An Innovative Sand Dune Restoration Project from Malta.

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Abstract

Sand dunes arguably qualify as the most endangered natural habitats in the Maltese Islands due to the small size of the dunes, the low proportion of sandy shores (just 2.4% of the entire islands' coastline), the intense human impact, and the lack of public awareness and information about these ecosystems. Out of 32 areas known to have harboured some sort of natural sand dune flora, only five localities now support dunes with a relatively intact characteristic dune vegetation. One of these, the dune at White Tower Bay was earmarked for a dune restoration project since this is the best-preserved sand dune system on the island of Malta.

Main threats to the White Tower Bay dune include illegal camping activities and parking especially during summer, trampling by humans and off-road vehicles, ill-conceived afforestation schemes, cultivation in the dune's catchment area, and huts that abut on the dune. These threats operate even though the White Tower Bay sand dune is scheduled as an Area of Ecological Importance and a Site of Scientific Importance.

Restoration of the White Tower Bay sand dune is being jointly undertaken by the Malta Environment and Planning Authority (MEPA) and the NGO Nature Trust (Malta), as part of MEPA's Environmental Initiative In Partnership Programme. Restoration includes both short-term (temporary) and long-term (permanent) measures. Emergency measures included the installation of metal bollards joined by metal chains around the dune's landwards border to prevent vehicular access to the dune from the road skirting it, as well as the installation of educational signs explaining the importance of the dune and the scope behind the restoration works. Due to consultation with stakeholders and their involvement from the onset, it was ensured that conflicts were minimized. The permanent restoration measures will be completed within the next few years. These include the gradual relocation of the huts, closure of the road surrounding the dune, the manual removal of alien flora, and the planting of *Ammophila littoralis* (marram grass) – a stabilising pioneer species of foredunes that is now extinct from the Maltese Islands – along the seaward margins of the dune. In addition, the complete removal of seagrass wrack from the beach will be discouraged. Special emphasis will

be placed on the educational value of the site and on effective enforcement of existing and planned regulations concerning the area through wardening.

This restoration project is locally (and perhaps regionally) innovative for a number of reasons, including the extensive and ongoing consultative process with all stakeholders, the emphasis on the educational value of the site, the basing of restoration measures on sound scientific research, and the inclusion of a monitoring programme to assess effectiveness of the interventions and to fine-tune these as the need arises. This initiative can serve as a pilot upon which other habitat restoration projects may be based.

Introduction

The Mediterranean Sea is one of the world's top tourist destinations, with about 100 million tourist arrivals every year (GFANC, 1997), most of whom are enticed by the region's coastal recreational assets. This number is expected to reach 260 million by the year 2025 (Cassar & Stevens, 2002). In addition, some 40% of the indigenous Mediterranean population (roughly 130 million people) lives in the coastal zone; this figure is expected to double by 2025 (UNEP, 1996). As a consequence of human activities, over the last 30 years the region has lost ca 75% of its coastal sand dunes (GFANC, 1997; Gehu, 1985; Salman & Strating, 1992).

The Maltese Islands are no exception to the Mediterranean pattern and, if anything, are emblematic of the region. Accessible shores, comprising some 40% of the 272km-long Maltese coastline (Anderson & Schembri, 1989), are very popular with locals and visitors alike for the range of recreation opportunities under the benign Mediterranean climate that they provide. However, the Islands have one of the highest resident population densities in the world (over 1,200 people/km^2; Mallia et al., 2002) and with 1.22 million tourist arrivals every year (Mallia et al., 2002), also have one of the highest tourist densities (GFANC, 1997). About 94% of tourist accommodation facilities in the Maltese Islands are located on the coast (Mallia et al., 1999). Sandy beaches comprise just 2.4% (= 4.6km; Schembri, 1991) of the Islands' total coastline and within these beaches, sand dunes occupy just 25 hectares. All these factors unite to make Maltese sandy coastal habitats amongst the rarest, most vulnerable, and intensely anthropically impacted on the Islands (Schembri, 1993).

With the exception of the sand dune at Ramla l-Hamra on the island of Gozo (Figure 1), which is the best preserved in the Maltese Islands and still exhibits a fairly complete sand dune vegetation (Cassar & Stevens, 2002), all other Maltese sand dune habitats are highly degraded. Schembri et al. (1999) noted that only some 13 localities out of an original 32 beaches known to have harboured natural sand dune habitats in the past 40 years, still supported some form of dune ecosystem; of these only five localities supported dunes with relatively intact characteristic dune vegetation. These are Ramla l-Hamra on Gozo, Santa Marija on Comino, and Ghadira (within Mellieha Bay), Ramla tat-Torri (White Tower Bay) and Ramla tal-Mixquqa (Golden Bay) on Malta (Figure 1).

According to Schembri & Lanfranco (1994), White Tower Bay has, until recently, supported the best sand dune ecosystem in the Maltese Islands, which, in the

past, was more species-rich and diverse than Ramla l-Hamra in Gozo. Due to a number of factors, the White Tower Bay sand dune is gradually degrading (Scapini, 2002; Deidun et al., in press).

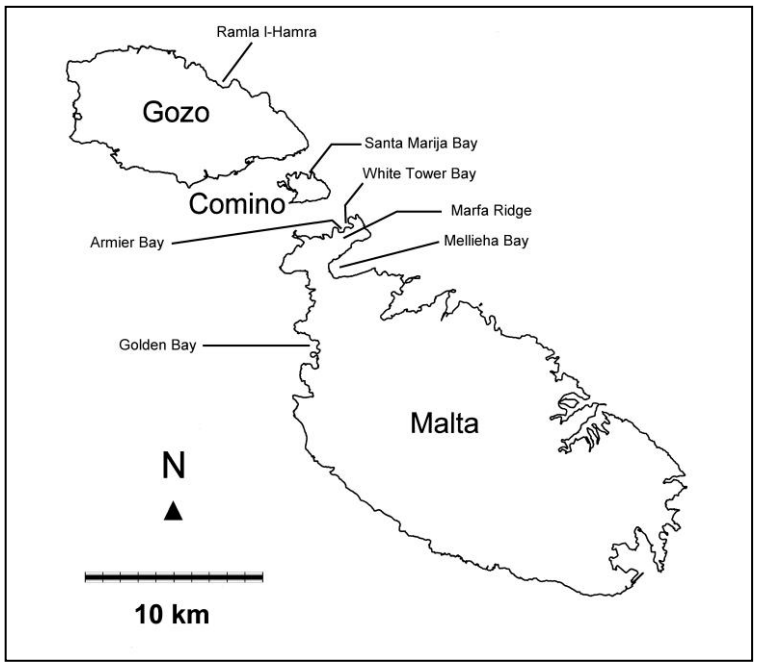

Fig.1: Map of the Maltese Islands showing the location of White Tower Bay and other localities mentioned in the text.

Due to their scientific and natural heritage importance, all sand dune habitats of the Maltese Islands are automatically candidates for scheduling as Areas of Ecological Importance (AEIs) under the Development Planning Act 1992 and its subsidiary instruments, chief amongst which is the Structure Plan for the Maltese Islands (Planning Services Division, 1990). White Tower Bay has already been scheduled as an AEI and additionally, as a Site of Scientific Importance (SSI) for the important biota it harbours (Government Notice 401 of 1996). Theoretically at least, these dunes are fully protected. However, lack of resources, including those related to enforcement, has meant that these dunes are protected on paper only, a situation not unique in the Mediterranean.

Following repeated pressure from the local NGO Nature Trust (Malta), in 2001 the Malta Environment & Planning Authority (MEPA), under its Environmental Initiatives in Partnership Programme[1], set up a steering committee for the management of the White Tower Bay site. This committee is composed of local stakeholders, including MEPA itself, the Mellieha Local Council (under whose legal jurisdiction the dune falls), and two local NGOs – Nature Trust (Malta) and Nixxiegha Kulturali (a

[1] The Environmental Initiatives in Partnership Programme (EIPP) is a partnership scheme launched by the Malta Environment & Planning Authority in a bid to protect and enhance Malta's built, cultural and natural heritage. In this scheme, projects are financed through 'Planning Gain' contributions requested by the Authority from developers of projects that may have some localised environmental impacts. The funds are then channelled into environment projects in areas where it was not possible to reasonably mitigate the negative effects of development.

cultural group). On World Environment Day, 5th June 2003, MEPA signed an agreement entrusting management of the area to Nature Trust (Malta). As a result of a request made to UNESCO to partly fund restoration works on the White Tower Bay sand dune under its Participation Programme, in May 2003 UNESCO awarded this NGO the sum of 15,500 US$ towards the dune restoration works.

The aim of this paper is to describe the restoration programme for the White Tower Bay sand dune as a case study of an innovative protocol for coastal habitat restoration projects in the Maltese Islands. This protocol might have applicability elsewhere in the Mediterranean, particularly where, as in the Maltese Islands, such habitats are subject to degrading pressures due to the multifarious human activities that have an impact on them but where the agents generating these impacts have traditionally not been part of the restoration programme. The protocol outlined in this paper adds another strategy to dune protection measures taken by other Mediterranean countries, such as the purchase of important natural coastal areas by the Conservatoire de l'Espace agency in France and the channelling of tourism to non-coastal areas such as the rural interior in Andalusia, Spain (GFANC, 1997), both of which are not options that are easy to implement in islands of limited size and whose key attraction is the coast, such as the Maltese Islands and many others in the Mediterranean.

Site description

White Tower Bay is the northernmost sandy beach on the island of Malta. The beach itself is small, covering an area of just 6000m^2 and is backed by a 4000m^2-sand dune. A narrow path to facilitate public access to the beach is cleared through the dune every year.

Cassar & Stevens (2002) state that, prior to its recent degradation, the White Tower Bay sand dune was characterised by dune grasslands based on *Vulpia fasciculata* and by back-dune vegetation of the *Centaureo-Ononidetum ramosissimae* association. Today, the dune is largely populated by species of the *Cakiletea maritimae* association, notably sea rocket (*Cakile maritima*), sea spurge (*Euphorbia paralias*), and purple spurge (*Euphorbia peplis*). The White Tower Bay sand dune consists of a 'mobile dune' proximate to the sea (in turn grading from foredune to yellow dune with increasing distance from the sea) and a much-reduced 'grey dune', characterised by a few tamarisk trees, at the back. As all other dunes on the Maltese Islands, it does not exhibit a 'brown dune' stage. According to Brown & Mclachlan's (1990) scheme, the White Tower Bay sand dune can be considered as an 'established foredune' since it is an area where there is limited sand transport and since the dune reaches a reasonable height and includes woody vegetation. Due to the limited sand supply that it receives and its restricted size, this dune also qualifies as a 'mainland dune' in the four-tiered Mediterranean dune classification system used by van der Meulen & Salman (in Doody, 1991).

White Tower Bay is the only sand dune locality on the island on Malta listed by Schembri et al. (1987) as having a high conservation value. This is mainly due to the presence of the sphecid wasps *Prionyx kirbi* and *Ectemnius sescinctus*, which are only known only from this locality, and other rare hymenopterans. The dune is the last

remaining locality on the island of Malta for the plants *Euphorbia peplis* and *Echinophora spinosa*, while it supports a population of the endemic broomrape *Orobanche densiflora* forma *melitensis* (Cassar & Stevens, 2002). The site is also one of the last remaining strongholds of locally rare sand-dune plants such as *Euphorbia paralias* and *Eryngium maritimum.* Two other plants known previously from this site (*Ammophila littoralis* and *Valerianella microcarpa*) are now extinct from the Maltese Islands (Lanfranco, 1989, 1999).

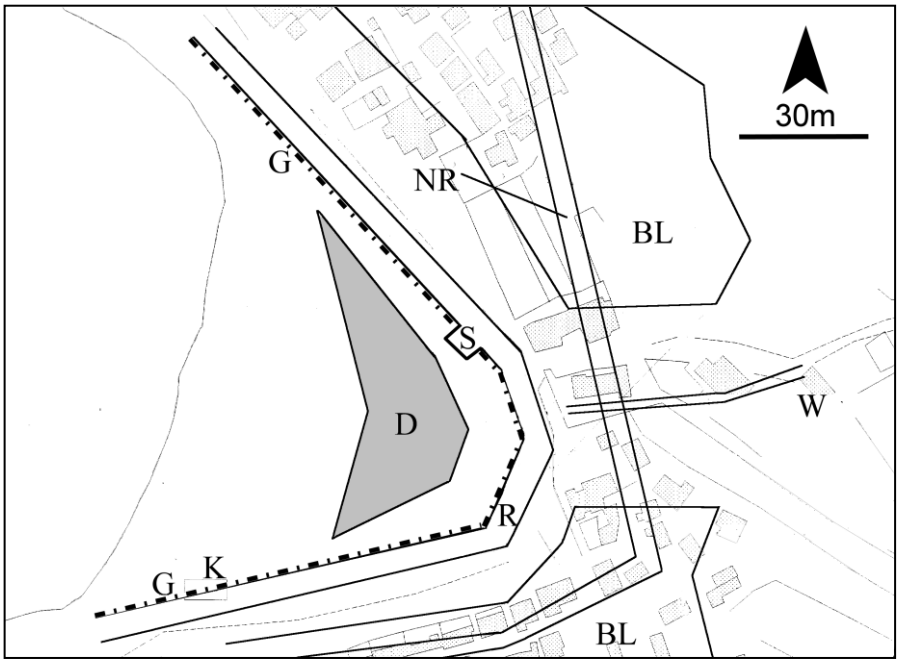

Fig.2: Map of the White Tower Bay area showing the location of the dune, present land use and interventions resulting from the rehabilitation project. Projected changes as proposed in the draft Marfa Action Plan are also shown.
Key: [Existing] D – dune (shaded polygon); W - watercourse; R - road; K - kiosk; shaded rectangles - boathouses; dot-and-dash line - bollard and chain line with gates (G) and area for refuse collection depot (S). [Proposed] NR - relocated road; BL – areas for relocated boathouses

Land-use issues and major threats

From calculations made using the maps in Cassar (1996), the dune's present extent is estimated to be about one-third of what it was prior to the start of full-fledged touristic development of the Maltese coastline in the 1950s and 1960s. The major reasons for the degradation of the White Tower Bay sand dune include the opening of a road that effectively bisected the dune into and western and eastern half (Figure 2), beachside constructions, agriculture in the dune's catchment area, and camping, trampling, off-roading and vehicle parking.

According to Stevens (quoted in Cassar & Stevens, 2002), aeolian erosion of the White Tower Bay sand dune was facilitated after works on the road skirting the dune were completed in March 1998. Beaches are usually sources of sand for coastal dunes

(Krumbein & Slack, 1956) and this road probably interferes with sand transport. However, it does not completely eliminate sand transport, as small pockets of incipient sand dune habitat form along the landward margins of the road bisecting the White Tower Bay sand dune. Input of terrestrial sediment to the dune at White Tower Bay has also been largely interrupted through tapping of the dune's fluvial source by the pumping of water for irrigation of the agricultural land at the back of White Tower Bay. Additionally, agricultural runoff containing fertiliser from the cultivated retro-dunal areas is probably responsible for the proliferation of nitrophilic opportunistic 'weedy' plant species on the dune.

The beach receives substantial annual inputs of seagrass debris (Deidun et al, in press) deposited on the shore by wave action. In summer this necessitates intensive beach cleaning activities to make the beach suitable for bathing. Until recently, such beach cleaning used to extend even over the dune (Cassar & Stevens, 2002) to remove 'spiny plants' such as *Echinophora spinosa* and *Eryngium maritimum* to render the beach more 'comfortable' for bathers. Following calls made by Nature Trust (Malta), beach cleaning is now limited to the unvegetated sandy part of the beach only, and prior to such activities, the NGO is alerted by the authority responsible (the Ministry for Tourism) so that volunteers can be present throughout the cleaning operation to monitor the works. This is an example of how cooperation between stakeholders, and a minimal shift in operating practice, can have a very significant effect on habitat conservation.

Over the past few decades, White Tower Bay, as much of the northern coastline of Marfa Ridge, has witnessed a proliferation of so-called 'boathouses' – mostly illegally-built beachside huts that ostensibly are shelters for fishing craft, but which are in the main used as summer houses. These boathouses have largely been tolerated by past and present administrations. The presence of such constructions, besides occupying valuable retro-dunal land, also ensures a year-round human presence in the region, generates considerable vehicular traffic, produces significant light pollution, and is a source of organic wastes.

The White Tower Bay dune is popular with campers. This results in caravans and tents smothering the vegetation underneath, which either fails to grow or is stunted; often the campers also actively remove vegetation to clear areas for their equipment. Overnight camping on sandy beaches, and vehicular access to both sandy beaches and sand dunes, is against policy (Planning Services Division, 1990) and is actually illegal since the White Tower Bay dune is a scheduled site. In addition, a long-standing legislation, the Sand Preservation Act of 1949 [Act XVI of 1949, "*Sand (Preservation) Act: To make provision for the preservation of sand*", Laws of Malta Cap. 127], prohibits the removal of sand and shingle from any beach without specific permission. It is well documented that once vegetation has been removed and bare sand is exposed, erosion of the dunes is accelerated (Hosier & Eaton, 1980; Carlson & Godfrey, 1989; Kutiel et al., 1999). Trampling on the dune is extensive, especially in the summer months. Besides damaging dune vegetation directly and causing soil compaction (Liddle & Moore, 1974), trampling also suppresses the germination of seeds (Crowder, 1983).

The planting of alien trees as a form of environmental embellishment, a practice especially common in the 1960s and 1970s, is in part responsible for the degradation of

the flora of the White Tower Bay dune. According to Cassar & Stevens (2002), the introduction of *Acacia saligna*, together with other exotic species, was partly responsible for the eradication of *Ammophila littoralis* from the site. The White Tower Bay sand dune was previously the most important stronghold in the Maltese Islands for this species, which is now locally extinct (Lanfranco, 1989). The White Tower Bay sand dune has also borne the brunt of the removal and heavy pruning in 1998 of about 50 tamarisk trees located on its periphery (reported in *The Times* [of Malta], April 12, 1998).

Temporary and permanent measures

As part of the current restoration project, a number of temporary (emergency) and permanent (long-term) measures to help mitigate the anthropogenic degradation of the dune were drawn up. Temporary measures included the installation of 125cm-high metal bollards around the 230m length of the dune on the landwards side, where it abuts the road (Figure 2). These bollards are situated at roughly 9m-intervals and are joined by 7mm short-link galvanised metal chains to prevent the parking of cars and camping activities on the dune area, one of the key factors that is causing the dunes to degrade. At the same time this bollard-and-chain line has as little visual impact as possible and still allows aeolian sand transport. Educational signs explaining the value of the dunes and the need for their conservation were also set up as the first step in a public awareness campaign. What was innovative (at least locally) in the implementation of this emergency measure was that the key stakeholders, in this case representatives of the local boathouse owners, were involved in the process. In fact, on their suggestion, an adequate space was set aside in the bollard-and-chain line for the temporary placing of refuse skips used by holidaymakers and which were previously placed on the dune area. Also emerging from this consultation with stakeholders was the need to cater for the requirements of the beach cleaners who remove wrack from the beach in April-May of every year prior to the start of the holiday period. This was done by the inclusion of two gates in the bollard-and-chain line at either end of the sandy beach to allow the beach cleaners' motorised transport access to the beach.

Two sets of educational signs were erected. One type of sign outlined the importance of safeguarding sand dune areas and sought public cooperation in the restoration project. The other type highlighted that it was illegal to camp and park on, and to trample, the dune area. If these initial measures prove to be a success, they will gradually be incorporated within the long-term management of the site.

The long-term restoration process includes mainly legislative and administrative measures, such as the relocation of the beachside constructions (the 'boathouses') further inland away from the dune, and the closure of the access road that presently meanders around the dune (Figure 2). These two measures are expected to allow the recolonisation by dune vegetation of at least part of the area previously occupied by the dune. Off-road vehicles can impact large areas on single trips (Priskin, 2003). Thus, total restriction of access to the dune by off-road vehicles after road closure is deemed to be very important for the restoration project. Other measures planned include the restriction of certain agricultural practices, especially the tapping of water through boreholes in the dune's catchment area, and the installation of a limited number of

amenities to promote the educational value of the site for organised visits by interested persons, together with the printing of educational material, such as leaflets.

In addition, it is planned to plant the sand-binding marram grass, *Ammophila littoralis*, along the dune-beach border so as to further stabilise the dune's seaward margins, which are most subject to erosion from human activities. Mediterranean sand dunes, including the one at White Tower Bay, can be considered to have a high degree of dune ridge mobility as soil development is not pronounced due to a limited sand supply from the sea and due to a low humus content, and since sand-binding vegetation is not so luxuriant due to the arid conditions (van der Meulen & Salman, 1993).

The *Ammophila* populations at White Tower Bay and nearby Armier, the last in the Maltese Islands, were completely extirpated by works at these sites in the late 1970s and early 1980s such that this species is now extinct from the Maltese Islands (Lanfranco, 1989; Cassar & Stevens, 2002). Therefore, to use this plant for dune restoration, stocks of *Ammophila littoralis* need to be reintroduced in the Maltese Islands from overseas, which leads to a conservation issue concerning whether an extinct species should be reintroduced in the first place and, if so, from where to obtain stocks, which must be as close to the previously existing ecotype as possible. Given the biogeographical affinities of the Maltese Islands, if *Ammophila littoralis* is re-introduced, stocks are most likely to imported from the Hyblean coasts of Sicily.

Another key issue and one of the most difficult to achieve, concerns enforcement of existing and future legislation protecting the dune. To this end, part of the funds awarded by UNESCO for the dune restoration project have been earmarked for wardening of the site on a part-time basis. To supplement this, the possibility of installing closed-circuit television (CCTV) cameras to deter vandalism is also being explored.

Discussion and future prospects

Despite the widespread notion that the restoration of damaged ecosystems is financially unsustainable, authors like Spurgeon (1999) believe that, using a 'Total Economic Value' approach (i.e. accounting for direct and indirect uses and 'non-uses'), many thousands of US$ per hectare could ultimately accrue from their rehabilitation/creation. In fact, unconventional financial considerations have started to place an economic value on enhanced landscape and scenery.

MEPA delegated management of the dune area to Nature Trust (Malta) with a number of conditions, including that the NGO formulates a detailed management plan for a long-term ecological 'vision' of the protected area that will make provisions for biodiversity protection, zoning, public awareness and education, and include performance evaluation, surveillance and monitoring. According to McGlashan (2003), a voluntary approach to ICZM has been adopted in many countries, with the consequence that there is a lack of long-term funding mechanisms, making coastal conservation ventures unsustainable in the long-term. The 'hamster wheel syndrome' highlighted by the same author, where staff spend too much time trying to raise money, as opposed to developing ICZM, was clearly experienced within the current

conservation venture since the funds available in the long-term for the White Tower Bay sand dune restoration project were not disclosed and small-scale expenses incurred during the restoration project were reimbursed by MEPA on an ad hoc basis. Mainly due to the small size of the dune area, it is extremely doubtful whether the site can ever become financially self-sufficient (the ultimate goal in most conservation initiatives) through contributions by visitors, for example.

Long-term plans for the whole of Marfa Ridge, where the White Tower Bay sand dune is located (Figure 1), are embodied in the Marfa Action Plan formulated by MEPA and presently in the public consultation stage. The legal framework sought to protect the sand dune at White Tower Bay, mainly in the form of a Conservation Order issued in terms of the Development Planning Act, must encompass all the elements involved in the dune dynamics, such as the sediment bank in the offshore zone, the dune's terrestrial fluvial source and the beach/dune boundary. Such a holistic approach at dune legal protection was lacking in previous attempts to protect, preserve and restore local dunes, for example, the Ghadira dunes at Mellieha Bay, with the result that in spite of all the attention it has received, this dune is now degraded (Cassar & Stevens, 2002).

Although marram grass was previously abundant at White Tower Bay, its extirpation from the site dates back to the 1970s and in the interim period, the dune biota may well have adjusted to the new ecological regime. Hence, a preliminary introduction of a small number of *Ammophila littoralis* individuals at the completely degraded adjacent dune of Armier will be made as an experiment, and this too is contemplated within the current restoration project. This is yet another innovative feature for local habitat management and restoration projects, since previous such initiatives were undertaken with little or no prior studies, much less experimental ones (for example, the marshland at Ghadira – see case study in Schembri et al., 1999)

Quoting from Brown & Mclachlan (1990), a simple formula to be observed in dune restoration ventures is: beaches = recreation; dunes = conservation. To this end, public use of the beach should be interfered with as little as possible. However, despite the potential unpopularity of such a measure, the abandonment of the practice of removing seagrass wrack from the beach needs to be addressed in the future. Wrack may be removed from the immediate vicinity of the sea to allow bathing but it should be translocated to a more duneward position. Mayer (1995) reports that *Posidonia* banquettes are important for the structure and construction of the beach itself and is an important factor in dune formation.

Environmental awareness-building is an integral component of many of UNESCO's programmes (Kuijper, 2003). To this effect, public educational conferences, bringing together experts on dunes and stakeholders in the project, will be organised by Nature Trust (Malta).

Monitoring has been identified by Micallef & Williams (2002) as one of four key components relevant to beach and shoreline management. Monitoring of the restoration project's success will be effected through biannual floral and faunal surveys together with periodic aerial photography after the completion of the restoration works. These will be used to evaluate changes in the dune's physical extent. Questionnaire surveys will be used to gauge public opinion about the restoration project.

Conclusions

Despite the numerous land-use and other environmental issues plaguing the area, with proper management skills and effective consultation with stakeholders aimed at consensus-building, the White Tower Bay sand dune can regain part of its former status, both in terms of spatial extent and in terms of biodiversity. Some hope that this may be achieved is provided by Conway & Nordstrom (2003) who state that intensively developed coastlines can retain natural dune features if residents allow ecological boundaries to replace cultural boundaries. The approach and methodology adopted in the White Tower Bay sand dune restoration project can be considered to have a truly innovative perspective, at least for the Maltese Islands and their regional neighbours, because of the close cooperation between a public regulatory entity like MEPA and an NGO, the proactive role adopted in the restoration project by the partners, the holistic approach espoused whereby all possible alternatives were analysed, the cautious strategy based on scientific study – including a monitoring component to assess effectiveness of the measures taken and to permit fine-tuning even during the implementation stages, the integral involvement of all stakeholders not only at the consultation stage but also in the project implementation, and the insistent emphasis on education and public awareness.

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