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## **DIVERSITY AND CONSERVATION OF THE NON-MARINE MOLLUSCS OF THE MALTESE ISLANDS**

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The Maltese archipelago, occupying an area of c.316 km<sup>2</sup> and situated in the central Mediterranean, consists of the inhabited islands of Malta and Gozo and a number of uninhabited islets and rocks. The islands are composed mainly of limestones of Oligo-Miocene age. Soils are young, show little horizon development, and are very similar to the parent rocks. There are no mountains, streams or lakes, but only minor springs. The main geomorphological features are karstic limestone plateaux, hillsides covered with clay taluses and gently rolling limestone plains. The southwest coast is mainly steep sea-cliffs and the land tilts gently seawards to the northeast. The islands are riven by valleys which drain runoff during the wet season. The average annual rainfall is c.530mm of which 85% falls during the period October to March. The mean monthly temperature range is 12-26°C. The flora and fauna are rich with c.2000 species of plants and more than 3000 species of animals recorded to date; a relatively large number of species are endemic. The main ecosystems are maquis, garigue and steppe. Minor ones include patches of woodland, coastal wetlands, sand dunes, freshwater and rupestral communities and those of caves. Human impact is significant. The islands have been inhabited since c.7000BP. The current resident population density is 1095 per km<sup>2</sup>. Some 38% of the land area is cultivated and c.15% is built up.

The non-marine Mollusca of the Maltese Islands have received more attention than any other faunal group, excepting the insects. More than 60 separate works mentioning Maltese molluscs exist, ranging from short notes on individual species, to descriptions of new species, entries in the regional catalogues, and monographs on the Maltese malacofauna (see bibliographies in Beckmann, 1992; Giusti *et al.* in prep.). The total number of species and subspecific taxa recorded from the Maltese Islands is very high, approaching the 100 mark, which is remarkable given their small size and limited range of habitats. Equally remarkable is the large number of endemic species described, ranging from 20% to 35%. However, there is still a lot of confusion as to which species actually occur and on the taxonomic status of several Maltese entities.

There are two main reasons for this: firstly, many works, especially the older ones, are based entirely on classical morphological criteria, sometimes only those of the shell; secondly, very little is known about the malacofauna of the central Mediterranean islands and North Africa and many new taxa have been instituted with very little justification. This problem is compounded by loss of type material. Additionally, some works on the Maltese malacofauna are based on unrepresentative museum collections of dead shells, while some authors did not carry out any fieldwork and appear unaware of the range of variation within each species. For these reasons, a complete revision of the Maltese malacofauna has been undertaken, using both classical and modern (molecular) techniques and based on extensive fieldwork (Giusti *et al.* in prep.). These studies have not only resolved some longstanding taxonomic and biogeographical problems, but have also revealed the conservation status of the Maltese species and have served as the basis for the Mollusca section of the Red Data Book for the Maltese Islands (Thake & Schembri, 1989)

Some 63-68 species (depending on whether certain taxa are considered to be full species or else subspecies) of non-marine gastropods, and a single freshwater bivalve occur. Of the gastropods, nine are brackish water species, nine are

freshwater, and the remainder are terrestrial. At least three species are of recent human introduction: *Pomatias elegans* (Müller) and *Discus rotundatus* (Müller) are only found in a single public garden; the third species, the freshwater planorbid *Helisoma duryi* Wetherby, occurs in ponds in two public gardens, however, a population became established in the wild during 1986-87, but subsequently disappeared.

None of the brackish water molluscs are now considered endemic. An indigenous population of *Melanoides tuberculatus* (Müller) was known from the mouth of a single spring exiting into Salina Bay (Malta). Building development in the area has completely obliterated this stream and this species is now probably extinct from the Maltese Islands, although because of its popularity with aquarists, non-indigenous populations may still occur. Three brackish water hydrobiids occur in large populations where found but have an overall restricted distribution since their habitat (saline marshlands) is only found in a few scattered localities: *Ventrosia ventrosa* (Montagu) is known from three marshes (Ghadira, Salina, Marsascala), one of which (Ghadira) is a protected area; *Hydrobia acuta* (Draparnaud) is known from two (Marsaxlokk, Salina); while *Heleobia stagnorum* (Gmelin) is known from a single site (Salina), the only other known population having become extinct due to dumping of industrial waste and pollution. The first named species is considered vulnerable while the other two are endangered, the main threats being habitat destruction. Of the other brackish water species, *Truncatella subcylindrica* (Linnaeus) and *Ovatella myosotis* Draparnaud are widespread, while *Paludinella littorina* (Delle Chiaje), *Auriculinea bidentata* Montagu and *O. firminii* (Payraudeau) are very rare, the first two probably due to increasing anthropization of the coasts.

Taxonomically, the most interesting freshwater species are the hydrobiids, which have been assigned a variety of names and some of which have been described as endemic species (eg. *Amnicola melitensis* Paladilhe; *Paludina kobelti* Westerlund; *Mercuria* n.sp. Boeters in Beckmann, 1987). It appears that only two species occur, belonging one each to the genera *Mercuria* and *Pseudamnicola*; the *Mercuria* belongs to a group of very similar forms occurring all along the coasts of the Mediterranean and in the absence of genetic studies it is not possible to say whether these are sibling species or simple morphs (Giusti *et al.*, in prep.). In view of this, the occurrence of an endemic freshwater hydrobiid in the Maltese Islands may be considered doubtful.

Two species, *Lymnaea* cf. *peregra* (Müller) and *Planorbis planorbis* (Linnaeus), known to have occurred in Maltese freshwaters in the past, have not been found alive in recent years and are considered extinct. With the exception of the freshwater limpet *Ancylus fluviatilis* Müller, which is widespread and abundant in all manner of freshwaters, all the other freshwater gastropods are common where found, however the dearth of freshwater in the Maltese Islands renders these species very patchily distributed. *Mercuria* and *Pseudamnicola* often co-occur and are limited to a few valleys with abundant freshwater, where they are considered endangered. The planorbid *Planorbis moquini* Requier is limited to two valleys (Wied tal-Lunzjata, Gozo; Wied tal-Bahrija, Malta) draining perennial springs; *Physella acuta* (Draparnaud) is more widespread and *Lymnaea truncatula* (Müller) more widespread still due to its amphibious habits. Nonetheless all these species are considered vulnerable, the main threat being habitat destruction. The only freshwater bivalve, *Pisidium casertanum* (Poli), was not recorded for many years and was thought to be extinct, but very recently a small population limited to a few square metres only was found in a single valley (Xlendi Valley, Gozo) draining a perennial spring (Sammut & Mifsud, 1988). This species is very endangered, the main threat being habitat destruction.

Of the terrestrial species, most interesting are the endemics. These include the slug *Deroceras golcheri* Van Regteren Altena, the helicids *Cernuella* cf. *caruanae* (Kobelt) and *Marmorana* cf. *melitensis* (Ferussac) and members of the clausiliid genus *Lampedusa* and the hygromiid genus *Trochoidea*. These two genera occur on the archipelago in a complex mosaic of species, possible subspecies, hybrid forms and ecotypes, mostly endemic to the small area they occupy. Soós (1933) split the Maltese *Lampedusa* into two subgenera: *Imitatrix* with three species (*imitatrix* (Boettger), *melitensis* (Caruana Gatto) and *gattoi* Soós) and *Muticaria* with another three (*syracusana* (Philippi) and its var. *oscitans* (Charpentier), *scalaris* (Pfeiffer) and *mamotica* (Gulia)). Zilch (1977) considered all the *Imitatrix* to be subspecies of *L. imitatrix*, and the

*Muticaria* to be subspecies of *M. syracusana*, elevating *oscitans* to subspecific rank. Holyoak (1986) followed Zilch except that he did not recognize subgenera. Beckmann & Gittenberger (1987) consider the Maltese populations of *L. syracusana* to be a separate species from Sicilian populations and have referred the Maltese populations to *L. macrostoma* (Cantraine) with four subspecies: *macrostoma*, *oscitans*, *scalaris* and *mamotica*. The taxonomic status of these various forms is currently being investigated using molecular genetic techniques. Whatever the outcome of this research, these populations are of great scientific importance and deserve to be protected and conserved. For example, while form *scalaris* appears to be a simple morph of *L. (Muticaria) macrostoma*, yet as *Clausilia scalaris* Pfeiffer, it is the type species of the genus/subgenus *Muticaria* (see Soós, 1933).

The situation with the *Trochoidea* is even more confusing. Recent enumerations (eg Soós, 1993; Alzona, 1971; Beckmann, 1987; Mandahl-Barth, 1988) list eight species: *T. (s.str.) spratti* (Pfeiffer), *schembrii* (Pfeiffer), *calcarata* (Benoit), *ogygiaca* (Westerlund), *cucullus* (Von Martens) and *despotti* Soós, and *T. (Xeroclausa) gharlapsi* Beckmann and *meda* (Porro); all except the last named are considered endemic. However, different authors interpret these species differently and the names used by one worker are not necessarily equivalent to those used by others. Recent work (Giusti *et al.*, in prep.) shows that many of the taxa attributed to *Trochoidea* (s.str.) can be referred to a single, highly variable species for which the oldest available name is *T. spratti* (Pfeiffer); the differences in shell morphology on which most of the classical 'species' are based are in reality peculiar to small local populations or else to groups of individuals forming part of larger populations in which shell morphology is very variable. Intermediate forms between most of the classical 'species' can be readily found. Only *cucullus* and *despotti* present some consistent differences and are sufficiently reproductively isolated to perhaps be retained as subspecies of *T. spratti* (sensu Giusti *et al.*). The problem of whether the various 'forms' represent different biological species or are simple demes of a single variable species is currently being investigated by means of molecular genetic techniques.

*Cernuella* cf. *caruanae*, *Marmorana* cf. *melitensis* and *Deroceras golcheri* are relatively widespread and common. Form *gattoi* of *Lampedusa imitatrix* and form *despotti* of *Trochoidea spratti* occur only on the island of Filfla, a small (c.2ha) rock some 5km off the southern coast of Malta. Filfla is a nature reserve and all the flora and fauna on it are protected by law. However, while the population of *despotti* is quite large, that of *gattoi* is very small; the former is considered vulnerable while the latter is endangered. Of the remaining endemic clausiilids and hygromids, the most seriously menaced is form *mamotica* of *M. macrostoma*, found in a very circumscribed area in a single valley (Xlendi Valley) in Gozo and where building development has already eliminated the species from a considerable portion of its previous range, making it endangered. Although not immediately threatened, both form *scalaris* of *M. macrostoma* and form *cucullus* of *T. spratti* are considered endangered as they occupy relatively small areas attractive for development, for example, a carpark now covers half the area previously inhabited by *cucullus* at Migra Ferha (Malta). *L. melitensis* is arguably the most endangered Maltese mollusc due to its very small population size and precarious habitat: a few hundred individuals on a small number of large boulders at the foot of a cliff in southern Malta. However, it is not under immediate threat from human activities since the locality where it is found is relatively remote and inaccessible. *L. imitatrix* and *T. gharlapsi* also live in relatively remote and inaccessible areas and are similarly not under immediate threat, but their population size is small, making them vulnerable.

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