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MARINE FISHES, HABITATS AND CONSERVATION

by

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ABSTRACT

Marine fishes and their habitats, from coastal waters to the deep sea, are imperilled by numerous threats, such as overexploitation, pollution, and habitat destruction. Spearfishing mainly threatens sedentary coastal fishes. One problem when studying threatened fish species is generally the shortage of quantitative data, for instance about population size and life cycles. Marine reserves can be the solution to problems of preservation of some species and habitats. Existing laws on conservation must be enforced by strong control and inspection measures; new regulations must be created; international agencies can provide advice and expertise.

KEY WORDS: marine fishes, habitats, conservation, threatened species.

INTRODUCTION

Man is attacking and depleting one of the most valuable environments of his own planet—the sea. Among the main factors threatening marine biotopes and fishes are overexploitation (legal or illegal) and pollution in its broad sense. The impact of tourist facilities, coastal engineering work and sometimes military activities, may be very destructive if their location and management are not carefully planned. Only a few situations among those existing all over the world will be discussed here.

LACK OF INFORMATION

Managing the exploitation of fish populations of economic interest is not always easy. Nevertheless statistical data on the yearly catches of the main commercial species are available (*e.g.* BEVERTON, 1992) as are models predicting available resources. Furthermore, international bodies such as ICES and FAO do much good work in getting the necessary data and in giving advice on managing fish resources.

But for non-commercial fishes, assessing population depletions or increases with precision is extremely difficult, and most threatened species fall into this category. In general there are no statistical data about catches of non-commercial fishes, and trying to get such data will be unrealistic.

In most cases, threats have been identified from subjective observations, many carried out underwater, without any statistical record. However, when these observations are done over many years, by people ranging from fishermen and divers to scientists (and even by illiterate people!), we can trust their consistency, but they lack objective, quantitative support and are not useful in serious numerical studies.

The scientific study of the impact of fishing on littoral fishes is too rarely promoted, sometimes because this activity is believed to have neither economic nor political importance. Furthermore, because of unofficial commercial circuits, some catches from artisanal fishing are impossible to record statistically; the same is true for recreational fishing (spearfishing and angling). These situations make any assessment difficult.

Recent quantitative assessments of population size of threatened species and habitat destruction (*e.g.* CHAUVET *et al.*, 1991; HARMELIN & MARINOPOULOS, 1992) were or are being carried out mostly by scientists and scientific institutions, many times without any support from national governments.

SPEARFISHING

Veteran divers speak of the progressive depletion observed along European coasts and elsewhere in the last 20 or 30 years where spearfishing has developed. Furthermore, the descriptions of early underwater explorers and spearfishermen, in the Mediterranean for example, written some 30 or 40 years ago, contain enthusiastic references to the great abundance of some fishes like the dusky grouper (*Epinephelus guaza* (L.)) or the brown meagre (*Sciaena umbra* L.) (J. G. HARMELIN, pers. comm.).

Spearfishing is spread world-wide and thousands of persons do it, primarily in a narrow strip along the continents and islands. It destroys species whose recruitment capacity cannot answer the catch pressure. Unfortunately these depletions are not quantitatively recorded. In every place it also very quickly promotes flight reactions in fishes.

I find it difficult to accept as a sport any activity where death is the ultimate objective or in which animals are bound to suffer (like hunting and bullfighting). According to MONOD (*cf.* JARRY, 1990) there are three conditions in which it is tolerable to kill an animal: 1) in self defence, 2) to eat, and 3) for scientific interest.

Furthermore there is also a question of bio-ethics (as defined by FONTAINE, 1980)—why destroy life for pleasure? Spearfishing as a sport

was condemned in the Fifth European Ichthyological Congress (Stockholm, 1985).

Of course it will be unrealistic to eradicate spearfishing completely, as so many people depend on the associated business (equipment manufacture, travel agencies, *etc.*). What can be done is to enforce the law in every country, requiring licences, restricting the areas and seasons where spearfishing is allowed, and above all inspecting and controlling the activity. Punishment must be effective. Such laws as do exist in many countries are often totally ineffective.

POLLUTION

Pollution is of course a principal threat to the marine environment and consequently to fishes at all stages of their life history (*e.g.* Ruivo, 1972; Brown, 1985; Cross & Sunda, 1985; Clark, 1989). Fishes are subjected to various chemical wastes, mainly in coastal waters: herbicides, detergents, radioactive wastes, oil spills, domestic effluents and power plant effluents. Even the action of dumping large quantities of fine material in the sea, *e.g.* from building activities, can blanket the bottom and kill marine life (pers. obs.; Portmann, 1972).

Different kinds of pollutants can affect the food resources for fish, reducing amounts of food and sometimes destroying some links in the fish food chain, endangering the fishes' life cycle (*e.g.* Eisler, 1972; Fontaine, 1972). They can also alter chemosensory mechanisms and change the ability of fish to detect their prey. For instance pollutants may act on the taste papillae of fishes and hence on their feeding behaviour, as do detergents in such low concentrations as 0.5 ppm (Bardach *et al.*, 1965).

Pollutants also affect respiration through a variety of mechanisms. Certain metals can modify the branchial cells, sometimes causing histological changes in the gill tissue (Wendelaar Bonga & Lock, 1992). Copper, for instance, seems to have a coagulative effect upon the gill epithelium, and can also trigger degenerative and necrotic changes in the liver, kidneys and haemopoietic tissues. As a general rule, copper concentrations induce lesions of haemopoietic tissue leading to haemolitic anaemia and dystrophic changes in epithelial and mucous cells of gills (Mitrovic, 1972).

Pollutants can equally be responsible for oxygen depletion in a water mass (Clark, 1989), leading to disturbances of the reproductive function and migration of fishes. Some fishes are able to stay alive for long periods in oxygen-depleted waters, but at the cost of deleterious metabolic effects, such as accumulation of lactic acid in the blood and excretion of this through urine, loss of energy and depletion of gly-

cogen reserves in the muscle. Suspended solids in water with low oxygen content can impair respiratory function (FONTAINE, 1972; RUIVO, 1972).

As osmoregulatory and ionic transport capacity in fish varies with temperature, thermal pollution may affect this phenomenon. In oceanic waters, pollutants may modify the thermoregulatory capacity of fishes like tuna and may alter their migration (FONTAINE, 1972).

Furthermore, numerous chemical substances affect population structure, size and mortality and increase susceptibility to various infections and attack by parasites (*cf.* MITROVIC, 1972).

COASTAL MANAGEMENT AND TOURISM

Poor coastal management also imperils marine ecosystems. Building marinas, piers, hotels in the wrong places generally damages the marine environment irreversibly. In many parts of the world, effluents from hotels near the shoreline go directly into, and contaminate, the sea. Some coral reef lagoons have been contaminated in this way, leading to eutrophication (pers. obs.; JOHANNES, 1972). Nevertheless, tourism, properly orientated, can be a good source of finance for protected areas.

HABITATS AND SPECIES

At the First World Conference on National Parks (Seattle, 1962), governments were recommended to create protected marine areas (*cf.* RANDALL, 1969). Marine protected areas are a great benefit for littoral fishes. As stressed by HARMELIN (1984, and pers. comm.), not only are the presence and abundance of species and individuals increased in protected areas, but also the size of individuals. Furthermore the natural behaviour of the fishes can be observed again in the presence of a diver. This so called 'reserve effect' has been widely demonstrated, for instance in the Mediterranean, South Africa and the Philippines (BELL, 1983; RUSS, 1985; GARCIA & ZABALA, 1990; BENNETT & ATTWOOD, 1991; FRANCOUR, 1991). Marine habitats are also recovered in this way.

Marine protected areas are perhaps a modest effort in relation to the amount of problems that threaten marine ecosystems, but they can be fought for in a realistic way. The creation of these protected areas is the least a government can do to preserve a small parcel of an invaluable patrimony. Nowadays two simultaneous efforts are necessary: saving the few damaged places worth protecting, and improving conditions for conserving areas already protected.

European Seas

In the European North Atlantic, undoubtedly the Azores Islands are the most interesting and unspoiled area, where a profusion of individuals of a great number of species can be observed. Several parks were fortunately created in these islands. Biogeographically their marine fauna presents species with different affinities: Atlantic, Mediterranean, African and American.

One abundant species in the region is the dusky grouper, *Epinephelus guaza* (L.), which must be considered a threatened species along the European coasts. QUERO *et al.* (1987) included it in the Red-book of French marine endangered species. The animal is appreciated as a trophy because of its size and flesh, and was practically decimated by recreational spearfishing. It nearly disappeared in several regions of European littoral waters where it had been abundant, some thirty years ago, from the Atlantic to the Mediterranean. In practice there are no quantitative data, such as population size, about it.

Recently some French scientists (*e.g.* CHAUVET & FRANCOUR, 1990; BOUDOURESQUE *et al.*, 1991; CHAUVET, 1991; CHAUVET *et al.*, 1991) started a programme to characterise the populations. They pointed out that the species does not reproduce north of 41° 5′ N in the Mediterranean and that individuals are not as sedentary as had been supposed, changing their place each year. French populations depend on those existing in Spanish, Italian and North African waters. At the island of S. Miguel, Azores, individuals were followed for at least five years at the same place (pers. obs.).

In the Azores, spearfishing *E. guaza* is illegal, but the species can be caught by commercial fishermen, and there is obviously a lot of abuse. A minimum catch length is not yet established and many juveniles are caught. In the island of Madeira, thanks to the good work of some citizens and the German owner of a diving club, it was possible to create a marine park at Garajau not far from Funchal. The creation of this park was primarily to protect a small population of *E. guaza*, and this goal was perfectly achieved. Furthermore, as in every protected zone, the abundance of other species improved very much.

Another threatened species in the north-western Mediterranean and southern Iberian coasts is the brown meagre *Sciaena umbra* L. (*cf.* BOUDOURESQUE *et al.*, 1991; HARMELIN, 1991; HARMELIN & MARINOPOULOS, 1992). As for *E. guaza*, there are no data about local population size, even in the now-protected areas. It is thus impossible to link subjective observations concerning depletion or increase of the number of individuals with objective data. The general impression is that there was a drastic decrease in population numbers compared with those of the 1940s or 1950s. This fish is very sensitive to direct predation by

spearfishing. It is an easy target due to its slow swimming and because it lives on rocky shallow bottoms, generally in the vicinity of *Posidonia* beds.

In France and in Spain it was recently concluded that individuals are now found inside the protected areas where spearfishing and other fishing activities are forbidden. There is also an increase in animal numbers. In other parts of the Mediterranean the situation deserves further attention.

Along the Portuguese coast the brown meagre practically disappeared. There are no data about its abundance in the 1950s when spearfishing started to be popular in Portugal, but there are records of big specimens caught by that time. The depletion of marine angiosperm beds by pollution or bad coastal management are also among the reasons affecting the species population density.

The same depletion is also threatening the sea-horse *Hippocampus ramulosus* Leach, included in the French Red-book on endangered marine species (Quero *et al.*, 1987).

As quoted by Harmelin (1991), some species with southern affinities like *Seriola dumerili* (Risso), *Diplodus cervinus* (Lowe), *Balistes carolinensis* Gmelin, *Epinephelus alexandrinus* (Val.) and *E. guaza* are being found more commonly along the north-west Mediterranean coasts. Juveniles of these species were observed at relatively high latitudes such as Calvi and Barcelona. Changes in the physical properties of the water and natural fluctuations of populations in space and time are perhaps responsible for these occurrences.

Coral Reefs

Coral reefs everywhere are sensitive ecosystems also subjected to all kinds of destruction (even atomic explosions!). As in other places, spearfishing, pollution and tourism are some of the threats hanging over this unique world (*cf.* Johannes, 1972; Russ, 1985; Clark, 1989).

In the Red Sea a good example of an efficient initiative was given by Israel and by the team led by Lev Fishelson (1980). When Israeli forces occupied Sinai in 1967, several marine parks were immediately created in the Gulf of Eilat and in some sections of the Gulf of Suez "to avoid the immediate and real danger of destruction by herds of souvenir collectors and animal hunters". Simultaneously the coral reefs were studied in detail and a legal framework for the establishment of these protected areas was created. Their executive bodies and bedouins were clearly instructed about the advantages of conserving coral reefs. Rules included total protection of animals, forbidden waste disposal and a ban on spearfishing. Punishments were also considered for those not respecting the law.

In 1985 (pers. obs.) the reefs of Djibouti seemed fairly undamaged and the main concern of the local authorities was about the possible destruction of the reefs by foreign military people.

In Kenya there is also a good example of coral reef conservation. The reef of Malindi is not one of the most spectacular, but it is well kept and the wardens show a great interest in their job.

The small coral formations of Inhaca Island, off Maputo in Mozambique, are the southernmost reefs along the African coast. In 1969 (pers. obs.) these reefs were subjected to spearfishing, souvenir collecting and, perhaps worst of all, the breaking of corals by yacht anchors. Large extensions of the small reefs were reduced to coral debris of different sizes while in other parts the fish fauna was truly impoverished. Now the Mozambican authorities show great concern for these reefs, which are totally protected. Different areas around the island are marked with buoys defining the boundaries of coral reefs and are watched by wardens. Yachts and boats have a special place to stay and no entry into the protected areas is allowed except for scientific purposes. A scientific programme to study the reefs was started and one of the main concerns is the increase of area occupied by corals. As already stressed, protective management of coral reefs maintains the high abundance of many species of fishes (Russ, 1985).

The Deep Sea

The most remote and unknown habitat on Earth, the deep sea, is also one of the most important on the globe due to the physical, chemical and biological processes that occur in it. The presence and distribution of pollutants in the deep sea are influenced or even controlled by the biogeochemical processes occurring at these depths and in the overlying water column. We do not know the capacity of the deep sea to absorb or neutralise pollutants. The presence of different wastes will certainly modify the chemical and biological parameters of the deep-sea ecosystem: radioactive wastes, for example, may have long-term effects in space and time depending on bioaccumulation processes.

A conspicuous type of pollution of the deep sea is that caused by plastics and other non-degradable solid wasted. Many parts of the slope, rise and abyssal plain of the world ocean are not free from all kinds of plastic coming mainly from ships (pers. obs.). It is estimated that some 1.1 or 2.6 kg per person per day of plastic waste is generated and practically all thrown overboard. Including plastic wrappings of cargo, the total amount of plastics discarded by ships is something like 6.5 million tons a year! (Clark, 1989).

Some years ago a haul done in the abyssal Tagus plain at a depth of 5100 m, by the R.V. 'Discovery', took some different kinds of plastics,

from bags to a bottle and other solid wastes. Even in the Arctic not far from the ice edge and off Spitsbergen a plastic glove and the remains of plastic bags were taken in July 1991 at 2000 m depth during a cruise of the R.V. 'Polarstern' (pers. obs.).

The damage caused by solid plastic waste is not yet assessed. Exchanges between the sediment and the water column and the respective biological processes will probably be influenced at any bathymetric level.

PERSPECTIVES

Fighting for the conservation of the marine environment is not an easy task. Step by step, perhaps not as quickly as in the terrestrial realm, many habitats will be destroyed and some species will disappear if we don't fight hard! The threats to the marine world will be even worse in the future. Industrial development with its pollution (*e.g.* BROWN, 1985; CLARK, 1989) and the use of chemicals in agriculture, for example, will not soon stop. There will also be an increasing necessity to consume more and more fish products, owing to demographic increase. By the end of the century, the total world demand for fish might be of the order of 100-110 million tons annually (F.A.O., 1989).

Of course some of these problems could be minimised if governments had the will to solve them and joined forces. There are already international agreements that try to limit marine pollution and to control the exploitation of living resources. Nevertheless they are far from giving the full answer.

We need better fisheries management and strong measures to prevent environmental degradation and pollution. We need also to inspect and control strongly the application of the laws on a large scale. We must also create new regulations where they are lacking. Without them even the survival of protected areas will perhaps be unrealistic in the future.

The European Ichthyological Union, with its unquestioned scientific authority and its independence, has an important role to play in the field of the conservation of the marine world and its fishes.

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