ENVIRONMENTAL ISSUES IN THE MALTESE ISLANDS

The often conflicting demands of Malta's flora and fauna and her human population are described by **MARK C. MIFSUD** MSc, MIEnvSc, MIBiol, MIEEM, CBiol, CEnv, of Junior College, University of Malta

The Maltese islands are a small archipelago, situated in the centre of the Mediterranean some 96km south of Sicily and 290km north of the coast of Libya. The Maltese archipelago comprises three inhabited islands; Malta (245.7 km^2), Gozo (67.1 km^2) and Comino (2.8 km^2), together with a number of uninhabited smaller islands; Cominotto (9.9 ha), Filfla (2.0 ha), Fungus Rock (0.7 ha) and St Paul's islands (10.1 ha). The islands are composed almost entirely of marine sedimentary rocks of Tertiary age, mainly Oligo-Miocene limestones, calcareous sandstones and clays (Schembri, 1992).

Originally, the islands were covered by the Upper Coralline Limestone which forms limestone platforms with karstic topography. This is now limited to areas in the west of Malta and the tops of hills and ridges. Where this layer has been removed, the less resistant Greensand and Blue Clay have been rapidly eroded to expose the underlying Globigerina Limestone. The Globigerina Limestone is the most extensive, exposed formation, which forms a gentle rolling landscape, intersected by the sloping and often terraced valleys. The low lying Globigerina Limestone areas have, over the centuries, been reclaimed for agricultural purposes and contain a soil cover, which is shallow and extensively modified through human influence. The Lower Coralline Limestone, the lowest stratum of the Maltese stratographic succession, is only found inland in a few areas of faulting, and is a massive limestone forming the lower part of the sea cliffs on the southern and western coasts of Malta and Gozo. Malta and Gozo, the two principal islands, have a seaward tilt to the Northeast, and the highest points are 253 metres at Dingli Cliffs in Malta, and 191 metres at Dbiegi in Gozo (Schembri, 1992).

Most of the valleys on the islands are dry valleys, carrying water along their courses only during the wet season. A few, however, maintain some water flowing throughout the year. The shelter provided by the valley sides, and the availability of water, makes these valleys some of the richest habitats on the islands. Together with valleys, inland cliffs are of particular ecological importance. The cliff base is invariably surrounded by screes of boulders eroded from the rock face. Both the cliffs and the boulder scree provide a suitable habitat for many species of flora and fauna, including endemic forms.

The surrounding sea is temperate and the coast is generally steep. The total length of the coastline is 190 km, 64% of which is natural, 18% seminatural with another 18% artificial, the latter consisting mostly of harbour shorelines. Some 5% of the coastline is composed of sandy beaches, only a few of which have significant sand dunes. At least 38 km of the coastline consists of sheer cliffs (Mifsud, 1996).

The climate is typically Mediterranean with characteristic hot and dry summers and mild, wet winters. The seasonal distribution of rainfall defines the wet period, from October to March with approximately 85% of the total annual precipitation, and the dry period from April to September. The islands have an average annual precipitation of 530mm, which is highly variable from year to year. Air temperatures may be described as moderate with a mean of 18.5°C, and never fall too low to affect the growth of vegetation (Chetcuti, 1988). Wind is common on the islands, with approximately 87% of the days of the year being windy. The commonest wind is the northwesterly, which prevails on 18% of windy days. The islands receive an average of 8.3 hours of bright sunshine per day (Chetcuti, 1988).

Originally, prior to colonization by man, the Maltese islands most probably supported large tracts of Mediterranean sclerophyll forest, dominated mainly by Holm Oak (Quercus ilex) and Aleppo Pine (Pinus halepensis), with an undergrowth of shrubs. Following colonization, man started to clear the woodland in order to make room for farmland and habitation. Grazing by domestic animals, goats in particular, also had a significant effect on the remaining natural forest, which is now only present in a few localised pockets on the principal island.

The only semi-natural woodland of any extent is the conifer wood at Buskett, which is dominated by Aleppo Pine. This semi-natural wood is relatively important as it represents the only well established woodland ecosystem in the Maltese islands, with its specifically associated flora and fauna. Maquis, frequently containing some large trees such as the carob (Ceratonia siliqua) and the olive (Olea europea), is often found in small sheltered pockets were grazing is prevented, or on steep slopes. Garigue is typical of rocky terrain and is characterized by low growing shrubs on karstland. Typical shrubs forming the garigue community include the Thyme (Thymus capitatus) and the spiny spurge (Euphorbia spinosa). Some garigue communities are natural, while others are the result of degradation of woodland and maquis. Likewise, steppe grassland is a community type which results in turn from the degradation of the maquis and garigue. The garigue and steppe communities are widespread and are consid-

ered the most common natural vegetation types occuring in the Maltese islands. Other habitat types found in the Maltese islands include: transitional coastal wetlands, sand dune systems, saline marshlands, temporary and permanent freshwater pools and water courses, cliffs and caves (Schembri, 1989).

Rubble walls and carob trees are typical features of the Maltese Islands. This is even more apparent in summer, when most other plants dry up while the deep green leaves of the carob tree remain as green as ever.

Environmental Issues in the Maltese Islands

The most serious environmental problems arise from the fact that Malta is one of the smallest states in the world, with an area of 316 km², also making it one of the most densely populated. The population density stands at more than 1,274 persons/square kilometre (State of the Environment Report, 2005). The high population density is augmented further by high tourist arrivals of approximately 1.2 million yearly (Mallia, 2002). Since 1995, the population has continued to increase and in 2000 stood at 388,613 (Planning Authority, 2001). The high population density has a significant effect on the natural environment of the islands. Natural sites are continually being removed to make way for structures. It is enough to consider that in 1955 only 6% of Malta was built up, in 1988 this figure had reached 15.4% (Structure Plan For The Maltese Islands, 1990), while in 2004 it had reached 16.5% (State of the Environment Report, 2005). The influence of a high population density on the environment and its resources is highly significant and clearly apparent. Some of the main threats include the clearance of natural habitats for agricultural and building development; activities such as the dumping of domestic and building waste; quarrying; and the collection of flora and fauna for commercial and domestic purposes and the hunting and trapping of birds (Mifsud, 1996).

One of the main problems directly arising from the high population density is waste production and management. The generation and management of wastes is of utmost importance in sustainable development, and current waste practices in the Maltese islands cannot be said to be sustainable. Materials and resources are not being conserved and future generations will inherit large dump sites and wastes created by the present generation. Municipal solid waste generation has steadily increased from 0.39 tonnes per inhabitant per year in 1998 to 0.59 tonnes per inhabitant per year in 2001 (Axiak, 2002a). However the majority of solid wastes produced comes from the construction industry where it is estimated that approximately 2 million tonnes of construction wastes are generated annually. The main waste management strategy in the Maltese islands is deposit of waste on land. The majority of solid waste is currently being collected, unsorted and dumped in a relatively large open dump (Maghtab dump) close to the coast in Malta and at Il-Qortin in Gozo. Considerable amounts of hazardous wastes are being stockpiled. These include materials such as asbestos, waste oils and used batteries. The Maghtab and Qortin sites are causing a negative impact on the landscape, reducing its aesthetic beauty. The sites are also areas that are causing air pollution including increased levels of particulates, methane and odours. Saliba (1999) identified the presence of toxic heavy metals including lead, copper, cadmium and arsenic in runoff water, in groundwater and in marine sediments in the vicinity of the Maghtab site. Illegal tipping of several categories of waste is still relatively common and the penalties imposed on the polluter do not seem to be a strong enough deterrent (Axiak, 2002b). A more sustainable approach based on waste minimisation and recovery is needed and this necessitates an increased awareness of Maltese people towards the limitations of the Maltese environment. Malta's EU accession and subsequent membership in 2004 has had a positive effect on solid waste management policy and legislation. Such measures lay down a time schedule of programmes and projects which need to be achieved over the next few years, although it remains to be seen how effective all this will be.

The sewerage system in Malta consists of two main networks: the largest one serves the southern part of the island and the smaller one the northern part (Malta Structure Plan, 1990). About 80% of the sewage produced in the islands is pumped untreated to the sewage outflows of Ghammieq and Cumnija, causing marine pollution. It was estimated that 23.2 million cubic metres of untreated sewage were dumped into the sea in 1992 (COWIconsult, 1992), and this increased to 25.8 million cubic metres in 1995 (Castaglia, 1996). The environmental impact of sewage in Maltese coastal waters results in an increased bacterial load (Axiak *et al*, 2000), and hence relatively poor

bathing water downstream of the Ghammieq outflow. High levels of lead, copper and zinc were also found in the vicinity of Wied Ghammieq. In addition, another study by Stafrace indicates that fish (Mullus surmuletus) collected in the vicinity of sewage outflows had the highest metallothionein induction caused by exposure to heavy metals (Stafrace, 2001). One should remember that the natural beauty of the Maltese coast attracts a large number of tourists every year.

The only sewage treatment plant on the island, Sant Antnin, treats approximately 20% of the wastewater produced (State of the Environment Report, 2005). The treated water is used for agriculture and for industry. Other treatment plants are planned in the North of the island and in Gozo and will be partly financed by the European Union. All domestic and industrial wastewaters are planned to be treated by 2007.

The extraction of limestone dominates the mineral industry in Malta. Limestone quarrying is carried out for two basic rock types: the softstone – derived from Globigerina Limestone and used as a building stone and the hardstone – derived from Coralline Limestones and mostly used for the manufacture of concrete products and road building and maintenance. The softstone quarries are mainly located in the central and eastern areas of Malta and occupy an area of 1.1 km², while the hardstone quarries are more widely distributed and occupy a land area of 1.3 km² (State of the Environment Report, 1998). Gozo has a smaller number of quarries and nearly no hardstone extraction activity. Quarrying results in resource depletion, impacts on landscape, ecology, water resources, archaeological sites and buildings, and also in the generation of noise, air pollution and waste (Mallia, 2002). Limestone is a non-renewable resource and current rates of production, consumption and waste production cannot be sustained indefinitely. In fact the Malta Planning Authority has set out a policy against the development of any new quarries until the first review of the structure Plan in 2010 (Mallia, 2002). Quarries sometimes lead to the destruction of whole habitats and ecosystems and the subsequent elimination of species. Unusable rock and rubble is often stockpiled close to the quarry and this together with the quarry and mechanical plant itself creates unsightly visual pollution in the countryside. In addition roads are built to service the quarry and this generates traffic which exposes the countryside and groundwater to possible sources of contaminants. About 80% of all the material deposited at the Maghtab dump during the year 2000 consisted of waste generated by the construction and building industry (Planning Authority, 2002).

A major determinant of the state of the environment is the types and intensity of use of energy resources. Malta imports all of its significant primary energy; currently this comprises refined oil products and liquid petroleum gas (State of the Environment Report, 2005). There are two power stations for generating electricity in the Maltese islands, one at Marsa and the other a newer facility at Delimara. Both power stations utilise heavy fuel oil as coal was phased out in 1995 because the open coal storage facility at Marsa was identified as a source of severe coal dust pollution in the area (Mallia, 2002). However problems are far from over as the close proximity of the power stations to built up residential areas magnifies problems. For instance, teachers and students have been forced out of their school at Marsa a number of times due to high concentrations of sulphur dioxide coming from the Marsa power station (Enemalta Annual Report, 1998). Furthermore, the Delimara power station uses sea water as cooling water. Approximately 450,000 m³ of chlorinated water with a temperature of around 7°C more than the intake water temperature is pumped into the Hofra iz-Zghira shoreline, destroying Posidonia oceanica, which is a key-stone species of the sea grass meadows ecosystem (State of the Environment Report, 1998). As the generating capacity of the power station increases so will this problematic water discharge.

A Bath White butterfly emerging from the pupa. The wings are not yet fully extended. Notice the breakage in the pupa from which the adult butterfly emerged.

Alternative sources of energy are at best under-utilised. Wood is used in a very limited quantity as biomass and wind energy is only used to pump water from the local aquifers (State of the Environment Report, 2005). Solar energy is the most commonly used alternative source of energy although it still under-utilised. The average daily solar energy falling on the Maltese islands ranges from a peak of 2.7 KWh/m² in winter to 7.8 KWh/m² in summer (State of the Environment Report, 1998). But only a small fraction of this energy is utilised. The popularity of solar water heaters is low with the population, although rising electricity prices and government subsidies for the purchase costs of the solar water heater might increase their popularity. Photovoltaic electricity production is very limited on the island, probably due to the high initial cost of the technology.

Private motor usage amongst the Maltese population is very high with an average of 1.5 cars per household (Planning Authority, 1998), possibly because of the inadequacy of the public transport system. At the end of the year 2000 there were about 300 km of major roads and 182,105 private cars in Malta, which means that there are 1.6 m of road per car (Mallia, 2002). This indicates the potential and actual congestion of local traffic. Motor-vehicle generated air pollution includes carbon dioxide, carbon monoxide, nitrogen oxides, particulates and, up to 2001, particulate lead owing to the use of leaded petrol. Lead content in playground dust was found to be at an alarming level (Savona, 1996); thus, leaded petrol was phased out in 2001. Volatile organic compounds are also emitted by cars, and a high level of VOCs including the carcinogen benzene have been identified in the Maltese islands. More than 78% of sites tested for benzene were found to exceed the WHO limit value of 1.5ppb (Vella, 2002). Motor traffic also generates noise pollution and residents in a number of areas are being subjected to levels of noise of approximately 65dB for at least 1-2 hours daily, which can be detrimental to health (Mallia, 2002).

Freshwater production in the Maltese islands is dependent on electricity. About 50% of the total water produced on the islands comes from reverse osmosis plants that desalinate sea water and require large amounts of electricity to function. The water thus produced is of a very high quality but it is then mixed with the lower quality groundwater from local aquifers, which is cheaper to extract. This reduces the water quality to levels that do not always comply with EU standards (State of the Environment Report, 1998). Leaching from artificial fertilizers results in groundwater with very high levels of nitrates, while the proximity of the groundwater table to seawater results in high levels of salinity in groundwater (Department of Health Policy and Planning, 1997, State of the Environment Report, 2005).

The flower of the milky orchid, Orchis lactea, which flowers in winter and grows in garigue, steppe and disturbed grounds.

The Maltese islands have a rich variety of flora and fauna considering their relatively small size. However, small, isolated islands tend to have a somewhat impoverished resident avifauna and the Maltese islands are no exception (Sultana and Gauci, 1982). Nevertheless, the Afro-European migration system has three principal migration routes over the Mediterranean, one of which passes over the Maltese archipelago. The islands' strategic location plays an important role for many species of migratory birds during the annual spring and autumn

migrations. More than 360 species of birds have to date been recorded in the Maltese islands, of which 15 are resident breeders, and the rest either regular or irregular migrants (Sultana and Gauci, 1982).

Bird hunting is a popular hobby pursued with a passion by people in various countries over the world and especially so in the Maltese islands. In Malta this issue attracts a large amount of public attention, most probably because of the very large hunting and trapping population that has increased from 11,300 in 1996 (Mifsud, 1996) to 15,216 in 2004 (State of the Environment Report, 2005). This creates a relatively large number of hunters with respect to the whole population and a high individual hunter figure per unit area of land. In addition, hunting of protected species and hunting during the closed season are extensive in the Maltese islands, most likely due to the lack of law enforcement and the hunters' attitudes (Fenech, 1992). Hunting and trapping of birds may be minority pastimes but they still constitute very powerful lobbies, and the two large political parties in the islands are normally unenthusiastic about moderating the practice.

Birds are almost certainly the most publicised threatened organisms on the Maltese islands. However, other important organisms such as the Maltese Freshwater Crab, Potamon fluviatile, are also decreasing in number owing to increased influence by humans such as direct persecution, and habitat destruction due to development. Some flowering plants, including the French Daffodil, Narcissus tazetta, are still being removed from the natural environment and sold at flea markets even though it is an illegal practice.

In summary, the major environmental issues in the Maltese islands include waste management, quarrying, habitat destruction, pollution from electricity generation and vehicle transport, the under-utilisation of alternative sources of energy, water quality, and the collection or hunting of flora and fauna. The main cause of these issues is the high population density that exerts a significant impact on the environment and its resources. In addition, the unwillingness of the major political parties to moderate practices and traditions, amplifies some of these issues.

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