tritonis	App II		Ann I									
Dendropoma petraeum	App II		Ann I									
Erosaria spurca	App II		Ann I									
Gibbula nivosa	App II		Ann I									Endemic to the Maltese Islands.
Lampedusa imitatrix							VU					
Lampedusa melitensis	Prop App II						CR					
Latiaxis babelis							LR					
Lithophaga lithophaga	App II		Ann I								Ann IV	
Luria lurida	App II		Ann I									
Mitra zonata	App II		Ann I									
Muticaria macrostoma							LR					
Pholas dactylus	App II		Ann I									
Pinna nobilis			Ann I								Ann IV	
Pseudoamnicola							DD					A local population of *Mercuria* cf.

melitensis												*similis*
Ranella olearia	App II											
Schilderia achatidea	App II		Ann I									
Tonna galea	App II		Ann I									
Trochoidea gharlapsi							VU					
Trochoidea spratti							NE (Vulnerable in 1994 edition)					
Zonaria pyrum	App II		Ann I									

ECHINODERMATA												
Centrostephanus longispinus	App II		Ann I								Ann IV	
Ophidiaster ophidianus	App II		Ann I									
Paracentrotus lividus	App III		Ann II									

ALGAE												
Cystoseira spp	App I		Ann I									Many species of this genus are endemic to the Mediterranean
Goniolithon byssoides	App I		Ann I									
Lithophyllum lichenoides	App I		Ann I									Of biogeographical importance
Lithothamnium coralloides											Ann V	
Phymatholithon calcareum											Ann V	

LOWER PLANTS												
Petalophyllum ralfsii	App I										Ann II	Restricted Mediterranean distribution
Riella helicophylla	App I										Ann II	Restricted Mediterranean distribution
Sphagnum spp.											Ann V	

<u>HIGHER PLANTS</u>												
Allium lojaconoi							Rare					Endemic to the Maltese Islands
Anacamptis urvilleana							Rare		Ind			Endemic; of biogeographical importance.
Cremnophyton lanfrancoi							Rare	CR				Endemic to the Maltese Islands
Crepis pusilla							Rare					Of cultural and biogeographical importance
Cymodocea nodosa	App I		Ann I									
Darniella melitensis							Ind					Endemic to the Maltese Islands
Daucus lopadusanus							Ind					Subendemic (Malta, Comino, Lampedusa)
Elatine gussonei							Rare	CR				Subendemic (Malta, Lampedusa, Favignana)
Enarthrocarpus pterocarpus	Formerly App I											Restricted Distribution in the Mediterranean
Euphorbia dendroides												EMERALD Network [Priority Habitat]; Tertiary relict species
Helichrysum melitense								CR				Rarest of the Maltese endemic plant species.
Hymenolobus revelieri								CR				Locally as subspecies *sommieri* which is subendemic (Comino, Lampedusa, Marettimo, Favignana)
Iris sicula							Ind	CR				Subendemic (Malta, Sicily)
Limonium zeraphae							Rare					Endemic
Linaria pseudolaxiflora								CR				Subendemic (Maltese Islands, Linosa)

Matthiola incana ssp. *melitensis*							Rare					Endemic to the Maltese Islands
Ophrys lacaitae								locally CR				Subendemic (Malta, Sicily, S. Italy)
Ophrys lunulata	App I						VU	CR	EN		Ann II [Priority Species]; Ann IV	EMERALD Network [Draft Species List]. Subendemic (Malta, Sicily)
Orobanche densiflora forma *melitensis*							Rare					Endemic form of biogeographical importance
Palaeocyanus crassifolius							Rare	EN	Rare			Endemic; Malta's National Plant.
Posidonia oceanica	App I		Ann I									
Ranunculus bulbosus ssp. *adscendens* f. *macranthus*							X					Endemic to the Maltese Islands
Romulea melitensis							Ind	DD				Endemic to the Maltese Islands
Scilla sicula								VU				Subendemic (Malta, Sicily, Calabria)
Tetraclinis articulata							Rare					Malta's National Tree. Restricted Distribution in the Mediterranean.

Note: For purposes of calculations *Cystoseira* spp. are included as 4 species and *Anthipates* spp. are included as 1 species, although more occur.

3.1.2.4 Legislation Protecting Species

3.1.2.4.1 National Legislation On Protection Of Biodiversity

3.1.2.4.1.1 ENVIRONMENT PROTECTION ACT, 1991

Environment Protection Act, 1991 - Act V of 1991
Notice of coming into force - LN 37 of 1991
Commencement Notice - LN 244 of 1997

The Environment Protection Act, 1991 is the main law which empowers the Minister responsible for the Environment, and other Ministers, to make regulations to protect the environment. The following are the regulations regarding the protection of biodiversity made by virtue of the powers vested in the Minister by this Act.

?? **Environment Protection Act (Revocation of Laws Order), 1993 - LN 143 of 1993**

These regulations revoke all previous regulations in connection with the protection of birds and the wild rabbit in view of the new legislation to be enacted.

?? **Birds and Wild Rabbit (Declaration of Protected Species and Nature Reserves) Regulations, 1993 - LN 144 of 1993 as amended by LN 150 of 1993, LN 215 of 1997 and LN 106 of 1998.**

These regulations list avian protected species and the wild rabbit for the purposes of the law. The regulations also list all areas considered as nature reserves and delineate such areas on survey sheets, which form part of the regulations.

?? **The Protection of Birds and Wild Rabbit Regulations, 1993 - LN 146 of 1993 as amended by LN 45 of 1996, LN 23 of 1997, LN 216 of 1997 and LN 75 of 1998.**

These contain the main body of regulations protecting birds and the wild rabbit. The regulations list the species of birds that can be hunted and/or trapped. They also establish closed seasons and prohibited areas for hunting and/or trapping. Moreover they regulate the possession and sale of birds; methods, implements and licences for hunting and/or trapping as well as the practice of taxidermy, trap-shooting and bird-ringing. These regulations also introduce the *Carnet de Chasse* as a pre-requisite for obtaining trapping licences.

?? **Reptiles (Protection) Regulations, 1992 - LN 76 of 1992**

These regulations protect all terrestrial and marine reptiles recorded in the Maltese Islands that are listed in a schedule to the same regulations. The regulations prohibit the pursuing, capture, killing, possession, sale, import, export or exchange of the protected species listed.

?? **Marine Mammals (Protection) Regulations, 1992 - LN 77 of 1992 as amended by LN 155 of 1997.**

These regulations protect all marine mammals recorded in the Maltese territorial waters that are listed in a schedule to the same regulations. As in the case of reptiles these regulations prohibit the pursuing, capture, killing, possession, sale, import, export or exchange of the protected species listed. Moreover these regulations also prohibit the maltreatment of the species listed and define maltreatment as putting a specimen in a situation which is not natural in its life cycle, excluding dolphinaria or oceanaria which have the permission of the Director of the Environment Protection Department.

?? **LN 49 1993 Flora and Fauna Protection Regulations, 1993**

These regulations protect a number of species of flora and fauna that are listed in two schedules to the same regulations. The regulations prohibit the pursuing, capture, killing, possession, sale, import, export or exchange of the protected species of fauna and also prohibit any disturbance of the species particularly during their breeding, rearing and hibernation periods. With regards to the species of flora the regulations prohibit the cutting, uprooting, damaging, sale, import or export of any of the protected species.

Note: *All the above regulations were drawn up in the light of the Council of Europe's Convention on the Conservation of European Wildlife and their Natural Habitats (Bern Convention). However, with regards to birds a reservation and an exception to the Convention were placed. The former was made to allow for the trapping of finches in autumn whilst the latter was made to allow for the trapping of finches in spring.*

?? **Fungus Rock (il-Gebla tal-General) Nature Reserve Regulations, 1992 - LN 22 of 1992 .**
?? **Selmunett Islands (St. Paul's Islands) Nature Reserve Regulations, 1993 - LN 25 of 1993.**

These regulations establish Fungus Rock and Selmunett Islands as nature reserves and prohibit the killing, capture, collecting, trapping, keeping in captivity, taxidermy, commercial exploitation, picking and hunting of any species of flora and fauna in or from the above mentioned islands. Climbing and access to the plateau surface of Fungus Rock is prohibited whilst access to Selmunett Islands is restricted to between sunrise and sunset and along designated footpaths.

?? **Trade in Species of Fauna and Flora Regulations, 1992 - LN 19 of 1992 as amended by LN 96 of 1992, LN 22 of 1995 and LN 140 of 1997.**

These regulations were drawn up to enable the enforcement of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The species that are governed by this convention are divided in three separate appendices depending on the kind of controls which apply to them. These regulations also incorporate in a schedule the whole text of the above-mentioned convention.

?? **Rubble Walls and Rural Structures (Conservation and Maintenance) Regulations, 1997 - LN 160 of 1997**

These regulations protect rubble walls and non-habitable rural structures in view of their vital importance in the conservation of the soil and water as well as due to their importance in providing a habitat for flora and fauna. These structures are also protected for their historical, architectural and aesthetic value.

?? **Motor Vehicles (Offroading) Regulations, 1997 - LN 196 of 1997**

These regulations regulate offroading by restricting it to particular sites.

3.1.2.4.1.2 Other Acts

Filfla Nature Reserve Act, 1988 - Act XV of 1988

This Act establishes the island of Filfla as a nature reserve and prohibits the killing, capture, collecting, trapping, keeping in captivity, taxidermy, commercial exploitation, picking and hunting of any species of flora and fauna in or from Filfla. Access to the island is also prohibited.

3.1.2.4.1.3 Regulations Made By Virtue Of Other Laws

Flora

Conifer Trees (Preservation) Regulations, 1949 - GN 328 of 1949 (Code of Police Laws)

These regulations are administered by Department of Agriculture and deal with the cutting down, uprooting and removal of any conifer tree of the genus *Pinus*.

Government notice establishing trees having antiquarian importance in the sense of Art.3 of the Antiquities Act, 1925 - GN 269 of 1933.

These regulations protect specified old trees.

Regulations protecting *Thymus capitatus* - GN 35 of 1932 (Police Laws)

These regulations are administered by the Department of Agriculture and regulate the exploitation of wild thyme.

Other

Fees (Certificates under the Convention on International Trade in Endangered Species of Wild Fauna and Flora) Regulations, 1997 - LN 150 OF 1997 (Fees Ordinance - Cap. 35)

These regulations are administered jointly by the Minister of Finance and Commerce and the Deputy Prime Minister, Minister of Foreign Affairs and the Environment (using the nomenclature in the original regulations). They establish the fee payable for the issue of permits or certificates required by the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

Hunting Licences Regulations, 1993 - LN 145 of 1993 as amended by LN 44 of 1996 and LN 221 of 1997 (Code of Police Laws - Chapter 10)

These regulations are administered by the Commissioner of Police and establish conditions for the issuing and renewal of a hunting licence. These regulations also introduce the *Carnet de Chasse* as a pre-requisite for obtaining a hunting licence.

Police Licences (Amendment) (No.3) Regulations, 1997 - LN 240 of 1997 (Police Licences Act - Cap. 128)

These regulations establish fees levied with respect to the possession and use of shotguns, the taking of birds and the wild rabbit, bird-ringing and taxidermy.

Development Planning Act 1992 and Related Legislation

Although this legislation does not have to do directly with the protection of species, indirectly it is very important in terms of conservation of species since it protects habitats and sites. This legislation will be treated fully in section 3.2.1.7.2.

3.1.2.4.2 International Legislation

The main international treaties concerned with the protection of endangered species are the Ramsar, Washington (CITES), Bonn, and Bern Conventions, and the Geneva protocol on Mediterranean Specially Protected Areas. Previous to 1987, Malta was not party to any of these. In January 1988 Malta acceded to the 1982 Geneva Protocol on Mediterranean Specially Protected Areas. In September of the same year it acceded to the Convention on Wetlands of International Importance, especially as Waterfowl Habitats (Ramsar, 1971), declaring the Ghadira Reserve as a wetland of international importance. In April 1989 Malta acceded to the 1973 Washington Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), while in November of 1993 it acceded to the Convention on the Conservation of European Wildlife and Natural Habitats (Bern, 1982).

The present status of Malta in relation to these treaties is given in Table 3.2.7. For information on the Geneva Protocol, Ramsar, Berne, the European Community's 'Habitats Directive', Bonn and the Convention on Biological Diversity, see Section 2.7 (Habitats of international importance).

The CITES Convention

The Convention on International Trade in Endangered Species of Wild Flora and Fauna, also known as CITES or the Washington Convention, entered into force on 1 July on 1975. It establishes a worldwide system of control on international trade in threatened wildlife and wildlife products, requiring permits issued by Governments for trade in a number of species of flora and fauna. The United Nations Environment Programme – UNEP – provides the secretariat of this convention.

The convention has three appendices. Appendix 1 lists species which are threatened with extinction and which are or may be affected by trade. No permits are issued for trade in such species. Among the species listed in this appendix and which are frequently imported into Malta are parrots, crocodiles (derivatives), cacti and orchids.

Appendix II lists species that might become endangered if trade in them is not controlled and monitored. To prevent threatened species from being traded under the guise of non-threatened species similar in appearance, some also non-threatened species are included in this appendix. Species listed in Appendix II can be traded but with proper documentation issued by the Government of the exporting country. In addition, countries may enforce even stricter control than that required by CITES, if they wish to give special protection to a species, and such species are listed in Appendix III of the Convention. Any trade in an Appendix III species with the country that made the listing has to be accompanied by documentation from that country.

The CITES convention is the second nature conservation convention which was acceded to by Malta; Malta acceded to this convention on 17 April 1989, and it entered in force locally on 16 July 1989. Regulations to honour the obligations of the Convention were published on 4 February 1992 as Legal Notice 19 of 1992. These were subsequently amended three times to include amendments to the appendices approved by the Conference of the Parties of CITES. However, the local regulations do not cover species in transit as provided for by the Convention.

3.1.3 Aliens

The introduction of alien species into local ecosystems is of increasing concern, especially now that human activities have greatly increased the potential for invasion.

Definitions

indigenous (or native)	occurs naturally in a particular place
exotic	does not form part of the original indigenous biota
introduced	exotic which enters an ecosystem through human agency, accidental or deliberate
adventive	exotic capable of reproducing without deliberate human intervention
naturalised	adventive which has become firmly established outside its native range
casual	adventive which establishes short-lived populations outside its native range or which only appears sporadically due to chance
archaeophytes (opposite = neophytes) archaeozoic (opposite = neozoic)	plants and animals introduced in antiquity; in Europe, the end of the 15th Century is generally accepted as the cut-off point

The term 'alien' is used interchangeably for 'exotic', 'introduced' and 'adventive'.

3.1.3.1 The Extent Of The Problem

A huge variety of alien species have been introduced over the years into the Maltese Islands. The ways in which these species have gained access is equally diverse and are summarised in Table 3.1.7.

Table 3.1.7
The modes of introduction of alien species into the Maltese Islands that are known or are suspected to have operated, with examples to illustrate the variety of species that have gained access.

<u>Mode of introduction</u>	**<u>Examples</u>**
Deliberate introduction for agriculture and aquaculture	In the mid-1970s spat of the oysters *Ostrea edulis* and *Crassostrea gigas* was imported from Anglesey, Wales. *Crassostrea gigas* is still occasionally met with in the wild along the Maltese coast
Deliberate importation for commercial purposes:	
?? Ornamental plants	Castor oil tree *Ricinus communis,* is an important escaped ornamental in the Maltese Islands Tree House-Leek, Aeonium arboreum, and Brazilian Pepper, Schinus terebinthifolius, are both naturalised alien species which have established important self-sustainable populations in the Maltese countryside.
?? The aquarium trade	The natural range of the freshwater snail *Helisoma duryi* is the southern parts of the United States of America. It was introduced into the Maltese Islands as an aquarium snail and is now found in private and public garden ponds. In 1986, a large population of this species was discovered at Wied

	il-Luq, Buskett, but this population disappeared in 1988.
Deliberate importation for scientific purposes	The Cape sorrel *Oxalis pes-caprae*, now the commonest plant in the Maltese Islands, was introduced in the beginning of the 19th Century at the Argotti botanical gardens. There is circumstantial evidence to suggest that the Narrow-Leaved Aster, Aster squamatus was originally introduced in the Argotti Botanical Gardens from where it escaped.
Deliberate introduction for biological control programmes	The ladybird *Rodolia cardinalis*, a common species in the Maltese Islands, is a native of Australia and was imported into Europe for biological control of scale insects. It was introduced into Malta from Portici (Naples) in 1911 to control infested gardens at St.Julians In the past ten years a number of exotic insects introduced for biological control, including: ?? *Dacnusa sibirica* and *Diglyphus isaea* for the control of leaf miners ?? *Encarsia formosa, Eretmocerus californicus* and *Macrolophus caliginosus* and for the control of the sweet potato whitefly *Bemisia tabaci*, ?? *Cales noacki* for the control of the citrus whitefly *Aleurothrixus floccosus*; ?? *Orius laevigatus*, *Orius insidiosus*, *Amblyseius cucumeris* for the control of thrips ?? *Aphidius colemani* and *Aphidoletes aphidimyza* for the control of aphids in greenhouses ?? *Phytoseiulus persimilis* for the control of red spider mite
Accidental importation with other species	?? The cottony cushion scale insect *Icerya purchasi*, a pest of citrus and other fruit trees reached Malta from Sicily in 1907 with imported ornamental plants . ?? The citrus whitefly *Aleurothrixus floccosus* was introduced around 1985. ?? The sweet potato whitefly *Bemisia tabaci* was introduced around 1993.
Accidental importation with food or other natural products:	
? Weeds imported with birdseed and crop seeds	Birdseed (e.g. canary grass, *Phalaris canariensis*) itself often escapes and naturalises, but it also often includes contaminant species, for example, *Centaurea diluta*, which has become naturalised in disturbed areas at least since the 1960s. A type of cockspur, *Echinochloa frumentacea*, also occurs occasionally in the wild, as result of it being present as a contaminant in seed mixtures. An exotic species of leech (possibly *Limnatis*

? Accidental importation with domestic animals	*nilotica*) used to occur in public animal drinking troughs at Birkirkara in the 1930s. This originated from the inside of the mouth and nasal passages of cattle imported from North Africa.
?? Accidental importation with ornamental plants	Examples include: The gallant soldier *Galinsoga parviflora*, the liverwort *Marchantia polymorpha* and the mushroom *Leucocoprinus birnbaumii*, as well as the giant terrestrial flatworm *Bipalium kewense*. Most of these can only survive in a greenhouse, however, *Galinsoga parviflora* seems to be a good candidate for naturalisation on disturbed ground.
?? Accidental importation with wood products	At least four species of cerambycid beetles have been imp orted into the Maltese Islands with wood products: *Rosalia alpina*, a European species imported with ash logs; *Morimus asper*, a common Italian species whose larvae feed on poplar and elm, imported into the Maltese Islands with firewood at Marsa; *Cordylomera spinicornis*, a West African species, collected from Santa Venera from imported logs.
Accidental introduction due to shipping: ?? Fouling species (sessile or vagile)	In 1977 two marine bryozoans not previously recorded from the Mediterranean were discovered fouling the cages of an oyster farm at Rinella: *Celleporaria pilaefera*, an Indo-West Pacific species, and *Celleporaria aperta*, which has a world -wide warm-water distribution.
?? Species which are taken on board with ballast water	An adult specimen of the Indian Ocean sea urchin *Prionocidaris baculosa* was collected from the ballast tank of a ship undergoing repairs in the Malta Dockyards in 1976.
Accidental importation with cargo	The Algerian whip snake *Coluber algirus* and the cat snake *Telescopus fallax* may have been introduced into Malta with shipments of firewood during the first World War and became established in the vicinity of the then fuel-yard at Floriana. The snake *Natrix natrix* was collected from Floriana after an Italian circus left from the area.
Discarding into the environment of deliberately imported species.	Examples include: algae (and accompanying micro -biota) used as packing material; mosses imported for use as 'vegetation' on Christmas cribs; species used as live bait for fishing; live food for captive animals. Pruned ornamental plants are often discarded in the wild. As a result, species like *Aptenia cordifolia*, *Carpobrotus edulis* and various *Pelargonium*, may be found in the wild. The former two are becoming serious invasive pes ts.

	A number of birds have been released on Comino by an inhabitant, including: Bobwhite, *Colinus virginianus* (essentially a Central American bird); the Chukar Partridge, *Alectoris chukar* (an Asian species extending to the Balkan peninsula and adjacent Mediterranean islands of the Aegean, Crete and Cyprus); and the Pheasant, *Phasianus colchicus* (essentaily an Asian species).
	The deliberate planting of potentially invasive non-native species in the Maltese countryside, e.g. deliberate planting of the Mediterranean Oriental Plane (*Platanus orientalis*) at Wied il-Hmar [l/o Gnejna]; that of the Arizona Cypress (*Cupressus arizonica*) at Wied Ghollieqa; that of *Bryophyllum* sp. (a succulent potentially highly invasive due to the high production of plantlets by vegetative propagation) at Il-Maghluq ta' Marsaxlokk.
Escape from captivity, for example from menageries or aquaria	The chameleon *Chamaeleo chamaeleon* was originally introduced as a pet escaped from St.Julians
Expansion of the range of Lessepsian immigrants	The Red Sea sea-grass *Halophila stipulacea* entered the Mediterranean after the opening of the Suez Canal in 1869 and spread westwards, partially aided by shipping, reaching the Maltese Islands around 1970.
	Other Red Sea immigrants now found in the Maltese Islands include: the alga *Caulerpa racemosa*; the opistobranch mollusc *Bursatella leachi*; the Shrimp Cad (a fish) *Alepes djedaba*; the Blunt Jaw Barracuda (fish) *Sphyraena chrysotaenia*, and probably other species.

3.1.3.2 Impact Of Aliens On Local Biota And Habitats

The effect of introduced species may be neutral, positive or negative.

+ Neutral	The introduced species finds an unoccupied niche and integrates well with local ecosystems, causing no disruption.

Case study: the Mediterranean chameleon *Chamaeleo chamaeleon* in the Maltese Islands

This arboreal lizard was introduced from North Africa between 1846 and 1865 and released in the gardens of a large house at St.Julians. From there it has spread and it now occurs in the wild all over Malta and also in Gozo and Comino. It does not seems to have caused any negative effects on any local species or ecosystem, perhaps because there is not native organism that occupies an identical or even similar niche to the chameleon and its population size has remained overall quite small.

+ Positive	Some introductions are necessary and beneficial to human society, for example:

?? crop plants

?? domestic animals

?? aquaculture species
?? biological control agents
?? ornamental plants
?? economically important species

+ Negative — Some introduced species have the potential for becoming nuisances. Possible negative effects result if the introduced species:

?? are pathogenic
?? are or become vectors for pathogens
?? become pests
?? seriously compete with species of economical importance
?? disrupt ecosystems which has been shaped by thousands of years of evolution (through competition, predation, parasitism, allelopathic effects)
?? cause extinction of unique variants and therefore irreparable loss of genetic diversity and loss of the natural heritage
?? adversely affect the aesthetic quality of traditional landscapes.

Hundreds of species have been introduced into the Maltese Islands over the millennia and of these relatively few have managed to establish themselves and fewer still have become fully naturalised. However, some of those that have established themselves, have had significant impacts on local biota and ecosystems.

Examples of impacts that introduced species have had on the ecosystems, habitats and biocoenoses of the Maltese Islands are given in Table 3.1.8.

Table 3.1.8
Examples of impacts which introduced species have had on the ecosystems, habitats and biocoenoses of the Maltese Islands

System impacted	**Alien species concerned**	**Impacts**
Garigue communities on karstland	African cornflag, *Chasmanthe aethiopica*	Become naturalised in these communities and compete with native species
	Common freesia, *Freesia refracta*	
	Sweet garlic, *Nothoscordum inodorum*	
	Shrubby putterlick, *Pittosporum tobira* (a *common* hedge shrub that often escapes)	Naturalised in some valleys including Xlendi Valley (Gozo), Wied Harq Hamiem and Wied il-Kbir (l/o Swieqi)
	Century plants, *Agave* spp.	Naturalised in many parts of the Maltese Islands. Particularly invasive at Bahar ic-Caghak to Ghallis/Qalet Marku coastal strip.
Maquis communities	Prickly pear *Opuntia ficus-barbarica* [= *O. ficus-indica*] (introduced into the Maltese	Becomes fully naturalised in these communities which are rare, especially in their primary

	Islands at beginning of the 16th Century for fruit, fodder and use as a hedge plant)	form, and compete with native species
	Coastal wattle, *Acacia karroo*	Originally introduced for ornamental reasons, and has become naturalised in many places, e.g. Ghallis and various parts of the Marfa Peninsula.
Valley watercourses	*Xanthium strumarium*	Dense populations of this adventive at Wied il-Qlejgha and Wied il-Ghasel.
	Paspalum paspaloides	Dense populations of this adventive at Wied il-Lunzjata and Wied tax-Xlendi (Gozo), Marsa and San Martin
	False pepper *Schinus terebinthifolius*	Naturalised at Wied Harq Hamiem and Wied il-Lunzjata (Gozo)
	Marvels of Peru, *Mirabilis jalapa* and *M. odorata*	Naturalised, sometimes forming dense populations as at Wied Harq Hamiem (Pembroke) and Wied il-Ghajn. Recently observed at Bahrija.
	Zantedeschia aethiopica	Naturalised as at Bahrija and Wied Harq Hamiem.
	Narrow-leaved aster, *Aster squamatus*	Common along watercourses
Cliffs	Kaffir fig *Carpobrotus edulis* (a South African succulent widely cultivated as a ground cover which often 'escapes')	Competition with native species growing in this habitat, possibly the most important in the Maltese Islands For example, at Ta'Cenc
	Century plant, Agave americana	
	Prickly pear, *Opuntia ficus-barbarica*	
Sand dunes	Blue wattle Acacia cyanophylla (planted extensively during the 1960s and 70s; regenerates from seed)	Has become invasive in the sand dune of Ghadira and is displacing native dune species
	Aptenia cordifolia	Naturalised at Ramla tat-Torri
	Kaffir fig, *Carpobrotus edulis*	Invasive in some dunes, and is increasing in others, e.g. parts of Ramla tal-Mixquqa

Saline marshlands	Narrow-leaved aster, *Aster squamatus*	Invasion by this weedy species which has a high salt tolerance.
Countryside in general	Cape sorrel *Oxalis pes-caprae* (ubiquitous weed) Narrow-leaved aster, *Aster squamatus* (humid and sheltered soils)	Competition with native species and prevent the re-establishment of native species on disturbed habitats.
	Glaucous Tobacco *Nicotiana glauca* (building rubble and in rubble filled crevices)	
	Tree-of-Heaven, *Ailanthus altissima* (planted and naturalised in various sites)	
	Wattles, *Acacia cyanophylla* and *Acacia karroo* (planted and naturalised in various sites)	
	Castor oil *Ricinus communis* (disturbed ground)	
	Eucalypts *Eucalyptus camaldulensis* and *Eucalyptus gomphocephala* (planted extensively in natural contexts)	Drain soil water and their leaf litter prevents other species from growing
Agriculture	Citrus whitefly *Aleurothrixus floccosus* (introduced around 1985)	Important pest of citrus trees
	Sweet potato whitefly *Bemisia tabaci* (introduced around 1993)	Serious pest of tomatoes and other greenhouse crops and a vector for the tomato yellow leaf curl virus
Aquaculture	*Crepidula fornicata* (marine snail native to the Atlantic coast of North America introduced with oysters to the western Mediterranean and known from Marsaxlokk and Marsamxett harbours	Serious nuisance to oyster and mussel as it competes for space and food. At present it occurs at low population densities in Maltese waters, however if bivalve culture becomes important locally, it has the potential to become a serious pest
Others	Argentine Fire Ant *Iridomyrmex humilis* (introduced and now widespread	Successful competitor and has displaced native species of ants

in the Maltese Islands)

Undisturbed ecosystems are inherently resistant to invasion by exotics, however this capacity is reduced in ecosystems that are disturbed. Such disturbance may be natural, but is usually due to human activity. Many successful introductions have appeared first in ecosystems that are not in equilibrium or are stressed, or are by nature highly labile and/ or are much subject to human interference for example:

- ?? agroecosystems
- ?? habitats suffering from periodic disturbance
- ?? habitats undergoing succession
- ?? harbours
- ?? polluted environments
- ?? engineered environments

In the Maltese Islands most exotics which have become established first gained a foothold in such disturbed ecosystems which include:

- ?? inhabited areas
- ?? gardens
- ?? fields
- ?? land cleared of its natural vegetation cover
- ?? harbours
- ?? valleys subjected to dredging

The chances of invading exotics successfully establishing themselves in the Maltese Islands are now much greater because:

- ?? Local ecosystems and habitats are small-scale and are easily disturbed even by minor interventions;
- ?? Many local habitats are already disturbed or stressed either naturally or due to anthropogenic factors;
- ?? Lack of knowledge often results in ‘embellishment’ projects that make use of inappropriate species and/or cause severe disturbance to natural ecosystems;
- ?? The opportunities for exotic species to reach the Maltese Islands have increased due to
    - ?? increasing commercial activity;
    - ?? more efficient transportation which has become accessible to a wider variety of people; and
    - ?? an increase in the general standard of living

Case study: Exotic pets in the Maltese Islands

Many Maltese have acquired a taste for keeping exotic fauna and flora. The Environment Protection Department has received requests for permits to import more than 100 different species of exotic animals, including reptiles, amphibians, spiders, scorpions, land crabs, crayfish and others.

3.1.3.3 Legislation Regulating Aliens

3.1.3.3.1 Local Legislation

Existing regulations are mainly aimed at preventing the introduction of diseases or pests affecting domestic plants and animals and at protecting human health. There is no specific legislation on alien species. However, Legal Notice 19 of 1992, issued under the provisions of the Environment Protection Act (Act V of 1991), includes two provisions that partially concern the introduction of aliens:

> Article 7(1):
> "The Scientific Authority and the Management Authority shall advise the Minister [responsible for the environment] to prohibit trade in any species of fauna and flora if in their opinion, or in the opinion of any one of them, such trade would endanger the biological identity of these islands and their waters."
>
> Article 7(2):
> "The Scientific Authority and the Management Authority shall advise the Minister [responsible for the environment] to prohibit trade in any species of fauna and flora if in their opinion, or in the opinion of any one of them, such trade would endanger any ecosystem or any species of fauna or flora."

3.1.3.3.2 International Legislation

Recommendations 45 of 1995, 57 of 1997 and 58 of 1997 of the Bern Convention, to which Malta is party, deal with aspects of the introduction and re-introduction of alien species. Article 8h of the Convention on Biological Diversity, which Malta has signed but not ratified, also concerns alien species.

3.1.3.4 Recommendations Regarding Alien Species

It is not being suggested that long established introduced species that are now part of the ecosystem be eliminated. Such species are:

?? archaeophytic and archaeozoic species
?? long-established species with no observable negative effects on the ecosystem (e.g. chameleon, introduced snakes, some plants).

However, it is recommended that recently introduced species be removed, especially

?? those with clear-cut negative effects
?? those which have still not gained a strong foothold on the islands
?? those which are capable of invading natural communities.

It is especially important to guard against the importation of alien stock of indigenous species, because although conspecific, these would rarely be identical since geographical races tend to evolve, especially on islands. Maltese strains are therefore unique genetic entities.

Care should also be taken when introducing species closely related to native ones since these may hybridise and pollute the local gene pool.

Case study: Introgression in Maltese species

Introgression is when two related species hybridise leading to replacement of both parents by a single hybrid species (in a sense, the opposite of speciation)

Elms, *Ulmus* spp.:
U.minor and *U.procera* are introduced, naturalised species. These hybridise freely with the very rare native Hoary/Grey-leaved Elm, *Ulmus canescens*. Hybrids are also interfertile. It is strongly suspected that only the Wied ir-Rum population of the native elm is now genetically pure.

Rye-Grasses, *Lolium* spp.:
L.*rigidum* is native while *L.multiflorum* is presumably introduced. Very often, plants of the Maltese Islands belong to the hybrid *L.* x *hubbardi*.

Pines, *Pinus* spp.:
Aleppo Pine, *P. halepensis*, is the native species. Brutia/Calabrian Pine, *P. brutia*, was introduced from the eastern Mediterranean. These two species form hybrids which are known to resist diseases and drought better than either parent. Hybrid pines have not been observed with certainty in the Maltese Islands, although they are suspected to occur since *P. brutia* has become naturalised in the Maltese Islands (as at Wied il-Kbir l/o Swieqi), and is widely planted (e.g. in the University grounds).

It is important to guard against known harmful invaders of other Mediterranean countries that have not yet reached the Maltese Islands. Such species include:

- ?? invasive caulerpae (seaweed), like the assassin weed *Caulerpa taxifolia* and *Caulerpa racemosa*
- ?? the japweed *Sargassum muticum*
- ?? Silverleaf Nightshade, *Solanum elaeagnifolium*: which is a serious agricultural and environmental pest in the Maghreb, and is expanding its range. It has also reached the Maltese Islands where it is still very rare.

Particular attention should also be paid to species native of regions with Mediterranean climates:

-- Cape Province of South Africa
-- south-western Australia
-- central California
-- central Chile

If introduced these are more likely to become invasive than others since they are pre-adapted to the climatic regime prevailing in the Maltese Islands

Genetically modified organisms (GMOs) are another potential threat to natural ecosystems and their biota.

There is a need for existing legislation to be augmented and extended to protect local biodiversity and ecosystems.

BACK TO CONTENTS

3.2. Habitats and Biocoenoses

Biocoenosis (or biotic community) is a general ecological term for any naturally occurring group of organisms inhabiting a common environment, which is known as their biotope or habitat. The habitat of a species is that set of locations that satisfies the niche requirements of the species.

3.2.1 Terrestrial Habitats And Biocoenoses

The terrestrial biocoenoses of the Maltese Islands may be grouped in three categories:

- ?? Major communities that are part of the successional sequence towards the climatic climax.
- ?? Minor communities which are either specialised to occupy particular habitats, or occupy habitats that are rare in the islands, or are relics from a previous ecological regime, now surviving in a few refugia.
- ?? Biocoenoses that owe their existence to anthropic activities.

Descriptions of Maltese terrestrial biocoenoses are based mainly on vegetation. Figs 2.1 to 2.7 show the distribution and location of the various habitat types and biocoenoses described below.

3.2.1.1 Biocoenoses That Are Part Of The Successional Sequence

? Woodland

It is thought that before man colonised the Maltese Islands, large areas were covered with Mediterranean Sclerophyll Forest, which is the highest type of vegetation that can develop in the Mediterranean climatic regime. In the central Mediterranean this forest is characterised by Holm Oak (*Quercus ilex*) and Aleppo Pine (*Pinus halepensis*) with an undergrowth of smaller trees, shrubs and climbers. The early settlers cut the trees for their wood and to clear the land for agriculture and buildings. Additionally, these colonisers introduced sheep and goats to the islands, whose grazing causes some damage to mature trees but more importantly prevents them from regenerating. In the Maltese Islands, the native forest is all but extinct and only remnants remain at four localities (Ballut tal-Wardija, Ballut ta' l-Imgiebah, Ta' Baldu/Wied Hazrun, and Il-Bosk near Buskett) all on the island of Malta. These forest remnants take the form of small copses of Holm Oak where the total number of trees is often less than thirty. Some of these trees are estimated to be between 500 and 900 years old.

? Maquis

Maquis is a more or less dense, mostly evergreen shrub community where the individual shrubs reach a height of between 1m and 3m. In Malta, a semi-natural maquis develops in relatively inaccessible sites such as the sides of steep valleys and at the foot of escarpments and *rdum*, while a secondary maquis develops round trees, mainly olives and carobs, planted by man.

The local maquis is characterised by a number of small shrubs principally Carob (*Ceratonia siliqua*), Olive (*Olea europaea*), Lentisk (*Pistacia lentiscus*), Mediterranean Buckthorn (*Rhamnus alaternus*), Hawthorns (*Crataegus* spp.), Bay Laurel (*Laurus nobilis*) and others.

Various subtypes of maquis occur, some of which (e.g. those based upon *Myrtus communis*, *Spartium junceum* and *Tetraclinis articulata*) are very rare and threatened.

? Garigue

Garigue (or garrigue) is a community of low (less than 1m) scattered, often spiny and aromatic shrubs with a herbaceous undergrowth. This is the most common natural vegetation type present in Malta. Some garigue communities are natural edaphic climaxes, others result from degradation of forest and maquis. Garigues are typical of rocky ground, particularly karstland, and are characterised by such species as Mediterranean Thyme (*Thymus capitatus*), Yellow Kidney-vetch (*Anthyllis hermanniae*), Tree Germander (*Teucrium fruticans*), Mediterranean Heath (*Erica multiflora*), Tree Spurge (*Euphorbia dendroides*), Olive-Leaved Bindweed (*Convolvulus oleifolius*) and the endemic Maltese Spurge (*Euphorbia melitensis*), accompanied by numerous geophytes (herbs with perennating buds below soil level) and therophytes (herbs which survive the unfavourable season as seeds).

Many subtypes of garigue exist, including Erica garigue (dominated by the Mediterranean Heath *Erica multiflora*), Thyme garigue (dominated by Mediterranean Thyme *Thymus capitatus*), Anthyllis garigue (dominatd by Shrubby Kidney-vetch (*Anthyllis hermanniae*) and, less commonly, Euphorbia melitensis garigue (dominated by the endemic Maltese Spurge *Euphorbia melitensis*). Other types (for example, Tree-spurge garigue) and mixed garigues also occur (for example, various combinations of Erica/Thymus/Anthyllis/Euphorbia garigues, and even all four together).

It is useful to distinguish between high and low garigues since there are marked structural difference between the two. Low garigues are characterised by low-growing bushes (less that 0.5m high) while high garigues are dominated by large bushes of up to 1m height. Anthyllis garigue can occur as both low and high varieties while an important type of high garigue is that dominated by Tree-spurge (*Euphorbia dendroides*) which normally occurs on steep rocky ground.

? Steppic grassland

This is a treeless grassland dominated by grasses, umbellifers, thistles and geophytes. Steppic grasslands are widespread and result from degradation of the maquis and garigue, mainly due to grazing, but also in response to other factors. Some steppic communities are, however, climactic or semi-climactic, for example, those dominated by Esparto Grass (*Lygeum spartum*) which develop on clay slopes. The more degraded steppes are characterised by Common Awn-grass (*Stipa capensis*), Aegilops (*Aegilops geniculata*) and a variety of thistles (e.g. Clustered Carline Thistle *Carlina involucrata*, Horse Thistle *Notobasis syriaca*, Mediterranean Thistle *Galactites tomentosa*) and geophytes (e.g. Asphodel *Asphodelus aestivus*, Seaside Squill *Urginea pancration*) and Sicilain Squill (*Scilla sicula*). Other steppic communities may also develop on abandoned agricultural land.

3.2.1.2 Specialised Biocoenoses

? Coastal communities

Saline marshlands
Saline marshlands form an interface between the marine, freshwater and terrestrial environments. Maltese coastal marshes are characterised by a muddy substratum on which a pool of brackish water collects in the wet season. During the dry season this water becomes progressively more brackish until it finally disappears completely, leaving the marsh dry until the following wet season. Because of these harsh environmental conditions, saline marshlands support a highly specialised biota that is only found in this type of habitat. Although several species are common to all local marshlands, yet each site has its own peculiar habitat characteristics and suite of species.

Transitional coastal wetlands
Some coastal wetlands appear to be transitional between freshwater wetlands and saline marshlands in the sense that the biotic assemblages they support consist of species typical of both freshwater and saline habitats. Such wetlands have been termed 'transitional coastal wetlands'. Such wetlands arise when rainwater collects in depressions close to the sea. Under appropriate conditions, these pools become colonised by species typical of freshwater and which have some degree of tolerance to maritime influence. During the dry period, the only water arriving in these depressions is seawater carried by wind and wave

action; conditions therefore favour brackish water species. The same habitat therefore supports different suites of species at different periods of the annual cycle. Some long-lived and tolerant brackish water species (mainly plants) may persist throughout the freshwater phase, giving rise to the specific biota which characterise such wetlands. The most important of such wetlands are Ghadira s-Safra, on the northeast coast of Malta between Maghtab and Ghallis, the Qammieh pools, and Il-Qattara on Gozo.

Sand dunes

Many local sandy beaches were backed by dune systems, but at present only very few still persist and even these have been much degraded due mainly to human activities connected with beach development for touristic purposes and with recreational use. Sand dune ecosystems are thus amongst the rarest and most threatened of local ecosystems. . Local dunes are dominated by the dune grasses *Elytrigia juncea* and *Sporobolus pungens*, and, until recently, also by Southern Marram Grass (*Ammophila littoralis*) which has now been totally extirpated.

Case study: Ramla l-Hamra dunes, Gozo

Due to its extent, species richness and ecosystem stability, this is the most important dune ecosystem of the Maltese Islands and in spite of the fact that it has suffered much disturbance in recent years, it still includes most of the recorded dune species, including a number found only here and nowhere else in the Maltese Islands.

The main sand binders at Ramla are the Sand Couch and the Dropwort grass. These are accompanied by other typical sand dune species such as the Spiny Echinophora (*Echinophora spinosa* - RDB 25: endangered) which occurs only in one other locality in Malta, the Sea Daffodil (*Pancratium maritimum* - RDB 40: vulnerable), the Sea Holly (*Eryngium maritimum* - RDB 25: vulnerable), and the Sea Spurge (*Euphorbia paralias* - RDB 22: endangered), the Coast Spurge (*Euphorbia terracina* - RDB 22: vulnerable) and the Purple Spurge (*Euphorbia peplis* - RDB 22: endangered), which is now restricted to Ramla Bay. Also common are the Sea Medick (*Medicago marina* - RDB 19: vulnerable), Sea Kale (*Cakile maritima*) and the annual Sand Fern Grass (*Cutandia maritima* - RDB 43: rare). Rarer species include the Sand Restharrow (Ononis *variegata* - RDB 19: endangered) which occurs only in this locality, and the Sand Carrot (*Pseudorlaya pumila* - RDB 25: endangered). An unusual and very rare sand-dwelling mushroom, *Montagnites arenaria* (RDB 54: endangered) is also known only from this locality. The dune is traversed by a belt of the African Tamarisk (*Tamarix africana* - RDB 23: rare). Clumps of Tamarisk also skirt the easternmost part of the bay. In this area, isolated shrubs of the Chaste Tree (*Vitex agnus-castus* - RDB 29: rare) also occur. This shrub, having habitat requirements similar to those of the Tamarisk, occurs mainly in Gozo, but is very rare in Malta.

Among the more important animal species one finds: two endemic collembolans, *Odontellina sexoculata* and *Mesophorus schembrii*, to date, both known only from the Ramla dunes; the subterranean cricket *Brachytripes megacephalus* (RDB 91: vulnerable) known only from the dunes at Ramla and Ghadira (Malta); the histerid beetles *Hypocaccus dimidatus* (RDB 110: restricted) for which Ramla is one of the only three sites and *Xenonychus* sp. and Hypocaccus sp. until now only recorded from Ramla; the anthicid beetle *Anthicius fenestratus* for which Ramla is the only known locality; at least four different species of carabid beetles all of which are only known from Ramla; the ants *Trachymesopus darwini*, known only from this area and *Leptothorax* sp. known from only one other site, also in Gozo; the sphecid wasps *Prionyx lividocinctus*, *Sphex pruinosus*, *Philanthus raptor siculus* (RDB 93: vulnerable), *Bembix oculata* and *Bembecinus tridens* (RDB 94: vulnerable), all species with very restricted distributions in the Maltese Islands; the halictid bee *Psuedoapis unidentata* which has a restricted distribution in the Maltese Islands; the amphipod *Talitrus saltator* and the burrowing isopod *Tylos latreilli* both of which have a restricted distribution in the Maltese Islands.

Note: **RDB** refers to the *Red Data Book for the Maltese Islands* (1989), and the number refers to the page where the entry for the particular species is found.

Maritime fringe

On gently sloping rocky shores, halophytic vegetation grows in isolated patches in the shallow saline soil which accumulates in pockets in the rock. The species present are typical of this type of habitat and mainly form part of the Mediterranean vegetational community called the *Crithmo-Limonietum*. In the Maltese variants of this biocoenosis, several endemic plants are found only in this community type and others also occurs, although not exclusively on low-lying maritime rock.

? Rupestral communities

These grow on sheer rock faces (sisien) and in cliff/scree environments (rdum). The south, southwest and west coasts of the island of Malta consist of vertical cliffs rising from the sea to heights of c.70-130m. In the Dingli Cliffs area, these cliffs give way to a steeply sloping substratum. This sloping ground is terraced and partly under cultivation. Further inland there is a second tier of vertical cliffs. The south and southwest coasts of Gozo consist of sea-cliffs similar to those of southern Malta. Because of the shelter they provide and their relative inaccessibility, both the sea-cliffs, and the second tier of inland cliffs with the boulder screes which form beneath them, provide important refuges for many species of Maltese flora and fauna, including many endemics.

The fauna of coastal cliffs includes some of the rarest of Maltese animals; for example, the endemic Maltese Door-snail (*Lampedusa melitensis*) occupies a very precarious habitat of a few tens of square metres only on the southwest cliffs of mainland Malta, while two other rare endemic snails are found in a few cliff-side localities only. Cliff-side communities are dominated by shrubs and are especially significant due to the presence of a large number of endemic plant taxa including two (*Palaeocyanus crassifolius* and *Cremnophyton lanfrancoi*) belonging to monotypic genera.

? Caves

In spite of being made up almost exclusively of limestone, the Maltese Islands have surprisingly few known deep caves (although unexplored examples may occur). Maltese caves are inhabited by organisms which are adapted to live in such habitats and therefore have a very restricted distribution. The best known cave-dwellers are bats but there are many other species, particularly invertebrates. Moreover, a number of these species are endemic to the Maltese Islands and therefore of great scientific interest. They are also highly vulnerable, both because of the limited habitat available and because of their poor dispersive ability. Additionally, many caves have deposits of Quaternary age (for example, Ghar Dalam), study of which is important for an understanding of the islands' palaeoenvironment and biogeography. One cave, that at Harq il-Hamiem near Pembroke is unique in that it houses a deep pool of freshwater, the only such body known in the Maltese Islands.

3.2.1.3 Anthropogenic Biocoenoses

? Communities of disturbed ground

Given the islands' high human population and its considerable land use, these biocoenoses have a large coverage. They are dominated by a variety of plant species, many of which are aliens. Sub-types occur in abandoned fields, along roadsides and in disturbed seaside habitats.

? Afforestation

Most of Il-Buskett was originally planted by man but is now self-regenerating and has the character of the natural climax community and may be described as a semi-natural woodland. Here the wood is dominated by Aleppo Pine (*Pinus halepensis*) with various other trees being sub-dominant (e.g. Olive, Carob, Holm Oak) and there is an extensive undergrowth of shrubs (e.g. Lentisk, Mediterranean Buckthorn and Hawthorns), herbs and climbers. This semi-natural wood is very important since it represents the only full woodland ecosystem on the islands and consequently harbours a large number of woodland plants and animals which, because of the lack of suitable habitats in Malta, are locally very rare. Particularly important woodland species are fungi that are symbiotic with trees, insects which feed, breed or live in trees and dead wood, and leaf-litter inhabiting invertebrates.

Many other wooded areas exist in the islands, however, all are man-made (e.g. public/private gardens, afforestation sites, orchards, etc.) and do not possess the character of the native climax forest ecosystem nor are they self-maintaining and self-regenerating as is Il-Buskett, and therefore do not qualify as semi-natural woodlands.

3.2.2 Freshwater water habitats and biocoenoses

? Watercourses

This is the commonest type of freshwater habitat in the Maltese Islands.

Widien (or valleys) are geomorphologically dry valleys, that is, river valleys formed during a previous climatic regime (the Pleistocene pluvial periods) which are now dry for some months of the year and in which water only flows during the wet season. However, some local widien drain springs originating from the perched aquifers and retain some surface water even during the dry season. Because of the availability of water, widien are important natural and agricultural areas. The bulk of local plant and animal species associating with water during some part of their life-cycle are found in widien environments, while where the terrain permits, the widien sides are terraced and cultivated. Many of the larger widien, and in some cases, even the smaller ones, have small dams built across them in order to retard water flow. This is mainly to enable farmers to draw off water for irrigation, however, such dams have created new freshwater habitats where a variety of aquatic and semi-aquatic species thrive.

Where widien are cultivated, the natural biotic communities are impoverished and dominated by opportunistic species. It is only in the deeply incised widien, which are relatively inaccessible, that well developed natural communities are found. The biotic communities of widien may be divided into two broad groups. Those growing on valley sides and those growing along the watercourse. In shallow widien where the sides slope gently, the watercourse communities grade into the valley-side ones, which are usually those associated with cultivated land or abandoned fields. In the steep-sided widien there is a much more distinct demarcation between watercourse and valley-side communities.

In general, watercourse communities depend much more on the water-flow characteristics of the wied than do the valley-side communities. By its very nature the watercourse environment is somewhat unstable. Its integrity depends on such factors as the amount and frequency of rainfall, the rate of siltation and the stability of the watercourse banks. The latter two factors are greatly influenced by human activities, including: damming, dredging, dumping, draining, cultivation, and the state of repair of constructions within and on the sides of the watercourse.

The substrate of the watercourse, being waterlogged, is unstable so that plants living here need good anchorage in the form of extensive underground systems of roots or rhizomes. The dominant plants in turn provide shelter for more delicate forms and for animals. The open water supports several smaller plants, mainly algae. Attached watercourse vegetation is dominated by slender rhizomatous plants such as grasses, sedges and rushes, of which many different species exist in the Maltese Islands. Trees also play an important part and may form a riparian woodland. This type of woodland is all but extinct in the Maltese Islands, but along a few watercourses with abundant flow there are still remnants of riparian woodland with White Poplar (*Populus alba*), Mediterranean Willow (*Salix pedicellata*), and Grey-leaved Elm (*Ulmus canescens*), sometimes accompanied by Bay Laurel (*Laurus nobilis*). Different subtypes occur in different localities.

A rich fauna also thrives in association with watercourses. One of the most conspicuous animals of these habitats is the Painted Frog (*Discoglossus pictus*), Malta's only amphibian and which is legally protected. A huge variety of insect and other invertebrate life also thrives in local widien including: dragonflies and damselflies, semi-aquatic grasshoppers, mayflies, aquatic and semi-aquatic beetles and bugs, water-associating flies, bees and wasps, and aquatic and semi-aquatic spiders, other arachnids, annelids, amphipod and isopod crustaceans, and many others. Some of these are only found in these habitats and some are only known from one or a few localities in the Maltese Islands.

? Permanent springs

The few remaining permanent springs support a distinctive flora and fauna many species of which, since they require a year-round supply of running freshwater, are limited to this habitat type and are therefore very rare and have a restricted distribution. One such species is the endemic local race of the Mediterranean Freshwater Crab (*Potamon fluviatile lanfrancoi*). In Malta, the main localities with perennial springs are those *widien* originating on the Rabat-Dingli plateau. The most important are the Wied Rini/Bahrija Valley system, Bingemma Valley, San Martin, Gnejna Valley, and the *widien* draining the Mtahleb area and the Girgenti area. In Gozo the most important locality with a perennial spring habitat is the Kercem end of Wied tal-Lunzjata.

? Temporary rainwater rockpools (Kamenitzas)

During the wet season, rainwater collects in natural depressions and hollows on coralline limestone karstland to form temporary rainwater pools. These pools are usually very transient and rapidly dry up, especially with onset of the dry season, although some deep pools may persist for a long time. These natural freshwater pools house many freshwater species which are overall rare in the Maltese Islands, and for some, also in the Mediterranean.

? Permanent ponds

A few pools that form in natural depressions are more or less permanent either because of their physical size or because they receive water from sources other than rainwater, usually from springs. These pools are of great local interest since they represent the only natural standing water bodies in the islands. Because of the dearth of freshwater in the islands, freshwater plants and animals are overall rather rare, and this is especially true for those species which require a more or less year-round supply of water. The most important examples of these natural ponds are Il-Qattara pool at Il-Qawra (near Dwejra) and L-Ghadira ta' Sarraflu at Ta' Sarraflu (between Dwejra Bay and Xlendi Bay) both on Gozo.

? Subterranean waters

Subterranean waters are characterised by very low light levels or complete absence of illumination. While such habitats are known to exist in the Maltese Islands, very little is actually known about their distribution and even less about their ecology. A large (surface area c. 600m²) underground freshwater pool is known to exist in the cavern known as Harq il-Hamiem near Pembroke. Some scarp-footsprings originate in underground channels formed by the springs themselves. Some of these have been enlarged into galleries by man in antiquity. Many such are found in the Mtahleb and Girgenti areas, and particularly important underground springs are those which emerge at Fontana (Gozo).

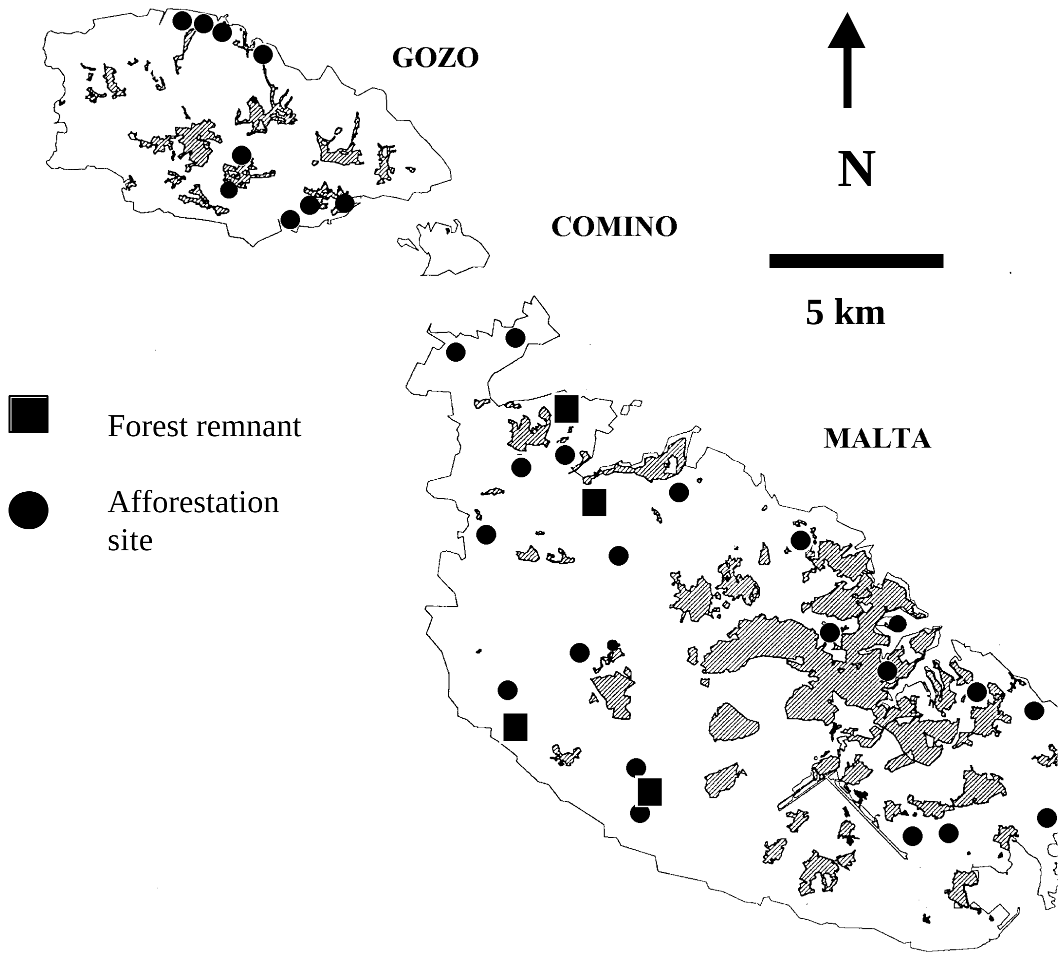


Fig. 2.1 Distribution of forest remnants and afforestation sites in the Maltese Islands

3.2.3 Terrestrial Habitats Map Of The Maltese Islands

No habitats map of the whole of the Maltese Islands exists at present, although parts of the islands have been mapped, mainly as part of the formulation of Local Plans by the Planning Authority. However, in 1989, the Planning Services Division (the forerunner of the present Planning Authority) commissioned a vegetation map of the Maltese Islands at a scale of 1:25,000 (Duca C., Zammit N., Lanfranco E. & Schembri P.J. unpublished). This was based on aerial photography and field surveys and recorded the main vegetation units (maquis, garigue, steppe, cultivated, disturbed, cliff side, and maritime), minor assemblages (saline marshland, sand dunes, etc.), and the uniformity of the vegetation. A simplified version of this map is reproduced as Fig. 2.7.

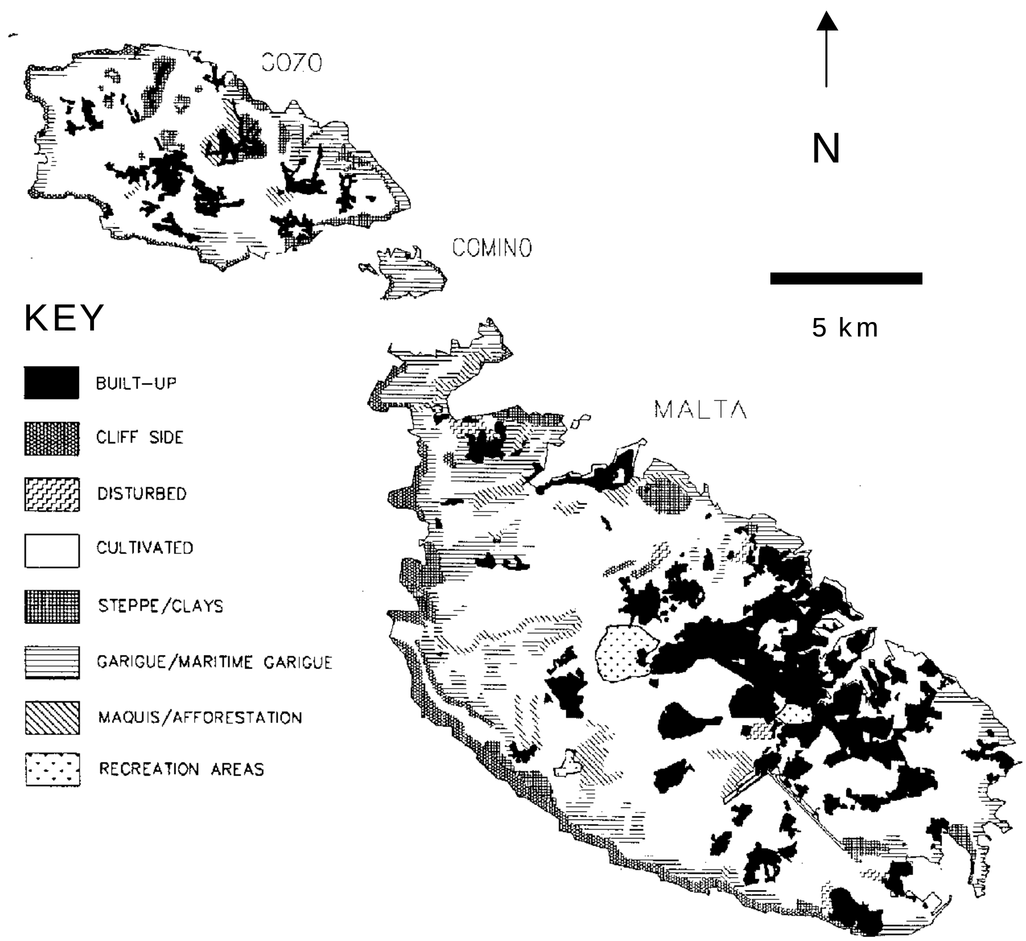


Fig 2.7 Distribution of the main terrestrial habitats in the Maltese Islands

From an analysis of this map it results that the vegetation of the Maltese Islands can be broadly divided into five regions:

1. The **western region of the island of Malta** is characterised by the Rabat-Dingli plateau and a series of ridges which support garigue communities and/or are afforestated, alternating with basins

which are under active cultivation. The coast is fringed by cliffs with rupestral and rdum vegetation. Clay steppes occur on exposures of Blue Clay, both on the coast and inland.

2. The **northeastern region of the island of Malta** is mainly built up or otherwise developed. The predominant natural vegetation here are the coastal garigues and steppes. Inland from the coast, land which is not built over is either cultivated or is characterised by vegetation of disturbed ground.

3. The **southeastern region of the island of Malta** is mainly under cultivation away from the coast. The coast consists mainly of cliffs with rupestral vegetation on the steep escarpments and garigues and steeps on more level ground fringing the coastal cliffs.

4. Except for the central part which is cultivated, and the village and the hotels on the southeastern coast, the vegetation of the **island of Comino** consists predominantly of coastal steppes and garigues.

5. The **island of Gozo** consists of a number of hills capped by plateaux of coralline rock, many of which have been built over; those which have not support garigues and steppes. The hill sides and the basins and plains between the hills are mainly cultivated. Much of the coast consists of cliffs supporting rupestral vegetation, fringed by maritime garigues and steppes

Table 3.2.1 gives a quantitative analysis of the vegetation cover of the Maltese Islands.

From Table 3.1.9 it results that at the time the surveys were carried out, some 30.6% of the surface of the islands no longer supported a vegetation cover, while some 46% was cultivated. The natural vegetation covered only 23.4%.

Comparatively more of Malta was devoid of vegetation than Gozo (34.5% as compared to 16.6%), while there was more cultivated land on Gozo than on Malta (56% as compared to 44%). For both islands, the natural vegetation covered less than 30% of the surface area, with Gozo have slightly more cover than Malta (27.1% as compared to 21.4%).

Overall, the most widespread type of natural vegetation is the garigue. Shrubs and trees (maquis and afforestation) collectively cover only some 4.2% of the islands' surface area.

Table 3.2.1
Land cover of the Maltese Islands with special reference to vegetation.

ISLAND OF MALTA		GOZO AND COMINO		TOTAL
Area (km^2)	**As % of total area**	**Area (km^2)**	**As % of total area of Gozo and**	**As % of total surface area of**

		of island of Malta		Comino	the Maltese archipelago
Built-up, roads, quarries, airport, Ta' Qali National Park, and disturbed	85.62	34.54	11.78	16.62	30.58
Cultivated	109.31	44.10	39.89	56.28	46.84
Natural vegetation and afforested: **Maquis**	6.95	2.80	1.87	2.64	2.77
Garigue	25.10	10.13	7.07	9.97	10.10
Steppe	5.09	2.06	3.54	4.99	2.71
Cliff side	5.38	2.17	2.74	3.87	2.55
Maritime garigue	4.53	1.83	1.26	1.78	1.82
Clay slope steppe	1.23	0.50	0.98	1.38	0.69
Afforested	3.07	1.24	1.48	2.09	1.43
Boulder screes	1.38	0.55	0.27	0.38	0.52

3.2.4 Marine Habitats And Biocoenoses

? Supralittoral

Supralittoral biocoenoses are those which occur high up on the shore where the substratum is only wetted by sea spray and the very highest waves. Supralittoral communities of rocky substrata are by far the commonest given that most of the islands' coastline is of this type

Two types of biocoenoses occur on soft substratum shores (beaches):

Rapidly-drying sediment
The biota of consists of small crustaceans and insects which burrow in the sand. Locally, this biocoenosis occurs on all sandy beaches where sandy areas are exposed to the sun, but it is best developed at Ramla l-Hamra, Gozo.

Slow-drying sediment
This occurs where sediment is covered by plant debris or by cobbles or boulders and desiccation is slow. The biota consists of insects, myriapods (millipedes and centipedes), arachnids (spiders and their relatives), crustaceans, and gastropods (marine and terrestrial snails). Locally this biocoenosis occurs on all sandy beaches where plant debris is deposited by wave action or where parts of the beach are covered by cobbles or boulders. In the present context, of most concern are the so called '**banquettes**' which consist of the shed leaves of sea-grasses (in Maltese 'alka') and weed debris deposited on the shore by autumn and winter storms. Where undisturbed, banks up to two metres high may accumulate, however, locally this only happens on some very remote and inaccessible pockets of sand as the banquettes which form on the more popular sandy beaches are cleared before the summer in anticipation of the tourist season. For this reason, mature banquette communities never develop.

? Mediolittoral

Mediolittoral biocoenoses are those which occur on that part of the shore continuously covered and uncovered by the sea. One such type of biocoenosis which is considered valuable on a Mediterranean scale and which also occurs locally, is the vermetid/coralline algal "trottoir" (or 'rim'). This consists of dense aggregations of vermetid gastropods (*Dendropoma petraeum*) whose uncoiled shells are cemented to the rocky substratum and to each other, and where the interstices are filled by the coralline alga *Neogoniolithon*. A second type of threatened trottoir, that formed by the coralline alga *Lithophyllum lichenoides* may also occur.

? Infralittoral

Infralittoral biocoenoses are those occurring under the sea, from mean sea level down to a depth where there is sufficient light for normal photosynthesis. In the Maltese Islands this is down to a depth of ca.60m.

The main assemblages developing on infralittoral rocky substrata are those dominated by attached macroalgae. Such assemblages occur on all rock types from the surface down to the lowermost regions of the infralittoral. When well-developed, these take the form of algal 'forests' which, like terrestrial forests, are stratified with tall-growing arboreal species forming a canopy, and a number of sub-strata of lower growing species, including a basal layer of encrusting, shade-tolerant species growing on the rock. Many subtypes are known, depending on shelter, light penetration, nature of the substratum, water movement etc. The most widespread are those dominated by species of the brown seaweed Cystoseira which grow on exposed rocky shores starting from very shallow water. Another type of Cystoseira community grows in deep water and is based on the species Cystoseira spinosa, Cystoseira dubia, and Cystoseira zosteroides. Most of the Mediterranean species of Cystoseira are endemic to the region.

Sea-grass meadows are perhaps the most important sublittoral biotic communities in the Mediterranean. Sea-grass meadows are highly productive ecosystems on which a large number of other ecosystems, and individual species, depend; for example, many fish and cephalopods use these meadows as breeding and nursery grounds. Although common and widespread round the Maltese Islands, sea-grasses are very sensitive to pollution and habitat modification. In many parts of the Mediterranean, these meadows have regressed and eroded away, leaving in their place much-impoverished thanatocoenoses (i.e. communities based on dead or dying organisms). The same seems to be happening to Maltese sea-grass meadows in enclosed or semi-enclosed coastal areas receiving a variety of effluents or subject to certain activities (for example, dredging, dumping, aquaculture operations etc.). Several types of sea-grass meadows exist. In deeper water these are formed mainly by Neptune Grass (*Posidonia oceanica*), a species endemic to the Mediterranean. In more sheltered localities and in shallow water, the meadows are based on Lesser Neptune Grass (*Cymodocea nodosa*), Red Sea Grass (*Halophila stipulacea*), in some localities accompanied by the alga *Caulerpa prolifera*.

? Circalitoral

This is a region of very dim light with fewer organisms than found in shallower water. On hard substrata, the circalittoral is dominated by attached forms, such as encrusting algae, tube-worms, false-corals (bryozoans), sponges and corals. This same assemblage of species is also found in shallower water, however, where environmental conditions mimic those of the circalittoral zone, for example in deep submarine caves. Soft circalittoral substrata are characterized by burrowing animals (e.g. heart-urchins) or those that live on (e.g. brittle-stars and sea-cucumbers) or partly embedded in the sediment (e.g. pennatulaceans or sea-pens and alcyonarians or soft-corals). Off the northern and northwestern coasts of the Maltese Islands, a characteristic maerl assemblage forms in the transition between the lower infralittoral and the upper circalittoral. Maerl consists of mixed coarse sand and shell gravel which becomes colonised by species of coralline algae, of which the most important local species are *Phymatolithon calcareum*, *Lithothamnion minervae* and *Lithothamnion corallioides* which are free living on the bottom and a constituent of the sediment. In the Mediterranean, maerl communities have a limited geographical distribution, and are considered a threatened habitat.

3.2.5 Marine Habitats Map Of The Maltese Islands

During the period 1991 to 1997, extensive baseline studies on the submarine infralittoral habitats and macrobenthic assemblages were carried out in 14 different localities around the Maltese Islands, using conventional SCUBA diving techniques. These were made as part of assessments of the environmental impact of existing or proposed projects, or in order to produce an inventory of coastal resources. In total, these surveys covered a sea-bed area of c.4.71km^2 and a coastline length of c.20 km, and represent the largest biological surveys of the marine environment carried out to date in the Maltese Islands. The results of these surveys are presented as maps showing the type, location, and spatial extent of these physical and biological features. Fig.2.8 is a simplified marine habitats map for the Maltese Islands based on these surveys and work carried out in 1990 as part of the preparation of the Malta Structure Plan.

In terms of spatial extent, the most important macrobenthic assemblages are the communities of photophilic algae on hard substrata, meadows of the sea-grass *Posidonia oceanica*, communities of bare, well-sorted sand, and maerl communities. For all these, many subtypes and facies exist, depending on the light intensity, hydrodynamic conditions, microtopography, sediment granulometry and other edaphic factors, and anthropic influences, including pollution.

Other assemblages with a limited spatial distribution include meadows of the sea-grass *Cymodocea nodosa* and of the Lessepsian immigrant *Halophila stipulacea* on sandy bottoms, the assemblages of boulder fields which are complexes of photophilic and sciaphilic communities, those associated with accumulations of pebbles and cobbles, and those of marine caves.

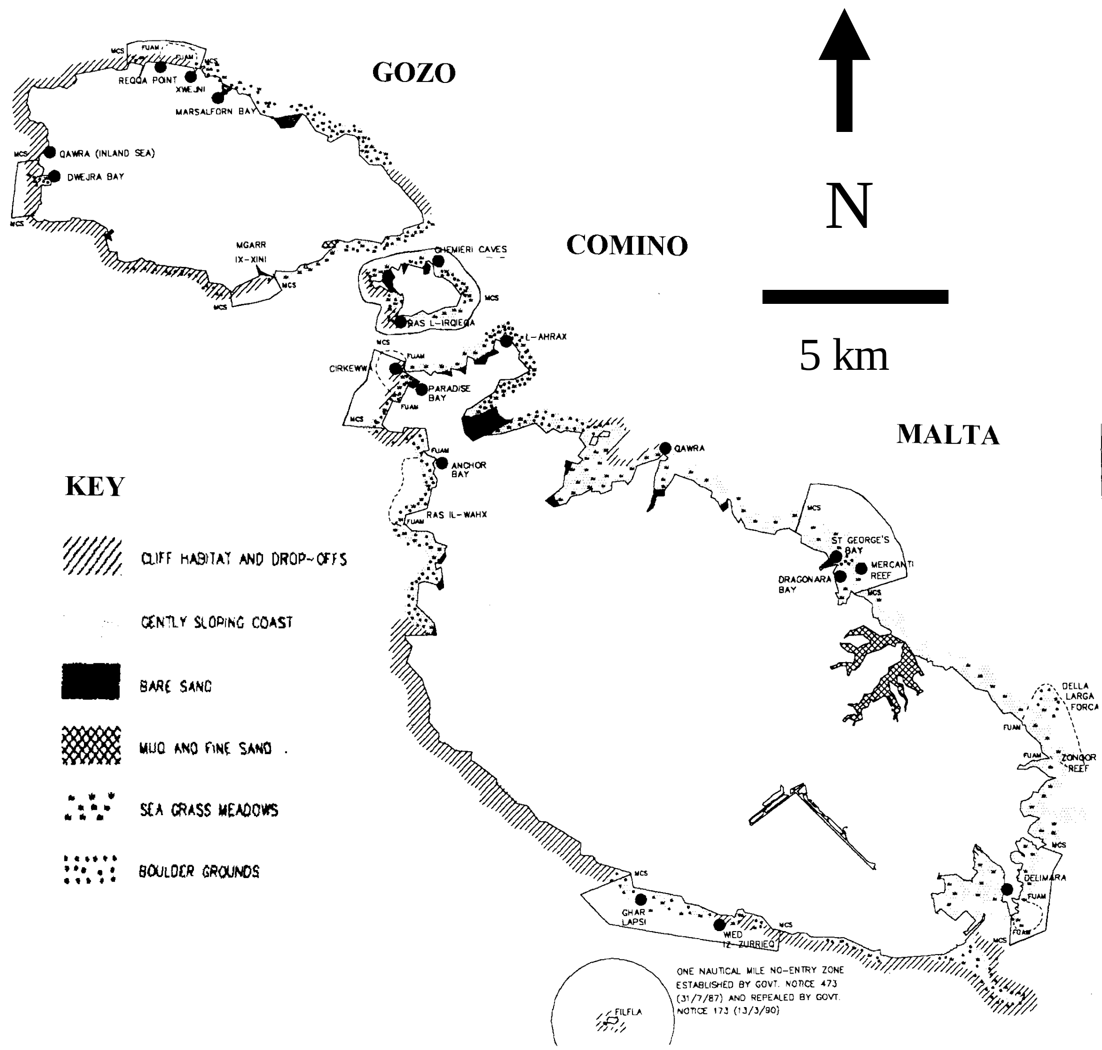


Fig. 2.8 Marine habitats map for the Maltese Islands

3.2.6 Threats

Given the small land area of the Maltese Islands and the very high human population density, it is hardly surprising that all natural habitats are under threat from human activities to varying degrees. The status and exploitation of, and threats to, the terrestrial and wetland habitats and biocoenoses of the Maltese Islands are summarised in Table 3.2.2 while those concerning marine habitats and biocoenoses are summarised in Table 3.2.3.

Table 3.2.2
The more important non-marine habitats and biocoenoses of the Maltese Islands and their status, exploitation and threats.

Type	**Status**	**Exploitation**	**Threats**
Rupestral habitats	A relatively extensive habitat as the southern, southwestern and western coastlines of Malta and Gozo consist predominantly of vertical cliffs rising from the sea to heights of up to 130m.	The cliff sides are not exploited, but quarrying in some parts of southern Malta has severely damaged the cliff faces.	Due to their inaccessibility, the cliff sides are not threatened, except where there is quarrying activity; this has perforated and destroyed the cliffs in the Hal Far and Benghisa area of southern Malta.
Low-lying rocky coasts	A relatively common habitat as most of the northern and northeastern coastline of the island of Malta, the east coast of Gozo and the north and south-facing coasts of Comino are gently sloping rock.	Extensive building development for residential and touristic purposes in some areas. Heavily industrialised in the harbours. Sheltered inlets and bays are used for berthing seacraft. Stretches of gently sloping coast which are not built over are used for recreation, mainly bathing and shore-fishing using rods.	Mainly from development, including beach amenities, and associated activities, such as dumping and pollution. Coastal quarries have severely damaged the coastline near Ras il-Qala in Gozo.
Sand-dunes	Of a coastline of c.190km, only some 2.4% is sandy beaches. Many of these beaches were originally backed by sand-dune systems, but most are now extinct and sand-dunes are one of the rarest coastal habitats in the Maltese Islands. Only Ir-Ramla l-Hamra (Gozo) still supports a relatively complete dune ecosystem. Formerly thriving dunes at Ir-Ramla tat-Torri, L-	All dunes are used for recreation purposes including sun-bathing, barbecues, sports (including motorbike scrambling), and camping. Kiosks selling refreshments are also often constructed (illegally) on dunes. Sand is also sometimes (illegally) removed from some dunes for use in the construction industry.	The main threat is trampling and disturbance of the sand and its vegetation due to human activity. Other threats include dumping of rubbish and fire. Some dunes are also occasionally 'cleaned' of their vegetation to make them more hospitable to sun-bathers. Storms also do a lot of damage to dunes although this is probably mainly a result of the degradation of the sand-binding vegetation

	Armier, and Ir-Ramla tal-Mixquqa (Malta) have been severely damaged through a combination of ‘beach cleaning’ and illegal development and are approaching an irreversible state of decline. The dune at Il-Qala ta’ Santa Marija (Comino) has been almost obliterated by carelessly executed infrastructural works, while a majopr dune system at L-Ghadira has been destroyed completely by road construction followed by ill-conceived tree planting.		due to human activities. Ill-conceived planting of non-dune species has severely degraded certain dunes.
Transitional coastal wetlands	Only very few examples of this habitat type are know. At present there are three sites with this habitat type: L-Ghadira s-Safra and Il- Qammieh pools on Malta, and Il-Qattara on Gozo.	Not exploited commercially, however, the wetland at Ghadira s-Safra is used as a picnic area, for parking, for hunting and for 'recreation'.	Il-Qammieh pools are not threatened. L-Ghadira s-Safra suffers from rubbish dumping and tramp ling. Il-Qattara also suffers from dumping while goldfish are often liberated in the pool.
Saline marshlands	Saline marshlands are very scarce in the Maltese Islands. At present there are five extant marshes, all on Malta, and another 12 sites (eight on Malta, three on Gozo, and one on Comino) which are very degraded..	Not exploited commercially, however, those marshes with free access are used as picnic areas, parking grounds, for hunting and for 'recreation'. Access to the marshes at L-Ghadira, Simar and Il-Ballut (M'Xlokk) is restricted by means of fences and embankments and these are used for scientific study and as an educational resource.	The main threat is development. Most of the badly degraded marshes have been destroyed due to development while a number of projects have been proposed in areas with important and still viable marsh habitats (e.g. Salina, Il-Maghluq at Marsascala, Il-Qaliet at Dragonara). Other threats include dumping of building waste and domestic rubbish, trampling, and in some cases, pollution (e.g. at Il-Maghluq at Marsascala). Some marshes are frequently the targetr of vandals (e.g. Is-Simar and Il-Ballut at M'Xlokk), while the marsh at Il-

			Ballut (M'Xlokk) has been damaged by roadworks in the vicinity. Habitat engineering works carried out in some marshes (e.g. Ghadira) have led to invasions by weed species.
Widien watercourses	The commonest type of freshwater habitat in the Maltese Islands, but limited in area and one of the most intensively exploited due to the dearth of freshwater	Exploited mainly for agriculture due to the abundant water supply during the wet season. Some widien have been built over while others are quarried	Many wied watercourses have also been converted for agricultural use. Quarrying has caused the wholesale destruction of certain widien, for example, Wied Filep, a tributary of Wied il-Ghasel and Wied Incita. Recently, buildings have started appearing on the sides of many previously untouched widien, for example, Wied Ghollieqa at Msida. Some widien are serving as dumps for building and quarry spoils, as for example, Wied Ilma in Gozo and Wied il-Kbir, Qormi.
Karstland pools	Common on coralline limestone karstland where trmporary pools and puddles of rainwater collect in depression in the rock	Karstland is exploited for construction of buildings both for habitation and for commercial purposes, and of associated services (e.g roads); it is also 'reclaimed' for agriculture	Development and land reclamation for cultivation and afforestation. Quarries at San Pawl tat-Targa and Dingli Cliffs have eaten away the karstland in these localities, including the important temporary rainwater rockpools which used to form in these localities.
Scarp-foot springs	Present at the foot of rdum where the Blue Clay/Upper Coralline junction is exposed. Only a very small number of widien now have perennially flowing water	Tapped for irrigation purposes and for some commercial use	Reduction in the availability of this habitat has drastically reduced the distribution and population size of those organisms associated with this habitat type, and in some cases leading to the near extinction of particular species from

			the islands (e.g. freshwater bivalves of the genus Pisidium).

Table 3.2.3
The more important marine habitats and biocoenoses of the Maltese Islands and their status, exploitation and threats.

Type	Status	Exploitation	Threats
Supralittoral sand	Communities and biota are poorly known. Probably communities of supralittoral sand occur on all local sandy beaches but these habitats are overall rare in the Maltese Islands. The best developed communit ies of supralittoral sand occur at Ramla l-Hamra, Gozo.	Sandy beaches are very popular recreational areas with both locals and tourists. Activities includes bathing, barbecues, sports, and boating. Sand is also sometimes removed for use in the construction industry of as a surface for sports fields and playgrounds. Removal of sand from sandy beaches is regulated by law, but illegal removal is common	The main threats to this habitat type are tramp - ling and disturbance, removal of sand, and mechanical damage due to shifting of sand and due to beach cleaning
Banquette communities	Common on all sandy beaches but are removed from the popular bathing beaches in summer. Mature banquette habitats are thus rare and limited to a few pockets of supralittoral sand situated in remote areas.	There is some very limited use of banquettes as a natural fertiliser, but this is minimal. The main 'exploitation' is removal to clear the sand for beach users.	Communities which develop in and under the masses of drying and decaying plant debris deposited on the shore by wave action during the winter months rarely survive past the start of the summer season on the larger beaches due to beach cleaning activities.
Supralittoral and mediolittoral rock	Over 95% of the coast-line of the islands is rocky. Some rock types are rarely exposed at sea-level however, and were these are so ex-posed, interesting geomorphologies and communities develop. One example is Middle Globigerina Limestone shores, which are only found in two or three localities in the Maltese	Most gently sloping rocky shores which are not built over are used for bathing. Coastal coralline limestone is quarried in some places.	The main threat is development, including: expansion of existing coastal urban or touristic centres; the building of new facilities such as beach amenities, concrete platforms, piers, slips, boat-houses, marinas etc; and coastal quarries. Dumping of building waste and littering is a localised

	localities in the Maltese Islands.		problem in some areas.
Mediolittoral bioconstructions	Platforms formed by the alga *Neogoniolithon notarisii* and the vermetid *Dendropoma petraeum* are common on all gently sloping rocky shores. *Lithophyllum* cushions are only known from a few shores (e.g.at Xlendi and Ghar Lapsi). These rocky shore bioconstructions are considered vulnerable on a Mediterranean scale (UNEP/IUCN/GIS POSIDONIE, 1990).	No direct exploitation.	The same as all local rocky shores, mainly from development.
Sea-grass meadows (*Cymodocea nodosa* and *Posidonia oceanica*)	Although common and widespread round the Maltese Islands, in some areas, especially in enclosed or semi-enclosed bays receiving a variety of effluents and subject to certain activities, these meadows have regressed and eroded away, leaving in their place much impoverished thanatocoenoses.	Not exploited directly, except for certain types of fishing, but their high productivity makes them one of the most important local sublittoral community types, as in the rest of the Mediterranean.	Dredging, which causes both mechanical damage and also increases water turbidity and the rate of sedimentation; terrestrial run-off in enclosed bays, particularly that containing sediment and agricultural run-off; cooling water from the local power stations; the hypersaline discharge from reverse osmosis plants; nutrient-rich effluent from sewage; waste from fish-farms; bottom trawling; the use of heavy anchors which physically damage the meadows; and the illegal use of explosives for fishing. Coastal developments have changed the current and sedimentary regimes in some areas (e.g. Marsaxlokk) and have caused regression of sea-grass meadows.
Posidonia 'barrier reefs'	Only very few such formations are known locally. The best documented are those in Mellieha Bay and in Salina Bay, both in Malta.	Not exploited directly, however, these 'reefs' are very important in protecting the shore from wave action by absorbing the energy of waves.	The same as sea-grass meadows in general, but particularly susceptible to mechanical damage, as for example, from boat anchors and moorings.
Halophila stipulacea	Meadows of this Red	Not exploited.	Dredging works in

meadows	Sea immigrant are only known from very few Maltese localities (e.g. Marsaxlokk Bay, Malta and Mgarr Harbour, Gozo). Some populations have regressed in recent years (e.g at Marsaxlokk)		connection with the new power station at Delimara, together with pollution resulting from the fishing harbour at Marsaxlokk, have caused a severe decline in the *Halophila* meadows in this locality.
Cystoseira communities	Seaweed ‘forests’ dominated by species of *Cystoseira* are the commonest type of biocoenoses on infralittoral rock. Different species of *Cystoseira* dominate depending on edaphic factors. Deep-water *Cystoseira* communities based on *C.spinosa, C.dubia*, and *C.zozteriodes* occur but are rare.	Not exploited directly, except for some types of fishing	Most species of *Cystoseira* are sensitive to pollution, particularly to high phosphate levels and upper infralittoral communities are disappearing from some areas receiving organic pollution; deep-water communities may be similarly affected . Other threats include changes in sedimentary and current regimes due to coastal developments, dumping, and fishing with explosives.
Cladocora cespitosa banks	In the Maltese Islands this coral forms banks some 20cm across. These were previously common but are now rare. Large and well-developed banks are particularly rare.	Collected for their curiosity value and for use as decorations in aquaria	Overcollecting and mechanical damage from the use of heavy anchors and fishing gear; also, illegal fishing with explosives.
Maerl communities	Occur off the northeastern coasts of Malta and Gozo at depths between 40-80m at the transition between the lower infralittoral and the upper circa-littoral.	Not exploited directly, except for some types of fishing.	The main threat seems to be from bottom trawling although changes in the sedimentary regime due to coastal development may pose an additional threat in some areas.
Coralligene communities	Occur in deep water (circalittoral) and poorly known locally. It is suspected that those occurring close to the transition zone between the lower infralittoral and the upper circalittoral may be threatened.	Not exploited directly, except for some types of fishing.	Bottom trawling and changes in the sedimentary regime due to coastal development. Possibly dumping in some areas.
Submarine caves	Common in Maltese waters and different types exist, ranging	Not exploited directly, except for 'sight-seeing' by tourist divers.	The main threat is from divers who enter the caves. These cause both

from those close to the surface and open to the air, to deep grottoes and tunnels	mechanical damage to erect sessile forms, and death of the biota on the ceiling due to air bubbles from diving cylinders becoming trapped there.

Case study: Biological effects of the thermal effluent from the Delimara power station
(Steve J. Jones, Jane Cachia and Patrick J. Schembri, unpublished)

Prior to 1987, when construction of a new thermal power station commenced, the Delimara peninsula (SE Malta) was a predominantly rural area with a coastline little affected by anthropic activities, which were mainly limited to bathing and boating. The Delimara power station started coming on steam in 1992, and currently has a capacity of 310MW. It is cooled by seawater in a once-through system that generates some 20,000m^3 of thermal effluent per hour. Seawater is pumped from the western coast of the peninsula and the effluent is piped through an underground channel to discharge on the eastern coast into a semi-circular bay know as Il-Hofra z-Zghira. No studies on the ecology of this bay were made prior to thermal effluent being discharged in it, however, since 1994 the effects of the thermal effluent on the marine environment of Il-Hofra z-Zghira have been studied by comparing it with an adjacent bay known as Il-Hofra l-Kbira, which is geomorphologically very similar but which does not receive effluent, and therefore acts as a control.

The water in Il-Hofra iz-Zghira was found to be 1-2°C warmer than that in the control site and a definite temperature gradient was observed, with temperature decreasing with distance from the point of discharge of the thermal effluent. A maximum temperature of 31-33°C was measured at the point of discharge. The water in the vicinity of the discharge outlet at Il-Hofra iz-Zghira was slightly hypersaline compared to the control site. The water was hyperoxic near the outlet, but it was slightly hypooxic overall, compared to the control site. The pH was more or less constant in both bays. At a distance of 6m from the discharge outlet, surface currents had a speed of 0.75ms^{-1}.

The dominant biotic assemblages at Il-Hofra iz-Zghira and Il-Hofra l-Kbira were photophilic algae on rock in shallow water, patches of bare sand, and meadows of the sea-grass *Posidonia oceanica*. Stands of the sea-grass *Cymodocea nodosa* occurred at Il-Hofra z-Zghira but not at Il-Hofra l-Kbira, while patches of bare sand were much more extensive at Il-Hofra l-Kbira than at Il-Hofra z-Zghira. As *Cymodocea* is known to replace *Posidonia* when the latter species is stressed, this may indicate some regression of the *Posidonia oceanica* meadows at Il-Hofra z-Zghira. A ca. 45m long 'corridor' of exposed bedrock covered by algal turf occurred in front the discharge point at Il-Hofra z-Zghira. This was probably due to the discharge current which winnowed away the bottom sediment.

At Il-Hofra l-Kbira, the shoot density, number of leaves per shoot, leaf area index, and leaf biomass of *Posidonia oceanica* were found to decrease with distance from the shore, and therefore with increasing depth. This is the normal situation in the Mediterranean. However, at Il-Hofra z-Zghira, the same parameters showed the reverse trend along transects radiating away from the discharge point. This effect was weakest along that transect least affected by the thermal discharge, while for all transects, the highest values attained by all these parameters were still below those measured for Il-Hofra l-Kbira. The *Posidonia* leaves at Il-Hofra z-Zghira also carried much heavier epiphyte loads than those at Il-Hofra l-Kbira, especially for stations close to the discharge point.

These results indicate that at Il-Hofra z-Zghira, *Posidonia oceanica* is showing signs of stress, and that this stress is probably due to the thermal discharge. Close to the discharge point, the ambient temperature in summer probably exceeds the upper limit of the optimum range for *Posidonia* (reported to be 10-30ºC), while further away the higher than normal temperatures stimulate epiphyte growth on the *Posidonia* leaves which in turn reduces the light available to the plant, as well as making the leaves more susceptible to mechanical damage. The discharge current has also changed the nature of the substratum, and therefore also the biotic assemblages, close to the discharge point. There are also indications that the biota of Il-Hofra z-Zghira is changing, both due to colonisation of the areas close to the discharge point by thermophilic species, and as the regressing *Posidonia* meadows are replaced by other assemblages.

The situation at Il-Hofra z-Zghira has not yet stabilised, and it is the intention of Enemalta, the public utility company that runs the power station, to increase its capacity as the demand for electricity increases.

3.2.7 Protection

3.2.7.1 Legislative Framework Protecting Sites

3.2.7.1.1 The Environment Protection Act 1991

Part 6 of this Act deals with the protection of flora and fauna and paragraph 32 in this section empowers the Minister responsible for the environment to issue regulations declaring a particular species a protected species, and a specified area of the Maltese Islands and their territorial waters a Nature Reserve. Paragraph 33(1) of the same section empowers the Minister to make regulations for the protection of areas declared Nature Reserves under the previous paragraph. It is in terms of the provisions of this Act that the various nature reserves currently existing in the Maltese Islands have been established. The Act does not define 'Nature Reserve' nor are there any blanket regulations applicable to all Nature Reserves; regulations are made ad hoc for each Nature Reserve or group of such reserves established under the Act.

A number of sites have been declared nature reserves in terms of this Act.

The Filfla Nature Reserve Act, 1988 (Act XV of 1988) established the land area of Filfla as a nature reserve with the aim of protecting the flora and fauna on the island. Local Notice to Mariners Nº16 of 1987 prohibited the berthing or navigation of any craft within an area of radius one nautical mile (1.852km) from Filfla, as well as swimming, underwater activities and any activity connected with fishing and trawling. The area thus effectively functioned as a strict nature reserve. However, Government Notice Nº173 of 1990 once again permitted fishing from surface fishing vessels within one nautical mile off Filfla.

The island of Fungus Rock in Dwejra Bay, Gozo was established as a Nature Reserve by Legal Notice Nº22 of 1992, and Selmunett Islands, also known as St.Pauls Islands, Malta were established by Legal Notice Nº25 of 1993. Legal Notice Nº144 of 1993 declared the following as Nature Reserves: the saline marshland at Salina; the saline marshland and dunes at Ghadira in Mellieha Bay; the saline marshlands at is-Simar in St. Pauls Bay and at Il-Ballut in Marsaxlokk Bay; the rocky headland at Xrobb l-Ghagin; the rocky shore and the wetland at Il-Qawra in Gozo; the Ta' Cenc cliffs also in Gozo; and the whole of the island of Comino.

3.2.7.1.2 The Development Planning Act 1992

This Act established a Planning Authority to promote and control development in accordance with approved policies and plans. One key responsibility of the Planning Authority is the preparation and periodic revision of a Structure Plan for the Maltese Islands and supplementary planning documents. The Structure Plan formulates a national planning policy and puts forward general proposals in respect of the development and other use of land. It has as its basic objective the optimal physical use and development of land which respects the environment and at the same time ensures that the basic social needs of the community are satisfied. The version of the Structure Plan currently in force (Malta Structure Plan, 1992) has a total of 320 separate policies.

The following is a summary of protection afforded to habitats and biocoenoses by the Development Planning Act 1992, of which the Structure Plan for the Maltese Islands forms part.

Terrestrial coastal areas may be designated as protected areas under a set of Structure Plan policies. Policy RCO 1 institutes several types of Rural Conservation Areas including Areas of Ecological Importance (AEIs) and Sites of Scientific Importance (SSIs).

?? The presence of any one of the following habitat types qualify an area as an **Area of Ecological Importance** (AEI):

1. Permanent springs
2. Saline marshlands
3. Sand dunes
4. Forest remnants
5. Semi natural woodland
6. Natural freshwater pools and transitional coastal wetlands
7. Deep natural caves
8. Coastal cliffs
9. Representative examples of typical Maltese habitats such as garigue, maquis, valley sides, watercourses, and gently sloping rocky coasts.

?? **Sites of Scientific Importance** (SSIs) are those which fit one or more of the following criteria:

1. The only known locality in the Maltese Islands where certain endemic and/or non endemic species are found;
2. A locality where certain endemic and/or non endemic species with a restricted distribution in the Maltese Islands occur ('restricted distribution' is taken to mean occurrence in five localities or less);
3. The type locality of an endemic species;
4. An important bird nesting site or of some other major ornithological interest;
5. A locality of special palaeontological interest;
6. A lithostratigraphical type section;
7. A locality of particular geomorphological interest;
8. Some other specific feature of scientific importance not listed above.

?? The Structure Plan requires the Planning Authority to give AEI and SSI or complexes of such a protection rating according to the following criteria:

LEVEL 1 zones will include important habitat types present only in small areas and/or sites with unique species or features.

LEVEL 2 zones will include habitat types present in relatively large areas and/or sites with rare species or features.

LEVEL 3 zones will include areas (buffer zones) where control is necessary to preserve habitats/species/features in adjacent sites.

LEVEL 4 zones will include habitats and/or features of general interest.

?? For AEIs and SSIs in general, the following general protection policies apply:

1. A general presumption against development, including roads and public utility services, and particularly on crests of ridges and the edges of coastal and inland cliffs.
2. A general presumption against activities likely to be a fire risk to a significant wooded area.
3. A general presumption against development where noxious emissions are likely to create problems in nearby AEIs and SSIs.
4. The removal of intrusive elements.
5. The inclusion of buffer zones to further their protection.

?? For LEVEL 1 AEIs and SSIs, the following are applicable:

1. Human intervention kept to the barest minimu m.
2. No physical development.
3. All efforts made to protect the identified features of scientific interest.
4. Management by the competent Government agency in an appropriate manner.

?? For LEVEL 2 AEIs and SSIs, the following are applicable:

1. Human intervention strictly controlled.
2. Physical development limited to the maintenance of already extisting structures, and construction of minor amenities designed to enhance the educational and recreational use of the area (eg. narrow footpaths, nature trails, small scale visitor centres). Any such developments to be carred out with the least possible damage to the environment.
3. Traditional activities (eg. agriculture) can continue, unless in conflict with other policies, but no new land diverted to these uses except for the suitable re-establishment of abandoned fields for agriculture.

?? For LEVEL 3 AEIs and SSIs, the following are applicable:

1. No residential, industrial, commercial, or tourism development.
2. No infrastructure or public utility works.
3. Small scale physical development can be considered providing the adjacent AEIs and SSIs are protected, and this is demonstrated by a suitable environmental impact assessment, and is consistent with other policies.

?? For LEVEL 4 AEIs and SSIs, the following are applicable:

1. Small to medium scale physical development can be considered, provided no suitable alternatives exist and features of ecological and scientific interest are protected.
2. A suitable environmental impact assessment is undertaken.

?? The Structure Plan also requires the Planning Authority to collaborate with other agencies to develop and implement policies for the protection and conservation of all local wildlife, but particularly threatened species. These policies will include the prohibition and/or regulation of certain activities; regulation of the use of weapons, traps and similar equipment; the establishment of open and closed seasons; and regulations concerning commercial and other exploitation of wildlife, and all related enforcement measures. In the wider interests of conservation, the Planning Authority will also promote legislation regulating the killing, capture, collection, and maintaining in captivity of certain flora and fauna, particularly those protected by European Community and other international regulations and agreements.

?? Additional policies on conservation include policies RCO 16, 17 and 18 concerning the protection of sandy beaches and sand-dunes; policies RCO 30, 31, 32 and 33 concerning trees and afforestation; and policy RCO 34 concerning the protection of the minor islands and islets of the Maltese archipelago. Policies RCO 35, 36, 37, and 38 concern the protection of the Qawra/Dwejra area in Gozo, considered to be a site of international as well as national scientific importance.

Sandy beaches are one of the country's most valuable resources, especially due to their recreational use by the local population and by tourists. Due to the human pressure on these beaches they are also among the most threatened of local environments.

Trees are a limited but very important feature of the Maltese landscape and a threatened resource. The Structure Plan presumes against the siting of afforestation projects where stable populations of indigenous species and natural vegetational communities are already established; it requires that only indigenous and archaeophytic (= brought to the islands by man in prehistoric times and now naturalized) species be planted in non-urban areas; and it protects specified individual trees or groups of trees of aesthetic, historical, cultural, arboricultural, and/or scientific interest by means of Tree Preservation Orders which prohibit the uprooting, destruction, or damage to trees growing in the wild and in public parks, gardens, and other s paces, or on private land, and regulate any other activity which may cause harm or death of such trees.

Many **minor islands** of the Maltese archipelago support wildlife species that are unique to them, besides other features of scientific interest. Because the land area of these islands is very small, any disturbance, even if small scale, is likely to disrupt the ecosystem and could lead to the extinction of the endemic populations.

?? Other relevant Structure Plan policies include policy RCO 19 and 20 which concern the identification and rehabilitation of degraded habitats and landscapes, and policies RCO 21 to 27 which concern the control of erosion, including that of sandy beaches and sand dunes.

?? The Malta Structure Plan also contemplates the setting up of Marine Conservation Areas (MCAs) and policy MCO 1 designates 14 separate areas round the Maltese Islands as candidates for the status of Marine Conservation Areas. Additionally, because of the limited knowledge of the marine environment, it also requires the Planning Authority to collaborate with the agency responsible for environmental protection to conduct an underwater survey of marine habitats in the shallow waters round the Maltese coast and to establish a national system of MCAs to include representative areas of all existing marine habitats as revealed by the said underwater survey. However, the Structure Plan does not define Marine Conservation Areas, neither does it give protection to the candidate sites listed in Policy MCO 1, but it simply states that " following further analysis, these and other possible areas will be categorised and given protection according to defined criteria".

A summary of the policies formulated within the provisions of the Development Planning Act 1992 and subsidiary legislation as relating to the conservation of habitats, sites, biocoenoses and species is given in Table 3.2.4. This table also includes information on the present status as regards the implementation of these policies, as well as on their effectiveness.

Table 3.2.4
Planning policies (Development Planning Act 1992 and subsidiary legislation) related to the conservation of habitats and species.

In addition to policies proper, where applicable this table also includes other paragraphs of the Malta Structure Plan as well as the relevant guidelines of the Malta Structure Plan Explanatory Memorandum (referred to as “Expl. Memo.” In the table). These paragraphs and guidelines have the same approved status, and are in some cases directly employed as policies (e.g. in the evaluation of development proposals and in the scheduling of AEIs and SSIs). Policies contained in ancillary Local Plans, Action Plans, Subject Plans, Policy Papers and Policy Guidelines are not included except as "comments".

Policy	Scope	Comments
Para. 6.9 & **Policy SET 11**	Blanket prohibition of urban development in the countryside.	
Para 6.10 & **Policy SET 12**	Make allowance for "special" cases where infringement of Policy SET 11 may be considered.	Often used as a loophole for development in the countryside. Negative impacts on certain rural habitats have ensued.
Para. 7.6	Reiterates blanket prohibition of urban development in the countryside. Indicates need to control development of "legitimate" rural structures.	
Policy BEN 5	Subjects development proposals in the countryside to RCO policies, Local Plan policies and Expl. Memo. provisions.	Link with habitat/species protection is achieved indirectly, by reinforcing other policies.
Para. 8.4	Identifies part of Pembroke as a Site of Scientific Importance and requires its protection.	The garigue, coast and watercourse at Pembroke, as well as the nearby ~arq il-~amiem area, have all been legally protected ("scheduled") accordingly.
Policy HOU 6	Requires the preparation of a Local Plan for Pembroke, and its subjection to an EIA.	Fulfilled through the preparation of the Pembroke Action Plan, which considers the garigue, coast and watercourse at Pembroke, as well as the nearby ~arq il-~amiem area, as conservation zones that are to remain undeveloped. The same plan also envisages the restoration of degraded habitats. No EIA has, however, been carried out.
Para 12.9 & **Policy MIN 5**	Prohibit quarrying in areas of ecological value. Also forbid the extraction of significant quantities of Blue Clay.	
Para. 12.12 & **Policies MIN 8-9**	Subject proposals for mineral extraction/processing to EIA and require refusal of development where impact is likely to outweigh the need for development.	Particularly relevant to hardstone quarrying, which has (almost invariably) affected important habitats such as cliffs, garigue and valley sides.
Policy TOU 10	Designates Ta' {en[in Gozo for a National Park associated with commitment of adjacent sites to touristic development; also identifies the need to carefully mitigate the impacts of such development.	See also policy RCO 14. Not yet implemented; negotiations with site owners had reached a moderately advanced stage but seem to have fallen through following change of land ownership.
Para. 13.15 & **Policy TOU 14**	Recognise fragility of the marine environment in popular diving sites and seek to reconcile underwater activities with habitat conservation.	Not yet implemented.
Policy TOU 15	Requires formulation of a comprehensive coastal zone policy, based on studies of this "unique ecosystem" and "including the coastal zone as an area requiring mandatory EIA procedures".	In progress. See also MCO and CZM policies.

Policy REC 6	Proposes relocation of existing firing ranges at Pembroke to another area (the San Anard area is identified on a preliminary basis).	Minimisation of current impacts on the garigue at Pembroke would possibly be outweighed by new impacts elsewhere. Policy has not yet been implemented.
Para. 13.24 & **Policy REC 8**	Identify the damage caused by offroading and motorcycle scrambling to natural habitats, and seek to curtail impacts by confining such activities to managed sites away from the open countryside.	In progress (Northwest Malta Local Plan). Offroading in the countryside is now legally prohibited.
Paras. 13.26-13.29 & **Policies REC 9-12**	Emphasise the problem posed by illegal coastal developments and require their removal.	Implementation should be a priority in view of the location of most such developments in top-importance conservation areas (e.g. the beaches around Il-Marfa and L-Armier). Implementation to date is very incomplete and unsatisfactory.
Policy IIT 4	Identifies L-G`adira area for the development of a ferry terminal to act as a bad-weather alternative to I[-{irkewwa.	Development had already started at Ix-Xewkija, destroying parts of the coast, garigue, and afforested area at L-A`rax tal-Mellie`a. This policy is superseded by the envisaged transformation of I[-{irkewwa into an all-weather harbour and should be deleted. Restoration of impacted habitats is also required.
Para. 15.21	Requires Planning Authority to "rigidly control development of the countryside and coast in general", especially conservation areas.	
Paras. 15.22-15.25	Highlight the need for the conservation of habitats, biodiversity and geological features.	Descriptive only. Important as context for RCO policies but otherwise not directly implementable.
Para. 15.28	Promotes designation of Rural Conservation Areas and reiterates blanket prohibition of urban development in the countryside.	
Policy RCO 1	Promotes designation of Rural Conservation Areas & sub-areas (including Areas of Ecological Importance, Sites of Scientific Importance and National Parks)	Cross-reference to IUCN criteria included in the policy.
Policy RCO 2	Reiterates provisions of policies SET 11, BEN 5, RCO 3, RCO 4, RCO 7 and RCO 8. Also promotes removal of rural structures that are incompatible with their siting.	
Policy RCO 3	Requires precise delineation of conservation areas (including AEIs and SSIs), detailed specification of protection measures to be applied therein, and proposals to resolve conflicts with other uses/activities.	Reference to Local Plans as the sole instrument for implementation is superseded by the Development Planning Act.

Policy RCO 4	Prohibits development that would, *inter alia*, destroy rubble walls and/or "adversely affect existing trees or shrubs".	Primarily intended to safeguard scenic value, but considers existing habitats and features as important "elements of the visual composition" of the countryside.
Policy RCO 5	Requires mitigation of visual impact of infrastructural interventions.	Inadvertently overlooks other associated environmental impacts especially habitat destruction and homogenisation. Fine-tuning of policy is required.
Policy RCO 6	Promotes inter-departmental efforts in afforestation, landscaping, rehabilitation of degraded habitats and disused quarries, sensitive reactivation of abandoned agricultural land, and relocation of incompatible structures away from the countryside.	Reference to Local Plans as the sole instrument for implementation is superseded by the Development Planning Act.
Para. 15.30 & **Policy RCO 7**	Require resolution of conflicts between agriculture and conservation of surrounding habitats.	
Policy RCO 8	Requires conformity of new agricultural development to conservation requirements.	
Policy RCO 9	Requires restitution of ecologically valuable areas degraded through agricultural malpractice. Also discourages reactivation of abandoned agricultural land that has been colonised by rare species.	
Policy RCO 10	Identifies springs, saline marshlands, sand dunes, forest remnants, semi-natural woodlands, natural freshwater pools, transitional coastal wetlands, deep caves, coastal cliffs, garigue, maquis, valley sides, watercourses and rocky coasts as Areas of Ecological Importance (AEIs).	Most sand dunes, marshlands, coastal wetlands, semi-natural woodland, natural freshwater pools, and coastal cliffs have been legally protected ("scheduled"). Reference to Local Plans as the sole instrument for implementation is superseded by the Development Planning Act.
Policy RCO 11	Identifies sites inhabited by rare species, type localities of endemic species, and sites of ornithological interest as Sites of Scientific Importance (SSIs).	Has been applied for the legal protection ("scheduling") of a number of sites/areas. Reference to Local Plans as the sole instrument for implementation is superseded by the Development Planning Act.
Policy RCO 12	Sets out criteria for assessing protection ratings to AEIs and SSIs. Identifies four levels of protection ("Level 1" to "Level 4", in order of decreasing protection).	Has been applied in the legal protection ("scheduling") of a number of sites/areas. Reference to Local Plans as the sole instrument for implementation is superseded by the Development Planning Act.
Expl. Memo. para. 15.34	Sets out general protective provisions to be applied in AEIs and SSIs.	Has been applied for the legal protection ("scheduling") of a number of sites/areas.
Expl. Memo. paras. 15.35;15.38-15.40	Sets out specific protective measures to be applied in AEIs and SSIs; the individual paragraphs refer to Level 1 to Level 4 zones respectively.	Have been applied for the legal protection ("scheduling") of a number of sites/areas.

Expl. Memo. paras. 15.36-15.37	Set out guidelines for the protective designation of conservation areas in accordance with IUCN criteria.	Superseded by amended IUCN criteria and designations.
Expl. Memo. para. 15.41	Requires precautionary protection of "unexplored" sites and areas.	"Unexplored" refers to sites/areas that have not been scientifically studied in detail. Never formally applied as yet.
Para. 15.31	Highlights the importance of local wildlife and trends toward decline.	Descriptive only. Important as context for policy RCO 13 but otherwise not directly implementable.
Policy RCO 13	Requires the Planning Authority to protect local wildlife through the prohibition/control of hunting, trapping and related activities.	This policy is beyond the Planning Authority's statutory remit. Never implemented.
Policy RCO 14	Promotes the designation of National Parks that conform to IUCN designation. Also identifies Ta' {en[and Id-Dwejra (including Il-Qawra) in Gozo as areas to be designated.	See also policies TOU 10 and RCO 35-38. Not yet implemented; efforts towards the designation of Ta' {en[had reached a moderately advanced stage but seem to have fallen through following change of land ownership.
Para. 15.32 & **Policy RCO 15**	Recognise the existence of sites of conservation value within urban areas and impose a prohibition on development in such areas.	
Para. 15.33	Recognises the conservation value of, and threats faced by, sandy beaches.	Descriptive only. Important as context for policies RCO 16-18 but otherwise not directly implementable.
Policy RCO 16	Prohibits permanent constructions in beach areas (including the inshore seabed) as well as the removal of sand from such areas. Also subjects beach/seabed enhancement to EIA.	
Policy RCO 17	Prohibits camping on, and vehicular access to, sandy beaches and sand dunes.	Position reinforced (legally) by protective scheduling of practically all sand dune areas as Level 1 zones (see Policy RCO 12 and Expl. Memo. paras. 15.34 & 15.35)
Policy RCO 18	Prohibits the removal of sand-binding vegetation from sand dunes.	Position reinforced (legally) by protective scheduling of practically all sand dune areas as Level 1 zones (see Policy RCO 12 and Expl. Memo. paras. 15.34 & 15.35)
Para. 15.34	Highlights the possibility of rehabilitation of certain degraded habitats.	Descriptive only. Important as context for policies RCO 19-20 but otherwise not directly implementable.
Policy RCO 19	Requires regular surveys of habitat degradation.	Frequency (biennial) unrealistically onerous. Never implemented.
Policy RCO 20	Promotes rehabilitation of degraded habitats, "subject to scrutiny and approval by competent experts".	Most "rehabilitation" schemes, especially in valleys have caused net negative impacts and have not satisfactorily solved existing problems, mainly due to use of inappropriate methodologies.

Para. 15.35	Highlights the importance of erosion minimisation and the need for careful approaches to preventive interventions.	Indirect relevance to habitat protection is two-fold: ?? erosion & sedimentation impact watercourse and marine (inshore) habitats ?? preventive and remedial interventions (e.g. dredging) entail additional impacts.
Policy RCO 21	Provides blanket prohibition of development in areas prone to erosion.	Indirect relevance to habitat protection is three-fold: ?? prevention of impacts of induced erosion ?? avoidance of additional impacts entailed by preventive/remedial interventions ?? coincidental protection of such habitats as cliffs, clay slopes, beaches, valleys etc. from development.
Policy RCO 22	Requires action to prevent loss of sandy beaches, sand dunes, clay slopes, soil and cliff edges.	
Policy RCO 23	Subjects coastal interventions to prior scientific studies so as to minimise environmental impact.	
Policy RCO 24	Reinforces existing regulations on excavation and transport of sand.	Indirectly protects beaches and sand dunes against unauthorised exploitation and development. However, updating of the Sand Preservation Act (1949) is required, since responsibilities assigned by this law are outdated following the creation of the Environment Protection Department and the Planning Authority.
Policy RCO 25	Promotes the repair of retaining walls on valley sides to contain soil erosion.	See Para. 15.35.
Policy RCO 26	Prohibits unnecessary devegetation of derelict land.	Concurrently favours erosion prevention and habitat regeneration.
Policy RCO 27	Prohibits the excavation of large quantities of Blue Clay.	As for policy RCO 21.
Para. 15.36	Identifies valleys as a "valuable national resource". Also highlights the impacts caused by dredging.	
Policy RCO 28	Requires protection of valleys as water catchments.	More detailed guidance is being formulated by the Planning Authority.

Policy RCO 29	Incorporates 5 distinct policies: 1. Blanket prohibition of most physical development on valley sides and watercourses. 2. Presumption against new dam construction. 3. Mitigatory constraints on dredging of valleys. 4. Action to prevent dumping in valleys 5. General prohibition of vehicular access into valleys.	More detailed guidance is being formulated by the Planning Authority.
Para. 15.37	Recognises the importance, and threatened status, of trees in the countryside.	Descriptive only. Important as context for polcies RCO 30-33 but otherwise not directly implementable.
Policy RCO 30	Sets out a blanket prohibition on afforestation projects that would negatively impact natural ecosystems. Also encourages afforestation on abandoned fields and derelict ground.	More detailed guidance is being formulated by the Planning Authority.
Policy RCO 31	Requires the exclusive use of indigenous/archaeophytic species for afforestation in rural areas, and restricts the use of exotic species to urban areas.	Mandatory requirement for the use of native genetic stock should be in-built into the policy. More detailed guidance is also being formulated by the Planning Authority.
Policy RCO 32	Encourages the planting of appropriate tree species, with particular reference (*inter alia*) to bird-attracting species.	Relevant to habitat creation, provision of ecological corridors, etc. Some plantations (e.g. at Valletta and G`ajnsielem) have become major ornithological sites. More detailed guidance is also being formulated by the Planning Authority.
Policy RCO 33	Establishes Tree Preservation Orders as a legal tool for the protection of individual trees or groups thereof.	Superseded by detailed provisions of Articles 46-48 of the Development Planning Act. More detailed guidance is also being formulated by the Planning Authority.
Para. 15.38 & **Policy RCO 34**	Identify minor islands in general (together with their ecosystems) as highly vulnerable sites of scientific importance, and establish a blanket prohibition on new physical development on minor islands.	The list of minor islands, intended to be exhaustive, needs some amplification. Geomorphological value of minor islands, implied in para. 15.38, needs more emphasis (thereby also reinforcing protective designation). Inclusion of minor islands in policies RCO 10 (AEIs) and RCO 11 (SSIs) would also be appropriate.

Para. 15.39 & **Policies RCO 35-38**	Identify the Id-Dwejra/Il-Qawra area (Gozo) as an area of international importance, and require: 1. Its declaration as a National Park 2. Efforts for its declaration as a World Heritage Site 3. A management scheme and management authority for the area 4. Additional protective zoning within the area	Detailed technical studies on the area have already been completed. Application for designation as a World Heritage Site has been submitted to UNESCO.
Paras. 15.43-15.44	Highlight the need to protect coastal and marine habitats.	Cross-reference to Article 192 (5) of the Law of the Sea Treaty is in-built in para. 15.43.
Policy MCO 1	Identifies 14 candidate Marine Conservation Areas (MCAs).	Not yet implemented.
Para. 15.46 & **Policies MCO 4-5**	Require studies of underwater ecosystems and seek to establish a national system of marine protected areas, with the following aims: 1. Maintaining ecological processes, protecting ecosystems and maintaining biodiversity 2. Establishing baseline data to assess environmental impacts of anthropogenic agents 3. Rendering exploitation sustainable 4. Rehabilitating degraded/polluted ecosystems 5. Quantifying the benefits of area protection	Not yet implemented, apart from underwater surveys at Id-Dwejra.
Policies MCO 2, 6-8	Specify criteria for siting of Marine Conservation Areas, including: 1. Contiguity with terrestrial conservation zones (MCO 6) 2. Overall incorporation of all marine and coastal ecosystem types (MCO 7) 3. Priority to areas that exhibit a wide variety of ecosystems and a greater ecological stability (MCO 8) 4. Incorporation of submarine wrecks (MCO 2)	Not yet implemented. Policy MCO 2 is primarily intended for archaeological purposes, but is indirectly relevant to submarine semi-natural habitats. Policy MCO 6 seeks to protect the selected areas against land-based threats.
Policy MCO 9	Requires conformity of MCAs with international designations	Not yet implemented.
Policy MCO 10	Requires the Planning Authority to rank MCAs by importance	Not yet implemented.
Policy MCO 11	Recognises fishermen's rights, and assigns them preference for site protection jobs/services if protection would threaten their current job.	Not yet relevant.
Policy MCO 12	Requires protection of areas of regional/international importance (e.g. migratory routes, breeding sites of migratory species)	Not yet implemented.

Policy MCO 13	Seeks to establish a management authority for MCAs and requires the preparation and implementation of detailed management plans.	Not yet implemented.
Para. 15.47 & **Policy CZM 2**	Require formulation of an integrated coastal zone management plan catering for (*inter alia*) conservation.	In progress.
Policy PUT 3	Requires avoidance of "land, sea and air pollution" through public utilities planning.	
Policy PUT 19	Favours use of artificial compost for (*inter alia*) afforestation. Also prohibits reclamation of garigue and karstland.	

3.2.7.1.3 Other Legislation

Sand (Preservation) Act, 1949 [Act XVI of 1949]

This act prevents the removal of sand and shingle from any beach, seashore, or any other place without specific permission.

3.2.7.2 Protected Sites

3.2.7.2.1 Nature Reserves

Up to 1997, 22 areas within the Maltese Islands were declared as Nature Reserves in terms of the Environment Protection Act of 1991. In 1997, the surroundings of the radio transmitting station at Xrobb l-Ghagin and of Tas-Silg Fortress, limits of Delimara were removed from the list as per L.N. 215 of 1997, while L.N. 106 of 1998 declared the Heliport at Ta‘ Lambert, limits of G’ajnsielem and Xewkija, Gozo and the surrounding areas up to 200 metres as a Nature Reserve.

It must be emphasised that the designation ‘Nature Reserve’ is a legal designation defined in the Environment Protection Act of 1991; it does not describe a management category such as defined by the IUCN. Of the sites currently designated ‘Nature Reserves’ most are in reality bird sanctuaries where the shooting and trapping of birds is prohibited. Others are parks, public gardens cemeteries, sports grounds and radio and radar installations, and are ‘protected’ not for the habitats and biota they support but to protect public and private property and to reduce nuisances.

In reality there are only two sites that function as nature reserves in terms of management. These are the islands of Filfla and of Fungus Rock. Filfla was established a Nature Reserve by means of the Filfla Nature Reserve Act, 1988. This Act prohibits access to the island with some exceptions and the killing, capture, collecting, trapping, keeping in captivity, taxidermy, commercial exploitation, picking and hunting of any species of flora and fauna in or from Filfla. Only the terrestrial biota is protected. Fungus Rock was established as a Nature Reserve under the Environment Protection Act of 1991 by means of the Fungus Rock (il-Gebla tal-General) Nature Reserve Regulations, 1992. Climbing and access to the plateau surface of Fungus Rock is prohibited and the trerrestrial biota is protected in the same manner as that of Filfla.

A third island group, that of Selmunett Islands, functions as a partial nature reserve since access is limited but not prohibited. This Natrure Reserve was established by means of the Selmunett Islands (St. Paul's Islands) Nature Reserve Regulations, 1993. Access to the islets is restricted to between sunrise and sunset and along designated footpaths, while the terrestrial biota is protected in the same way as that of Filfla and Fungus Rock.

Currently, the following sites are declared Nature Reserves as defined in the Environment Protection Act 1991:

- ?? Surroundings of the Addolorata Cemetery and within 50 metres of any other cemetery in Malta and Gozo.
- ?? Surroundings of Kennedy Grove and Salina.
- ?? Marsa Sports Ground.
- ?? San Anton Gardens and all other public gardens in Malta and Gozo.
- ?? Portes-des-Bombes area including surrounding bastions.
- ?? Manoel Island.
- ?? Surroundings of Ghadira, at Mellieha Bay.
- ?? Within 200 metres from Luqa/Gudia airport and within 50 metres of the approach lights indicating the runways.
- ?? The island of Comino.
- ?? The islet of Filfla.
- ?? Surroundings of Buskett Gardens and Verdala Palace.
- ?? The area on the heights of Ta‘ Cenc cliffs, Gozo.
- ?? Ta‘ Qali complex, including the area formerly used as aerodrome and its adjacent land.
- ?? Within 50 metres of the Radio Stations operated by the Department of Civil
- ?? Aviation at:
  - ?? Benghajsa, limits of Birzebbuga.
  - ?? Dingli Heights, limits of Dingli.
  - ?? Wied Rini, limits of Rabat.
  - ?? Non-directional beacon, Fort San Rocco, limits of Rinella.
  - ?? VOR Station, it-Tafal, limits of Ker[em, Gozo.
- ?? Surroundings of Simar, at Pwales Bay, St. Paul‘s Bay.
- ?? The surroundings of the saltmarsh at il-Ballut, Marsaxlokk.
- ?? St.Paul‘s Islands.
- ?? Girgenti.
- ?? Wied Ghollieqa.
- ?? Il-Qawra, Gozo.
- ?? Ghammar Hill, Gozo.
- ?? Ta‘ Lambert, Gozo.

Apart for the sites listed above, some other areas of ecological and/or scientific value are offered some degree of protection although they have not been declared Nature Reserves.

?? Wied Hazrun

Wied Hazrun is one of the few remaining Holm Oak forest remnants in the Maltese Islands. In addition, the site is the only remaining habitat of some maquis species, such as the endangered Hoary Rockrose *Cistus creticus* spp. *creticus*. The site therefore has considerable ecological value.

The land was previously leased out to farmers for cultivation. However, over the years the lessors have systematically eliminated the maquis habitat, burned some trees, cut down others, covered vegetation with soil and sprayed pesticides, all in order to plant fruit trees.

As an immediate action to conserve what remains of this forest remnant, the site in question was leased to the Environment Protection Department as from 18th March 1998,. Although the farmers concerned were informed of this, they continued to cultivate the site and more fruit trees were planted. Discussions were held between the Department of Agriculture, the Environment Protection Department and the farmers concerned in an attempt to find a compromise solution.

The case is now being considered at Ministerial level and the Environment Protection Department is awaiting instructions as how to proceed.

?? Ghajn Tuffieha

Ghajn Tuffieha is an area of ecological and scientific importance. This area is one of the most frequented by locals and foreigners, and this intense pressure has been causing a general degradation of the habitats present in this locality. A local environmental non-governmental organization, the GAIA Foundation, has drawn up a management plan for the conservation of the area which it has presented to the Environment Protection Department and the Planning Authority. This management plan is currently being implemented by virtue of a contract signed between the GAIA Foundation and the Environment Protection Department. This was done after the area in question was leased to the Environment Protection Department.

3.2.7.2.2 Scheduled Sites

The provisions of the Development Planning Act 1992 and its subsidiary legislation, particularly the Malta Structure Plan, have already been described in detail (section 3.2.7.1.2). Sites scheduled in terms of this Act are given in Tables 3.2.5a, b.

Table 3.2.5a
List of sites scheduled as Areas of Ecological Importance (AEIs) and/or as Sites of Scientific Importance (SSIs) in terms of the Development Planning Act 1992 and its subsidiary legislation. The relevant Government Notice (GN) establishing such scheduling is also given.

GN No.	Site	Locality	AEI/ SSI
661/94	Part of watercourse at Wied Musa	Mellieha	AEI SSI
7/95	Ramla l-Hamra Bay	Xaghra	AEI
117/95	Ghajn Tuffieha Bay	Mgarr	AEI
721/95	Il-Fekruna (Wied tax-Xlendi) l/o Munxar	Munxar	SSI
63/96	Wied il-Bahrija/Wied Rini and Wied Gerzuma	Rabat	AEI SSI
241/97	Wied Ghollieqa l/o San Gwann	San Gwann	AEI SSI
288/95	Freshwater wetland at Ghajn Klin, ix-Xatt l-Ahmar	Ghajnsielem	AEI
288/95	Freshwater wetland at Ghadira ta' Sarraflu	Kercem	AEI SSI
288/95	Freshwater wetland at il-Qattara, Dwejra	San Lawrenz	AEI SSI
288/95	Freshwater wetland at il-Qammieh	Mellieha	SSI AEI
288/95	Freshwater wetland at l-Ghadira s-Safra, Ghallis	Naxxar	AEI SSI
288/95	Freshwater wetland at Il-Qaliet	San Giljan	AEI
288/95	Saline marshland at ir-Ramla tal-Bir	Mellieha	AEI
288/95	Saline marshland at Ramlet il-Qortin	Mellieha	AEI SSI
288/95	Saline marshland at Ta' Qassisu	Mellieha	AEI
288/95	Saline marshland at il-Hofra	Mellieha	AEI
288/95	Saline marshland at Qalet Marku	Naxxar	AEI SSI
288/95	Saline marshland at the mouth of Wied il-Mistra	San Pawl il-Bahar	AEI SSI

288/95	Saline marshland at il-Maghluq	Wied il-Ghajn	AEI SSI
400/96	Coastal cliffs from ic-Cirkewwa to Benghajsa		AEI
400/96	Coastal cliffs from il-Ponta tal-Qrejten to il-Qala ta' San Gorg	Marsaxlokk	AEI
400/96	Coastal cliffs from id-Dahla ta' San Tumas to is-Sarc	Marsaxlokk	AEI
400/96	Coastal cliffs from il-Ponta tal-Mignuna to il-Bajja ta' San Tumas	Wied il-Ghajn	AEI
400/96	Coastal cliffs at Ta' Bulebel	San Pawl il-Bahar	AEI
400/96	Coastal cliffs from tal-Blata to il-Qala tal-Ghazzenin	Mellieha	
400/96	Coastal cliffs from Irdum tal-Griebeg to il-Qala tal-Mistra	Mellieha	
400/96	Coastal cliffs from il-Ponta ta' l-Ahrax to Rdum il-Hmar	Mellieha	
401/96	Sand dunes and saline marshlands at il-Qala ta' Santa Marija	Kemmuna	AEI SSI
401/96	Sand dunes at Dahlet ix-Xilep	Mellieha	SSI
401/96	Sand dunes at ir-Ramla tal-Mixquqa	Mellieha	AEI SSI
401/96	Sand dunes at ir-Ramla tat-Torri	Mellieha	AEI SSI
401/96	Sand dunes at l-Armier	Mellieha	AEI SSI
402/96	Trees at Kennedy Grove and Kennedy drive, is-Salini	Naxxar	
402/96	Saline marshland, garigue, grove and rocky steppe at is-Salini	San Pawl il-Bahar	AEI SSI
403/96	Il-Buskett	Dingli	AEI SSI
583/96	Wied Harq Hamiem and Harq Hamiem Cave	Pembroke	AEI SSI
583/96	Rocky coast, watercourse and karstland surrounding and including the Pembroke Rifle Ranges	Pembroke	AEI SSI

Table 3.2.5b
List of valleys that are protected in terms of the Development Planning Act 1992 and its subsidiary legislation. by virtue of falling within scheduled sites, mostly coastal areas (see Table 3.2.5a).

Locality	**Protected valleys**
Mellieha	valley behind *ir-Ramla tat-Torri; il-Wied ta' L-Imgiebah; il-Wied ta' Ghajn Hadid*; valley behind *ir-Ramla tal-Mixquqa; Wied in-Nahlija; Wied ta' Rdum; il-Wied tal-Baqra*; parts of *il-Wied ta' L-Armier.*
San Pawl il-Bahar	*il-Wied tal-Mistra* (partial).
M'Xlokk	*il-Wied ta' San Pawl*; valley at *il-Hofra l-Kbira*.
B'Bugia	*Wied il-Mixta; Wied Znuber*.
Zurrieq	*Wied Moqbol; Wied Diegu; Wied il-Bassasa; Wied Hareb; Wied Ganu; Wied Babu*.
Qrendi	*Wied iz-Zurrieq; Wied Hoxt; Wiex iz-Zellieqat; Wied il-Maghlaq*.
Rabat	*Wied Gerzuma; Wied Rini; Wied il-Bahrija.*
Siggiewi	*Wied ta' l-Ilsna; Wied ta' San Gorg; Wied il-Buskett*.

Dingli	two unnamed valleys at Dingli Cliffs; *Wied ir-Rum; Wied Hazrun; Wied ta' Ghar Ilma; Wied ta' L-Imtahleb; Wied Markozz; Il-Wied ta' Migra l-Ferha; il-Wied ta' l-Ghajn it-tajba; Wied Gordajna.*
Mgarr	*Wied il-Hmar; il-Wied ta' Fomm ir-Rih; Wied il-Gnejna.*
Ghajnsielem (Gozo)	*Wied L-Ahmar* (Comino).
Mosta	the mouth of *Wied il-Ghasel*.
San Gwann	*Wied Ghollieqa.*
Pembroke	*Wied Harq Hamiem.*

3.2.7.3 Management Of Protected Sites

Until recently, most Nature Reserves did not have a management plan. This has resulted in Reserves being 'managed' on an *ad hoc* basis by whoever was in charge of the site at the time. In some cases this has led to a number of negative impacts on the habitats and biota within the Reserve. A case in point is the Reserve at Ghadira. Although this sites is legally a 'Nature Reserve', it is actually managed as a bird sanctuary for educational purposes and the environment with the Reserve has been engineered such as to promote use of the site by birds. This has however led to deterioration of certain habitats previously present within the site, and of the populations that they supported (see case study. Of particular concern are the sand dunes fringing the seaward border of the Reserve. These have been overrun by weed species and have been planted with non-dune species, resulting in almost total elimination of the previously existing dune habitat.

Case study: Changes at Ghadira followi ng habitat engineering works
[based on Borg, M.J. *et al*. (1990) Centro 1(5): 13-32; and Lanfranco, E. (1990) Centro 1(5): 47-55]

Saline marshland occupies less than 0.5% of the 190km coastline of the Maltese Islands. The Ghadira marsh, situated on the northeastern coast of Malta at Mellieha Bay, and covering an area of c.6 hectares, is the largest such habitat in the islands.

On the microtidal Maltese shores (mean tidal range 0.06m), saline marshlands are maintained by seasonal changes in water level rather than by tidal fluctuations. These changes are controlled by the annual cycles of temperature and precipitation.

The Ghadira marsh is situated on the northeastern tip of a downthrown block of limestone between two SE to NW running parallel normal faults, which define Marfa Ridge to the north and Mellieha Ridge to the south. The Ghadira graben is tilted downwards to the northeast. The northeast shore of the graben is therefore surrounded by higher land on three sides and this has resulted in alluvial and colluvial deposits accumulating at Ghadira. The saline marshland known as the Ghadira marsh develops on these deposits. On the seawards side this marsh is bounded by the sandy shore of Mellieha Bay. A system of sand dunes develops at the back of the beach forming a boundary between the marshland at Ghadira and the beach. The marsh substratum consists of beach sand towards the northeast The substratum becomes predominantly alluvial deposit towards the southwest.

Previous to 1980, a pool of water formed in the centre of the Chadira marsh during the wet season and then gradually dried up until by mid-summer, it was completely dry. It seems likely that the pool formed partly by accumulation of rainwater, directly, and from surface runoff from the surrounding high ground, and partly by incursion of seawater directly from Mellieha Bay during heavy seas and indirectly through seepage through permeable strata. During the dry season this water evaporated, the pool becoming progressively more saline until it dried up completely leaving a deposit of salt in the soil. The greater part of this salt was washed back to the sea by overflow from the pool during the following wet season.

In 1980 habitat engineering work was started in the Ghadira area as part of a plan to tum the Ghadira marsh and part of the surrounding land into a bird sanctuary. The main aim of the work was to deepen the central pool such that it would retain some water all the year round. Additionally, a ditch and embankment were constructed round the perimeter of the protected area, a reservoir was excavated to the west of the pool and several artificial islands were created within the pool itself. This work was completed by 1984. The reserve was officially opened on 10 May 1988.

The modifications carried out on the Ghadira site in connection with its conversion into a bird have caused at least one major change in the nature of the habitat. In the pre-modification stage, Ghadira supported a large, rather shallow pool that invariably dried up in summer while now there is a permanent water body – although the water level fluctuates widely throughout the year. It is thus the aquatic biota which have been most profoundly affected by these changes. The principal change observed is the decline in the population of *Ruppia drepanensis*. This is regrettable in view of the rarity of this species. It is possible that this species favours waters which dry up periodically. However, it is more likely that the main reason for its decline is the great increase in the population of a species of *Cladophora*. Prior to the changes undertaken on the site, the only macroscopic alga noted was a seecies of *Vauchria* (which now seems to have disappeared). The waters of Ghadira tend to become heavily eutrophic from late spring through summer, a phenomenon which, again, is mainly due to the great proliferation of *Cladophora* which depletes the oxygen supply of the pool and dies off. In fact during the hot months, much of the *Cladophora*, especially in the shallower parts, would be dead and in a state of putrefaction. An extensive development of pink halobacteria forms on these dead algal mats. The situation is relieved in the wet season when the pool is replenished by rainwater.

The Environment Protection Department is currently trying to rectify the situation by ensuring that any works carried out within Nature Reserves follow a management plan that has been approved by the Department. Table 3.2.6 summarises the current management status of Nature Reserves and other sites falling under the jurisdiction of the Environment Protection Department.

Table 3.2.6
The management status of Nature Reserves and other sites falling under the jurisdiction of the Environment Protection Department.

Site	Status	Management plan	Operation
Kennedy Grove and Is-Salina	Nature Reserve	None	Nil
Manoel Island	Nature Reserve	Currently none. As part of proposed development, a management plan is to be prepared	Nil
Ghadira	Nature Reserve Managed as a	None	Under the care of Bird Life (Malta)

	bird sanctuary		
Comino	Nature Reserve Managed as a bird sanctuary	None	Nil However, Wied l-Ahmar is currently nder the care of BirdLife (Malta)
Filfla	Nature Reserve	None	Used for bird ringing by BirdLife (Malta)
Buskett Gardens and Verdala Palace	Nature Reserve	Prepared by SSCN for behalf of the Department of Agriculture in 1995	Not implemented
Ta‘ Cenc Cliffs	Nature Reserve	None	Nil
Is-Simar	Nature Reserve Managed as a bird sanctuary	Prepared by BirdLife (Malta) in 1995	Under the care of BirdLife (Malta)
Il-Ballut	Nature Reserve	In preparation by Nature Trust (Malta) and the Environment Protection Department	Nil A fence is being constructed around the periphery of the site
St.Paul‘s Islands	Nature Reserve	None	Nil
Girgenti	Nature Reserve	None	Nil
Wied Ghollieqa	Nature Reserve	Submitted by Nature Trust, in process of revision	Some restoration works have been carried out; works are pending until management plan is approved
Il-Qawra, Gozo	Nature Reserve	None	Nil
Ghammar Hill, Gozo	Nature Reserve	None	Nil
Wied Hazrun	Site of ecological and scientific importance	Submitted by Arbor (now part of Nature Trust)	No actual restoration works are being carried out pending negotiations with lessors
Ghajn Tuffieha	Site of ecological and scientific importance	Submitted by GAIA Foundation, approved by the Environment Protection Department	Second year of implementation
Il-Maghluq ta‘ Marsaskala	Site of ecological and scientific importance	None	In the care of the Countryside Section, Environment

			Protection

There are no monitoring programmes in operation for any habitat in the Maltese Islands, including sites declared as Nature Reserves in terms of the Environment Protection Act or sites scheduled in terms of the Development Planning Act 1992.

A site-monitoring programme has recently been initiated by the Ecological Sites & Habitats and Biodiversity Sections of the Environment Protection Department. However, this programme is still in its initial phases and there is still no information available.

3.2.8 International Treaties Concerned With The Protection Of Habitats

The main international treaties concerned with the protection of habitats of international importance to which Malta is a party are the Ramsar, Bonn and Berne Conventions, and the Geneva protocol on Mediterranean Specially Protected Areas. The present status of Malta in relation to these and other conventions/treaties related to the protection of nature and natural resources is shown in Table 3.2.7.

Table 3.2.7
The status of Malta in relation to the main international treaties concerned with the protection of habitats and biota.

Treaty/Convention	Adopted/Entered into force	Signed by Malta	Ratified by Malta
Protocol for Specially Protected Areas and Biodiversity in the Mediterranean	3 April 1982 Amended 10 June 1995		11 January 1988 Amendments not yet ratified
Ramsar	Adopted 1971 Entered into force 1975		19 August 1988
CITES	Entered into force 1 July 1975	17 April 1989	
Berne	Entered into force 1 June 1982	26 November 1993	
Bonn	Entered into force 3 November 1983	Malta has not yet acceded	
Convention on Biological Diversity	Adopted 22 May 1992 Entered into Force 29 December 1993	22 May 1992	Not yet ratified

3.2.8.1 Protocol for Specially Protected Areas and Biodiversity in the Mediterranean

The Convention for the Protection of the Mediterranean Sea against Pollution was adopted on 16th February 1976. A number of protocols were adopted under this convention, amongst which is the Protocol concerning Mediterranean Specially Protected Areas done at Geneva on 3 April 1982. The Government of Spain is the sponsor of this protocol.

Parties to this protocol are obliged to establish specially protected areas and shall endeavour to undertake the action necessary in order to protect these areas and, as appropriate, to restore them as rapidly a possible. They shall also take measures with regards to their planning and management and develop scientific and technical research. Malta ratified the protocol for Specially Protected Areas on 11 January 1988. This protocol was later amended by the parties and its name changed to Protocol for specially Protected Areas and Biodiversity in the Mediterranean. A number of species were also listed in the two newly set up appendices: one listing endangered or threatened species and the other listing species whose exploitation is regulated.

This new Protocol was adopted on the 10 June 1995. Species recorded in the Maltese territorial waters which are included in the two appendices are: 8 species of plants, 17 species of invertebrate, 5 species of birds, 3 species of reptiles, 12 species of birds and 19 species of mammals listed under endangered or threatened species and 9 species of invertebrates and 16 species of birds whose exploitation is regulated. Although Malta had acceded to the original Protocol, the amendments approved on 10 June 1995 have not yet been ratified.

Under this protocol, which concerns marine and coastal protected areas, Malta has listed the Ghadira Nature Reserve and the Filfla Nature Reserve. However only the avifauna is protected at the Ghadira Reserve, while for Filfla only the terrestrial habitats are protected.

3.2.8.2 The Ramsar Convention

The Convention on Wetlands of International Importance especially as Waterfowl Habitat, also known as the Ramsar Convention, was adopted in 1971 and entered in force in 1975. This intergovernmental treaty provides the framework for international co-operation for the conservation of wetland habitats. The convention describes such wetlands as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water, the depth of which at low tide does not exceed six meters." The Secretariat for this convention is provided by the World Conservation Union - IUCN

It is a general obligation for the contracting parties to this convention to include wetland conservation considerations within the national land use planning, and formulate and implement this planning so as to promote the wise use of wetlands in their territory. Another obligation is the designation of at least one site which must be selected based on its "international significance in terms of ecology, botany, zoology, limnology, and hydrology". Furthermore parties are obliged to promote the conservation of wetlands in their territory, whether or not these are included in the list of the convention, through the establishment of nature reserves. Contracting parties are also obliged to train personnel competent in wetland research, management, and wardening.

This is the first nature conservation convention that was joined by Malta, which acceded to it on the 19 August 1988. The Ghadira Nature Reserve was designated as the wetland for the Ramsar list. The local legislation to honour the obligations of this convention is contained in Legal Notice 144 of 1993 wherein Ghadira is declared a Nature Reserve, however, the regulations forming part of the same legal notice are only concerned with Ghadira as a bird sanctuary. There is no local legislation to declare Ghadira as a nature reserve as outlined in the Convention. In actual fact, only the avifauna is protected at Ghadira. More recently, Is-Simar Nature Reserve was declared an additional Ramsar site.

3.2.8.3 The Bern Convention

The Convention on the Conservation of European Wildlife and Natural Habitats, generally referred to as the Bern Convention, is designed to protect threatened species of flora and fauna, the habitats of these species, the habitats of migratory species, endangered natural habitats, and to safeguard migratory species. It entered in force on the 1st June 1982 and is sponsored by the Council of Europe. As at 9th February 1995, there were 37 members states including the European Union and Senegal, Burkina Faso, Monaco and Tunisia, the last four of which are non-member states of the Council of Europe.

The aims of the convention are to conserve those wild flora and fauna and their natural habitats whose conservation requires the co-operation of several states and to promote such conservation. Particular emphasis is given to endangered and vulnerable species, including endangered and vulnerable migratory species.

The Bern convention has four appendices. Appendix I lists strictly protected flora species. Each party is required to take appropriate steps to prohibit the deliberate picking, collecting, cutting or uprooting of such plants and to protect their habitats. Of the flora listed in Appendix I, 11 species are found in the Maltese Islands.

Appendix II lists strictly protected fauna species and the Convention prohibits the deliberate capture, the destruction of breeding or resting sites, the deliberate destruction or taking of eggs and the deliberate killing of and trade in these species. The following groups found in the Maltese Island are listed in appendix II of the Convention: 9 reptiles, 1 amphibian, 6 fish, 17 invertebrates, 1 insectivore, 9 bats, 18 marine mammals, and over 300 bird species.

Appendix III lists protected species of fauna can be exploited. Parties are obliged to keep these species out of danger by introducing closed hunting seasons, temporary or local prohibitions of exploitation, and the regulation of sale, keeping for sale, and transporting of these species.

The following groups found on the Maltese Islands are also listed in Appendix III of the Convention: 13 fish, 9 invertebrates, 3 reptiles, 5 mammals and a number of birds.

Appendix IV lists prohibited means and methods of killing, capture and other forms of exploitation with regards to exploitation of birds and mammals listed in appendix III.

The contracting parties are also obliged to take appropriate and necessary measures to protect the habitats of the wild flora and fauna listed in Appendix I and II, as well as those areas that are of importance for the migratory species listed in Appendix II and III, both as routes or as wintering, staging, feeding, breeding or moulting areas. On becoming a party, any state may enter a reservation with regards to any species listed in the appendices or to any method listed in Appendix IV.

Malta acceded to this Convention on the 26th November 1993 and entered two reservations in accordance with Article 22 of the Convention. These reservations were later amended and now regard the following:

?? Birds, which can be trapped from 1 September to 31 January i.e. Greenfinch (Carduelis chloris), Goldfinch (Carduelis carduelis), Siskin (Carduelis spinus), Linnet (Carduelis cannabina), Serin (Serinus serinus), and Hawfinch (Coccothraustes coccothraustes). All these species are included in Appendix II - strictly protected fauna species.

?? Following the recent additions to the appendixes of the Bern Convention, another reservation was placed with regard to five species of fish. Furthermore, one exception was placed with regard to two marine flora.

All the species of flora and fauna recorded in the Maltese islands and listed in the Bern Convention are protected (Legal Notices 76 of 1992, 77 of 1992 and 49 of 1993). However, although the species are protected their habitats are not.

Table 3.2.8 gives a summary of the 'Recommendations' and 'Resolutions' of the Bern convention that are applicable to the Maltese Islands

Table 3.2.8
Recommendations and Resolutions of the Bern Convention of relevance to the Maltese Islands

Area of concern	**Recommendation /Resolution**	**Title**
Alien species	Rec 45/95	On controlling the proliferation of *Caulerpa taxifolia* in the Mediterranean
	Rec 57/97	On the introduction of organisms belonging to non-native species into the environment
	Rec 58/97	On the reintroduction of organisms belonging to wild species and on restocking and reinforcing populations of such organisms in the environment
Birds	Rec 5/86	On the prosecution of persons illegally catching, killing or trading in protected birds
	Rec 48/96	On the conservation of European globally threatened birds
Marine turtles	Rec 7/87	On the protection of marine turtles and their habitat
Invertebrates	Rec 21/91	On the conservation of insects of the order Hymenoptera and their habitat
	Rec 29/91	On the conservation of wetland invertebrates
	Rec 52/96	On habitat conservation for invertebrate species
Fauna in general	Rec 59/97	On the drafting and implementation of Action Plans of wild fauna species
Plants	Rec 30/91	On the conservation of species in Appendix I to the Convention
	Rec 40/93	On the elaboration of conservation or recovery plans for species in Appendix I of the Convention
	Rec 49/96	On the protection of wild plant species which are subject to exploitation and commerce
Habitats & EMERALD Network	Res 1/89	On the provisions relating to the conservation of habitats
	Res 4/96	Listing endangered natural habitats requiring specific conservation measures

	Rec 14/89	On species habitat conservation and on the conservation of endangered natural habitats [relates to the EMERALD Network]
	Rec 15/89	On the conservation of endangered natural habitat types [relates to the EMERALD Network]
	Rec 16/89	On Areas of Special Conservation Interest (ASCIs) [relates to the EMERALD Network]
	Rec 25/91	On the conservation of natural areas outside protected areas proper
	Rec 36/92	On the conservation of underground habitats

The Habitats Directive

The European Union's *Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora* has become known as the 'Habitats Directive'. While the 'Habitats Directive' has the Bern Convention as its basis, it goes further in that it establishes the important principle that natural habitats should be preserved for their own sake, and not only because they support certain species of conservation interest. The 'Habitats Directive', together with the 'Birds Directive' (Council Directive 79/409/EEC on the conservation of wild birds), form the European Union's main legislative instruments in the field of nature conservation.

In brief, the 'Habitats Directive' establishes a common framework for the conservation of animals, plants and natural habitats of interest to Union Member States, and provides for the creation of a network of "Special Areas of Conservation" to be called "Natura 2000. The 'Habitats Directive' consists of four main parts. The first defines important terms used (Article 1) and sets out the aims of the Directive (Article 2). The second part (Articles 3-11) defines the procedures, criteria and time frame for the selection and designation of Special Areas of Conservation (SACs) as well as the obligations of Member States to establish priorities and conservation measures for the maintenance and restoration of those habitats and species of Union interest that are listed in the annexes to the Directive (Annexes I and II, respectively). The third part (Articles 12-16) describes the measures which Member States are required to take for the conservation of certain species of animals and plants designated as requiring "strict protection" (Annex IV). The final part of the Directive (Articles 17-24) concerns complementary activities for the implementation of the Directive, including dissemination of information and promotion of research and education.

A key part of the Directive is the annexes, of which there are six. Annex I lists natural habitats whose conservation requires the designation of SACs. Some 200 different types of habitat are listed, some of which are further designated as "priority habitat types". These habitats are not all those found in Europe, but rather, only those considered as the Union's most valuable. Included in the list are rare habitats and those which only cover small areas, habitats that are very rich in species, those which are essential for migratory species and those which illustrate how the European environment has evolved. A number of habitats listed in Annex I are also found in the Maltese Islands (Table 3.2.9); examples include: meadows of the sea-grass *Posidonia* (a priority habitat), coastal cliffs with endemic species of sea-lavender (*Limonium*, of which at least three species are endemic to the Maltese Islands), Mediterranean salt meadows, Mediterranean sand dunes, Mediterranean temporary rainwater pools (a priority habitat), spurge (*Euphorbia*) garigue growing at the foot of cliffs, vegetation of limestone pavements (a priority habitat), caves and submerged and partly submerged sea-caves, and woodland with Holm Oak (*Quercus ilex*).

Table 3.2.9
Priority Habitats listed in Annex I of the European Union's Habitats Directive, which also occur in the Maltese Islands

Code	Habitat
11.34	*Posidonia* beds
22.34	Mediterranean temporary ponds
32.18	Matorral with *Laurus nobilis*
34.5	Pseudo-steppe with grasses and annuals (*Thero-Brachypodietea*)
?62.4	Limestone pavements
?42.A6	*Tetraclinis articulata* forests

Annex II lists species of plants and animals whose habitats must be protected for their survival. Annex II species that are also found in the Maltese Islands include: several bats, the Bottle-nosed Dolphin (*Tursiops truncatus*), the Loggerhead Turtle (*Caretta caretta*), the Leopard Snake (*Elaphe situla*), the Killifish (*Aphanius fasciatus*), the longhorn beetle *Cerambyx cerdo*, and two species of mosses (*Petalophyllum ralfsii* and *Riella helicophylla*).

Annex III lists criteria for selecting sites eligible for consideration as "Sites of Community Importance" and designation as SACs, while Annex IV lists species of Union interest in need of strict protection. This annex includes more than 170 species of plants, 160 species of vertebrates and 70 species of invertebrates. Again, a number of species listed in this annex occur also in the Maltese Islands. These include: the Algerian Hedgehog (*Erinaceus algirus*), all Maltese bats, all species of whales, dolphins and marine turtles that occur in Maltese waters, most species of Maltese reptiles and the local frog (*Discoglossus pictus*), the Date Mussel (*Lithophaga lithophaga*), the Noble Pen-shell (*Pinna nobilis*), and the Long-spined Sea-urchin (*Centrostephanus longispinus*).

Annex V list species of plants and animals of Union interest whose taking from the wild and exploitation is subject to management, that is, their exploitation must be controlled such as to ensure their survival in the wild. Of interest to Malta in this list is the Red Coral (*Corallium rubrum*) and the Mediterranean Locust Lobster (*Scyllarides latus*). Finally, Annex VI lists prohibited methods and means of capture and killing of mammals and fish, and prohibited modes of transport. It should be pointed out that no birds are listed in any of the annexes, as the protection of birds and their habitats are the subject of a separate Council Directive -- the 'Birds Directive' mentioned above.

The ultimate aim of the 'Habitats Directive' is the designation of Special Areas of Conservation and their integration into a larger entity – the European "Natura 2000" network. The main threat to European habitats and wildlife is seen as the fragmentation of natural habitats and the blocking of ecological corridors between different areas due to development. The "Natura 2000" network will be a system of linked conservation areas aimed at the maintenance of European biodiversity primarily through sustainable land management in and around habitats of Union or wider importance.

The EMERALD Network of the Bern Convention

In 1989 the Standing Committee of the Convention on the Conservation of European Wildlife and Natural Habitats (the Bern Convention), to which Malta is a party, created the EMERALD network [Standing Committee of the Berne Convention Recommendation No. 16 (1989) and Resolution No. 3 (1996)]. This is explicitly concerned with the protection of natural habitats, which are designated as Areas of Special Conservation Interest (ASCIs) and is a non-EU version of the Habitats Directive, although it expands upon this, enabling inclusion of sites important for species other than those listed in its annexes (unlike the Habitats Directive).

The EMERALD network is not yet functional and is presently (1998) awaiting approval of the draft species lists to be included in its appendices, by the Standing Committee of the Berne Convention. Various species of interest to Malta are included in the draft lists. Amongst these are the Crescent Orchid (*Ophrys lunulata*), a threatened Siculo-Maltese endemic, the Leopard Snake (*Elaphe situla*) and the sponge (*Petrobiona massiliana*).

Amongst the threatened natural habitat types requiring specific conservation measures, the following, listed in Resolution No. 4 (1996), are of relevance to the Maltese Islands: benthic communities (CORINE 11.2); sea-grass meadows (11.3); Mediterranean salt meadows (15.5); dunes (16.2); tree-spurge formations (32.22); Mediterranean xeric grasslands (34.5); riparian willow formations (44.1) and caves (65).

3.2.8.4 The Bonn Convention

The Convention on the Conservation of Migratory Species of Wild Animals is an intergovernmental treaty that aims to conserve terrestrial and marine species over the whole of their migratory range. Migratory species are particularly vulnerable to a wide range of threats which can include destruction of habitat in breeding areas, excessive hunting along migration routes, and the degradation of feeding sites. This convention also known as the Bonn Convention was concluded in 1979 and came into force on 3 November 1983. The secretariat for this convention is provided by the United Nations Environment Program - UNEP.

The Bonn Convention provides for the adoption of strict protective measures for migratory species that have been listed as endangered. It also provides for agreements for the conservation and management of migratory species that have been listed as endangered, and provides for agreements for the conservation and management of migratory species that have an unfavourable conservation status or would benefit from conservation measures taken by countries - called range states - that exercise jurisdiction over any part of the species distribution.

Appendix I lists species that are in danger of extinction throughout all or a significant proportion of their range. Species included on the list and recorded in the Maltese Islands include amongst others, the Loggerhead Turtle (*Caretta caretta*) and Audouin's Gull (*Larus audouinii*). Range states are required to give species listed in Appendix I full protection, and as such prohibit the taking or such species. ‘Taking’ is understood to mean hunting, fishing, capture, harassing and deliberated killing. Range states are defined to include also countries under whose flag, ships on the high seas are involved in taking migratory species. Furthermore, range states of species listed in Appendix I are to endeavour to conserve these species, their habitats, to counteract factors impeding their migration and to control other activities that might endanger them.

Appendix II lists migratory species, not necessarily threatened with extinction, whose conservation status require, or would benefit from, international co-operative agreements. Species listed in Appendix II that are recorded from the Maltese Islands include dolphins and the White Stork, amongst others.

The Convention provides for two types of agreements for species listed in Appendix II. There are ‘AGREEMENTS’ (written in capital letters in the convention) and 'agreements' (to distinguish them from ‘AGREEMENTS’). ‘AGREEMENTS’ are intended to benefit migratory species, especially those with an unfavourable conservation status over their entire range.

These agreements are open to the range states of the species concerned, but also include those range states that are not a party to the parent convention. Guidelines are offered in the text of the convention as to what the minimum requirement should include. These agreements should provide for:

?? Co-ordinated conservation and management plans;.
?? Conservation of appropriately situated habitats;
?? Control of factors impeding migration;
?? Research initiatives;
?? Periodic assessments of the species' conservation status; and
?? Exchange of information among range states.

The aim of such 'AGREEMENTS' is to restore the migratory species concerned to a favourable conservation status or to maintain it in such a state.

The other type of agreement is for migratory species that periodically cross national jurisdictional boundaries. Such 'agreements' can be done for species that are neither migratory, as defined by the Convention nor listed in APPENDIX II. These 'agreements' can be reached between some, but not necessary all, range states.

A number of 'AGREEMENTS' have been concluded under this Convention. Besides the Wadden Sea Agreement and that for common seals, which do not directly concern Malta, two other 'AGREEMENTS' were concluded which are of great interest to Malta in the management of biodiversity. The **AGREEMENT on the conservation of bats in Europe** was concluded in September 1991. This covers 29 species of bats from the families Rhinolophidae and Vespertilionidae. This 'AGREEMENT' obliges parties to prohibit the deliberate capture, keeping of killing of bats except under permit, to identify and protect sites of importance for their conservation, and to promote research programmes and public awareness initiatives.

Another 'AGREEMENT' on the conservation of the small cetaceans of the Baltic and North Sea was concluded in September 1991. Another similar **'AGREEMENT' on the conservation of small cetaceans in the Mediterranean and the Black Sea** has been prepared and is pending further negotiations by the range states. There are other AGREEMENTS being developed amongst which is the 'AGREEMENT' on the conservation of African/Eurasian waterfowl which provides for a comprehensive management plan for waterfowl conservation.

Malta has not as yet acceded to the Convention on Migratory Species or to any of the AGREEMENTS. This is despite the fact that the local regulations for the protection of marine mammals (LN 76 of 1992), reptiles (LN 77 of 1992), avifauna (LN 146 of 1993) and other fauna (UN 49 of 1993) are sufficient to honour the basic obligations arising out of the parent convention and also the respective AGREEMENTS. Although some local species of fauna are legally protected there is hardly any international commitment and involvement in international programs. This does not help local efforts for the protection and management of biodiversity, the more so since most of the protected species are migratory species.

3.2.8.5 The Convention on Biological Diversity

The Convention on Biological Diversity was adopted on 22nd May 1992. On the 5th June 1992, it was signed by 150 states, including Malta. The Convention entered in force on 29 December, 1993.

The Convention on Biological Diversity is a framework convention. In this convention there are no lists and no annexes of accepted sites or of species to be protected. Its provisions are not expressed as hard and precise obligations. They are mostly expressed as overall goals and policies. Neither does it set targets such as the 'Natura 2000' of the European Union. Instead, the Convention on Biological Diversity puts emphasis on decision making at the national level.

The Convention's objectives include the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of utilisation of genetic resources. It requires parties to develop national strategies, plans or programmes for the conservation of biodiversity and for the sustainable use of biological resources. The convention sets out policies to be followed. Major policies include effective in-situ conservation of biological diversity, giving also goals on which to establish laws and policies.

The same approach is given to ex-situ conservation. Other policies include those on sustainable use of biological resources, and on environment impact assessment. These are supplemented by commitments on research and training and on education and awareness. Other policies outline access to genetic resources, and access to and transfer of technology. The Convention also emphasises the possibility to negotiate annexes and protocols by the Conference of the Parties. It is emphasised that states have a sovereign right over biological resources, however, the conservation of biological diversity is a common concern of humankind implying a common responsibility based on the importance of biodiversity to the international community as a whole.

The Convention creates obligations to develop national strategies and plans, and to integrate the conservation and sustainable use of biological diversity into relevant plans, programmes and policies as well as into national decision-making, as for example, road-building policies, land clearance polices, medicinal plant policies etc.

In-situ conservation obligations are emphasised. These call for measures ranging from the establishment of a system of protected areas to the rehabilitation of degraded ecosystems, the recovery of threatened species, the protection of natural habitats, and the maintenance of a viable population of species in natural surroundings.

In its preamble, the Convention on Biological Diversity makes a reference to the precautionary principle: "*….where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimise such a threat*."

3.2.9 The Pan-European Biological and Landscape Diversity Strategy

At the Ministerial Conference "*Environment for Europe*" (Sofia, 23-25 October 1995), the environment ministers of 55 European countries endorsed the **Pan-European Biological and Landscape Diversity Strategy**, hereafter referred to as the 'Strategy'.

Scope

The Strategy presents an innovative and proactive approach to stop and reverse the degradation of biological and landscape diversity in Europe, and promotes the integration of such diversity considerations into social end economic sectors. It also provides a consistent approach and common objectives for national and regional action to implement the Convention on Biological Diversity.

The Legal framework for protecting Europe's biological and landscape diversity already exists in the various conventions, including the Convention on Biological Diversity, Bern, Bonn and Ramsar Conventions and the EU's Habitats and Birds Directives. The Strategy is not a treaty, directive or convention but seeks to provide a co-ordinating, unifying framework to strengthen the existing treaties, conventions and other related initiatives.

Aims and Objectives

1. To reduce and, if possible, eliminate current threats to Europe's biological and landscape diversity;
2. To increase the resilience of Europe's biological and landscape diversity;

3. To strengthen the ecological coherence of Europe as a whole;
4. To ensure full public involvement in the consideration of various aspects of biological and landscape diversity.
5. To conserve, enhance and restore key ecosystems, habitats, species and features of the landscape through the creation and effective management of the Pan-European Ecological Network;
6. To ensure sustainable management of Europe's biological and landscape diversity by taking full advantage of the social and economic opportunities available at national and regional levels;
7. To integrate diversity conservation and s ustainable use objectives;
8. To improve information on, and public and decision-makers' awareness of, biological and landscape diversity issues; to increase public participation in action to conserve and enhance such diversity;
9. To improve understanding of the state of biological and landscape diversity in Europe and of the processes that render it sustainable.

The strategy has a 20-year scope, but will be implemented through a series of five-year action plans, so as to make optimal use of opportunities as they occur over the next two decades.

The first Action Plans for the 1996-2000 include the following action themes:

1. Establishing a Pan-European Ecological Network
2. Integration of biological and landscape diversity considerations into sectors;
3. Raising awareness and support policy makers and the public
4. Conservation of landscapes
5. Coastal and Marine Ecosystems
6. River ecosystems and related wetlands
7. Inland wetland ecosystems
8. Grassland Ecosystems
9. Forest Ecosystems
10. Mountain Ecosystems
11. Action for threatened species

CONTINUE

3.3. Exploitation of wildlife

3.3.1 Hunting And Trapping

3.3.1.1 Number Of Hunters/Trappers

The total number of hunters and trappers can be estimated from the number of hunting and trapping licences issued by the police.

Information on the number of hunting and trapping licenses issued by the police since 1985 has been requested from the Commissioner of Police. An acknowledgement was received but to the time of writing no information has been supplied.

Amendments to the Protection of Birds and Wild Rabbit Regulations,1993 made in 1997 have set up different categories of licenses for shooting and trapping birds and the wild rabbit and have introduced the *Carnet de Chasse* as a pre-requisite for obtaining trapping licences. The different kinds of licences are:

Licence	Description
A	Hunting on land
B	Hunting on land for Turtle Dove and Quail in spring
C	Hunting at sea
D	Hunting of wild rabbit
E	Trapping in autumn
F	Trapping in spring
G	Trapping of wild rabbit

This new licensing system only came into operation in 1997 and hence only one year's worth of data is available so far.

During 1997 a total of 4257 *carnet de chasse* forms were forwarded to the Environment Protection Department by the Commissioner of Police, each form representing a licensee Table 3.3.1). This figure is not representative of the total number of licensees. The total number of licensed hunters and trappers is believed to be greater.

Table 3.3.1
The number of licences issued under the new licensing and *carnet de chasse* regulations

Type of licence	Number of renewals for 1997		
	Gozo	**Malta**	**Total**
Licence A	489	2550	3039
Licence B	492	2559	3051
Licence C	2	37	39
Licence D	3	32	35
Licence E	231	736	967
Licence F	153	588	741
Licence G	5	12	17
Unknown	18	972	990

Total Number of Licensees	545	3712	4257

Notes

1. Unknown licences refer to those cases where the licensee did not specify what type of licence/s he has. A large number of 'unknowns' were submitted in 1996, about 25% of the total number of completed forms.

2. The total number of licences issued is greater than the total number of licensees since a single individual may hole more than one type of licence.

Bird ringing licences

A bird ringing licence is issued by the Commissioner of Police, in accordance with LN 146 of 1993, Reg. 20. In order to apply for a bird ringing licence a person must be authorised by the Minister responsible for the Environment, be in possession of a bird ringing training certificate from EURING (European Union for Bird Ringing), have the approval for bird ringing from EURING and not be in possession of a hunting or trapping licence. This licence allows the study of birds through their taking for ringing or marking at any time of the day, as well as in nature reserves.

Table 3.3.2
Total number of applications for bird ringing licences forwarded to the commissioner of police

Year	Number of licences
1996	14
1997	14
1998	14

3.3.1.2 Bag statistics

The *carnet de chasse*

The *carnet de chasse*, as the name implies is a statement of the previous year's catch of hunted and trapped birds. To have a hunting or trapping licence renewed for another year, each applicant is required to complete a form declaring the previous year's catch. From these forms the total number of birds of each species declared to be hunted or trapped may be derived. The applicants are required to declare the total number of finches of each species trapped in spring and in autumn. The data for the spring catches of finches are necessary for Malta to honour its commitments in terms of the Bern Convention by submitting a report to the Secretariat of the Convention on the number of trapping licences and the number of species of finches trapped.

Reporting

Reporting on the numbers of birds taken is done by the licensees themselves by filling a prescribed form and therefore there is no independent verification of the accuracy of the data. The completed forms are submitted to the Commissioner of Police before the licence is renewed and the forms are later passed on to the Environment Protection Department.

Available data

As stated above the declaration refers to the previous year's catch. The regulations that introduced the *Carnet de Chasse* were only established in 1997 and therefore the only data available so far are for the 1996 catch (Table 3.3.3).

Table 3.3.3
The total number of birds of each species shot in Malta and Gozo during 1996 as per the *Carnet de Chasse* declarations received by the Environment Protection Department.

Species shot			MALTA	GOZO	TOTAL
Wizza tal-Ful	*Anser fabalis*	Bean Goose	4	2	6
Wizza Griza	*Anser anser*	Grey Lag Goose	25	2	27
Silfjun Ewropew	*Anas penelope*	Wigeon	8	2	10
Kuluvert Griz	*Anas strepera*	Gadwall	38	2	40
Sarsella	*Anas crecca*	Teal	61	2	63
Kuluvert	*Anas platyrhynchos*	Mallard	43	2	45
Silfjun	*Anas acuta*	Pintail	37	3	40
Sarsella Hamra	*Anas querquedula*	Garganey	53	2	55
Palettuna	*Anas clypeata*	Shoveler	5	2	7
Brajmla	*Aythya ferina*	Pochard	20	2	22
Brajmla tat-toppu	*Aythya fuligula*	Tufted Duck	5	2	7
Serra	*Mergus serrator*	Red-breasted Merganser	9	2	11
Tigiega tal-Bahar	*Fulica atra*	Coot	13	3	16
Pluviera	*Pluvialis apricaria*	Golden Plover	270	17	287
Pluviera Pastarda	*Pluvialis squatarola*	Grey Plover	38	5	43
Venewwa	*Vanellus vanellus*	Lapwing	67	3	70
Cikonja	*Lymnocryptes minimus*	Jack Snipe	14	2	16
Bekkacc	*Gallinago gallinago*	Snipe	90	7	97
Gallina	*Scolopax rusticola*	Wood Cock	306	11	317
Tundun	*Colomba palumbus*	Wood Pigeon	126	2	128
Alwetta	*Alauda arvensis*	Skylark	7420	413	7833
Malvizz Iswed	*Turdus merula*	Blackbird	1743	56	1799
Malvizzun tal-Qtajja	*Turdus pilaris*	Fieldfare	853	18	871
Malvizz	*Turdus philomelos*	Song Thrush	9404	246	9650
Malvizz Ahmar	*Turdus iliacus*	Redwing	558	45	603
Malvizzun Prim	*Turdus viscivorus*	Mistle Thrush	429	22	451
Sturnell	*Sturnus vulgaris*	Starling	4424	54	4478
Gallozz Iswed	*Gallinula chloropus*	Moorhen	90	2	92
Girwiel	*Philomachus pugnax*	Ruff	45	2	47
Gallozz tax-Xitwa	*Rallus aquaticus*	Water Rail	33	2	35
Gamiema	*Coturnix coturnix*	Turtle Dove	19658	4444	24102
Summiena	*Streptopelia turtur*	Quail	9496	2563	12059

	TOTALS	55385	7942	63327

Table 3.3.4
The total number of birds of each species trapped in Malta and Gozo during 1996 as per the *Carnet de Chasse* declarations received by the Environment Protection Department.

Species trapped			MALTA	GOZO	TOTAL
Summiena	*Coturnix coturnix*	Quail	490	46	536
Gamiema	*Streptopelia turtur*	Turtle Dove	1257	269	1526
Gojjin	*Carduelis cannabina*	Linnet	3412	643	4055
Apparell	*Serinus serinus*	Serin	1407	348	1755
Verdun	*Carduelis chloris*	Greenfinch	948	334	1282
Gardell	*Carduelis carduelis*	Goldfinch	638	116	754
Sponsun	*Fringilla coelebs*	Chaffinch	1550	272	1822
Ekru	*Carduelis spinus*	Siskins	155	32	187
Taz-Zebbug	*Coccothraustes coccothraustes*	Hawfinch	266	45	311
Pluviera	*Pluvialis apricaria*	Golden Plover	110	10	120
Malvizz	*Turdus philomelos*	Song Thrush	206	20	226
Sturnell	*Sturnus vulgaris*	Starling	92	7	99
		TOTALS	**10531**	**2142**	**12673**

CONTINUE

3.4. Fisheries

3.4.1 Characteristics Of Local Fisheries

Although fishing in the Maltese Islands is practised all year round, the bulk of the effort concerns coastal or small-scale fisheries. Only the larger craft, of which there are very few, practice fishing on the high seas throughout the year.

Most vessels can be termed multipurpose craft although the larger ones are specific to long-lining and Lampuki fishing. Multipurpose vessels undertake all types of fishing but on a smaller scale.

Fishing in Malta is mainly seasonal. Fishers are classified as 'full-timers' if they are licensed boat owners whose main income is derived from fishing. These own only about 17% of the total fleet. The rest are 'part-timers' apart from a handful who occasionally sell fish through the wholesale market. However, most full-time fishers operate at least one small craft and one large craft enabling them to practice offshore fishing during the milder seasons (spring and summer) and inshore-fishing during the winter months.

The actual number employed on each boat is on average three persons per unit during the winter months while when undertaking fishing trips of more than two days, generally during the milder seasons, extra hands (part-timers) are sometimes employed.

3.4.1.1 Fishing fleet

The General Fisheries Council for the Mediterranean (GFCM), at its twenty first session held in Alicante, Spain, agreed to set a minimum length limit of 15m for the application of the '*Agreement to promote compliance with international conservation and management measures by fishing vessels on high seas*.' Maltese vessels over 15m in length are thus considered as full-time employees in line with this agreement.

In 1998 the total number of licensed fishing vessels was 1792 (1475 in Malta and 317 in Gozo). Out of these only 47 are considered industrial vessels (i.e. over 15 m length), mainly trawlers, long-liners and netters.

Within the framework of the study of artisanal fisheries set up by the FAO-COPEMED project and during the meeting held in Malta in March 1998, experts from the eight COPEMED countries defined the fleets that should or should not be included under artisanal fisheries. All fleets should be termed artisanal except for the following:

?? Trawls
?? Big seines for small pelagic (other than those using the 'Lampara' method)
?? Gears targeting big pelagic (purse seines, long-liners, driftnets, madragues, tuna rods and drag-nets)
?? Hydraulic drag-nets for shellfish

All 'Lampara' seine fishing is considered artisanal.

3.4.1.2 Fishers

Fig. 4.1 shows the number of registered fishers (full time and part time for the period 1959 to 1995. On the 31st August 1998, the total registered fishing population was 1864, according to the official figures available at the Department of Fisheries. Out of these, the number of registered gainfully employed full-time fishers was 374.

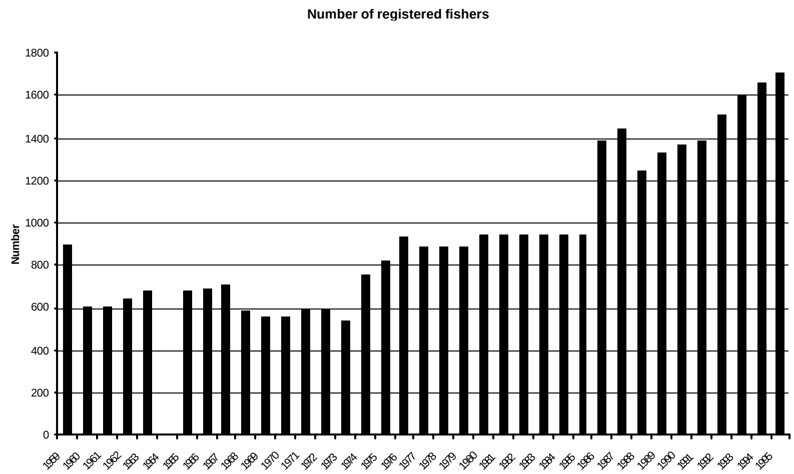


Fig. 4.1 Annual variation in the number of registered fishers

3.4.1.3 Fishing Seasons

The most important fishing seasons are listed below according to the species targeted.

??	Bluefin tuna	May and July
??	Dolphin fish	September to December

The above are the most commercially important seasons for the Maltese market, both because of the amount of fish caught and the income generated by the catch. Other species that are less important but still provide a significant contribution to the catch and income include:

??	Stone bass, groupers and snappers	January to April
??	Lampara (1)	March to July
??	Swordfish (2)	September to November

(1) The Lampara fish include all species caught by the Lampara technique.
(2) The Swordfish season was shifted from spring/summer to accommodate the upsurge in Tuna catches and the opening of the Tokyo market.

Bottom trawling takes place during two seasons due to the changes in weather that prevent open seas fishing in the winter months. Deep offshore bottoms are trawled for crustaceans during spring/summer and shallow coastal waters are trawled in the autumn/winter for demersal species.

3.4.1.4 Fishing Methods

The most widely used gear are long-lines, set adrift for pelagic species and close to the bottom for demersal species. Modified seines are used for Lampuki and Lampara. Long-lines are called the *konz* locally. This method involves unravelling a long line of baited hooks, kept afloat by means of buoys and displaying flags with the fishing team's colours. How distant the hooks are from each other, what kinds of bait hooks are used and so on depend on the species targeted. This technique is mainly used for tuna and swordfish, while a deep-sea version (with the line just a few meters off the seabed) is used for *pistin*. This is a word adapted from Italian for ‘ugly fish,’ that is dogfish, stone bass and so on. The gear used for Swordfish is surface drifting long-lines (LLD) and the number of baited hooks varies according to the boat’s size and range. The larger boats that venture beyond 25 nautical miles and remain at sea for at least 5 days may set as many as 2000 hooks at any time, weather permitting. Smaller craft spend a maximum of three days at sea and set between 500 and 700 hooks per effort. A stronger version of the pelagic long-line is used specifically for large sharks.

The Lampuki and Lampara methods are basically the same, that is purse-seining, but the size of mesh and the materials used differ. Fishing aggregating devices, or FADs, locally termed *kannizzati*, are used to attract Dolphin fish (*Lampuki* in Maltese) as they provide shade for the fish. These are rectangular rafts, anchored to the bottom, constructed of expanded polystyrene coated with an impermeable material that can be dismantled once the season is over. Each fishing team has its own site with a number of *kannizzati* distributed several meters away from each other and displaying the team’s colours. A special flag is used every so often to facilitate counting. This method was introduced after it was noticed that Dolphinfish (*Coryphaena hippuris*) along with other species, such as the Pilotfish (*Naucrates ductor*) and the Amberjack (*Seriola dumerili*), tend to aggregate within the canopy of shadow these floats make. Bright lamps are used in the Lampara method, hence the name. The fishing team includes one small boat that bears a bright lamp while the rest form a ring of modified purse seines around it. Fish attracted by the light are surrounded and caught. This technique is mainly used for the Atlantic mackerel, but other species of mackerel are also caught.

Bottom trawl nets and trammel nets are mainly used in winter. Two techniques are used for trawling depending on whether the sea bottom is sandy of rocky. Pelagic trawling is not practised. In all cases the nets used are the Mazara type otter trawls which are adjusted according to the type of terrain in which operations are being conducted. Drift nets are used during May to August for specific pelagic species.

Traps are widely used for the coastal fishery of demersal species, especially for catching small fish for fish-soup, and for octopus. They are constructed in different shapes and sizes according to the species targeted. For species such as the Moray eel and octopus the material used is chicken wire netting. For Bogue, Picarel and similar species the material used is cane cut into fine strips or a specific species of reed imported from North Africa. Shapes vary according to the migratory habits of the targeted species. Demersal species require a rectangular trap while the shape is oval or round for mid-water species.

3.4.1.5 Species Fished

Table 3.4.1 is a list of the 60 most important species exploited between 1959 and 1996 (both years included). Some of these species have been grouped into general categories as explained in the section on trends.

Table 3.4.1
The 60 most important species caught between 1959 and 1996.

Scientific Name	English Name	Maltese Name
Aphya pellucida	Pellucid sole	Makku
Auxis rochei	Frigate mackerel	Tumbrell
Auxis thazard	Frigate mackarel	Tumbrell
Belone belone	Garfish	Insella

Boops boops	Bogue	Vopa
Centrophorus granulosus	Roughshark	Zaghrun
Centrophorus sp.	Dogfish	Mazzola
Chromis chromis	Damselfish	Cawla
Conger conger	Conger eel	Gringu
Coryphaena hippuris	Dorado	Lampuka
Crangon crangon	Shrimp	Gamblu
Dasybatus pastinachus	Ray	Boll
Dentex dentex	Dentex	Dentici
Euthynnus alletteratus	Little tunny	Tunnacc
Helicolenus dactylopterus	Rockfish	Cipullazza
Heptranchias perlo	Seven-gilled shark	Murruna
Hexanchus griseus	Six-gilled shark	Murruna
Lamna nasus	Porbeagle	Pixxiplamtu
Lepidopus caudatus	Silver scabbardfish	Xabla
Loligo vulgaris	Squid	Klamari
Lophius sp.	Anglerfish	Petricia
Lophotus lacepedei	Crested oarfish	Xabla
Merluccius merluccius	Hake	Marlozz
Mugil sp.	Mulett	Mulett
Mullus barbatus	Red mulett	Trilja
Muraena helena	Moray eel	Morina
Naucrates ductor	Pilot fish	Fanfru
Oblada melanura	Saddled bream	Kahlija
Octopodidae	Octopus	Qarnit
Oxynotus centrina	Angular roughshark	Gurdien
Pagellus centrodontus	Common seabream	Pagell
Pagrus sp.	Red bream	Pagru
Phycis sp.	Forkbeard	Lipp
Polyprion americanus	Stone bass	Dott
Polyprion cernium	Grouper	Cerna
Prionace glauca	Blue shark	Huta kahla
Sarda sarda	Atlantic bonito	Plamtu
Sardina pilchardus	Pilchard	Nemusa
Sardinella aurita	Gilt sardine	Lacca
Sargus sargus	Bream	Sargu
Sarpa salpa	Salema	Xilpa
Sciaena umbra	Brown meagre	Gurbell
Scomber scomber	Mackarel	Kavalli
Scophthalmus rhombus	Common sole	Barbun
Scorpaena scrofa	Scorpionfish	Cipullazza
Scyliorhinus sp.	Dogfish	Qattus
Sepia sp.	Cuttlefish	Sicc
Seriola dumerili	Amberjack	Accola
Serranus cabrilla	Comber	Sirran
Serranus scriba	Painted comber	Burqax
Smaris vulgaris	Picarel	Arznell
Sphyrna sp.	Hammerhead shark	Kurazza
Squatina squatina	Angel shark	Xkatlu
Tetrapturus belone	Mediterranean spearfish	Pastardella

Thunnus alalunga	Albacore	Alonga
Thynnus thynnus	Bluefin tuna	Tonn
Trachinus araneus	Spotted weaver	Tracna
Trachurus trachurus	Scad	Sawrell
Triglia lyra	Gunard	Gallina
Xiphias gladius	Swordfish	Pixxispad
Zeus faber	John Dory	Pixxi San Pietru

3.4.1.6 Marketing

According to Fisheries Regulations all fish caught by local fishers have to be sold throughout the Wholesale Market in Valletta (Fish Marketing Regulations, 1957 - G.N. 395, par. 6). Catches are sold by auction through middlemen to retailers. These then sell to shop owners and hawkers. All dealers in fish are registered with the Fisheries Dept.

3.4.1.7 Fishing Grounds

Most pelagic fishing activities are conducted in an area to the south of Malta where Tuna and Swordfish are known to congregate. Demersal fishing for commercial species takes place mainly to the west and southwest of the island as far away as 90 nautical miles or more.

The following parameters define the Maltese fishing zones:

- Western limit Lat. 35?52’00” Long. 13?30’00” (50 n. miles from Marsaxlokk)
- Southern extremity Lat. 35?21’58” Long. 14?25’24” (30 n. miles from Marsaxlokk)
- Southeast limit Lat. 35?22’74” Long. 15?03’14” (37 n. miles from Marsaxlokk).

This covers a sea area of approximately 2000 sq. nautical miles.

Although Swordfish can be found all around the Maltese Islands, the main effort is restricted to the south for the following reasons:

The zone to the north of the islands is shared with Sicilian fishermen and consequently the exploitable area is limited to a maximum of 20/25 n. miles offshore.

The Northern zone known as the Malta Channel is nearly always full of marine traffic which constitutes a hazard.

Marsaxlokk, the main fishing port, is situated in the southern zone. The fishing area has almost unlimited boundaries towards the West, South and East and is less congested.

During the Dolphin fish season an exception is made in part of the Marsaxlokk District where a 20 n. mile wide corridor is left free of FADs for Swordfish fishing, making this particular stretch of sea an extra Swordfish fishing zone during the autumn and early winter months. The two sides of this corridor have the following co-ordinates: SSE Lat. 35?41’30” Long. 14?37’00” and SE Lat. 35?47’24” Long. 14?45’12”.

Three main trawling zones exist, in which different species are targeted:

- King prawns – Between 500 and 600 m in an area about 8 n. miles to the northwest of Malta within the co-ordinates: Lat. 36?10’03” Long. 13?54’86” and Lat. 36?13’97” Long. 13?59’40” at the northern extremities, and Lat. 36?03’72” Long. 14?01’80” and Lat. 36?08’77” long. 14?06’66” to the south. The bottom in this area is soft mud and clay.

?? Shrimps, Hake, and other species – This area is a corridor about ¾ n. miles off the coast.

?? Red mullet, Hake and other species – All along the northern side of the Islands but the main zone is on and around Hurd Bank where stocks are more abundant.

3.4.2 Trends In Fisheries

The following graphs summarise the available information. Vessel statistics were obtained from the records of the Fisheries Department. Small craft, that is, any craft that does not fall under any of the five categories listed below, were excluded from the analysis as the data for these are missing from 1964 (when 743 small craft were registered with the Water Police) to 1987. The composition of the fleet was calculated separately for motor vessels and for non-powered vessels, excluding the small craft in both cases.

The raw data for fish catches were also obtained from the Department of Fisheries. Statistical data for fish landings is collected through the Wholesale Fish-market in Valletta. The data shown in the graphs only covers sale in Malta as there is no such market in Gozo. Furthermore, it is assumed that at least 25% of all catches are not recorded for various reasons that are beyond the control of the Fisheries Department. It is already evident from the graphs that stocks of some species are declining. Some species show a decline for a number of years after which they recover again. Some are no longer caught while others have only recently started appearing on the market.

3.4.3 Status of stocks

No stock assessment has ever been made for the fisheries resources exploited by Maltese fishers. However, a crude and an indirect estimate of stocks may be made by calculating the ‘catch per unit effort’. This was done by dividing the total annual catch by the fisher population for that year (see Fig. 4.1). These estimates are displayed in Fig. 4.14

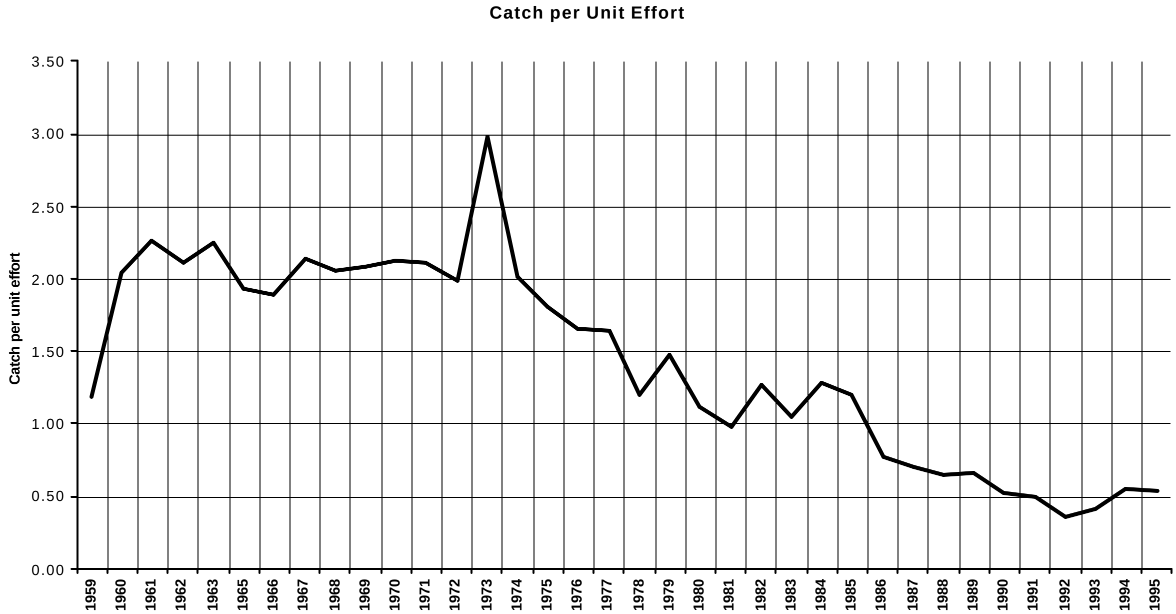


Fig. 4.14Yearly values of catch per unit effort.

The trend is evident: a downward trend from 1972 onwards. The decrease in total catch is not due to a decrease in effort. It appears that stocks exploited by Maltese fishers are decreasing. Whether this is due to overfishing or some other environmental factor remains to be assessed.

4.4 Legal Framework Concerning Fisheries Management

Legislation (Fishery Regulations, 1934 - G.N. 206) lays down that nobody can fish without a license. Any boat owner who intends to undertake any sort of fishing activity must register the boat, stating whether he/she intends to work part-time or full-time.

The following is a list of regulations issued to control fishing and to manage fish stocks.

Fishery Regulations – G.N. 206 of 1934 as amended by: L.N. 48 of 1962, L.N. 19 of 1964, L.N. 80 of 1978, and L.N. 58 of 1979

It shall not be lawful to use any fishing implements other than those permitted by article 1 without a license from the Controller of Fisheries. A separate license is required for the use of each type of implement not mentioned in article 1.

It shall not be lawful for any steam or power-propelled vessel or trawler as well as for sailing vessels to shoot or tow any kind of nets within the territorial waters of these Islands. Neither may the method of towing a trawl between two power-driven vessels (*paranze*) be practised within the said territorial waters.

It shall not be lawful to keep or use a seine net without a license for its use. No mesh of this implement shall be less than 8.5 mm long each side knot to knot even when the net is wet, and its weights shall not be so heavy as to cause the sinking of the floats.

In all bays and creeks the limit of the area within which the use of this net shall be lawful will be outwards of a line drawn between two stone pillars placed on opposite sides of such bays and creeks.

The Controller may grant special permits for stated periods for the use of this implement within the prohibited areas for the purpose of catching migratory fish provided no mesh for the fish is less than 25.5 mm square.

It shall not be lawful to keep or use a shrimp dredge without a license for its use. The net of this implement shall have no meshes less than 6.3 mm square, even when wet, and shall in no case be longer than 3.10 m. The iron bar at its mouth shall not exceed 1.50 m in length and the weight of the implement shall not be greater than that of a sample dredge kept at the Office of the Controller.

The use of this implement shall only be permitted from the 1st November to the 31st January; and outside the localities where the use of the seine is not prohibited.

It shall not be lawful to keep or use a long-pole net without a license for its use. The net for this implement shall have no meshes less than 6.5 mm square. This implement shall be subject to the conditions laid down for the shrimp dredge.

The use of the cast net (*terrieha*) shall not be permitted inside bays and harbours and none of its meshes shall be less than 25.5 mm square.

Trammels and gilling nets be used from the 15th February to the 15th July in those localities where the use of the seine net is prohibited. In the Grand and Marsamxett Harbours the use of these implements is prohibited at all times.

Subject to a license from the Controller, the following sites are available for the laying of tunny nets:

?? Mellieha

?? Cirkewwa and id -Delli

?? Ghajn Tuffieha and Gnejna

Should anyone propose to lay a tunny net in any other locality, an application should be made to that effect to the Controller who will decide as to whether the site may conveniently be leased for the purpose.

The use of basket traps others than those mentioned in article 1 shall not be permitted within bays and harbours if the size of any of the meshes is less than 2.5 mm wide.

It shall not be lawful to sell or buy or be on land in possession of any fishes or cephalopods of a size less than is prescribed in the following schedule with the exception of the Transparent Goby (*Makku*) and of Whitebait (*Srajdna* and *Nemusa*) for which no size limit is prescribed at present.

Schedule of minimum sizes

Boops boops	90 mm
Smaris vulgaris	90 mm
Mullus barbatus	100 mm
Mullus surmuletus	100 mm
All others except those mentioned in regulation 35	115 mm
Cuttlefish	75 mm
Squid	100 mm

It shall not be lawful to keep or use the implement locally known as '*hanzir'* without a license for its use.

It shall not be lawful to keep or use the implement known locally as '*hgiega'* without a license for its use.

It shall not be lawful to dredge for molluscs except in such sections of the Valletta Harbours as will be indicated for specified periods by the Controller nor to use for such dredging any implements except those of a type as established by the same Controller.

It shall not be lawful to land or expose for sale or otherwise be found on land in possession of and bivalves, excepting stone borers (*Tamar*), which shall be less than the gauge established for each species by the Controller.

All fishers and sellers of molluscs shall be provided with the necessary gauges bearing the Government mark.

The type of gauges mentioned in the preceding two articles shall be in accordance with the specimen kept at the Office of the Water Police, Custom House, Valletta, and such species of bivalves landed or exposed for sale shall not be less than the size limit shown on the gauge and marked respectively 1, 2, 3 and 4, as hereunder specified, namely:

Ostrea lamellosa	1
Venus verrucosa	3
Dosinia exoleta	3
Tapes decussatus	2
Cardium rusticum	1
Tapes aureus	1
Cardita sulcata	2
Cardium paucicostatum	2
Psammobia vespertina	1
Mytilus galloprovincalis	3

The use of the grapples (*imqass*) for the use of raising bivalves will only be permitted under the same conditions as are imposed for the use of dredges.

No fish may be brought ashore except at specified landing places notified as such by the Controller.

It shall not be lawful to use for fishing purposes poisons or any other substance which acts as poison on fish; and it shall not be lawful knowingly to collect from the sea or to expose for sale, or otherwise be in possession of any fish killed or caught by means of explosives or poisons or by any substance which acts as poison on fish.

The Department of Fisheries issues licenses in which fishing with a particular gear for a particular species only is allowed.

Long-lining is undertaken in the open seas without definition of parameters.

The setting of '*Kannizzati*' (Lampuki FADs,) traps and *ormeggios* (set long-lines) is licensed in areas specified by the Department.

All fishermen pay an annual registration fee according to their category: 'F' Lm 5.00; 'M.F.' Lm 7.50; 'P.T.F.' Lm 10. No charges are levied for fishing vessels.

Licensing, supervision and enforcement is the responsibility of the Fisheries Department and the Maritime Branch of the AFM.

CONTINUE

3.5 Aquaculture

3.5.1 Background

The Maltese Islands offer considerable potential for the development of the aquaculture industry. Excellent water quality and very favourable water temperatures favour the production of a top quality product.

The National Aquaculture Centre was established in 1988 within the Ministry of Agriculture and Fisheries to promote the industry of aquaculture in the Maltese Islands by providing expert advice, research and monitoring services and a link to foreign investments. This was rapidly followed by private investment in the sector and the first private commercial marine-based farm was established in Malta in 1991.

3.5.2 Characteristics

3.5.2.1 Production units

The Aquaculture industry in the Maltese Islands consists mainly of the farming of marine finfish species in marine-based and land-based farms (Fig. 5.1).

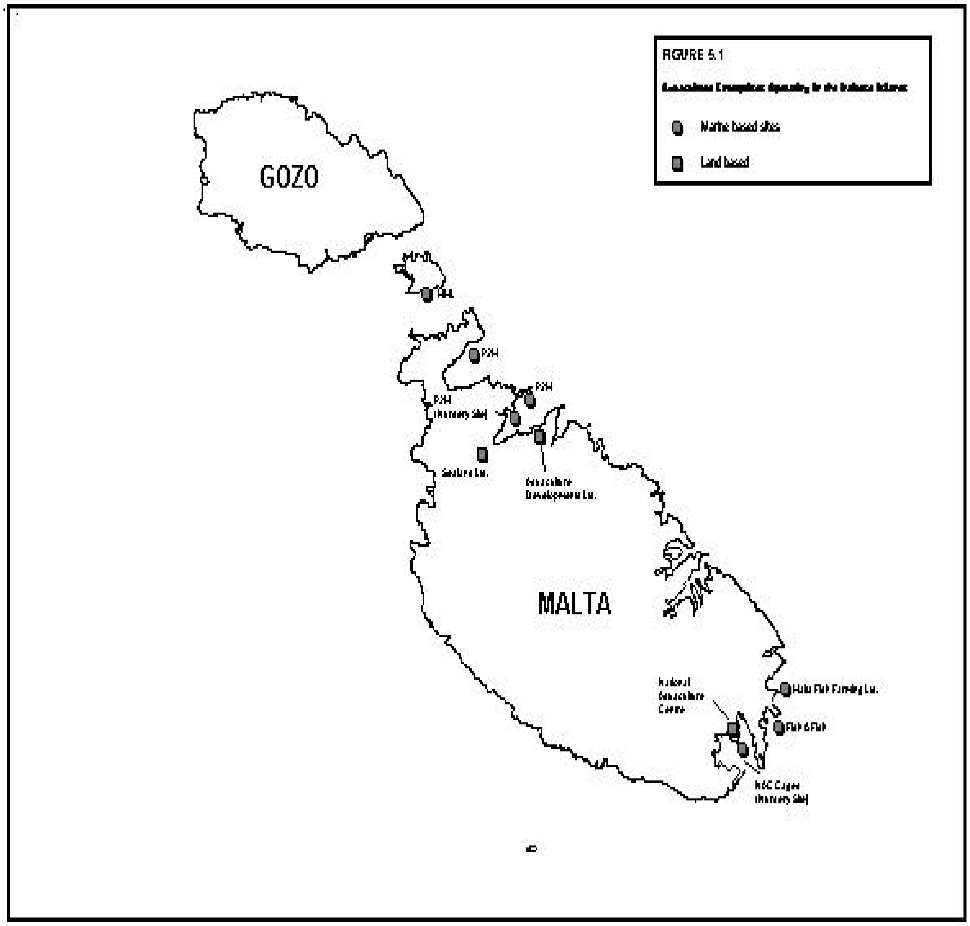


FIGURE 5.1
Marine based sites
Land based
GOZO
MALTA
P2M
P2M
P2M
P2M (Nursery Site)
Aquaculture Development Ltd.
National Aquaculture Centre
Malta Fish Farming Ltd.
Fish & Fish
NAC Cages (Nursery Site)

Marine-based farms account for 98% of the total aquaculture production in the country. Presently, four companies operate five offshore units on an intensive commercial scale for the fattening of two marine finfish species: sea bass (*Dicentrarchus labrax*) and sea bream (*Sparus aurata*). Two small marine units are located in inshore sheltered areas and used as nursery sites (Table 3.5.1a).

Table 3.5.1 a
Marine-based aquaculture production units in the Maltese Islands.

Company	Location of marine cages	Location of shore base facilities	Total cage surface area (sq. m)	Annual production capacity (m. tons)
MALTA MARICULTURE LTD.	South Comino Channel	Marfa peninsula	50,000	500
P2M COMPANY LTD.	Mistra Bay *(nursery)* St.Paul's Islands Mellieha Bay	Mistra Bay Redoubt	80,000	1000
MALTA FISHFARMING LTD.	Marsaxlokk Bay *(nursery)* Munxar Reef l/o St. Thomas Bay.	*Marsaxlokk	N/A	700
FISH & FISH COMPANY LTD.	Il-Hofra z-Zghira, l/o Delimara	*Delimara	N/A	400

**temporary premises*

Table 3.5.1 b
Land-based coastal aquaculture units in the Maltese Islands

Company	Location	Type of production	Annual production
NATIONAL AQUACULTURE CENTER	Fort San Lucjan, Marsaxlokk	Sea bream hatchery	1.0 million fry
SEALAND LTD.	Pwales Valley, Xemxija	Sea bream hatchery	1.5 million fry
AQUACULTURE	Salt Pans, Salina Bay	Ongrowing of sea bream	50 tons

DEVELOPMENTS LTD.			

Land-based coastal aquaculture consists of a small scale ongrowing farm with a production of 50 tons of sea bream annually and two hatcheries for sea bream, one within the National Aquaculture Centre, with a total production of 2.5 million fry per year (Table 35.1b). Hatchery production does not meet the local demand for fry, therefore, a high proportion of the required juveniles are imported from overseas hatcheries, mainly in Europe. A large-scale hatchery producing about 5 million fry per year is planned in Gozo, however, to date this has not proceeded beyond the planning stage.

3.5.2.2 Production

In 1998, the total annual production of finfish for the export market from local aquaculture enterprises amounted to 2000 tons, as compared to a mere 300 tons in 1992 (Fig. 5.1). Additionally, about 70 - 80 metric tons are consumed annually in the local market. The total licensed production potential of existing farms is estimated at 3000 metric tons per year and is expected to be achieved by the year 2000 (Meilak, 1996).

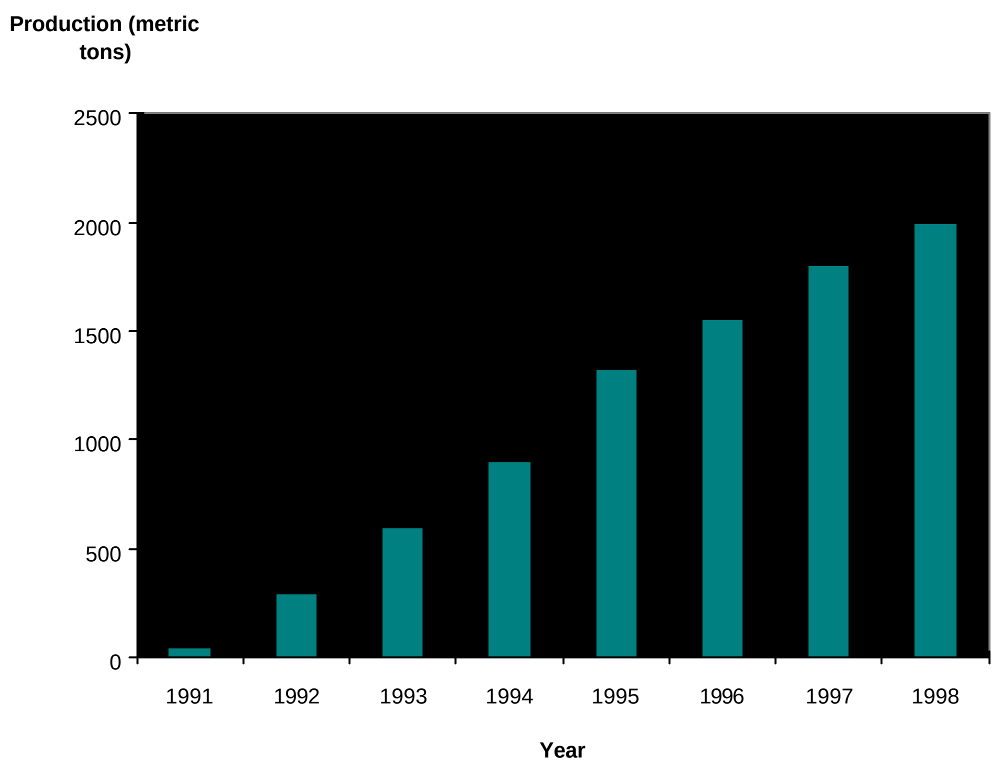


Fig. 5.2 Total annual production of finfish for export from local aquaculture enterprises.

3.5.3 Environmental Impact Of Aquaculture

3.5.3.1 General

The development of the aquaculture industry over the past years has increased concern on the implications for the marine environment. Intensive aquaculture can have significant detrimental effects on the marine environment through the generation of particulate and soluble wastes from uneaten food and from fish wastes. Localised impacts from aquaculture practices are generally observed as:

- nutrient enrichment
- reduced oxygen levels
- accumulation of particulate wastes on the seabed
- alteration of benthic habitats.

Other impacts of aquaculture on the natural environment are more widespread and difficult to quantify. These include impacts resulting from the use of additives in feeds, pharmaceuticals and antibiotics applied regularly for the treatment of disease, and the use of other chemicals such as anti-fouling coatings on cage nets.

Ensuring good environmental conditions, however, is also an important requisite for the success of any aquaculture venture. Poor water quality within the farm may result in stressful conditions for the fish and leads to disease. It is of interest to the farmer to maintain excellent environmental conditions. This is mainly achieved through good management practices and, for marine farms in particular, through the selection of an appropriate site with a good water exchange for the location of cages. For land-based farms, it is important to ensure that any wastewater is treated prior to discharge in the marine environment.

3.5.3.2 Environmental Impact Of Fish Farming In Malta.

Information on the impacts of local aquaculture practices on the marine environment is obtained from environmental monitoring programmes which are implemented at aquaculture sites, as required by the *Planning and Design Guidance for Fishfarming* approved by the Planning Authority in 1994. The parameters for the monitoring program include water and sediment quality, currents and monitoring of benthic communities (Table 3.5.2).

Table 3.5.2
Protocol for the environmental monitoring program of aquaculture units in the Maltese Islands
source: *Planning and design guidance - Fishfarming*, (1994) Planning Authority (Malta).

Environment	Parameters measured	Sampling stations	Frequency
Water column	?? temperature ?? salinity ?? dissolved oxygen ?? chlorophyll ?? nitrogen ?? phosphorus ?? ammonia ?? total bacteria ?? turbidity.	Several stations around the cage site at various depths	2 months

Sediments	?? granulometry ?? organic carbon ?? organic nitrogen.	Several stations within the cages site	6 months
Benthic environment	?? extent and location of species diversity	Mapping of all benthic communities within mooring area and samples as necessary.	6 months

The data gathered from the monitoring programmes is not comprehensive however, mainly because not all farms are undertaking such programmes. The National Aquaculture Centre carries out monitoring of water quality regularly (monthly) at each marine fish-farm site, in agreement with the Planning Authority. Data on the impacts of aquaculture on the benthic habitats from marine-based farms is limited to three sites, and only for one season following the establishment of the farm

No data is available to determine the environmental impacts of land-based farms.

3.5.3.2.1 Impact On Water And Sediment Quality

Results of water quality monitoring for offshore farms confirm that the impact of aquaculture on the water column is minimal. Water quality parameters measured on and in proximity of cage sites conform to levels at control sites. This was generally observed both for sites in semi-enclosed inshore waters and in semi-offshore and offshore sites, indicating that water exchange at local sites is sufficient to prevent build-up of significant pollution levels from aquaculture practices.

Abnormally high levels of pollutants such as faecal bacteria and nutrients measured occasionally in inshore areas (such as Mistra Bay) could be attributed to other sources of pollution, such as climatic factors, the presence of sewage overflows and possible underwater freshwater outlets.

No information on sediment quality is currently available.

3.5.3.2.2 Impact On Benthic Habitats

Data on the impacts on benthic communities at marine cage sites are available only for Mistra Bay, St. Paul's Islands and Mellieha bay (P2M sites) and refer to surveys carried out intermittently at the three sites between 1994 and 1996.

The three cage sites are located in semi-enclosed areas and in relatively shallow water depths over sea-grass (*Posidonia oceanica*) meadows. A significant environmental impact was measured at the three sites. The *Posidonia* meadows have been modified to an extent by the high nutrient input from the cages in the form of fish faeces and leftover food. Sea-grass communities directly beneath the cages were greatly degraded and the seabed consisted of with dead *Posidonia* matte, anoxic sediment and bacterial mats. The conditions of the sea-grass meadows as measured by their phenological parameters (leaf length, live-to-dead shoot ratio and epiphyte growth) gradually improved with distance from the cages, however, due to the limited survey area, it was not possible to determine the distance at which the *Posidonia* meadows re-attained a healthy state.

Impacts on the benthic communities were particularly acute in Mistra Bay and St. Paul's Bay. The *Posidonia* meadows there were in a clear state of regression. This may be related to the shallow water depths in which the cages are sited and to the enclosed nature of the bay. However, the effects of sewage overflows into St. Paul's Bay were significant and could not be distinguished from the effects of fish-farm wastes, except for the areas directly below the cages.

In Mellieha Bay, the observed impacts were less severe. The bare sand below the cages was moderately anoxic and supported a higher biodiversity. The *Posidonia* meadows in the survey area were in a generally good state of health except for the area directly below the cages where patches of dead matte were present and a large proportion of the *Posidonia* shoots were dead.

There is no information available for the other marine-based farms. However, given their location in more exposed and deeper waters, impacts on benthic communities are expected to be less severe than those described above.

3.5.4 Legislation and Control

3.5.4.1 Planning Control

In accordance with the Development Planning Act (1992) and the 1997 amendments to this Act, the establishment of a marine or land-based fish-farm requires full development permission. Furthermore, an Environmental Impact Assessment (EIA) is required in accordance with the *Planning Guidance for Environmental Impact Assessment in Malta* of the Planning Authority and the Environment Protection Department.

3.5.4.1.1 Malta Structure Plan policies

Structure Plan policies on aquaculture AHF 15 and AHF 16, encourage the development of offshore large-scale production units. Small-scale units should preferably be located on the coast within committed areas.

3.5.4.1.2 Planning And Design Guidance

The *Planning and Design Guidance for Fishfarming* is the key policy adopted to regulate the development of fish-farming within the Maltese Islands. The *Policy Guidance* was adopted by the Planning Authority in 1994 and defines the requirements for the development of marine and land based fish-farms as well as for hatcheries. It also provides guidelines on farm management, and includes the protocol for the monitoring programs. Currently, the *Guidance* is being reviewed and updated.

3.5.4.1.3 Control

Control of aquaculture operations is the responsibility of several regulatory bodies including:

?? Planning Authority
- ?? Policy formulation
- ?? Processing of applications for development permission
- ?? Co-ordination of EIA procedures
- ?? Enforcement of conditions within the development permission
- ?? Enforcement and management of environmental monitoring programs

?? Veterinary Services Department
- ?? Fish health and quality control, in accordance with EU standards.
- ?? Importation, use and disposal of chemicals

?? Ministry of Agriculture and Fisheries/ National Aquaculture Centre
- ?? Advice and policy development

- ?? Licensing fish farm operations
- ?? Importation, use and disposal of chemicals
- ?? Control of pesticide use

?? Environment Protection Department

- ?? Participation in the EIA process
- ?? Control of importation, use and disposal of chemicals.

CONTINUE

3.6. Agriculture

3.6.1 Characteristics Of Local Agriculture

The latest available full statistics are those contained in the 1990 -1991 *Census of Agriculture* (henceforth referred to as the Census) issued by the Central Office of Statistics. This information is now more than eight years old and the full extent to which the situation has changed is not known. Moreover, sources within the Department of Agriculture have expressed doubts about the reliability of some of the information contained in the Census. This is especially so since the data relies almost exclusively on the accurate registration of full details on land area, quantity of produce, *etc*., which information is provided by the farmers themselves.

A request for updated data was made to the Department of Agriculture. To date, only partial information has been provided.

3.6.1.1 Number Of Farmers

According to the Census, the total number of registered full-time farmers is 1,510 (1,400 males and 110 females), whereas there are 21,418 part-time farmers (12,656 males and 8,762 females). The age-group distribution is shown in Table 3.6.1.

Table 3.6.1
Age distribution of registered farmers (1991 Census)

Age group (years)	Full-time farmers		Part-time farmers	
	Male	Female	Male	Female
< 19	21	1	270	57
20-29	200	12	1376	746
30-39	379	27	2741	1877
40-49	337	34	2947	2210
50-59	304	23	2001	1810
60-69	112	9	1901	1340
> 70	47	4	1420	722
Subtotals	1400	110	12656	8762
Totals	1510		21418	

The distribution of farmers according to geographic region is summarised in Table 3.6.2.

Table 3.6.2
The distribution of registered farmers according to geographic region (1991Census).

Geographic	Full-time farmers	Part-time farmers

region	Male	Female	Male	Female
Inner Harbour	27	1	267	173
Outer Harbour	219	8	1575	1193
South-eastern	139	9	2866	1883
Western	380	30	3037	2042
Northern	436	44	2040	1496
Subtotal (Malta)	1201	92	9785	6787
Gozo	199	18	2871	1975
Total	1510		21418	

The Census also gives figures for hired labour, but these have not been included here as they are beyond the scope of this report.

3.6.1.2 Distribution Of Agricultural Land

The Census classifies agricultural land in the Maltese Islands into three categories as follows:

?? **Dry-farmed land** (*Raba baghli*), which is land that depends exclusively on rainwater for irrigation.

?? **Irrigated land** (*Raba saqwi*), which is landed that is irrigated by water from sources other than rainwater.

?? **'Wasteland'** *(Moxa)*, which is a term used to describe all non-productive registered agricultural land.

This is a rather confusing terminology. Irrigated land can be further subdivided into **semi-irrigated** land and **fully irrigated**. The former has a supply of irrigation water that, however, is not sufficient to last the whole of the dry season. The latter has a water supply that enables irrigation of the fields throughout the dry season. 'Wasteland' does not include all non-cultivated land, but only that within registered agricultural land. However, it does include such important natural and semi-natural habitats as garigues and rocky steppes (*xaghri*) if they are located within registered agricultural land. This unfortunate terminology has resulted in widespread misconceptions and in such malpractices as the 'reclamation' for agriculture of thriving natural biotic communities by covering them with rubble and soil.

The Census provides details of the area and distribution of the different agricultural land categories in the Maltese Islands (Table 3.6.3).

Table 3.6.3
The area and distribution of different categories of agricultural land categories in the Maltese Islands (1991 Census).

Geographic	Land area (hectares)			
region	Dry-farmed land	Irrigated land	'Wasteland'	Total
Inner Harbour	53.334	8.967	6.243	68.544
Outer Harbour	679.907	199.240	65.472	944.619
South-eastern	1828.256	98.935	194.111	2121.302
Western	2889.727	180.640	462.444	3532.811
Northern	1923.943	243.807	362.586	2530.336
Subtotal (Malta)	7375.167	731.589	1090.856	9197.612

Gozo	1628.291	44.618	159.951	1832.860
Total	9003.458	776.207	1250.807	11030.472

Of the total arable land area of 9779.665ha (9003.458ha dry-farmed + 776.207ha irrigated), the census identifies 1145.911ha (11.7%) as lying idle and 789.459ha (8.1%) as fallow. No precise definitions of the terms "idle" and "fallow" are provided by the Census, and neither is their distribution by geographical region. There is no obvious correlation between the proportion of idle/fallow land and the sizes of the respective holdings.The Census provides an analysis of the size of holdings; a summary of this given in Table 3.6.4.

Table 3.6.4
The size-distribution of holdings in the different geographical areas (1991 Census). Figures are number of holdings.

Size of holding (ha)	Geographic region							
	Inner Harbour	**Outer Harbour**	**South-eastern**	**Western**	**Northern**	**Subtotal (Malta)**	**Gozo**	**Total**
- 0.25	85	384	627	669	377	**2142**	825	**2967**
- 0.50	47	328	567	633	395	**1970**	659	**2629**
- 0.75	26	196	358	427	254	**1261**	431	**1692**
- 1.00	6	111	204	259	159	**739**	210	**949**
- 1.25	14	93	154	231	140	**632**	154	**786**
- 1.50	8	59	111	125	108	**411**	107	**518**
- 1.75	7	43	81	102	91	**324**	46	**370**
- 2.00	4	23	40	70	82	**219**	37	**256**
- 2.25	2	26	31	71	69	**199**	30	**229**
- 2.50	2	21	29	45	55	**152**	21	**173**
- 2.75	2	12	18	35	35	**102**	13	**115**
- 3.00	1	8	15	39	26	**89**	12	**101**
- 4.00	2	26	38	78	73	**217**	24	**241**
- 5.00	0	12	23	48	37	**120**	11	**131**
- 6.00	0	5	12	22	16	**55**	5	**60**
- 7.00	0	4	5	16	10	**35**	3	**38**
- 8.00	1	0	0	6	6	**13**	0	**13**
- 9.00	0	1	0	4	5	**10**	1	**11**
-10.00	0	0	0	1	1	**2**	0	**2**
+10.00	1	0	2	3	2	**8**	1	**9**
Total	208	1352	2315	2884	1941	8700	2590	11290

The data clearly show that the majority of holdings are of small size and some are very small. This is mainly as a result of fragmentation of land due to the local land-inheritance system. Problems associated with this include: increasingly complicated access arrangements (with their legal implications, as well as environmental impacts due to multiple access routes), lowered long-term tenement viability, and limitations on the range of farming methodologies which can be adopted (e.g. restrictions on mechanisation, even where topography is not a major limiting factor). Although no statistics are available, these problems are known to be significant.

Additional details about land titles (rented, freehold, etc.) and types of management arrangements (*e.g.* by family membership, by employees, partnerships, "others", etc.) are provided by the Census but will not be treated here.

3.6.1.2.1 Trends In Registered Agricultural Land

Available statistics indicate a marked decline of the area of registered agricultural land from over 17,000ha in 1963 to 11,902ha in 1991, a percentage reduction of over 30% (Fig. 6.1). Overall, some 37.6% of the total land area of the Maltese Islands was registered as agricultural in 1991, down from about 56% in 1957 (Fig. 6.2).

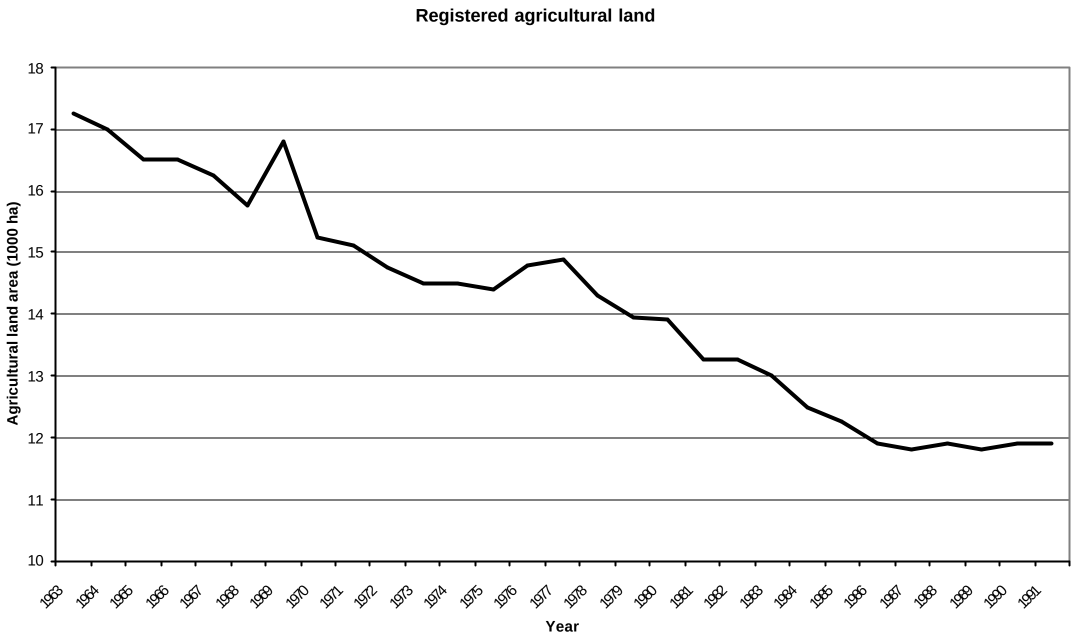


Fig. 6.1 Variation in area of registered agricultural land with time. (data from *Abstracts of Statistics* and Department of Agriculture).

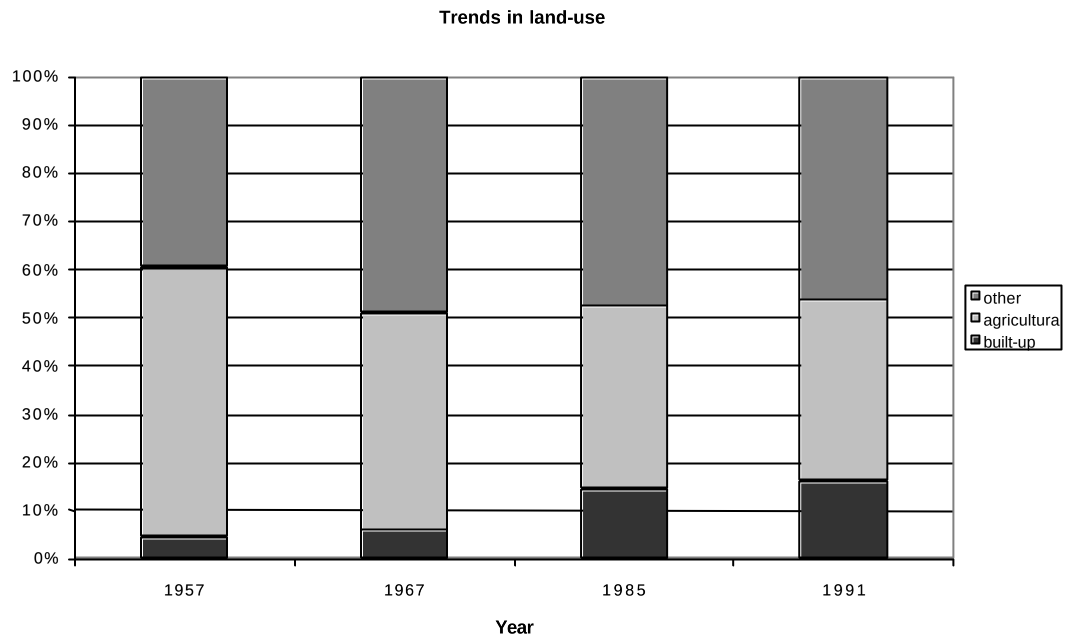


Fig. 6.2 Trend in land-use as percentage area built-up, registered agricultural land, and other) for the Maltese Islands (data from Planning Authority).

3.6.1.3 Main Crops And Animals

3.6.1.3.1 Major Plant Crops Cultivated

The latest available details are those provided by the 1991 Census. Data provided in later issues of the *Quarterly Digest of Statistics* are limited to the quantities and monetary value of the various cultivated crops and exclude fodder crops; this data is summarised (together with the corresponding data provided by the Census, for ease of comparison) in ***Section 3.6.1.4*** below.

(a) Vegetables and other crops

The Census gives moderately detailed data on cultivation of vegetable, which also identifies the type of cultivated land for each crop (Table 3.6.5).

Table 3.6.5

Area sown with vegetables and other ground-crops on different categories of agricultural land (1991 Census).

Crop	Area sown (hectares)					
	Malta		Gozo		Total	
	Dry		Dry		Dry	
Patata tax-xitwa	*310.215*	*96.484*	*44.191*	*26.228*	*354.406*	*122.712*
Patata tas-sajf (ta' qatgha bajda)	*364.406*	*252.886*	*56.432*	*8.799*	*420.838*	*261.685*
Patata tas-sajf (ta' qatgha safra)	*405.581*	*164.975*	*27.614*	*24.891*	*433.195*	*189.866*
Basal ahdar u niexef	*224.421*	*21.609*	*35.267*	*1.488*	*259.688*	*23.097*
Qaqocc	*1.848*	*20.200*	*0.519*	*0.243*	*2.367*	*20.443*
Hass	*1.920*	*36.427*	*0.086*	*0.533*	*2.006*	*36.960*
Artichokes, indivja, krafes, tursin, spinaci, buzbiez, kurrat, sieq, naghniegh	*4.090*	*11.620*	*0.186*	*0.364*	*4.276*	*11.984*
Bzar ahdar	*1.793*	*13.858*	*0.165*	*1.111*	*1.958*	*14.969*
Hjar	*0.445*	*5.956*	*0.207*	*0.290*	*0.652*	*6.246*
Brungiel, centinarja, bzar ahmar	*0.584*	*9.413*	*0.300*	*1.261*	*0.884*	*10.674*
Karrotti	*15.554*	*34.607*	*0.157*	*0.140*	*15.711*	*34.747*
Gidra	*9.046*	*28.416*	*1.960*	*1.878*	*11.006*	*30.294*
Basal tal-pikles, pitravi, tewm niexef, tewm ahdar, figel, ravanell, nevew	*48.663*	*8.167*	*7.713*	*0.231*	*56.376*	*8.398*
Fazola hadra, pizelli hadra	*18.465*	*5.157*	*1.661*	*0.178*	*20.126*	*5.335*
Kabocci, Brussels sprouts	*15.267*	*50.574*	*1.544*	*2.078*	*16.811*	*52.652*
Qara' ahmar, qara' rotta, qara' twil	*6.479*	*30.816*	*3.058*	*1.229*	*9.537*	*32.045*
Qara' baghli	*80.042*	*53.364*	*4.625*	*2.611*	*84.667*	*55.975*
Bettieh, dulliegh	*168.175*	*45.964*	*90.085*	*1.909*	*258.260*	*47.873*
Tadam (minbarra tas-serer)	*239.299*	*122.172*	*118.081*	*3.747*	*357.380*	*125.919*
Ful ahdar	*165.672*	*21.723*	*44.436*	*1.964*	*210.108*	*23.687*
Pastard, brokkoli	*101.486*	*46.363*	*3.399*	*2.589*	*104.885*	*48.952*
Fjuri mkabbra fil-berah	*2.228*	*6.295*	*0.168*	*0*	*2.396*	*6.295*
Pjanti ornamentali fil-berah	*0.684*	*0.730*	*0.093*	*0*	*0.777*	*0.730*
Subtotals (cultivated land type)	**2186.363**	**1087.776**	**441.947**	**83.762**	**2628.31**	**1171.538**
Total cultivated land by island	**3274.139**		**525.709**		**3799.848**	

Analysis of these data indicate that:

?? Potatoes are by far the major agricultural crop (excluding fodder crops), followed by tomatoes, onions, melons (including watermelons), broad beans and cauliflower (including broccoli); in Gozo, tomato production in 1990-91 nearly equalled potato production. Cultivation of Solanaceae (potatoes and tomatoes) exceeds that of all the other vegetables combined.

?? 69.17% of the total area of the Maltese Islands that is used for the cultivation of vegetables and other crops (excluding fruits and fodder) is dry agricultural land (*raba baghli*), whilst only 30.83 % is irrigated land (*raba saqwi*).

?? Gozo accounts for only 13.84% of the total area of the Maltese Islands that is used for the cultivation of vegetables and other crops (excluding fruits and fodder). The island of Malta accounts for the remaining 86.16%.

?? In terms of irrigated land (*raba saqwi*), Gozo accounts for a meagre 7.15% of the total area of the Maltese Islands that is used for the cultivation of vegetables and other crops (excluding fruits and fodder), whilst the island of Malta accounts for the remaining 92.85%. In terms of dry land (*raba baghli*), Gozo accounts for 16.81% of the total area of the Maltese Islands that is used for the cultivation of vegetables and other crops (excluding fruits and fodder) whilst mainland Malta accounts for the remaining 83.19%.

(b) Fruit trees

The Census quantifies the cultivation of fruit trees both in terms of land coverage and in terms of the number of fruit trees (Tables 3.6.6a and b)

Table 3.6.6a
Area planted with fruit trees (1991 Census).

Crop	**Area under trees (hectares)**		
	Malta	**Gozo**	**Total**
Citrus fruits	*55.213*	*19.350*	*74.563*
Apples	*25.945*	*10.999*	*36.944*
Pears	*7.203*	*0.495*	*7.698*
Bambinella	*17.453*	*0.901*	*18.354*
Peaches	*202.201*	*11.444*	*213.645*
Cherryplum, Plums & Prunes	*50.094*	*4.580*	*54.674*
Apricots & nectarines	*10.460*	*0.944*	*11.404*
Medlars, “Zabrikott”, Prunes & Cherries	*2.909*	*0.285*	*3.194*
Almonds	*12.964*	*1.573*	*14.537*
Pomegranates & Banana	*6.219*	*0.583*	*6.802*
White mulberries & Black mulberries	*3.543*	*0.005*	*3.548*
Grape vines	*386.585*	*28.116*	*414.701*
Carobs	*75.357*	*2.094*	*77.451*
Olives	*10.943*	*1.395*	*12.338*
Figs and related fruit	*25.942*	*0.322*	*26.264*
Prickly pears	*32.281*	*5.425*	*37.706*
Strawberries	*6.272*	*0.056*	*6.328*
Totals	**931.584**	**88.567**	**1020.151**

Table 3.6.6b
The number of productive and unproductive fruit trees (1991 Census).

Crop	No. of productive trees			No. of unproductive trees		
	Malta	Gozo	Total	Malta	Gozo	Total
Citrus fruits	*22521*	*7988*	*30509*	*3418*	*1347*	*4765*
Apples	*13093*	*5673*	*18766*	*2833*	*270*	*3103*
Pears	*41245*	*240*	*4365*	*1151*	*42*	*1193*
Bambinella	*14112*	*295*	*14407*	*1807*	*218*	*2025*
Peaches	*143780*	*6592*	*150372*	*8656*	*619*	*9275*
Cherryplum, Plums & Prunes	*31616*	*2287*	*33903*	*1339*	*387*	*1726*
Apricots & nectarines	*4979*	*607*	*5586*	*2045*	*10*	*2055*
Medlars, "Zabrikott", Prunes & Cherries	*1097*	*80*	*1177*	*54*	*9*	*63*
Almonds	*2800*	*478*	*3278*	*5331*	*151*	*5482*
Pomegranates & Banana	*2486*	*287*	*2773*	*286*	*9*	*295*
White mulberries & Black mulberries	*2855*	*4*	*2859*	*56*	---	*56*
Grape vines	*700254*	*86240*	*786494*	*72324*	*10697*	*83021*
Carobs	*6806*	*143*	*6949*	*835*	*17*	*852*
Olives	*1386*	*112*	*1498*	*1098*	*54*	*1152*
Figs and related fruit	*6697*	*124*	*6821*	*461*	*11*	*472*
Prickly pears	---	---	---	---	---	---
Strawberries	*398074*	*3000*	*401074*	*16030*	---	*16030*
Subtotal	**1356681**	**114150**	**1470831**	**117724**	**13841**	**131565**

Total number of fruit trees by island	**Malta:1474405**	**Gozo: 127991**	**Total: 1602396**

Analysis of these data indicates that:

?? The cultivation of fruit trees is dominated by grapevines, followed by peaches and related stone fruits; carobs, citrus fruits and apples/pears are next in importance.

?? 91.32% of the land area occupied by fruit trees is located on the island of Malta, whilst only 8.68% is on Gozo.

?? The island of Malta accounts for 92.01% of fruit trees as compared to 7.99% for Gozo. In terms of productive trees, Malta accounts for 92.24% and Gozo 7.76%; the respective figures for unproductive trees are 89.48% (Malta) and 10.52% (Gozo).

?? On a nation-wide scale, 91.79% of fruit trees are productive, with unproductive trees amounting to 8.21%. On the island of Malta, 92.02% are productive (7.98% are unproductive), whereas in Gozo, 89.19% are productive (10.81% are unproductive).

?? Overall, the density of fruit tree plantations (number of trees per unit land area) is marginally greater in Malta than in Gozo.

?? Gozo has a proportionately larger number of unproductive trees in its plantations when compared to Malta. This may be indicative of some degree of decline in the cultivation of fruit trees.

?? Many of the types of trees cultivated have a high rate of water consumption, a particularly unfortunate characteristic in the relatively semi-arid Maltese environment. In this regard, field observations suggest that fruit orchards are relatively concentrated within specific valleys with abundant natural water supplies, rather than evenly spread throughout the countryside.

?? Indigenous and archaeophytic species such as almond (*Prunus dulcis*), pomegranate (*Punica granatum*), carob (*Ceratonia siliqua*), olive (*Olea europaea*) and fig (*Ficus carica*) are moderately abundant. Discontinuation of cultivation and subsequent reversion of the trees to the wild state (as is possibly the case with unproductive trees) frequently results in the development of a secondary maquis community around the trees in question.

?? The statistics do not give any indication of the specific crop strains. Certain strains of grapevine (*Vitis vinifera*) appear to have been developed locally. Grapevine is by far the most widely cultivated species of fruit tree.

?? Potentially invasive species, including prickly pear (*Opuntia ficus-indica*), grapevine (*Vitis vinifera*) and fig (*Ficus carica*) are among the most common fruit trees. Discontinuation of agricultural maintenance occasionally poses a threat to nearby habitats if the species in question are allowed to grow wild.

(c) Fodder crops

In terms of cultivated land area, fodder crops (particularly wheat, clover [more properly, sulla] and barley) assume even greater importance (Table 3.6.7). This is of particular environmental relevance in view of:

?? The soil-stabilising (and hence erosion-retarding) effect of cereal grasses and of the stubble left after their harvesting; and

?? The soil-fertilising effect of the root nodules of ‘clover’ (Sulla, *Hedysarium coronarium*), a property shared with other legumes.

Analysis of this data indicates that:

?? On a national scale, cereals provide 68.02% of the total fodder crop, as compared to 30.65% for legumes.

?? Cereals account for 72.58% of the total fodder crop on the island of Malta, as opposed to 49.30% in Gozo, whilst the respective figures for legumes are 26.27% (Malta) and 48.67% (Gozo). *Prima facie*, this indicates a higher degree of crop rotation, as well as a lower degree of soil stabilisation by cereals, on the island of Gozo. However, the statistics provided are essentially a ‘snapshot’ (whereas crop rotation usually occurs over more than one year) and may have been heavily influenced by the situation at the time of sampling; consequently, no real conclusion can be drawn in this respect.

Table 3.3.6.7
Area sown with fodder crops (1991 Census).

Crop	Area sown (hectares)		
	Malta	**Gozo**	**Total**
Qamh midrus	*860.991*	*77.846*	*938.837*
Qamh mhux midrus	*1380.616*	*61.315*	*1441.931*
Xghir midrus	*69.656*	*121.549*	*191.205*
Xghir mhux midrus	*76.730*	*94.830*	*171.560*
Furrajna (xghir ahdar)	*120.227*	*58.814*	*179.041*
Subtotal: cereals	**2508.220**	**414.354**	**2922.574**
Ful ghan-niexef	*83.881*	*69.988*	*153.869*
Gulbiena, widna, zozfa u legumi ohra	*75.518*	*47.573*	*123.091*
Silla	*748.589*	*291.447*	*1040.036*
Subtotal: legumes	**907.988**	**409.008**	**1316.996**
Ucuh ohra ghall-ghalf	*39.820*	*17.060*	*56.88*
Totals	**3456.028**	**840.422**	**4296.45**

?? The island of Malta produces 80.44% of the total fodder crop, with Gozo producing 19.56%. With regard to legumes, Malta produces 68.94% of the crop as compared to 31.05% for Gozo. In terms of cereals, Malta produces 85.82% whilst Gozo produces 14.18%.

(d) Overall situation

The data provided by the 1991 Census also enable a comparison of the land areas cultivated with vegetables, fruits and fodder (Table 3.6.8)

Table 3.6.8
Summary of cultivated area sown with different crop types in the Maltese Islands (1991 Census).

Type of Crop	**Area sown (hectares)**			**% of cultivated area by island**		
	Malta	**Gozo**	**Total**	**Malta**	**Gozo**	**Total**
Vegetables	*3274.139*	*525.709*	*3799.848*	*42.73*	*36.14*	*41.68*
Fruit trees	*931.584*	*88.567*	*1020.151*	*12.16*	*6.09*	*11.19*
Fodder	*3456.028*	*840.422*	*4296.45*	*45.11*	*57.77*	*47.13*
Subtotals	**7661.751**	**1454.698**	**---**	**(100.00)**	**(100.00)**	**(100.00)**
TOTALS			**9116.449**	**84.04**	**15.96**	**100.00**

Analysis of these data shows that:

?? 84.04% of the total cultivated area in the archipelago lies on the island of Malta, with Gozo contributing only 15.96%. These figures cannot be accounted for entirely by the smaller geographical area of Gozo, and the statistics therefore suggest a larger degree of abandonment of agricultural land in Gozo. This is supported to a large extent by field observations, which show many abandoned fields on steeply sloping hillsides. This trend is apparently compensated for by the fact that Gozo is much less built-up than Malta and also has a smaller proportion of uncultivated rural land (*e.g.* garigue and other natural habitats, afforested land, quarries). Under-registration of land may therefore be an important factor, and it is therefore recommended that the statistics in question be interpreted with caution.

?? In terms of land coverage, fodder crops are collectively the most important category of crop in both Malta and Gozo, as well as on a national scale. Fodder accounted for over half of the land cultivated in Gozo at the time of the Census.

?? Vegetables form the second most important category (which also includes a small statistical contribution by horticultural non-food crops). In Malta and on a national scale, but less so in Gozo, this category follows closely after fodder crops.

?? Fruit trees only cover a small proportion of the cultivated land area, especially in Gozo, where such coverage is half as important, proportionately, as in Malta.

It is unclear whether the cultivated land on Comino (primarily at Il-Wied l-Ahmar, Wied Imdied, Il-Hazina and Il-Wied ta' San Niklaw) is incorporated with the statistics for Gozo or is omitted altogether. Nevertheless, the extent of cultivation on the island is likely to be insignificant except on a very localised basis. No cultivation has been noted on the other islets of the Maltese archipelago, although relics of past small-scale cultivation (some of which is also partly documented) abound on Kemmunett and Selmunett (St Pauls) Islands, as well as in scattered patches within uncultivated areas on Comino.

3.6.1.3.2 Main Animals Bred

Tables 3.6.9 and 3.6.10 below give a breakdown of the number of animal breeders and of the main types of animals bred locally.

Table 3.6.9
The number of registered breeders of different types of animals and their geographical distribution (1991 Census).

Geographic region	Number of registered breeders						
	Bovines	Caprines	Ovines	Swine	Poultry	Rabbits	Equines
Inner Harbour	17	8	15	4	34	28	35
Outer Harbour	73	50	67	35	145	190	175
South-eastern	92	76	130	38	216	203	296
Western	60	53	189	42	245	302	162
Northern	24	61	141	12	172	245	79
Subtotal (Malta)	266	248	542	131	812	1068	747
Gozo	69	300	614	9	865	928	81
Totals	335	548	1156	140	1677	1996	828

Table 3.6.10
The number of different types of animals bred and their geographical distribution (1991 Census).

Geographic Region	Number of animals							
	Bovines	Caprines	Ovines	Swine	Poultry	Rabbits	Equines	Bees *
Inner Harbour	886	113	139	776	763395	660	45	114
Outer Harbour	2892	598	376	13343	137358	2838	216	157
South-eastern	3563	896	672	12174	185911	2069	307	98
Western	1687	442	847	22637	217545	2933	189	413
Northern	436	219	657	10426	406568	4098	99	274
Total (Malta)	9464	2268	2691	59356	1710777	12598	856	1056
Gozo	3427	1161	1932	2251	115149	16615	88	252

Total	12891	3429	4623	61607	1825926	29213	944	1308

(* for bees, number of beehives)

It is important to note the following:

?? The localities given indicate the place of residence of the breeder rather than the actual location of the farms (hence the inflated figures for the "Inner Harbour" region, which is not an agricultural area). From an environmental viewpoint, this constitutes a serious deficiency in the data, as impacts (which are generally substantial) are mainly tied to the siting of the farm.

?? Data on apiculture relate to the number of beehives. No data on the number of breeders are available.

?? The figures quoted in the tables incorporate all types (and breeds) of animals falling within the respective categories as follows (The Census gives more detailed statistics):
?? bovines: calves, heifers, cows, bulls and oxen
?? caprines: kids and goat
?? ovines: rams, sheep and lambs
?? swine: all categories of pigs and piglets
?? poultry: chicks, broilers, hens, cocks, ducks, geese and turkeys
?? equines: horses, ponies, mules and donkeys

?? There is an apparent mismatch between the relative numbers of breeders in the respective categories and the numbers of animal heads. This is due to the different sizes of breeding establishments. Thus, while swine and cattle are generally bred in relatively large farm complexes, ovines and caprines are often reared in small numbers (e.g. within households in certain villages).

?? The number of breeders of caprines, ovines, poultry and rabbits is particularly high in Gozo (in fact, it exceeds the subtotal for Malta for the first three). This pattern is reversed in the statistics for the number of animal heads, i.e. more caprines, ovines and poultry are produced (overall) in Malta than in Gozo, whereas the number of rabbits bred in Gozo exceeds the equivalent figure for the island of Malta. This indicates a lesser tendency toward industrial-type animal farms on Gozo as compared to Malta, except for rabbit breeding.

?? The statistics for caprines and ovines do not specify the type of husbandry involved, i.e. whether feeding is carried out inside farm complexes or by means of grazing. *Prima facie*, field observations indicate grazing as being more widespread on Gozo. Statistics in this regard are desirable, in view of the severe ecological impacts associated with grazing; there appears to be a direct correlation between an observable increase in maquis habitat on the island of Malta and the concurrent decline in grazing activity.

3.6.1.4 Agricultural Production: Quantity And Value Of Produce

The Census provides a detailed breakdown of the quantity and wholesale value of agricultural products sold through organised markets for 1989-90 and 1990-91. More updated figures covering the periods 1991-92 and 1995-96 are given, respectively, in issues 128-131 and 144-147 of the *Quarterly Digest of Statistics*. A summarised version, together with a computation of average unit value of the produce is given in Table 3.6.11.

Table 3.6.11
Quantity, value and average unit value of produce for various time periods (1991 Census and *Quarterly Digest of Statistics*)

Category of product	Quantity (metric tons)			
	1989-90	1990-91	1991-92	1995-96
Vegetables (total)	30820	31820	29273	35627
Fruit (total)	2308	3198	3425	3266

Category of product	Value (x Lm 100)			
	1989-90	1990-91	1991-92	1995-96
Vegetables (total)	43968	52392	46085	61060
Fruit (total)	7990	9682	9158	10549

Category of product	Average Unit Value (Lm per metric ton)			
	1989-90	1990-91	1991-92	1995-96
Vegetables	143	165	157	171
Fruit	346	303	267	323

These figures indicate that:

?? Fruits are, overall, consistently more valuable than (around twice as much as) vegetables; and

?? There is no clear-cut correlation between price and quantity. A number of factors, probably including different trends for individual crops (not revealed by the grouping under “vegetables” and “fruits”), variations in the usage of specific agricultural techniques (plus associated expenditure), variations in competition by imported produce, etc. appear to be exerting an effect.

3.6.2 Environmental Impact

3.6.2.1 Agriculture-Related Development

3.6.2.1.1 Agricultural Buildings And Related Structures

The proliferation of agricultural buildings and structures (e.g. stores, garages, pump rooms, reservoirs, boundary walls/retaining structures, farms, greenhouses) in the countryside is a major issue.

Most structures (especially large farm complexes and large greenhouse clusters) have considerable visual impact, cluttering what is in theory open countryside and (policy-wise) a Rural Conservation Area (as defined in the Malta Structure Plan). Particularly noteworthy examples include the following:

?? farms between San Pawl Kuntent and Il-Buskett (Rabat)
?? farms at Hal Tartarni (Buskett)
?? farms along Triq Had-Dingli (Rabat / Had-Dingli)
?? farms at L-Ahrax ta‘ Gewwa and Ta‘ Msid (L-Ahrax tal-Mellieha)
?? farms around Il-Wied ta’ M]arr ix-Xini (Xewkija, Gozo)
?? farm clusters throughout Tal-Qadi (Burmarrad) and Il-Maghtab -- these areas have been practically transformed into disorganised “industrial estates” made up of large concentrations of farm buildings
?? greenhouses at Il-Qortin t’ Isopu (Nadur, Gozo)
?? greenhouses at Wied il-Pwales (San Pawl il-Bahar)

Additional impacts associated with individual developments include:

?? Habitat destruction as a result of siting within non-agricultural land – e.g. farm complexes on garigue at L-Ahrax ta‘ Gewwa and L-Ahrax tal-Ghajn (L-Ahrax tal-Mellieha), farms within the valley bed at Wied il-Baqqija (Haz-Zebbug), greenhouses on valley banks at Wied l-Imtahleb.

?? Damage to historical fortifications inappropriately converted into animal farms – e.g. San Anard, Il-Fortizza ta' Delimara and (formerly) Il-Fortizza ta' Bingemma

?? Overspills (including leakages and deliberate outflows) of slurry and other agricultural effluents into nearby watercourses – e.g. as noted at Wied Sara (Ghasri, Gozo).

?? Rock cutting, dumping of excavation debris and/or ancillary levelling of garigue – e.g. farm complex at L-Ahrax ta‘ Gewwa, greenhouse complex at il-Qortin t' Isopu (Nadur, Gozo)

?? Opening and/or retention of undesirable vehicular access to remote sites, together with associated indirect impacts – e.g. farms within the valley bed at Wied il-Baqqija (Haz-Zebbug).

?? Indirect urbanisation through the exploitation of loopholes in a number of policies that seek to constrain building development in the countryside whilst not precluding agricultural development. This is attested to by:

?? permit applications for residential development in rural areas, often with stretched reference to farmers' entitlement to such facilities according to existing policies;

?? permit applications for the conversion of disused farm buildings into residential, recreational, semi-industrial and/or retail development; and

?? permit applications for developments that are presented as 'farms', 'agricultural stores' or 'tool rooms' but which are actually intended for different use. Following the enactment of the General Development Order in 1993 (and following further relaxation of constraints on development by virtue of the amendments effected to the Order in 1997), numerous small rural buildings have been constructed without the legal need for a development permit under the pretext of being 'pump rooms' or even agricultural reservoirs.

Detailed statistics on the permit applications for agricultural development submitted to the Planning Authority in the period 1993 -1997 are currently being compiled and analysed by the Environmental Management Unit (Countryside and Coastal Planning Team) of the Planning Authority. This work is at a moderately advanced stage, and seeks to:

?? identify existing demands (together with their justification or otherwise) and establish trends;

?? quantify the various types of agricultural developments (including stores, garages, pump rooms, reservoirs, boundary walls/retaining structures, farms, greenhouses, and land reclamation);

?? provide geographical referencing of the existing and proposed developments;

?? assess the effectiveness of control procedures vis-à-vis agricultural development.

3.6.2.1.2 Land Reclamation

Significant expanses of garigue, inappropriately considered as barren "wasteland" have been ‘reclaimed’ for agricultural use by dumping of rubble, leveling of the land and subsequent topping with soil. The impacts include:

? Total habitat destruction within the footprint of the "reclaimed" area.
? Visual eyesores..
? Overspill of material during the leveling operations (as well as a result of subsequent soil/sediment erosion) onto the surrounding areas, causing indirect habitat degradation.
? Invasion of adjacent habitats by opportunistic species introduced with the dumped material and favoured by site disturbance.
? Loss of soil from the ‘reclaimed’ land, particularly since most of the karstland in question is exposed to the wind and/or is located on steeply sloping ground prone to the effects of erosion by runoff; erosion is further favoured by inappropriate management (e.g. absence of retaining walls).
? Sedimentation of nearby watercourses as a result of erosion of soil and rubble from the ‘reclaimed’ sites.

Land reclamation was carried out by the Department of Agriculture in the following areas as part of the *Izra u Rabbi* project *(Source: Department of Agriculture, June 1998)*:
?? Wied iz-Zurrieq
?? Hagar Qim/ Wied Hoxt area (Il-Qrendi)
?? Ix-Xaghra tal-Gzira (Ghar Lapsi)
?? Ta‘ Laroka (overlooking Il-Bosk, at Il-Buskett)

The following stretches of karstland are also among those affected by similar development:

?? Tat-Tunnara, the hinterland of Ir-Ramla tat-Torri, Ta' Msid, the environs of the Mellieha-Cirkewwa main road, the sides and environs of Wied Musa, and Ghajn Tuta (L-Ahrax tal-Mellieha)
?? Il-Prajjet, Tat-Tomna, Bejn il-Gonna, the environs of the Mellieha bypass, Selmun, Tat-Tomna and Ghajn Znuber (Mellieha)
?? Ix-Xaghra l-Hamra (Manikata)
?? L-Imbordin (Mellieha / Xemxija)
?? Ghajn Astas (San Martin)
?? Il-Ballut (Wardija)
?? Il-Bahrija / Il-Kunzizzjoni area
?? Tal-Merhla (Mtahleb)
?? Wied Hazrun and environs (Had-Dingli / Mtahleb)
?? L-Ghemieri area (Rabat)
?? Ix-Xaghra ta' Lawrenti, the environs of Verdala, and the environs of Ghar il-Kbir (Buskett)
?? Wied ix-Xaghri area (Girgenti)
?? Wied il-Kbir (Hal Qormi)
?? along the Ghar Lapsi-Hagar Qim main road (Ghar Lapsi)
?? Wied il-Mixta (Benghisa)
?? Wied Dalam (Hal Ghaxaq)
?? Ix-Xghajra
?? Bahar ic-Caghaq / L-Ghallis area
?? Il-Qortin t' Isopu (Nadur, Gozo)
?? Ta' Lambert / Mgarr ix-Xini area (Xewkija, Gozo)

Proposals have been submitted for the ‘reclamation’ of ecologically valuable karstland in other areas, including the environs of Is-Salib tal-Gholja (Siggiewi), Ghar Hasan (Hal Far) and the remarkably steep sides of Wied Hanzir (Hal Qormi).

Other even more inappropriate sites have also been ‘reclaimed’ by the dumping/leveling of material (with or without the construction of retaining walls), infilling of watercourses, and occasionally, the destruction of trees. Examples include:

?? The valley bed and valley sides at Il-Wied ta' Msid (L-Ahrax tal-Mellieha) – most of the valley has in fact been obliterated.
?? The saline marshland at Il-Hofra (Mellieha) – significant damage has been inflicted to the remnant of a very rare habitat.
?? The lower watercourse at Wied il-Ghasel (Burmarrad) – a major watercourse abruptly ‘disappears’; as a result valley runoff after storms has to find its way through a vineyard, each time carrying away the soil in its path.
?? The watercourse at Wied il-Gnejna (Mgarr) – part of the watercourse has been constricted to accommodate a cultivated field.
?? The watercourse at Wied il-Hemsija (Ta' Qali) – much of the watercourse has been constricted into a very narrow channel by the gradual encroachment of the adjoining fields.
?? The woodland at Wied Hazrun (Mtahleb) – one of the last woodland remnants has been virtually destroyed; the agricultural land thus created is highly prone to soil wash.
?? The valley bed at Wied Dalam (Hal Ghaxaq) – damage to the valley bed; site prone to high volume of flow during storms.
?? The valley bed at Wied Zembaq (Birzebbuga) – damage to the valley bed; site prone to high volume of flow during storms.

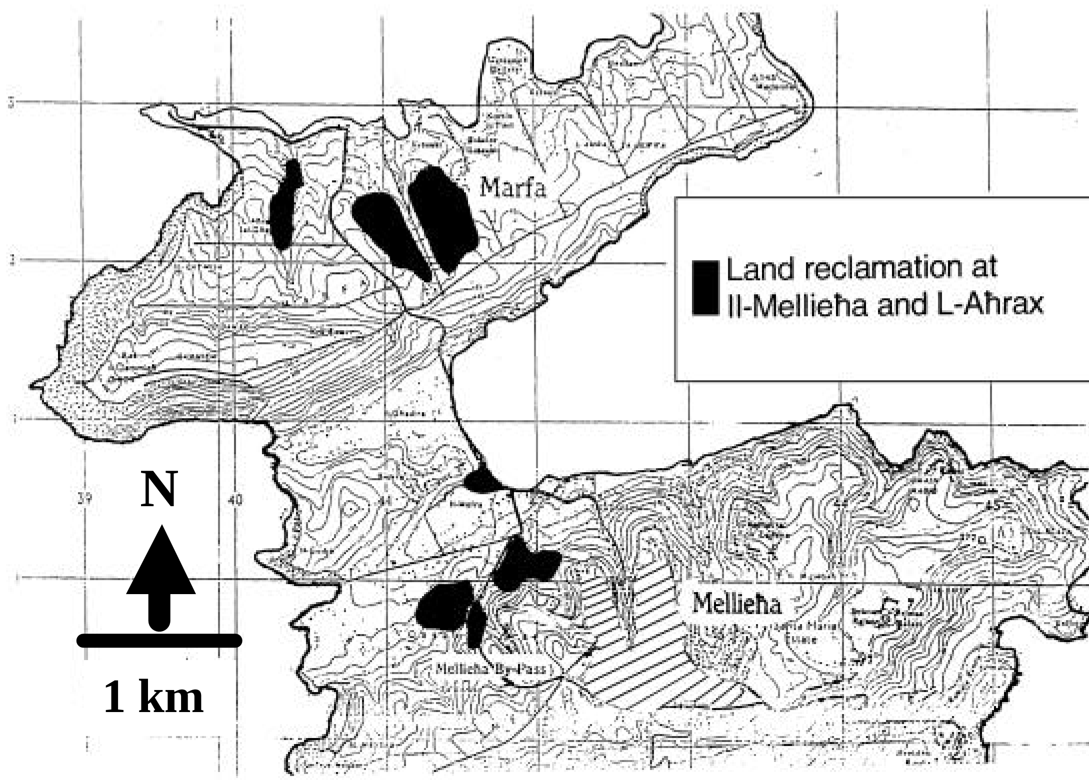


Fig. 6.3 Map of northern Malta showing land reclamation for agriculture at Il-Mellieha amd L-Ahrax

Reclamation of land for cultivation has also been carried out (or a permit applied for) in areas where adverse environmental impacts would be avoidable provided that adequate precautions are taken to prevent:

?? erosion and/or over spill of material;
?? contamination of produce;
?? aquifer pollution by the leaching of agrochemicals;
?? pollution of nearby watercourses by runoff transporting sediments and agrochemical residues.

The sites in question include:

?? disused parts of the landfill at Il-Maghtab--
?? disused quarries at L-Imqabba / Il-Qrendi / Hal Kirkop
?? disused quarries at Il-Wied ta‘ Sdieri and Wied il-Mielah at L-Gharb in Gozo.

In other areas, even the seemingly innocuous reclamation of degraded sites may have indirect environmental impacts by displacing existing (even if informal) land uses onto nearby habitats. Instances have been observed where significant expanses of degraded public land have been committed to agricultural (or other) use, thereby denying free public access to the degraded area and diverting informal recreational pressures (especially trampling) onto nearby sites. The net result is a cumulative deterioration over the whole area.

3.6.2.1.3 Access Routes

Following increased mechanisation of agricultural activity, numerous roads and tracks for vehicular access to remote rural areas were opened. In relatively recent times, many tracks have been widened and surfaced, some by the Department of Agriculture through an ongoing scheme for the ‘improvement’ of rural areas, others by Local Councils (particularly at Haz-Zebbug), and the rest by individual farmers (or groups of farmers). Statistics provided by the Department of Agriculture on farm access roads asphalted or concreted by the Department of Agriculture are given in Table 3.6.12.

Table 3.6.12
Number and area of access roads surfaced between 1988 and 1997 (source: Department of Agriculture)

Year	No. of roads surfaced	Area surfaced (m^2)
1988	8	20,000
1989	14	16,800
1990	11	13,770
1991	16	11,817
1992	16	9,711
1993	20	13,345
1994	11	14,306
1995	73	82,264
1996	91	79,758
1997	18	9,532

Whilst assisting farmers in reaching their land without undue hardship, this practice also has a number of important environmental impacts, including:

?? Direct habitat destruction and/or breaching of retaining walls as a result of the opening or expansion of tracks (e.g. on garigue throughout L-Ahrax tal-Mellieha).

?? Facilitation of vehicular access to previously inaccessible areas, thereby introducing problems related to trampling, dumping, theft of produce, demolition of rubble walls, etc.

- Visual impacts due to the increased introduction of conspicuous artificial elements into the rural landscape.

- Reduction of water percolation, in the case of tracks surfaced with impermeable materials (concrete, asphalt, tarmac).

- An increase in the quantity and velocity of runoff in the case of impermeable surfaces, especially if located on steep valley sides (e.g. throughout Wied il-Bahrija, and at Wied l-Isqof) or within a valley bed (e.g. at Wied il-Bahrija, and at Wied Marsalforn). The ultimate effects include increased soil erosion (e.g. at Wied ir-Ramla in Gozo, virtually the entire soil cover of a field was lost during a storm in 1993), structural damage to rubble walls (as reported at Ir-Ramla tat-Torri), and accelerated sedimentation and pollution of nearby watercourses (together with their consequent invasion by opportunistic weedy species).

- Tracks surfaced with spalls (*zrar*), hardstone dust (*torba*), poor-quality asphalt/concrete, or other loose material gradually release gravel, which smothers the flora in adjacent habitats, promotes its replacement by opportunistic weedy species, contributes directly to accelerated sedimentation in watercourses, and also increases the physical erosive capacity of runoff water (thereby promoting soil loss and further sedimentation).

3.6.2.2 Habitat clearance

3.6.2.2.1 Deforestation

The Maltese countryside is characterised by a relative absence of trees. In part, this appears to be attributable to deforestation that started in ancient times, and has continued throughout the Middle Ages and up to relatively recent times. Deforestation of the Il-Wardija/Il-Bidnija plateau appears to have occurred mainly in the early 20th century. Concurrently, grazing activity (mainly sheep and goats) prevented regeneration of trees and undergrowth by destroying seedlings; grazing is nowadays virtually insignificant except in Gozo, although localised effects on maquis communities have been observed (*e.g.* at Wied Ghomor, l/o San Giljan).

The only surviving traces of the Mediterranean sclerophyll forest which once covered areas of the Maltese Islands, are all of very small scale and are located at Il-Ballut (Wardija), Il-Wied ta‘ l-Imgiebah (Mellieha), Il-Bosk (now part of IBuskett) and Wied Hazrun / Ta‘ Baldu (Mtahleb). In 1991, the copse at Wied Hazrun was mostly destroyed by its tenant through a combination of felling and burning to make way for the planting of orange trees. Only four out of about 60 oak trees were spared; the undergrowth (including a locally rare species of *Cistus*) beneath the few surviving trees was also largely destroyed by the use of herbicides, ploughing and the cultivation of broad beans. Fortunately, some of the stumps are showing signs of recovery, but the other ‘surviving’ trees are declining. Unless urgent remedial action is taken, it is highly likely that this copse will cease to exist. Moreover, since the site lies on steeply sloping terrain, loss of now-unprotected soil is likely to become a problem.

3.6.2.2.2 Clearance of Reed Beds

Habitat clearance associated with agricultural activity in valleys includes the razing of reed beds (especially *Arundo donax*) within watercourses, for the purposes of:

- harvesting (e.g. to make windbreaks and cane curtains), very evident at Wied San Blas (Nadur, Gozo) and also observed at Wied il-Bahrija;
- runoff management by removal of obstructions to water flow, for example as recently observed at Wied il-Lunzjata (Kercem, Gozo)

The reeds themselves regenerate quite rapidly, but indirect impacts may be significant. These include:

?? the associated flora and fauna often fail to recover, especially from wholesale clearance of extensive stretches;
?? temporarily unprotected sediment becomes more prone to erosion and subsequent sedimentation further downstream, leading to siltation of water drainage cahnnels;
?? the 'pruning' favours excessive proliferation of reed growth, thereby smothering other vegetation as well as secondary effects such as alteration in land levels (reeds have sediment-binding roots).

3.6.2.3 Exploitation Of Freshwater Resources

Natural freshwater resources are exploited for irrigation by:
?? Pumping of groundwater;
?? Tapping of springs and seepages;
?? Exploitation of valley runoff;
?? Collection of runoff from roads and other surfaces.

3.6.2.3.1 Pumping of Groundwater

Overpumping of groundwater in coastal areas has contributed to saltwater intrusion, with a consequent salinisation of the water resource used for irrigation. Particularly high salinities have been recorded at Wied il-Pwales and L-Armier.

3.6.2.3.2 Tapping Of Springs And Seepage Points

Tapping of springs and water seepages appears to have been carried out since antiquity. Most springs no longer flow into watercourses, which has resulted in the elimination of nearly all former permanent stream habitats. Places with still-existing permanent streams are Wied il-Bahrija, Wied l-Imtahleb and Wied il-Lunzjata (Gozo). A few other springs that flow directly through coastal boulder screes where cultivated land is relatively absent have also survived – for example, at Ghajn Hadid (Selmun) and Ghajn Barrani (Xaghra, Gozo). Positive impacts have been limited to the excavation of deep, and often elaborate, artificial water galleries (some of which date back to the 17th century) which ecologically function as semi-natural caves that also incorporate subterranean freshwater habitats. Numerous tapped springs/seepages are known in the following locations (the list is not exhaustive):

?? L-Ghajn il-Kbira (Girgenti)
?? Il-Buskett and Gnien iz-Zghir (Rabat)
?? L-Irdum ta' Ghajn Gidem (Had-Dingli)
?? Wied Liemu, including Santa Katarina and L-Irdum tal-Lunzjata (Had-Dingli/Rabat)
?? L-Ghemieri and Bieb ir-Ruwa (Rabat)
?? Wied ir-Rum, Wied Hazrun, Il-Wied ta' Ghar Ilma and Il-Wied tal-Ghajn it-Tajba (Mtahleb)
?? Ghajn Ballut (Wardija)
?? Bin]emma, Bunahhala, L-Ghajn ta' San Pietru and Wied il-Gnejna (Mgarr)
?? In-Nahhalija (Manikata)
?? Wied San Niklaw, il-Wied ta' Gnien Ingraw, Il-Wied ta' Ghajn Zejtuna,Taht il-Palma and Wied l-Imgiebah (Mellieha)
?? Ghajn Tuta, Il-Wied tal-Baqra and Il-Wied tas-Sajjettun (L-Ahrax tal-Mellieha)
?? Ghajn Lukin, Ghajn Sellum, L-Irdum tax-Xaghra, Wied il-Pergla and Ghar Kalipso (Xaghra, Gozo)
?? Ir-Ramla l-Hamra, L-Irdum tal-Hawt, Wied San Blas, Wied ir-Rihan and Wied Dahlet Qorrot (Nadur, Gozo).

The tapping of the source at Ghajn Klin (Ghajnsielem, Gozo) has been combined with the creation of a large semi-natural freshwater pool which is now an important habitat (and a site of major ornithological interest) in addition to its role as a semi-natural water reservoir. This illustrates how agricultural activity and wildlife interests can co-exist if the requisite precautions are taken.

3.6.2.3.3 Exploitation Of Valley Runoff

The impacts of exploitation of valley runoff are indirect, but can be severe. These impacts are mainly associated with watercourse engineering, especially damming, and in some cases widening and deepening, to provide reservoirs for the collection of water. Subsequent mechanised dredging of sediment causes additional impacts. The overall effects can be summarised as follows:

<u>Positive effects</u>

Provision of a formerly unavailable water resource.

Control over the rate of water flow, with associated benefits such as decreased storm impact further downstream (if interventions are carried out carefully).

Increased retention time for percolation, and hence, aquifer recharge.

Creation of new semi-permanent freshwater habitats – for example, the formerly very rare bulrush *Typha domingensis* appears to have become quite common in dammed valleys.

<u>Negative effects</u>

Modification of site geomorphology and, in extreme cases, transformation of the local landscape into an increasingly artificial one.

Destruction of the original habitat present on the site proper due to the initial physical impact of the construction and engineering operations, together with the subsequent inundation by water and smothering by silt of the biota behind dams and further upstream.

Fragmentation of the watercourse habitat as dams form barriers between the various stretches.

Induced ecological imbalances behind dams, triggering the excessive growth of certain species, such as bramble (*Rubus ulmifolius*).

More rapid drying up of those parts of the watercourse located downstream from the dams, thereby extirpating specialised hydrophilic species and favouring the proliferation of hardier opportunistic ones (e.g. *Aster squamatus*).

Provision of vehicular access for construction and maintenance equipment, thereby promoting secondary problems such as dumping and offroading/motorised scrambling in the watercourse.

Associated impacts such as dumping of excavated/dredged material and/or surplus construction material onto valley sides, destabilisation of banks, disintegration of poorly-constructed dams and consequent siltation.

The following are among the sites that have been subjected to damming for agricultural and other purposes (see also Fig. 6.4):

Il-Wied tac-Cirkewwa, Wied Musa and Il-Wied ta‘ Msid (L-Ahrax tal-Mellieha)

Il-Wied tal-Ghajn, Wied San Niklaw, Il-Wied ta‘ Gnien Ingraw, Wied l-Imgiebah and Wied il-Mistra (Mellieha)

Wied il-Gnejna and Wied il-Hmar (Mgarr)

Il-Wied ta‘ Migra l-Ferha and Wied ir-Rum (Mtahleb)

Wied il-Fiddien and, especially, Wied il-Qlejgha (Rabat)

Il-Wied ta‘ l-Isperanza and Wied il-Ghasel (Mosta)

Il-Wied ta‘ l-Imselliet, Il-Wied tal-Hzejjen, Il-Wied ta‘ Ghajn Mula, Il-Wied ta‘ Ghajn Rihana and Wied Qannotta (Bidnija / Burmarrad)

Wied il-Faham (Hal Gharghur)

Wied il-Kbir (Swieqi)

Wied is-Sewda (Hal Qormi)

Wied Hanzir, Wied Qirda, Wied il-Kbir and Wied it-Tigieg (Hal Qormi / Haz-Zebbug)

Wied il-Luq, Wied il-Girgenti, Wied il-Hesri and Il-Wied ta‘ Sant‘ Andrija (Siggiewi)
Wied il-Knejjes (Marsa / Hal Luqa)
Wied Blandun (Fgura)
Wied il-Ghajn (Marsaskala)
Il-Wied ta‘ Bur Glat (Gudja)
Wied Dalam (Birzebbuga / Hal Ghaxaq)
Wied il-Qoton (Birzebbuga)

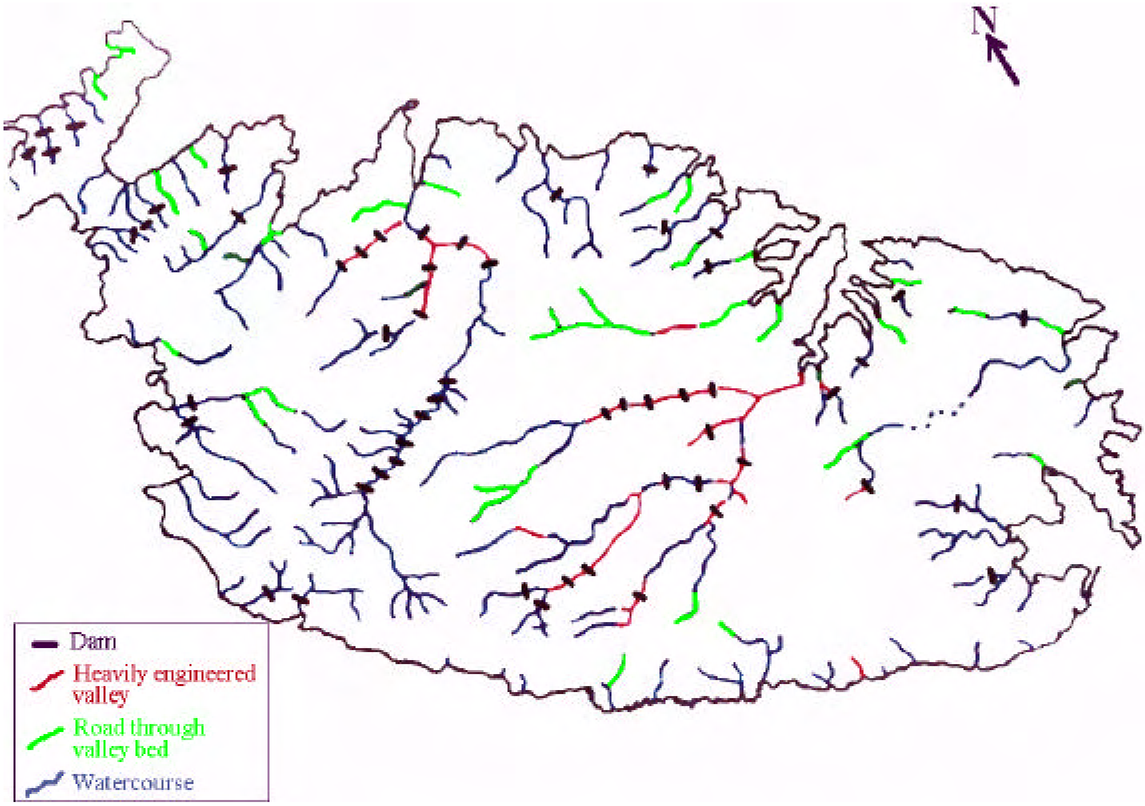


Fig. 6.4 Map of the island of Malta showing the principal watercourses and engineering works undertaken in them.

3.6.2.3.4 Collection Of Runoff From Roads And Other Artificial Surfaces

Runoff from artificial surfaces as an exploitable resource is gaining greater potential as the land area occupied by artificial surfaces increases. Such exploitation offers an environmentally innocuous alternative to the exploitation of other water resources. Moreover, collection of this runoff minimises runoff-induced soil erosion and related environmental problems at source and therefore generally has a positive environmental impact (subject to proper siting of facilities).

Statistics for the exploitation of ‘artificial’ runoff are not available but it seems that the degree of tapping is still relatively low.

3.6.2.4 Importation of fertilisers

A request for data was made to the Department of Agriculture. To date, no information has been provided.

3.6.2.5 Importation of pesticides

*A request for data was made to the Department of Agriculture. Raw data on importation of pesticides for the years 1992-1998 was supplied but this reached the compiklers too late for incorporation in this report***.**

3.6.3 Soils

3.6.3.1 Soil types

Maltese soils are characterised by:
Their close similarity to the parent rock material;
Their relatively young age;
The ineffectiveness of the climate in producing soil horizon development;
The great importance of human activities in modifying them.

Using the Kubiëna and FAO classification systems, Maltese soils are of three main types (Table 3.6.13).

Table 3.6.13
Classification of Maltese soil types under the Kubiëna and FAO systems.

Name of soil type		Characteristics	Occurrence
Kubiëna system	***FAO system***		
Terra soils	**Calcaric regosols**	Relic soils formed during the	Develop on karstland.

(Red Mediterranean soils)		Pleistocene, probably under Mediterranean woodland or scrubland and which are little affected by the present climate. They are mature and extensively weathered, have a low calcium carbonate content, and are also low in organic matter.	
Xerorendzinas	**Calcic cambisols**	Immature soils that have a high calcium carbonate content and are low in organic matter.	Develop on weathered Globigerina Limestone and on valley deposits.
Carbonate raw soils	**Chromic cambisols**	Immature soils that have a very high calcium carbonate content and are very low in organic matter.	Develop on weathered Quaternary sandstones, Greensand, the lower beds of the Upper Coralline Limestone, Blue Clay and Globigerina limestone.
Other types		*Rdum* sequences, saline soils, alluvial soils.	Formed within *rdum*, coastal localities and alluvial plains, respectively
Soil complexes		Formed through human agency by the addition of rock debris to soil during reclamation of disused quarries, or by mixing domestic waste with soil for use in land reclamation, or by mixing of different soil types transported from different localities	Occur mainly in existing and former agricultural land

Distribution Of Soil Types

The most recent soils map of the Maltese Islands available is that produced by Lang in 1960 (Fig. 6.5).

Since the date of issue of this map, considerable translocation of topsoil, subsoil and regolith has occurred, together with occasional mixing of soil with other material. These interventions have generally been associated with, *inter alia*:

site clearance for development;
infilling of disused, or partly exhausted, quarries;
'reclamation' of land for agriculture;
soft landscaping of development sites;
disposal of excavation debris;
overspill from development sites;
valley engineering projects.

The volume of soil relocated by the private sector is not recorded at the Department of Agriculture. Very rough estimates may be made by measuring the land areas given over to development, but these are likely to be of limited value owing to high margins of error arising from:

non-uniform soil depth;
numerous developments scattered in the countryside (individual areas are difficult to estimate);
numerous small-scale and/or illegal (and therefore undeclared) developments that are not recorded in official documentation (*e.g.* trapping huts and other rural rooms);

illegal burial, dumping, translocation and/or mounding of soil, as well as illegal admixture of soil with other material.

Detailed updating of the existing soils map is strongly recommended in view of the extensive translocation of soil and the urbanisation of significant tracts of former soil-covered land.

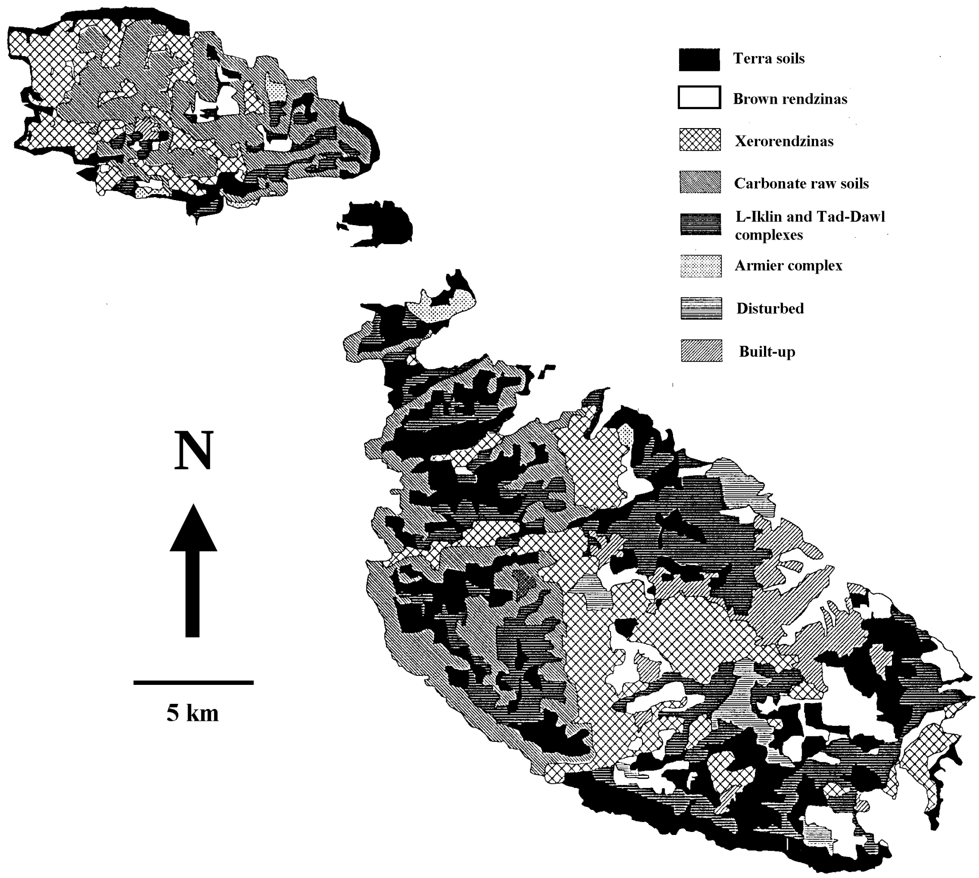


Fig. 6. Soils map of the Maltese Islands (after Lang, 1960)

3.6.3.3 Soil Erosion

This phenomenon constitutes a major ongoing problem throughout the whole Maltese countryside, especially in valleys. It appears to be on the increase owing to a number of factors which include the following:

? Dereliction and subsequent collapse of soil-retaining random stone walls (*hitan tas-sejjiegh*).

? Deliberate/accidental damage to soil-retaining random stone walls as a result of snail-collecting, offroading and motorised scrambling, and infrastructural and/or maintenance interventions such as trenching, dredging, and cleaning/'weeding' of country roads.

? Breaching of soil-retaining random stone walls to provide new access points to fields.

? Replacement of random stone walls with less adequate structures (for example, ashlar walls that lack weep-holes often collapse when the soil becomes waterlogged).

- ? Abandonment of traditional runoff management structures (*e.g. mwejjen* – tunnels constructed in rubble walling underneath cultivated land).
- ? Clearing of vegetation from uncultivated land.
- ? Localised deforestation.
- ? Compaction of soil surfaces as a result of the passage of heavy vehicular traffic associated with offroading and motorised scrambling, as well as with general access and parking in (and/or around) popular recreational areas, hunting areas, trapping sites, agricultural areas and isolated rural buildings/hamlets.
- ? Clearing of vegetation, deposition of material, compaction and inhibition of plant growth (using herbicides) for the preparation and maintenance of trapping sites (*mnasab*).
- ? Undermining of watercourse banks in the course of valley engineering works.
- ? Reprofiling of land into steep escarpments.
- ? Excavation on sloping ground.
- ? Downslope ploughing.
- ? Modification of soil structure through the excessive use of fertilisers (nitrates, in particular, are known to oxidise soil humus, rendering the soil crumbly and readily erodible).
- ? Lack of attention to incipient gullying.
- ? Deposition of soil and other material (for agricultural reclamation, 'temporary' storage, or permanent dumping) on sloping ground prone to runoff-induced erosion, and on land exposed to wind.
- ? Reclamation of land in valley beds and watercourses.
- ? Construction of impermeable surfaces (e.g. buildings, paved areas) on valley sides and valley catchments.
- ? Rendering rural tracks impermeable, especially those on sloping ground and within valley beds, thereby increasing the quantity and speed of water runoff.
- ? Channelling of urban runoff into valleys.

There is little existing information on soil erosion in the Maltese Islands, beyond a few specific case studies. There is no systematic erosion status/erosion susceptibility database, and consequently, no corresponding map of erosion risk for the Maltese Islands. However, the Environment Protection Department intends to embark on a pilot project on soil erosion mapping and assessment (see box).

Soil erosion mapping and assessment

The Environment Protection Department, in collaboration of the Department of Agriculture, intends to embark on a pilot project on soil erosion mapping and assessment in order to produce a database of soil erosion status and erosion susceptibility. Initially this study will cover limited areas.

This exercise will lead to the identification of erosion-prone priority areas. The production of erosion maps, photo catalogues and assessment reports will form the basis for sustainable land management and therefore the formulation of recommendations for the prevention of land degradation and the formulation of a National Environment Action Programme. The results would also be used as a baseline study for rehabilitation projects of degraded habitats.

The protection of the environment is an important aspect in this activity. A consolidated map of soil erosion risk would provide institutions such as the Environment Protection Department and the Planning Authority with a tool for drawing up policies for the protection of sites of scientific and ecological importance. The Department of Agriculture would also benefit from this activity since the results could be used for the drawing up of guidelines for the enhancement of agricultural practices and for the protection of soil.

Soil erosion risk maps can also be used in hydrological studies in order to obtain more information on the infiltration processes of unsaturated land zones. The survey would also serve as a baseline study for the identification of pollution sources that contaminate the soil and hence the groundwater.

The final product of this project will be the physical assessment of erosion-prone areas and documentation of this in a cartographic database. This would be used in the identification of areas with a high priority for curative and remedial measures. This project is in line with the implementation of the United Nations Convention to Combat Desertification. Through the ratification of this Convention, the Government of Malta has taken the first measures towards soil conservation.

3.6 4 Existing Legislation Concerning The Environmental Aspects Of Agriculture (Table 3. 6.14)

Table 3.6.14
Existing local legislation concerning the environmental aspects of agriculture

Legislation	Provisions	Comments
Wild Thyme Protection Regulations, 1932 [G/N 85/1932]	Protects Mediterranean Thyme (*Coridothymus capitatus* -- saghtar) as an important source of nectar for honey production. Unauthorised destruction, uprooting, sale, purchase or keeping of the plant is prohibited.	Compatible with both apiculture and conservation. Effectiveness is undermined by the 1988 zoning of significant tracts of former garigue habitat for development (*e.g.* at Bahrija, Had-Dingli, Xemxija, Mellieha and Pembroke) or for quarrying (practically all hardstone quarry areas), and by the encouragement given (until very recently) by the Department of Agriculture and the Department of Lands to the "reclamation" of garigue for agriculture.
Agriculture (Plant Protection) Act, 1966 [Act XXXIX of 1966]	Seeks to prevent the introduction of plant diseases and pests into the Maltese Islands. Based on 4 schedules: 1. Dangerous pests and diseases. 2. Organisms whose importation is prohibited. 3. Plants which can only be imported if accompanied by a health certificate. 4. Plants which can only be imported with prior authorisation and subject to a health certificate as well as to additional declarations specified in the schedule.	An important legal tool for integrated pest control. It provides a valuable safeguard against damage to agricultural produce and, indirectly, against certain environmental impacts of agriculture.

Fertile Soil (Preservation) Act, 1973 [Act XXIX of 1973] & Preservation of Fertile Soil Regulations, 1973 [L/N 104/1973]	Protect fertile soil by prohibiting: 1. Unauthorised transport of soil. 2. Admixture of soil with material in ways which would sterilise it. 3. Deposition of material on soil, or covering of soil with material. 4. Building upon soil. 5. Deposition of fertile soil on land already covered with 1m of soil. 6. Deposition of soil in heaps or in any manner which would render it unsuitable for immediate cropping.	Some provisions (*e.g.* prohibition of soil deposition in heaps or in any manner that would render it unsuitable for immediate cropping) are impractical and their breaching is consequently often officially tolerated. Provisions to protect soil against activities contributing to soil erosion (*e.g.* reclamation of watercourses, reclamation of land that is exposed and/or steeply sloping, deforestaton and/or clearing of wild vegetation) are absent and need to be added.
Dairy Farms Regulations, 1976 [L/N 28/1976] issued under the Food, Drugs and Drinking Water Act, 1972 [Act XL of 1972]	Specify requirements and standards for: construction features of dairy farms activities in the practice of dairy farming.	Requirements include: minimum dimensions and layout specifications for the various farm structures the requirement for a mains water supply, an electricity supply and ancillary facilities impervious jointless floors arrangements for the disposal of liquid waste Regulations came into force on 01.05.1978 by virtue of L/N 57/1978.
Temporary Provisions Act, 1988 [Act X of 1988]	Regulates the granting of development permits, and makes other ancillary provisions.	Mostly superseded by the Development Planning Act, but the "*Pjan Regolatur (Provvedimenti Temporanji)*", which identifies the limits to development, is still in force. Agricultural land that is located within development zones is committed to urban development, whilst areas located outside development are safeguarded (to some extent) against such development.

Environment Protection Act, 1991 [Act V of 1991]	Provides legal framework for the protection of the environment against activities and practices that are potentially harmful.	Provisions of the Act seek a holistic treatment of the environment, and therefore include soil and agricultural land. Provisions for the control of pollution (*e.g.* by agrochemicals) and for controls over the importation of flora and fauna (*e.g.* new crop strains, new animal breeds, and additional indirect safeguards against the introduction of agricultural pests) are of direct relevance to agricultural activity. The Act is too vague and difficult to implement. Implementation is largely dependent on the issuing of subsidiary regulations.
Development Planning Act, 1992 [Act I of 1992] & 1997 Act to Amend the Development Planning Act [Act XXIII of 1997]	Provides legal mechanism for the planning, management and control of development, and ancillary provisions such as legal protection ("scheduling") of sites of conservation value.	Highly relevant to the agriculture-environment interface since it provides for: land use planning control of agricultural (and supposedly "agricultural") development in the countryside control of development at the expense of agricultural land

General Development Order, 1993 [L/N 178/1993] & General Development Order, 1997 [L/N 103/1997] (amended version of previous Order)	Class 11 of the Order exempts certain types of agricultural development from the need for a development permit according to the Development Planning Act. Exempted development includes: reservoirs located below ground level and not exceeding specified dimensions land reclamation for afforestation by Dept of Agriculture pump rooms not exceeding specified dimensions the levelling and the widening of rural roads The following are explicitly excluded from the exemption: farms and related development reservoirs located above ground level the installation of irrigation systems (with the exception of "drip sprinkler" systems) the creation of pools land reclamation development on scheduled land	The exemptions contained in the Order provide a serious loophole vis-à-vis the important controls on development in rural areas which the Structure Plan for the Maltese islands and the Development Planning Act seek to provide. In particular, some exempted developments (*e.g.* widening of rural tracks and their covering with impermeable surfaces; afforestation on garrigue) have an adverse environmental impact which is worse than that entailed by non-exempted developments. some of the exempted developments are actually used for non-agricultural purposes or for agricultural purposes that are not officially "intended" in the exemptions. the exemption of pump rooms is unnecessary and hinders the adoption of more-acceptable alternatives such as the use of submersible pumps and/or mobile pumps. enforcement of specified dimensions is difficult. very poor differentiation is made between location of facilities on cultivated land and siting on non-agricultural land (including habitats of conservation value). An overhaul of the Order, taking due account of environmental considerations is desirable.
Poultry Slaughterhouse Regulations, 1995 [L/N 93/1995] issued under the Prevention of Disease Ordinance [Cap. 36]	Provisions include: requirement for a licence from the Director of the Veterinary Service to develop, operate and/or extend a poultry slaughterhouse requirements and standards for construction features of slaughterhouses requirements and standards for activities in the practice of poultry slaughtering.	Requirements include: minimum distance from livestock farms, industrial (or other) development that may emit fumes or contaminants, and habitable buildings layout specifications for the various slaughterhouse structures the requirement for a mains water supply and ancillary facilities waterproof floors and walls with rounded edges and corners control of transportation of produce

Poultry Chicks and Hatching Eggs (Importation) Regulations, 1997 [L/N 48/1997] issued under the Prevention of Disease Ordinance [Cap. 36]	Provisions include: requirement for authorisation by the Director of the Veterinary Service to import hatching eggs and chicks requirement for certification that the imported eggs and chicks, and/or their place of origin, are free from specified diseases	
Hatcheries Regulations, 1997 [L/N 51/1997] issued under the Prevention of Disease Ordinance [Cap. 36]	Provisions include: requirement for a licence from the Director of the Veterinary Service to develop, operate and/or extend a hatchery requirements and standards for construction features of hatcheries requirements and standards for activities in the practice of dairy farming.	Requirements include: minimum distance from livestock farms, processing plants and habitable buildings layout specifications for the various hatchery structures the requirement for a mains water supply and ancillary facilities impervious jointless floors provision for incineration, fumigation and disinfection using approved disinfectants as listed in the regulations. provision of a boundary fence and control of traffic into the farm protection of the hatchery against insects, rodents, vermin, birds and other animals (including mandatory use of approved pesticides)
Rubble Walls & Rural Structures (Conservation & Maintenance) Regulations, 1997	Seeks to protect rural structures, especially rubble walls (*hitan tas-sejjiegh*) and to enforce their maintenance.	Positive in principle, but provisions of the regulations are prone to interpretation and enforcement may be difficult.

CONTINUE

3.7 Recommendations

As stated in the introduction it is difficult to make detailed recommendations in the absence of stated national environmental objectives. What is offered here are a number of **general** recommendations concerning certain key issues that were identified as requiring attention during the compilation of the present report. Justification for these recommendations will be found in the relevant sections of the report. In some cases, more detailed recommendations are made in the relevant sections of the main report.

3.7.1 Biota And Habitats

The rich biodiversity of the Maltese Islands should be better publicised as an important component of our national heritage.

Endemic species in particular should be regarded with the same esteem as are other unique features of our heritage

Research aimed at gaining a better understanding of the diversity of the biota of the Maltese Islands should be promoted and funded.

Existing inventories and databases of local biota should be reviewed, updated and extended to cover the whole of the Maltese Islands and their territorial waters. In particular, the *National database on biodiversity* project currently being undertaken by the Malta Council for Science and Technology together with the Department of Biology of the University of Malta needs to be supported and funded on a permanent basis.

The *Red Data Book for the Maltese Islands* should be revised, updated and published with urgency.

Threatened species of local biota, and the majority of endemic species, should be included in the list of protected species. Different species should be given different protection ratings depending on their particular conservation status.

Locally occurring species of international conservation importance that are not already legally protected under local legislation should be included in the list of protected species.

The *Environment Protection Act 1991* should be reviewed and revised in order to remedy certain deficiencies and bring it in line with modern international practice.

In particular, the designation 'Nature Reserve' in the *Environment Protection Act 1991* should be totally revised as it does not conform with internationally accepted definitions of nature reserves.

It is strongly recommended that the various categories of protected areas that are internationally accepted and used, be incorporated into local legislation (the *Environment Protection Act 1991*).

Certain discrepancies between the *Environment Protection Act 1991* and the *Development Planning Act 1992* and subsidiary legislation should be resolved.

Malta' implementation of the various international conventions and agreements concerned with the protection of nature and natural resources to which it is party should be reviewed. This review should also include sites and species declared under these conventions.

As soon as is practicable, Malta should become party to those international conventions and agreements concerned with the protection of nature and natural resources, in particular the Bonn Convention (and agreements reached under it) and the Convention on Biological Diversity.

Local agencies that have the responsibility of implementing the various international conventions and agreements concerned with the protection of nature and natural resources to which Malt is party, should be given the necessary resources to carry out the required work. In some cases, implementation requires the concerted efforts of a number of different agencies, in which case the necessary administrative machinery for taking such concerted action should be set up.

An official policy concerning the importation of alien species for commercial and other purposes needs to be formulated and local legislation enacted and/or emended accordingly.

All efforts should be made to prevent invasion of natural ecosystems by aliens and genetic contamination of native species, subspecies, races, varieties and stock by alien genetic material.

Apart from other implications, the use of Genetically modified organisms (GMOs) poses a potential threat to natural ecosystems and their biota and therefore GMOs should be included in any policy and/or legislation on alien species.

Where local ecosystems have become invaded by alien species, all efforts should be made to eradicate the invaders and to prevent re-invasion.

Existing inventories (including cartographic ones and GIS databases) of local habitats and biocoenoses should be reviewed, updated and extended to cover the whole of the Maltese Islands and their territorial waters,

Existing protected areas should be reviewed and their protection status amended in line with internationally recognised criteria and protection categories, particularly those operating in Europe and the Mediterranean.

Scientifically important, rare, and/or threatened ecosystems and habitats and areas with complexes of such ecosystems and habitats that are not already legally protected should be should be included in the list of protected sites.

7.2 Marine protected areas should be declared.

For every protected area of whatever status, a management plan should be formulated, and a body or agency charged with its implementation. A monitoring programme to ensure that the objectives of the plan are being met should be set up. Any deficiencies should be assessed and addressed.

Existing management plans for protected sites should be revised and updated. In particular there needs to be a clear statement of the objectives of the protected site on which to base management.

Bodies, governmental or non-governmental, entrusted with the management of a protected site should be closely monitored by the central authority responsible for protected sites to ensure that national policy is being met. It is recommended that a Board of Management for each protected site be set up.

Locally occurring habitats and ecosystems of international importance, particularly in the Mediterranean region, should be protected as required by the various conventions and agreements to which Malta is party, and managed according to internationally accepted standards.

Deficiencies in the present legislation regulating hunting and trapping need to be addressed.

An official policy, backed by legislation, concerning the exploitation of wildlife (other than hunting and trapping) needs to be formulated.

All regulations concerning biota and habitats need to be effectively enforced.

3.7.2 Fisheries And Aquaculture

The type of statistical information concerning fisheries that is presently collected needs to be reviewed and updated, especially in the light of modern international practice, and fisheries statistics need to be complied and published on a regular basis.

Legislation regulating fisheries needs to be reviewed, updated and incorporated into one coherent suite of regulations that conform to international standards, particularly those operating in Europe and the Mediterranean.

In particular, regulations concerning stock management need reviewing and updating, especially in view of the changing target species and fishing technologies.

There is urgent need to undertake modern stock assessments of the local fisheries resource. No effective management of the stock can be undertaken without such an assessment.

It is strongly recommended that Malta participate fully and effectively in international programmes aimed at assessing the Mediterranean fisheries resources and those concerned with their management.

Sustainable use of territorial waters for aquaculture should be promoted, however, the negative environmental impacts associated with this industry should be assessed and addressed now while the industry is still in its infancy and impacts on the marine and coastal ecosystem are still limited.

Data on the operational and environmental aspects of aquaculture need to be collected and published regularly.

All regulations concerning fisheries and aquaculture need to be effectively enforced.

3.7.3 Agriculture

The type of statistical information concerning agriculture that is presently collected needs to be reviewed and updated, and agricultural statistics need to be complied and published on a regular basis. In particular, the Census of Agriculture needs to be conducted much more frequently and the system of self-reporting that is presently in operation re-assessed and changed. Other deficiencies also need to be addressed (for example, information on siting of animal farms).

The system of land classification in use by the Department of Agriculture needs to be re-assessed and changed, particularly the designation ‘wasteland’. A more extensive classification with clearly defined categories is recommended.

Existing inventories (including cartographic inventories and GIS databases) of local agricultural resources should be reviewed, updated and extended to cover the whole of the Maltese Islands.

All efforts should be made to identify the factors causing the present decline in agricultural land and to reverse this trend. In particular, abandonment of prime agricultural land is a matter of great concern and should be addressed with urgency, particularly in the case of Gozo.

Existing policies regarding agricultural buildings and other constructions need to be re-assessed. In particular the present loophole of all manner of development in rural areas being passed off as ‘agriculture-related’ needs to be addressed.

Sites of scientific or conservation importance and historical buildings should not be used for agriculture and animal husbandry unless such use is compatible with the nature of the site or building.

Policies regarding land reclamation for agricultural purposes require urgent review. In particular, the policy of different agencies concerning this issue (especially the Planning Authority and the Department of Agriculture) should be reconciled and the present of reclaiming non-degraded natural habitats stopped. Land reclamation of degrading agricultural land should be encouraged.

The disposal of agricultural waste, including that from animals farms should be studied and the necessary policies, legislation and facilities set up.

Policies regarding building and surfacing of access roads for agricultural purposes require urgent review. The policy of different agencies concerning this issue (especially the Planning Authority and the Department of Agriculture) concerning this should be reconciled.

Policies regarding afforestation require urgent review. The policy of different agencies concerning this issue (especially the Planning Authority and the Department of Agriculture) should be reconciled. In particular, the questions of siting, species used and origin of stock for afforestion in rural areas need to be addressed.

Other policies that require urgent review and where the policy of different agencies needs reconciliation concern:

Clearance of vegetation especially scrub
Clearance of reed beds
Pumping of groundwater
Tapping of springs and seepages
Exploitation of valley runoff
Collection of runoff from roads and other surfaces

The soils of the Maltese Islands require urgent study using modern methods and the existing 1960 soils map needs to be updated. It is recommended that a joint soil survey and soil erosion status and erosion-susceptibility mapping project be undertaken and that the result of these studies be entered in a GIS database. The efforts of the Environment Protection Department and the Department of Agriculture this regard should be encouraged and adequately funded.

All efforts should be made to identify the factors causing the increasing soil erosion and to reverse this trend. In particular, ways and means of maintaining rubble walls and other rural structures in a good state of repair should be sought and a programme of repair and restoration of deteriorated such structures be implemented.

All regulations concerning agriculture and the preservation and management of agriculture resources need to be effectively enforced.

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4. THE COAST AND FRESHWATER RESOURCES

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BACK TO GENERAL CONTENTS

4. THE COAST AND FRESHWATER RESOURCES

Introduction

The present section of the state of the Environment Report will deal with two main issues, namely; the quality of the coastal environment, with special reference to the inshore marine environment; and the freshwater resources of the Maltese Islands.

These two main areas of concern have also been treated from other viewpoints in other sections of the present report.

Apart from Monaco, the Maltese islands have the highest population density in the Mediterranean. This is approximately 1100 inhabitants per km^2. Summer tourism may be expected to increase this figure to 3655 inhabitants per km^2 each year. As an island-state, Malta has also one of the smallest land areas, which is 316 km^2 . The high population density, small size and relatively high standard of living and economic development have led to great anthropogenic pressures being exerted on the environmental quality of our coastal areas.

In general, over the past 40 years there was a progressive loss of natural coastal habitats mostly to touristic developments. The few sandy beaches have been exposed to excessive sand erosion, mostly due to inland building developments. More recently, the number of leisure power boats have increased tremendously to the extent that many popular bathing sites are changed into unofficial summer marinas.

Industrial and urban waste waters are mostly discharged untreated into the coastal waters, and several infrastructural problems lead to a deterioration of water quality rendering a number of popular sites unfit for bathing during the summer months. Marine litter has increased and there are reports of significant accumulations on some seabed areas. It is evident that our coastal marine resources are at risk from mismanagement and unplanned development leading to a general deterioration in coastal environmental quality.

4.1 The State of the Coastal Marine Environment

4.1.1 On-Going Marine Environmental Monitoring Programmes

As a signatory state to the Barcelona Convention, Malta has a commitment to monitor the levels of certain pollutants in coastal waters and sediments, as well as in wastewater's being discharged into the sea (i.e. the MEDPOL Monitoring Programme). The pollutants, which are analysed for, include heavy metals, detergents, nutrients and fecal coliforms, as well as other bacteriological indicators. This monitoring program was initiated in the early 1980s, when it included a bigger range of parameters such as petroleum hydrocarbons and pesticides. The raw data, which was generated, was annually reported to the Mediterranean Action Plan Office in Athens. No attempt was ever made to use such data to evaluate the risks of marine contamination hazards and to draw general conclusions on the state of the marine environment in Malta.

For a considerable period of time, due to lack of sufficient resources the MEDPOL monitoring program had been much reduced in scope and only bacteriological parameters in seawater were being measured. More recently, the Pollution Control Co-ordinating Unit, within the Environment Protection Department, has again revived this MEDPOL monitoring program and a number of coastal stations are being monitored for basic water parameters such as nutrients, chlorophyll, water transparency, which may be utilized as indicators of environmental quality.

The monitoring of bacteriological parameters (fecal coliforms and fecal streptococci) in bathing waters represents by far the most extensive program of environmental monitoring of the local coastal waters. The resultant data is regularly evaluated and published by the Public Health Department.

Since 1985, the Marine Ecotoxicology Laboratory of the Department of Biology (University of Malta) has undertaken a number of 'ad hoc' field studies. These include studies on: eutrophic conditions in Marsamxett and Grand Harbour; levels of certain heavy metals in biota; the levels of petroleum hydrocarbons in sediments in local harbours and Mellieha Bay; and on marine litter on selected shores and coastal waters. More recently, together with the Department of Chemistry and as part of an international research programme (MedSPA), the levels of organotins originating from antifouling paints, have been monitored. Though none of these studies constitute a long-term environmental monitoring programme, they have provided the only useful albeit incomplete data on the state of the local marine environment.

4.1.2 Sewage and Bacterial Pollution

As indicated above, the most comprehensive set of environmental data, which is currently available, deals with bacteriological contamination of bathing waters. All bathing localities are monitored for one bacteriological indicator of pollution, which is the level of faecal coliforms (colony forming units, CFU) per 100ml of seawater. Such monitoring is undertaken from May till October and results have been published since 1992. 24 localities in Malta, 10 localities in Gozo and 3 localities in Comino, are included in this monitoring program. These localities include all popular bathing waters, as well as others.

4.1.2.1 Microbiological Standards for Bathing Water Quality

There are as yet no legal standards set for bathing water quality in Malta, though the Interim Criteria for Bathing Water (1985) adopted by the Contracting Parties to the Barcelona Convention are used as a basis.

These Interim Criteria (1985) are based on faecal coliforms (FC) as an indicator and are as follows:

50% of samples are to have less than 100CFU/100ml
90% of samples are to have less than 1000 CFU/100ml

The minimum number of samples for each station is 10, for the whole bathing season. Only surface waters (depth approx. 30cm) are sampled.

In Malta, the following scheme for water quality classification was adopted from 1992 to 1995:

First Class: less than 100FC/100ml in 95% of samples
Second Class: Compliance with Interim Criteria (1985) on a monthly basis and on a seasonal basis.
Third Class: Compliance with Interim Criteria for the whole season but not on a monthly basis.
Fourth Class: Fail to conform to Interim Criteria (1985)

Bathing in any beach is temporarily prohibited when FC exceed 1000CFU/100ml for any period. (according to a UNEP report published in 1996: UNEP/OCA/MED WG.111/Inf.8)

In 1996, this classification scheme was amended as follows:

First Class: less than 100FC/100ml in 95% of samples
Second Class: Compliance with Interim Criteria (1985) on a seasonal basis (though not necessarily on a monthly basis).
Third Class: Fail to conform to Interim Criteria (1985)

Since 1995 less sites were sampled and generally less samples were taken from each site for the area being considered. Moreover only the water classification for each site are indicated.

Microbiological pollution of inshore waters may be expected to change rapidly with time. Faecal coliforms are known to persist in inshore waters for relatively brief periods of time not normally extended beyond 36 hours. Since sampling is carried out normally on a weekly basis, it is possible that sporadic episodes of bacterial and sewage pollution may be missed out from the present programme. Moreover as stated in the published reports: " *Outcomes of extra-ordinary sampling taken were not considered (for classificatory purposes) as this would have introduced a bias, which is not taken into account by the Barcelona Convention Criteria*." This may presumably mean that during health warnings when FC counts exceed 1000CFU/100ml, such counts are not taken into account.

The above monitoring strategy and method of reporting may lead to occasional difficulties in the interpretation of the published reports. For example: while according to the 1995 Report, Balluta Bay was unfit for bathing for 27 days (26 June up to 22 July, i.e. 20% of the official bathing season) , the monitoring site in Balluta was given a class 3 (i.e. it conformed with the Interim Criteria on a seasonal basis but not on a monthly basis). This may mean (but cannot be confirmed from the published data) that while for 27 days, 'extra-ordinary sampling' taken from this site showed FC levels exceeding 1000CFU/100ml, such readings were not taken into account for classification.

Notwithstanding these difficulties, the monitoring programme for bathing waters as carried out by the Department of Health, represents the only long-term water quality monitoring programme for these islands and the published results have been found extremely useful in the preparation of the present review.

4.1.2.2 Other Bacteriological Quality Standards

Latest recommendation of the Mediterranean Action Plan (which has not been adopted as yet) is to consider FC and FS (faecal streptococci) as the two indicators of microbial pollution to assess health risks:

For both FC and FS:

50% of the samples (minimum 10 samples per year and minimum frequency every 2 weeks during bathing season) should not exceed 100CFU/100ml
90% of samples should not exceed 1000CFU/100ml.

Alternatively

80% of samples should not exceed 100CFU/100ml for both FC and FS
95% should not exceed 2000CFU/100ml for FC and 400CFU/100ml for FS

The EC Directive (1976) on bathing waters have set standard both for total coliforms (TC) and FC. In the case of guide standards:

80% of samples should not exceed 100 CFU/100ml for FC.
80% of samples should not exceed 500 CFU/100ml for TC.

A proposal for a new Council Directive (EC, 1994) shows that the EC standards may change to include only *Eschericia coli* (which falls within the FC group) and faecal streptococci. In effect, as *E.coli* is one species out of a number of the faecal coliform group, retention of the same guide value (100 CFU/100ml) represents a degree of relaxation in the set limits, as they now apply to one species rather than to a whole group of species. There is zero tolerance for up to 4 samples taken from the same station (in one year). Beyond this, the number of samples allowed to exceed the standard rises by 1 for every additional 5 samples taken.

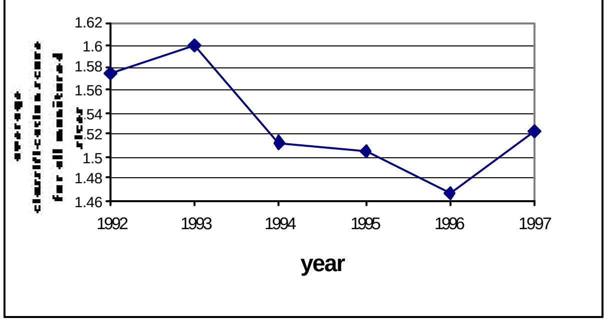
The Public Health Department's bathing waters monitoring programme also include other microbiological parameters such as total coliforms , faecal streptococci and Salmonella.

4.1.2.3 Identifying long-term Trends in Bathing Water Quality

The purpose of the present section will be to identify long-term trends in the quality of bathing waters since 1992, as based on the annual reports published by the Department of Health. For the purpose of the present review, only data extending up to 1997 was considered. The identification of long-term trends was based on the published categories (or water quality classes) for each locality and monitoring station. A score of 1 was given to Category 1; a score of 2 was given to Category 2 and a score of 3 to Category 3. This review also takes into account the change in the scheme of categories, which was adopted in 1996. As indicated above, the lower the score (or category) the more the bathing water is fit for bathing.

In the first case, the overall mean of score for all monitored sites was computed, for all the years (1992 to 1997). The results are presented in Fig.4.1.

Figure 4.1 Trend in bathing water quality classification for the whole of Malta and Gozo



This figure shows evidence of a general improvement of inshore waters, with the lowest category score being registered for 1996, and the highest score for 1992. This trend was found not to be statistically significant (at P>0.05) by analysis of variance. It is evident that the identification of statistically significant long-term trends in such a parameters would possibly require more temporally distributed data than that which is currently available.

Fig. 4.2 shows the quality of bathing waters at the various monitored stations, based on the overall mean classification score for each monitored locality over the period 1992-1997. As expected, the locality of Xghajra where Malta's major sewage outfall is located, is the locality, which is mostly exposed to bacteriological pollution. Marsascala and St. Julian's bays were also relatively polluted over the period under review. The cleanest bathing waters were generally located in Comino, on the north-west of Malta mainland and in various localities in Gozo.

Table 4.1.1 presents the ranking of the various monitored localities n the basis of the average classifications scores over two periods 1992-97 and then 1996-97. This will facilitate the identification of long-term trends in bathing water quality at each locality, over the past years.

From this table it is evident that:

a) As expected Xghajra had persistently been classified as unfit for bathing;
b) St Julian's and Marsascala have show signs of recent improvements in their bathing water quality;
c) The number of localities with very clean bathing waters have increased over the past two years.
d) Deterioration is evident in some areas such as St. George's Bay (St. Julians); Dahlet Qorrot (Gozo) and others.

4.1.2.4 Other Microbiological Monitoring Programmes

As indicated above, a number of short-term monitoring programmes have been undertaken over the past 5 to 10 years, in which the microbiological levels of pollution have been monitored and which are also useful in that they present data on localities other than bathing areas. For example, the localities of Marsamxett and Grand Harbour had been monitored from 1989 to 1992 by the Marine Ecotoxicology Laboratory of the Department of Biology (University of Malta).

More recently, the Pollution Control Co-ordinating Unit of the Environment Protection Department has conducted a survey of coastal waters for microbiological and other parameters. Forty two sites were monitored over two 8-week periods in Summer of 1997 and then in Winter of 1998. This was undertaken through a LIFE Project TCY 96/M/06 which was co-ordinated by Mr. Lawrence Micallef.

This monitoring programme indicated significantly high levels of faecal coliform (FC) and faecal streptococci ((FS) at the various sewage outfalls. Some port areas and other coastal sites also showed elevated levels of FC.

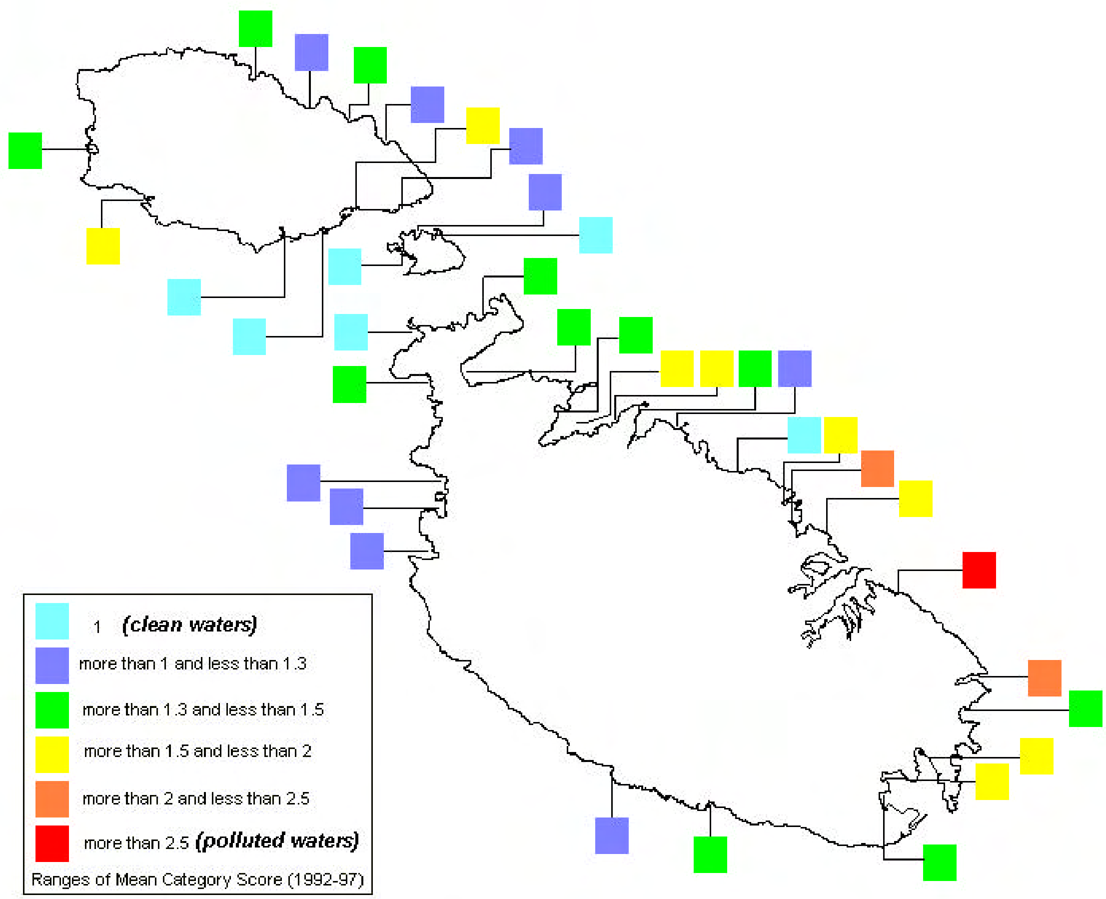


Figure 4.2 **Bathing Water Classification based on average classification scores for 1992-1997.**
(classification based on faecal coliform levels)

Table 4.1.1 : Bathing Water Quality, ranking on the basis of average classification scores by the Department of Public Health over two periods of time, 1992-97, and 1996-97.

Site	1992-97	Site	1996-97
Cirkewwa	1	Armier	1
Paradise Bay	1	Bahar ic-Caghaq	1
Pembroke	1	Cirkewwa	1
Mgarr ix-Xini	1	Ghajn Tuffieha	1
Xatt l-Ahmar	1	Ghar Lapsi	1
Blue Lagoon	1	Gnejna	1
Santa Marija	1	Paradise Bay	1
Bahar ic-Caghaq	1.11	Pembroke	1
Ghajn Tuffieha	1.17	Hondoq ir-Rummien	1
Ghar Lapsi	1.17	Mgarr ix-Xini	1
Gnejna	1.17	Xatt l-Ahmar	1
Golden Bay	1.17	Zewwieqa Bay	1
Dahlet Qorrot	1.17	Blue Lagoon	1
Hondoq ir-Rummien	1.17	Santa Marija	1
Ramla	1.17	San Niklaw	1
Zewwieqa Bay	1.17	Golden Bay	1.25
San Niklaw	1.17	Pretty Bay	1.25
Anchor Bay	1.33	Ramla	1.25
Mistra	1.33	Qawra	1.30
Wied iz-Zurrieq	1.33	Mellieha	1.33
San Blas	1.33	Sliema	1.42
Marsalforn	1.39	Anchor Bay	1.50
Sliema	1.42	Mistra	1.50
St Thomas Bay	1.42	St Thomas Bay	1.50
Mellieha	1.44	Wied iz-Zurrieq	1.50
Qawra	1.46	Dahlet Qorrot	1.50
Armier	1.50	Dwejra	1.50
Pretty Bay	1.50	San Blas	1.50
Dwejra	1.50	Xlendi	1.50
Marsaxlokk	1.56	Marsascala	1.70
Xlendi	1.58	Bugibba	1.75
St. George's Bay B'Bugia	1.67	Marsaxlokk	1.75
Bugibba	1.89	St. George's Bay B'Bugia	1.75
St George's Bay St. Julians	1.92	Marsalforn	1.75
St. Paul's Bay	1.98	St Julians	1.88
St Julians	2.00	St. Paul's Bay	1.90
Marsascala	2.03	St George's Bay St. Julians	2.00
Xghajra	2.50	Xghajra	2.50

Though the frequency of sampling was rather low, it may be instructive to present the percentage number of samples for each particular sites, which exceeded the 100FC/100ml level. These were as follows:

Cumnija Outfall	86%
Wied Ghammieq Outfall	38%
Grand Harbour Inner	29%
Grand Harbour Outer	25%
Ras il-Hobz Outfall	20%
Marsamxett Outer	14%
Hofriet (Shore)	13%
St. Paul's Bay	13%

The highest levels of FS were recorded in the coastal waters exposed to the Cumnija outfall. This suggests that agricultural wastewaters may be more significantly found in this northern outfall.

4.1.3 Eutrophication

Sewage pollution is often associated with increased levels of nutrients, which in turn may lead to eutrophic conditions and alga blooms . Eutrophication is a phenomenon of poor water quality usually associated with sewage pollution and elevated nutrient levels. This condition may lead to uncontrolled growth of microscopic plants (some of which may be directly toxic to humans and to marine life), with the colour of water becoming abnormally green and turbid. There is usually a reduction in oxygen levels which may lead to fish mortality and to stress on marine life.

The data available on the relevant water parameters (dissolved oxygen and nutrients levels, water transparency and chlorophyll A) which may be used to evaluate the risks of eutrophication in inshore coastal waters is very limited in time and generally restricted to the specific localities such as Marsamxett, the Grand Harbour, Marsascala and Marsaxlokk. However, this state of affairs will soon be expected to improve through a four-year monitoring programme which uses LANDSAT TM data to assess water quality in Malta. This programme conducted by the Marine Ecotoxicology Laboratory of the Department of Biology (University of Malta) is being financed through the Italo-Maltese Financial Protocol.

Transient alga blooms associated with sewage overflows have been reported to occur in Marsamxett Harbour and Salina Bay. The latter case may have led to massive fish mortalities in a mariculture centre located within the saltpans in the inner part of the Bay in 1992. Moderate eutrophic conditions have been reported in Marsascala Bay as well as in Marsamxett and Grand Harbour. Dredging activities within Marsamxett may have contributed significantly to high nutrient loads in 1990-92.

Axiak (1994, 1994b) reviewing data available until 1994, indicated that the nutrient levels within Marsamxett were generally high. Particularly high levels of phosphates (e.g. 7.6 ug-at P/l) were found in Marsamxett during dredging activities, and this may be one of the major factors contributing to elevated nutrient levels in this harbour, in addition to land run-off and sewage overflows. High levels of nitrates are reported most frequently at Msida Yacht marina with peak levels of 45 ug-at/l being reached in September 1991. The overall mean level of nitrates at this station was 2.7 times higher than the mean level at the reference station. These levels of nitrates in the innermost parts of Marsamxett are comparable and in some cases even higher than nitrate levels reported from highly eutrophic areas such as Elefsis Bay, Greece (Friligos, 1988) and Izmir Bay, Turkey (Buyukisik, 1988).

Chlorophyll *a* levels in Marsamxett are generally higher than those in the Grand Harbour. Peak values ranging from 2.4 to almost 9 ug/l were recorded in many stations in Marsamxett especially from October to January. These peak values are however much less than those generally recorded in eutrophic inshore waters, especially during algal blooms associated with these conditions.

Within Lazzaretto Creek, during 1989-91, chlorophyll *a* levels, were recorded at a mean annual level of 1.88 ug/l, with maximum and minimum levels being 4.6 and 0.3 ug/l respectively. More recent data generally confirm such levels.

Fig. 4.3 shows synoptic pictures of levels of chlorophyll *a* within Marsamxett as recorded by LANDSAT satellite data in August 1997. This picture confirms the presence of moderately eutrophic conditions in the ports area.

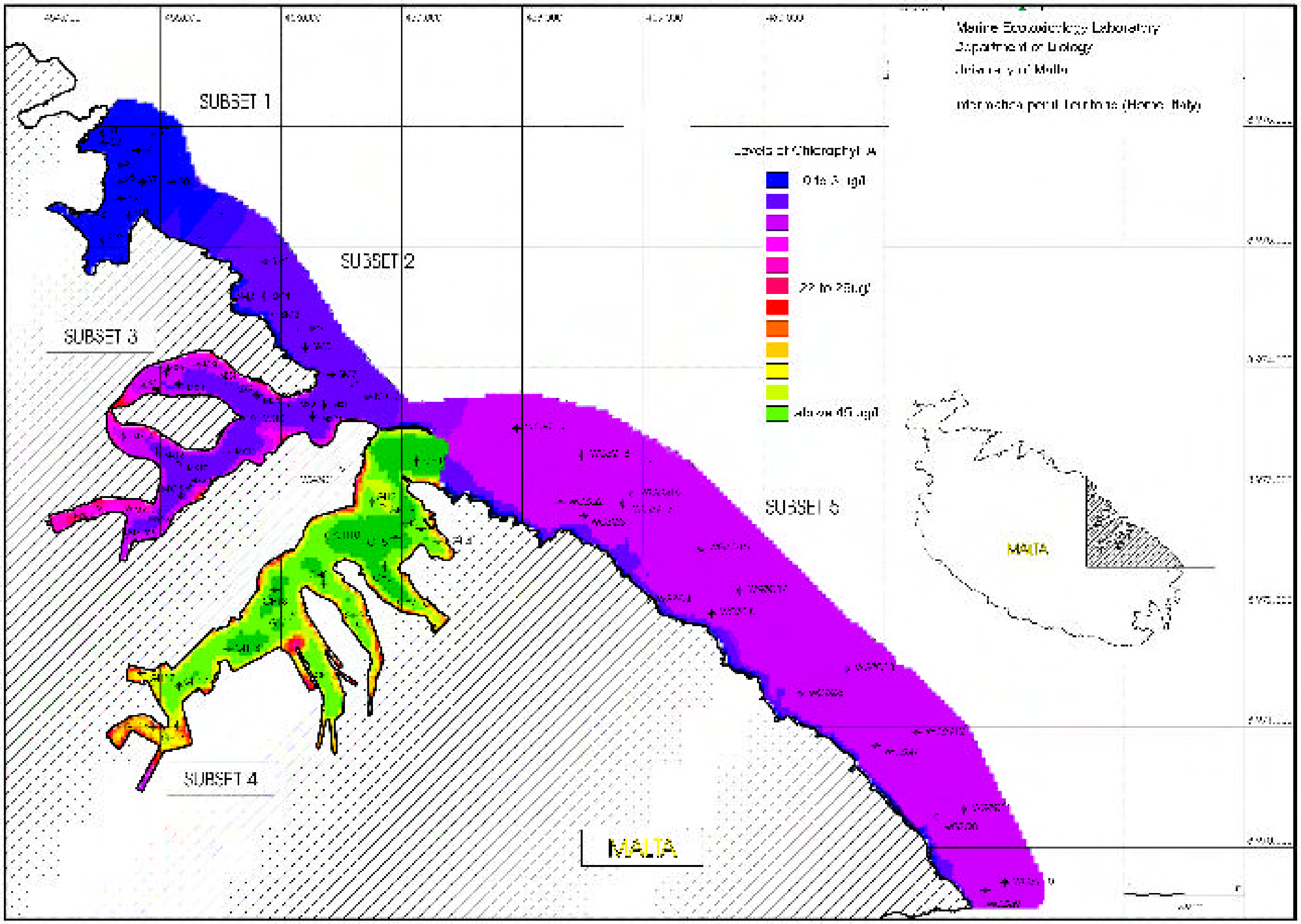
Water transparency is another good indicator of water quality and of eutrophication. It may be measured either in terms of Secchi depths (more turbid waters have reduced Secchi depths) or Beam Attenuation Coefficients (more turbid waters have higher coefficients) as measured by an in situ transmissometer.

The mean Secchi depth, indicating the degree of water transparency outside the harbours is generally over 15m and this is typical of oligotrophic coastal waters of the region. The transparency of the waters decrease significantly towards the innermost parts of both harbours where minimum levels ranging from 1.2 m to 1.8 m have been recorded in various months of the year. Dredging works at Marsamxett during summer of 1991, must have been the cause of particularly reduced water transparencies in the central parts of this harbour in July 1991(1.75m).

Secchi depths within Marsamxett creeks such as Lazzaretto, usual vary from 6 to 1.5 with an annual mean value of 4.2m. During the survey of June 1998, Secchi depths varied from 4m in the innermost part to 8 m near to Manoel Island Point. Similar low Secchi depth readings have been recorded in the vicinity of sewage outfalls and near major coastal engineering works (such as that at the Hilton Hotel, Spinola).

Water transparency as measured in terms of beam attenuation coefficients show that offshore water are generally very clear with BAC values below 0.2 m^{-1} for surface waters. Inshore waters such as creeks within Marsamxett and Grand Harbour or in Marsascala and Marsaxlokk may have relatively turbid waters with values above 1 m^{-1}. Again, this situation is confirmed for August 1997, using Landsat satellite data (Fig. 4.4).

To summarize, the data presented in this section shows that the nutrient levels, water transparency and chlorophyll *a* levels within some localities such as the Msida marina, Lazzaretto Creek, and Marsascala are such so as to indicate risks of moderate eutrophic conditions during certain parts of the year. Though the available data is not sufficiently extensive in terms of geographical and temporal extents to enable us to draw definite conclusions, it shows that in general, pollution by sewage and other land-based sources (e.g., agricultural run-off) have led to mild eutrophic conditions in these localised semi-enclosed areas. The overall impact of this phenomenon on marine life have not been fully evaluated as yet (Axiak *et al*. 1992, Axiak and Vella 1996).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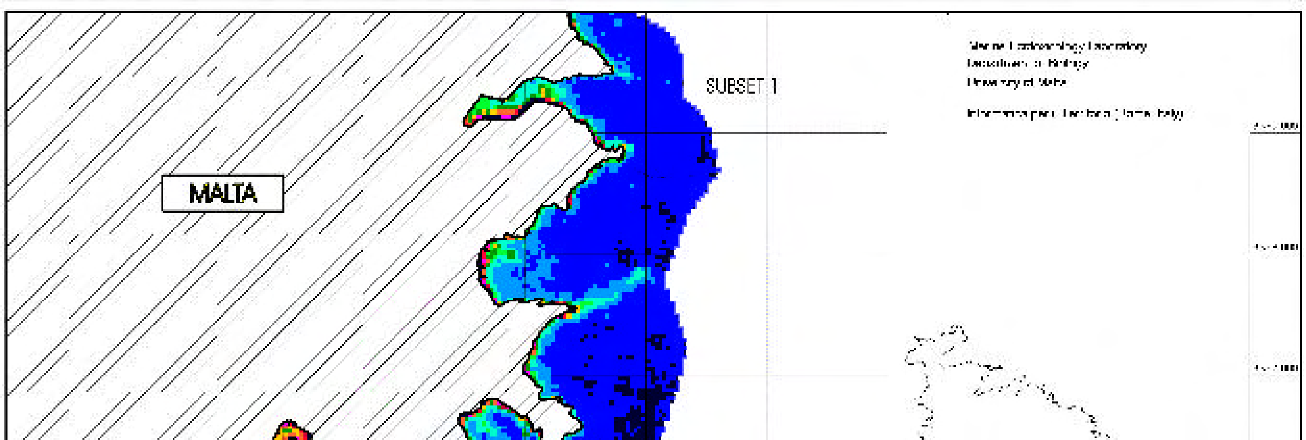
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Figure 4.4: Levels of water transparency as monitored by LANDSAT (Satellite) TM data in June 1997

No reports are as yet available that such conditions have ever led to algal blooms (which may in some cases be associated with eutrophic conditions). The occurrence of 'red tides' due to algal blooms have been reported in Msida Creek, Marsamxett (Fudge, 1977), and therefore the risks of such phenomenon occurring within these creeks may not be ruled out.

Inshore fishfarming is also a potential threat to water and sediment quality, especially when the floating cages are very close to the shore and are located in semi-enclosed body of waters with limited circulation (e.g. Mistra Bay). The environmental impact of fishfarming in Malta will be reviewed elsewhere in the present report.

4.1.4 Pollution by oil

The information available on inputs of petroleum hydrocarbons (PHC) and crude oil into the Mediterranean Sea is still limited (UNEP, 1996). Accidents, sewage and industrial discharges, riverine and runoff inputs, atmospheric depositions and offshore drilling activities are all important sources of petroleum hydrocarbon deposits in the Mediterranean (Briand as quoted by Scoullos *et al*., 1993).

4.1.4.1 Potential Risks of Oil Pollution

Risks of oil pollution to our marine and coastal environment may arise from:

Major or moderate accidents involving maritime traffic, including bunkering;
Moderate to minor incidents of spills resulting from inshore or land-based activities;
Illegal discharges of ballast waters by maritime traffic;
Operational and minor losses of fuel and diesel oils from small water craft.

Fortunately, no major oil spill has as yet been reported to occur in Maltese territorial waters which could lead to massive stranding of oil on our shores. However, the Central Mediterranean is an area with relatively high maritime traffic and the associated risks of incidents are evidently high.

Bunkers are delivered off-shore inside Maltese territorial waters at 5 locations as shown in Fig. 4.5. All bunkering operations are controlled by the Malta Maritime Authority. At present, two companies are involved in bunkering, namely: the Mediterranean Offshore Bunkering Company Limited (MOBC) and San Lucian Oil Company Ltd. MOBC services all types of ships, both in harbours and in offshore areas. These include cargo ships, tankers, passenger liners, yachts, catamarans etc. Vessels carrying Petroleum products, in a non gas-free condition, are bunkered 12 miles offshore at Hurd's Bank. The total quantities of oil bunkered in Malta on an annual bases is approximately 400,000 metric tonnes, of which 65% is undertaken offshore. To date, only minor incidents have occurred during bunkering, and these have not resulted in the release of oil.

Minor oil spills have been reported in inshore waters, resulting mostly from land-based operations such as oil storage, or fuel landings. A total of approximately 572,000 metric tonnes of fuel oil, diesels gasoline, LPG and other types of fuels, have been handled by Enemalta Corporation in 1993. This was mostly carried out in within Marsaxlokk and Grand Harbour. Only minor incidents have been reported as yet, which could be directly linked to such fuel handling activities.

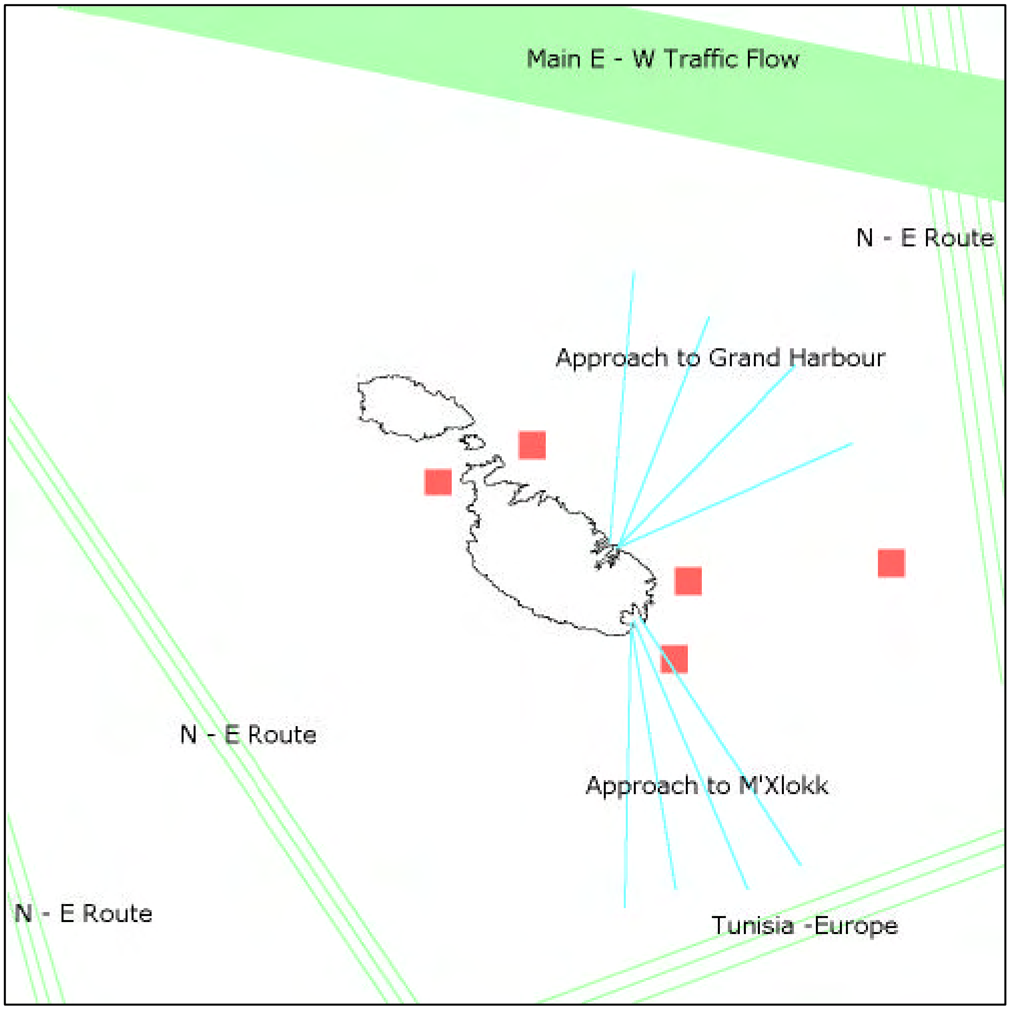


Figure 4.5 **Approximate location of main maritime traffic flows and routes around Malta. Offshore sites designated for bunkering activities are indicated by boxes.**

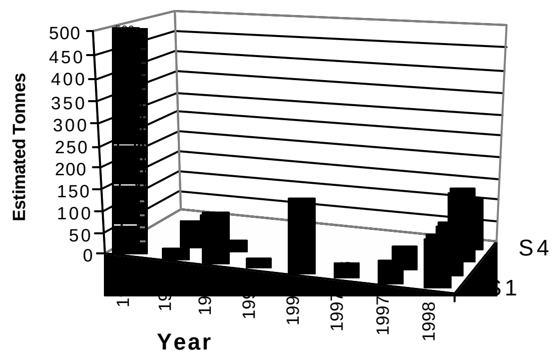
Minor oil spills have been reported in Marsamxett (March 1998), Grand Harbour (September and October 1997) and in Marsaxlokk, Birzebbugia (Summer, 1998). The estimated amounts of oil spilt in such incidents varied from less than 1 to 4 tonnes. The Pollution Control Co-ordinating Unit played a key role in successfully controlling such incidents. Some of these incidents were related to Enemalta and MOBC storage activities.

Operational losses of fuel oils from small water craft, may also constitute a significant and chronic input of oil into the marine environment. This is mostly related to intense boating activities during the summer months.

4.1.4.2 Reported Oil Spills

The Pollution Control Unit of the Environment Protection Department, keeps a record of all reported oil spills within the territorial waters. Fig. 4.6 shows a synoptic representation of such reports for oil spills which were bigger than 5 tonnes, since 1989. To date, the biggest oil spill by far was that reported on the 28th December 1989 off Marsascala, where the Italian ship, MT Nerone was grounded releasing an approximate 500 tonnes of aviation fuel. Since it is sometimes quite difficult to estimate the total amounts of oil spilt, the quantitites indicated in the figure are only meant for comparative purposes. It is to note that in 1998, the highest incidence of oil spills (4) were reported, with each generally exceeding at least 50 tonnes.

Figure 4.6: Reports of Incidents of Oil Spills (> 5 tonnes)



4.1.4.3 Levels of Oil Pollution

Monitoring of levels of PHC in inshore local waters was undertaken prior to 1990s as part of a national MEDPOL monitoring programme. The results have never been fully evaluated, interpreted and published. More data is currently available on levels of PHC in superficial sediments. This is because such sediments are known to act as sinks of such pollutants and as such represent a more stable environmental phase, which would produce more valid long-term data.

It is important to note that the levels of PHCs depend on the extraction technique used and on the method of detection. The detection methods include the use of UV-fluorescence and gas chromatography. In general, gas chromatography is used for the identification of the petroleum hydrocarbons in the environment, whereas UV-fluorescence is used for regular monitoring of the levels. UV-fluorescence is a relative technique and the levels obtained are compared to a standard, such as chrysene. The standard used greatly affects the values of PHCs obtained.

Table 4.1.2 lists the available data on the levels of PHC in superficial sediments in various localities around Malta. It also includes levels from other Mediterranean localities. The Marine Ecotoxicology Laboratory of the Department of Biology (University of Malta) utilizing standard UV-spectrofluorometry and Chrysene Equivalents has produced all local data.

Table 4.1.2: Levels Of Petroleum Hydrocarbons In Local And Mediterranean Sediments

Location	PHC concentrations in ? g/g DW chrysene equivalents	Reference
St. Peter's Pool	0.00	Vella, 1993
Marsaxlokk	0.07	Vella, 1993
Marsaxlokk(St.Lucian Tower)	0.11	Vella, 1993
Delimara	0.20	Gauci, 1990
Mellieha Bay	1.20	Vella, 1993
Birzebbugia (Pretty Bay)	3.41	Vella, 1993
Ricasoli	3.97	Gauci, 1990
Manoel Island	5.6	Grech, 1988
Opposite Manoel Island	6.7	Grech, 1988
Marsa (off Ras il-Hanzir)	12.7	Vella, 1993
French Creek	15.18	Vella, 1993
Sliema Creek	17.23	Vella , 1993
Mouth of Msida Creek	20.27	Vella, 1993
Rinella Creek	23.19	Vella, 1993
Dockyard Creek	35.50	Vella, 1993
Mouth of Grand Harbour	41.55	Vella, 1993
Pieta' Creek	43.92	Vella, 1993
Marsa (Power Station area)	49.70	Vella , 1993
Msida Creek (innermost pier)	78.70	Vella, 1993
Opposite Manoel Island	7.91	Sammut, 1996
Mouth of Marsamxett	7.18	Sammut, 1996
Sliema Creek -	9.13 / 102	Sammut, 96 / Axiak 98
off Msida yacht marina	13.93	Sammut, 1996
Last pier at Msida marina	24.46	Sammut, 1996
First pier at Msida marina	49.54	Sammut, 1996
Lazzaretto Creek	59.71 / 270	Sammut, 96 / Axiak 98
Mediterranean Regions: [a]		
French coast	13-952 aliphatics + aromatics	Mille et al., 1982
French riviera	0.06 - 8.5 PAH's	Garrigues et al, 1990
Spanish coast	0.4 - 77.1 aromatics	Albaiges et al., 83; 85
Western Mediterranean	0.6 - 2.3 (DW) aromatics	Albaiges et al., 83; 85
Corsica	0.003 - 0.05 PAHs	Garrigues et al., 1990
Italy	1.3 - 45 (mean.14.73)	Strusi, 1984
Yugoslavia	1.0 - 18.9 (fluorescence)	UNEP/IOC, 1988
Cyprus	0.114 - 1.301 (fluorescence)	UNEP/IOC, 1988
Turkey	0.0043 - 1.0 (fluorescence)	Sunay et al., 1983
Baltic Sea sediment	0.1-2.6?g/gDW aliphatic hydrocarbons (GC) 4-120?g/gDW PAH content (GC)	Poutanen E.L., Raeisaenen S and Lindberg JJ
Aegean Sea	chrysene equivalent (fluorescence) 0.31?g/g sediment	Balci A. Muezzinoglu A and Izdar E.

(a) = literature mostly from UNEP 1996.

Heavily polluted areas around Malta are found within the two main harbours, Marsamxett and the Grand Harbour. The highest values of PHCs were recorded by Vella (1993) in the innermost part of Msida Creek and in the vicinity of the Marsa Power Station. Levels of PHCs in the Msida Yacht Marina are also rather high (approx. 40?g/gDW chrysene equivalents) with respect to the cleaner areas. Negligible levels of PHCs were recorded from St. Peter's pool. Also, Mellieha Bay can be considered as being mildly polluted (3.6?g/g DW chrysene equivalents).

The most polluted sites contain a PHC content which is similar to that in the more industrialised Spanish coast (which harbours important dockyards). The Msida marina has similar PHC levels as those found along the Italian coast and in the Adriatic (ex-Yugoslavia).

The above studies, undertaken between 1987-1993, indicate that the levels of PHC's (such as diesel, fuels, and oil products) in superficial sediments from several coastal areas show an upward trend. Within the Grand Harbour, PHC levels increased from 5 to 12 times over a period of five years. Development of yacht marinas in Marsamxett may have led to a five-fold increase in oil pollution load in the sediments in Pieta and Msida over this same period.

These data indicate that although our coastal waters have not yet been exposed to any massive oil pollution accident, chronic low-level pollution by oil and petroleum products from yachts and boats is becoming increasingly significant (Axiak and Vella, 1996).

Moreover, oil that is discharged by maritime traffic often ends up as tar deposits on oil beaches. Though it is common experience that a number of local areas are exposed to such risks of contamination (which may have significant economic relevance) the available data is too limited to enable us to evaluate this type of contamination with any confidence.

4.1.5 Pollution by litter

Marine litter, especially persistent plastics, are known to constitute a hazard to various forms of marine life as well as to boating activities. To date, only limited investigations have been undertaken to assess the extent of this problem in Maltese coastal waters (Sciberras and Axiak, 1995; Sciberras, 1992; Axiak and Zammit, 1998; Gardiner, 1996).

In the first investigation, two beaches at Fomm ir-Rih (North-East Malta) were surveyed in August 1991 and April 1992 in order to assess qualitatively and quantitatively the extent of pollution by marine debris originating from sources at sea. The mean density of shore-stranded litter ranged from 60 to 650 g/m^2 according to position on the beach away from the waterline. This was in general comparable if not higher than data reported in other regions in the Mediterranean. Plastic litter occupied the highest percentage by number of items, with wood being also predominant. Litter was found to be both of local and foreign origin. Sea surveys for floating marine litter showed an overall mean density of 41 items per km^2 of floating megalitter in coastal areas around Malta. In 55% of the surveys, the highest densities were recorded for plastic debris.

In a more recent survey undertaken in 1995, Gardiner (1996) has undertaken a study over two days on beach litter at four local beaches. He reported a mean density of 15 g/m^2 for Pretty Bay, St. George's Bay and Golden Bay, which were comparable or lower than similar data from other places such as U.K. On the other hand, a much higher density of approximately 73 g/m^2 was reported for Ghajn Tuffieha. The author attributed this difference to different degrees of beach cleaning effort at these sites.

Gardiner found that plastic items were the most frequent type of beach litter found in these beaches. Most of this litter originated from local (mostly touristic) sources.

In the second investigation, weekly observations were made of marine litter in Xlendi over a period of several months during 1997 (Axiak and Zammit, 1998). In general 33.5% of all reported litter on the beaches and at sea within Xlendi, was composed of paper items. Plastic items were the next most frequent type of litter at 26%. Most of the paper, plastic and expanded polystyrene items were normally found to be associated with fast-food outlets.

A survey amongst boat owners (Sciberras, 1992) indicated that the negative economic implications of such marine litter may be considerable. A number of cases were reported in which water intakes of yachts were clogged by floating litter, or litter got entangled with craft propellers or drive shaft. Cases of floating debris interfering with radar signals were also reported.

There are several reports of significant accumulation of benthic litter in certain inshore localities around Malta such as Wied iz-Zurrieq. Annual campaigns are conducted by local volunteers to collect such marine refuse, and this type of pollution receives significant media coverage.

4.1.6 Pollution By Heavy Metals

Marine pollution by heavy metals usually result from land-based industrial activities, or from car traffic.

Data on the levels of heavy metals in local waters, sediments and biota is very limited. MEDPOL data indicate that such levels in fish are relatively low, though occasionally high levels were reported in harbours. Such MEDPOL data is unfortunately not available for proper evaluation. On the other hand, the Marine Ecotoxicology Laboratory has generated a substantial amount of data over the past decade on levels of heavy metals in a range of organisms and in sediments. This data will be briefly reviewed here.

4.1.6.1 Heavy Metals in Biota

Three locally occurring mollusc species were to date utilized as bio-indicators of metal pollution, in various studies conducted by the Marine Ecotoxicology Laboratory (Department of Biology, University of Malta); these include the clam *Venus verrucosa*, the limpet *Patella rustica* and the marine snail *Hexaplex trunculus*. The total metal content in the tissue of these organisms was determined using atomic absorption spectroscopy.

In clean reference sites (such as Qawra) limpets showed copper levels similar to other clean sites elsewhere. However background levels of metals in limpets were apparently higher than in limpets (*P. vulgata*) from reference sites in U.K.

High levels of zinc and copper were measured in biota collected from Manoel Island (near the yacht repair yard). Marine snails collected from Bahar ic-Caghaq showed the highest levels of cadmium, copper and zinc. It is worth noting that the sampling point chosen was right under the Maghtab Landfill. The limpets also exhibited high cadmium, copper and zinc levels in Xghajra and Marsascala.

The determinations of heavy metal concentrations in the red mullet in Maltese waters were performed within the framework of the MEDPOL Phase I programme.

Fish (including the red mullet) accumulate lower concentrations of heavy metals in their tissues than marine molluscs. Copper levels lie well within the average for this region and they are low when compared to those in the French and Greek coasts; whilst zinc levels in the fish are closer to the maximum value quoted for the central Mediterranean. Zinc levels are however lower than those in the more industrialized countries.

In general it may be concluded that the selection of local biota studied accumulated metals in the same range as that of a spectrum of invertebrates from polluted locations in the Mediterranean. High copper and cadmium levels in locally occurring molluscs are comparable to levels in similar biota from foreign industrialised countries and in certain cases exceed them. High levels of metals in biota were found in the vicinity of Malta's major landfill (Maghtab); the main sewage outflow at Xghajra; and the local harbours.

4.1.6.2 Heavy Metals in Sediments

Heavy metals are known to accumulate in bottom sediments due to a number of factors. Analysis of superficial sediment in local coastal areas is restricted to determinations from locations along the north, and north-east coast of Malta and only a very restricted number of locations were to date sampled. The levels of heavy metals in coastal waters are compared to those found in various regions of the Mediterranean in

Table 4.1.3. These comparisions need to be made with proper caution and are only meant to be indicative. For example, it is well known that heavy metal content of sediments is partly determined by their granulometric characteristics and organic content. Ideally, such parameters need to be standardised to enable one to make strict comparisions. Nonetheless, the present review of available data does show a number of important features, as follows:

Heavy metal analysis of the sediment in the Msida Yacht marina showed this to be rich in cadmium and zinc. High copper levels were also recorded in sediment from the Sliema Creek area (close to the Manoel Island Yacht Repair Yard). Sediment analysis in the Marsamxett Harbour showed that the levels of pollution in the area range from areas of relatively high metal contamination in the innermost sites of the harbour to cleaner areas towards the mouth of the harbour.

In general, levels of cadmium in local coastal sediments appear to be high. The lowest level found in Qawra is higher than that along the French coast. The maximum level recorded in the Msida Marina exceeds levels quoted for the more industrialised French and East coasts.

The lowest levels of copper were found in Mellieha sediment whilst the highest values occur in the Msida Marina area. The maximum copper value lies well within the average range of copper levels proposed for the Mediterranean region however it is much higher than that recorded for the French and Greek coasts (yet again lower than that found in Turkey, in the East Mediterranean).

Mellieha sediment possessed the lowest zinc and lead levels whilst the highest values were found in the Msida Yacht Marina. The maximum zinc level is higher than that found in the nearby Gulf of Catania and Cagliari lagoon but is lower than the mean for the French coast. Lead levels in sediment were rather high.

Table 4.1.3 Heavy metal concentrations in the sediment of various locations in Malta and the Mediterranean (values expressed as ? g/gDW)

Locality	Cadmium	Copper	Zinc	Lead	Reference
Averages for the Mediterranean	0.02-64	0.6-1890	1.7-6200	3-3300	UNEP, 1996[a]
French Coast	3.7	29-34	28-2250	26.4	UNEP, 1989[a]
Mediterranean Background levels	0.15		20	10-25	Scoullos, 1992
French Background levels	0.15	30	90	30	IFREMER, 1998
Cagliari Lagoon	0.5-2.5	10-44	20-56	19-94	UNEP, 1989[a]
Gulf of Catania	2.2-4.6	3.8-25	25-236	4.5-19	UNEP, 1989
East Basin Turkey, Egypt	0.16-2.0	29-280	20-425	-	UNEP, 1989
Thermaikos Gulf, Greece	Not available	8-60	41-344	18-246	Satsmadjis and Voutsinou-Taliadouri, 1985[a]
Pagassitikos Gulf, Greece	Not available	11-117	38-391	22-35	Satsmadjis and Voutsinou-Taliadouri, 1985[a]
Axios River, Greece	3.3	27.3	95	20.5	Sawidis et al., 1995[a]
Rabat, Morocco	0.81	1.0	20.4	15.3	Mahyaoui et al., 1989[a]
Mediterranean coast	<0.1-0.84	0.8-89	2.4-278	2.9-	Herut et al., 1995[a]

of Israel				82ppm	
Marsamxett	-	159	88	117.6	Galdies, 1991 [a]
Mellieha	-	4.9	63.9	38.2	Sammut, 1996
Qawra	5.3	26.0	70.9	63.3	Pace, 1998
First Pier at Msida Yacht Marina	43.01	193.5	1032.3	430.1	Sammut, 1996
Last Pier at Msida Yacht Marina	159.1	96.8	645.0	107.5	Sammut, 1996
Off Msida Yacht Marina	152.6	82.5	1567.0	1030.9	Sammut, 1996
Lazzaretto Creek	63.5 2.7 to 1.8	182.7	1100.0 230 - 90	538.5 110 to 87	Sammut, 1996 Axiak *et al*.,1998
Opposite Manoel Island (Ta' Xbiex side)	21.0	42.1	463.1	52.6	Sammut, 1996
Sliema Creek	95.8 6.8 1.8	312.5 51	1193.7 66.4 90	485.4 131.5 87	Sammut, 1996 Pace, 1998 Axiak *et al*. 1998
Mouth of Marsamxett	-	99.7	634.0	159.5	Sammut, 1996
Bahar ic-Caghaq	7.5	44.2	75.9	41.2	Pace, 1998

(a) Literature as quoted by Pace (1998).

In a recent investigation, which the Marine Ecotoxicology Laboratory (Department of Biology, University of Malta) is conducting and financially supported, by the Environment Protection Department, the possibility of pollutants leaching out of the Maghtab landfill is being investigated. Samples of superficial marine sediments (see Fig. 4.9) from the vicinity of the landfill, as well as rain runoff from the landfill itself, are being analysed for a range of pollutants. The first results indicate the levels of lead in such sediments may increase twofold immediately after rainfall, and may be as high as 130 ug/gDW Moreover, laboratory-based leaching experiments have shown that various samples from the Maghtab landfill leach lead into water at significant rates. These results confirm that this landfill is possibly a major source of lead and other pollutants into the marine environment.

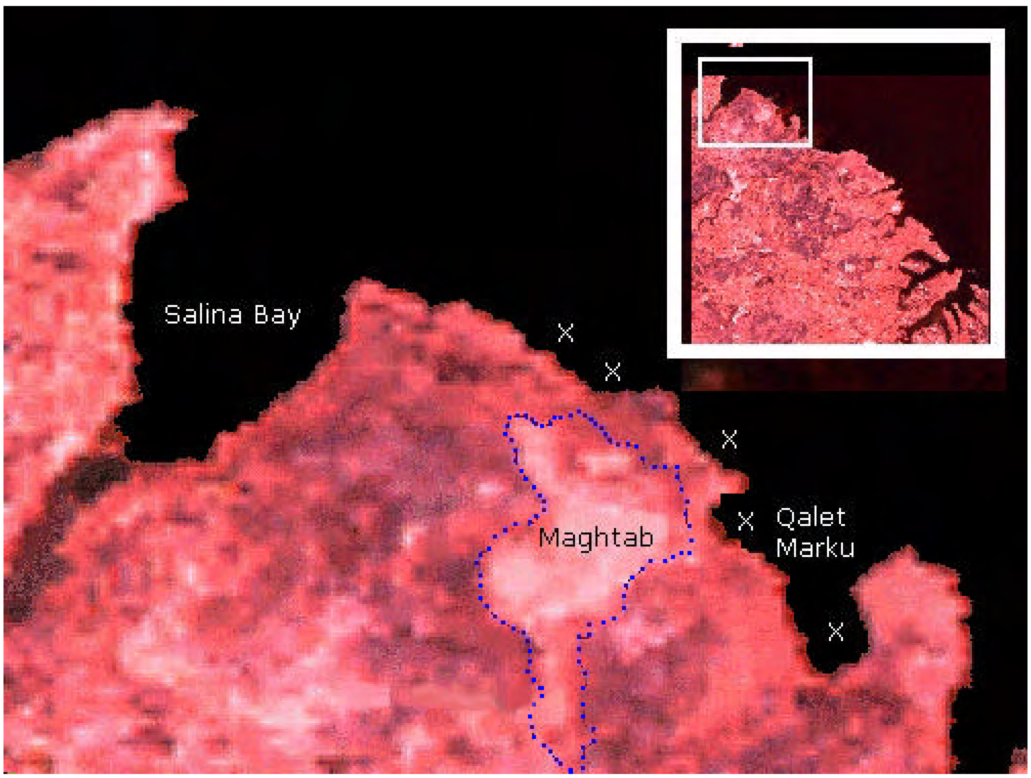


Figure 4.9 LANDSAT satellite image of Maghtab Landfill showing location of stations (X) where superficial sediments were sampled and analysed for heavy metal content.

To summarise: levels in Mellieha, the control site, are relatively low and typical of the cleaner areas in the Mediterranean. However the values obtained by Sammut for the Msida and Marsamxett areas (both the centre of dense boating activities) are rather high: cadmium and lead levels are higher than those quoted for the more industrialized northern Mediterranean coast and are comparable to the maximum average values reported in UNEP 1996. It is possible that such particularly high values may be partly due to experimental error, but this is not likely to be the case for Zinc and Lead. Copper and lead levels in the Grand Harbour are comparable to those in the more polluted French and Greek coasts.

4.1.6.3 Potential sources of metal contamination in local coastal areas

Inland Industrial Activities

Industry is generally regarded as a prime source of pollution by heavy metals. The Wied Ghammieq sewage outfall discharges untreated domestic and industrial sewage into the sea. The metal-related industry in Malta which contribute substantially towards increasing the metal load of effluents discharged into the main sewers include the electro-plating, leather tanning, steel galvanising, electronics and photographic industries. Industry can be considered as a significant contributor to the heavy metal pollution of the environment, especially in what concerns ***uncontrolled discharges*** of these elements into the marine environment.

Interestingly, Xghajra and Marsascala always exhibited higher metal loads in biota than those found in Wied Ghammieq, the point source of pollution. This indicates that harmful waste, of industrial and domestic origin, discharged from the sewage outfall is carried downstream in a south-easterly direction by the prevailing bottom currents affecting the coastal biota of other localities. When the outfall pump fails, waste water accumulates in the inlets and bays along the Xghajra coastline which is a popular summer resort and a quiet tourist area.

Industrial effluent from four industrial estates are treated at the Sant' Antnin Waste Treatment Plant (SAWTP) in Marsascala. A study carried out in 1995 (Portelli, 1995) showed that certain industrial effluents which have a heavy metal component (such as inks, liquid chemicals and dyes) have an inhibitory effect on the treatment of sewage and thus jeopardise the efficiency and efficacy of second class water production.

The potential for re-use of the semi-solid sludge derived from sewage treatment in compost depends on its content of toxic components in particular heavy metals (COWIconsult, 1992). There is a potential for trace elements, such as the more toxic cadmium, to be transferred from sludge-treated soils to crops (including lettuce, spinach and cabbage).

The leaching of material from the Maghtab Landfill could explain why the Bahar ic-Caghaq coastal area was found to contain high metal levels, especially since the dumping site lies only a few meters away from the sea. Moreover, there is also the possibility of contamination of the water table by toxic substances present in the waste. Leachates from spent lead-acid batteries, slurries derived from the electro-plating industry and from domestic solid waste, as well as iron and metal from Drydocks activities are all sources of heavy metals. The metal industry contributes 9% of the total estimated 1,200 tonnes of solid waste produced by local industry per week in 1991 (National Waste Interim Report, 1992). Moreover, 6% of the domestic solid waste consist of metals (comparable to the 8% value quoted for the European Union, RH & H Consult, 1993).

Maritime Related Industrial Activities

The Yacht Repair yard on Manoel Island and the boating activity in the Sliema Creek area contribute towards increasing the copper load of the sea, this being derived from leaching of copper from metal-based antifouling paints and from paint scrapings. The Malta Drydocks within the Grand Harbour is also bound to lead to significant releases of copper, zinc and possibly lead, as well as other metals, into the marine environment. No quantitative information is currently available regarding such sources of pollution.

Atmospheric Fallout

The relatively high levels of lead within Marsamxett are more likely to be related to atmospheric fallout of vapours and exhaust residues originating from car traffic in the area. Moreover, one of the major problems faced by the Msida marina, which also affects its marketability abroad is the soot released from the chimney incinerator at St. Luke's Hospital. When the wind is favourable, this soot settles on the boats, sometimes staining them permanently. The soot is also deposited at sea; although the exact nature of the emissions has not been investigated, it is known to consist of dust, carbon monoxide and heavy metals (RH & H Consult, 1993).

4.1.7 Organotins

More recently, a substantial amount of data on the levels of certain organotins have been generated through a MedSPA funded international research programme. Tributyltin (TBT) is the active biocide which is used in antifouling paints on water craft. It may cause environmental damage to certain marine forms, especially molluscs. Levels of TBT in sediments, seawater and biota have been found to be relatively high in Marsamxett marinas, in the vicinity of Manoel Island yacht yard, and in Dockyard Creek in the Grand Harbour (Vella, *et al*, 1998)

One biological effect of TBT is the induction of imposex in some species of marine snails. Imposex happens when a female snail starts to grow a penis and other male genital organs. Locally, the species *Murex trunculus* (Maltese: Bekkun) have been found to be effected by imposex along most of the coastline of Malta and Gozo. 100% of females of this species are affected by imposex within Marsamxett, Grand Harbour and Mgarr Harbour (Axiak *et al*. 1995).

Using the expression of imposex as an index of TBT pollution**,** it was evident that harbours and marinas in both Malta and Gozo are already contaminated by this antifouling agent to a large extent. Such areas include Marsamxett and Grand Harbour, Marsaxlokk, Mgarr and Marsalforn. Other areas exposed to heavy boating activities are also contaminated including Xlendi, Mgarr ix-Xini, Wied iz-Zurrieq, Mellieha Bay and others. The long-term biological effects of such contamination are presently being investigated.

4.1.8 Marine Environmental Quality: General Conclusions

The above review has shown that in spite of the very limited data available, both in terms of time and geographical coverage, there are certain features and trends in marine pollution which may now be identified as follows:

Bathing Water Quality: To date, the most comprehensive and long-term data is available for the microbiological monitoring of bathing waters. The above review has shown that there are signs of a general improvement in the quality of bathing waters. The number of localities with very clean bathing waters have increased over the past two years. As expected, Xghajra and other areas in the vicinity of sewage outfalls has been persistently classified as unfit for bathing. Some localities such as St Julian's and Marsascala have shown signs of recent improvements in their bathing water quality, while deterioration is evident in some areas such as St. George's Bay (St. Julians); Dahlet Qorrot (Gozo) and others.

Eutrophication: Sewage pollution is often associated with increased levels of nutrients, which in turn may lead to eutrophic conditions and alga blooms. Eutrophication is a phenomenon of poor water quality usually associated with sewage pollution and elevated nutrient levels. This condition may lead to uncontrolled growth of microscopic plants (some of which may be directly toxic to humans and to marine life), with the colour of water becoming abnormally green and turbid. There is usually a reduction in oxygen levels which may lead to fish mortality and to stress on marine life.

The above review concludes that the nutrient levels, water transparency and chlorophyll *a* levels within some localities such as the Msida marina, Lazzaretto Creek, and Marsascala are such so as to indicate risks of moderate eutrophic conditions during certain parts of the year. Though the available data is not sufficiently extensive in terms of geographical and temporal extents to enable us to draw definite conclusions, it shows that in general, pollution by sewage and other land-based sources (e.g., agricultural run-off) have led to mild eutrophic conditions in these localised semi-enclosed areas.

Oil Pollution: A number of potential sources of oil pollution have been identified including chronic low level of pollution resulting from small water craft and other sources, to occasional small to medium spills from land-based activities, and finally acute risks of massive pollution resulting from major maritime accidents. The available data indicate that to date, while the risks of massive spills are ever present, it is the chronic low level type of pollution which is most significant. In fact, a significant increase in the levels of oil pollution in superficial sediments from several coastal areas has been identified. Within the Grand Harbour, PHC levels increased from 5 to 12 times over a period of five years. Development of yacht marinas in Marsamxett may have led to a five-fold increase in oil pollution load in the sediments in Pieta and Msida over this same period.

Marine Litter: Marine litter, especially persistent plastics, may constitute a hazard to various forms of marine life as well as to boating activities. In fact, several local investigations have shown plastic (mostly originating from beach users and touristic and fast food outlets) to be the most prominent component of such litter. The quantitative data available is not sufficient to enable us to identify any trends in such pollution. The levels of such litter on our beaches are in some cases comparable (and possibly less) to those in other coastal areas in the Mediterranean and elsewhere, which are exposed to intense beach use.

Heavy Metals: Data on the levels of heavy metals in local waters, sediments and biota is very limited. For fish, the levels of some metals in the 1980s were found to be lower than in other industrialised regional areas. No data are available to identify any recent trends. Likewise, it is not yet possible to compare the levels of heavy metals in local sediments with those from other countries. Nonetheless, significant levels of some metals (e.g. cadmium and lead) have been found in harbour areas and in areas in the vicinity of Maghtab landfill and the sewage outfall at Xghajra.

Significant amount of data is available for organotins (active biocide in antifouling paints on water craft). Such data show that the levels of tributyltin in sediments, seawater and biota are relatively high in Marsamxett marinas, in the vicinity of Manoel Island yacht yard, and in Dockyard Creek in the Grand Harbour. Moreover, using the expression of imposex in a marine snail as an index of TBT pollution, it was evident that all areas normally exposed to heavy boating activities have been exposed to this type of pollution. No trends may be identified as yet.

4.1.9 Marine Environmental Monitoring: Requirements And Future Strategies

A management strategy for environmental protection requires a clear definition of goals to be achieved and the means to achieve such goals. Such a strategy should aim to protect the marine environment against the adverse effects of human activities so as to conserve marine ecosystems and to safeguard human health while providing for rational use of living and non-living resources.

This strategy must necessarily be based on scientific information of the 'state of health' of the marine environment; on whether such state of health is improving or otherwise; and on whether any control measures being applied within the framework of this strategy, are being effective. Such scientific information is obtained through monitoring of the environment. More specifically, we need to accurately assess environmental quality in order to:

a) ensure cost-effective pollution control measures which are neither over- nor under-protective, as well as to optimise such control measures;

b) to identify liabilities of potential polluters, as well as to find out whether marine users are complying with regulations;

c) to predict the extent of any consequences of man's activities on the marine environment at the earliest possible stage of planning of the activity.

Apart from bacteriological monitoring of bathing waters, there is no comprehensive marine environmental monitoring programme in Malta which would satisfy the criteria identified above. The most basic element for environmental management, i.e. environmental information, is often lacking. There is an urgent need to make available a considerable amount of resources (including scientific personnel and equipment) for this purpose.

BACK TO CONTENTS

4.2 State of Preparedness in Case of Environmental Disasters

4.2.1 Introduction

All countries need to prepare themselves against the eventuality of some accident or incident, which could lead to acute risks to human health, to our natural resources as well as to the environment. Such risks are usually associated with spills of oil, fuels or other harmful substances. But they should also include accidental release of radioactivity, as well as biological agents.

In the case of Malta, our geographical vicinity to major maritime traffic routes, offshore bunkering and transshipment activities at the Malta Freeport are may lead to a number of environmental risk both to water and air quality.

The following account is not meant to be an exhaustive thesis on environmental risk assessment and management. Its main aim is to very briefly review our state of preparedness in case of such environmental disasters, as well as to try and identify the main bottlenecks in the national capability to control such risks.

The Civil Protection Directorate has been recently set up to deal with most of these environmental acute hazards, which may put human life or the environment at risk. We are however still in the initial phases of our national development against such risks and it may be fairly stated that as yet, our state of preparedness in case of major accidents such as radioactive spills, or major atmospheric release of toxic chemicals, is very low indeed.

4.2.2 Risks of Accidental Marine Pollution: Institutional Developments

To date, most of the public and authorities concern has been directed to environmental disasters related to the marine environment.

In 1990, the EU made available funds through its Third Financial Protocol in order to identify institutional and resources requirements as well as provides equipment to improve the national state of preparedness in case of major oil spill incidents. In 1991, the French Consultants CEDRE were appointed to prepare a technical report and recommendations which would address the legislative, institutional and operational aspects. As a direct result of such recommendations, the Pollution Control Coordinating Unit (PCCU) was set up with the Environment Protection Department in 1992.

In 1995 and 1996, a significant amount of oil pollution combating equipment was procured by the PCCU, and this included floating booms, oil dispersants (actually obtained from FINASOL in 1992/93), oil skimmers, oil sorbent pads, pumps and other ancillary equipment. By 1998, the PCCU was equipped with a harbour-cleaning vessel, an all-purpose work barge and a dedicated pollution control vessel.

In 1998, CEDRE was again commissioned to provide training in oil pollution combating as well as to prepare a national oil contingency plan. In 1999, 28 personnel from various governmental departments attended training courses in the U.K and France on connection with oil spill control.

In 1997, a memorandum of understanding was signed between the Ministry for Environment and the Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC), which provided for REMPEC to prepare an interim Emergency Response Procedure. This would be used instead of a properly developed national contingency plan, until the latter would be available. This interim Emergency Response Procedure identified the various agencies, which are to be involved in controlling oil spills at sea, as well as their respective responsibilities in such a response. It furthermore provided an operational framework for such operations by the various agencies.

4.2.3 Small to Medium Oil Spills

This Emergency Response Procedure treats three levels of emergencies:

The first level of oil spill emergency deals with small oil spills of less than 5 tonnes. In case of such small spills, the operator responsible for the spill is expected to deal with the cleanup directly or through a sub-contractor. A number of private companies have some oil spill combating equipment, which may be used in small-scale emergencies.The PCCU is still responsible to supervise such cleanup operations.

The second level of emergency deals with medium size spills of up to 1000 tonnes. The PCCU has currently the capabilities to deal with such spills. In practice such spills are much less frequent (at 2 to 3 events per year) and past experience has proved that the PCCU has both the expertise as well as the personnel and equipment to deal promptly and successfully with such moderate spills. Nonetheless, there is urgent need to upgrade the resources and facilities of the PCCU in order to ensure its continuing efficiency in dealing with such spills. It is to note that the type and extent of resources which would be required by the PCCU and which were identified in 1992 by CEDRE, are still not available by the time of writing this report. Furthermore, this unit, which is presently located at Starkey Annex (Vittoriosa), will soon be relocated elsewhere due to a major development project for the whole locality. There is an evident need to ensure that such relocation will not negatively affect the present capabilities of this unit.

To date, small to medium oil slicks within the 3-mile territorial waters are not usually treated with oil dispersants. Nonetheless the PCCU has stored dispersants which could be used to handle up to 1000 tonnes of spilt oil (and possibly more). It is a general policy that oil dispersants which would be stored for any length of time, would need to be checked for dispersant efficiency through regular (at least every 2 years) laboratory tests, and that the storage containers will be inverted periodically. It is important to ensure that such provisions for stored depots of oil dispersants are strictly and scrupulously abided by.

At present there are no legal binding regulations which control the use of oil dispersants in Maltese waters. However, the PCCU has adopted the following policy: Only oil dispersants as appearing in the approved list published by REMPEC are used. Furthermore no such dispersants are used within the 3-mile territorial limit.

4.2.4 Large Oil Spills

The third level of emergency deals with oil spills beyond 1000 tonnes. Such spills would be considered as major disasters and have to be treated at the national level with promptness and efficiency in order to avoid major economic repercussions and threats to our resources. The interim Emergency Response Procedure identifies the Civil Protection Directorate with the operational responsibility to control such spills. Such directorate has at present three purposely designed oil pollution control vessels as well as other oil combating equipment. Nonetheless it is highly probable that the present degree of preparedness of such a Directorate to deal with real oil spills of this magnitude, needs to be greatly improved.

The major difficulty in the state of preparedness against such oil spills is possibly of an institutional nature. There is an evident lack of defined responsibilities between the various agencies involved. It is quite likely that this situation has led to undue friction between the Civil Protection Directorate and the Armed Forces of Malta on one hand, and the PCCU and the Malta Maritime Authority on the other hand. This situation may be resolved by a cabinet decision, which would identify and delineate agency responsibilities in a clear and unequivocal manner. Furthermore appropriate legislative and regulatory provisions would ideally back such decision. It is hoped that this situation will be clarified by September of 1999, when a national Contingency Plan against oil spills is expected to become an operational reality.

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4.3 The Coastline: Erosion and Other Factors

In spite of its limited dimensions, the Maltese coastline provides 190 km of highly varied topography, geology, numerous sites of significant ecological importance such as sea-cliffs, sand dunes, saltmarshes, and coastal clay slopes, as well as a rich and diverse wildlife. Moreover, the coastal areas are being exploited by multi users (often conflicting in nature) including touristic establishments, sports amenities; fish farming, desalination plants, urbanisation and others.

4.3.1 Geomorphological background.

Human accessibility and subsequent coastal land and sea use are greatly influenced by the geomorphological features. In turn, such features affect erosional processes and other natural phenomena on the coast.

The following is a brief account of the major geomorphological features of the local coastline.

The rdum comprises a short cliff face of Upper Coralline Limestone, below which is slope which is higher, more gentle angled, and covered by boulders. The bare cliff coastline is characterised by a single usually vertical free face with no boulders. The low rocky coast is characterised by gently shelving coastal platform.

High Lower Coralline Limestone cliffs predominate on the south-western coastline while blue clay slopes are prominent on the western and north-western sides. A number of small sandy beaches are also located here. The northern coastline is mainly composed of Upper Coralline Limestone, while the eastern and southern coasts are almost entirely made up of globigerina Limestone, with some exceptions of Lower Coralline Limestone.

Tectonic movements and karstification in the deeply indented parts mostly determine the Maltese coastline, which is approximately 190 km long. Karstification is dissolution of limestone rock by acidic percolating groundwater. It is evident in all local limestone rock but is especiallyexpressed by the coralline limestones.

Coasts may be classified as emerged or submerged. Emerging coasts are advancing due to the result of deposition, while submerged coasts experience active erosion leading to retreating of the coastline. In general, Rdum and bare cliffs represent an emerging coastline while the low rocky parts represent submerging coasts. Rdum type of cliffs are characterised by irregular masses of marl and fragmented limestone rocks that have slid down. In the case of cliffs composed of globigerina Limestone, shore platforms are produced by the mechanical action of waves. On the south of Malta vertically plunging cliffs generally cut in Lower Coralline Limestone, generally lack such shoreline platforms. (though they may have notches at sea level).

A definite emersion of the whole archipelago occurred about 7 million years ago and this has been affected by karstification, which is now found at an advanced stage in the southern parts, featuring caves and depressions. Subsidence of the islands occurred in the Quaternary period accompanied by a general tilting movement towards the Northeast.

Changes in sea level have submerged the mouth of several drainage channels on the coast, which has resulted in headlands, creeks and bays especially evident on the north-eastern aspect of the mainland. This system of drowned valleys form the creeks of Marsamxett and Grand Harbour.

4.3.2 Erosion

Coastline erosion may be evident both on rocky and sandy coastlines. The main factors leading to such erosion are:

a) Natural phenomena, such as wave and sea currents, as well as wind transport, climatic fluctuations;

b) Human activities

For example, waves and nearshore currents contribute to the erosion of the headlands, Ras il-Wahx, il-Karraba and Ras il-Pellegrin, on the Northwest of Malta. At Ghajn Tuffieha, the prevailing northwesterly currents hit the headland, il-Karraba, move in a circular motion first depositing broken rock, and eventually shingle along the southern part of the beach.

Sandy beaches amount to only 2.5% of the total coastline and are generally located in pocket areas between headlands. There is evidence to indicate that most of such beaches are at present exposed to significant erosional processes.

Human activities may lead to enhanced erosion on sandy beaches, when constructions are built across valleys leading to such beaches, and therefore preventing their replenishment by sedimentary material through land runoff. Building of quays and other coastal engineering works may also lead to changes in the sedimentary budget of beaches, often leading to erosion.

Unfortunately very little quantitative information is available regarding the extent of such beach erosions as well as about the changes in beach profiles, which erosion is expected to produce. Very few published investigations are available on the dynamics of sandy beaches in Malta, except for reviews, which mostly deal with general features of erosion. (e.g. Spiteri, 1990).

The Euromed Centre on Insular and Coastal Dynamics of the Foundation for International Studies has been reported to conduct some quantitative investigations on changes in local shore profiles. However this Centre failed to provide any data or information, in spite of repeated requests.

The sediment supply to local beaches is mainly derived from the erosion of the coast and shelf. Other sources include terrigenous sediment inputs. Banks of dead *Posidonia* leaves on the shoreline help to reduce sediment loss, while meadows of *Posidonia* below the shoreline act as sediment traps.

Human activity on the coastline (as well as inland) can generally alter the sand budget of a particular beach (i.e. leading both to net accumulation, but more often, to net loss and erosion of sand). The construction of coastal roads next to sandy beaches and other coastal constructions has interfered with nearshore and coastal sediment dynamics, promoting aeolian erosion, and negatively affected the beach sediment budget.

The degradation of vegetation cover as well as the construction of coastal roads has increased eolian transport of beach sand, which may result in a net loss of sediment. Such transport is particularly significant in northern Malta. At Mellieha Bay a road which has replaced vegetation that was effectively trapping sediment at an early stage borders the 100m wide beach. The establishment of a protected nature reserve may have helped protect the Ghadira sandy beach from further erosion.

It has been observed that the beaches on the northern part of Malta (and eastern part of Gozo) are remarkably different from the rest. They are wider, have a low angle beach slope and carry medium grained and well-sorted sand. Elsewhere, beaches are narrower, with a steeper slope and consist of coarser grained and less sorted sediments. The factors leading to these differences include: rate of coastal subsidence, the level of nearshore biogenic production of sand, and the degree of coastal accumulations of dead *Posidonia* leaves.

Human activities may affect the different types of sandy beaches identified above, in different ways. In the wider and more mature northern sandy beaches, illegal extraction of sand for industrial purposes may exhaust the source of relict sand from drowned former beaches and sand ridges. Eolian sand transportation is also a major problem. The removal of accumulated *Posidonia* leaves will also help to unstabilize such sandy beaches, through increased wave action. Moreover, since recent skeletal productivity is low, the sand lost cannot be compensated for, leading to erosion. The rest of the beaches are even more susceptible to human activities.

Human activities within Marsaxlokk, and in particular, the construction of the breakwater for the Malta Freeport, have significantly changed the local hydrodynamics and the resultant sediment budget of various small sandy beaches. Moreover, dredged sediments were deposited purposely on to the beach or within the vicinity of Pretty Bay, Birzebbugia. This led to a dramatic increase in the width of this beach. It is quite likely that this case represents the only evident increase in sandy beaches directly related to human coastal activities. In other cases, such activities are leading to rapid sand erosion.

4.3.3 Sandy Beach Reclamation.

There have been numerous proposals to reclaim sandy beaches by depositing imported sand material or by using dredged sediment material from other places. This has actually been carried out at Kalafrana, Pretty Bay and St. George's Bay (St. Julian's) and the results were not always as expected (Borg and Schembri, 1995, Spiteri, 1990).

Two main problems may be identified with respect to these initiatives:

a) Lack of sufficient knowledge of coastal sediment and hydrodynamics;
b) Potential contamination in dredged sediment material to be used for reclamation.

Sandy beaches reclamation efforts have been known to be successful in other coastal Mediterranean states such as Israel. However in all such cases, such reclamation was based on long-term baseline information on the local sea currents, nature of nearshore bottoms, and sediment budget of the particular beach. Any successful human intervention leading to beach reclamation must necessarily compliment and enhance natural sediment deposition processes. Otherwise such initiatives are bound to be a waste of time (and sand). The present account has shown that our level of information on coastal dynamics needs to be improved before we may hope to implement such schemes successfully.

Another potential problem with beach reclamation may be due to the proposed use of sediments which have been dredged from local ports and semi enclosed creeks. Such areas are more often then not, exposed to a wide range of marine contaminants such as pesticides, hydrocarbons, heavy metals, etc.. Many of such contaminants are known to accumulate in bottom sediments and are quite likely to present a potential health and environmental risk if used for beach reclamation.

It is evident that such beach reclamation schemes must be carefully planned and integrated into local plans of development

4.3.4 Coastal Activities and their Impact

According to Anderson and Schembri (1989), 38% of the Malta coastline and as much as 73% of Gozo's coastline is in fact inaccessible due to physical features. In 1989, as much as 84% of the accessible coastline in Malta and 74% in Gozo and Comino is dominated by touristic developments. Presently, these figures are bound to be higher, especially in the case of Malta mainland.

In 1989, industrial activities such as ship repairing, salt production, desalination plants, and quarrying extended up to 8% and 4.5% of the total coastlines of Malta and Gozo respectively. Coastline frontage dedicated to maritime activities was estimated to be 16.5% for Malta and 4.5% for Gozo. Coastal agriculture is more prominent in Gozo where it extends up to 57% of the coastline, while in Malta it covers approximately 23% of the coast.

There is an evident need to review such numerical data so as to identify any changes and trends in coastal land use over the past decade.

Intense human activities, mostly related to tourism and less so to fishfarming and industry, have exerted great pressures on our coastal resources. These effects would be elaborated upon in several sections of the present State of the Environment Report. However, we may here refer briefly to some of these negative impacts.

Alteration in coastal features have led to loss of special habitats such as sand dunes and saline marshes. Sand-dune systems associated with some of the major beaches are much degraded due to intense beach use by locals and tourists. Some coastline quarries (two in Malta and one in Gozo) have broken completely through coastal cliffs and are degrading and altering the natural coastal features present. Marine litter on beaches and in various inshore sea bottoms is often reported to be significantly high though little quantitative data is presently available.

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4.4 Freshwater Resources

4.4.1 General Introduction

The water availability on the Maltese Islands is basically determined by climate and by their catchment characteristics.

Rainfall is the only natural source of water. Based on considerations of rainfall and ambient temperatures, Malta's climate may be best described as semi-arid and typically Mediterranean. The seasonal distribution of rainfall defines a wet period (October to March with 70-85% of the total annual precipitation) and a dry period (April to September). The average annual precipitation is circa 530mm. However, rainfall is highly variable from year to year.

Only a small percentage (6%) of this rainfall is lost directly to the sea as surface runoff. The rest of the water percolates through the ground where it is partly retained by the soil. Most of this water (70-80 % of total rainfall; Cilia and Schembri, 1992) is in turn lost to the atmosphere via evapotranspiration.

The remaining water percolates deeper into the ground until it reaches the aquifers as recharge water. It is estimated that almost half of this recharge water is in turn lost to the sea by natural subsurface discharge at various points along our coastline.

4.4.2 Aquifers

4.4.2.1 Background

The only natural freshwater source in the Maltese Islands is ground water present in aquifers. It has been estimated that between 16-25% of the total annual rainfall falling on the Maltese Islands accumulates in natural aquifers.

In 1996-97, 13 pumping stations, 136 registered boreholes and 18 springs provided approximately 22 million m^3 of potable water which corresponds to 47.3% of the total potable public water supply (WSC Annual Report 1996/7).

Water seepage from the perched aquifers drains into wider water courses. The tapping of this water by farmers and the WSC reduces flow and results in the loss of natural habitats. Small dam construction and increase ground infiltration has provided additional habitats but at the same time has caused extensive disturbance and degradation of valley ecosystems.

4.4.2.2 Protection of Aquifers

There are two aquifers in Malta from where this fresh water is extracted. The upper aquifer is in the Upper Coralline, perched above the Blue Clay. It is prone to contamination from the surface but is used for irrigation. The second main freshwater aquifer is in the Lower Coralline Layer and forms a lens above a denser brackish or saline aquifer below. This freshwater aquifer is at its thickest towards the centre of the island (about 4m), becoming more sparse towards the peripheries. It provides about half of Malta's potable water supply.

The Water Services Corporation has initiated an intensive programme to protect the aquifers from illegal use as well as to conserve their water quality. Regulations regarding registration of boreholes are now in place but need to be properly enforced. Policies have been formulated with regard to 'aquifer protection zones'.

The salinity of water obtained from the pumping stations is published in the Abstracts of Statistics. There is evidence to suggest that the levels of chlorides (i.e. salinity) are greatly determined by the rates of extraction from a particular source. Nonetheless, some trends may be identified as follows:

In general, water extracted from the Ta' Kandja Pumping station has the highest salinity whilst that from Wied il-Kbir has the lowest salinity. Also, from the data analysed during the period, 1990-1994, it appears that there is a trend towards increasing salinity of groundwater extracted from Ta' Bakkja, Ta' Kandja and Tal-Hlas pumping stations. Water salinity at Tal-Isperanza declined in the same time period.

There are clear indications that our aquifers are vulnerable to pollution. The quality of ground water is sensitive to the leaching of pollutants carried by rainfall from the surface. When heavy downpours are minimal, ground water production is greater not because of increased pumping rates but because pollution effects on ground water quality are less significant, and therefore this allows for increased use of such aquifers. Such an event of increased water production was recorded between August 1996-July 1997. This shows the extent of vulnerability and sensitivity of our aquifers to leaching of pollutants by rain.

On the other hand, the heavy rainfall period in 1995 resulted in the contamination of 969, 420 cubic meters of ground water from Tal-Hlas, Wied il-Kbir and Ta' Falka pumping stations. This arose from improper animal husbandry practices which contaminated the catchment areas of these stations. The Tal-Hlas pumping station was non-operative for 6 months (WSC, 1995).

In 1994, the Hydrology Section completed a survey of catchment areas to identify and compile an inventory of pollution sources. All of the protected zone (around 180km ^{2}) was covered and details were plotted on survey maps (WSC, 1994).

The inventory of polluting sources was integrated with other hydrogeological data so as to classify those areas of the aquifer which are vulnerable to pollution. An aquifer vulnerability map for Malta has been produced indicating various levels of vulnerability of the aquifer in most regions (WSC,1994-95). These vulnerability studies, completed in 1995-96, are currently being integrated with pollution-risk analysis (imposed by different types of developments) and with flow-simulations obtained through modelling techniques. This will enable to assess the potential impact, in terms of pollution and contaminant generation, of human activities and development at large on the aquifers.

The Department of Agriculture is actively participating in various aspects of this study; other institutions are also expected to be involved in this study (WSC,1995-96).

In general, all available evidence confirm that while our aquifers represent a precious resource, they are presently threatened by a number of pollution hazards, as well as from over-exploitation due to heavy consumer demand. Recent claims have been made that for 1998, significant amounts of water have been lost due to contamination of the aquifers. This represents a monetary loss of over Lm380,000.

4.4.3 Potable Water

4.4.3.1 Quality of potable waters reaching the consumer

It is evident that maintaining a good quality water supply is a prerequisite for maintaining a high standard of human health protection as well as for sustainable social and economic development.

Presently, the WSC as well as the Department of Public Health undertake regular monitoring of the quality of potable water reaching the consumer. While data on a number of water quality parameters are regularly available (e.g. total hardness and alkalinity; calcium, nitrites and nitrates; conductivity and chlorides; sodium and other mineral ions; faecal coliforms and other bacteriological indicators) such data is not normally published. Furthermore, there is insufficient data on many other water quality parameters. These include: dry residues; heavy metals; trihalomethanes; polycyclic aromatic hydrocarbons, and others.

In a recent report by the WSC (McLay and Vella, 1996) the setting of national standards for drinking water quality was discussed. It was stated that the present levels of nitrates; chlorides and sodium are such that remedial action need to be taken if Malta is to be able to comply with the existing EU standards.

This report states that relative to various international criteria, there are some parts of the distribution system (i.e. potable water reaching the consumer) with unacceptable nitrate levels. To date it is understood that there is no epidemiological evidence that this situation is related to health effects. Furthermore, the report suggests that this is probably due to the high incidence of the use of bottled water for human consumption.

The relatively high levels of nitrates in drinking water which are generally attributed to the leaching from artificial fertilisers. Also, there is still abuse of pesticides locally; however data on the contamination of ground and surface waters by these substances are lacking. The levels of nitrates in potable water are kept within safe or acceptable limits through blending of extracted groundwater with RO water. This blending method may be difficult to implement whenever the rates of RO water production are reduced due to operational circumstances (such as power cuts). During these periods it is quite likely that the levels of nitrates in some parts of the distribution system would increase to significant levels.

To date there is very little data available for the sodium levels in potable waters. Nonetheless there are indications to suggest that these levels do not always comply with EU standards (80/778/EEC Directive: 150 mg/l). Excessive sodium intake may be linked with certain public health hazards.

The issue of high salinity (i.e. high chlorides, and/or conductivity) in local potable waters is quite complex, and there are several aspects related to it. The available evidence suggests that this parameter is highly variable with time and with geographical location within the distribution system. Moreover, the chloride parameter is generally more relevant to aesthetic and consumer preference standards rather than to human health standards. Therefore, while these parameters as monitored in local drinking waters exceed the set threshold standards of the EU Directive, this may not be considered as a risk to public or consumer health.

The relatively high levels of salinity in local waters are mainly due to the proximity of the groundwater table to sea level and it does not seem possible to reduce the chloride levels to less than 650mg/L at best (Department of Health Policy and Planning, 1997).

The most important standard for drinking water supplies is that for faecal coliforms. 98% of all investigated samples were found to be free of such coliforms. Any detection of this important indicator is immediately communicated to the general public who are advised to boil their water.

Our freshwater resources should also be protected from other potential contaminants such as heavy metals, pesticides and other organics. There is currently very limited data on the levels of such contaminants. There are plans for the Institute of Water Technology to provide such data in the near future.

4.4.3.2 Monitoring Programmes

Water supplies are tested regularly by the Department of Public Health. 114 fixed sites are monitored weekly throughout the year for chemical parameters (including sodium levels, salinity, chlorides, nitrates, nitrites and fluorides) and microbiological parameters (mainly faecal coliforms). Also sampled weekly are a number of main boreholes, reservoirs and pumping stations. All the results are forwarded to the Director of the WSC (Department of Health Policy and Planning, 1997).

The WSC, through its Institute of Water Technology, also carries out its own bacteriological and chemical tests on water samples. It monitors all production sources and distribution points; testing at consumer points have also intensified.

Hydrological and climatological data are collected regularly since 1994 from 40 gauging boreholes, 19 rainfall stations and 2 run-off recorders for storage in a databank. Three weather stations, financed by the 2nd Financial Protocol of the EU, were installed at Ta' Qali reservoir, Mizieb pumping station and Luqa Headquarters. They have been calibrated and are now recording data in real time. One of these is equipped with new pollution monitoring sensors which measure levels of CO, SO_2 and NO_2 in the air.

Gathering of hydrological data has been partly automated with the introduction of data-logging equipment. 80% of gauging boreholes have been fitted with a dedicated logger.

4.4.3.3 National Quality Standards for Potable Waters

The above review has shown that due to a number of circumstances, there is room for improvement in the quality of potable waters reaching the consumer. Furthermore there is urgent need for a more adequate monitoring programme which would cover more quality parameters than is currently done. Remedial action and programmes should then be identified on the basis of the data produced by this monitoring programme.

In order to ensure consumer protection, as well as to strive for compliance with EU standards (EEC Directive 80/778 and the proposed revisions) there is an evident need to adopt a comprehensive national standard of water quality. This standard would need to take into consideration economic and geo-hydrographical constrains as well as consumer expectations.

4.4.4 Reverse Osmosis Desalination Plants

More than half of Malta's drinking water supply is produced by the reverse osmosis desalination of sea water. There are four main RO plants operating at Lapsi, Marsa, Cirkewwa and Pembroke. The latter produces the largest amount of water (as much as 54% of the total volume in 1996-1997). A fifth RO plant at Tigne' had proved to be the least efficient and in its 1996-97 report, the WSC had inidcated that its production could easily be replaced by the Pembroke plant from the point of view of distribution of product . It is understood that such plant is no longer operational.

It is evident that the country only manages to cope with water demand through its RO plants which operate at both financial and environmental costs.

4.4.4.1 Trends in energy consumption

RO desalination is a high energy consumer as indicated in the table below. In 1988, the electricity consumption by the RO plant sector was of 79.77 GWh, which was 11% of the total electricity produced (National Committee for UNCED,1992). In 1995-96 the WSC accounted for 19% of the total electricity produced (includes energy for RO plants and groundwater production and distribution). The energy requirement of this sector has practically doubled in 10 years.

Published data (WSC Annual Reports) indicate that the RO production consumed from 14 to 20% of the national energy production, over the past few years.

In 1995, energy consumption was 13.3% less that that in 1994 due both to reduced production and to more efficient energy utilization (WSC Annual Report, 1995-96). This trend is attributable to increased efforts to minimize energy consumption per unit product by the RO plants, improve RO performance and water conservation measures. In fact , there is evidence to suggest that improved efficiencies and management of RO plants have reduced the amount of electrical energy required per m^3 of RO water production from 6.06 kWh to 5.81 kWh.

4.4.4.2 Operation of RO Plants

In 1994, the RO plants suffered only 5.6% downtime (due mainly to interruption of 0power supply). They produced an average of 79, 800m^3 water/day. In 1995 - 88,the average daily production was of 581m^3/day.

The operation of the plants is susceptible to contamination by sewage pollution. In summer 1995, the operation of the Marsa RO plant was interrupted for some weeks due to contamination by sewage of the water boreholes.

In 1995, the WSC filed an application with the Planning Authority for the development of an RO plant at a site at Zonqor Point/Swali, limits of Marsascala. Suitable site-assessments were carried out; water quality was also tested via two test seawells (to investigate mainly the possible effects of the nearby Wied Ghammieq sewage outfall).

4.4.5 Water Distribution and Accounting

4.4.5.1 Water Distribution

The majority of houses and premises in Malta are supplied with mains water, although there are a number of private boreholes and wells. The mains drinking water or first-class water supplied to consumers is a blend of groundwater, reverse osmosis product and distillate (WSC - 1994).

The WSC also co-ordinates the distribution of effluent (or second-class water) from the Sant' Antnin Sewage Treatment Plant to industry and agriculture. In 1996, an average of 1,400m^3/day were distributed. Wastewater treatment is limited to only 12% of all sewage produced.

The work being carried out on the distribution system includes new pipe laying, service main replacement project; leakage identification and repair and general maintenance.

These works were often the cause of generally short and localised interruptions of supply.

4.4.5.2 Water accounting

Only 40**%** of the total amount of water produced in the Maltese Islands (by RO plants and groundwater extraction) is accounted for.

The other 60% (as much as 34.5 million m^3) is water produced but not billed. This is high relative to figures reported by other countries (WSC, 1995-96). An attempt was made to produce a significant index on the amount of unaccounted for water and evaluate the economic level of leakage control under Maltese conditions.

A suitable index considered was that which expressed water loss as cubic meters (unaccounted-for) water per hour per kilometre of main. An average figure for Gozo was of 0.22m3/hr/km compared to network averages of 0.75m3/hr/km (range 0.1m3/hr/km to 1.4m3/hr/km) in highly advanced countries in Europe (WSC, 1995-96). This index requires further investigation to arrive to a more realistic target setting.

A study conducted in 1993 revealed that such 'unaccounted for' water was composed of under-registration of water meters (20%), billing errors (11%), water theft and leakages in the mains network, the latter estimated at 29% of total water production (Moviment Ghall-Ambjent, 1997 ; WSC 1994).

4.4.5.3 Measures to reduce percentage of unaccounted-for water: improved water distribution

Meter replacement programmes and a re-organisation and stepping-up of leakage detection and control measures are amongst the measures aimed at improving water accountability.

In 1995, approximately 120, 000 ‘stopped meters’ and meters older than 20 years were changed (WSC, 1995). In 1996, another 19, 200 meters were replaced. In 1997, 2,909 meters were changed in the Maltese Islands.

In 1995-96, a total of 14,500 leaks were repaired. 80% by number of the leaks are traced to damaged household service pipes. Between 1995-96, approximately 12,300 household services supplying consumer’s premises from the distribution network, were replaced (WSC, 1995-96). All new services installed were made of polyethylene instead of galvanised iron because of the better performance and longer lifetime of the former material.

A comprehensive study has established that there are some 320km of galvanized iron distribution mains spread around Malta and Gozo. These pipes need to be replaced if network reliability is to be enhanced and road disturbance minimized on a long-term basis (WSC, 1997).

A major difficulty in leakage control is the inaccuracy and gaps in site plans of the distribution network and layout. Thus, leakage control has been usually labour-intensive and involved repeated investigations and mains detection.

In 1997, 17 water theft cases and 49 cases of unauthorized tampering with the installation were detected out of 4, 670 inspections and investigations effected over the year. It is clear that the problem and its magnitude are not yet fully understood.

4.4.6 Water Consumption

It is quite difficult to determine with certainty the gross annual per capita consumption of freshwater. This is partly due to the problem of ‘unaccounted for water’. If one does not take into account this ‘unaccounted’ water, then it was estimated that in 1994, the gross annual per capita consumption was at 155 litres per day. According to other estimates (Friends of the Earth, 1997), this consumption rate would increase to 242 litres for 1989 and 388 litres for 1994, if the ‘unaccounted’ water is included.

Notwithstanding such uncertainties in these figures, there is evidence to suggest that the demand for water has been decreasing steadily since 1995, and this is partly due to water conservation, improvement in leakage control and increased water tariffs.

4.4.6.1 Consumption Rates by Sector

The Table 4.1.4 shows the degree of water consumption by various sectors as compiled by various reports of the WSC.

Evidently domestic demands account for most of the water being consumed (67%), while industrial demands are much less and in general amount to 10 to 12% of the total.

Some industries place much bigger demands for water consumption than others. The top ten most water consuming industries (as at 1992) are shown in Table 4.1.5

In spite of increased water tariffs, potable water supply to industry is still heavily subsidies and consequently most industrial companies do not have any economic incentives or disincentives to implement any water conservation measures.

Table 4.1.4 Water Consumption By Various Sectors

Sector	% of total consumption of potable water	per capita consumption	Remarks
Domestic	67%	150 Litres/day	Such high consumption is the main cause of water problems in Malta.
Agriculture	3-4%	?	Animal farms consume significant amounts. Problem of illegal (non-registered) boreholes. In areas of irrigated land, groundwater nitrate levels are consistently high.
Tourism	8%	250-300 Litres/day 300-45 Litres/day in 4* and 5* Hotels	Tourism sector is charged full cost of water consumed. Some hotels have installed their own RO Plants
Industry	10%		First class water highly subsidised. No measures of water conservation. Only one out of 10 industrial estates is provided with treated effluent

Table 4.1.5 The top ten most water consuming industries (as at 1992)

Industry	Water Consumption (1000 m^3/year)
Farsons Breweries, Mriehel	249
Malta Drydocks, Cospicua	236
SGS Thomson, Kirkop	219
Civil Abattoir, Marsa	188
Portanier, Hamrun	105
Malta Dairy Products	50
Marsovin, Marsa	41
Royal Products, Mriehel	35
Malta Shipbuilding, Marsa	34
China Dock, Corradino	28
TOTAL	**1,185,000 m^3/year**

(Source: Environment Protection Department, 1994)

4.4.6.2 Trends in Water consumption

The demand for water in 1996 was lower than the previous year's demand. In Malta the reduction averaged 8% and in Gozo 10%. In general, the demand for water has been decreasing steadily for the past two years. This is due to more effective water conservation measures namely the improvement in leakage control.

With improvements in the distribution network and the use of more efficient pumps, the power demand on groundwater sources declined (WSC, 1997). The exception was the demand on pumping stations in 1995-1996 where heavy rainfall and subsequent contamination meant that some water was diverted (and thus lost) to drain after being pumped to the surface.

In 1996, water production by RO desalination was 16% less than the previous year, this being due mainly to a decreased demand of water and to fuller utilisation of the ground water that was harvested (better conservation mentioned above).

There is an apparent decrease in water production by the RO plants and this has been attributed to improved conservation measures.

If the amount of unaccounted-for water (including network leakages) were to be reduced to 20% of total production, total water production would have to reach 30 million m^3 per year by the year 2010. This is approximately 12 million m^3 greater than the sustainable yield of the aquifers.

If no sustainable measures are taken to control water production and consumption, a 21% increase in the current first-class water production would be required to meet the water demand for the year 2010.

4.4.6.3 Water shortages

Water shortages in various localities are still being felt, mainly in areas that have developed much faster than the required infrastructure (including tourist resorts).

The Bowser service offers a supply of potable water when requested in case of the interruption of service for service pipe repairs, request for additional supplies (to fill wells) and requests for industrial concerns; the latter two services are provided against payment.

In 1995-96, the bowser service handled 3 to 4 calls ***daily*** from consumers. The six road-tankers of the bowser section were relatively lightly loaded during this time span.

When breakdown in major pipes occurs, the workload increases to approximately 9.4 calls daily (3,426 calls throughout 1995-96) (WSC, 1996).

No details regarding the number of days of suspension of water supply, are currently available.

4.4.7 Initiatives and Achievements

Over the past decade, we have witnessed a steady improvement in the production of potable water and in its distribution. Furthermore, there were significant developments in institution building as well as in legislation and regulations. The creation of the Water Services Corporation in 1991, was one prime factor behind these developments. More recently, the setting up of the Institute of Water Technology with the main responsibility of training and professional development of the relevant personnel, further improved the infrastructure and instruments of management of our water resources. This Institute also incorporates a water laboratory which is responsible for all monitoring activities undertaken on behalf of the WSC.

Efforts are currently in progress to establish national water quality standards. Furthermore, a national strategy for the development and management of the water supply in Malta is being drawn up. The aspects being considered include the following:

1. Definitions of levels of service which the WSC should adopt
2. Water resource development, including non-traditional sources and their integration with the distribution system.
3. Distribution system development, including support studies such as demand patterns
4. demand management, including conservation and leakage control
5. water quality both at the production source and along the distribution system
6. financial resources required

The achievements since 1995 include:

?? a complete study on the demands upon the system i.e. the identification of available data, its processing to obtain the required information and the identification of other investigations still to be carried out.
?? the development of a Geographical Information System (GIS) of the major distribution system (over 3500 pipe segments).
?? the computerisation of daily production data since 1995.
?? the collation of all water quality data (over 315 sites) since 1991 into a computerised database
?? the collation of all distribution flow meter data since 1995

4.4.8 Conclusions

The above review has identified a number of priority areas which need to be taken into consideration in the management of our water resources.

Protection of our aquifers from contamination should be given top priority, since recent experiences have indicated its extreme vulnerability and sensitivity to various anthropogenic pressures, including agriculture and illegal extraction.

While the quality of potable waters is in general improving, there is evidence to suggest that EU (and in some cases, WHO) thresholds for nitrate levels, salinity (chlorides and sodium content) as well as other quality parameters are often exceeded. There is an evident need to develop the present water quality monitoring programme to include more quality parameters.

Water conservation measures are bound to be more productive with the recent increases in water tariffs for all sectors. Furthermore, the authorities should consider more pro-active incentives such as subsidies for the building of rain reservoirs. The present initiatives in improvements of water distribution to minimize water loss must be sustained. Agricultural drip irrigation rather than sprinkler irrigation should also be encouraged.

Finally, the national strategy for water management should incorporate all efforts and initiatives to deal with waste waters and their treatment. The idea of amalgamating the Water Services Corporation and the Drainage Department, would be a move in the right direction. The increased production of treated wastewaters should be managed by the WSC in order to cut on potable water consumption by certain industries, agriculture as well as touristic establishments, which do not require high quality water. Furthermore, the recharging of aquifers by treated wastewaters should be carefully considered after thorough analysis of the likely implications on aquifer quality and cost-benefit evaluation.

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5. SOLID & LIQUID WASTES

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5.1 SOLID WASTES

5.1.1 Introduction

> **The generation and disposal of waste is a major concern. Methods are outdated and enforcement ineffective. Illegal dumping is a national pastime. A complete change of policies, procedures and attitudes is required.** (23)

Waste, in contrast to air, land and water, is not strictly an environmental medium. However, it is generally recognised that its generation and management have significant relevance to human health and the environment, in terms of resource management and pollution potential. It is in this respect that it features in this State of the Environment Report.

This report is intended as a factual presentation of the state of the local environment. It is intended to:

- ?? provide objective data for policy makers, planners and developers
- ?? inform and raise awareness among the public at large
- ?? identify problem areas and propose solutions

Unless otherwise stated, the report contains information that was believed to be correct up to the end of 1997.

5.1.2 Definitions

In what follows:

<u>Waste</u> means all by-products, which may be solid, liquid or gas, that results from any activity of man, but mainly from the extraction, manufacture and use of materials and products. It is often not economically feasible to make use of these by-products, which therefore fall out of the traditional economical cycle and are discarded. It must be mentioned that the current tend in Europe is to classify all products that are not the intended product of an activity as waste, irrespective of whether the product has commercial value or not.

<u>Pollution</u> is the introduction by man into the environment of materials and energy in such a way that it causes or has the potential to cause harm to human health or living resources, impairs use of resources or otherwise interferes with the legitimate use of the environment.

<u>Waste management</u> refers to the generation, storage, collection, transportation, treatment, reuse, recovery and disposal of waste in a planned and efficient way that minimises impacts on human health and the environment.

<u>Waste manager</u> is that person who generates, stores, collects, transports, imports, exports, treats, reuses, recovers or disposes of waste.

The <u>generator of waste</u> is that person whose activities directly or indirectly produce waste.

The <u>holder of waste</u> is the generator of the waste or the person who is at the time in possession of it for purposes that many include storage and transport, irrespective whether he or she is the generator of the waste.

<u>Reuse of waste</u> is the process by which used products, such as empty containers, are used again for the same or for a slightly different purpose with minimal treatment, e.g. washing.

Recovery of waste is the process by which waste products are converted into usable secondary materials that enter the economical cycle, or into usable energy.

Composting is a form of recovery of the "organic" fraction of waste. In this process, the "organic" fraction of waste is subjected to a more or less controlled biological degradation in the presence of air in such a way that the product is relatively safe and stabile, and can be used as a soil conditioner.

Waste minimisation is the process by which waste, which would otherwise have been produced, is not produced.

Waste disposal means those waste management techniques which, in contrast to minimisation, reuse or recovery, are based on the burning, deposit or discharge of the material into the environment.

Waste deposit site is a site where waste is deposited for recovery or disposal.

Sustainability means the satisfaction of the needs of the present generation without compromising the legitimate needs of future generations. With respect to waste management, sustainability is achieved by the conservation of material and energy resources and by stabilising waste generated by one generation within the lifetime of that generation (30 to 50 years).

5.1.3 Abbreviations used in this Document

Table 5.1 shows the more important abbreviations used in this document.

Table 5.1: List of the more important abbreviations used in this document

C&D	Construction and Demolition
EPD	Environment Protection Department
EU	European Union
LN	Legal Notice
MDI	Ministry for the Development of Infrastructure
MFAE	Ministry of Foreign Affairs and the Environment
MPWC	Ministry of Public Works and Construction
MSW	Municipal Solid Waste
RCV	Refuse Collection Vehicle
SFE	Secretariat for the Environment
WMSID	Waste Management Strategy Implementation Department

5.1.4 Previous Studies and Reports

During the last 30 years, the Government of Malta contracted a number of overseas consultants to assist in waste management issues. Important studies have been carried out by ATIGA Consortium (1), VBB (33), Tebodin Consulting Engineers (32), Secretariat for the Environment (31), METAP (24), ECRU (10) and Grontmij (18, 19, 20).

5.1.5 Classification of Solid Waste

For the purpose of this report, the following categories of waste are recognised:

Domestic or household waste is that waste produced from premises that are exclusively used for human habitation.

Institutional waste is that waste that is generated in schools, health-care centres, offices, etc.

Commercial waste includes waste generated as a result of the retail and wholesale of goods, and light manufacturing and servicing industry, as well as other activities that require a trading license and are located within Local Councils' territory.

MSW includes domestic waste, waste that results from street sweeping and other public cleansing activities, commercial and institutional waste, etc. that is generated within Local Councils' territory. Since 1995, collection of MSW has been the responsibility of the respective Local Council.

Bulky waste is that fraction of MSW which because of its size cannot be managed together with other municipal waste.

Agricultural waste is that waste generated from crop cultivation and animal husbandry.

"Organic", biodegradable or putrescible waste is that fraction of waste that is biologically degradable, and includes food leftovers, "green" waste and paper, but not plastics.

Hazardous waste is that waste which is toxic, infectious, explosive, flammable or corrosive, or contains significant quantities of components of this nature, as defined in Directive 91/689EEC. All other waste is considered as non-hazardous.

Inert waste is that waste which in respect to a specific management process, does not undergo physical, chemical or biological changes that cause it to be a pollutant

Compostable waste is that "organic" waste that under the specific conditions prevailing in the composting plant will degrade and stabilise with the production of compost.

Industrial waste is that waste generated by manufacturing and servicing establishments, mostly located in industrial sites

Construction and Demolition waste is that waste resulting from quarrying operations, excavation works, demolition and construction of buildings, road works, and related activities.

Special waste is that waste which because of its nature or quantity and with respect to a specific management process cannot be managed together with municipal waste.

Waste that is similar to municipal waste is that waste generated by commercial, industrial or agricultural activities that because of its nature or quantity and for specific management processes can be managed together with municipal waste.

Specific health-care waste, clinical waste or contaminated health-care waste is the hazardous fraction of health-care waste and includes such components as anatomical parts, sharps, laboratory waste, food left over by patients in infectious wards, cytotoxic drugs, contaminated bedding and radioactive residues.

Non-specific health-care waste or uncontaminated health-care waste is that fraction of health-care waste that is similar to municipal waste. This fraction includes residues resulting from the preparation of food, office waste, etc.

5.1.6 Legislation

Following are the main Acts and regulations that deal with waste and its management, with a brief description of their respective sphere of control and the administrative agency:

The Litter Act of 1968

?? Originally intended to control the disposal of domestic waste

?? Primarily concerned with littering
?? The Act *indirectly* controls dumping of refuse and defacement of any place
?? Specifies a standard dustbin.

This Act was administered by the Public Health Department, in conjunction with the Police Department.

The Marine Pollution (Prevention and Control) Act 1977 (not yet brought into effect).
?? Controls the discharge into the sea of oil or any other pollutant or mixture containing oil

The Development Planning Act 1992
?? Primarily concerned with land use and development.
?? The Act defines the deposition of waste as development. In effect, therefore, the Act controls the siting, and *indirectly* also the design of waste management facilities.
?? The Act requires that implementation of developments be subject to a permitting system. A development permit may require an environment impact assessment.

This Act was administered by the Planning Authority.

The Environment Protection Act 1991
?? Primarily concerned with environmental quality and its protection.
?? The Act empowers the Minister to make regulations to control harmful "substances", without specifically mentioning *waste*.
?? The Act does not relate to internationally recognised principles of sustainable practices.
?? Demands an environment impact assessment prior to all major developments (although this part has not been brought into effect); thus, it also *indirectly* controls the siting and design of waste management facilities.

The relevant Legal Notices issued under this Act are as follows:

?? LN8 of 1983 Sewer Discharge Control Regulations

This LN was administered by the Drainage Department. It mandates that a permit is required to discharge non-domestic wastes into the sewerage system, and this to protect the health of maintenance employees, the sewerage infrastructure, sewage treatment, water and sludge reuse, and the marine environment. It is felt that during 1997 LN8/93 was not sufficiently enforced.

?? LN128 of 1997 Deposit of Wastes and Rubble (Fees) Regulations

This was perhaps the most important regulation on solid waste management. This LN was administered partly by the EPD, partly by the Drainage Department and partly by the WMSID in conjunction with the Police Department. The Regulation mandates that

?? Waste deposit sites need to be licensed against the presentation of an insurance cover
?? Operators of waste deposit sites must collect data on the quantities of waste that are deposited and this data must be made available to the EPD
?? The deposit of hazardous waste needs authorisation from the EPD
?? Waste hauling vehicles require to be registered against the presentation of a Bank Guarantee with the WMSID.
?? Deposit of waste at public waste deposit sites is subject to a fee of 35c per tonne
?? A higher fee is due for the deposit of hazardous waste.

This has been the most forward-looking regulation on solid waste in Malta. Unfortunately, several problems have been encountered in the enforcement of this regulation. Several concessions had to be applied in this respect and neither the public nor the private waste deposit sites operated in full accordance with this LN.

?? LN 183 of 1994 Non-alcoholic Beverages (Control of Containers) Regulations

This LN was administered by the EPD. It mandates that, with the exception of essence or syrup intended for the manufacture of soft drinks, water, electrolyte-replacement drinks, milk, tea, coffee, cocoa, fruit juices, nectars and squashes, all refreshment drinks containing not more than 2% alcohol shall be bottled in refillable glass bottles. This LN also established a mandatory refundable deposit on the containers.

It must be noted that this LN was not intended as an environmental measure but a protective measure towards the local soft drink bottling industry. It is in fact debatable whether the Environment Protection Act gives enough power to the Minister to issue such a Regulation. Moreover, the exceptions contemplated in this Regulation contributed some problems in the enforcement of same. By focussing exclusively on glass and one particular type of beverage, this Regulation may be considered as discriminatory against the free trading of goods.

Factories (Health, Safety and Welfare) Regulations, 1986-Factories Ordinance (Cap. 107)

?? Primarily concerned with the health and safety of factory workers

?? It *indirectly* controlled the disposal of industrial waste without specifying how this may be achieved.

This Act was administered by the Health and Safety Unit, within the Ministry of Labour and Social Security.

Code of Police Laws (Chap. 18 of the Laws of Malta)

?? Primarily concerned with law and order

?? It *indirectly* controlled waste management by controlling the transportation of industrial waste in uncovered vehicles, dirtying of streets, and control of refuse collection and scavenging

?? It also set conditions for the issue of trading licenses for “industrial” activities.

This Act was administered by the Police Department.

LN 125 of 1993 Swill Control Regulations

?? Primarily concerned with the protection of livestock from imported diseases

?? It *indirectly* controlled the management of swill landed from ships, boats and aircraft.

This LN was administered by the Veterinary Services Department, within the Ministry of Agriculture and Fisheries.

Other related Regulations include:

?? the Food, Drugs and Drinking Water Act, administered by the Public Health Department, prohibited the use of used oil in bakeries

?? the Agricultural Returns Ordinance – Chap. 84 of the Laws of Malta, provides an instrument by which the Director of Agriculture can obtain information concerning agricultural waste generation

?? the Fertile Soil (Preservation) Act (1973) – Chap. 236 of the Laws of Malta, mandated that soil must be dispose of to the satisfaction of the Director of Agriculture

?? the Pesticide (Control of Importation, Sale and Use) Act (1996) – Chap. 192 of the Laws of Malta; administered by the Department of Agriculture

?? the Medical Clinics (Licensing) Regulations (LN 110 of 1981); administered by the Ministry of Health

5.1.7 International Obligations

Malta was a Contracting Party to a number of international Conventions. The most important obligations that relate to solid waste management were as follows:

?? The Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean, and its Protocols.

?? The London Convention on the Prevention of Marine Pollution from Wastes and other Matter (1972).

Among other obligations, this Convention bans the following activities:

?? the incineration of hazardous wastes at sea, and
?? the dumping of industrial wastes at sea.

?? International Convention for the Prevention of Pollution from Ships (MARPOL)
Among other obligations, this Convention calls on parties to provide adequate reception facilities for wastes generated at sea.

Other Conventions and Protocols related to waste management and to which Malta is a party are the Montreal Protocol on the control of substances that deplete the ozone layer and the Convention for the Prevention of Pollution from Ships. Another Convention to which Malta intends to be a party in the near future is the Basle Convention on the Control of Transboundary Movement of Hazardous Waste and their Disposal.

When Malta becomes a Member State of the European Union, full conformity with its policies would need to be achieved. Since Waste Policy forms a very important part of European Environmental Policy, it makes sense to look at EU legislation on waste. The EU Commission has published a number of Directives, Decisions and Regulations that pertain to solid waste management. Table 5.2 shows the most important of these pieces of legislation.

Table 5.2: List of the most important pieces of legislation dealing with or related to waste management in the European Union

67/548EEC & 79/831EEC	Classification, Packaging and Labelling of Dangerous Substances
75/442EEC & 91/156EEC	Framework Directives on Waste
75/493EEC	Disposal of Waste Oils
76/403EEC	Disposal of PCBs and PCTs
78/176EEC, 82/883EEC & 83/29EEC	Waste from the Titanium Dioxide Industry
81/972EEC	Reuse of Waste Paper
82/501EEC	Hazards of Certain Industrial Activities
84/360EEC	Air Pollution from Industrial Plants
85/337EEC	Requirement for EIA
86/278EEC	Use of sewage sludge in agriculture
87/217EEC	Pollution by Asbestos
89/369EEC	Air Pollution from new MSW incineration plants
89/429EEC	Air Pollution from existing MSW Incineration Plants
89/684EEC	Transport of Dangerous Substances and Waste by Road
89/C251	Civil Liability
90/170EEC	Acceptance of the Basle Convention
90/C122/02	Waste Policy
91/157EEC	Batteries and Accumulators containing dangerous substances
91/689EEC	Hazardous Waste
91/271EEC	Urban Waste Water Directive
92/3/EURATOM	Shipments of Radioactive Waste
92/880EEC	Eco-Label award scheme

93/259EEC	Supervision and Shipments of Waste within, into and out of the EC
93/1836EEC	EMAS Scheme
94/3EEC	Waste Catalogue
94/62EEC	Packaging Waste
95/C 165/07	Proposed Directive for Integrated Pollution Prevention and Control
96/C 59/01	Proposed Directive on the Landfilling of Waste
L158	Public Access to Information
L395	Management & Storage of Radioactive Waste
COM(93)47	Environmental Liability

5.1.8 Policy

The issue of solid waste is only marginally treated in the Structure Plan. However, this important document acknowledges that the generation and disposal of waste is a major concern and is an issue requiring a complete change of policies, procedures and attitudes (23). Relevant policy statements of the Structure Plan include the following:

Table 5.3: List of Policy Statements in the Structure Plan Relevant to Waste Management	
Policy – Public Utility	
13	need for the safe disposal of waste
14	applications for the deposit of waste, except inert waste, require an Environmental Impact Assessment
15& 16	need to identify strategic locations for the management of waste, including civic amenity sites
17	need to identify new landfill sites
18	disposal of hazardous waste
19	Local Plans should consider waste management; waste transfer stations
20	preparation of a waste management subject plan.

During 1997, the MFAE drafted a Waste Management Policy Document for the Maltese Islands (25). This policy document was published for public consultation. The main points that emerged from this document are shown in Table 5.4.

Table 5.4: Main Points of Waste Management Policy
1. Waste management must be based on principles that go beyond public cleansing and littering.
2. It must be based on principles that have been established on a global level, *e.g.* those of sustainability and the polluter pays principle.
3. Local constraints must be taken into account in implementing such a policy, *viz*. the small size of the Maltese Islands, the density of the population, the fact that most raw materials are imported.
Sustainable waste management in most cases can be achieved by applying the following hierarchy of options: minimisation of waste arising, the separate collection, reuse and recovery of unavoidable waste and landfilling of waste in secure landfills.
Implementation of policy instruments, including economic ones, are a necessary prerequisite for the successful implementation of these options.

5.1.9 Persons and Agencies Involved in Waste Management

Table 5.5 shows the main public key players that were active in waste management during 1997.

Table 5.5: Public Key Players Active in Waste Management during 1997	
Player	***Main Activities***
The EPD, within the MFAE	?? Planned, drafted policies and strategies ?? Monitored, regulated and inspected waste management sites ?? Reported incidents of illegal tipping, etc. to the Police for necessary action ?? Carried out public education and awareness campaigns
The Planning Authority	?? Regulated development and indirectly waste arisings and its management ?? Regulated the siting of waste management facilities ?? Inspected and took enforcement measures
The WMSID, within the MPWC	Implemented waste policy and strategy in complemetarity with the private sector by: ?? Providing a public cleansing and waste collection service ?? Collecting waste that was not collected by Local Councils, *e.g*. illegally dumped waste ?? Operated waste management facilities, *e.g*. the Sant Antnin composting plant, the landfills ?? In part regulating waste management ?? Carrying out other initiatives, e.g. trials related to the separate collection of waste fractions
The Projects and Development Department, within the Gozo Secretariat	?? Implemented waste management policy in Gozo
The Local Councils	?? Responsible for MSW collection and its disposal in their respective territory ?? Issued bylaws on waste management ?? Informs residents about waste management issues pertaining to their locality
The Police Department	?? Enforced regulations
The Public Health Department	?? Inspected sites and took enforcement measures ?? Managed health-care waste
The Veterinary Services Department	?? Authorised the disposal of swill
The Ministry of Finance	?? Approves and allocates funds for waste management activities to all public agencies.

Table 5.6 shows the persons and private agencies that during 1997 were involved in the management of waste.

Table 5.6: Persons & other Private Agencies involved in waste management	
The household owner	?? Generated waste ?? Presented it for disposal
The industrial operator	?? Generated waste ?? Reused, recovered or disposed of waste
The waste contractor	?? Collected, transported and disposed of waste on behalf of Local Councils, industry, etc.
The operator of a waste deposit site	?? Accepted the waste for reuse, recovery or disposal

The Malta Institute of Wastes Management + other NGOs	?? Raised awareness on the issue

In 1997, there were a few large private waste contractors and a relatively large number of small ones.

5.1.10 Waste Statistics

A word of caution needs to be said regarding waste statistics. There were no accurate quantitative waste management data. Available data could at best be considered only as indicative. This was due to various factors, amongst which were the following:

?? There were no legal obligations on entities to keep records of waste generation, and to make such records available to Government.

?? Apart from the general concept of cleanliness, there was insufficient awareness in both the public and private sectors about the significance of waste production and its sustainable management. As a result, collection of data pertaining to waste generation was not considered as a priority activity.

?? Where statistics pertaining to the generation of industrial and commercial waste were kept, these were considered as commercially sensitive to be made available.

?? There was a lack of uniform definition of what actually constituted waste. Thus, a by-products which was classified as waste by one generator might not be classified as such by another generator. This was particularly the case of by-products which were recovered in-house or which were considered to have some commercial value.

?? There was no uniform way of keeping waste statistics. Waste generation was recorded in terms of skip-fulls, bags, kilograms, etc. This resulted in data not being immediately meaningful or comparable.

?? There was no system in place that tracked down waste from its point of generation to its point of final disposal.

?? Considerable information on waste generation included in this document was based on data collected at the point of acceptance of public waste deposit sites. It must be pointed out that quantities of waste presented for disposal might not be exactly equivalent to quantities of waste generated. This was so because there might have been waste that never reached an official waste deposit site. Such was the case of waste that had been illegally dumped or recycled at the point of generation.

?? Only the Maghtab landfill and the Sant Antnin Composting plant were equipped with a weighbridge. While the weighbridge at the composting plant had been operational since 1993, the one at Maghtab had only been fully operational since September 1997. In the absence of an operational weighbridge, statistics of waste accepted at waste deposit sites for the period prior to 1997 have been based on records of vehicles entering the site, together with an estimation of their load. For 1997, the statistics have been based on extrapolation of weighbridge records for the period September-December.

5.1.11 Waste and Sustainability Indicators

Sustainability has been defined as satisfying today's needs without compromising the ability of future generations to satisfy their legitimate needs. Two key elements in achieved sustainability are the controlled use of non-renewable resources and the control of environmental pollution. In the field of waste management, the following measures are generally considered necessary in order to achieve sustainability:

?? minimising waste arisings
?? recovery of unavoidable waste
?? ensuring that waste is adequately stabilised within 30 years.

A number of indicators have been proposed to gauge sustainability. In the field of waste management, the following indices may be considered:

?? the amount of waste generated
?? the amount of waste that is recovered
?? the amount of waste that is landfilled
?? the change in waste production, compared with change in household expenditure.

The above may be expressed with respect to total waste, with respect to particular waste fractions, per inhabitant, per year, etc.

For the computation of these indices and in particular for these indices to be meaningful, it is necessary to have available reasonably accurate waste statistics and a standard definition of waste, waste fractions and materials recovered from waste.

A standard definition is also required for such terminology as minimisation, recovery, reuse, etc. Above all, this requires centralisation of waste management regulation. These requirements are hard to come by in the global context and Malta is not an exception.

5.1.12 Waste Accepted at Public Waste Deposit Sites in Malta

During 1997 there were two authorised public waste deposit sites in Malta, *viz*. the Maghtab landfill and the Sant Antnin Composting Plant. The Maghtab landfill comprises a total area of 1 million m^2, of which 600,000 m^2 had already been covered by waste.

Statistics of waste accepted at Maghtab and at the Sant Antnin Composting Plant permit an approximate differentiation to be made between Municipal waste, C&D waste, and Industrial and other waste.

Table 5.7 shows the quantity of waste accepted at these sites during the last 8 years.

The statistics for 1997 are based on extrapolation of weighbridge records for the period September to December. They show an apparent decrease in all categories of waste as compared with previous years.

Since it seems unlikely that a true decrease in industrial and C&D waste occurred during 1997, the reason for the apparent decrease must be sought elsewhere. The most likely reason is thought to be related to the introduction during 1997 of a landfill fee of LM0.35 per tonne. This fee was levied on C&D waste, and on industrial waste, but not on MSW. It is probable that in order to avoid paying the fee, some waste collectors might have presented industrial, and C&D waste as MSW.

Table 5.7: Total Waste Accepted at the Maghtab Landfill and at the Sant Antnin Composting Plant, Malta (11, 36)

Year	*Municipal x1000 tonnes/year*	*% by weight*	*C&D x1000 tonnes/year*	*% by weight*	*Industrial & other waste x1000 tonnes/year*	*% by weight*	*Total*
1990	115	6.46	1540	86.47	126	7.07	1781
1991	115	6.49	1537	86.79	119	6.72	1771
1992	121	4.53	2424	90.79	125	4.68	2670
1993	125	9.5	1043	79.26	148	11.25	1316
1994	126	8.08	1260	80.82	173	11.1	1559

1995	127	8.49	1230	82.22	139	9.29	1496
1996	126	8.21	1244	81.1	164	10.69	1534
1997	96	10.3	744	79.83	91	9.76	932
MEAN (1990-1997)	**119**	**7.3**	**1378**	**84.4**	**136**	**8.3**	**1632**

During 1997, building contractors were also urged to deposit their waste at licensed private waste deposit sites. This might also have accounted for a decrease in the deposition of this waste at Maghtab. Moreover, as invariably happened in other countries, the introduction of landfill fees might also have increased the practice of illegal dumping.

5.1.13 Waste Accepted at the Public Waste Deposit Site in Gozo

During 1997, there was only one Public Waste Deposit Site in Gozo for the landfilling of MSW and industrial waste, *viz*. the Qortin landfill, limits of Xaghra. Most C&D waste was deposited at a number of designated sites.

Table 5.8 shows the estimated amounts of waste that were accepted at this site during 1997. The table also includes historic data for comparison.

Table 5.8: Waste Accepted at the Qortin Landfill, Gozo (32, 24,16)

Year	***Municipal x1000 tonnes/year***	***C&D x1000 tonnes/year***	***Industrial & other waste x1000 tonnes/year***	***Total***
1985	7.7		5.7*	13.4
1986	8.0		5.0*	13
1987	7.0		5.5*	12.5
1988	8.0		6.0*	14
1989	8.5		5.8*	14.3
1992	8.5		4.5	13
1997	8.0	1.8	15.8	25.6
MEAN (1985-1997)	7.96		6.9	

The Qortin landfill had been established in 1986. The landfill occupied an area of approx. 34,000 m^2 is sited on high ground and quite visible from the surroundings. In common with similar facilities in Malta, this landfill was not equipped with leachate collection or gas monitoring and collection facilities. Moreover, its management left much to be desired in that waste compaction and cover was inadequate. In proportion, much less C&D waste was accepted at this site than at Maghtab. Consequently, cover-up of landfilled waste was less complete and fires were common at the site.

Both Tebodin Consulting Engineers (32) and METAP (24) had recommended the transfer of solid waste generated in Gozo to Malta. For this purpose, both companies had agreed that a waste transfer station should be set up. Preliminary designs and an environmental impact statement in this respect were prepared in 1995. However during 1997, it became evident that the Gozo waste could not be accommodated at the Sant Antnin composting plant. On the other hand, a more likely scenario emerged, where the "organic" waste from Gozo would be separately composted in Gozo. Accordingly, implementation of the transfer station project was suspended.

5.1.14 Additional Information on Selected Categories of Waste

5.1.14.1 Municipal Waste

During 1997, 96,121 tonnes of municipal solid waste were reported to have been accepted at public waste deposit sites in Malta (Maghtab and Sant Antnin). This constituted approx. 10.3% by weight of the total waste that was accepted at such sites and on a population of 370,000, this was equivalent to a waste generation rate of approx. 0.7 kg/ca.day. It may be noted that in Europe, domestic waste production ranges from 0.5 to 1.5kg/ca.d, the higher figures generally occurring in more affluent areas (6). During the period March 1996 – May 1997, fraction analysis of municipal waste was carried out by sorting out approx. 1.4 tonne of solid waste arising from each of 20 localities in Malta. The waste was sorted into 17 different fractions. Table 5.9 shows the composition of municipal waste that resulted from this study:

Table 5.9: Fraction Composition of Municipal Solid Waste, % by weight (11)			
Specific Weight, Kg/m3	272	208	383
Fractions, % by weight:	***Mean***	***Min***	***Max***
Plastic film	11.1	6.6	18.8
Plastic Water Bottles	1.1	0.1	3.2
Other Plastics Containers	2.0	0.7	5.3
Wood	1.4	0.2	2.7
Food Remains & Green Waste	44.8	33.0	57.5
Clear Glass	1.7	0.0	3.1
Green Glass	0.6	0.0	2.8
Other Glass	0.2	0.0	1.8
Textiles	4.7	0.7	8.2
Paper & Cardboard	19.8	14.0	35.5
Steel	4.1	1.7	7.4
Aluminium Cans	0.2	0.0	0.5
Aluminium Foil	0.2	0.0	0.9
Ceramics	0.2	0.0	1.8
Building Rubble	0.9	0.0	4.6
Other materials (polystyrene & rubber)	0.5	0.0	2.8
Fines (<20mm)	5.8	1.7	12.7

Table 5.10 shows the composition of MSW in European Union Member States.

Table 5.10: The Composition by weight of MSW in Europe (6)	
Component	***%, by weight***
"Organic"	25 – 40
Paper and Cardboard	20 – 40
Glass	5 – 10
Metals	5 – 15
Plastics	5 – 10
Other	10 – 15
Moisture content	15 – 30

MSW collection and haulage to the disposal site has been the most organised aspect of local waste management. Traditionally, MSW has been collected free of charge to the householder on a daily basis (except Sundays) by means of a door-to-door collection system.

Since 1995, responsibility for the collection of municipal and commercial waste, and for public cleansing rested on Local Councils. Local Councils financed waste collection from the funds that Government allocated to every Local Council on a yearly basis to cover expenditure incurred in fulfilling their responsibilities. In some instances, Local Councils applied for and were allocated extra funds for special approved projects.

To fulfil their waste management obligations, Local Councils issued 2-3 year contracts, mostly to private contractors, for the collection and transportation of the waste to disposal sites.

Waste contractors used Refuse Compaction Vehicles (mostly of max. capacity of approx. 4 tonnes), open trucks and skips. Local Councils opted either exclusively on the door to door (kerbside) system, or on a hybrid system, *ie*. partly using the door-to-door system and partly using the "bring" (skip) system.

Local Councils gave high priority to cleanliness and absence of litter in their localities. They invested in providing the public with litter bins and skips to discourage the abandonment of waste. They did not invest, however, on systems that encouraged the separate collection of waste fractions.

There were some attempts by Local Councils to set up local waste deposit sites (civic amenity sites). The objective of these attempts was mainly to provide the public with a convenient disposal site in an attempt to discourage illegal waste tipping.

During 1997, discussions started with the Local Councils of Marsascala and Pembroke with the intention of carrying out in these localities a trial related to the separate collection of selected waste fractions, *viz*. "organics", plastics, metals, paper and glass. Another Local Council, in collaboration with a waste contractor installed special bins for the separate collection of waste fractions. Apart from these isolated instances, however, there were no other attempts by Local Councils to separately collect waste fractions.

The "organic" fraction of MSW is one of the fractions of concern with respect to landfilling. The proposed EU landfill directive prohibits the landfilling of this fraction.

According to Table 5.9, the "organic" fraction constitutes approx. 71% by weight of MSW and is made up of food residues (45% by weight), paper / cardboard (20% by weight) and fines (6% by weight).

Local soil is poor in organic matter. Addition of compost to local soil would result in an appreciable contribution of plant nutrients, including trace elements. However, the major benefit would be in an improvement of soil texture and of its water retention capacity. ATIGA (1) and VBB (33) concluded that utilisation of waste-derived compost would result in a significant benefit to local agriculture. Composting was therefore rightly considered to be a natural solution for the management of this waste fraction. In fact, the composting option has the potential of deviating this problematic fraction of waste from the landfill, as well as produce a resource. The validity of the composting option was also confirmed by Grontmij Consulting Engineers (18, 19) and Grontmij Consulting Engineers and Ramboll (20).

The contract for the operation of the Sant Antnin Composting Plant by Messrs. Environmental Technology Ltd. expired during 1997. Operations continued by direct labour. The problem of finding suitable personnel to work at the composting plant continued to be felt.

During the period 1995 – 1997, the amount of waste accepted at the Sant Antnin plant has been progressively decreased in an attempt to keep odour emissions within control. Table 5.11 shows the quantity of municipal waste accepted at the Sant Antnin plant during this period.

Table 5.11: Quantity of Municipal Waste Accepted at Sant Antnin Composting Plant (11, 36)

Year	***Tonnes***
1995	22,835
1996	13,834
1997	9,687

Of the 9,687 tonnes that were accepted at the Sant Antnin Composting Plant during 1997, approx. 60% were uncompostable residues, mostly plastics, glass and metals. The metals were transferred to private scrapyards while the rest were landfilled. The “organic” fraction was composted using the open windrow system, the product raw compost was refined and left in the open to mature. The compost produced was sold at LM 5 per tonne in bulk, mostly to farmers, and at LM 0.30 per 4 kg bag for garden and potting use.

5.1.14.2 Post Consumer Packaging Waste

Table 5.12 includes data with respect to selected beverage packaging.

Table 5.12: Beverage Packaging during 1996 (37)		
Beverage	***Non-returnable millions***	***Returnable millions***
Water	17.85	1.62
Fruit juices	11.78	0
Sports Drinks	3.6	0
Ice Teas	4	0
Soft Drinks	0	80.413
Beers	12.896	45.29
Squashes	0.2	1.6
TOTAL	**50.326**	**128.923**

During 1997, there were on the local market soft-drinks that were packaged in non-returnable plastic bottles. Legal action had been taken by the police in terms of LN 183/94.

5.1.14.3 C&D Waste

Building contractors were responsible for disposing of their waste. In so doing, they either utilised their own transport facilities or contracted out the service.

During 1997, a total of 744,000 tonnes of C&D waste were accepted at the Maghtab landfill. This constituted approx. 80% of all solid waste that was accepted at this site, and is equivalent to 5.5 kg/ca.d. This is a much higher generation rate than usually encountered in most other countries. In the UK and the Netherlands, for example, C&D waste constitutes 20% and 25% by weight, respectively, of total solid waste generation.

The drive to deviate C&D waste from the Maghtab landfill resulted in some problems associated with insufficient material to cover putrescible and other waste at this landfill. This was considered to be an artificial problem since sufficient cover material already exists at the Maghtab landfill. Use of this material, however requires additional equipment to crush, load and transport the material. Such equipment was not available.

For the period January 1995 to March 1997, the Freeport authorities accepted and even paid for C&D waste for use as bulk fill in connection with the Freeport Phase II Project. However, although the project created a demand of approx. 460,000 m^3 (700,000 tonnes) of such material, the actual amount of construction and demolition waste that was deviated to this site was less than half this amount. The main reasons for this were as follows:

- ?? building contractors found it more convenient to dump at Maghtab than at the Freeport (most of the C&D waste was generated to the North of Malta)
- ?? not all construction and demolition waste was of the right specifications for use on this project.

The Planning Authority identified 22 softstone disused quarries which could be dedicated to the deposit of C&D waste. This would have the secondary benefit of rehabilitating these sites. However, there was considerable opposition for the use of these quarries by the Water Services Corporation. Another study by the Planning Authority (26) identified an additional three hardstone disused quarries with a total capacity to receive approx. 4.6 million tonnes of C&D waste.

Negotiations were started between Government and quarry owners for the use of disused quarries for the deposit of C&D waste, and a tentative agreement was reached. Following the publication of LN 128/97, six quarry sites were licensed during 1997 for the deposit of C&D waste. License conditions specified that quarry owners had to be insured against damage to groundwater resources and had to provide Government with data re. amounts of C&D waste accepted at their site. Up to the end of 1997, none of the quarry owners had conformed to these conditions. In effect, this rendered the deposition of material in these quarries in breach of Law.

Additional C&D waste was disposed of as follows:

- ?? filling of cavities and landscaping at building sites
- ?? use of hardstone residues as spalls for use in concrete
- ?? dumped at sea.

No data exist regarding the composition of C&D waste. However, visual observation suggests that its major component (probably more than 90%) was limestone.

An estimated 250,000 tonnes of C&D waste per year was generated in Gozo. This waste was for the most part fly-tipped (26). Deposition of this material in 12 disused quarries (capacity approx. 2 million tonnes of C&D waste) in Gozo was proposed by the Planning Authority as a short-term option. One quarry, *viz.* that at Tal-Qsajjem was identified for immediate use. In the meantime, proactive measures that include minimisation of C&D waste generation was recommended.

5.1.14.4 Industrial waste

During 1997, 91,000 tonnes of industrial and other waste were recorded at the Maghtab gate. This constituted approx. 9.8% by weight of total waste production.

Studies to quantify and characterise industrial waste production have been carried out in 1992 and in 1996. Both studies were carried out by visits to industrial sites, speaking to industrial operators, filling up of questionnaires, and weighing and sorting waste at the production site. The 1992 study quantified industrial waste production at 79,040 tonnes per year, of which 16,640 were recovered and 62,400 tonnes landfilled. The 1996 study determined industrial waste production at 104,000 tonnes per year. This represented an increase of 32% over the production statistics for 1992, and contrasts sharply with the amounts of industrial waste recorded at the Maghtab landfill.

Table 5.13 shows the results of the 1996 study.

Table 5.13: Fraction Composition of Industrial Waste (3)

Waste Fraction	***% by weight***
Food residues	13.27
Slaughterhouse residues	5.05
Paper	11.82
Plastics	2.58
Wood	1.64
Textiles	2.25
Glass	1.97
Metals	5.18
Salt	1.06
Hydrocarbons	6.73
Ash	0.44
Sludges	1.49

Inert residues	42.10
Other	4.44

It is estimated that approximate 10-15% by weight of this waste was hazardous.

Industrial operators were responsible for disposing of their waste. Considerable quantities of industrial waste were recovered in-house. In the case of plastics industries, for example, runners, offcuts and off-specification products were crushed, mixed with virgin resin and extruded. A fraction was also transferred to other industries for recovery, while another fraction was exported.

Industries utilised their own transport facilities or contracted out the transportation of waste to the recovery or disposal site.

It is to be noted that an estimated 8000 L of PCB oils and PCB-filled electrical transformers, as well as asbestos and asbestos-containing materials were in store at a number of industrial sites. This waste has been awaiting an acceptable management solution for the last few years. Asbestos-containing waste results from maintenance work on visiting ships.

5.1.14.5 Scrap Metal

Considerable, but otherwise unquantified quantities of metal scrap, especially ferrous materials, were accepted by private scrap dealers. Most of this material was stored on site and periodically shipped overseas. Operations at scrap sites left much to be desired in terms of environmental considerations, in particular with respect to emissions and visual impact.

The police were responsible for the collection of abandoned derelict vehicles. These were stockpiled to be later on passed on to scrap dealers.

It is to be noted that a restricted number of persons carried out “controlled scavenging” of scrap metal at the Maghtab landfill. The amount of scrap scavenged from the landfill during 1997 was estimated at 1,200 tonnes. The activities of these scavengers can be considerably improved so as to avoid unnecessary health risks.

There were no scrap dealers in Gozo, with the result that most metal scrap was landfilled at the Qortin landfill.

5.1.14.6 Health-care Waste

In Malta, health-care waste was mainly generated from the public hospitals, *viz*. St. Luke’s Hospital (1000 beds), St. Vincent de Paul Hospital (1000 beds) and Boffa Hospital (90 beds). In addition, there were a number of smaller public and private hospitals and clinics. In Gozo, health-care waste was generated from the Gozo General Hospital (260 beds).

Waste generated in hospitals and other health-care centres was broadly categorised as specific or contaminated (including sharps), non-specific or similar to municipal waste, and food left-overs from food preparation. These three categories of waste were segregated at source into yellow bags, black bags and green bags, respectively.

Table 5.14 shows data relevant to waste production from health-care centres.

Table 5.14: Waste Production from Health-care Centres

Quantity	***Waste Category***	***Unit***	***Source***
0.7-5.8	Total waste from Public Hospitals	Kg / bed / day	31
7359	Uncontaminated waste from Public Hospitals	Kg / day	31

1700	Contaminated waste from Public Hospitals	Kg / day	31
750	Contaminated waste from Public Hospitals	Kg / day	11
100	Private Hospitals, Clinics, Diagnostic Laboratories	Kg / day	11
34	Contaminated waste (Malta)	M^3/week	11
17	Contaminated waste (Gozo)	M^3/week	11
376	Uncontaminated waste (Malta)	M^3/week	11

From a survey carried out at Karen Grech Hospital (320 beds), Cassar (5) concluded that waste production at this hospital averaged 3.73 kg/bed.day. Of this 2.35kg was contaminated (yellow bags), 1.34kg was similar to MSW (black bags) while 0.4kg was food left-overs from food preparation (green bags). However, Cassar remarked that staff were insufficiently aware of waste management problems and that waste separation was incomplete. The Secretariat for the Environment (31) had also noted a lack of control over the at-source separation of waste at the hospitals. Cassar (5) noted that significant quantities of non-contaminated waste were being incinerated, while the possibility that some contaminated waste was being picked up with MSW could not be ruled out. A number of occupational accidents were also attributed to this lack of awareness.

There exist a wide range of figures in the literature regarding waste generated from health-care centres. Thus, contaminated waste arisings in Denmark, France and Italy is 0.2, 2.3 and 3.5kg/bed.day respectively. This is partly due to different definitions being given to this fraction in different countries.

Table 5.15 shows the average rate of generation of health-care waste in Europe and the predicted health-care waste generation rate in Malta based on these figures.

Table 5.15: Predicted Total Health-care Waste Generation in Malta based on Average European Statistics

Waste Category	*Generation rate, in Europe, kg/ca.y*	*Estimated quantity of Health-care waste generated in Malta tonnes per year*
Non-Specific or uncontaminated	6.3	2,331
Specific or contaminated	1.33	492
Total	**7.63**	**2,823**

80% by weight of contaminated waste was produced at St. Luke's Hospital. Waste in yellow bags from public and private hospitals, except from the Gozo hospital, was incinerated at the St. Luke's Hospital incinerator at the rate of approx. 700kg/day. Waste in black and green bags was picked up with MSW and landfilled (31). The possibility that some green bag waste was utilised as animal feed could not be ruled out.

Approx.180kg of contaminated waste per day was incinerated at the Gozo hospital (31).

There were instances, lasting several days, when due to breakdowns of the St. Luke's Hospital incinerator, contaminated waste was not incinerated. During such episodes most of the contaminated fraction was landfilled at Maghtab. Burning and other unacceptable practices were also resorted to in such situations.

Radioactive waste was generated in diagnostic laboratory tests and in radiotherapy at hospitals. Additional radioactive waste was generated in private clinics, as a result of the use of X-ray machines.

5.1.14.7 Slaughterhouse Waste

Slaughterhouse waste was generated at the public abattoirs in Malta and Gozo, as well as at private slaughtering plants.

The waste generated from public abattoirs consisted of hooves, gristle, hide, offal, blood and fat. In addition, butchers bring in to the Malta abattoir meat offcuts and carcasses of infected animals. Approx.

2,600 tonnes of such waste were generated during 1997 at this abattoir, while the corresponding figure for the Gozo abattoir was 200 tonnes.

Some animal hides are treated and exported. The public abattoirs were equipped with waste incinerators and infected waste were incinerated. All other waste was landfilled. During periods of breakdowns of the incineration facilities, all waste was landfilled.

Considerable slaughterhouse waste was discharged to the sewer while 911 tonnes of such waste were estimated to have been accepted at the Maghtab landfill during 1997.

5.1.14.8 Agricultural Waste

Considerable quantities of waste were generated as a result of crop cultivation (vegetable residues, tree prunings, etc.) and animal husbandry (animal dung, food residues, bedding material, etc.). Degaetano (8) estimated production of animal manure at 116,000 tonnes per year. Vegetable residues were generated at the Ta' Qali Pitkali. Additional waste consisted of agrochemical residues, empty containers, used plastic covers, used micro-irrigation plastic pipes, etc.

Vegetable residues were either used as animal feed or landfilled. Considerable quantities of agricultural wastes were abandoned on rubble walls and in the countryside.

5.1.14.9 Seaweed

During 1997, approx. 2,000 tonnes of seaweed were removed from bathing beaches around Malta and Gozo especially during the four months immediately preceding the bathing season. This material was used in agriculture or landfilled.

5.1.14.10 Waste From Shipping Activities and the Malta Drydocks

According to the Malta Maritime Authority, a total of 2,700 tonnes of solid waste similar to municipal waste were downloaded from ships visiting Malta during 1997. Most of this waste was landfilled. In addition, the annual production of swill from visiting ships was approx. 6,000 tonnes. However, permission for landing this swill in Malta was only exceptionally granted. Swill and other waste from ships visiting the Malta Drydocks was incinerated at the Drydocks incineration facility. According to the Malta Maritime Authority, approx. 2,500 tonnes of oily waste per year were generated from the harbour area. Additional oily wastes were generated at the Malta Freeport.

Asbestos and other hazardous waste resulted from maintenance work carried out on ships visiting the Malta Drydocks.

There were unconfirmed reports that visiting ship dumped their waste in the sea just out of the breakwater.

Marinas and the Gozo ferries also generated used lubricating oil. Visiting ships made use of the facilities offered by the Malta Drydocks to discharge ballast oil and slop oil (strictly speaking liquid waste). The facilities received additional oily waste via land. At the station, ballast oil was separated and the water discharged to the sea. Most of this oil was recovered.

An estimated 1,500 tonnes of oily sludges were generated form the Malta Drydocks (31). These were landfilled.

There were instances when Malta was faced with the arrival of ships which had to dispose of their cargo locally. This happened either due to accidental damage to the ship, due to urgent repairs, because the cargo was impounded by customs or because the cargo would have perished by the time it had arrived in Malta. There were attempts at composting such waste but by an large this material was landfilled.

5.1.14.11 Swill

The estimated generation rate of swill from catering establishments, institutions, etc. at over 7,300 tonnes per year (22). For some time, a swill plant which was supposed to thermally treat swill had been in operation. Treatment of swill, however, had not been satisfactory. The plant had subsequently been closed down.

During 1997, swill was disposed of by landfilling. The possibility that part of this waste was fed to pigs without further treatment cannot be excluded.

5.1.14.12 Sewage Treatment Plant Sludge

During 1997, the Sant Antnin Sewage Treatment plant treated approx. 1,500,000 m^3 of sewage. This resulted in the production of approx. 2,000 tonnes of sludge dry solids. These were discharged as a 3-5% slurry to a sewer downstream of the plant. Here, it mixed with the rest of the untreated sewage and was discharged to the marine environment from the Wied Ghammieq outfall.

Works were at hand to upgrade this plant to treat approx. 6 million m^3 of sewage per year.

5.1.14.13 Oily Waste from Enemalta

An estimated 250 tonnes of oily sludges per year were generated from Enemalta fuel storage tanks (31). This was landfilled.

5.1.14.14 Waste from Grit blasting Activities

It was estimated that the Malta Drydocks generated approx. 17,000 tonnes of copper and nickel grit (31). This material was partly dumped in the sea and partly landfilled.

5.1.14.15 Waste From Airport

The Malta International Airport estimates that during 1997, 220 tonnes per year of dry waste resulted from approx. 29,000 aircraft movements (airside wastes generated from aircraft cleaning operations), equivalent to over 2.5 million passenger movements. This maximum generation of this category of waste was 24 tonnes per month during peak months, e.g. July – August. In addition, 620 tonnes of aircraft food waste were also generated.

On the land side, MIA estimated that approx. 500 tonnes of terminal and industrial waste was generated during 1997. Catering waste accounted for 160 tonnes of food preparation waste.

This material was openly burned within the grounds of the Malta International Airport.

5.1.14.16 Used Lubricating Oil

In addition to oily wastes generated in the ports, it is estimated that approx. 500 tonnes of used lubricating oil were generated in Malta during 1997. This amount was generated from industrial sources, car service stations, and by private car owners who changed the engine oil (31).

Most of this oil was either discharged into the sewer or collected and stored by a private company that was set up some years ago and which intends to convert used lubricating and edible oil into fuel oil. The company, however, encountered problems and the date for the start of operations could not be established.

5.1.14.17 Used Edible Oil

Catering establishments, including restaurants and fast food centres were a source of used edible oil.

This oil was either discharged into the sewerage system or collected by a private company for eventual recovery (conversion into fuel oil).

5.1.14.18 Waste from SPCA

The SPCA estimates that approx. 300-350 kg per day of animal carcasses resulted from their activities during 1997. These peaked to 1000 kg per day in exceptional circumstances.

This waste was landfilled.

5.1.14.19 Dredging Waste

Considerable quantities of dredging spoils were generated as a result of the dredging of ports and marinas. This could not be quantified.

Dredged material was dumped at sea at sites established by the Malta Maritime Authority. The navigational aspect was the main criterion considered for establishing these dumping areas.

5.1.15 Waste Management Options

The main waste management options practised in Malta during 1997 were as follows:

5.1.15.1 Minimised

It is reasonable to assume that some waste, in particular industrial waste, that would have otherwise been produced, was actually not produced due to the adoption of clean technologies, etc. The amount of waste thus minimised was difficult if not impossible to quantify.

5.1.15.2 Reused

In 1996, more than 129 million beverage containers were reused by returning for refilling (37). This was perhaps the best example of the reuse option.

5.1.15.3 Recovered in-house

Many plastics industries crushed extrusion runners, offcuts and off-specification products, mixed them with virgin resin and presented them again for extrusion. The practice of utilising animal waste as manure is also an example of in-house recovery.

5.1.15.4 Other recovery

Examples of other recovery processes include the following:

?? the composting of the “organic” fraction of municipal waste at the Sant Antnin plant
?? the composting of animal waste by farmers
?? the use of oil waste at the power plants
?? the use of C&D waste at the Malta Freeport.

During the period 1996 to 1997, an estimated 350,000 tonnes of C&D waste were used as bulk fill at the Freeport site. C&D waste was also used for landscaping and as spalls for concrete production.

5.1.15.5 Exported

Industries, in particular those that operate under license from an overseas-owned parent company were encouraged to export their waste to the parent company.

During 1996, ECO Paper Management Ltd. collected, stored, baled and exported approx. 700 tonnes of waste paper. This company operated on a temporary basis from Government-owned land. This company did not manage to find an alternative premises from which to operate and regrettably its activities had to be terminated.

During 1997, a number of companies invested in equipment for the collection, storage, sorting, pre-processing and export of selected waste fractions. Most of these utilised industrial waste fractions, such as plastics. Perhaps the best example of such companies was set up at Maghtab, adjacent to the landfill site. Here a local company accepted a wide variety of industrial waste fractions for export.

Considerable quantities of ferrous and non-ferrous metal scrap were also collected by scrap dealers and exported.

Oil waste disposed of at the Tank Cleaning Farm was also exported.

Export of hazardous waste was hindered by the fact that Malta was not yet a party to the Basel Convention for the transboundary movement of hazardous waste.

5.1.15.6 Used as Animal Feed

According to unconfirmed reports, some swill resulting from catering establishments, institutions and visiting ships was used as animal feed without further treatment. This constituted an unacceptable health risk.

5.1.15.7 Discharged into the Marine Environment

14,000 tonnes of copper and nickel grit were dumped at sea (SFE, 1992).

C&D waste, in particular from developments taking place at the coastline, and dredging waste was also dumped at sea.

5.1.15.8 Incinerated

Incineration was the management option for the following categories of waste:

?? Contaminated waste from public and private hospitals (St. Luke’s Hospital incinerator)

?? Contaminated waste from the Gozo General hospital (Gozo Hospital incinerator)
?? Slaughterhouse waste (Malta and Gozo Civil Abattoir incinerator)
?? Waste fractions originating from cruise liners and ships visiting Malta Drydocks (Malta Drydocks incinerator)
?? Waste arising at the Malta International Airport (open incineration)
?? Other selected waste, e.g. that arising at the De La Rue and Central Bank.

Of the above, the Gozo Civil Abattoir incinerator was a rotary kiln incinerator which although did not incorporate any flue-gas cleaning, was an example of a modern incinerator. None of the others could be so described and were not operated according to any known standards.

5.1.15.9 Discharge into the Sewerage System

Considerable quantities of industrial waste, including used lubricating and edible oil were discharged into the sewerage system.

Relatively large quantities of agricultural wastes, in particular those originating from pigfarms, were discharged into the sewerage system.

Radioactive waste from health care centres was partly discharged to the sewer after a residence period. It is not clear if the material was tested for residual activity prior to disposal.

5.1.15.10 Landfilled

Landfilling has been the traditional way of disposing of waste in the Maltese Islands. Table 5.16 shows sites which have served as landfills and for which there exist records.

Table 5.16: Details of sites which have served as landfills (11)

Site	*Opened*	*Closed*
Luqa	pre-1938	1974
Cumnija	pre-1938	1990
Gzira (Kappara)	pre-1938	1958
San Gwann (Misrah Lewza)	pre-1938	1960
Qortin (Xaghra)	1968	STILL IN OPERATION
Xwieki (Tal-Balal)	1974	1976
Sant Antnin	1974	1979
Gnien San Pawl (Madliena)	1976	1977
Maghtab	1977	STILL IN OPERATION
Hagar Qim	1977	1978
Wied Fulija	1979	1996
Buskett	1979	1979
Mtahleb	1982	1985
Ghar Lapsi (Wied Hoxt)	1982	1985
Benghisa		1995

Most of these sites have been closed down. Such sites, have either been converted into agricultural land, built upon or just abandoned. This latter case is exemplified by the Benghisa site which served to dump power station fly ash up to 1995. The Luqa site and the Wied Fulija sites have also been abandoned. A rehabilitation plan is required for these sites.

During 1997, landfilling was the main waste management option. Two official landfill sites were available for the landfilling of mixed waste during 1997:

- ?? The Maghtab landfill in Malta (dumping started in 1977)
- ?? The Qortin in Gozo (dumping started in 1968).

The Maghtab landfill had been considerably improved during the last 5 years with fencing off of the site, resurfacing of internal and access roads, installation of a weighbridge and associated recording of waste intake. There had also been an attempt at deviating C&D waste away from this site, prior notification for the landfilling of hazardous waste and the introduction of a nominal landfill fee.

In spite of these improvements, however, both the Maghtab and the Qortin landfill remained largely "uncontrolled" landfill, due amongst other things to co-disposal of hazardous and non-hazardous wastes, lack of proper equipment, insufficient control of materials accepted at the site, scavenging, lack of proper cover material, lack of proper compaction, burning of waste, the absence of surface runoff and leachate, and landfill gas management, lack of work plans and lack of site rehabilitation plans.

Fencing of landfilling facilities was only partly complete. At Maghtab, this was due to the fact that, in spite of the fact that all the land designated for landfilling belonged to Government, considerable parcels of this land was under cultivation by private individuals. There was, therefore, incomplete control of the site by Government.

During 1997, the Maghtab landfill accepted all sorts of wastes, including municipal, industrial, oily sludges, health-care and abattoir waste (when the respective incinerator was non-operational), residues resulting from sewer cleaning operations, batteries, used lubricating and edible oil, etc.

Radioactive waste from health care centres was partly landfilled with the uncontaminated waste after a residence period. It is not clear if the material was tested for residual activity prior to disposal.

Considerable C&D waste was also deposited at disused quarries.

Both the Maghtab and Qortin landfills have been for some time operating close to their useful life span. Considering that landfilling must remain as a necessary evil in any waste management strategy, during the period 1996-1997 the EPD, in collaboration with the Environment Management Unit of the Planning Authority, carried out a preliminary siting exercise with the aim of exploring the possibility of establishing a new landfill. This study recommended a number of sites for further consideration. However, the study established that all proposed sites would suffer from significant environmental and other impacts.

5.1.16 Stockpiled

Considerable quantities of wastes were stockpiled, due to the in existence of a proper management option in the short-term. This waste included used oil, asbestos containing material and PCB-containing material.

5.1.17 Separate Collection of Waste Fractions

Separate collection of waste fractions has been recognised as a pre-requisite for better management of waste, in particular for the recovery of selected fractions. Separate collection of the "organic" fraction is the only way of producing a quality product from the Sant Antnin Composting Plant.

A scheme to separate household waste had been launched on a national level in 1995. This scheme involved the separation of household waste into two fractions: an "organic" fraction for composting, and other waste. It was the intention to collect the former fraction for composting on Mondays, Wednesdays, Thursdays and Saturdays, while the latter would be collected on Tuesday's and Friday's, and landfilled.

ECO (9) revealed that approx. 23.1% of the population stated that they were participating in the scheme. They showed that there was insufficient awareness among the public with respect to the benefits of the scheme. Since the scheme was intimately related to the success of the composting plant at Sant Antnin and that at that time this facility had been plagued by odour emission complaints, it was decided that until a solution had been found for this problem, the waste separation scheme would be kept low key.

Following achievement of some progress with respect to the odour problem at the Sant Antnin plant, another attempt to introduce the at-source waste separation scheme was initiated in 1997. In consultation with Local Councils, it was decided that initially the scheme would be introduced on a trial basis in two localities, *viz*. Marsascala and Pembroke.

Increased but cautious interest was shown by the private sector during 1997 with respect to the processing of particular waste fractions. One private company previously involved in waste collection and transportation in particular, diversified its activities in 1997 and set up a waste sorting yard at Maghtab. This company collected pre-sorted industrial waste, such as paper, plastic, glass and metals, further sorted the material, shredded and packaged the material for export.

Following this increased interest, it was decided that, in addition to the separate collection of the "organic" fraction, the new separate collection scheme would include the separate collection of paper, plastics, metals and glass. The scheme would be implemented using a hybrid of the kerb-side and the bring-systems. By the end of 1997, this trial was still in the planning stage.

Considering that material recovery from waste was the main reason for introducing separate collection of waste, and that material recovery was still in its infancy, it is not surprising that separate collection of waste had still not taken off to any significant extent.

Used dry batteries are a significant source of heavy metals, in particular with respect to the composting of municipal waste. The separate collection of batteries had been initiated in 1994. During 1997, 503 retail outlets, 160 schools, and offices and other institutions had been provided with plastic battery bins (36). The bins were emptied as a free service by the EPD up to 1996 and later by the WMSID.

Table 5.17 shows the quantities of batteries collected as a result of this service.

Table 5.17: Quantities of Separately Collected Used Dry Batteries (11, 36)

Year	***Button Type Kg***	***Other Batteries kg***	***Total kg***
1995	38	6,816	8,849
1996	71	8,172	10,239
1997	68	7,849	7,917

The amount of used batteries that was collected by this scheme is estimated to be less than 10% of dry battery imports.

During 1997, separately collected used batteries were packaged in plastic drums and, partly stored and partly landfilled at Maghtab. To date, no better management options have been available.

5.1.18 Pressures on human health and the environment

Significant pressures on human health and the environment result both from the generation of the waste, as well as from its management or mismanagement. This has been recognised in all developed countries. In these countries the need has been felt to establish regulations that control the generation and management of waste.

The Maltese Islands exhibit characteristics that render some of these pressures more pronounced than in other countries. Following are some of these characteristics:

- ?? the high population density
- ?? the limited land area
- ?? the vulnerability of groundwater resources
- ?? the limited availability of natural resources
- ?? the peculiar climatic conditions, e.g. relatively high temperatures, wind
- ?? the dependence on tourism as a major source of foreign currency.

All these suggest that Malta should have a sound regulatory framework, which in certain aspects need to be stricter than in other countries, e.g. EU Member States.

However, in the local scenario it was only relatively recently that the need has been felt to improve the management of waste beyond public health and aesthetic aspects. This has come about as a result of increased waste production and higher environmental awareness by the local population.

Lack of accurate quantitative waste management data, as well absence of quantitative studies regarding the impact of waste on human health and the environment, render the assessment of these impacts arduous.

5.1.18.1 Impact on Human Health

Human health is negatively affected by improper management of waste. Lack of cleanliness and presence of waste abandoned by the wayside and in the countryside imparts a sense of shabbiness and neglect to the environment. This scares off visitors from the area and is stressful to the residents of the locality. Moreover, fly-tipped waste provides a breeding ground for a number of vectors of disease such as insects, rats and other vermin.

The practice of feeding animals with untreated swill constituted a way of spreading a number of human and animal diseases, among which Foot and Mouth Disease, African Swine Fever, Salmonellosis and Newcastle disease.

Landfill gas contains potentially asphyxiant gases, such as CO_2 and CH_4. These might be of concern from an occupational health point of view, especially in confined places.

Past are the days when waste was routinely burned in landfills. However fires still occurred. It is not clear whether these fires were intentional or spontaneous. The burning of landfilled material, in particular PVC, is a most unacceptable practice and should not be allowed to happen. During such burning, emission of chlorinated organic gases, including dioxins and furans, both of which are recognised carcinogens, is inevitable. This is of particular concern in view of the proximity of the Maghtab landfill to the popular recreational area of Bahar ic-Caghaq, and to the Qortin landfill being close to the equally popular area of Marsalforn.

Improperly designed and operated waste incinerators might also have been sources of toxic gas emissions.

In addition, some of the negative impacts on the environment that result from improperly managed waste, also indirectly affect human health.

5.1.18.2 Impact on the Environment

Aesthetic Impact

Impacts on the landscape

Both the Maghtab and Qortin landfills are very visible. The former is on sloping ground next to the coast road while the latter is on high ground between the bay of Marsalforn and that of Ramla l-Hamra. Both have a marked impact on the surrounding landscape. ERCU (10) found that the effectiveness of environmental servicing in many of the surveyed locations left much to be desired. They concluded that the intrinsic environmental qualities which make Malta distinctive and attractive, such as its rural and coastal landscapes and its architecture, are being eroded.

Illegal tipping

In spite of the fact that considerable emphasis, was made by central Government and Local Councils against littering and illegal dumping of waste, abandoned waste continued to be observed along public roads and in the countryside.

ERCU (10) found the overall standard of cleansing in the surveyed localities poor to unsatisfactory. Domestic and commercial wastes were found to be the major components of road litter. In their report, they registered the assortment of receptacles that were used for waste containment by industry and households.

Rubbish floating in recreational coastal areas and on beaches is unpleasant and gives a bad impression to the locals and overseas visitors alike. In this regard, the very popular practice of barbecuing on beaches need to be controlled.

The introduction of landfill fees during 1997 brought about an increase in illegal tipping of waste. An increase in illegal tipping of waste has been observed to occur following increase in landfilling fees in such environment-conscious countries as Holland and Germany. However, this has not discouraged the authorities in these countries from applying realistic landfilling fees. Rather it has urged these authorities to embark on sustained education campaigns, as well as introduce sufficiently deterrent penalties against waste tipping.

Pollution Risks

The chemical composition of waste is similar to that of virgin raw materials that are used to manufacture products. It is recognised that precautions must be taken in handling some of these virgin raw materials, and this chiefly because of their hazardousness.

However, waste has an even higher pollution potential than virgin raw materials. This ensues from the fact that the holder of waste might not have a direct interest in its safe keeping. There is therefore a special risk of waste being haphazardly introduced into the environment.

Although MSW is normally considered as non-hazardous, it is a fact that such waste contains hazardous materials, such as batteries, paint residues, neon tubes, medicines, pesticides, cleaning chemicals and used oil.

Pollution of Air

Waste and waste management facilities were a potential source of emissions to air. The chief air pollutants were as follows:

Dust

Some of the most significant potential sources of dust emissions related to waste management were as follows:

- ?? uncovered accumulations of C&D wastes awaiting collection
- ?? waste collection vehicles
- ?? the Sant Antnin Composting facility
- ?? landfills.

Odour

Accumulations of MSW and industrial waste awaiting collection were potential sources of offensive odours. Offensive odours also resulted from the uncontrolled composting of farm wastes by farmers and application of the resulting insufficiently stabilised product to land.

None of the existing landfill sites was equipped with gas emission control measures. Moreover, the recognised remedy towards controlling emissions, *viz*. daily cover and compaction of waste, was not always effective. This was particularly the case at the Qortin landfill where the proportion of cover material accepted at this site was much less than at Maghtab.

Both landfills were characterised by the emission of unpleasant odours of waste putrefaction which could easily be detected from the surrounding area.

Since plant start-up in 1993, the Sant Antnin composting plant had been a source of odour complaints from the surrounding area comprising Marsascala, Zejtun and Zabbar. Odour monitoring is a particularly laborious and subjective task.

A system for odour monitoring was adopted using a questionnaire system, whereby a number of residents in the affected area reported odour detection on an hourly basis. Table 5.18 shows the result of this monitoring exercise.

Table 5.18: Percent of the Time when Odour was Detected (11)

Year	***%***
1994 (Sep-Dec)	6
1995	11
1996	9
1997	8

Although there are no records in the literature that conclusively demonstrate direct damage to the human health of normal individuals by odours that emanate from composting operations, such odours can undoubtedly constitute a serious nuisance and psychological stress to neighbouring communities. Moreover, it is not excluded that such emissions might be allergenic to susceptible individuals. The inhalation of particulates emitted from composting activities is also of concern due to these particulates being charged with allergens, including dead and living micro-organisms. The genus *Aspergillus*, in particular, has been reported in the literature to be involved in the aetiology of particularly severe respiratory diseases, in particular among operatives of composting facilities.

Odour detection from the plant was positively correlated with wind direction and with the quantity of waste processed at the plant (11).

With respect to odour emissions from the Sant Antnin Composting Plant, Grontmij (18) concluded that:

?? The open windrow system adopted at this Plant was the major contributor to the odour emission problem; secondary sources were the maturation area, the waste reception area and the waste conveying system
?? Such odour emissions could not be completely eliminated
?? It is possible to minimise odour emissions to levels that do not constitute significant nuisance to neighbouring communities chiefly by adopting a closed composting system, with ventilation and biological filtration of the exhaust gases prior to atmospheric discharge.
?? The “tunnel” system provided such a satisfactory closed system.

One disadvantage of this system was the very high capital and running costs.

A novel technology, by the name of Eco-Pod System was identified during 1997. This system had a number of attractive attributes, amongst which were the following:

?? its potential effectiveness in achieving minimal odour emissions
?? its low investment and running costs
?? its flexibility and mobility.

Some of the disadvantages of this system were the following:

- ?? the system was more land intensive than the "tunnel" system
- ?? the system relied on disposable plastic "pods"

Adoption of the system as an alternative to the open windrow system started to be explored towards the end of 1997.

Greenhouse Gases

CO_2, a typical greenhouse gas, resulted from vehicle emissions during waste transportation.

Combustion of MSW results in the production of approx. 0.7 tonnes of CO_2 per tonne of waste. Assuming that aerobic biological decomposition of MSW and industrial waste produced approx. half this amount and that the total quantity of municipal and industrial waste landfilled in Malta and Gozo in 1997 was 200,000 tonnes, the CO_2 generating potential is estimated at 70,000 tonnes.

If, on the other hand, it is assumed that biological decomposition proceeded exclusively *via* the anaerobic pathway, the same amount of waste had a landfill gas generating capacity of 74 million m^3 of landfill gas ($370m^3/t$). Landfill gas can be assumed to consist of an approx. 50-50 mixture of CO_2 and CH_4, with other gases in trace amounts. Since the actual conditions that prevailed at the landfills are unknown, it is impossible to speculate on the extent of biological activity and pathway by which decomposition of the waste occurred at these sites. However, the significant quantities of biologically inert materials that are accepted at these sites, e.g. C&D waste, the low compaction of the waste and the dry climatic conditions, suggest that biological decomposition may be expected to have been slow and mainly aerobic.

Monitoring for methane, carbon dioxide and oxygen was carried out at the Fulija landfill during June 1995. The readings were taken at depths that ranged from 0-50m. Table 5.19 shows the mean results obtained.

Table 5.19: Results of Landfill Gas Components at Fulija (11)

Component	***% by volume***
CH_4	0-0.1
CO_2	0-20.7
O_2	4-21-1

These results indicate the presence of landfill gas; however, the amounts of methane that were detected at this site do not give rise to concern.

A similar monitoring exercise was carried out in 1996 at the Qortin landfill by Secor Ltd. and AIS Ltd. Table 5.20 shows the results of this exercise.

Table 5.20: Results of Landfill Gas Components at Qortin landfill (30)

Component	***% by volume***	
	Mean	Range
CH_4	2.2	0 – 12.4
CO_2	5.4	0 – 20.0
O_2	14.6	0.4 – 21.7

At this landfill the proportion of "organic" wastes was higher than in Fulija and consequently, conditions were more conducive to landfill gas evolution. The results in Table 5.20 confirm the presence of methane. However, Secor and AIS (30) concluded that the levels detected did not give rise to concern, as long as the evolved gas were allowed to ventilate freely to the atmosphere.

The above results were obtained from just one monitoring operation at each landfill site, and as such cannot be considered as conclusive.

Flammable and Explosive Gases

Besides being a powerful greenhouse gas, CH_4, at concentrations ranging from 5-15%, is flammable and forms explosive mixtures with oxygen.

The limited monitoring data available does not indicate that this constituted a major problem at the landfills.

Ozone Depleting Substances

The landfills were a dumping ground for solvents and commodities (refrigerators, air conditioning units, *etc*.) containing CFCs.

Toxic gases

CH4 is toxic to vegetation because it removes oxygen from the root zone.

RCV exhaust constituted one source of toxic gases. This is of particular relevance in view of the predominantly old fleet of RCV that still are allowed to operate.

A range of very toxic, persistent and accumulative gases, e.g. organo-chlorine gases such as dioxins and furans, and and PAHs, are emitted as a result of the open uncontrolled burning of rubbish. These gases are suspected or confirmed carcinogens. The emission of organo-chlorine gases is very relevant to the local situation in view of the relatively highly saline environment (including wastes) and the fact that where waste still burns at the landfills. Landfills apart, it is still the practice locally to dispose of waste, e.g. agricultural residues, by open burning. This practice should be discouraged.

The incinerator at St. Luke's Hospital was the subject of complaints from neighbouring areas, in particular Pieta and Gwardamangia. The incinerator, as indeed all other incineration facilities in Malta, were intermittently operated, manually loaded and raked, not equipped with flue gas cleaning, and the incineration process was insufficiently controlled. These factors went against internationally recognised design and operating standards.

Pollution of Water

Rain water that falls on landfills such as those at Maghtab and Qortin, comes in contact with an assortment of fresh, decomposing and decomposed wastes. Some waste components pass on to the liquid phase and get carried away by the water. This creates a contaminated surface runoff and leachate. The latter is a foul cocktail that percolates through the rock fissures until it reaches ground water.

None of the existing landfills was equipped with surface runoff and leachate control systems, with the result that during storms, polluted surface runoff flowed to nearby roads, valleys and the sea. Any leachate that formed, soaked into the ground, percolated through the fissured geology and mixed with groundwater.

Both Maghtab and Qortin, as well as Fulija, are sited on the periphery of the ground water lens. According to the Water Services Corporation, groundwater flow under these sites takes place in the direction of the sea, rather than inland. This constitutes a safeguard against pollution of groundwater by landfill leachate.

In May 1995, samples were taken of groundwater standing in three boreholes within the Fulija landfill area and in one borehole within the Maghtab landfill. Samples of clean sea water from the Blue Grotto area were also taken for comparison. These were analysed for a number of pollution parameters. Table 5.21 shows a summary of the most significant results obtained.

Table 5.21: Results of analysis of groundwater within the Fulija and Maghtab landfills (11)

Parameter	***Unit***	***Fulija***	***Maghtab***	***Sea Water***
Ph		7.27	7.24	8.08
Elect. Cond	?S/cm	7,650	10,600	50,700
TOC	mg/L	<0.10	<0.10	<0.10

Absorption Coefficient	m^{-1}	1.4	2.1	3.2
Dissolved Solids	mg/L	4,845.11	6,559.71	41,449.82
Total solids	mg/L	4,852.5	6,596.2	41,465.3
Al	?g/L	33.6	69.60	7.30
Sb	?g/L	0.10	0.10	0.10
As	?g/L	0.67		1.67
Ba	?g/L	65.6		
Pb	?g/L	118.0	273.0	187.0
Cd	?g/L	1.9	3.5	3.0
Cr	?g/L	23.2	84.0	32.8
Fe	?g/L	214.0	212.0	9.0
Cu	?g/L	33.0	94.0	60.0
Li	?g/L	1.0	39.0	121.0
Mn	?g/L	50.0	166.0	5.0
Ni	?g/L	13.0	20.0	1.0
Hg	?g/L	<0.30	<0.30	<0.30
Se	?g/L	0.20		0.13
Ag	?g/L	0.07	0.03	0.10
Zn	?g/L	72.0	51.0	1.0
PAHs	ng/L	<2.0	<2.0	<2.0
Total Herbicides	mg/L	<0.0001	<0.0001	

The results are not indicative of any significant groundwater pollution by leachate from the landfilled waste. This conclusion, however, must be considered in the light that the borehole water was not flushed prior to sampling and that the results are based on just one monitoring operation. It is in fact likely that, considering the local climatic conditions, leachate formation is episodic and happens only during the peak of the rainy season (December to February).

Although the existing landfill sites might not constitute a significant pollution hazard to groundwater, there was a risk of sea water pollution in these localities. Sea water samples taken from the area in connection with the bathing water monitoring programme did not show any evidence of pollution. However, it must be noted that such samples were tested exclusively for microbiological parameters. Part 4 of the present State of the Environment Report further elaborates on this issue.

The heaping of farm and other agricultural waste, and metal scrap in the open, as well as the application of unstabilised wastes on agricultural land, constituted a serious risk of environmental pollution, in particular with respect to groundwater resources.

Seawater pollution was also caused by the discharge of sewage treatment plant sludge, by grit containing heavy metals and by waste discharged from ships. During annual symbolic cleanups at bays and ports that are organised by the Environment Protection Department, tonnes of rubbish, ranging from glass and plastic containers and metal scrap, are collected.

C&D waste, mostly resulting from coastal development, was dumped at sea. Although this material can be considered as inert, it is believed that insufficient precautions were taken in establishing dumping sites and in particular to ensure against the release, transportation and sedimentation of fines. These fines decrease light penetration, travel with water currents and smother benthic communities, including *Posidonia* meadows. The same comment applies to dredged material, especially that originating from ports. Such material may contain petroleum hydrocarbons and antifouling paint residues.

Anti-fouling residues in the marine environment have been proved to cause profound physiological alterations in marine creatures. Such residues resulting from maintenance work on yachts and ships, should not be dumped in the marine environment.

Increased sea water turbidity may also negatively affect the visual aspect of the marine environment, making the locality unsuitable for scuba diving and other recreational activities.

Pollution of Land

The dumping of waste on land obliterates any indigenous flora and fauna that thrives at that particular site. Moreover, considering that all sorts of wastes, including unstabilised and hazardous materials are dumped at the Maghtab and Qortin sites, these sites must be considered as polluted sites. This applies also to former landfill sites, such as Fulija and Luqa sites.

Such is also the case with agricultural sites, industrial and scrap metal sites, where leachable wastes were left to accumulate in the open, without any precautions against leachate formation.

The application of insufficiently stabilised animal waste and the application of waste-derived compost to agricultural land was also of relevance to pollution of land, in particular with respect to accumulation of heavy metals and their uptake by crops.

Table 5.22 shows the quantity of compost distributed from the Sant Antnin composting plant since plant start-up in 1993.

Table 5.22: Quantity of Compost distributed from the Sant Antnin Composting Plant (11, 36)

Year	***Tonnes***
1993 (Oct-Dec)	200
1994	1099
1995	1324
1996	1757
1997	no records available

Table 5.23 shows the mean results of analysis of the compost for the period 1992-1997. Standards for the application of sludge to agricultural land as per EU Directive 86/278/EEC and the compost quality standards that are expected to be in force in the EU in the medium term are included for comparison.

Table 5.23 : Compost Quality (1992-1997) (11)

PARAMETER	UNITS	MEAN	MIN	MAX	86/278/EEC	EU expected
Humidity	% ds*	28	5	49		
Ph		8.2	7.3	9.2		
Elect. Cond.	MicroS/cm	6103	2641	8393		
Dry Solids	% ds	71	51	85		
Iron	% ds	1	0	3		
Glass	% ds	5	1.7	9.4		
Inerts	% ds	3	0.2	11.1		
Plastic	% ds	0.3	0.1	0.7		
>25mm	% ds	22	0	39.3		
<0.5mm	% ds	12.6	6.6	22.6		
Organic Matter	% ds	53	35	69		
Ash	% ds	46	24	65		
Total C	% ds	28	18	36		
TKN	% ds	1.7	0.9	4.8		
Hydrogen	% ds	4	4	5		
P_2O_5	% ds	1.2	0.4	2.7		
Humus	% ds	19	6	31		
Boron	% ds	0.015	0	0.06		

Na	% ds	1	0	2		
K_2O	% ds	1.27	0.8	2		
Organic C	% ds	13	6	28		
Chloride	% ds	1	1	1		
C/N		19	5	33		
Cellulose	% ds	33	10	45		
As	mg/kg ds	3	0	6		
Cd	mg/kg ds	3	0	19	20-40	1.3
Total Cr	mg/kg ds	19	1	82		100-200
Hg	mg/kg ds	2	1	7	16-25	1-1.5
Ni	mg/kg ds	46	2	193	300-400	30-75
Pb	mg/kg ds	773	63	2082	750-1200	50-300
Cu	mg/kg ds	373	99	1565	1000-1750	50-140
Zn	mg/kg ds	1065	670	6617	2500-4000	150-300
Se	mg/kg ds	3	0	9		
Ag	mg/kg ds	5	1	12		
Fe	mg/kg ds	7717	2126	18650		
Mn	mg/kg ds	181	6	453		
Co	mg/kg ds	35	1	367		
Sn	mg/kg ds	15	1	86		

*dry solids

According to Carbone and Sacco (4), and Vella (34), the alkaline nature of local soil mops up heavy metals, rendering their uptake by plants unlikely. To date there is no EU Directive that specifically stipulates standards relative to the application of compost to agricultural land. Directive 86/278/EEC refers to the application of sewage sludge to agricultural land. It may be seen from Table 5.23 that compost produced from the Sant Antnin composting plant on the whole conformed to these standards. However, it must be realised that existing national standards in European Member States with respect to compost use are much stricter than those indicated in 86/278/EEC. A new Directive on compost quality is expected to be issued in the medium term and is expected to reflect these strict standards. Compost quality will conform to these new standards only if it is produced from separately collected "organic" waste. Hence the urgency of implementing measures to collect separately that fraction intended for composting.

5.1.18.3 Squandering of Resources

Land Resources

Land is undoubtedly one of Malta's most precious resources.

The deposit of waste is a land intensive option. The area designated for landfilling at Maghtab covers an area of approx. 1million m^2. Of this, in 1997 some 600,000m^2 had already been covered by waste.

The Qortin landfill covers an area of approx. 34,000 m^2.

Assuming that the total amount of waste that is landfilled per year is 1 million tonnes, and that this waste assumes a density of 2 tonne/m^3 (after landfilling), and assuming an average waste depth of 10m, it may be calculated that 10,000 m^2 of land are currently being consumed per year to landfill waste. This is equivalent to approx. 2m^2 of land per person over an average lifetime of 70 years.

Material and Energy Resources

The generation of waste constitutes a loss of raw material resources as well as energy that was used to extract the material and manufacture the product. Waste generation is therefore the result of inefficient use of material and energy resources. This is true on the global scale, but particularly true on the local scenario where most raw materials and energy are imported. It therefore makes sense to recover materials and energy from waste.

5.1.18.4 Other Impacts

Fire risks

There were reports of waste skips being set on fire and other instances when fires developed at waste-paper deposit sites.

The accumulation of combustible waste constitutes a fire hazard. Fires can start both spontaneously and otherwise at such sites. This must be kept in mind when separately collected combustible waste fractions such as paper and plastics are stockpiled prior to shipping or recycling.

Traffic impacts

Table 5.24 shows the number of vehicle trips recorded at the Maghtab landfill during 1997.

Table 5.24: Vehicle trips recorded at the Maghtab Landfill during 1997 (36)

Waste transported	**Number of vehicle trips**
MSW	43,000
Industrial and other	14,500
C&D	58,000
TOTAL	**115,500**

5.1.19 Envisaged Developments

It is envisaged that for the short to medium term, both municipal and industrial solid waste generation will increase. According to Grontmij and Ramboll (20), there is a direct relationship between economic growth and waste production. On the basis of this relationship, and in the absence of effective changes in consumption habits and waste minimisation and recovery measures, they projected that up to the year 2010, annual MSW and industrial waste production (excluding C&D waste and sewage sludge) would increase at the rate of 4% *per annum* to approx. 500,000 tonnes. By comparison in the UK, where waste recovery during the last ten years may be described as moderate, MSW production increased by 2-3% per year during the same period of time.

Treating this amount of waste would cost 15 million Liri per year, *ie*. approx. LM 42 per ca. They strongly recommended developing the legal and financial instruments, and the implementation of waste minimisation and recovery measures. They also considered essential the provision of waste treatment and disposal infrastructure, *viz*. an incineration plant, a new engineered landfill and treatment facilities for particular fractions of special wastes.

It is difficult to predict how the waste challenge will develop with time. However, as the standard of living continues to increase leading to more affluence, the following changes can be predicted to occur in the short to medium term:

?? an increase in particular categories of waste, such as packaging waste, electronic waste, tyres, non-durable goods, etc.
?? an increase in the variety of goods presented for disposal
?? an increase in what the public and the visitor expects out of the local environment
?? more demanding international obligations.

The coming into operation within the short term of a new public hospital with approx. 930 beds will increase health-care waste production.

Malta is a net importer of goods. As such, therefore, in addition to being influenced by local policies, these changes will also be influenced by regulations passed in the country of origin of the imported goods.

Paradoxically, the passing of certain new regulations and enforcing of existing regulations may be expected to result in the generation of additional quantities of solid waste. Following are typical examples:

?? Curbing the marine discharge of sludge from the Sant Antnin Sewage Treatment Plant will result in the generation of approx. 3,000 tonnes of dry solids (sludge) per year
?? The coming into operation of another three sewage treatment plants will result in the production of approx. 7,000 tonnes of dry solids (sludge) per year
?? The treatment of effluents from slaughtering industries will result in the production of approx. 260 tonnes of dry solids (sludge) per year
?? The treatment of liquid waste from manufacturing establishments will result in the production of additional sludge
?? The introduction of flue-gas cleaning measures will result in the production of sludge, gypsum residues, etc.
?? Oil drilling operations may result in the production of drilling muds.

This emphasises the need to adopt an integrated approach towards waste management issues.

5.1.20 Conclusion

Waste practices in Malta cannot be referred to as waste *management*, as this term has come to be defined in developed countries. Such practices in the Maltese Islands are unsustainable in so far that material and land resources are not being conserved, and future generations are being burdened with waste-related problems created by this generation.

Current legislation does not reflect corresponding state-of-the-art environmental legislation in developed countries. The main shortcomings are as follows:

?? archaic and fragmented legislation
?? lack of effective incentives to encourage preferred waste management options, rather than landfilling
?? any controls that exist are incidental and not conducive to the sustainable management of waste.

There is need to adopt measures that have been developed overseas, eg. EU Member States. Local factors may require the adoption of even stricter controls.

Local needs apart, international obligations need to be abided by.

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5.2 Liquid Wastes

5.2.1 Introduction

The sewerage system on the island of Malta collects both domestic and industrial wastes, as well as some stormwater runoff, and consists of two main networks (Malta Structure Plan, 1990). The largest of these networks services the southern part of the island and most of which converges at the Marsa Sewage Pumping Station, from where it is pumped either to the submarine sewage outfall at Wied Ghammieq, or to the only sewage treatment plant, at Sant Antnin (Malta Structure Plan, 1990). Currently, the Sant Antnin Plant treats approximately 20% of the wastewater produced on the island (COWIconsult, 1992). The rest is disposed untreated at Wied Ghammieq. This is estimated to be 18 million m^3/year (COWIconsult, 1992).

5.2.2 Marine Sewage Outfalls

5.2.2.1 The Wied Ghammieq Outfall

The Wied Ghammieq outfall is situated on the north-eastern coast of Malta, some 1.75 km south-east of the entrance of Grand Harbour, and some 1.4 km north-west of the coastal settlement of Xghajra. The sewage is released into the sea via a 716m long submarine pipeline, running at right angles to the coastline, the terminal diffuser being at a depth of some 36m (COWIconsult, 1992).

When operating normally, the Wied Ghammieq pumping station discharges raw sewage through the outfall at an average rate of 58,000 m^3/day. This value varies with season and is less when the sewage treatment plant at Sant Antnin is in operation. The Wied Ghammieq submarine outfall is designed to produce an immediate dilution of 1:200 at the point of discharge, and a further dilution of 1:1000 as the freshwater plume rises to the surface above the point of discharge, under calm sea conditions (Rizzo, 1996). However, frequent rupture of the pipeline along its submerged section results in undiffused sewage being discharged at a distance much closer to the shore than actually intended. In such cases, sewage emerges in a jet with minimal dilution and is carried by surface currents, usually in an easterly or south-easterly direction, since the prevailing winds are westerly and north-westerly.

Geologically, the shore at Wied Ghammieq consists of Lower Coralline Limestone. The same type of rock outcrops southeast of Wied Ghammieq as far as Blata l-Bajda. Northwest of Wied Ghammieq, the shore consists of Globigerina Limestone as far as Sliema, with only a minor outcrop of Lower Coralline Limestone at Tigne (Oil Exploration Directorate, 1993). The submarine geology is not known, as the bottom offshore is largely obscured by weed and sediment. However, it is probable that close to the land at least, the submarine geology is a continuation of that onshore. The bottom slopes gently from the shore seawards.

5.2.2.2 Other Outfalls

The northern Malta catchment of wastewater is conveyed to two outfalls on the western coast, at Mellieha (Anchor Bay) and ic-Cumnija. Both outfalls are presently shoreline discharges.

In Gozo, almost 90% of all wastewater is discharged through a submarine outfall at Ras il-Hobz. Another two outfalls are located on the northern coast at Wied Mielah and in San Blas. These outfalls discharge minor quantities of wastewater. At Wied il-Mielah, it was intended to convey wastewaters through a septic tank upstream to the outfall, however this is presently out of use. In San Blas, wastewater from Nadur is discharged through a short pipe.

In 1992, the total amount of wastewater discharged into the marine environment was estimated to be 23.2 million m^3 per year. (COWIconsult, 1992).

5.2.3 Wastewater Composition

Wastewater effluents in Malta have been described as having a high organic load when compared to that of other regions. This is mainly due to the discharge into the municipal sewers of untreated agricultural and animal husbandry wastes. This fact, in conjunction with the relatively low water consumption in Malta, render the local sewage more concentrated in organic content.

Heavy metals may also constitute potential contaminants in wastewater discharged into the marine environment. These mostly arise from industrial sources and it is estimated that only 11% of the total wastewater production comes from the industrial sector.

5.2.4 Upgrading of the Sewerage System

The sewerage system is presently being upgraded. Within the next few years, it is expected that all domestic and industrial wastes will be treated to secondary level and that the effluents will be discharged into the marine environment through submarine outfalls equipped with proper diffusers. A Storm Water Master Plan is also presently being implemented to make full and efficient use of stormwater and to prevent overloading of the sewerage system which would have negative environmental impacts.

The number of sewage outfalls will be reduced to one in Gozo (Ras il-Hobz) and two in Malta (Wied Ghammieq and Cumnija).

5.2.5. Wastewater Treatment

At present we have a single sewage treatment plant which has been recently upgraded to treat 17000 m^3 per day. The treated waters are used for agriculture (with requirements fluctuating seasonally) and for industry. This plant has been commissioned to an Italian firm who was responsible for its upgrading and now is responsible for its operation for the next 5 years.

A consultancy contract has been issued for the formulation of a plan with the presentation of alternative proposals including treatment facilities which might not be of a centralized nature. One (or possibly more) other treatment plant is planned for the southern region in Malta. This will treat up to 58,000 m^3 per day and it is most likely that this production will exceed the present industrial and agricultural demands. It is also likely that this plant will be sufficiently advanced so as to produce water of high quality which could be used to recharge our aquifers. New disinfection techniques alternative to chlorination, are being considered.

Another treatment plant may be planned at ic-Cumnija (max. production: 7500 m^3 per day) and Ras il-Hobz, Gozo (max production: 6500 m^3 per day). These two relatively small plants will produce water mainly for agricultural use. It is hoped that plans will be finalized in the near future through a consultancy contract for the North of Malta which is currently in progress.

5.2.5.1 Comments on Present Operation of Sant Antnin Sewage Treatment Plant

The following observations are based on site visits made to this treatment plant as well as on discussions held with Dr. Piovelli and Mrs. Catherine Mercieca

The successful operation of a sewage treatment plant depends not only on its own design and operation, but also on the degree of coordination and cooperation that may exist between different bodies or interests which directly or indirectly make use of or provide services to the treatment plant. These would include:

The Water Services Corporation
The Drainage Department
The Works Division
The Department of Agriculture
The Environment Protection Department
The end-users of the treated water

There are reasons to suspect that such co-ordination is presently insufficient and that this is leading not only to a number of environmental problems, but also to an under utilization of the plant.

The plant which has been recently upgraded and which is presently being operated by an Italian firm on commission by the Works Division, is able to produce a maximum of 17000m^3 per day. Since it started to operate again in January 1998, the maximum production never exceeded 9000m^3 per day and this usually varies from 2000 to 8000m^3 per day. This represents only 12 to 47% of maximum expected output.

The plant supplies treated wastewater which is chlorinated to the level of 0.1 to 1ppm of free chlorine at source, and which are delivered to 7 reservoirs distributed in a number of localities in the South-West of Malta. The plant is presently fully automated and most of the critical operation points (including the external reservoirs and supplying pumps) are under remote control through an extensive and well-developed computer and telemetry system. It may be run by no more than 3 technical people together with one supervisor.

The demand for treated water fluctuates with time of year and is at a maximum during summer. During this period, the present plant is not capable of satisfying such a level of demand. A number of problems may be leading to this unsatisfactory situation. Foremost amongst these would be the sudden and unpredictable fluctuations in the rate of wastewater reaching the plant for treatment. This in turn is mostly due to:

(i) Low pumping rates from Marsa Pumping station or other stations (40% of the time);
(ii) Power failures;
(iii) Mechanical blockage of input screening section due to solid wastes in sewers.

There is an evident need to upgrade the pumping stations upstream of the plant. Moreover, all modifications or future developments in the sewerage system needs to take into account the requirements of such a treatment plant, as well as of the future plants currently being planned.

The supply of energy also needs to be stabilized and rendered more adequate.

Most of the mechanical blockages of the intake section is being caused by agricultural produce and wastes including animal waste, and dead carcasses. Surprisingly enough, pig waste (and poultry) feature prominently in such waste. It is evident that this is due to illegal dumping of such waste into the sewer inspection manholes (many cases are reported during the weekends).

The plant is producing a significant amount of activated sludge which is potentially enriched in heavy metals and other contaminants. This sludge is presently being discharged into the marine environment (through the Wied Ghammieq submarine outfall). This essentially means that the major benefit being derived from the SASTP is that of waste water reuse, and not of environmental protection from sewage discharge into the marine environment. The setting up of additional sewage treatment plants will necessarily lead to the production of bigger volumes of activated sludges. Therefore there is urgent need to invest in treatment facilities capable of adequately treating such activated sludges.

There is the need to ensure maximal benefits from the operations of such wastewater treatment plants within a comprehensive national water management strategy. This will also require the satisfactory control of waste water losses which are presently occurring. As much as 15 to 20% of the wastewater produced by SASTP and which are currently leaving the plant, fail to reach the various reservoirs! This is evidently due to theft of such waters along the route. A sudden drop in such output may lead to mechanical problems in the distribution system, which may in turn exasperate engineering problems at the plant itself.

The above review was not meant to be exhaustive or technical in nature. It only serves to underline some operational problems which need to be successfully tackled before the SASTP as well as other future plants will manage to attain their original objectives.

The present author feels that the fundamental requirement to improve the present situation is to ensure full coordination in the administration and technical operations of such plants. All the Government entities (as identified above) as well as the private and public sectors (as represented by constituted bodies and local councils) must be actively involved in such coordination. This does not call for the setting up of yet another ‘talking’ board, but for a small group of responsible people would have full access to the main players so as to elicit rapid and coordinated responses from them.

5.2.6 Environmental Impact of Marine Sewage Discharges

Over the past 5 years, the Department of Biology, of the University of Malta has produced significant amounts of data on the marine environmental impacts resulting from sewage discharges at Wied Ghammieq (Axiak and Chircop, 1995; Axiak, 1998; Mallia, 1991; Mallia and Schembri, 1995; Rizzo, 1996). The following review is based on such work.

This outfall has been reported to be malfunctioning on a number of occasions (e.g. for most of March 1999). This often led to the discharge of untreated wastewaters at the coastline. Under these circumstances, the whole shoreline extending up to Zonqor Point (Marsascala) was found to be contaminated. LANDSAT satellite images produced by the Marine Ecotoxicology Laboratory (Department of Biology, University of Malta), are available to prove this fact (Fig. 5.2.1).

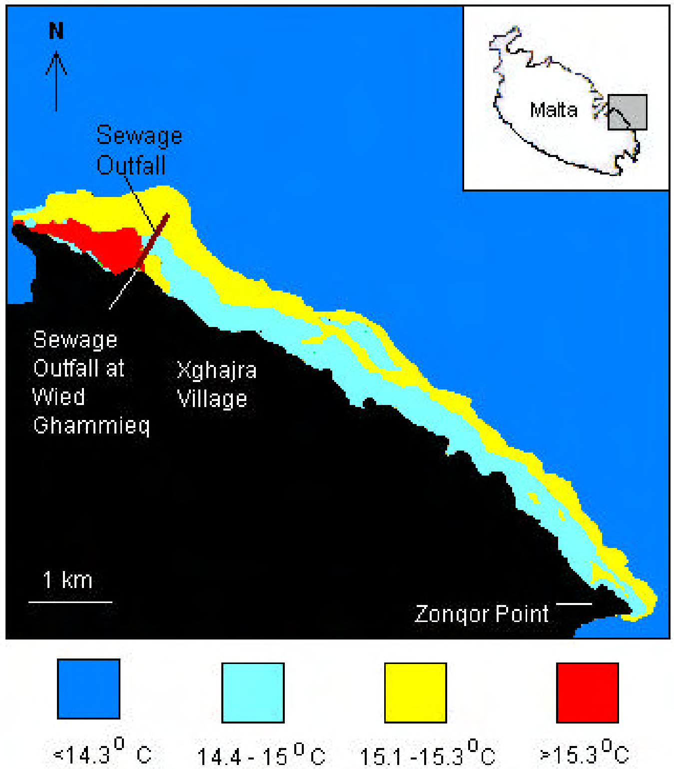

Figure 5.2.1 LANDSAT TM imagery showing plume of untreated sewage discharged by Malta's major outfall at Wied Ghammieq as indicated by surface water temperatures (Jan.1995). On this occasion the submarine sewage outfall was not in operation.

5.2.7 Dispersion and Extent of Contaminanted Waters

The geographical extent of the wastewater effluent discharged through the Wied Ghammieq outfall was estimated to be 3km from the point of discharge. Wastewater was transported mainly along the south east coastline, in the direction of the prevailing currents. Extensive microbial pollution was recorded in bottom waters throughout the year, indicating effluent entrapment and possible accumulation of wastewaters in t he discharge area.

The nature of the currents in the Wied Ghammieq area indicate that wastewater discharged through the submarine outfall would be transported mainly towards south-east. This was confirmed by the field data. In normal outfall discharges, that is, when wastewaters were discharged through the submarine pipeline, faecal pollution was generally observed in surface and bottom waters south-east to the outfall, and not towards the harbours. The unidirectional flows of the currents, as resulted from the field surveys, favours the flushing of the effluent away from the discharge area and enhance the dispersion of pollutants in the marine environment. Furthermore, the current flow is parallel to the coastline, therefore wastewater is transported away and not towards the shores. However, currents must be sufficiently strong to actually transport the effluent away from the discharge area. There was no evidence of circulatory currents, which may lead to accumulation, and stagnation of pollutants.

The outfall diffuser is located at a distance of about 700m offshore. In a homogenous environment the plume is expected to surface at approximately this distance from the coastline, this is within the predicted radius of influence of the wastewater plume as predicted by the calculation models. There is therefore the risk that undiluted wastewater is transported to the shoreline in favourable winds. The area most at risk from surface wastewater pollution from the Wied Ghammieq outfall is the coastal area south east to the outfall in the direction of the prevailing currents, including the Xaghjra coastline, up to Zonqor Point, in the limits of Marsaskala. This was confirmed during the field surveys. Microbial pollution resulted mainly on the southern side of the outfall, while no faecal pollution was recorded in surface and bottom waters northwards from the outfall, towards the harbours. Surface currents are influenced by the prevailing wind conditions, and therefore the transport of the surface plume in a westerly direction, towards the harbours is expected when winds are easterly. In effect, Drago (1991) observed such reversal of surface current flow in Wied Ghammieq. This implies that wastewater can theoretically be transported 3km northwards to the outfall, towards the harbours and part of the Sliema coastline.

The most acute pollution in Wied Ghammieq was recorded when wastewater was discharged at the shoreline, due to outfall pump failure. Wastewater was transported by the prevailing surface currents along the Xaghjra coastline and accumulated in the inlets and bays. High bacterial concentrations were measured in surface waters near the discharge area. The concentration of faecal coliforms in transect A, west to the outfall reached more than 13,000 CFU/100ml, indicative of the low effluent dilution. Significant bacterial contamination (>100CFU/100ml) was measured up to Ras il-Gebel, about 1.5 km from the point of discharge.

The available evidence from models as well as from field monitoring suggests that even when the sewage submarine outfall is fully operational, wastewater may be entrapped below the water surface due to a number of natural features (including the water stratification set up in the area, during the summer months). Extensive microbial pollution was in fact found in bottom waters south east to the outfall up to Il-Gorf l-Abjad, about 3km distant from the point of discharge. Such entrapment is possible during most of the year. This implies that the effect of such discharges on benthic marine life and on the quality of sediments may be more than originally expected.

5.2.8 Impact on Marine Life

Impacts on demersal fish (*Serranus scriba*) within the vicinity of thus outfall were detected through increased hepatic EROD activities (i.e. an indication of biological stress) (Axiak, 1998). On the other hand, there was no significant effect on nutrient levels and phytoplankton communities within the area surveyed.

In 1997, a benthic survey was carried out in the vicinity of the outfall. This work was undertaken jointly by the University of Malta and the University of Bari. The following is a brief review of the findings of this survey.

The whole area in the immediate vicinity of the pipeline, both close to the shore (due to repeated damage to the pipeline) and that at a distance away from it (due to the operation of the terminal diffusers) showed evidence of degradation. These negative effects extend some distance south-east and north-west of the pipeline due to the variable currents present.

The whole sublittoral coastal strip in the vicinity of the pipeline was colonised by a rich and dense population of *Dictyopteris polypodioides*, most probably associated with the increased nutrient load as a result of the direct discharge of organic matter near the coast from the damaged pipeline. Such inputs have probably been occurring for a long time, since *Dictyopteris* has proliferated to form an extensive stand, probably displacing other species presumably less adapted to the prevailing environmental conditions.

In general, there are no obvious signs of serious degradation some distance away from the terminal diffuser. This may be partially due to the intermittent operation of the diffusers. However, close to the terminal diffuser, anaerobiosis is evidenced by the blackened sediments sampled.

With increasing distance from the pipeline, degradation diminishes, and disappears almost completely some 3 km from the pipeline both in a south-easterly and a north-westerly direction. This is indicated by the composition of the meiofauna as well as by the distribution of particular species indicative of degraded conditions, such as the annelids *Audounia tentaculata* and *Neanthes (Nereis) caudata*.

Dead matte of *Posidonia oceanica* occurs in patches on the sandy bottoms in the area. Live *Posidonia* was only found at a considerable distance southeast of the outfall. This suggests the former presence of a *Posidonia* along the entire coastal strip, which, however, has disappeared in the vicinity of the outfall, most probably as a result of the changing chemistry of the water and sediments, due to operation of the outfall.

5.2.9 Conclusions and Recommendations

Over the past years we have witnessed a sustained effort to upgrade and improve the sewerage system of these islands. In 1992 the Sewerage Master Plan for the Maltese Islands (COWIconsult, 1992) identified the needs and requirements in this field and it was followed by heavy investment in restructuring projects. There are already first indications that the general bacteriological quality of our bathing waters is improving (another section of this report), and this is definitely attributed to the sewerage system upgrading programme.

Several studies have indicated that the discharge of untreated sewage, especially through shoreline points (rather than through submarine outfall pipes) is already posing a direct threat to human health, marine life as well as sediment quality at Wied Ghammieq and Xghajra. It is imperative that the apparently perennial operational problems of this major outfall will be solved for good.

There is also a massive development of water treatment capacity and in the near future, it is planned to treat all wastewater produced in these islands All treatment plants are planned to be ready by the year 2002. The ultimate aim of such programme will be to make full use of wastewater as a water resource for agriculture and industry as well as to protect our marine environment.

The above text has identified a number of potential bottlenecks (administrative and operational) which need to be tackled in order to ensure that the present and future wastewater treatment plants will prove to be effective instruments for environmental protection. There is a need to improve the coordination between the various different bodies or interests which directly or indirectly make use of or provide services to the treatment plant.

The development of new treatment plants must be accompanied by improvements in the pumping stations upstream to the plants as well as in the supply of energy reaching such plants. Furthermore there needs to be strict enforcement of regulations prohibiting illegal dumping of agricultural and other solid waste in the sewers.

The present plant at Sant Antnin is producing a significant amount of activated sludge which is potentially enriched in heavy metals and other contaminants. This sludge is presently being discharged into the marine environment (through the Wied Ghammieq submarine outfall). This essentially means that the major benefit being derived from the SASTP is that of waste water reuse, and not of environmental protection from sewage discharge into the marine environment. The setting up of additional sewage treatment plants will necessarily lead to the production of bigger volumes of activated sludges. Therefore there is urgent need to invest in treatment facilities capable of handling such activated sludges.

Another major upgrading programme deals with stormwater and their roting and management. It is expected that this programme will in the near future solve the problems associated with the discharge of rainwater into the main sewers, which in turn lead to flooding during the October rainstorms as well as mismanagement of our freshwater resources. In fact, in our opinion, the single most important development we have witnessed over the past decade is the realisation at the highest levels of policy making that the management of wastewaters is to be an integral part of freshwater resources managment.

5.2.10 Acknowledgements

The author (for the section on Liquid Waste) wishes to acknowldeg the assistance of Ing. K. Gatt and Ing. S. Cachia of the Drainage Department, as well as of Mrs.Catherine Mercieca and Dr. Piovelli.

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6. ENERGY, TRANSFORMATION, USE & ENVIRONMENTAL IMPACT

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6. ENERGY, TRANSFORMATION, USE & ENVIRONMENTAL IMPACT

Introduction

Two main determinants of the state of an environment are the prevalent modes of land use and the types and intensity of use of energy sources. Both have direct and indirect effects. Land put to a specific use has had its vocation in the general ecosystem changed -- a fact which will inevitably modify the functioning of the rest of the system. Moreover, if energy flows connected with the land area are drastically changed, then there will be a further effect on the remaining parts of the ecosystem e.g. the change in absorption and re-radiation of solar energy when agricultural land is built on.

On the other hand a significant fraction of energy transformation and use takes place at specific dedicated locations. The products will impact on the surrounding human and natural environment at ranges and with intensities determined by types of transformations which are taking place. However, with the advent of mass transportation of people and goods we have also created mobile energy converters which deposit the products of conversion wherever they go, from under the sea to the upper stratosphere. While the impact of single vehicles is very small, numbers and frequency of use have now reached such levels that mobile sources are the dominant ones where certain impacts are concerned.

This section of the report will be concerned with the various transformations and uses of energy. Contrary to an original intention, we feel that the section would make a better whole if type and magnitude of impact of energy transformations and uses are discussed.
This would offer a better foil to the section on Air Quality which follows.

6.1 Energy use and Gross Domestic Product

6.1.1 Energy intensity

Energy intensity, expressed in various ways, is reckoned to be a measure of a number of elements involved in economic development. There is no wide agreement on the exact significance, partly because of the changing nature of econometrics and of economic development, partly as a result of two major oil price shocks, and partly because current notions of GDP contain items which are irrelevant to energy consumption. There are other specific elements in our case which render comparisons with other countries of doubtful value : the lack of a heavy industrial sector of any size; the small scale of the country; the need of an island state to have autonomy in a number of basic services e.g. power generation. Moreover, with some 60% of potable water coming from Reverse Osmosis (RO) of sea water, water production is clearly an energy intensive process for us. Demand for water is significantly affected by tourist presences, which can be accounted for by computing an average addition to the local population. From the annual number of bed-nights it is estimated that there is an addition of close to 40,000 to the local population. This has to be trimmed by about 5000 to account for locals abroad at any one time.

There is another aspect to GDP which should not be ignored : the black economy. It is not known to what extent GDP estimates for developed countries take this into account.; certainly in our own case there does not seem to be any attempt to do so.

At the national level it is possible to determine ***primary energy*** consumption per unit GDP with some confidence, even if interpretations may vary widely. However, any attempt to examine sectorial situations, e.g. energy use by manufacturing industry per unit GDP contribution, is doomed to failure at present. There is a serious lack of data which can only be remedied by an extensive survey.

A very general view of energy intensity in an economy can be obtained from looking at a number of indicators of energy use per capita or per unit GDP. The first set of such indicators that we have chosen are annual values of primary energy in tonnes of oil equivalent (toe) per capita, electrical energy in megawatthours (MWh) per capita, CO_2 production in tonnes (to) per capita, and water consumption in m^3 per capita.

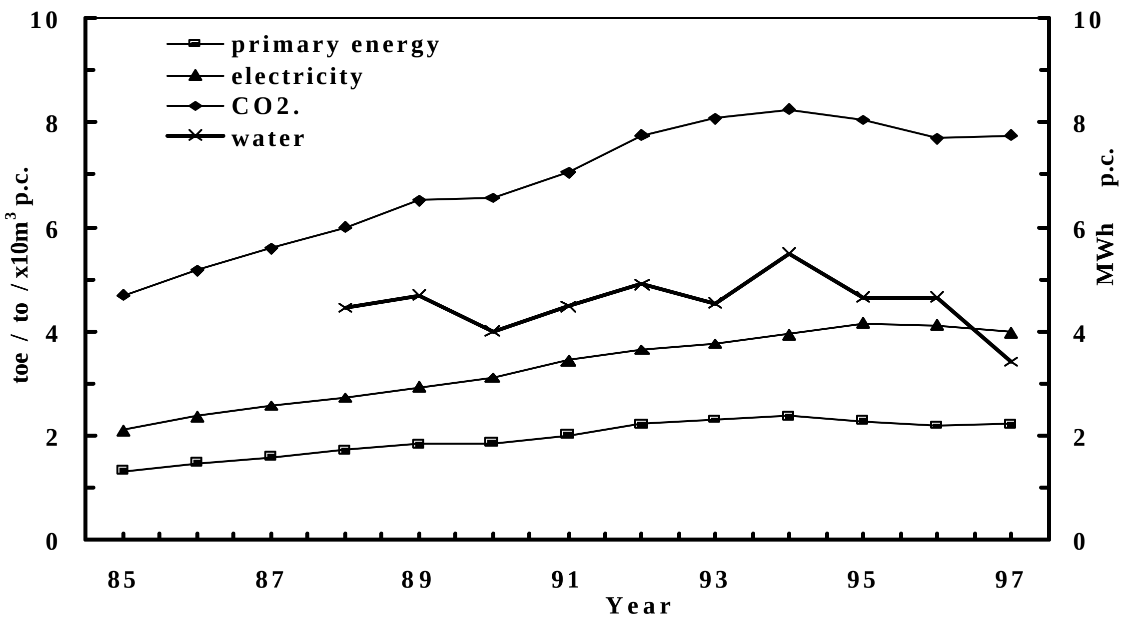

Figure 6.1 Per capita consumption of energy and water and CO_2 emissions

All of these indicators, except that for water consumption, increased steadily up to 1994 and declined slowly thereafter, albeit at different times. For instance, the decline in CO_2 per capita came after 1994. As CO_2 production is dominated by electricity generation and over 1994/95 coal was being phased out in favour of oil, the decline was probably connected with this fact. It runs parallel to a decline in primary energy intensity per capita, as oil has a higher calorific value than coal.

Electrical energy intensity, on the other hand, only declined after early 1995. The main influence here was surely the decline in water consumption following the 1994/95 price rises; in fact the (strong) decline in water consumption per capita coincides with the electrical energy decline.

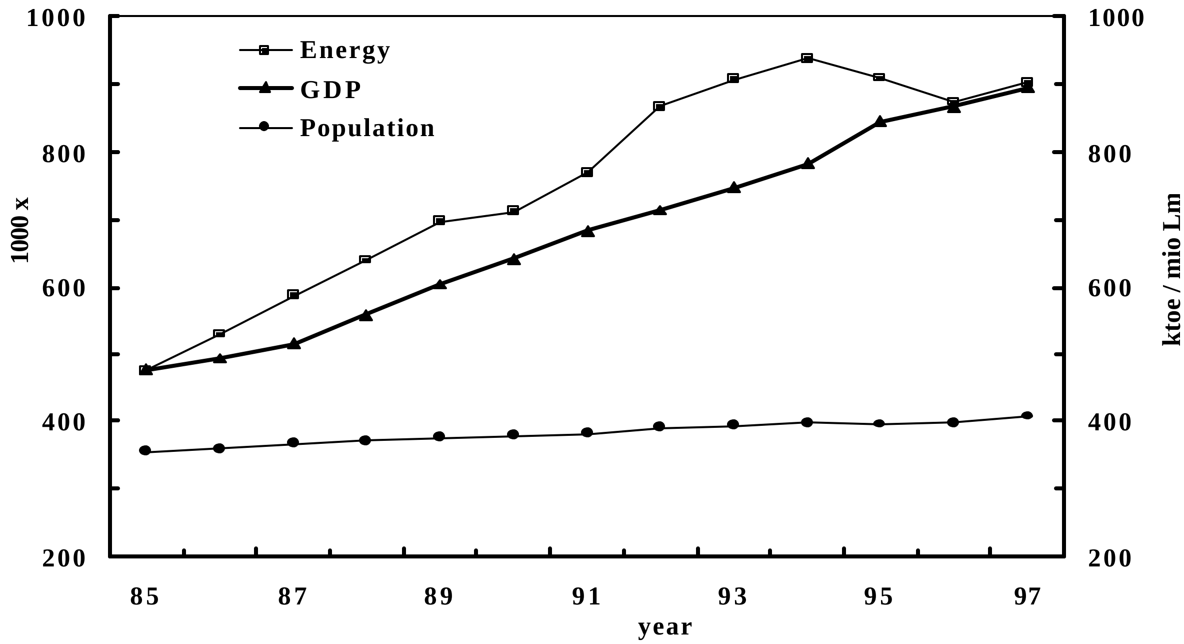

Figure 6.2 GDP, energy consumption and population trends

Energy intensity as ktoe per unit GDP (Lm 1 million) also peaked in 1994. Thereafter, a small decline in primary energy use per capita and a ***continued increase*** in GDP led to a sharp decline in ktoe per unit GDP. At present there is no indication as to whether this decline, a feature of developed economies, will be sustained. Nor is it possible to pinpoint its causes. Increased energy efficiency in manufacturing industry; a move towards service industries; electricity saving by the WSC; are all possible contributors.

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6.2 The Sources of Energy

6.2.1 Local Source of Petroleum

Oil exploration has been going on in the Maltese Islands and their Maritime Economic Exclusion Zone since 1958. This was the only land-based well, which was drilled at Naxxar; the rest were drilled offshore. In recent months an exploratory well was drilled in Gozo in an attempt to locate the eastern limit of the Ragusa (Sicily) oil bearing-basin. The projected limiting depth was 5000m. Oil and gas traces at some 4500m encouraged extension first to 6000m and then to 7500m., and later to a final depth of 8018m at the end of January 1999. The results are still being analysed; first indications are for the presence of gas and oil in non-commercial quantities.

6.2.2 Imported Petroleum Products

All significant primary energy is imported, with the totality being made up of refined oil products and liquid petroleum gas (LPG). No crude is actually imported. Purchases of crude are made on the open market; the agreement with Libya for part purchase of our oil needs was allowed to lapse some two years ago when the continuing downward slide in market prices was already well-developed. In any case, Libyan crude furnished transport and industrial fuels only; heavy fuel oil (HFO) for electricity generation comes from Saudi and Kuwaiti crude, which has a high (2-3%) sulphur content [1].

The table below gives the type and quantity of imported fuel over the period 1992 - 97.

Year	92/93	93/94	94/95	95/96	96/97	97/98
Type		Quantity 1000 mt		(metric tonne)		
Gasoil	123	128	138	170	167	150
Premium	63	64	62	62	60	60
Unleaded	7	9	12	15	17	15
Jet A1	82	101	108	107	109	110
Kerosene	16	16	17	19	18	15
Heavy Fuel Oil	411	432	500	457	497	500
Thin Fuel Oil	46	46	49	14	13	12
Avgas 100L	0.1	0.1	0.1	0.1	0.1	0.1
LP Gas	17	16.5	16.8	16	15	20
Coal	233	225	78	-	-	-

Figure 6.3 shows the amounts of fuels imported in Malta.

Coal, whose large scale importation started in 1974/75, in the aftermath of the first oil crisis, was phased out in 1995. Its sole use had been in Marsa Power Station (MPS), where the coal store at the Menqa was a source of severe particulate pollution over surrounding dwellings and offices. Major problems were caused by the fly and bottom ash which had to be carried by truck to various landfills.

While having some design features to enable it to use coal, Delimara Power Station (DPS) has never taken on any coal in fact.

Malta Oil Bunkering Company (MOBC), a 90% Enemalta owned subsidiary, and smaller private firms import bunkering fuels - Heavy Fuel Oil (HFO) and Gasoil. In 1993 MOBC imported 42,000MT of Gasoil and 86,000MT of fuel oil [2], while in 1997 the MOBC quota was close to 12,900 MT. All the other firms combined imported just under 5,000MT in all in the latter year.

The Enemalta storage capacities for various fuels are shown below :

Fuel	*Capacity (mt)*
Gas Oil	169,000
Leaded petrol	12,200
Unleaded petrol	4,000
Jet A-l	35,000
Heavy Fuel Oil	84,000
AV gas	<50 (in bowsers)
LPG	2860

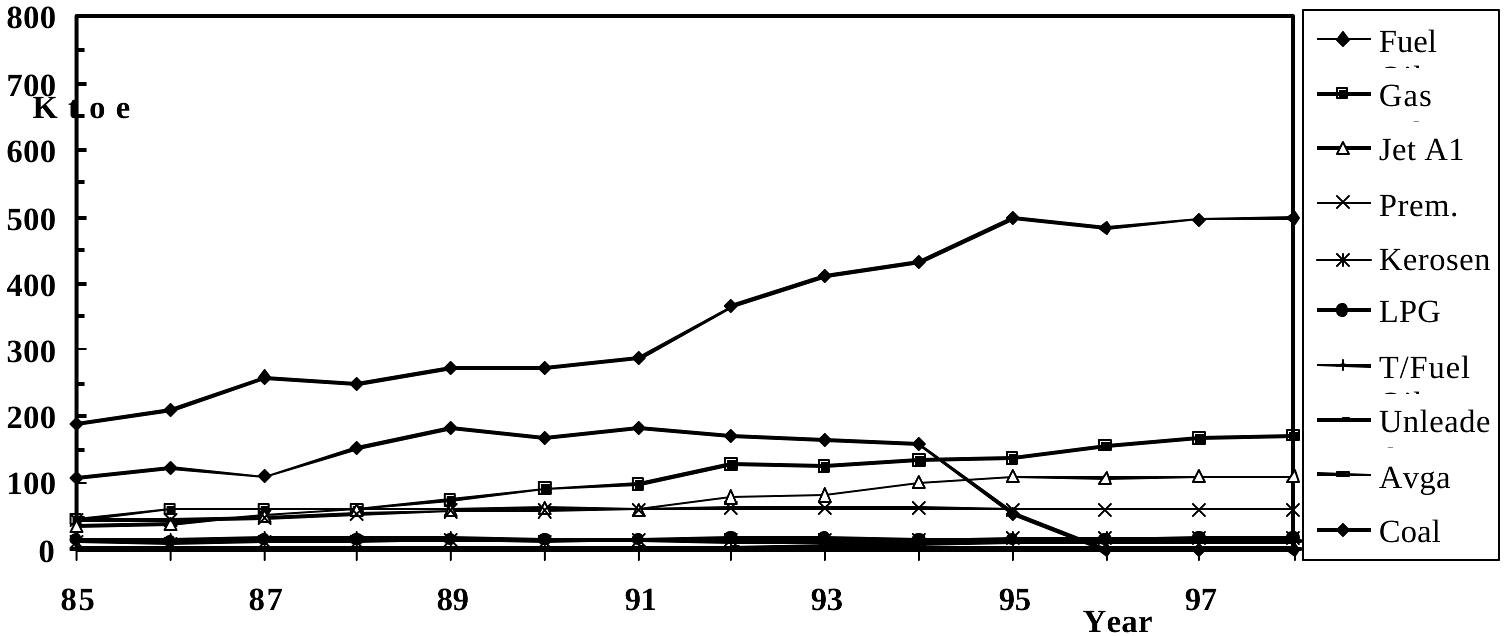

Figure 6.3 Fuels imported in Malta.

Apart from the phasing out of coal, the one other major change that has occurred in fuel importation is the advent of lead-free petrol. Starting with a very modest proportion (1%) in 1989/90 it has reached 25% of all petrol sales in 1997/98. There has also been a recent (1999) commitment to import a low lead brand of leaded petrol. This measure, though long overdue, has been greeted with a certain amount of trepidation by owners of older cars, who are concerned with the performance of valve seatings designed to work with high-lead petrol.

A general trend over the past decade has been one of steadily increasing imports of heavy fuel oil (HFO) for electricity generation. This has been flanked by imports of gasoil (diesel) and by more modest increases in petrol, LPG and Jet A-1. In connection with this last fuel one should note that Jet A-1 is the "source" of locally used kerosene, which is not imported as a separate fuel because of the relatively small quantities involved.

6.2.3 Solar Energy

The average daily insolation in winter (January) and summer is 2.7 kWh/m^2 and 7.8 kWh/m^2 respectively [3]. Only a tiny fraction of this energy is utilised through solar water heaters (SWH) or photovoltaic (PV) panels. Apart from a small number of institutions (Mtarfa Old People's Home; Dar tal-Providenza; Caritas) and hotels (Danish Village; Ramla Bay Hotel; Comino Hotel; Radisson Bay Hotel, the University), there are probably fewer than 1200 solar water heaters in use in houses. However the numbers of importers of solar water heaters has been steadily increasing over the last five years. There are now some 15 such importers and installers. Malta Drydocks (MDD) has declared an intention of setting up a SWH production line [4]. One estimate of solar water heating potential concludes that annual savings of around 60 kto of HFO and 183 kto of CO_2 are attainable.

As for photovoltaic generation, this is limited to a small number of specialised applications, among which are experimental mains-connected systems, house battery charging, inside and outside lights, and electric car-battery charging. Of the two local suppliers, there is one manufacturer of PV panels, as yet with a low volume of sales. The other is an importer; both offer a technical back-up service.

Potential is difficult to estimate realistically in view of the high cost even of small installations. As a very general indicator it can be pointed out that 4 km^2 (1.3 % of land area and 7.2% of built-up area) of PV panels will, in high summer, generate 400MW of power, more than Marsa and Delimara power stations combined.

6.2.4 Wind Energy

Wind energy has been in long-time use mainly to pump water from wells and shallow water tables. The pumping is done directly using multi-blade farm-type windmills. A few sea-going yachts have small (200-400 W) wind generators for on-board battery charging. The potential for wind energy has been explored in two local studies [5],[6] which have reached broadly similar conclusions as far as land based wind generators are concerned. With the inevitable constraints of suitable space, there is a potential for 10 - 15 MW of wind energy. This rises to two or three times that power if off-shore generators are considered. The latter would provide some 4% of the energy from the power stations on an annual basis; but the usefulness for supplying the grid depends on the extent of calm periods. One study [5] reckoned these to be as long as 3.5 months every year.

6.2.5 Biomass and Bio-Fuels

The only form of biomass in use is wood in very limited quantity as there is no forest cover or large tracts of agricultural land. Bakeries and pizzerias are the main users; domestic use is restricted to 'fireplaces', a device ill-suited to the local climate but with considerable social cachet. Scrap wood, garden waste and tree prunings are also available. The first is used by bakeries; the latter two generally ended up in a landfill but recently have been diverted to the Sant'Antnin compost plant for use as bulking agents.

No biofuel has been produced in Malta to date, though there are ideas to do so from marine sources. Small quantities of rapeseed-derived biofuel have been imported for experimental purposes [7].

The potential for electrolytic production of hydrogen for use as a transport or industrial fuel is being explored in an M.Sc. project at University [8].

6.2.6 The electricity generating system

Generating capacity :

MARSA B		230MW	Steam plant;
		37MW	Open cycle gas turbine plant;
DELIMARA	1	120MW	Steam plant;
	2a	75MW	Open cycle gas turbine plant;
	2b	110MW	Combined cycle gas turbine;

While seasonal peak loads have been increasing, with winter generally in the lead, the gap between them has been narrowing, with the last difference (1998) available being as small as 18MW at 315MW. The increased demand for air conditioning in summer seems to be the main cause for the smaller winter-summer peak differences. However, a cold spell like that of early February 1999 sends demand soaring (354 MW peak) even though the domestic sector is supposed to account for just 30% of total consumption.

In 1997/8 average consumption of fuel in electricity generation was 1,386 MT/day of HFO and 48 MT/day of diesel for the gas turbines. So, 30-day fuel requirements amount to 41,580 MT of HFO and 1,440 MT of diesel. With the coming on stream of the combined cycle plant at Delimara Power Station (DPS), the daily diesel requirement is likely to double.

The storage capacities at the two power stations are:

MPS	34000 mt HFO;	1000 mt diesel.
DPS	50000 mt HFO;	24000 mt diesel.

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6.3 Energy Consumption

This section outlines the energy transformations involved in the direct use of fuels, as well as in generation and use of electricity.

6.3.1 Fuels

For the year 1996 - 1997 the use of fuels was divided as follows:

LPG Butane (total)	16,161mt	
Propane (total)	173mt	
Jet A-1(Airlines only):	110,000mt	preferential price structure to boost sales
Kerosene	55000mt	users: govt. --1%; domestic – 11%; catering – 14%;
		Industry – 62%; Gozo – 12%.
Premium	58,900mt}	
	}	land transport (mainly private cars).
Unleaded	18,300mt}	
Gasoil (Diesel)	170,000mt	users: land transport – 86%;
		electricity generation – 13%;*
		bunkering – 1%;
*Set to increase with the coming on stream of combined-cycle plant at Delimara P.S.		
Light fuel oil	11,000mt	Industry
Heavy Fuel Oil	494,000mt	Electricity generation by EneMalta only.
Heavy Fuel Oil	8,000,mt	Sold to MOBC
Av gas	161mt	

The general trends in fuel use over the last two decades are shown in Fig. 6.4

The dominant use of primary energy for electrical generation is very evident; the modest drop over 1994/95 represents the phasing out of coal from MPS. Use of fuel for transport has also risen steadily after recovery from the price rises following the second oil shock, the residual effects of which can just be glimpsed at the start of the 1980s.

The other fuel-consuming sectors have not seen any dramatic changes; fuel for bunkering (diesel) saw a rapid rise over the first four/five years of MOBC but has remained almost steady ever since.

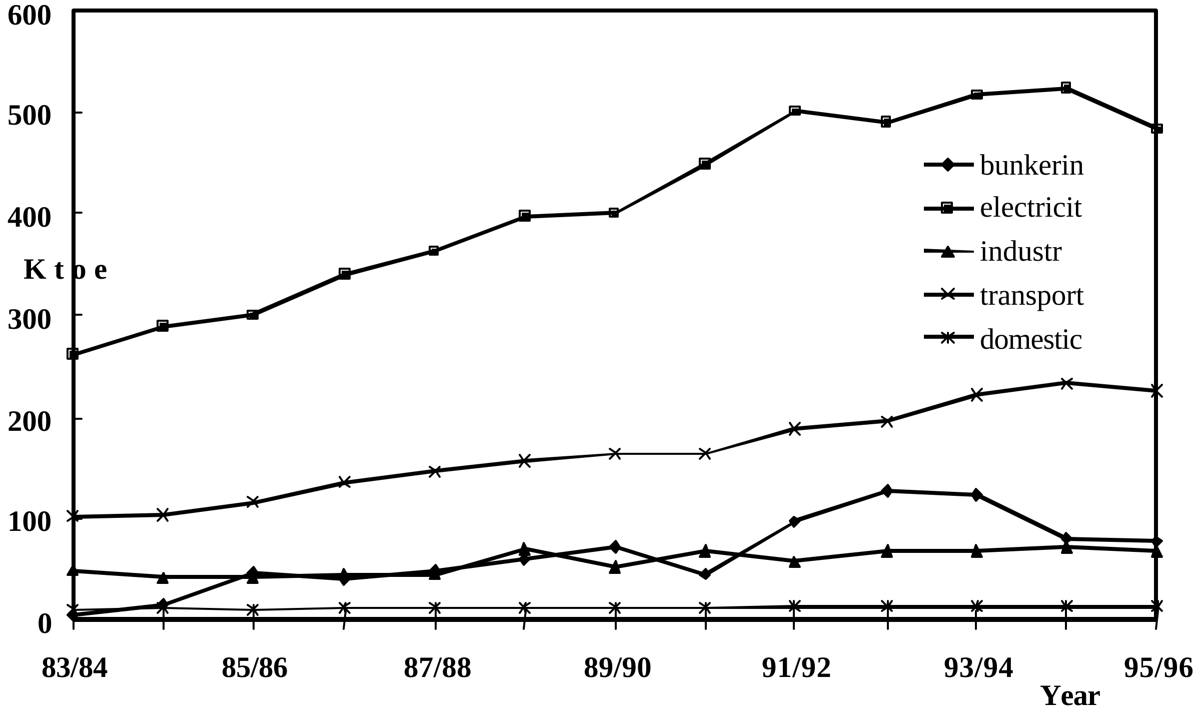


Figure 6.4 Utilisation of fossil fuels in Malta.

A good overview of the final destinations of imported fuels might be obtained from the table below, giving the 'fuel factor' (fraction of total importation of fuels devoted to each application) The values are for 1997/8.

		factor of fuel per application				
fuel	electricity gen.	industry	transport	catering	domestic	hotels
Fuel Oil	0.96	0.04	0	0	0	
Gas Oil	0.19	0.19	0.62	0	0	
T/Fuel Oil	0	1	0	0	0	
Petrol lead	0	0	1	0	0	
Petrol unleaded	0	0	1	0	0	
Jet a1	0	0	1	0	0	
Avgas	0	0	1	0	0	
Kerosene		0.23	0.11	0.11	0.2	0.35
LPG	0	0.10	0	0.30	0.6	

6.3.2 Electricity Generation

The complete switch to heavy fuel oil for electricity generation has proved to be a mixed blessing at MPS. The heavy falls of coal dust over the Menqa area have vanished and the problems of disposal of fly ash have also gone, even if residual problems remain in the area of the Benghisa dump. On the other hand, the

MPS electrostatic precipitators (EPS) have not proved effective in removal of particulate matter (soot) generated in oil-burning. One result has been continuous particle deposition on neighbouring settlements. The addition of emulsifying agents to the fuel (see below) has led to significant reductions in particle emissions; but the residual quantities still produce easily-detectable deposits on roofs and clothes lines. Worse still, there are episodes of heavy fall when stacks are blown (usually at night) to clear accumulated soot. On occasions when an air temperature inversion occurs over MPS, the smoke plume is actually deflected downwards, with dramatic results for settlements downwind from the stacks.

Incidentally, there is no type of particle filter at present at DPS. The height of the main stack (160m) is reckoned to ensure sufficient dilution of all pollutants coming out of the stack.

As far as sulphur content is concerned there is little to chose between coal and the currently-used heavy fuel oil. Sulphur dioxide concentrations in flue gases are high and measurements down wind from MPS have yielded values significantly higher than WHO standards particularly in the presence of particulates.

Because of the high costs involved, there are no plans for flue gas desulphurisation. However, Enemalta is looking at the possibility of using HFO derived from low-sulphur (<1%) Libyan crude as a way to cut down on SO_2 emissions, which we will be forced to do in any case under EU rules. One estimate [9] is that the switch to Libyan HFO will add about 12% to generation costs.

The two clear gains accruing from the switch to HFO from coal are reduced production of CO through better control of combustion conditions; and reduced CO_2 per unit of electrical energy generated through the higher calorific value of HFO.

6.3.3 Power Station Emissions

Emissions from power stations are closely connected with the fuel type that is being used. A major change occurred in 1995, with the final phasing out of use coal at MPS. Before that, coal had been excluded from DPS even though the first steam turbine sets had boilers designed to work on oil or coal. At DPS the phase 1 boilers have a continuous monitoring system for concentrations of CO, CO_2 and O_2, but no figures are available. A more elaborate system is planned for phase 2B, the combined cycle gas turbine plant.

At MPS emissions of NO_x (nitrogen oxides), and SO_2 (sulphur dioxide), opacity and dust (particulates) are now continuously monitored in the two 60 MW boilers; oxygen levels are measured in all the boilers, in order to ensure that slight excess of air that cuts down on the production of CO (carbon monoxide). Some CO cannot be avoided as this depends on the detailed distribution of air and fuel in the combustion chamber. Such a distribution is a property of the equipment.

The quality and quantity of fuel used largely determine the emissions from a power station. The one exception is NO_x, which is directly related to the combustion temperature. While higher combustion temperatures yield a higher efficiency of fuel use, they also increase the amount of NO_x produced.

With the current use of heavy fuel oil with 2.5 to 3.5% sulphur content SO_2 emissions ranging from 4000 to 7000 mg/Nm^3 have been measured in flue gases from both MPS and DPS [10]. The use of low sulphur oil (1%) would still leave both generating plants with SO_2 flue gas content slightly above the current EU limits [11].

Through the use of fuel additives, particulate emissions from MPS have been cut down by a factor four (from around 700 mg/Nm^3 to 150 mg/Nm^3); yet the lower value is still three times higher than the EU limit, currently at 50 mg/m^3. This reduction is often masked by episodes of soot blowing from chimneys. At present the electrostatic precipitators are not operational because of problems associated with the size and character of soot particles produced by oil firing.

There are isolated studies of emissions of SO_2 from MPS in the wider environment [12]. Overall there are two CORINAIR inventories, one for 1990 and one for 1994 [13]; while a greenhouse gas inventory for

1997 has been drawn up by the EPD [14]. Available results are collected below, without any critical attempt to assess their quality. The SO_2 value for 1997 has been computed on a proportional basis from CO_2 emission figures for 1994/1997. As can be seen there are no estimates or measurements for particulates, a key factor in public perception of power station emissions. Work on SO_2 attack on buildings [15] points to MPS as the main source of soot particles in the air for a radius of 6 km from Marsa.

		Pollutants (t/year)			
		SO_2	***NO_x***	***CO***	***CO_2***
	1990	2152	7459	248	1,411,000
Power Generation	1994	11987	6667	296	1,572,000
	1997	12505	5800	320	1,640,000

Averages of SO_2 (sulphur dioxide) concentrations measured at various locations within 3km <u>downwind</u> of MPS are given below [12]:

MPS:	**175 ? g/m^3**.
WHO guideline:	**125 ? g/m^3**
For short term exposure in presence of particulate matter.	

Over the period covered by the inventories (1990-1994) coal was still being used at MPS. There is at least one legacy from that period still with us. Ash from the main dump at Benghisa, about 1.3km south west of the Freeport, is regularly deposited on the surrounding countryside on windy days. The ash is chemically active and also weakly radioactive, but unless it is inhaled or come into contact with eyes, it poses no significant danger to health. On the other hand, its heavy metal content makes it an undesirable additive to soil.

Emissions from DPS have not been reported in any systematic manner. No type of particle filter is installed at DPS. There has been mention in a court case of metallic particle falls close to the main stack, and of carbon particle falls at Marsaxlokk, B'Bugia and Zejtun. But the impression is that in the original design of DPS, the height of the main stack (160m) was reckoned to reduce all emission problems to acceptable levels.

An 'emission' problem not connected with the stack involves the disposal of cooling water taken in from Marsaxlokk Bay and pumped out at the shoreline of *"Il-Hofra iz-Zghira"*. A daily cooling water volume of some 450,000m^3 with a temperature of 7?C above intake is pumped into the rather small volume (~2 million m^3). With the use of chlorine to prevent sea weed growths from blocking the outfalls, the meadows of *Posidonia Oceanica* a main sustainer of shallow water eco-systems, are being destroyed [16]. Increased generating capacity at DPS will make the situation worse.

6.3.4 Consumption of Electrical Energy by User

There is insufficient information at present for a very detailed breakdown of electrical energy by user; but an adequate picture can be drawn from Enemalta and WSC annual reports [17],[18] together with additional information kindly supplied by both corporations.

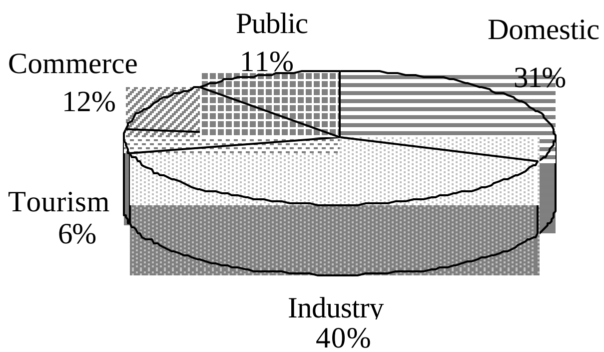
Over the last five years around 6% of generated power has been actually used at the generating stations, which is about the going rate for isolated power stations. Losses in the distribution system are of the same order of magnitude (~5%), which compares favourably with continental networks. That still leaves 7-8% of generated units unaccounted for, variously assigned to billing anomalies and plain theft.

Despite numerous court cases, Enemalta has had little success in bringing energy theft under control. In either case, these 'lost' units form part of total units actually consumed, rather than wasted. As such the problem is a financial rather than a technical one.

As far as units sold are concerned, Enemalta has three classes of consumer: domestic commercial and industrial, each taking approximately a third of generated units, with industry in the lead.

A more detailed breakdown of the units sold over 1996/97 gives the following:

Figure 6.5 Electricity Consumption by Sector



6.3.4.1 Water Production

One major use of electricity in Malta is in water production. It is for this reason that this is being detailed in a separate section. The Water Services Corporation (WSC) is the leading single consumer of electricity. This is why water demand has been included in an energy audit. In 1994/95 electrical energy demand by WSC soared to almost one fifth of the units sold by Enemalta; but it has been dropping steadily since, for two reasons outlined below.

Water from the Reverse Osmosis (RO) plants still forms about 50% of daily production. For 1996/97 R.O. production amounted to 24.5 million m^3 at 5.8kWh per m^3. WSC thus remains the largest single user of electrical energy, even if its annual consumption has seen a marked decline over the last three or four years. The reported consumption of electrical energy by WSC is given in the table below.

	1994/95	1995/96	1996/7	1997/98
WSC (GWh)	239.75	206.33	174.99	162.50
EneMalta Sales	1259.00	1382.00	1414.00	1710.00
WSC usage	19%	15%	12%	9.5%

The drop in energy consumption is mainly the result of a decline in demand for water. Most of the decline is *real*, as it started soon after the 1995 water price increase; but the efforts of WSC to cut back on leakage losses may also have appeared as an apparent drop in consumption, as more of the water produced would have been reaching the end user.

On the question of 'lost' water, there is no agreed figure, not least because the matter has been turned into a political football. The best that can be said in the present circumstances is that unaccounted-for water has declined from its January 1995 peak of 67% of production to around 50% at present (January 1999). At an average (RO and Groundwater) of 3.26 kWh $/m^3$ this represents an energy wastage of 75 million kWh or 43% of the total energy consumed by WSC. Some of this water loss (around 10% of production) must be due to theft, and does not really contribute to the energy wasted. However, there is clearly plenty of room for WSC to make further cuts in its consumption of electricity.

Incidentally, there is no estimate of (electrical) energy used in the production of second class water from the sewage treatment plant at Sant'Antnin, l/o Marsascala.

6.3.5 Fuel use in industry

The energy content (in ktoe) of fuels used in industry has shown only modest fluctuations over the period 1980/81 to 1997/98 (see Table below)

There was an upward discontinuity in 1988/89 from around 45 ktoe in the previous five years to 65 ktoe in the following eight years. From the piechart for fuel use in industry for 1994 (shown below), it looks as if the increased consumption was the result of greater activity in the construction industry. The importation of gasoil (diesel), the major fuel used by the construction industry, points in the same direction, with the on-going increase of some 14 ktoe p.a. starting off in 1988/89. The series of major infrastructural works started after the change of government in 1987 points in the same direction. But examination of the breakdown of gasoil consumption over the period 1990-98 shows that the major part of the increase is now coming from transport demands.

tons of oil equivalent (k t o e)														
	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98
Coal														
Fuel Oil				2.4	20.1	5.3	19	7.5	18.5	14.8	17	17	17	17
Gas Oil	13.7	15.1	13.3	13.0	14.6	15.5	16.8	18.4	19.5	22.5	24.2	19.7	21.4	20.0
T/Fuel Oi	13.8	13.7	17.9	17.0	17.8	16.0	15.0	13.0	12.0	11.5	11.5	12.0	12.0	13.0
Prem.														
Kerosene	8.2	7.7	9.2	9.8	11.7	10.3	11.9	12.2	12.1	12.5	13.7	13.7	13.7	3.8
LPG	6.0	5.2	6.2	6.1	6.2	6.4	6.5	7.2	7.0	6.8	6.8	6.9	6.8	6.8
Total toe	41.7	41.7	46.6	46.0	70.4	53.5	69.2	58.2	69.1	68.1	73.1	69.3	70.8	60.6

Fuel consumption in industry is dominated by the construction industry demands for petrol and diesel, with the latter contributing about 78% of the total fuel ktoe for the construction industry and 36% for industry as a whole.

LPG is widely used in manufacturing, food processing, bread making, catering and furniture making. However, any attempt to estimate environmental impact of fuel use in industrial activity can only give very approximate results. In 1994, for instance, out of a total of 421ktoe of fuel used, 6.5 ktoe (1.5%) came from unspecified "other fuel". Some clue to possible identities for "other fuel" might be obtained from the fact that in bread making, out of the total energy used (2.1 ktoe excluding about 0.65 ktoe electricity) 39% comes from "other fuel", which in this case can range from scrap wood, to spent motor oil and to kerosene. On the other hand, fuel consumption for food processing and for beverages was 67% "other fuel", for which kerosene is the most likely candidate. In fact in making "other fuel" ktoe estimates, we have assumed that the "other fuel" **is** kerosene sold at 10c per litre.

Electrical energy from the power stations is the source of practically all of the secondary energy used in industry. Over most of the period 1981 - 1997, electrical energy consumed by industry has risen at the same rate as the general increase: 9% p.a. compound up to 1994. Thereafter, the rise in demand from industry alone has eased off. Although there may be some contribution from an alleged reduction in industrial activity, the main contributor to this easing off has been the largest single user of electricity, the WSC. Between 1995 and 1998 the electrical energy devoted to the production and distribution of water fell from 19% to just 9% of units sold by Enemalta. There was no corresponding easing off in demand in the combined commercial and domestic sectors.

The energy cost of water provided by the WSC ranges from 5.4kWh for $1m^3$ of RO water to 1.1kWh for $1m^3$ of ground water. The consumption of metered water by industry reached a peak of 2.11 million m^3 in 1994 and has dropped to below 1.35 million m^3 in 1997. Total industrial consumption will be higher than this through utilization of unmetered sources like rain water, privately-owned boreholes and small in-house RO plants in cases of access to the sea.

It is not possible to obtain a breakdown of electricity and water use by specific industries. Official statistics simply give the <u>combined monetary value</u> of electricity and water consumption. This reflects the fact that the WSC is the metering and billing agent for both itself and for Enemalta. So for instance, any attempt at determination of the CO_2 contribution by various sectors of industry is doomed to fail unless consumption of electrical energy and of water are separately known.

6.3.5.1 Emissions and waste production

The two CORINAIR inventories both contain estimates of emissions by industry as a result of combustion and in the course of production processes. The production of CO_2 decreased by about 5% between 1990 and 1994, probably through increased use of electricity by industry; SO_2 suffered a much steeper decline of 20%. In absolute quantities these pollutants remained at a level of 3 -6% of those produced in electricity generation. Carbon Monoxide (CO) on the other hand rose by close to 40%, while remaining at about 8% of power generation CO.

Pollutants (t/year)

		SO_2	NO_x	VOC	CO	CO_2
Ind. Combustion	1990	464	145	-----	13	91000
	1994	331	116	3	20	86000
Prod. processes	1990	---	8	1801	5	4000
	1994	4	12	2725	5	4000

Of more concern was the hefty increase of 50 % in VOC emission, mainly through solvent use. Although the absolute quantities remain fairly small and somewhat less than those from road transport, the impact on people does depend on the exact situation in which VOCs are released. A badly ventilated spray workshop for instance, may expose workers to elevated quantities of VOCs even if the absolute quantities released are relatively harmless if there were to be rapid dispersal.

Aside from the official inventories on emissions from industry, there are a number of situations which require at least qualitative comment. At least two important public institutions -- St.Luke's Hospital and Malta International Airport (MIA) -- operate "incinerators", one to deal with clinical waste and the other with waste generated by air travel. In neither case is there any proper control of combustion conditions, any particle filters or any treatment of flue gases.

The hospital incinerator is sited in a heavily built-up area which is subjected to a constant drift of soot particles. These, however, may be the most "benign" pollutant emitted from the "incinerator". The following quote [19] describes the St. Luke's situation perfectly :

A number of important problems in relation to this treatment method can be mentioned: emissions of CO, dust, HCl, heavy metals and dioxin are estimated to be very high from these incinerators. The emissions are mainly caused by the fact that incinerators generally are not equipped with adequate flue gas cleaning systems, adequate systems for the control of temperature and oxygen, and they are not designed with an adequate after-burning chamber. Furthermore, waste is stoked in batches creating large variations in the combustion, the incinerators are run by operators with little or no knowledge of combustion technology, and finally the incinerators are used only a few hours per day thereby creating a daily start and stop of the plant during which combustion is badly controlled.

These comments refer to experience with Danish hospital incinerators of some 20 years ago. Further comment on our situation is superfluous.

Mention must also be made of the disposal of plastic products (generally containers) after a single use. Low temperature combustion of plastics, particularly the ubiquitous PVC, occurs frequently at Wied Fulija, Maghtab and Qortin (Gozo) in the presence of organic matter. In such situations CO, dust, HCl and dioxins are produced and will deposit over human settlements downwind from the landfills. No attempt has ever been made to monitor emissions either from "incinerators" or burning landfills.

Information about solid and liquid waste production by industry is available in some detail. The major component of solid waste comes from the building industry which sent 1.215 million tonnes (81%) to Maghtab in 1997. A further quantity of at least 0.5 million tonnes went into worked-out quarries, according to an agreement reached two years ago between quarryowners, construction companies and government. This deflection of construction waste from Maghtab should provide a breathing space for a more systematic approach to managing the landfill and particularly to curtailing its spread. But a concerted attempt to recycle significant fractions of construction waste must be made. This must be accompanied by a crackdown on fly tipping, which has now reached damaging levels.

Other types of industrial waste amounting to 165,000t were generated in 1996/7. Close to 40% of this was recycled, re-used or sold. Paper and cardboard, with around 8% of total waste, are the favourite candidates for recycling, most of which occurs abroad. Glass and textile waste (4%) come next.

Two comparatively new areas for reuse are scrap aluminium and CFCs. These complement the older materials like copper and iron/steel which have generally been collected and exported. Aluminium is turned into ingots and exported.

Uncompacted white goods and cars constitute an as yet untackled residue of industrial waste, one moreover which tends to invade many sites outside Maghtab

The final destination of toxic solid or liquid wastes are not well known. Although Enemalta has been running a collection scheme for spent lubrication oil for some years, much of this is still finding its way into storm water drains, sewers, or into bakery burners where it can transfer is lead content into bread in old fashioned ovens.

Large amounts of spent oil, waste chemicals and batteries have been deposited at Maghtab. Recent monitoring of coastal waters next to the landfill has detected the presence of heavy metals which are almost certainly being leached out of the landfill [20].

The small battery collection scheme set up in 1995 is still functioning with a fair degree of success. However, in its years of operation no method of recycling batteries has emerged; storage space is running short. As for dead car batteries, these are now routinely returned to the seller, with a small discount being given on the price of a new battery.

Another industry which is known to invade the sewage system is the agro-industry. With high density pig and chicken breeding significant quantities of liquid waste is generated. While there is a bowser collection service for such waste, many breeders attempt to dump it in the normal sewage system or in a nearby water course. A recent case involved a chicken farmer who was dumping large quantities of semi-liquid waste into Wied is-Sewda, Attard. The sources of a pumping station downstream from the farm were contaminated; a number of days worth of production of water were lost and minor flooding caused in Qormi by the pumping station off-loading contaminated water.

Shipyard activities constitute sources of industrial waste. The tank cleaning farm at Ricasoli treats bilge oils, tank washings and ballast waters. Recovered oil is used as an energy source for plant operations. The final effluent is discharged into the sea outside the harbour. Analytical tests [21] have shown residual oil content which is high compared to limits set by the Maritime Authority.

The other major source of shipyard waste is grid blasting. The copper slag used as grit contains copper and nickel; the spent grit containing the metals as well as rust and anti-fouling compounds constitutes hazardous waste. Production is currently around 10,000t annually which are dumped at sea in designated areas.

One other respository of industrial waste might be mentioned: the small disused power station at Corradino. The building, which is permanently closed, contains several tens of tons of asbestos [19], a silicate material which in the bulk solid state is inert. But if it is sawn or cut up with the release of fibres it becomes a mechanical carcinogen; its fibres lodge in the lungs causing asbestosis.

Much more problematic is the stock of old electrical transformers full of the coolants polychlorinated biphenyls (PCBs). These chemicals are non-inflammable and extremely stable; unfortunately they are also fat soluble like other organo-chlorines (e.g. DDT), and have become a universal environmental pollutant, even though their manufacture was banned over twenty years ago. As long as the PCBs remain inside the transformers they can do no harm; but period inspection is required to ensure that there are no leaks.

6.3.5.2 Land use by Industry

Industrial development prior to 1965 - 70 was concentrated in the inner harbour area. The major activities in ship repair, power generation and flour milling were firmly wedged into the residential areas of Cottonera, Valletta and Marsa.

A more rational siting for industry came about through the activity of the Malta Development Corporation, a government agency with the brief of promoting foreign investment in the local economy. The MDC owns a number of industrial estates (IE) most of which have been properly planned as industrial areas. The largest of these are at Hal Far, Bulebel, Marsa and Kordin. Together with the single IE at Xewkija, Gozo, these estates cover 357ha. or 1.15% of the national territory. At least another 0.25% must be added to this to cover Malta Dry Docks, Malta Shipbuilding and Marsa and Delimara power stations.

Outside the IE's there are other areas which have been assigned to industrial uses in an *ad hoc* fashion in the course of delineating development schemes. As these assignments were not backed by appropriate planning they have now attained a high nuisance value in residential areas and are coming under increasing pressure to relocate to an IE. The total area assigned to industrial use has been given in the Table below [22]. An additional 65ha have been added to cover the craft villages at Ta' Qali (Malta) and Ta' Dbiegi (Gozo).

Location	Area (ha)	% total area
Ind. Estates	357	1.15

Craft Villages	65	0.21
Other	120	0.38
Total	542	1.74

Two other types of land use might be connected directly with industry. The construction industry depends on quarrying activities for major parts of its raw material. Aside from differences in quarried area, the impact of hardstone and soft stone quarries on the local ecosystem is different. Hardstone quarrying is concentrated on coralline limestone outcrops which are usually areas of high quality garrigue. The quarrying not only destroys garrigue over the quarried area but, with the dumping of spoil and the shroud of fine dust from the crushers sterilises an area two or three times that of the quarry itself. Total areas covered by active and disused quarries of both types are given below [23]:

Softstone 1.1 km^2 of which 0.1 km^2 illegal;

Hardstone 1.4 km^2 of which 0.2 km^2 suspended.

The other industrial land use is made up by landfills. At present only two landfills are fully operational: Maghtab (Malta) and Qortin (Gozo). On both islands there is now some use of disused quarries for dumping construction waste, even if much greater quantities can in fact be taken. On Malta there are three closed landfills : Luqa, ic-Cumnija and Wied Fulija.

The total area covered by landfill is close to 60ha (0.14%); small additions like that of the Benghisa ash dump, industrial estate dumps etc. might be made. At present the only expanding landfill is Maghtab; it will continue to expand as long as there is no easing off in the dumping of construction waste. A recent ministerial statement gave the ultimate capacity of Maghtab as 11 million tonnes of waste.

6.3.5.3 The Tourist Industry

Tourism is considered to be a key sector in the economy of the Maltese Islands. Since 1959 tourist arrivals have grown from a mere 12,5000 to 1,182,240 in 1998. Income for the period 1959 - 1997 grew from around Lm 750,000 to over Lm 249 million. Tourism in 1997 contributed 22.9% to the export of goods and services and employed a total of 9445 persons or 6.9% of the gainfully occupied in hotels and catering establishments [24].

Catering for tourists requires land for the construction of appropriate facilities. Very often such developments are sited in areas of high landscape value. However, development usually does more harm than good to the area as a result of degradation of pristine and sensitive environments and of coastal and rural landscapes of high scenic value. This is particularly the case when a proposed development is out of scale with its setting.

Tourist development in the Maltese Islands has been characterised mainly by the development of tourist accommodation facilities. Around 94% of the tourist accommodation supply in terms of beds is found in coastal areas and some developments have facilities occupying stretches of the foreshore with hotel developments and beach concessions. There are also a number of developments that have been constructed in rural areas and outside development zone boundaries. Very often such intrusive developments have resulted in a negative visual impact on the rural landscape.

From a physical survey [25] carried out by the Planning Authority hotels and holiday complexes take up 0.3% of the total land area; this figure does not include holiday flats. Most of the tourist development is concentrated along coastal stretches particularly in the areas around St. Paul's Bay, Sliema, St. Julians/Paceville and Marsaskala in Malta, and Marsalforn and Xlendi in Gozo.

Energy and water consumption by tourists have not varied greatly over the period 1990 - 1997. Water consumption has ranged between 1.1 and 1.7 million m^3 p.a., but has remained close to 7.5% of total consumption. Most of the water used for tourism purposes goes in an untreated state through the main outfalls to the sea. Some 80% of water used goes into the sewage system, generating some 880,000 m^3 of sewage.

Electricity consumption has increased steadily from 56.8 GWh in 1990 to 83.6 GWh in 1997. Here again tourism consumption has moved between 6 and 7.5% of total consumption.

The results from the Tourist Survey show that 50%, 42.4% and 48.7% of the respondents coming in the summer , winter and shoulder months respectively, make use of public transport. In 1998 a total of 567,000 tourists made use of public transport. With a conservative estimate of three trips per tourist, this works out at 1.5 million journeys by public transport, generating a total income of at least Lm 150,000 from ticket sales.

Car rental is another service which tourists avail themselves of. The Tourist Survey results show that in 1998 a total of 329,000 tourists made use of hired cars. The traffic increase resulting from tourist activities ranged from 57 cars per day in the low season to 190 in the high season. The impact appears to be small but is not as small as it appears because of concentration of tourist cars in specific areas. In one specific type of car hire the impact is anything but small. 'Safari trips' in off-road vehicles are causing widespread damage in garrigue areas on Gozo mainly. Local off-roaders generally restrict themselves to Malta, with equally damaging results of course.

6.3.6 Transport

The table below shows fuel consumption in ktoe by transport mode. Figures for sea transport are for fuels (fuel oil and diesel combined) used in bunkering. In the case of bunkering and aviation fuels, the quantities sold by MOBC and MIA respectively are mostly burnt outside national territorial boundaries. Attempts to inventory pollution arising from aircraft movements, for instance, must assume model aircraft landing and take-off patterns.

USE	FUEL TYPE	90/91	91/92	92/93	93/94	94/95	95/96	96/97
	Diesel	37	39	41	45	48	41	53
Road	Premium	61	63	63.4	64	62	62	60
	Unleaded	1.7	4.2	7.3	9.6	12.0	13.0	13.0
Sea	HFO+Diesel	45.2	96.7	127	123	80	78	82.9
	Jet A1	61	80	105	132	139	123	149
Air								
	Avgas	0.1	0.1	0.1	0.1	0.1	0.1	0.1

The use of fuels for land transport has been influenced by technical, environmental and prices considerations. For more than 20 years we have kept a strong price differential (now nearly a factor of 2) between petrol and diesel in favour of the latter. The grounds were mainly economic, as diesel is used by commercial, public transport and industrial vehicles. Fairly late in the day compared to european countries we have been increasing imports of unleaded petrol. While the degree of use of such petrol is well documented, there is little information on the prevalence of catalytic converters. The first imported cars using lead free petrol did not have converters installed; car dealers reported no great rush to install them at Lm 100 - 120 extra cost. At present, most cars of european make come with an installed converter, but then there is no routine emissions testing to warn the motorist when the converter is reaching the end of its useful life.

With the very large increases in petrol prices a good number of private car owners are switching from petrol to diesel-engine models, despite the premium of at least an extra one thousand Liri on purchase price. This shift has also been pushed by the increasing popularity of four-wheel drive vehicles and to a lesser extent of pick-up trucks as private cars. Such vehicles almost invariably have diesel engines. The 1997 consumption of diesel for road transport purposes amounted to a total of 71.7% by weight, of all road transport fuel [13].

6.3.6.1 Traffic environment and emissions

The road network has close to 300 km. of major road and a total of 1500 km of surfaced roads of all types. Taking only private cars and cars for hire for 1997 [13], this works out at about 1.8 m of major road per car, which is well short of one car length. This is a good indicator of the potential, and in specific areas and at specific times actual, congestion of local traffic.

The growth in motor vehicle usage on main arterial and distributor roads has averaged between 3% and 5% over the last five years [26]. In terms of congestion of the road network vehicle usage cannot be treated in isolation. Lack of proper parking space leads to use of most distributor roads and sometimes even arterial roads (e.g. Hamrun High Road) for parking during working and shopping hours. In the evening cars shift to streets in residential areas, where garage space is limited and costly to rent. Here street parking is a source of hydrocarbons (lubricating oil) in run-off water, to the extent that direct collection and use of such water is rendered impossible.

Traffic accidents, most of them minor, average about 30 per day over the whole road network; while fatalities among car users and pedestrians vary between 15 and 25 per annum. In view of a lack of detailed accident evaluation, one cannot arrive at a breakdown of causes. Poor road engineering, pot holes and bad repairs; excessive speed; non-observance of road and parking rules; and mechanical failure in poorly maintained vehicles must all contribute. The projected introduction of a vehicle road test should improve matters; but government is being very pusillanimous in bringing existing legislation into operation.

Over the period 1990 - 1997 an average of 9500 new cars were imported every year, while the total increase in licensed private cars reached 57800. Estimates of cars scrapped each year range up to 2000; but no figures are available for importation of second-hand cars.

At the end of 1997 there was a total of 164,873 licensed private cars, which puts us at 1.5 cars per household. This high average figure masks the dramatic rise in the number of two and three-car families over the period 1989 - 1998 : from 18.2% to 29.5% and from 4.7% to 10.3% respectively [27].

The rise in car ownership has been reflected in changing modes of travel as determined by household travel surveys [27]. While the proportions of mini-bus/coach, motorcycle and foot travellers did not change much between 1989 and 1998, the proportion of car drivers/passengers rose from 54.7% to 70.2% while public bus travellers nose-dived from 24.3% to 11.5%.

The relative numbers of car drivers to car passengers point to vehicles carrying single persons on around 75% of journeys. Moreover, estimates of annual distances covered -- 5500 km to 8000 km – point to a multiplicity of short journeys. Such journey lengths, combined with low average speeds (~30 kph at rush hours) and some 30% of the car fleet being more than 15 years old [26], must lead to a high incidence of traffic-generated pollution. Diesel engines in particular are sensitive to RPM (and therefore to speed of vehicle) in the amount of pollutants they put out.(From 1500 RPM to 3500 RPM, CO decreases by factor of 2.2; NO_x by a factor 10; smoke (particulates) on the other hand, increases by a factor of 14) [28].

There are as yet no emission standards set locally, no mandatory emission testing and no continuous monitoring of air quality. The use of emission values given by car manufacturers is futile; actual emissions are usually at least twice specified [29], all the more here where local conditions determine emissions . As a result almost no direct measurements of traffic emissions are available to date, though there are estimates based on fuel consumption. However, even these estimates do not include particulates – an item of increasing importance with the increasing presence of diesel-engined private cars and the almost universal use of diesel engines for goods, commercial and public vehicles.

A set of absorption tube measurements for NO_2 and SO_2 and were carried out by the B'Kara local council at two sites in the town : one in the most sheltered part of the busy arterial road going through the town, and the other about 500m away and 30m up the side of the valley. Results are given in the Table below. As sampling time was 30 days, and repetition interval 60 days, data points are few and far between, providing no basis for correlation between traffic density, weather conditions and high-pollution episodes. Among other things, one cannot determine the contribution to SO_2 content reaching the area from MPS over the collection period.

Location	**Month**	**NO_2 ?g/m^3**	**SO_2 ?g/m^3**
Valley Rd.	Aug.97	61.3	30
Old Church		29.5	20.6
Valley Rd.	Oct.97	76.6	33.4
Old Church		43.8	16.7
Valley Rd.	Dec.97	56.4	47.6
Old Church		33.1	9.1
Valley Rd.	Feb.98	44.8	40.1
Old Church		30.2	15.2

It is evident that the WHO guidelines: NO_2 < 40 ?g/m^3; SO_2 < 50?g/m^3 are being reached quite frequently. The SO_2 concentration is particularly worrying in view of the known synergism between SO_2 and airborne particulates. The work of Pulis [30] provides the only set of measurements to date on airborne particulate matter correlated with traffic . The concentrations measured under conditions of high traffic density (from 700 to 1200 vehicles per hour) were above the 50 ?g/ m^3 limit assumed in the WHO-EU guidelines. In the case of Msida particulate densities reached 95 ?g/m^3 and this in an area likely to have both traffic and MPS SO_2 at elevated levels.

The use of leaded petrol injects quantities of lead into the atmosphere. The consumption of such petrol reached its peak in 1993/94 (64,000Mt) and declined to 60,000Mt in 1996-97.

Atmospheric lead concentration correlates strongly with traffic densities, reaching 1.6 ?g/m^3 at peak traffic times and going as low as 0.043 ?g/m^3 in rural areas [31].Traffic also contributes to lead content in soil situated close to roads; in playground dust and in urban area household dust [32]. The last two can constitute important pathways for lead ingestion by children, while the first may remain inactive because of the alkaline nature of local soils. However, recent changes in fertiliser practice can lead to lowering of soil pH and so to mobilising the lead for plant absorption.

The urgency of phasing out leaded petrol has been highlighted by recent work on benzene and toluene levels in urban air [33]. Concentrations of benzene several times the UK guideline value were frequently found immediately after morning rush hours. These hydrocarbons can only be removed from vehicle exhaust by use of catalytic converters which require unleaded petrol for correct functioning.

Despite a 5% annual rise in the car fleet, transport related lead emissions have been slowly declining from their 1993/94 peak, while blood lead levels of neonates and adults have been declining steadily from the middle 1980s to the present. However, neonate values particularly must still call for continued efforts to curb atmospheric lead levels. In this respect the recent announcement by Enemalta that it will start importing leaded petrol with about a third of the current lead content is a step in the right direction.

Inventory quantities of road transport-related emissions determined for two CORINAIR inventories (1990 and 1994) are shown below.

	Pollutants (t/year)				
Year	**SO_2**	**NO_x**	**VOC**	**CO**	**CO_2**
1990	256	3559	2640	20974	351000
1994	256	3544	2640	20974	351000
1994 (EPD)	513	7078	5015	41809	701000
1997	330	4500	------	31800	383000

Clearly the 1994 quantities cannot be correct as they are in almost all cases identical to the 1990 values. A "correct" set supplied by EPD shows that the quantities of major traffic emissions CO_2, CO, SO_2 and NO_x all doubled over the four year period. Even these values are doubtful as the overall increase in registered motor vehicles of all types was around 22%, while the consumption of petrol and diesel increased by 20%.

An independent approach to the problem, using quantities of fuel consumed to calculate CO_2 road transport emissions gives the following values :

	CO_2 (000 Mt)	**% inc**	**% inc. reg. veh**
1989/90	297 (304[1])		
		21	24
1993/94	361		
		6	8
1996/97	383 (388[2])		

([1]) Private communication Ing. C. Buttigieg.
([2]) 1997 Synoptic Greenhouse Gas Emission Inventory (EPD).

From the 1997 Inventory, the values for the main land transport pollutants including CO_2 and SO_2 are given in the CORINAIR table above.

Clearly a standard procedure and agreed quantities of fuels are required for drawing up these inventories. Apart from that a field monitoring network needs to be put urgently into place.

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6.4. Heat Pollution

The total injection of heat energy into the atmosphere from an annual consumption of around one million toe of various fuels is some 10 billion kWh. This value is about 5% of the solar energy incident on the whole of the national territory over a similar period.

6.4.1 Hydrocarbon losses

Despite the potential importance to the health of specific social groups and ecosystems, little consideration has been given to routine hydrocarbon losses. There are neither estimates nor measurements of unburnt fuel in car exhausts, for instance; nor any indication of evaporative losses in petrol stations, where the pump operators could easily be inhaling health-threatening quantities of VOCs. from motor vehicle fuel. A significant but largely ignored hydrocarbon loss arises from leakages of lubricating oil from vehicles, including heavy vehicles, parked in streets and roads.

On a larger scale, episodes of fuel or oil spillage are recorded, in most cases at least with rough estimates of the volume lost. Recent analysis [21] of Grand Harbour sediments has detected persistent residues from from recent MPS oil spills.

Enemalta does not publish figures of fuel loss from storage tanks such as seems to be occurring at Wied Dalam. A major problem is the age of the storage installations and the expense involved in replacing them.

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6.6 Energy Efficiency - limited action

This section attempts to determine the levels of efficiency in the various areas of energy use and transformation. These include energy efficiencies at the two power houses, in buildings, in transport and in industry. The discussion is conditioned by the data available, which is adequate only in the case of the power stations.

6.6.1 Electric Power Generation

While generation efficiencies are ultimately set by well-known physical laws, type and age of equipment, as well as the nature of demands made on it can have significant effects on the efficiency obtained in practice.

Marsa Power station (MPS) with its ageing equipment still generates around 55 - 60% of electricity. The combined overall thermodynamic efficiency of both power stations is close to 25%. With station use and distribution losses of 6% and 5% respectively, electricity end-user efficiency would be around 22%.

The coming on stream of new generating sets at DPS has seen a gradual improvement in the situation. The base load steam turbines (120 MW) are rated at 28.6%, while the gas turbine units (74 MW) are rated at 25.4%. The new combined cycle (CC) plant (110 MW) has been test run at more than 45% efficiency, which would yield an overall DPS efficiency of 32%. In practice the efficiency should be somewhat higher as the least efficient open cycle gas turbines are used as sparingly as possible.

The coming on stream of the CC unit will lead to increased efficiency of generation for another reason. The steam turbine sets can be run at a constant level to provide the average base load, while the CC plant, with its greater flexibility, can cater for load peaks.

Winter peak demand has been higher than the summer one by an average of 25%. The actual difference in MW has depended on winter temperatures. Over the last three years, however, winter peaks have been only some 7% higher than summer peaks, and both summer and winter temperatures are now influencing the difference. This change has come about through increasing installation of air conditioning equipment. The very hot period in late June-early July 1998 narrowed the winter - summer maximum demand gap to a mere 18MW. Heavy and possibly wasteful use of air conditioners pushed up the summer peak demand.

In fact there has been little attempt at demand management by Enemalta. The notion that MPS could be closed down once DPS was up and running was soon abandoned in the face of an 9% compound annual increase in demand in the late 80's and early 90's. Special night rates have been taken up only by two heavy industrial users and the WSC, and even then have produced no significant amount of load levelling. No operations customarily carried out by day were shifted to night In any case, until very recently WSC was obliged to run the RO units 24 hours/day to keep up with demand for water. Now that the demand has slackened, it has proved possible to switch off individual trains in a R.O. plant. All R.O. plants recover energy for the pumps from the reject water which makes up 2/3 of input. Overall, WSC is pursuing a vigorous leakage elimination program and is now attempting to cut back on electrical energy consumption by installing speed controls on distribution pumps as well as by a general energy efficiency drive.

Enemalta has been working steadily at cutting its transmission and distribution losses. With the full coming on stream of the Phase I capacity of DPS, a 132kV link from DPS to Marsa South DC. was set up to supplement the five 33kV feeders. The 132 kV underground cable circuits have been extended to Mosta.

Step down from 132 kV to 33kV or 11kV direct is carried out at Marsa South DC. Power factor improvement is achieved by introducing capacitors in the 11kV/415V distribution substations. The Corporation also encourages heavy users to improve their power factor by charging them on the basis of kVA rather than kW.

6.6.2 Energy Use in Buildings

The general climatic conditions of the Maltese islands have hot, dry summers, with peak daytime temperatures above 30?C between June and September and mild, rainy winters with peak temperatures between 10?C and 15?C. Apart from temperature, the perceived degree of discomfort is also strongly determined by the relativly high humidity both in summer and winter. As a result, the simple use of ‘degree-days’ to determine a heating or cooling load may not give the best results. For instance in summer, with outside shade temperatures of 30?C, air conditioners are often set to 18?C, with disregard of thermal comfort criteria. This is energetically expensive; leads to unpleasant thermal shock in moving to non-conditioned parts of a building. A summer setting range of 22-26?C with a 45-65% relative humidity should suffice for thermal comfort [34].

Traditional building methods and design had features intended to provide some protection against winter and summer temperature extremes. Most of these features have been lost in modern building design mainly through pressure of cost, space and relatively cheap energy which encouraged occupants to resort to (energetically expensive) technical fixes. At present, insulation, lighting, heating and ventilation are hardly ever integrated into the initial design stages of a building.

Domestic water heating is now almost exclusively electrical. Gas-fired hot water tanks have practically disappeared, mainly because of unwarranted doubts about their safety. Space heating, on the other hand, normally takes place through localised heating of the occupied space only (as opposed to heating the whole house). The fuels used in descending order of preference are electricity, gas and kerosene. The latter two, with a delivery of some 80% of the calorific value of the fuel are much more energetically efficient than electricity. But the general absence of flues in houses does make the burning of fossil fuels somewhat dangerous, polluting and a source of condensation. There is no use of an integrated boiler and hot water system in dwellings. The combination of temperatures and relative humidities between mid November and mid April are such that accepting thermal comfort criteria there is a case for space heating. Electricity consumption and peak demand show a strong dependence on ambient temperature

The role of humidity in producing “perceived cold” is largely unexplored. The porosity of globigerina limestone certainly does not help to lower the ambient air humidity, particularly in old houses, often built without a damp course. Quite frequently a dehumidifier in a room running at 200 - 300W will serve to remove the *sensation* of cold far more effectively than a 1000W fan heater. The role of cross-ventilation in controlling humidity has been largely neglected. Very often the more voluminous spaces in older houses have given way to an extra floor, with a total disruption of the original ventilation regimes.

Windows have also lost their ability to control the microclimate. Vertically proportioned openings with louvers on the outside have been superceded by horizontal picture windows, with a greater concern for the view than for solar exposure. Inside blinds remove glare but do not cut down solar exposure at all. Electrical systems have been brought in to compensate, with an expenditure of energy that is being felt nationally.

There is little or no use of thermal insulation in cavity walls of new building stock. Stone-cutting techniques and structural stability requirements of local limestone buildings have taken cavities from 150mm down to 10mm. Current building technology concentrates on reducing the cost of stonework and on gaining internal space; but it shows little concern for the thermal performance of buildings. Dwellings in particular have no thermal cavity insulation. The capital cost “saving” made at the construction stage is paid for dearly in running costs due to the inefficient thermal performance of the building envelope. Roof insulation is treated in similar fashion. The latest trend of having a waterproof membrane has raised some awareness about some form of thermal insulation, laid under the waterproof membrane, although some still confuse waterproofing with insulation. Worse still, few realise that the generally dark-coloured membranes increase the absorption of solar radiation by the roof. This area of building technology is devoid of *savoir faire* at grass-roots level.

Bond-stones of double leaf external walls provide a bridge for humidity from an external surface into indoor space. Rising damp tends to proliferate in case of abridged damproofing at the finishing stage, often attributed to the persisting problem of a lack of good workmanship or supervision.

Building services are always an afterthought in most domestic buildings. Installation methods generally enhance thermal and damp bridging; there is no insulation applied to hot water pipes, particularly those buried underground or running down service shafts. High heat losses are accompanied by increased water wastage while waiting for hot water to reach a tap.

Orientation is another factor often overlooked by architects and developers alike. Layouts are often more dictated by standard planning norms (e.g. the sitting room as the front room) while not so much concerned with making the best use of solar gains in winter and shading devices in summer. In non-domestic buildings air conditioning is called in for south facing open plan offices or showrooms. These are often single glazed without overhangs, allowing the high summer sun to penetrate inside.

Concrete technology has boosted the spread of the open plan from factory and office buildings into homes. The standard yardstick for terraced houses was to maximise open spaces, often inefficient in terms of their winter thermal environment. Two typical examples are oversized bathrooms and the 'impressively' large combined (sitting-dining) room.

Imposing hall-staircases transform a large poorly lit ground floor space into a centrally-located living room. However, such spaces lack comfort during our cool damp winters; they are difficult to heat as warm air rises up the stair well. Very often electric oil-filled radiators are used to no significant effect except on the electricity bill.

6.6.3 Energy Efficiency in Transport

As far as air transport is concerned, energy efficiency is entirely outside our control, as we have no aircraft or engine construction industry. The negative side to this neutral position is that we do refuel old, inefficient aircraft because of our low fuel prices.

The main local use of fuel is of course in road transport. At first sight efficiency in fuel use here might be thought to resemble that in air transport. We do not produce any cars and the local market is too small to make its own demands on the makers as far as fuel economy is concerned. However, these factors are completely overborne by local conditions. The major road network, only some 280 km. in length, is in a poor condition. There are energy losses amounting to 1-2% of total energy used in a given journey in negotiating pot-holed surfaces; and even in conditions of free traffic flow, one cannot safely run at speeds at which the engine is at its most economical. In any case, traffic densities on most main roads on working days also limit speeds; at rush hours an average speed is below 30 km per hour. At such a speed, even a well-tuned engine is working under conditions where combustion is incomplete; there is an increase in fuel consumption and exhaust emissions. With the prevalence of poor vehicle maintenance, and about 30% of the vehicles over 15 years old [26], the driving conditions exacerbate inefficient fuel use and lead to increased pollution.

From the point of view of fuel consumption per passenger-km we are also badly off because of the limited use of public transport. The number of passengers carried went down by 40% between 1992-97 [13]. There is almost a total absence of 'car-pooling', where people would normally share the use of a car for common work trips. According to a recent Planning Authority survey, some 65 to 70% of rush hour private cars are carrying just the driver.

6.6.4 Energy Efficiency in Industry

Apart from the situations at Enemalta and at WSC, there is an almost complete lack of information on energy efficiency programmes being currently pursued by industry. In fact it is not even possible to estimate energy use in the various sectors of industry principally because the CoS compilations [34] only give monetary value for *combined* water and electrical energy consumption.

However, there are at least two firms which are actively pursuing energy efficiency/conservation programmes. ST Electronics is in the middle of a four year programme which has set annual targets for reduction of water and energy consumption in all sections of the complex microchip production line at the Kirkop works.

Brandt International, on the other hand have concentrated on an energy saving drive for their office section, with controlled energy-saving lighting and a low energy standby for their computer network.

One other conservation effort known to have been undertaken by industry is the new fermentation building at Farsons brewery; this has been designed to ensure a constant working temperature by passive solar means.

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6.7 Acknowledgements

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To others, from The Planning Authority, The Public Transport Authority and the Environment Protection Department, whose help was specifically acknowledged in the text , we wish to say thank you once again.

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7. AIR QUALITY

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7. AIR QUALITY

7.1 Introduction

Air quality in a country is generally determined by economic activity. In Malta, industrial production is heavily reliant on electrical energy and thus, the most serious air pollutants from industrial activity are principally those emitted from chimney stacks at the power houses in Marsa and Delimara. In addition to these two point sources of pollution, the other serious contributor to air pollution in Malta is transportation. Most of the petrol and especially diesel engine vehicles are not equipped with air pollution abatement equipment and thus their exhaust gases and particles are being emitted into the local ambient air with probable significant effects on air quality and health of the general population. Other lesser sources of air pollution, which may however be very important locally are: quarrying and construction activity; incinerators; dockyard activities; fuel storage and dispensing; garage industries involving spray paint operations; landfill sites; concrete batching plants and fireworks.

The detailed state of pollution of Malta's ambient air is largely unknown since no robust monitoring programme of air pollutant measurements was ever undertaken prior to 1997; at the time of writing (1999), such monitoring work is still lacking. The only information on local air quality as exists derives from sporadic publications from academics at the University of Malta and some data generated by the Pollution Control Coordinating Unit (PCCU) of the Environment Protection Department. The present report is based on such data as has appeared up to 1997.

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7.2 Sulphur Dioxide

Together with nitrogen oxides, sulphur dioxide (SO_2) is the source of environmental acidification. The gas converts into sulphuric acid which can kill aquatic organisms, damage habitat and erode buildings and monuments. The alkalinity of Maltese soil is particularly effective in buffering the effects of sulphur dioxide but does not protect vegetation from the direct effects of the gas on leaves, fruit etc. SO_2 contributes to both local pollution and large scale pollution through long distance transport in the atmosphere.

SO_2 emissions are determined by industrial structure and energy consumption, which is affected by both energy intensity and efficiency. Emissions are also influenced by the standard of pollution abatement and control and the use of clean production technology.

The two power stations in Malta (at Marsa and Delimara) are not equipped with end of pipe sulphur dioxide removal systems; nor do they burn fuel using fluidized bed technology with lime injection which is the main technique of sulphur dioxide abatement employed in modern fossil fuel derived power generation. This technique is not without problems for Malta since the disposal of the gypsum by-product may not be trivial. Pollution control is achieved by dispersal from chimneys, of which, only the one at Delimara is of suitable height. The four chimneys (two of 45 m height and two of 80 m) at Marsa station are prone to fumigate and downwash smoke onto neighbouring densely populated sites. Electrostatic precipitators present on three of the 7 boilers for the removal of particles do not work well with fuel oil because of the high humidity of the flue gas.

A pilot study of air pollution from sulphur dioxide was undertaken during May-December 1990 and was published three years later[1] and this represents the only study to date where active sampling techniques were used to cover a wide area of the island. The results indicated that the sulphur dioxide concentration in ambient air was strongly dependent on atmospheric conditions: at Paola, concentrations (1 hour averages) ranged from below detection limit (25 ?g m^{-3}) to 160 ?g m^{-3} depending on wind direction; in Marsa, downwind from the power station (wind from the NE), values ranged from 200 to 320 ?g m^{-3} but were otherwise low or even below detection limits; in Hamrun, with southeasterlies blowing, concentrations ranging between 110 to 220 ?g m^{-3} were observed. These preliminary results suggest that the power station at Marsa is the principal polluter in the area with respect to sulphur dioxide and automotive traffic contributes in a very minor way. Indeed, in 1990, traffic-derived SO_2 was less than 5% of the total SO_2 pollution load emitted into Malta air. The percentage contribution from road traffic has been further reduced by the sharp increase in powerhouse emissions brought about by the operation of the Delimara station.

The WHO guidelines for short term (approx. 1 hour) exposure to sulphur dioxide are as follows (in ?g m^{-3}): 500 (with no particulate matter); 125 (combined with particulate matter)[2] . Human exposure to SO_2 and its products in air contributes to respiratory morbidity and mortality; particularly sensitive to airborne sulphur dioxide are children and the elderly, asthmatics and individuals with cardiovascular or chronic lung disease. The health effects of sulphur dioxide are known to be much more pronounced when the gas is accompanied by suspended particles and water vapour. No information on the particulate load in Malta air is currently available but results from a study on the effects of air pollution on limestone surfaces[3] shows that the atmosphere in areas which are close to major traffic roads is indeed polluted with carbon particles which deposit onto exposed surfaces of the built environment. Particulate carbon is associated with vehicular exhausts, particularly those from diesel engines. For these reasons, and using the results of the 1990 study together with meteorological information on wind direction, one can conclude that it is likely

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[1] Vella AJ, Caruana S and Demanuele J, 1993, *Malta Medical Journal,* v 5(2) 34-38.

[2] Anon, 1987: Air quality guidelines for Europe, WHO, Copenhagen.

[3] Vella AJ, Camilleri AJ and Tabone Adami JP, 1996, *Environmental Geochemistry and Health,* v 18(40) 165-170.

that inhabitants of areas surrounding the Marsa power station lived in an atmosphere that was polluted with harmful amounts of sulphur dioxide originating from the power station for about 15% of the time.

In 1997, the situation had changed from that of 1990 in the following ways: (1) coal burning at Marsa was discontinued in favour of fuel oil; (2) a new power station was built in Delimara, which caused a substantial part of the generating power to shift to the new site and (3) automotive traffic volume increased dramatically over that obtaining in 1990. It is practically impossible to predict the net result of these three effects on the sulphur dioxide pollution status in the areas of interest. The situation can only be remedied by the launch of a robust programme of air monitoring especially in areas of perceived high risk. Policy decisions regarding steps to be taken in order to improve air quality require such crucial primary data.

During 1997 the B`Kara local council contracted out a diffusion tube analysis programme for sulphur dioxide monitoring: measurements of one month duration were taken on a bimonthly basis over a period of five months. The results are shown in Table 7.1.

According to EU standards, the annual mean guideline value for sulphur dioxide is 50 ?g m $^{-3}$. The Valley Road sulphur dioxide average value was about 75% of the guideline limit while the Old Church area value was significantly lower. These results, which, in view of the methodology adopted, can only be regarded as indicative, suggest that traffic-generated sulphur dioxide in Birkirkara, while probably within EU guideline values, is not negligible.

Table 7.1: Mean monthly SO_2 concentrations (Diffusion Tube Analysis), B`Kara Local Council August-December 1997

Location	Month	$[SO_2]$ /?g m^{-3}
Valley Road	August 97	30.0
Old Church Area	August 97	20.6
Valley Road	October 97	33.4
Old Church Area	October 97	16.7
Valley Road	December 97	47.6
Old Church Area	December 97	9.1

Although sulphur dioxide pollution in areas which are distant from the power stations is indeed expected to be significantly lower than that in proximate areas, the values in Table 1 which represent *monthly averages* measured from passive samplers cannot be compared with values quoted earlier from the 1990 study which pertain to *hourly averages* taken from active samplers.

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7.3 Nitrogen Oxides

Nitrogen oxides (NO_x), mainly nitric oxide (NO) and nitrogen dioxide (NO_2), are predominantly emitted by transport sources as well as by other energy uses and industrial sources. In Malta, there are no chemical industries which release significant amounts of nitrogen oxides into the air as a process by product. Another source of airborne nitrogen oxides is nitrogeneous fertilisers when used in excessive quantities in agriculture. Nitrogen oxides are associated with both respiratory morbidity and mortality in humans. NO_2 is particularly poisonous and can irritate the lungs and lower the resistance to respiratory infections. In the presence of sunlight, NO_x react with volatile organic compounds (VOCs) to form tropospheric ozone and other oxidizing chemicals: these are oxygen compounds that are toxic to living forms, including human beings. Nitrogen oxides convert into nitric acid in rainwater and condensation water (fog, mist, cloud) and they exacerbate the deleterious effects of sulphur dioxide on aquatic organisms, stone artefacts, agriculture and habitat.

Published data on nitrogen oxide concentration in Malta air is limited to that provided by the B'Kara Local Council study of August-December 1997: the information is reproduced in Table 7.2.

Table 7.2: Mean monthly NO_2 concentrations (Diffusion Tube Analysis), B`Kara Local Council August-December 1997

Location	Month	$[NO_2]$ /?g m^{-3}
Valley Road	August 97	61.3
Old Church Area	August 97	29.5
Valley Road	October 97	76.6
Old Church Area	October 97	43.8
Valley Road	December 97	56.4
Old Church Area	December 97	33.1

The EU guideline value for the annual mean NO_2 concentration is 40 ?g m^{-3}. The values in Table 7.2 suggest that air pollution in Valley Road is significantly higher than that in the old church area and this is compatible with the traffic density difference at the two sites. Also, the data suggest that in Valley Road, the pollution status exceeds the EU guideline value for deemed safe exposure to the gas.

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7.4 Ozone, carbon monoxide, particulate matter, volatile organic compounds

No reliable data on these air pollutants were available for 1997 and none was published prior to the date.

Ongoing work by the Atmospheric Pollution Unit of the Department of Physics (University of Malta) involves monitoring of background ozone and carbon monoxide at a remote site in Gozo (Tal-Gordan lighthouse). Ozone is also being measured at Xewkija and at Tal-Qroqq campus, Msida. The results of this work have not yet been published.

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7.5 Lead in air

Leaded petrol containing tetraethyl lead is the main source of airborne lead-containing particles in the ambient air in Malta. Lead chloride and lead bromide particles are emitted from exhaust pipes and settle out slowly from the air. During their transit from the air to the ground, lead-containing particles can be inhaled; contamination of house- and street-dusts with lead compounds and consumption of contaminated food, especially bread, can also contribute to ingestion of the toxic heavy metal. The presence of high levels of lead in the local environment and, in particular, in the blood of the local population is a well established fact[1] and indicates significant pollution with respect to this toxic metal. With the banning of importation of red lead-containing paint, the main source of lead input into the local environment is leaded petrol, with shotgun lead pellets being a second, probably less significant source.

Emissions of lead into the air from the combustion of leaded petrol can be calculated on the basis of the empirical relationship, namely, $E = 0.75\ K_{Pb} . b$ where E is the emitted lead load in kg, K_{Pb} is the lead content of petrol in kg/kg and b is the total consumption of petrol in kg. The average lead content of imported leaded petrol is 0.0004 kg/kg and in 1997, 60322 tonnes of the fuel were imported. Thus, for 1997, the emitted lead load was 18100 kg. This compares favourably with the value for 1990 which was 21000 kg. Despite the fact that the size of the car fleet has increased at an average of 10% per year over the period of interest, the consumption of unleaded petrol has increased from about 2% in 1990 to about 25% in 1997.

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[1] C. Savona-Ventura, Lead in the Maltese environment and its significance to man, 1998, *J.Euromed Pharm.*, v 1(4) 8-13 and references therein.

7.6 Greenhouse gases (GHG)

The main greenhouse gases (GHGs) are carbon dioxide (CO_2) , methane (CH_4) and nitrous oxide (N_2O). While there are natural emissions of GHGs, anthropogenic emissions have been identified as a source of climate change and are the subject of an international instrument (UN Framework Convention on Climate Change). Such emissions are determined by a country's energy use and production systems, its industrial structure, its transportation methods, agriculture and livestock management, waste management and consumption patterns of the population.

The Intergovernmental Panel on Climate Change (IPCC) has determined that the earth's temperature could rise by between 1 and 3.5 degrees Celsius by 2010: an average rate of warming probably higher than any in the last 10 000 years.

Parties to the Climate Change Convention are committed to return, by 2000, their anthropogenic emissions of carbon dioxide and other GHGs not controlled by the Montreal Protocol to their 1990 level.

No data is available on nitrous oxide concentrations in Malta air. However, background levels of carbon dioxide, carbon monoxide (which is an intermediate product of oxidation of hydrocarbons) and methane have been routinely measured since 1993. Samples of air have been collected on a quasi-weekly basis since October 1993 using a portable Martin and Kitzis sampler from Pinu Point Gozo (36^{o} 15'N, 14^{o} 13'E, 125m above sea level). The site was chosen since it is a relatively isolated area with little effect of contamination from locally generated air pollutants.

The collected air samples are sent for analysis to the National Oceanic and Atmospheric Administration/ Climate Monitoring and Diagnostic Laboratory (NOAA/CDML) in the USA.

Table 7.3 illustrates data collected for the calendar year 1997.

Table 7.3 Measured background concentrations of greenhouse gases (EPD)

Date	Time	Sample	CO/ppb	CH_4 / ppb	CO_2 /ppm
5/1/97	0830	307-91	104.570	1825.360	367.38
5/1/97	0830	308-91	104.500	1827.220	367.32
15/1/97	0830	251-91	138.810	1805.430	364.18
15/1/97	0830	252-91	137.690	1806.000	364.20
3/2/97	0815	4153-91	297.430	1826.300	369.93
3/2/97	0815	4154-91	298.250	1832.720	369.86
27/2/97	0825	609-91	163.850	1805.770	366.93
27/2/97	0825	610-91	164.350	1809.140	367.05
4/3/97	0900	841-91	173.930	1815.320	369.12
4/3/97	0900	842-91	172.970	1822.610	369.04
8/3/97	0900	829-91	165.900	1805.060	366.48
8/3/97	0900	830-91	165.670	1806.000	366.41
24/3/97	0900	1193-91	214.610	1841.740	370.52
24/3/97	0900	1194-91	214.570	1844.900	370.60
18/4/97	0900	541-91	162.270	1807.070	367.97

Table 7.3/ continued Measured background concentrations of greenhouse gases (EPD)

Date	Time	Sample	CO/ppb	CH_4 / ppb	CO_2 /ppm

18/4/97	0900	542-91	161.210	1806.090	367.91
26/4/97	0815	1463-91	206.670	1829.970	370.99
26/4/97	0815	1464-91	206.190	1826.070	370.99
28/4/97	0800	269-91	201.730	1770.650	368.11
28/4/97	0800	270-91	203.210	1768.560	368.06
8/5/97	0915	605-91	168.430	1743.810	366.63
8/5/97	0915	606-91	252.840	1765.120	375.02
17/5/97	0815	537-91	174.560	1819.650	367.82
17/5/97	0815	538-91	174.770	1821.010	367.88
21/5/97	0735	589-91	220.270	1758.470	367.57
21/5/97	0735	590-91	217.310	1761.300	367.54
29/5/97	1000	57-91	234.010	1819.570	364.99
29/5/97	1000	58-91	233.580	1816.490	364.89
3/6/97	0730	293-91	161.790	1727.940	365.27
3/6/97	0730	294-91	164.000	1659.740	363.35
15/6/97	0735	515-91	183.720	1774.750	368.17
15/6/97	0735	516-91	183.510	1769.400	367.99
25/6/97	0700	329-91	125.480	1796.390	361.20
25/6/97	0700	330-91	138.840	1785.520	361.28
12/7/97	0745	27-91	138.030	1807.370	361.10
12/7/97	0745	28-91	135.380	1808.980	361.00
18/7/97	0830	1615-91	171.380	1749.330	355.37
18/7/97	0830	1616-91	168.340	1746.100	355.28
24/7/97	0830	4401-91	212.290	1800.510	360.57
24/7/97	0830	4402-91	211.620	1797.230	360.57
3/8/97	0730	4415-91	131.060	1790.800	359.06
3/8/97	0730	4416-91	133.670	1788.170	358.99
8/8/97	0830	161-91	143.560	1715.130	360.52
8/8/97	0830	162-91	140.640	1710.520	360.58
15/8/97	0900	341-91	171.530	1854.280	355.87
15/8/97	0900	342-91	170.430	1854.360	356.04
22/8/97	0830	4659-91	150.550	1805.640	362.56
29/8/97	0900	4661-91	105.200	1770.000	358.82
29/8/97	0900	4662-91	101.260	1770.550	358.87
12/9/97	0730	1927-91	139.610	1809.550	360.82
12/9/97	0730	1928-91	133.810	1811.140	361.06
19/9/97	0830	1198-91	138.060	1792.700	362.77
3/10/97	0830	517-91	122.170	1767.340	359.96
3/10/97	0830	518-91	121.740	1769.200	360.17
16/10/97	0730	1419-91	178.270	1789.350	367.40
16/10/97	0730	1420-91	176.910	1785.870	367.36
30/10/97	0730	379-91	116.280	1795.250	357.56
30/10/97	0730	380-91	114.580	1786.350	358.05
5/11/97	0830	645-91	138.010	1805.340	361.24
5/11/97	0830	646-91	138.640	1810.240	361.85
10/11/97	0730	473-91	177.870	1811.540	367.45

Table 7.3/ continued Measured background concentrations of greenhouse gases (EPD)

Date	Time	Sample	CO/ppb	CH_4 / ppb	CO_2 /ppm

10/11/97	0730	474-91	178.290	1816.640	367.86
20/11/97	0730	153-91	132.050	1829.340	360.19
20/11/97	0730	154-91	130.720	1825.680	360.25
25/11/97	0730	329-91	117.190	1824.410	362.24
25/11/97	0730	330-91	117.690	1820.480	362.58
3/12/97	0730	1483-91	191.020	1794.840	364.23
3/12/97	0730	1484-91	192.640	1798.350	364.45
10/12/97	0730	113-91	167.680	1758.860	367.22
10/12/97	0730	114-91	169.070	1754.240	367.45
18/12/97	0830	369-91	172.880	1785.640	365.55
18/12/97	0830	370-91	174.340	1780.540	365.24
22/12/97	0830	423-91	237.240	1775.240	364.28
22/12/97	0830	424-91	235.720	1769.240	365.05
29/12/97	0830	608-91	178.850	1794.350	365.58
29/12/97	0830	609-91	178.850	1787.540	365.86

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Figure 7.2 shows levels of methane in air for the period August 1994 to December 1997. In this case the trend is not as clear as that for carbon dioxide, although a 5-10% difference between peak and troughs exists. Fluctuations in methane concentrations would result from variation in air concentrations of atmospheric oxidants but other factors may also be involved.

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Figure 7.1 Concentration data for Carbon Dioxide

Annex A

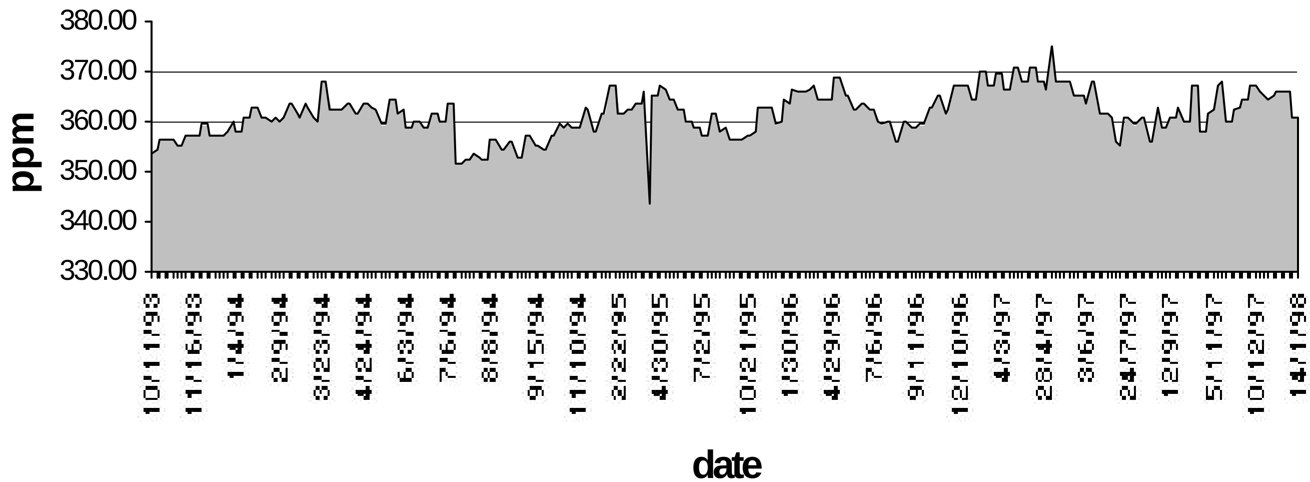
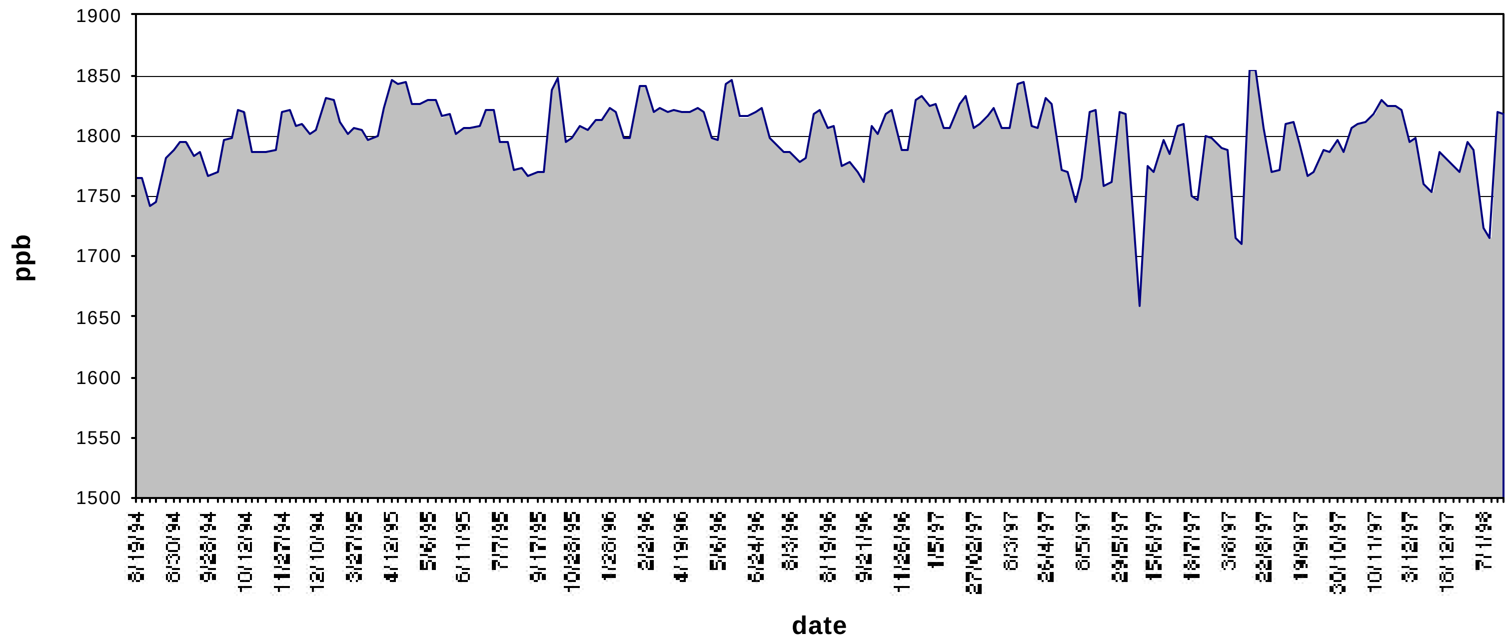
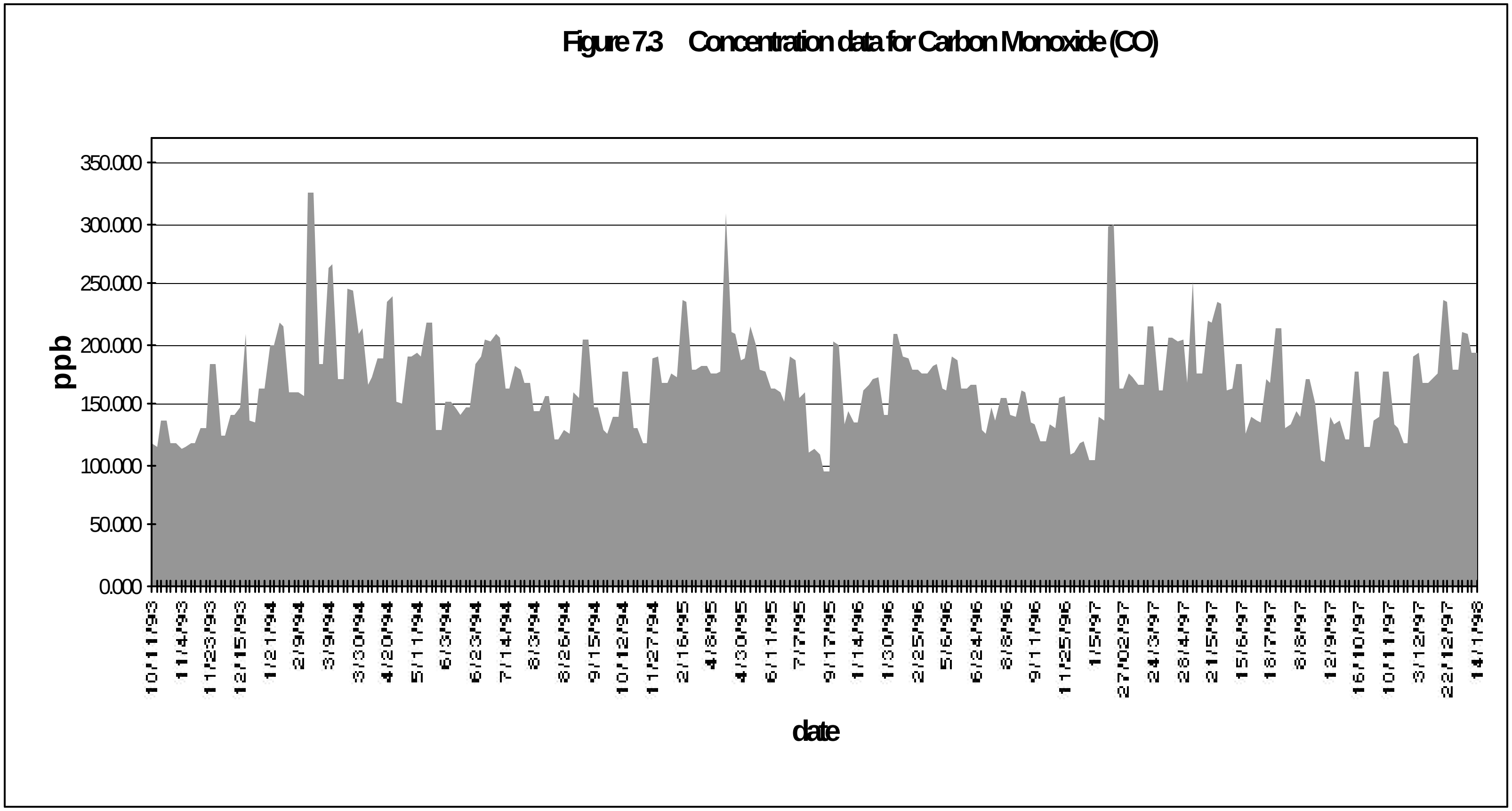


Figure 7.2 Concentration data for Methane (CH_4)





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7.6 Greenhouse gases (GHG)

The main greenhouse gases (GHGs) are carbon dioxide (CO_2) , methane (CH_4) and nitrous oxide (N_2O). While there are natural emissions of GHGs, anthropogenic emissions have been identified as a source of climate change and are the subject of an international instrument (UN Framework Convention on Climate Change). Such emissions are determined by a country's energy use and production systems, its industrial structure, its transportation methods, agriculture and livestock management, waste management and consumption patterns of the population.

The Intergovernmental Panel on Climate Change (IPCC) has determined that the earth's temperature could rise by between 1 and 3.5 degrees Celsius by 2010: an average rate of warming probably higher than any in the last 10 000 years.

Parties to the Climate Change Convention are committed to return, by 2000, their anthropogenic emissions of carbon dioxide and other GHGs not controlled by the Montreal Protocol to their 1990 level.

No data is available on nitrous oxide concentrations in Malta air. However, background levels of carbon dioxide, carbon monoxide (which is an intermediate product of oxidation of hydrocarbons) and methane have been routinely measured since 1993. Samples of air have been collected on a quasi-weekly basis since October 1993 using a portable Martin and Kitzis sampler from Pinu Point Gozo (36^{o} 15'N, 14^{o} 13'E, 125m above sea level). The site was chosen since it is a relatively isolated area with little effect of contamination from locally generated air pollutants.

The collected air samples are sent for analysis to the National Oceanic and Atmospheric Administration/ Climate Monitoring and Diagnostic Laboratory (NOAA/CDML) in the USA.

Table 7.3 illustrates data collected for the calendar year 1997.

Table 7.3 Measured background concentrations of greenhouse gases (EPD)

Date	Time	Sample	CO/ppb	CH_4 / ppb	CO_2 /ppm
5/1/97	0830	307-91	104.570	1825.360	367.38
5/1/97	0830	308-91	104.500	1827.220	367.32
15/1/97	0830	251-91	138.810	1805.430	364.18
15/1/97	0830	252-91	137.690	1806.000	364.20
3/2/97	0815	4153-91	297.430	1826.300	369.93
3/2/97	0815	4154-91	298.250	1832.720	369.86
27/2/97	0825	609-91	163.850	1805.770	366.93
27/2/97	0825	610-91	164.350	1809.140	367.05
4/3/97	0900	841-91	173.930	1815.320	369.12
4/3/97	0900	842-91	172.970	1822.610	369.04
8/3/97	0900	829-91	165.900	1805.060	366.48
8/3/97	0900	830-91	165.670	1806.000	366.41
24/3/97	0900	1193-91	214.610	1841.740	370.52
24/3/97	0900	1194-91	214.570	1844.900	370.60
18/4/97	0900	541-91	162.270	1807.070	367.97

Table 7.3/ continued Measured background concentrations of greenhouse gases (EPD)

Date	Time	Sample	CO/ppb	CH_4 / ppb	CO_2 /ppm

18/4/97	0900	542-91	161.210	1806.090	367.91
26/4/97	0815	1463-91	206.670	1829.970	370.99
26/4/97	0815	1464-91	206.190	1826.070	370.99
28/4/97	0800	269-91	201.730	1770.650	368.11
28/4/97	0800	270-91	203.210	1768.560	368.06
8/5/97	0915	605-91	168.430	1743.810	366.63
8/5/97	0915	606-91	252.840	1765.120	375.02
17/5/97	0815	537-91	174.560	1819.650	367.82
17/5/97	0815	538-91	174.770	1821.010	367.88
21/5/97	0735	589-91	220.270	1758.470	367.57
21/5/97	0735	590-91	217.310	1761.300	367.54
29/5/97	1000	57-91	234.010	1819.570	364.99
29/5/97	1000	58-91	233.580	1816.490	364.89
3/6/97	0730	293-91	161.790	1727.940	365.27
3/6/97	0730	294-91	164.000	1659.740	363.35
15/6/97	0735	515-91	183.720	1774.750	368.17
15/6/97	0735	516-91	183.510	1769.400	367.99
25/6/97	0700	329-91	125.480	1796.390	361.20
25/6/97	0700	330-91	138.840	1785.520	361.28
12/7/97	0745	27-91	138.030	1807.370	361.10
12/7/97	0745	28-91	135.380	1808.980	361.00
18/7/97	0830	1615-91	171.380	1749.330	355.37
18/7/97	0830	1616-91	168.340	1746.100	355.28
24/7/97	0830	4401-91	212.290	1800.510	360.57
24/7/97	0830	4402-91	211.620	1797.230	360.57
3/8/97	0730	4415-91	131.060	1790.800	359.06
3/8/97	0730	4416-91	133.670	1788.170	358.99
8/8/97	0830	161-91	143.560	1715.130	360.52
8/8/97	0830	162-91	140.640	1710.520	360.58
15/8/97	0900	341-91	171.530	1854.280	355.87
15/8/97	0900	342-91	170.430	1854.360	356.04
22/8/97	0830	4659-91	150.550	1805.640	362.56
29/8/97	0900	4661-91	105.200	1770.000	358.82
29/8/97	0900	4662-91	101.260	1770.550	358.87
12/9/97	0730	1927-91	139.610	1809.550	360.82
12/9/97	0730	1928-91	133.810	1811.140	361.06
19/9/97	0830	1198-91	138.060	1792.700	362.77
3/10/97	0830	517-91	122.170	1767.340	359.96
3/10/97	0830	518-91	121.740	1769.200	360.17
16/10/97	0730	1419-91	178.270	1789.350	367.40
16/10/97	0730	1420-91	176.910	1785.870	367.36
30/10/97	0730	379-91	116.280	1795.250	357.56
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22/12/97	0830	423-91	237.240	1775.240	364.28
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Annex A

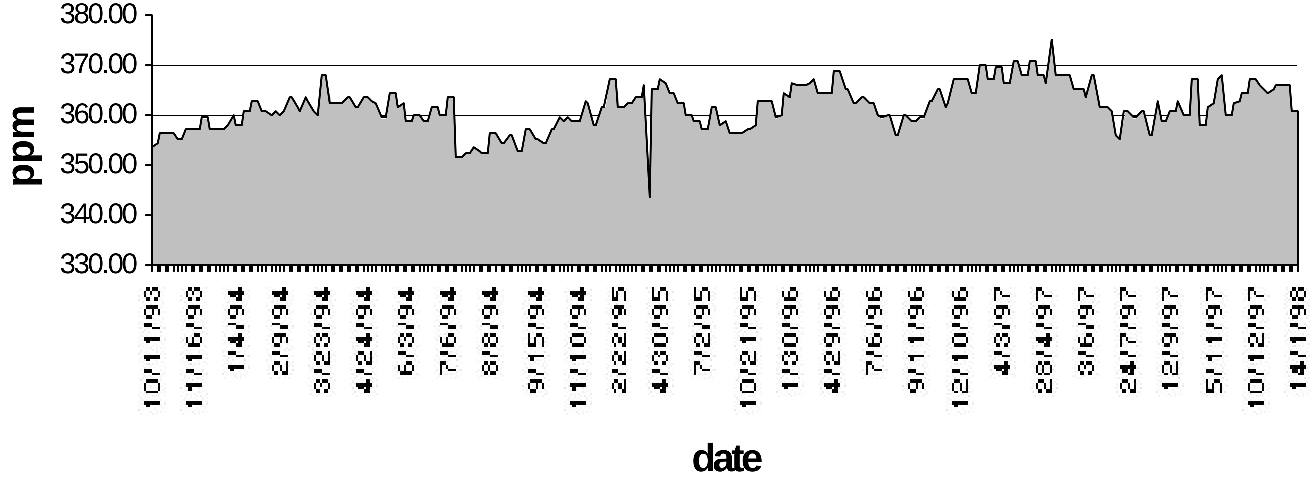
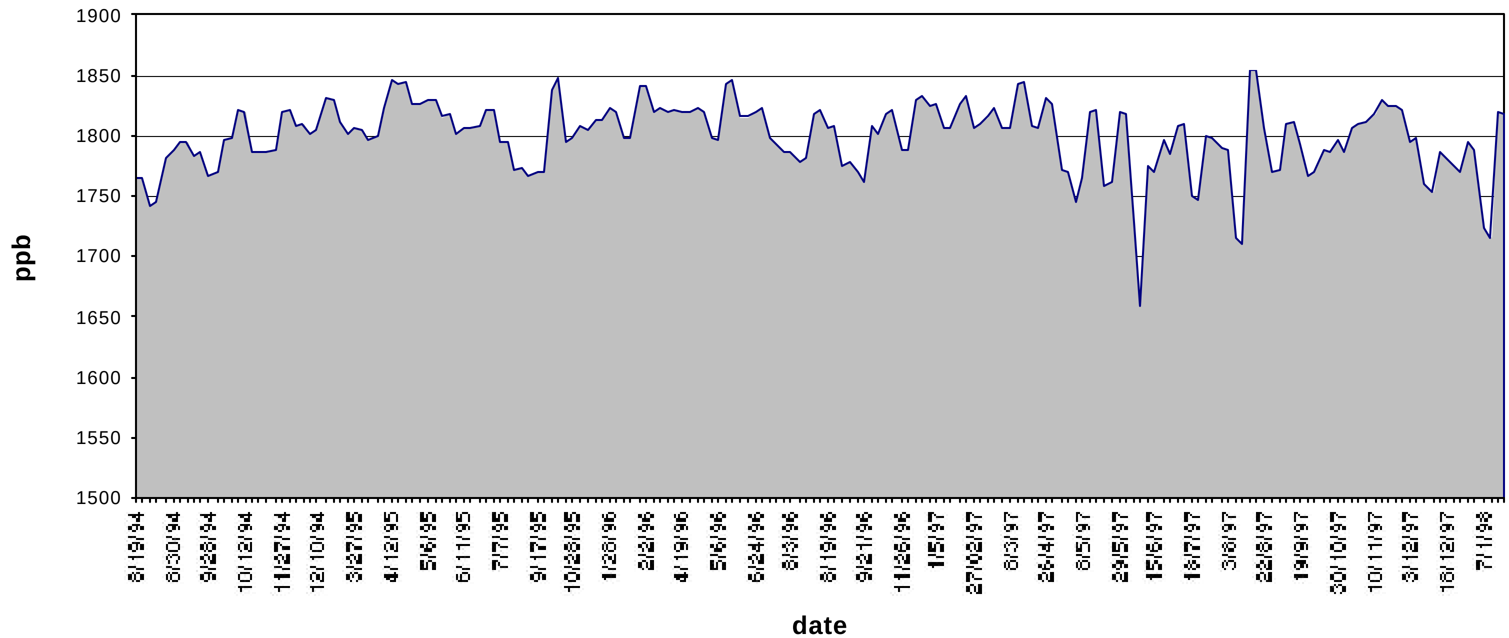
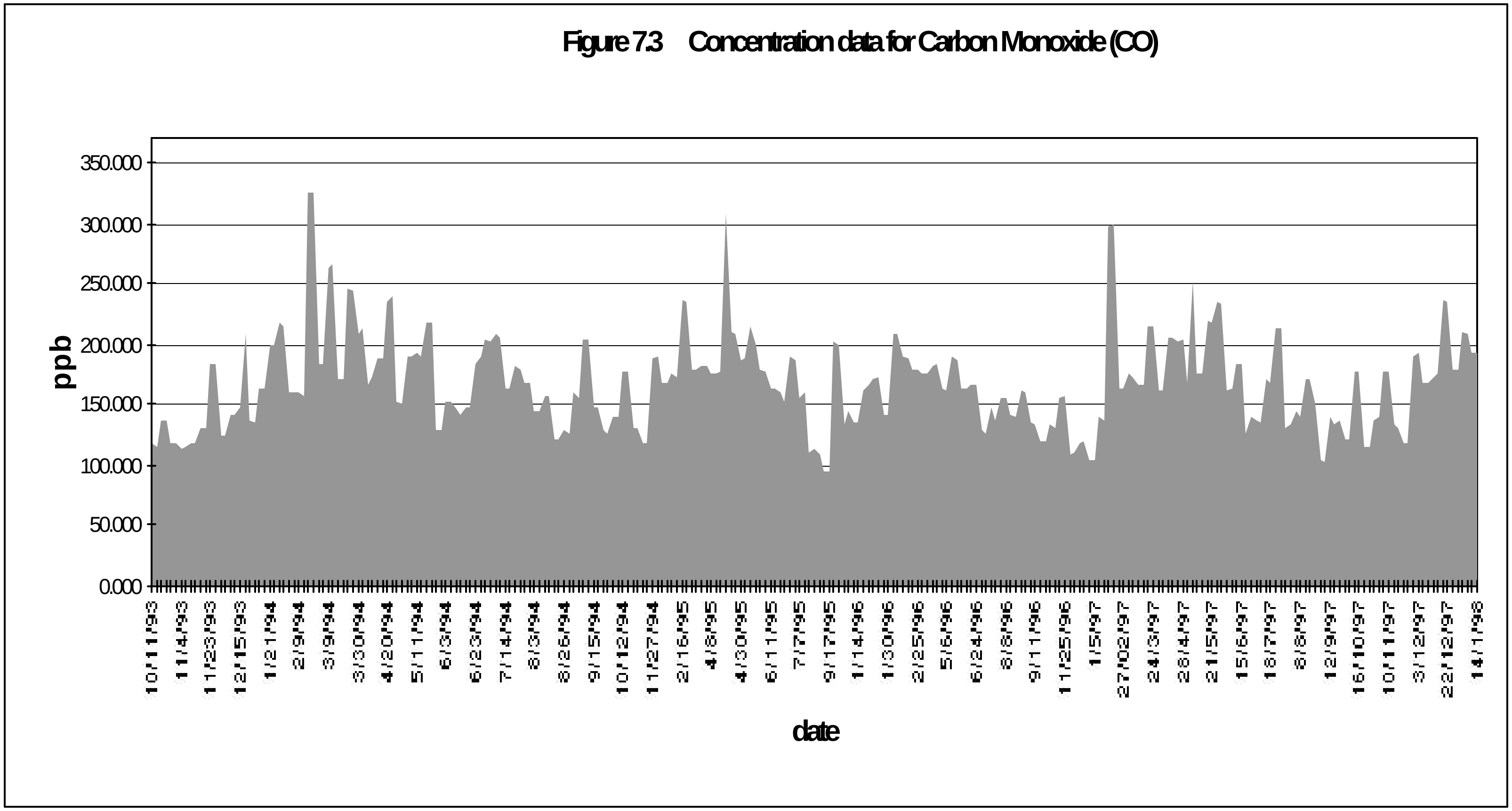


Figure 7.2 Concentration data for Methane (CH_4)





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7.7 Ozone Depleting Substances

Following the concern by the scientific community expressed during the 1970s and 80s resulting from the accelerated depletion of the ozone layer brought about by the widespread use of halogenated alkanes, the Vienna Convention for the Protection of the Ozone layer was adopted in 1985. In order to restrict usage of ozone depleting substances (ODS`s) the Convention was further elaborated through the 1987 Montreal Protocol which embodied a definite 'timetable' for the phase-out of the consumption and production of ODS`s together with restrictions on their manufacture, export and import. However as further scientific data revealed that the ozone depletion process was even more serious than previously supposed, further amendments to the Montreal Protocol were introduced by the London (1990) and the Copenhagen (1992) Amendments.

Malta acceded to the Vienna Convention and ratified the Montreal protocol in 1988. Following this ratification, the PCCU formulated an action plan to identify quantities of imported ODS`s together with end user distributed quantities, thus creating a comprehensive database for the annual consumption of ODS`s. The PCCU currently monitors the import and use of ODS`s , through *(i)* the investigation of import licenses by importers of ODS and *(ii)* *in situ* inspections of imported substances and surveillance of chlorofluorocarbons (CFC) trade movements.

The Montreal Protocol classifies ODS in three lists in Annexes A, B and C. Annexes A and B substances have to be phased out most rapidly.

Malta imports the following ODS:

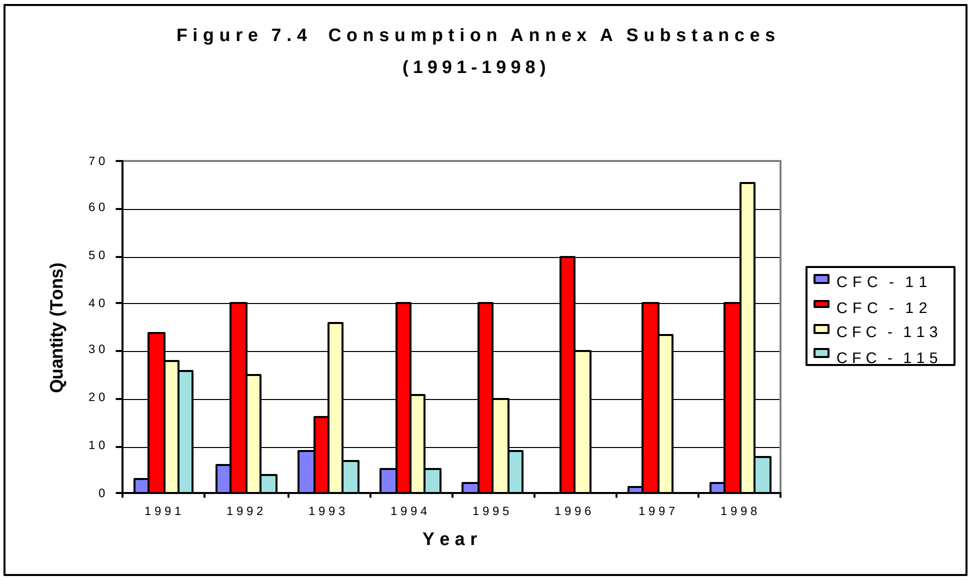
Annex A: CFC 11, CFC 12, CFC 113, CFC 115, Halon 1211, Halon 1301
Annex B: Methyl chloroform
Annex C: HCFC 22, HCFC 141b, Methyl Bromide

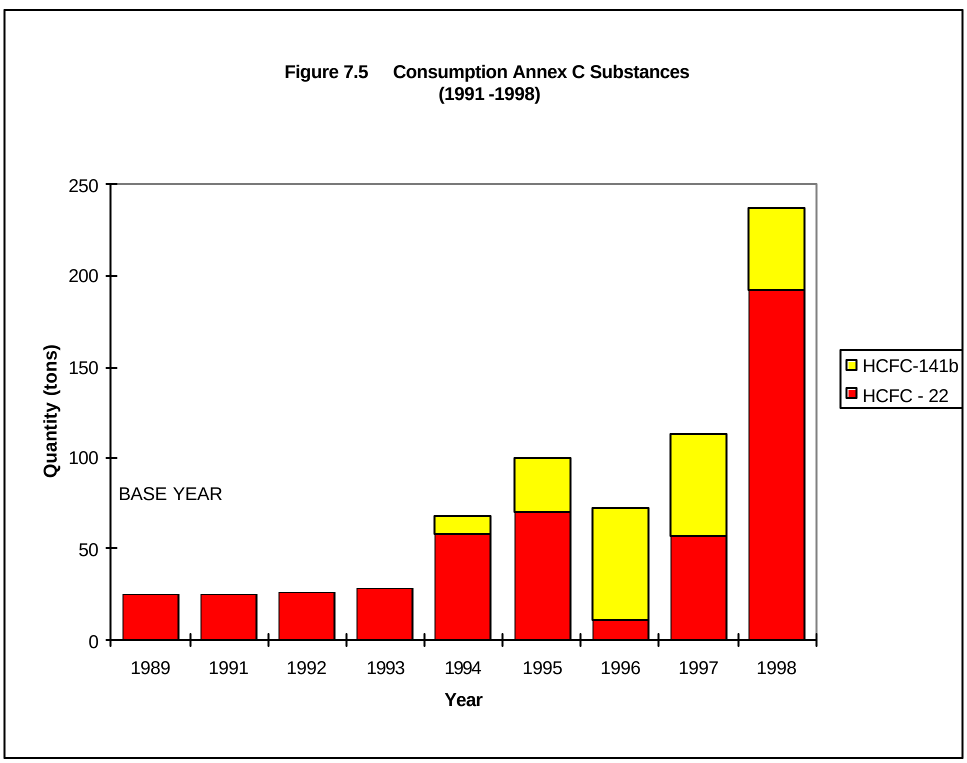
Table 7.4 gives the quantities of imported ODS for 1997:

Table 7.4: Imports of ODS for 1997

ODS	Chemical Formula	Application	Quantity Imported /kg
Annex A			
R-113	$CClF_2CCl_2F$	Cleaning/ Degreasing	40,000
R-12	CCl_2F_2	Refrigeration	36,129
R-11	CCl_3F	Refrigeration	7,700
Halon 1211	CF_2ClBr	Fire extinguishers	26.61
Halon 1301	CF_3ClBr	Fire Extinguishers	27.90
CFC 115		Air-conditioning Refrigeration	1,515
Total Quantity			85433.51
Annex C			
R-22	$HCClF_2$	Air-conditioning, Dehumidification	57,609
R-141b	CH_3CCl_2F	Foam production	55,435
Methyl Bromide	CH_3Br	Agriculture	5,729
Total Quantity			118,773

Figures 7.4 and 7.5 illustrate in graphical format data on the consumption volume for Annexes A and C substances from 1991 to 1998 (estimated).





Annex A substances: It may be seen from Figure 7.4 that whilst the level of consumption of Annex A ODS has not decreased since 1991 (except for CFC-11), their consumption has leveled out, meaning that in spite of an increased market demand, a phaseout is successfully being implemented since the demand has not been met with increased ODS imports. In the case of CFC 12, the estimated 1998 consumption level is not due to increased import but to the tapping of existing stockpiles of the chemical.

The planned phase-out of Annex C substances is slower due to their lesser ozone destruction capacity. In line with a phase-out of more harmful ODS, the quantity of imported Annex C substances has steadily increased since December 1993 (see Figure 7.5). From Figure 7.5 it can be seen that 1997 levels have tripled with respect to 1993 levels and are set to double as can be seen from the 1998 estimate. This is a move in the correct direction since more widespread use of such ODS will support a faster phase-out of Annex A ODS`s.

Phase-out Timetable for ODS Malta will be following the line of the `Developing Countries` ODS phase-out schedule`, as agreed by the Parties to the Montreal Protocol at their 9th Meeting (Montreal , 15-17 September 1997). The obligations Malta will be facing are summed up in Table 7.5 below:

Table 7.5 Timetable for a phase-out of ODS in Developing Countries

Date	Phase-out Obligation
1 July 1999	Freeze of Annex A CFCs at 1995-97 average levels
1 January 2002	Freeze of halons at 1995-97 average levels; freeze of methyl bromide at 1995-98 average levels.
1 January 2003	Reduction by 20% of 1998-2000 consumption figures of Annex B CFCs; freeze in methyl chloroform at 1998-2000 average levels.
1 January 2005	50% reduction of Annex A CFCs with respect to 1995-97 average levels; 50% reduction of halons with respect to 1995-97 average levels; 85% reduction of carbon tetrachloride with respect to 1998-2000 average levels; 30% reduction of methylchloroform with respect to 1998-2000 levels
1 January 2007	85% reduction of Annex A CFCs with respect to 1995-97 average levels; 85% reduction of Annex B CFCs with respect to 1998-2000 average levels
1 January 2010	CFCs, halons, carbon tetrachloride phased out; 70% reduction of methyl chloroform from 1998-2000 average levels
1 January 2015	Methyl chloroform and methyl bromide phased out
1 January 2016	Freeze of HCFCs at baseline figure of year 2015 average levels
1 January 2040	HCFCs phased out/complete phase-out

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7.8. Air Emission Inventories

Air emission inventorying is a calculation-based methodology used to estimate the total quantities per unit time of various air pollutants emitted into the atmosphere.

To date, the PCCU unit within EPD and Enemalta Corporation have completed the following detailed inventories: *(i)* Greenhouse Gas Inventory Report for the base year 1990 (Table 7.6a); and *(ii)* CORINAIR emission inventory for 1990 and 1994: this inventory considers emissions of anthropogenically generated gases and particulate matter from various emitting sources.

Greenhouse gas inventory
Data for 1997 is available for the greenhouse gas inventory. Compilation of this inventory is required to satisfy part of Malta`s obligations following the ratification of the Convention on Climate Change on 14 March 1994. The methodology used in the completion of this inventory is based on IPCC guidelines and includes the calculation of yearly emissions of $CO_2$, $CH_4$, $NO_x$, CO, $N_2O$, non-methane VOC`s from electricity generation as well as from the industrial, commercial, residential and transport sub-sectors.

Table 7.6b below gives greenhouse gas emissions from the various sub-sectors for 1997.

The calculated amounts shown in the table represent only emitted gases resulting from locally used fuels and do not include potential emissions from the use of fuels which were bunkered during 1997. This is in line with calculations of strict country-localised emissions. It should be noted that the emissions have not been broken down into the level of detail that is exhibited in Appendix 1 for the 1990 emissions since relevant statistics which permit this detail were not yet available at the time of writing.

Table 7.6a: Greenhouse Gas Emissions from the Energy Sector for 1990 (EPD)

	CH_4 /Mg	**NOx/Mg**	**CO/Mg**	**N_2O/Mg**	**NMVOCs/Mg**	**CO_2 /Gg**
Electricity Generation						
Coal	3.790	5413.097	88.429	5.053	N/A	585.575
Fuel Oil	6.917	1986.274	148.229	19.764	29.646	756.889
Diesel	2.158	71.047	12.307	N/A	N/A	26.949
Sub Total 1	12.865	7470.418	248.965	24.817	29.646	1369.413
Industrial						
Fuel Oil 200	0.179	9.676	1.027	0.150	0.180	5.600
Fuel Oil 450	0.350	18.530	1.930	0.270	0.350	10.280
Fuel Oil 750	0.660	33.670	3.420	0.470	0.660	17.280
Diesel	0.528	52.940	6.651	0.710	1.367	25.541
Kerosene	2.469	17.635	7.054	0.705	1.058	24.966
LPG	0.035	1.514	0.322	N/A	N/A	2.0110
Sub Total 2	4.221	133.965	20.404	2.305	3.615	85.678

Table 7.6a/continued: Greenhouse Gas Emissions from the Energy Sector for 1990 (EPD)

	CH_4 /Mg	**NOx/Mg**	**CO/Mg**	**N_2O/Mg**	**NMVOCs/Mg**	**CO_2 /Gg**
Commercial						
Fuel Oil 200	0.030	3.350	0.470	0.970	N/A	2.126
Fuel Oil 450	0.220	21.290	2.730	6.230	N/A	12.362
Diesel	1.122	11.967	2.992	2.936	N/A	13.711
Kerosene	1.255	8.967	3.587	0.359	0.538	12.695

LPG	0.088	3.773	0.803	N/A	N/A	5.012
Sub Total 3	2.715	49.347	10.582	10.495	0.538	45.906
Residential						
Kerosene	0.377	2.269	1.076	0.108	0.161	3.808
LPG	0.588	25.121	5.345	N/A	N/A	33.371
Sub Total 4	0.965	27.390	6.421	0.108	0.161	37.179
Transport						
Sea	0.199	144.872	19.603	0.314	6.426	7.687
Land Petrol	84.292	1821.600	23871.841	4.220	4344.866	179.911
Land Diesel	5.216	830.994	770.471	6.008	185.473	124.288
Sub Total 5	89.707	2797.466	24661.915	10.542	4536.765	311.886
Total	110.473	10478.586	24948.287	48.267	4570.725	1850.062

Table 7.6b: 1997 Synoptic Greenhouse Gas Emission Inventory (EPD)

Fuel	*Generated Air Pollutants*				
	CO_2/Gg	**CH_4/Mg**	**N_2O/Mg**	**NOx/Gg**	**CO/Gg**
Leaded petrol	170.750	79.896	3.982	1.727	22.625
Unleaded petrol	56.379	26.373	1.315	0.570	7.470
Gas Oil	398.424	18.474	20.104	2.244	1.639
Heavy Fuel Oil	1401.723	14.641	47.582	3.607	0.275
Kerosene	0.0432	0.004	0.001	<0.001	<0.001
Jet A1	284.143	28.100	8.028	0.201	0.083
Av. Gas	0.410	0.041	0.012	<0.001	<0.001
LPG	44.842	0.790	NA	0.034	0.007
Propane	0.267	0.005	NA	<0.001	<0.001
Totals	2356.981	168.324	81.024	8.383	32.099

A comparison of the total quantities of greenhouse gases generated from fuels in 1997 with that in 1990 shows that the total quantity of emitted carbon dioxide during 1997 has increased by 27% over the 1990 value. Methane emissions have increased by 58% mainly from increased petrol consumption concomitant with the numerical increase of the car fleet. Dinitrogen oxide increased by 68% and this is largely due to electrical energy production at Delimara Power Station (especially that using gas turbines) and the increase in the vehicle fleet.

NOx emissions decreased by 20% in 1997 compared to the 1990 values. The main reason for this trend reversal would appear to be that due to the changeover from coal to heavy fuel oil combustion for electricity generation. Coal has a significantly higher emission factor for NOx emission when compared with fuel oil thus: 0.8-0.9 tons NOx/TJ for coal combustion to approximately 0.2 tons NOx/TJ for heavy fuel oil.

Carbon monoxide emissions increased by 29% over the 1990 values. This is due to the increased size of the car fleet from 1990 to 1997.

CORINAIR Inventory

The Corinair Inventory of air pollutants consists of a database system which categorises emission sources and allows for the calculation of several air pollutants in mass emitted /year. Initially only the following air pollutants were calculated using this software programme: SO_2, NOx, NMVOC, CH_4, CO, CO_2, N_2O and ammonia, NH_3. A more recent version of Corinair is capable of calculating emissions of heavy metals (lead, cadmium, mercury) and persistent organic pollutants (POPs), substances which are known to cause deleterious effects on human health and ecosystems. The Corinair inventory is now regarded internationally as the standard method of emissions estimation.

Corinair inventories for 1990 and 1994 are available (EPD) and are included in this report as Table 7.7 and 7.8 respectively.

Sulphur dioxide emissions during 1994 increased by a factor of 2.6 with respect to the 1990 value and the main reason for such a drastic increase was due to an increase in electricity generation resulting from the then newly operational Delimara power plant. This was accompanied by a concomitant rise in carbon dioxide emissions.

NOx emissions from power generation decreased slightly during 1994 with respect to 1990 emissions and the reason for this decrease was due to the replacement of coal with heavy fuel oil as the energy source for electricity generation.

The emissions of non methane VOCs increased in 1994 mainly due to a greater use of solvents in the industry sector.

Table 7.7 Pollutants emitted during the calendar year 1990 (Tons/year) (EPD)

Group Name	SO_2	NOx	NMVOC	CH_4	CO	CO_2	N_2O	NH_3
Public Power Co-generation Plants	2,152	7,459	0	13	248	1,411000	5	0
Comm/Res/Inst Combustion. Plants	193	79	0	1	13	84,000	4	0
Industrial. Combustion	464	145	0	2	13	91,000	1	0
Production Processes	0	8	148	0	5	4,000	0	0
Extraction/ Distribution of fossil fuels	0	0	0	0	0	0	0	0
Solvent Use	0	0	1,653	0	0	0	0	0
Road Transport	256	3,559	2,640	92	20,974	351,000	11	2
Other mobile sources/ machinery	3,002	5,634	0	191	1,800	267,000	11	0
Waste treatment/ disposal	0	0	0	7,264	0	0	12,775	0
Agriculture	0	0	15	1,478	0	0	44	5,485
Nature	0	0	0	0	0	0	0	0
Total	6,067	16,884	4,456	9,041	23,053	2,208000	12,851	5,487

Table 7.8 Pollutants emitted during the calendar year 1994 (Tons/year) (EPD)

Group Name	SO_2	NOx	NMVOC	CH_4	CO	CO_2	N_2O	NH_3
Public Power Cogeneration Plants	11,987	6,667	17	16	296	1,572000	33	0
Comm/Res/Inst Combustion. Plants	196	90	1	4	20	101,000	11	0
Industrial. Combustion	331	116	3	4	20	86,000	2	0
Production Processes	4	12	288	0	5	4,000	0	0
Extraction/ Distribution of fossil fuels	0	0	0	0	0	0	0	0
Solvent Use	0	0	2,437	0	0	0	0	0
Road Transport	253	3544	2640	156	20974	351000	11	2
Other mobile sources/ machinery	3,025	5,868	0	389	2,183	273,000	11	0
Waste treatment/ disposal	0	0	120	5,524	210	0	12,895	0
Agriculture	0	0	14	3,315	0	0	43	6,368
Nature	0	0	0	0	0	0	0	0
Total	15798	16297	5520	9408	23708	2387000	13006	6370

The data for road transport for 1994 appear dubious: considering that 20,000 more vehicles were on the road in 1994 when compared to 1990, pollutant emissions would not be expected to remain practically unchanged from 1990 values. Rather, based on petroleum fuel sales for ‘94 when compared to ‘90, one would expect an approximate 20% increase of all emissions from road transport for 1994.

Dinitrogen oxide and ammonia emissions are largely generated by waste treatment/disposal and agriculture. In 1994, the only significant change in emissions of these pollutants was a 14% increase in ammonia emission from agriculture.

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7.9. Inside air quality: radon

In 1997, the results of a preliminary study on the concentration of radon in inside air of homes in Malta and Gozo was published[1]. Radon-222 is a product of radioactive decay of uranium and thorium: lung cancer cases have been attributed to exposure to alpha particles emitted by radon. A synergistic effect has been observed between exposure to radon and to cigarette smoke. The results of the local study indicate that radon levels are dependent on various factors which include floor location, type of underlying geological formation and ventilation. The measured values were within the safety limits recommended by WHO and varied from 20 to 104 Bq m^{-3}; the range of average radon levels in European dwellings varies from about 7 to 140 Bq m^{-3}.

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[1] Mifsud I, Amato Gauci AJ, Licari L and Sammut M, 1997, Preliminary investigation on radon levels in local dwellings, *Xjenza*, v 2(1) 34-38.

7.10. Why monitor air pollution? Regulations, standards and control

As stated in the introduction, the quality of Malta's ambient air in 1997 was largely unknown since no monitoring of any of the priority air pollutants was practiced. The collection of data on air quality is not an end in itself: rather, the information obtained through monitoring is used to provide a sound scientific basis for developing specific policies and strategies for controlling emissions and hence improving the quality of the air and that of the environment in general. It allows policy makers and planners to make informed environmental management decisions. Monitoring also permits an objective assessment of the efficacy of any control strategies and systems and establishes whether enforcement action is required to allow national air quality objectives to be attained. In this regard, it is to be noted that neither air quality objectives nor a regulatory framework covering major activities which have an impact on air quality were in place in 1997.

Regulation and enforcement have significant resourcing implications and these need to be addressed along with the resourcing of an air monitoring programme. There is no point in spending money on air monitoring activities if the generated data is not acted upon profitably.

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8. ENVIRONMENTAL POLICY & EDUCATION

Team Leader: Vincent Gauci

Team Members: Paul Pace

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8.1 ENVIRONMENTAL POLICY

8.1.1 Introduction

The following part of the Report will give a brief overview of the policy and legislative structures as related to the environment.

The Maltese environmental legislation stems from obligations set out in the Environmental Protection Act of 1991. The Structure Plan & the Development Planning Act 1992 is another important legislative instrument. Moreover, Malta is party to a number of International Conventions and as such has a number of international commitments.

It has become increasingly clear that the EPA has certain shortcomings; eg. it does not cover air quality aspects and sustainable waste management. Moreover, parts of the EPA have never been brought into effect.

Difficulties have been experienced by the EPD to make certain Government Departments understand, let alone implement, basic environmental policies, including those related to biodiversity conservation.

8.1.2 Environmental Standards

Environmental standards are required in the following areas:

- Discharges into the environment
- Air quality
- Noise levels
- Water quality
- Hazardous substances
- Waste management.

8.1.3 Legislation

The primary legislation with respect to environment protection is the Environment Protection Act of 1991. The following regulations have been issued on the strength of this Act:

LN 37/91 Notice of Coming into Force.

LN 19/92 Trade in Species of Fauna and Flora Regulations

LN 22/92 Fungus Rock Nature Reserve Regulations

LN 76/92 Reptiles (Protection) Regulations

LN 77/92 Marine Mammals Protection Regulations

LN 96/92 Trade Species of Fauna and Flora (Amendments) Regulations

LN 08/93 Environment Protection (Sewer Discharge Control) Regulations

LN 25/93 Selmunett Islands (St Pauls Islands) Nature Reserve Regulations

LN 49/93 Flora and Fauna protection regulations

LN 136/93 The authority of Review (Declaration on Oath) Rules

LN 143/93 Environment Protection Act (Revocation of Laws Order)

LN 144/93, 145/93, 146/93, 150/93 Birds and Wild Rabbit (Declaration of Protected Species and Nature Reserves) (Amendment) Regulations.

LN 1/94 Environment Protection (Preventive and Remedial Measures)

LN 87/94 Authority of Review (Procedure) Rules

LN 183/94 Non Alcoholic Beverages (Control of Containers) Regulations

LN 133/95 Environment Protection (Control of Substances Depleting The Ozone Layer Regulations

LN 44/96 1996 Regulations to amend the Regulations on the protection of Birds and the Wild Rabbit

LN 45/96 1996 Regulations to further amend the Regulations on the Protection of Birds and the Wild Rabbit.

LN 23/97 1997 Regulations to further amend the Regulations on the Protection of Birds and the Wild Rabbit.

LN 24/97 -do- Amendments

LN 128/97 Deposit of Waste and Rubble (Fees) Regulations, 1997

LN 140/97 Regulations of 1997 to amend the Regulations on Trade in Species of Wild Flora and Fauna.

LN 155/97 Marine Mammals (Amendment) Protection Regulations.

LN 160/97 Rubble Walls and Rural Structures, Regulations 1997.

LN 196/97 Motor Vehicles (Offroading) Regulations

LN 214/97 Commencement Notice of coming into force of Section 49 of the EPD.

LN 215/97 Birds and Wild Rabbit Regulations, Amendments (Declaration of Protected Species and Nature Reserves).

LN 216/97 Birds and Wild Rabbit Regulations Amendments

LN 221/97 Birds and Wild Rabbit Regulations, Amendments

These are by no means the only regulations that have a bearing on the environment. In fact, legislation that has a bearing on the protection of the environment may be described as fragmented and insufficient.

8.1.4 International Conventions

Malta is party to a number of regional and international Conventions related to environmental protection and management, amongst which are the following:

?? Convention on International Trade in Endangered Species of Flora and Fauna (CITES)
?? Convention on the Conservation of European Wildlife and its Habitats (BERN)

?? Convention on Biological Diversity (CBD)
?? Convention for the protection of the marine environment and coastal areas of the Mediterranean (Barcelona Convention).

8.1.5 Institutions

In Malta, the Government agency that is specifically designated as being responsible for environment protection is the Environment Protection Department. However, in practice other agencies have an environmental remit. This results first and foremost from the fact that the Environment Protection Act of 1991 gives powers to all Ministers to protect the Environment.

It may be argued that all agencies have some activity that impinges on the environment. However, the Environment Protection Department apart, the following agencies are mostly involved:

✍✍The Works Division
✍✍The Malta Maritime Authority
✍✍The Planning Authority
✍✍The Civil Protection Department
✍✍Local Councils
✍✍Department of Agriculture
✍✍Department of Fisheries
✍✍The Health Division

An environmental capability is therefore a requirement for most if not all agencies. This makes co-ordination of activities of primary importance. In practice, this co-ordinating agency is the Environment Protection Department. However, it is widely recognised that the unclear legislative mandate and the paucity of resources render this role arduous. The result is considerable overlaps, if not outright conflicts.

It has been agreed that both the Environment Protection Act and the institutional set-up of the Environment Protection Department need to be revised and upgraded. The new Act and set-up should take into account the new challenges linked to development and higher standard of living, as well as international obligations and responsibilities that in the meantime have been entered into as a result of the signing and ratification of Conventions.

8.1.6 Enforcement Of Regulations

Difficulties are consistently encountered by the EPD to enforce regulations. This is mainly due to the lack of adequate inspectorate resources and lack of a dedicated environmental police force.

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8.2 Environmental Education in Malta

8.2.1 Introduction

The term ‘environmental education’ generates a myriad of interpretations that do not always reflect its true holistic nature, i.e. a balance between education *about*, *in* and *for* the environment. Therefore, in the following analysis of the state of environmental education in Malta, initiatives that are ultimately monodisciplinary or emphasise the acquisition of knowledge about a narrow aspect of the environment are omitted.

A closer examination of the Maltese situation regarding environmental education reveals an evolutionary process gradually unfolding within the Maltese society. Each new evolutionary step built and improved on the previous one while, at the same time preparing the foundation for the next step. Although there are no clear demarcations, a deeper analysis of environmental education initiatives in the Maltese Islands shows that these evolutionary steps can be classified into three major phases (Pace, 1995):

a) the ***Awareness Phase*** (1960s - 1970s) - characterised by sporadic activities, mainly organised by NGOs, aimed at raising public awareness on the need to do something to improve the state of the Maltese environment. These activities helped shape public opinion, providing the necessary argumentation that justified the need for a supportive infrastructure for future environmental education initiatives.

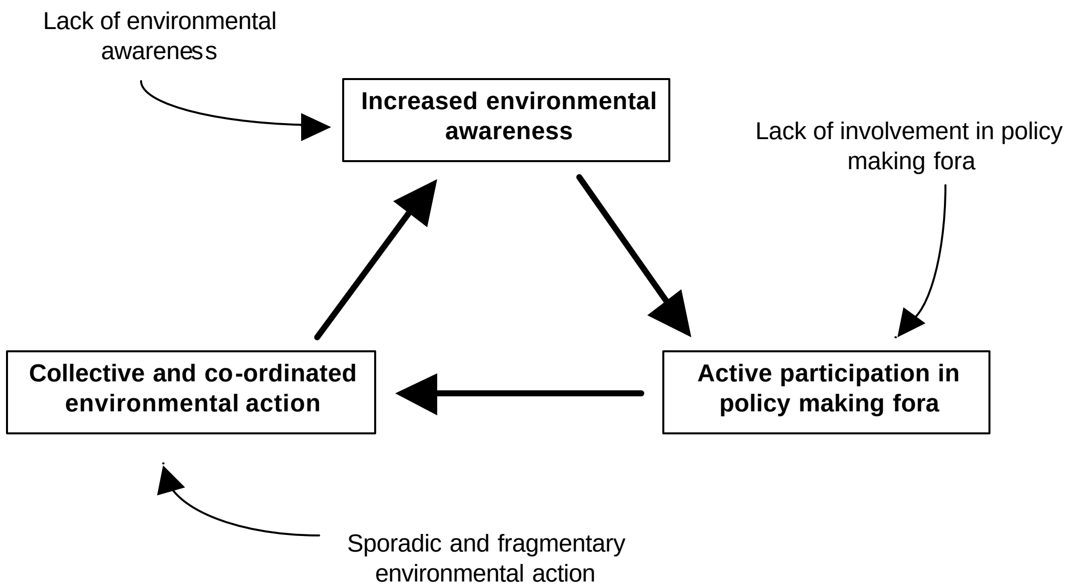
b) the ***Fragmentary Phase*** (1980s - early 1990s) - characterised by the ‘institutionalisation’ of environmental education. Various actors assumed responsibility for environmental education, but failed to co-ordinate initiatives creating a lot of difficulties like duplication of work, wastage of human and financial resources, conflicts of territoriality between the parties concerned and little significant progress.

c) the ***Co-ordinated Phase*** (mid 1990s) mainly involving the setting up of National Environmental Education Strategy (NEES) and characterised by a nation-wide will to co-ordinate activities and to make the best use of available resources.

Weaved within the evolutionary phases are three main interrelated trends (summarised in Figure 8.1) that can also be recognised in similar accounts on the development of environmental education in other countries. The first involves a move from a lack of environmental awareness to a more informed idea about the environment and the effects of human activities on it. The second is the increased participation of an informed public in decision making matters involving the environment. The third trend that can be identified, involves a shift from a fragmentary approach to problem solving to a collective, more co-ordinated strategy. This shift promotes a wider exposure of the public to environmental issues which in turn generates more awareness – starting the whole cycle again.

Any attempt to maintain the dynamic balance established by these trends needs to consider the creation of a supporting infrastructure. Besides setting up the political framework for the consolidation of environmental education in Malta, NEES needs to ensure the continuation of efforts at the grassroots level to offer support for this framework (UNCED, 1992). Concurrent with the consolidation of initiatives in non-formal education, NEES needs to focus on the formal education sector. Action in this sector will surely require the development and evaluation of new management structures and curricula within schools, by tapping the invaluable contribution of teachers – that seems to be the major ingredient for success in formal environmental education initiatives.

Figure 8.1: *The relationship between the trends identified in the development of environmental education in Malta*



The five major organisations actively involved in environmental education are: the Education Division, the Environment Management Unit of the Planning Authority, the Environment Protection Department, the Faculty of Education and the various categories of NGOs (which have multiplied considerably in recent years).

8.2.2 Initiatives In The Formal Education Sector

The pedagogy suggested for environmental education is not fully compatible with the present situation in schools - characterised by overloaded syllabi, an examination-oriented pedagogy and a tendency to prefer traditional patterns of teaching. Nevertheless, environmentally aware teachers who feel the need to act, still manage to integrate environmental issues in daily teaching.

Realising the crucial role teachers play in curriculum development, certain NGOs focus their attention on teachers. Besides directing most of their environmental campaigns at school children, NGOs supply a variety of teaching resources and promotional material. There was a time when NGOs even organised courses for teachers with the aim of giving them the knowledge and skills required to organise environmental education activities. This teacher-oriented strategy has been relatively successful, considering that practically each school had one or two teachers who acted as a NGOs' contact point with schools.

The Environment Management Unit (EMU) of the Planning Authority also focused its attention on schools. It set up a programme of planned excursions to various sites with the aim of helping school children appreciate the environment - from all its facets. EMU also organised an exhibition of environmental projects conducted by school children. Nevertheless, since schools lack an official environmental education strategy, such NGO and EMU activities are not a regular feature in school programmes and lack a sound integration within the curriculum.

The first systematic step toward an environmental education strategy in the formal education sector was the "National Training Workshop on Environmental Education in Malta" (6-10 April 1987) organised by the Ministry responsible for education and the environment (IDEA, 1987). The workshop's aims were in tune with the strategy to develop prototype curricula and teaching materials promoting environmental education, proposed about four months later by the Moscow Congress (UNESCO-UNEP, 1987). Environmental and curriculum specialists from the university, Education Division officials and practising teachers from all levels of formal education participated in the event. Workshop sessions proposed several recommendations for the implementation of environmental education at all levels of formal education. However, lacking an official body responsible for their implementation, these recommendations were soon shelved and forgotten.

Environmental education was one of the areas addressed in the National Minimum Curriculum (NMC) for the primary (Legal Notice 73, 1989), secondary (Legal Notice 103, 1990) and post-secondary schools (Legal Notice 56, 1991) published by the Ministry of Education as a direct result of the Education Act of 1988. Being overly optimistic, one can consider the publication of the NMC as an important milestone for environmental education in Malta, providing the legal backing to justify curriculum development initiatives in environmental education (Ventura, 1994). However, a closer look at the language used in these documents betrays an uncertainty – on the part of local policy makers – of what environmental education really involves. While being quite familiar with the affective objectives of environmental education, local policy makers, like many of their international counterparts, are still unclear about how to achieve them. Moreover they tend to traditionally equate environmental education with the acquisition of scientific knowledge (Pace, 1992). A closer examination of what the implementation of the NMC really implies, clearly elucidates its impotence since the present educational system is not flexible enough to accommodate the innovations proposed. Moreover the vaguely stated and ambiguous demands made by the NMC lack the necessary punch to get things going (Mifsud, 1994). Viewed in this way, the NMC, at best only provides moral support – a legal trump card that can be used by advocates of environmental education in policy making discussions.

Although rigid syllabi and looming Junior Lyceum Examinations still exert pressures on primary school teachers, the primary school is a relatively fertile scene for the inclusion of environmental education – when compared with the other educational sectors. This may explain why the three major attempts at introducing environmental education in formal education focused on the primary level.

The first attempt was a UNESCO funded project run by the Faculty of Education. The project, called the Environmental Education Programme (EEP), aimed at producing a teacher's manual with practical suggestions on how to infuse environmental education into the primary school subjects as a cross-curricular theme (University of Malta, 1991). It identified attainment targets and presented teachers with the opportunity to plan environmental education activities within their normal classroom activities. Teachers were consulted from the start of the project and were actively involved in the drawing up of sample activities. The Teacher's Manual produced was even evaluated in a national seminar that involved the participation of teachers, head teachers, education authorities and teacher educators (Faculty of Education, 1991). Although the project's implementation in schools was effectively obstructed before it had the time to be sufficiently tested and improved, EEP was successful in generating a new approach to environmental education in schools based on interdisciplinarity (Pace, 1992).

A year later, the Science Centre of the Education Division inaugurated the second initiative by publishing its own teacher's manual on the implementation of environmental education in the curriculum (White, 1993). The publication followed a series of in-service courses, on science and environmental education in the primary school, which were attended by all state primary school teachers and some teachers from the private sector. The manual, also promoting a cross-curricular theme approach, was distributed to all teachers with the hope that they would implement its suggestions in their schemes of work. Whether teachers complied with the suggestions or not, is still unknown since no monitoring and evaluation of the implementation were initiated.

The most recent development was *Dinja Wahda* (One World) - an award scheme initiated by BirdLife Malta, one of the local NGOs (MOS, 1994). The scheme aimed at co-ordinating the NGO's campaigns in primary schools to avoid "*lacunae of environmental efforts in schools between the various campaigns*" and create "*an educational campaign that would last throughout the entire scholastic year*" (Grima, 1996). The initiative presented schools with 14 activities promoting pro-environmental behaviour that varied from simple tasks (e.g. drawing a poster) to more demanding ones (e.g. organising a clean-up campaign). *Dinja Wahda* did not attempt to provide guidelines to teachers on how the activities could be infused into the syllabus, but still some teachers took the initiative to integrate them into their normal teaching. Results from the evaluation questionnaire, distributed to all the schools, showed that *Dinja Wahda* was a success. In fact 74 primary schools – more than 50% of all the primary schools –

participated in the award scheme. Following this success, BirdLife Malta plans to extend the scheme to secondary schools and other sectors of the community (Grima, 1996).

Rigid compartmentalisation of subject areas, lack of teacher preparation, inflexible time-tabling and management structures, render the infusion of environmental education across the secondary school curriculum very difficult. Under these conditions, Dunlop (1992) suggests the organisation of environmental education as a multidisciplinary subject hence avoiding most of the problems an interdisciplinary approach would meet. This is exactly what the MATSEC Board did when it proposed the subject Environmental Studies. The syllabus combines elements of biology, geography, social studies and history under three main themes: the Natural Environment, the Human Environment and the Built Environment. In its introduction, the syllabus stresses the need for an integrated approach and the use of teaching methodologies that promote active learner participation particularly in the study and the care of the environment (MATSEC, 1993). However, the subject's implementation in schools is finding various obstacles which result from three major deficiencies: a lack of pre- and in-service training to prepare teachers for the new demands the subject poses; a lack of adequate teaching resources; and the absence of a scheduled time slot which allows teachers to co-ordinate their teaching. The motivation to improve the situation is also lacking since the concept of multidisciplinarity is not congruent with the Education Division's monodisciplinary organisation (Mifsud and Zammit, 1995).

Another attempt at providing an environmental education resource pack for the secondary school curriculum came from ECO, another local NGO. The pack is a translated adaptation of the 'One World' project of the North-South Centre (European Centre for Global Interdependence and Solidarity). It presents a holistic view of the environment, focusing not just on the natural but also on the cultural and social dimensions (Hamilton, 1996). Teachers are presented with a series of guidelines, student worksheets and posters focusing on seven different but related environmental issues. However, teachers were not consulted during the pack's design and the initiative failed to acknowledge the limitations of the secondary school sector, hence automatically restricting its dissemination in schools.

Since its inception, in 1989, Systems of Knowledge (SoK) provided students with an opportunity to review contemporary environmental issues from a variety of perspectives. In an effort to improve this course, the co-ordinators opted to stress interdisciplinarity by: (a) reorganising the content matter into integrative themes; (b) replacing lectures by subject specialists with seminar-based sessions led by an interdisciplinary team of teachers; (c) publishing a new student workbook that, besides presenting the relative theme, guides the student to make the necessary links with the other areas of knowledge; and (d) restructuring the examination questions to assess higher order cognitive skills rather than simple recall of factual knowledge (Giordmaina, 1995). The second phase of this restructured course, launched during the 1996-97 academic year, contains the theme "Values and the Environment". The theme attempts to (a) familiarise students with the various ways humans related with their environment throughout the ages, (b) help them to critically analyse their present way of life, and (c) develop pro-environmental values and attitudes for the future (Giordmaina & Scerri, 1996).

The syllabus for Environmental Science, devised by MATSEC in 1994, provided another possibility for the introduction of environmental education principles at the intermediate matriculation level. While acknowledging that a study of the environment necessitates a holistic approach, the syllabus falls short of its recommendation. It disregards socio-cultural perspectives of the environmental problems studied and adopts a purely scientific treatment to help learners understand the problems and to propose adequate solutions (MATSEC, 1994).

Initiatives at tertiary level have traditionally focused on the running of courses aimed at the training of specialists in environmental science, environmental management, environmental law and environmental economics. In 1994, as a follow-up of the EEP, the Faculty of Education offered a course unit in environmental education as one of the compulsory EMY (Early and Middle Years) course units in the B.Ed. programme. Besides introducing student-teachers to the goals and principles of environmental education, the course had a very strong practical component that provided an opportunity to work in interdisciplinary groups and plan learning experiences that infuse environmental education objectives into the primary school curriculum. A similar course is presently being offered as an option in the PGCE course.

The Faculty of Education has also initiated an environmental education research programme based on three main lines of research: (a) studies about the local environment – providing new knowledge about various aspects of the natural environment; (b) surveys – about environmental awareness, attitudes towards the environment, the incidence of environmental issues in the press, the role of NGOs in local environmental education; and (c) the development and evaluation of curriculum materials.

Initially, dissertations and projects in the latter category were characteristically focused on the development of curriculum materials that utilised the science curricula and promoted teaching *through* the environment. However, after the publication of the EEP, the research diversified reflecting a wider notion of environmental education. The work mainly focuses on the infusion of environmental education through specific subjects like Maltese in the primary schools, Italian and Integrated Science in the secondary schools and religious education. Other work approached the infusion of environmental education through cross curricular themes in the primary, the secondary and the intermediate level curricula. More innovative research addressed specific methodologies, such as gaming and simulation, and educational walks as part of an non-formal environmental education programme. Work has also been done on the promotion of environmental education through music, multimedia software packages and the Internet.

8.2.3 Initiatives In The Non-Formal Education Sector

As a response to a growing concern about the degree of environmental degradation, the Maltese Parliament approved the “Act to protect the environment”. Although the Act assumes that every Maltese citizen will actively participate in the protection of the Maltese environment (Act No. V, 1991), research shows that the majority of the Maltese are unable to take on this responsibility.

In a nation-wide strategy to protect the environment from further degradation, legislation may be effective – but only as a temporary measure. There is the need to devise strategies that develop attitudes and values that induce pro-environmental behaviour naturally rather than forcefully. The then Parliamentary Secretary for the Environment, Dr Stanley Zammit, explicitly acknowledged this need: "*As a direct consequence of our own action* (i.e., the enactment of the Act to protect the environment), *we are appreciating better the full significance of 'environmental education'. It is very evident to us how strategically important it would be to have a population which is intrinsically receptive and sympathetic to new legislation for the protection of the environment*," (Foundation for International Studies, 1991).

Thus, it is no wonder that the Structure Plan, Malta’s strategy to achieve the best balance between development and the environment by the year 2010, dedicates four policy statements to environmental education and research. The policies envisage:

(a) the organisation of educational programmes to promote pro-environmental behaviour;

(b) the establishment of an environmental education resource centre which will:

?? inform the public about environmental matters,

?? increase the awareness for environmental protection and the wise use of resources, and

?? provide the mass media with good quality environmental education programmes;

(c) the setting up of Field Centres and interpretative Visitor Centres associated with Conservation Areas; and

(d) the promotion and dissemination of research on the environment and environmental problems (Planning Services Division, 1990).

The mechanisms for the implementation of these policies (except for the setting up of the environmental education resource centre) have been set in motion by the various agencies involved in environmental education. However, these efforts have largely been sporadic and certainly not co-ordinated. One of the agencies striving to implement these policies through a co-ordinated effort was the Environment Secretariat, set up in 1990. Through its support, NGOs received the required assistance to carry out research on sensitive habitats, to propose environmental protection strategies and campaigns as well as to develop and manage nature reserves and environmental interpretation centres. The Secretariat also launched its own campaigns aimed at developing pro-environmental behaviour through prime-time educational spots on Television Malta, clean-up campaigns, and various stickers, posters and booklets featuring "*Xummiemu*"- a hedgehog adopted as the Secretariat's mascot. Although these initiatives addressed the general public, the focus of the Secretariat's efforts was school children. The launching of *Xummiemu*'s Fan Club strengthened this interface with school children facilitating future environmental education campaigns (Azzopardi, 1996). Following the 1996 change in government, the functions of the Environment Secretariat have been absorbed within the Environment Protection Department.

8.2.4 The National Environmental Education Strategy

In an effort to establish co-operation between all the interested parties, in October 1994, a proposal was made to the Environment Secretariat, the Faculty of Education and the Ministry of Education to set up a steering committee which would co-ordinate the organisation of a second National Training Workshop on Environmental Education in Malta with the theme: "*In Today's Education ... Tomorrow's Environment*". The goal of the event was that of getting all those involved in environmental education together to (a) become aware of the state of environmental education in Malta, (b) identify the problems, needs and support required for the successful implementation of environmental education initiatives, and (c) discuss the possibility of co-ordinating these initiatives to improve their effectiveness.

The Training Workshop, held in Valletta on 26 and 27 May 1995, was attended by 150 participants coming from various sectors: teachers from all formal education sectors of both private and state schools, university staff and education officials, NGO members and other interested persons from other governmental and private enterprises. Participants identified the problems caused by a predominantly fragmentary approach to environmental education and the need to mobilise efforts to maximise local human resources in the development of a National Environmental Education Strategy (NEES). The various working groups came up with recommendations that were conceived as the working agenda for an Action Group entrusted with the development of NEES. The recommendations proposed that NEES would strive to utilise available resources and develop new ones to initiate a serious concerted effort at implementing environmental education initiatives at the formal and non-formal levels directed towards all sectors of the population.

Although, to date, NEES is still in its initial consultative phase, it seems that the time for its implementation is ripe. During the training workshop, participants clearly expressed their commitment for action. This grassroots interest and participation in policy making bodies is an essential requirement for the success of NEES and for the success of the implementation of the recommendations of Agenda 21 (UNCED, 1992). Moreover, an analysis of the 1996 electoral manifestos of the major political parties shows a change in the political attitude toward environmental education. Both parties recognised the importance of environmental education and proposed plans to improve the situation in the formal education sector (Malta Labour Party, 1996; Partit Nazzjonalista, 1996). This commitment has been translated into action by (a) the continuation of the school curriculum review which aims at making the curriculum more holistic, learner centred and community-oriented – attributes that are synonymous with environmental education, and (b) the Minister of Foreign Affairs and the Environment and the Minister of Education and National Culture endorsed the plan outlined by NEES and agreed that it should be officially supported by the Ministry responsible for the environment.

8.2.5 Conclusion

Environmental education in Malta has made great advances, but is currently at the cross-roads. Continued progress can only be ensured through the successful structuring and implementation of NEES. However, there are some major issues that still need to be addressed:

- ?? for most people the term 'environment' is synonymous with the natural environment. In so doing they are perpetuating a very narrow view of the environment which might prevent learners from identifying with their surrounding environment.
- ?? for quite some time environmental education has been equated with the acquisition of information (preferably of a scientific nature) about the environment. This was the result of a widely held belief that learners automatically develop pro-environmental values and attitudes if they are provided with the required knowledge base. This mistake is particularly common in 'educational packs' produced by individuals who are not professional educators. Research has shown that the only way by which values and attitudes can be developed is through a pedagogy that is oriented towards the development and clarification of these particular set of personal beliefs.
- ?? although NEES has been officially recognised by the relevant authorities, the task of co-ordinating the different actors, catering for their different needs and setting up administrative structures, is particularly difficult to go by. Most of the actors have been working in isolation from other individuals/associations for quite some time and are bound to view 'co-operation' and 'co-ordination' initiatives with suspicion.
- ?? most of the environmental education initiatives have traditionally addressed children or youths, because they are seen as being a hope for the future. On the other hand, adults seem to dismissed because 'they are already set in their ways'. Besides adopting a defeatist attitude, this approach disregards the basic fact that most of the environmental degradation occurs through the action of adults, and if they are not addressed through environmental education there might not be any environment left to safeguard in the future.

8.2.6 References

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9. CONCLUSION

All our activities have an impact on the environment, and at the same time, all our initiatives for social and economic developments are greatly affected by environmental constraints and totally dependent on the carrying capacity of our environment.

The present State of Environment Report for Malta has reviewed the available data and information on a number of environmental issues including water and air quality, living resources, energy and wastes. In addition it has identified the main features of demography, tourism, landuse as well as environmental policy and education which have a bearing on the quality of our environment.

Each part of the Report which deals with specific issues, assesses the reliability of the available information and data up till 1997; assesses the present status and whenever possible, identifies trends, and finally makes general recommendations and identifies priorities on the specific theme being considered.

The Report indicates several areas of potential environmental deterioration and concern. It also identifies significant deficiencies in the quantity and quality of environmental data, which are crucial for environmental-related policies and decisions.

Over the past decade, we have witnessed at the national level, an increasing number of initiatives in environmental management and protection. There is also clear evidence of acceptance and adoption in practice (albeit rather slow) of a number of sound guiding principles including the integration of environmental considerations in the formulation and implementation of economic and sectorial policies as well as of shared responsibility in environmental management and an increasing dialogue between partners in environmental management. There is now an urgent need to sustain such emerging practices through long-term efforts and clear vision about our national environmental priorities.

The present Report also demonstrates an increasing willingness on the part of local authorities to have confidence in the capabilities of local expertise and experts to undertake such an assessment and evaluation initiative in a professional manner without the need of foreign consultants.

As expected, the compilation of the present Report has indeed encountered a number of difficulties, which prevented us from achieving all of our initial objectives. These difficulties included lack of response on the part of a number of local entities to provide us with relevant data, in spite of repeated requests. However, such initial difficulties may eventually be overcome as we gain confidence in our professional capabilities to produce such reports on a regular basis.

On the other hand, the help and assistance from a number of official sources was at times, impressive and encouraging to the Panel members and such collaboration has been fully acknowledged in the respective sections of the Report.

Greater efforts are now required to help us overcome a number of bottlenecks for improved environmental management, as identified in the present Report.

There is an evident need for a clear and unified Environmental Policy and Strategy, which would encompass all the various sectors of environmental management. Such a national strategy will require the full commitment and understanding of all relevant authorities and departments who would be responsible for attaining its objectives.

Lack of identified responsibilities often lead to inter-departmental conflicts and unnecessary friction between partners who should view mutual collaboration as an asset rather than as a threat to their status. The present Report has identified a number of cases to illustrate this issue.

We still need to formulate specific national environmental standards and objectives to cover all aspects of environmental quality. It is hoped that the present Report will have contributed substantial baseline information to assist in the setting up of such national standards and objectives.

It is evident that the main onus for the formulation of a national environmental strategy and policy as well as of national environmental standards and objectives should rest with the Environmental Protection Department within the Ministry for the Environment. There is however no doubt that the present resources and infrastructure available to this Department are totally inadequate and will not enable it to achieve such goals. It is hoped that such a situation will be remedied as soon as possible.

Finally, we hope that the present initiative will be sustained and developed into a permanent system or structure, which would be capable of producing annual SoE Reports to be addressed both to the political and administrative authorities as well as to the general public. The success or otherwise of all environmental management initiatives will ultimately be determined by the degree of public acceptance, cooperation and involvement. It is hoped that SoE Reports, which would be presented in an adequate format, will help sensitize and educate citizens on the various environmental issues, which ultimately will determine the quality of our life and well being.

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