REHABILITATION OF HABITATS AND MANAGEMENT OF RESOURCES

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This paper deals with two major themes. One, the rational exploitation of marine living resources and their potential to recover from over exploitation; and the other, the potential for recovery of marine and coastal habitats and ecosystems. Also, of importance is turtle conservation, as this relates to both and links the two themes.

Firstly, I will give an example regarding the rational management of fishery resources.

Marine-living resources are renewable and can therefore sustain fruitful exploitation for long periods, hopefully forever, if properly managed: If they are misused, natural production can be severely crippled. Fisheries management is a difficult art and the present state of most fisheries in the world testifies to this.

The demersal fisheries of the Mediterranean are considered exploited and often overexploited, especially in the developed countries of Europe.[1,2,3,4] The General Fisheries Council for the Mediterranean (GFCM) has been promoting better management techniques for these resources, with particular emphasis on two major aspects of management -- the regulation of age at first capture, through the use of appropriate mesh sizes, and the limitation of fishing effort. However, progress is very slow, especially in heavily over-fished areas for various reasons, including the apparent lack of understanding of the consequences of excessive fishery development; definition of objectives by higher authorities; commitment by regulating authorities; clear perception of the potential gains of the measures and consequently, passive or active resistance of fishermen to management measures. Politicians are also often reluctant to adopt unpopular measures.

In 1982, the Fisheries Department of Cyprus started implementing a new fishing regime, restraining maximum fishing power of the already limited number of trawlers and, more importantly, extending the 4-month closed season by 1 month to protect juveniles during the very critical period of their arrival on the fishing grounds.[5] The results were spectacular.

In the trawl fishery the annual catch which had been dropping at about 17% per year since 1978 increased sharply from 1983 onwards by about 90%. This increased catch has been sustained since then. There were also parallel increases in the catch of the inshore fishery which by 1984 was about 80% higher than that of 1981. This increase was also sustained.

These minor management measures have obviously had revolutionary effects on the yield potential of the resource. Production models based on the old fishing regime predicted a maximum sustainable yield of about half of the present production model. The old production models have obviously become obsolete as parameters for the "yield per fish recruit" and the annual recruitment of fish into the resource has changed dramatically.[6,7]

I am giving this as an example which demonstrates the need and the effects of rational management. It demonstrates what can be done if juveniles are protected in order to reach commercial size and what is known as Growth Overfishing is curbed. Growth Overfishing occurs where there are losses of total catch because the fish is caught too early with too much of an effort and, therefore, not being given enough time to grow. The state of the Cyprus fisheries before 1982 had much in common with many Mediterranean fisheries: resources were heavily fished and the catch of the year depended largely on the new recruits to the fishing grounds in October. The recruits were heavily fished by trawlers in October and November, and the survivors were the basis for the catch of the trawl and the inshore fishery the following year.

The problems created by the exploitation of "a common property fish resource" in the absence of limitation of fishing effort has been discussed in detail by Pearse[8] and FAO GFCM (1982)[3,4] in the case of the Mediterranean, and in FAO (1983)9 from a more general viewpoint. The regulation of effort, its limitation and the decisions on resource allocation this regulation requires are difficult tasks. Through lack of awareness of the problem, or fear of the difficulties involved, the regulation of fishing effort has not yet been properly implemented in most of the Mediterranean countries, nor in a great number of other areas in the world.

In general, over-fishing results in shortening the lifespan of fish, reduction in the size of the fish caught, their abundance, catch rates as well as in reduced profitability; and frequently, a shift in catch composition to lower-valued species. Consequently, the trawl fishermen, who are always trying to optimise their operations, are forced to increase their pressure on younger fish in the short-term concentrating their activity on the periods and the areas where the fish are most vulnerable. There is, at the same time, a trend towards reducing mesh sizes or the effective mechanical selectivity of the net.

The natural resistance of fishermen to regulation is abetted by favourable price changes in the market, which keep the fishing of small-size fish still profitable. This is particularly the case in the Mediterranean.

I have, of course, but touched on the subject of gross over-exploitation of resources. Whole stocks of fish have collapsed, the spectacular collapse of the Peruvian anchuvetta fishery is a much quoted example.

Whales have been fished so intensly their stocks are now dramatically low. The grey whale in the North Atlantic is extinct and the humpback and blue whales survive as relic populations only. Regulations have helped somewhat in the case of the fin and sei whales, however, their stocks are also depleted (FAO 1978).[10]

The recovery of demersal fishery resources is possible with good management if resource is in a reasonable state. In the Western Adriatic valuable demersal resource have been replaced by the low-value, small pelagic fish (sardines etc.), as a result of a virtual collapse of the demersal stocks due to overexploitation. Can such demersal resources recover given the chance? This is an open question.

In the case of the whales the only stock that has demonstrably recovered under protection is the California grey whale. It is still too early to say if the blue whale stocks have recovered since their protection. The process is slow for large whales, though the humpback and white whale stocks have shown some evidence of increases in recent years.

The situation regarding small cetaceans is even less well-known, though some stocks are apparently severely endangered. There is little known about these in the Mediterranean.

It is not only exploitation that is endangering stocks of marine animals. Habitat modification and degradation also play a part and even in cases where exploitation no longer takes place, some species are now facing extinction as a result of habitat changes.

Turtle stocks have been and still are, in some areas, heavily exploited. I will concentrate on the Mediterranean, which to some degree reflects the global picture. About 4000 Loggerhead turtles are fished every year in Tunisia. The catch in the Mediterranean is estimated to be at least 6000-8000 animals per year. Given the slow growth rate of these animals, which may take anything from 10-20 years to mature, the picture is very disturbing indeed. Current information on the Loggerhead Turtles shows these animals breeding in only a few areas in the Mediterranean. The Loggerheads largest single nesting site known in the Mediterranean is in Zakynthos, where at best estimates, about 600-800 turtles breed every year. Even if we assume that they breed every 3 years this would make a total of about 1800-2400 turtles. Of course there are other nesting areas in Greece, Turkey, and Cyprus perhaps tripling this number. Recent information has the Loggerhead turtles also breeding in small numbers in Tunisia and in unknown, (presumably not large) numbers in Libya and Egypt. A catch of 6000-8000 turtles per year, however, implies a much larger population than what is now breeding in the Mediterranean. There is some evidence that some may be breeding outside the Mediterranean on the West African Coast, carrying out migrations into the Mediterranean as indeed they do within the Mediterranean. Several turtles tagged in Zakynthos were caught in Tunisia.

There is clear evidence that as recently as 20 to 30 years ago, turtles used to nest on many more beaches in the Mediterranean. Beaches which are no longer available to them, due to other activities such as tourism, or sand extraction which renders them unsuitable for nesting.

There are many questions unanswered. What is clear however, is that the current recruitment into the population from breeding in the Mediterranean is practically negligible compared to the number of turtles killed in the sea each year, and deaths caused by fishing nets. It is very likely that the present turtle catches depend on a sizeable stock of older turtles that once bred in large numbers on the Mediterranean shores. If this is the case then we can expect a virtual collapse of the stocks in the very near future. This may well be the case with the Green Turtle, a tiny population which now lives in the East Mediterranean nesting only in a handful of beaches in Cyprus and Turkey.

It is also very clear that the remaining nesting beaches in the Mediterranean are crucial to the survival of the turtles in the sea. These beaches are in need of immediate protection if the Mediterranean turtles are to even have a chance of surviving.

A regional approach to the protection of turtles and their nesting beaches is necessary, and we cannot but applaud the Mediterranean Action Plan of UNEP for its current and planned activities. UNEP is implementing the Specially Protected Areas Protocol of the Barcelona Convention, not only for the protection of turtles and the Mediterranean Monk seal, but also for the protection of other vulnerable habitats. Much is needed to be done by the Mediterranean States themselves, and in support of the Mediterranean Action Plan. The pressure from development in the Mediterranean along its shores and the rate of change is frightening.

In Cyprus, turtles, along with seals and dolphins, have been protected by law since 1971 (Fisheries Law Cap 135 and Regulations).

In 1976, a project was conceived as to how the Marine Turtles of Cyprus could be helped. 2 years later, in 1978, a project was launched by the Fisheries Department. The project is financed by the Cyprus Government. Late in 1980, it received World Wildlife Fund support for 3 years, as an International Union for the Conservation of Nature/World Wildlife Fund Project.

In 1976 and 1977, before the project was launched, a thorough survey of the turtle breeding beaches was undertaken. Surveys undertaken since then confirm the initial observation: though nesting on some beaches, in eastern Cyprus, nesting has practically ceased as a result of the intensive use of these beaches for tourism, recreation etc..

In Cyprus turtles lay every 2 years from the beginning of June until the middle of August. During the breeding season they lay 3-5 times approximately every 2 weeks. Each clutch of about 100 eggs is laid deep in a hole dug in the sand at night. The hatchlings emerge from the sand at night, about 7 weeks later, and head directly and infallibly towards the sea.

Their instinctive location of the sea is based on their attraction to the brightest area, the sea. This instinct, however, may well be the downfall of the turtles, as hatchlings are attracted to the brightest light near the breeding beach -- be it a hotel, cafe or a camp -- hence the need to avoid any such "development" near the breeding beaches. Female turtles are shy, and lights and movement at night will affect their laying. If the eggs are retained for too long by a female that cannot find a suitable beach to lay, they will be disposed of in the sea.

The active conservation of Cyprus' Marine Turtles started in 1978 with the setting up of a seasonal station and hatchery at Lara. Eggs are collected and incubated by reburying them in the sand as the female turtle does.

Hatching success improved with better handling techniques and a very creditable 75% success rate is now achieved. This however, is still a little lower than that of protected undisturbed nests, which is about 80-90%.

At Lara, most of the nests that can be protected on site by cages are left where they were laid. The project was deemed necessary to protect nests against predators. Every nest is now valuable.

In a survey that was undertaken on the extensive beaches of North-west Cyprus, more than 70% of the nests were found to have been dug up and the eggs eaten by foxes which patrol the beaches during the breeding season.

At the beginning of the project there was an estimated breeding population of about 100 Green Turtles breeding mainly in the Lara area. The Loggerhead population is apparently somewhat larger - we tentatively put this at about 300 adults. We have recently noticed however a "larger" number of 5-7 year old turtles at sea, off the coast of Cyprus.

The Lara Turtle project is the first and only one of its kind in the Mediterranean. Through the project about 4,000 hatchlings are released every year. This is about 3-4 times the number that would normally reach the sea if the nests were not protected.

The young turtles are released on the beach they were laid on. Though the time required for maturation is still uncertain it is expected that 10-15 years after hatching, the turtles that survive will return to the same beaches to lay their own eggs. The imprinting mechanism through which they find their way back is still subject to debate, for this reason all precautions are taken to disturb as little as possible the hatchlings incubation and first descent to the sea.

Raising turtles to larger sizes and releasing them is also being currently experimented with in an effort to cut down on predation at sea. About 150 turtles ranging from 1 to 10 years old are being kept in sea cages in Paphos harbour. About 50 have already been released at various ages. Releasing such ongrown turtles may cut down on mortality at sea as they will be too large to be eaten by most predators. These are tagged, so that when they come back, hopefully to lay on the beaches where they were laid, they can be identified. All the adult female turtles found nesting are also tagged.[11,12,13]

The North Lara beaches are within the Akamas Main State Forest and are leased by the Department of Fisheries. They are managed as a nature reserve. The intent is of course to have the main breeding beaches permanently protected in such a way as to avoid human interference with the breeding activity both during nesting and hatching.

Without such habitat protection, long term prospects for the survival of the turtles in Cyprus, or elsewhere for that matter, irrespective of the success of the project in increasing the recruitment of young turtles into the population, is, at best, doubtful.

The destruction of the turtles' nesting beaches may well be irreversible. The spectacular failure of the now famous "Operation Green Turtle" launched in the late 1950s by Archie Carr, to reintroduce Green Turtles to old nesting sites, is good evidence (though admittedly not foolproof) that such reintroductions may not be possible.[14] The recovery of some stocks, may well be impossible. In other words, in some cases we may not be in a position to undo the damage we have done.

Much more information is needed before final conclusions are reached on the possibilities for recovery of resources and the rehabilitation of damaged habitats.

In contrast to the information that is available on the effects of pollution on ecosystems and habitats in the Mediterranean, the information on the recovery and rehabilitation of habitats is sparse, probably reflecting a lack of tangible examples for such studies.

The complexity of habitats is such that it is often essential to have baseline information to evaluate the degree of recovery of a damaged habitat or a resource. For much of the Mediterranean, and more so for the coast of developing countries, such information is limited or non-existent. Nonetheless, there is some evidence that the recovery of at least certain habitats is possible. The speed of recovery, however, may vary significantly depending on the habitat and on environmental conditions.

Studies on the effects of thermal effluents have indicated that even a seasonal recolonisation of an area affected by lethal temperatures is (for some species at least) possible.[15] The colonization of artificial reefs, albeit a somewhat better documented subject, indicates a succession of population states before a "balance" is reached. This may be relevant to the recovery of certain kinds of rocky habitats. Colonization is, in this case also, quick, though one cannot claim that such colonization can be anything more than an indication of the speed at which certain species move in to occupy a niche and that several years may elapse before balanced populations of the various species that make up the biota of a habitat, are achieved. Colonization is also apparently quick in nearshore soft bottom habitats even after apparently catastrophic environmental disturbance such as dredging operations.[16, 17]

The regression and often the disappearance of Posidonia oceanica from stretches of coastline resulting from illegal trawling18 and pollution, may take many years to reverse. Since the seeds of this sea grass are carried by currents, the recovery "upstream" of the prevailing current may well prove impossible, unless artificially carried out. The seeding of Posidonia in the North-west Mediterranean is in itself still subject to studies. Vegetative reproduction is slow (3-4 cm/year), and it may take, under natural circumstances, many decades, if not centuries, for the recovery of the Posidonia meadows in parts of this area by this method of reproduction.19 Posidonia flowers and seeds recovery can start fairly quickly. In Morphou Bay (Cyprus), 3 years after mining effluents (iron oxides and hydroxides) blanketing the sea bed stopped being discharged into the Bay, clumps of live Posidonia were noticed in several areas by fishermen.

Following the control of a chlor-alkali effluent in the North Tyrrhenian Sea (Rosignano Solvav) and the drop in mercury input in 197320 environmental recovery has been followed over 10 years by means of bio-indicator organisms.[21] The time needed for complete recovery to the natural background level has been estimated by trend analysis with reference to a remote, unaffected area. Since 1978, the mercury input was reduced from 35-40 kg d-1 to 1-2 kg d-1 in 1975-7622 and finally to less than 0.1 kg d-1s. Limpets (Patella sp), crabs (Pachygrapsus marmoratus) and fish (small-seated scorpion fish, Scorpaena porcus and the rainbow wrasse, Coris julis) were collected at the same stations as before and wet materials analyzed for mercury. The results show that decontamination of a heavily polluted marine environment by mercury requires considerable time. Recovery to the reference level of the two fish species is estimated to be 23.2 to 23.8 y-1. Less time is required for Patella (13.4-14.= y-1) and P. marmoratus (15.2 y-1).

Quick recolonization rates were observed in muddy sand sediments in an in situ experiment carried out in the Fos gulf.23 This experiment involved the planting of trays with heavily polluted sediments with high organic and heavy metal loads in the sea bed.

It was concluded that the colonization and dynamic processes of the mollusc populations studied do not depend on the concentrations of the solid phase pollutants, but are related to the release of these pollutants in the interstitial water of sediments which in turn is induced by ambient condition variations and particularly by salinity.

The natural recolonization and rehabilitation of special habitats such as coastal wetlands which do not have common stock of species from which to draw on for recolonization purposes (such as is available in the sea), may well prove impossible. These can probably be re-established after considerable care and artificial reintroductions and even then, success is uncertain.

Several kinds of habitats in the Mediterranean have been seriously damaged or had their equilibrium disturbed. This is particularaly so in the case of enclosed bays receiving industrial and other effluents, and of Posidonia meadows disturbed by trawling. More information on the speed and degree of recovery of a variety of habitats would be useful in forecasting and assessing the results of measures intended to reduce pollution and improve and manage the marine environment. Needless to say, great care should be taken now of special habitats such as coastal wetlands or parts of ecosystems, the destruction of which may well have a permanent effect on the species relying on them.

Much remains also to be done towards understanding the effects of pollutants, especially the long term effects. What are its effects on vulnerable species, such as dolphins, seals and turtles. Are the jellyfish booms and the mass mortality of sponges and sea urchins recently noticed in the Mediterranean really natural phenomena or are they being helped by man- made changes. Do we have enough information to know the difference? Much work obviously awaits us and it is urgently needed.

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