

# CONSERVATION OF NATURE IN THE MARINE ENVIRONMENT

by

P. KORRINGA

*Netherlands Institute for Fishery Investigations, IJmuiden, The Netherlands*

## ABSTRACT

It was on land that the need for conservation of nature was first felt. Setting aside of noteworthy areas for that purpose often led to a serious clash with other interests. Therefore the need was felt to formulate on a scientific basis which factors should be carefully considered in deciding which sections of the continents should be destined for nature conservation. It turned out that all these factors operate directly or indirectly in the interest of man himself, not for nature as such. An effort is made to study the applicability of all these factors in the marine environment. Comparison with the situation on land leads to the conclusion that the recreational value of the coral reefs in tropical areas requires above all measures for their protection, whereas other factors are already duly taken care of or require no action at all for the time being.

It was at the turn of the century that the conception "Conservation of Nature" evolved and became a reality to those in the western world who had an open eye for the importance of nature. In the beginning it was an élite group that came to action, but gradually the need for protection of nature became understood in broader segments of society. For ages man had considered nature in the first place as a source of food, and had devised religious conceptions which told him that nature had especially been put at his disposal for his advantage. And he took advantage, first by collecting edible items in the wild from a great diversity of plants and animals, later, realizing that not so many mouths can be filled that way, by interfering grossly, reducing the number of species drastically, in what is now called agriculture and animal husbandry. The areas unsuitable for these activities were long considered as hostile to man and called "waste"; plants and animals of which no use could be made in any way were by definition called "weeds" and "vermin".

In due course man saw that indiscriminate interference with nature could lead to disaster, to a complete loss of productivity by erosion, as when the topsoil was either washed away by torrents after felling of woods (which had served as a sponge when it rained heavily), or was simply blown away by the wind when the protecting mat of vegetation was destroyed by man or by his cattle. Several once fertile areas became derelict this way and desert-like conditions obtain now where one found long ago centres of civilization. To compensate for such losses man made an effort to put more and more "waste" to "good use" by reclamation, manuring and irrigation, driving back what was left of "nature", which took refuge to the poorest grounds.

It took a long time for man to realize that nature should not be considered as something hostile to him, that he cannot do without that nature, and that he is not a supernatural creature, but that he arose from nature and belongs to it, just being one of the mammals competing for food and space with other animals. Realizing where he abused nature, causing irreparable erosion and exterminating several species of larger animals, he feels now inclined to be more careful in his attacks on what is left of nature.

However, it was not in the first place the utilitarian aspects that led to the first efforts to protect nature, safeguarding areas denominated "nature reserves". In densely populated countries of the western world one witnessed the gradual disappearance of various once opulent bird sanctuaries and of terrains with a lush natural vegetation, rich in flowering plants. Industrialization, the rapid increase of the human population, and above all, improvement of transportation facilities were to blame, locally com-

bined with a lowering of the water-table as a result of engineering works.

In the Netherlands it was the intention to use the Naardermeer, an abandoned reclamation scheme, as rubbish-dump for the city of Amsterdam that triggered a series of activities leading in 1905 to the creation of the Society for the Conservation of Nature Reserves, which Society managed to purchase the Naardermeer, renowned for its rich bird life, among which are the rare spoonbills. This is how it began in The Netherlands; gradually more and more terrains of particular interest were purchased to protect nature against the rapid encroachment by man. Fortunately this development coincided with a growing interest in nature in broader segments of the Dutch population, stimulated by the writings of E. Heimans and Jac. P. Thijssse.

It should be clearly understood that the activities of the Society for the Protection of Nature Reserves took place in the realm of private enterprise. This means that the Society was free to decide which terrains it thought important enough to protect by purchase. There was no need to justify its choice since public money was not involved. The Society was also free to decide how to protect its possessions and to frame its conditions for admittance.

In addition to the nature reserves of the Society, usually chosen to protect rare species of animals and plants, which always fascinate the naturalist, one gradually saw in The Netherlands the development of a system of National Parks, not unlike those set up in the United States. In this development the Government takes part in one way or another, and the intention is in the first place conservation of a characteristic landscape against encroachment by man's multiple activities, and that whenever possible in quite large units. Public money is involved and the public is admitted, be it under a well-framed set of conditions. These National Parks, of which the "Hoge Veluwe" and the "Kennemer Duinen" are two well-known examples, have not as their primary object the protection of rare species of animals and plants, though a great diversity of species, especially of flowering plants and of birds, is appreciated and protected.

This, in a nutshell, is what happened on land in The Netherlands and in other densely populated countries of the western world, but gradually man began to create nature reserves and national

parks all over the globe. It is not surprising at all that conservation of nature started on land, since land and air form man's natural environment. From various sides the question has been raised whether it is not high time to extend these activities to the marine environment, before it is too late. The intertidal grounds, which are of such great importance for the foraging of countless wading birds, can be claimed to belong to the land for this special purpose. But what about true aquatic life? The sea has been used since time immemorial as a source of food, leading to the development of the fishing industry, and for navigation; in our time also for recreation, for the extraction of minerals including oil and gas, and for discharge and dumping of wastes of various descriptions. It is especially the consequences of marine pollution that have drawn the attention of so large a public that it has become a political issue of considerable importance. The interests of the fishing industry (including cultivation of fish and shellfish), of recreation (on the beaches), and of waste disposal (which is for economic reasons by preference carried out as closely inshore as feasible), are liable to clash. In many sites one or the other interest has already suffered from the ill effects brought about by the others. Major spills of oil have already drawn the attention of the general public, but what will be the results of the increasing discharge of chemical and radioactive waste, less easy to observe, on life in the oceans? Is it true that already 40% of life in the oceans has been destroyed by pollution? This is what we are told by Jacques Cousteau and he is supported in his opinion by the ethnologist Thor Heyerdahl. Will the sea in due course get lost as a source of food for man, and are the countless thousands of species of animals and plants living in the marine environment threatened by extinction? Is it true that the biological equilibrium in the sea is already endangered by man's multiple activities, that the diversity of species is on the verge of showing a dramatic and irreparable decline, and that the marine phytoplankton will soon fail to supply the atmosphere with oxygen?

We know that a modest beginning has already been made to safeguard marine animals, e.g. by the international convention for the protection of the herds of the Northern Fur Seal, *Callorhinus ursinus*, on the Pribilof Islands. This case belongs, however, to the same realm as the regional

fisheries conventions aiming primarily at a rational exploitation of a natural resource, and has not been set up to set aside a fair section of a special type of landscape in behalf of present and future generations of man.

Before trying to formulate a reply to the questions put above, it is good to consider objectively, which components of the flora and fauna of the sea could be of such paramount importance that action should be taken to prevent their deterioration, even if this would cost appreciable sums of money. Since the sea is by law public property, private organizations cannot purchase sections of it in their efforts to protect nature. When public money is involved, the necessity of spending such money on projects of nature conservation should be made very clear indeed. For the situation on land the factors which are considered to be of at least some importance for the sake of future generations of man have often been listed. A fair choice of such items could be as follows:

1. Nature is still a source of food and materials. This item is often left out of the lists since the factual importance of food collected in the wild, including game, fruits and mushrooms, is dwindling to insignificance, at least in the western world, and since one rightly hesitates to create nature reserves for the sake of the pleasures of the chase. One should not forget, however, that especially the tropical rain forest can be seen as a source of valuable wood, and of various forestry by-products, which merits a rational exploitation in which only the "interest" of this natural "capital" should be harvested.
2. Nature, as little affected by man as possible, is indispensable for fundamental scientific investigations, giving more insight in the biology of all the species occurring in the given area and in their interrelationships. Such fundamental studies may in their turn sooner or later be found of considerable importance for future developments in agriculture, horticulture and animal husbandry, all of considerable interest to man.
3. Nature provides a great assortment of species and variants from which man can select in his efforts to improve the hereditary qualities of his cultivated plants and animals.
4. Nature is important for its buffering capacities, supplying predators and parasites when

something gets out of control in the arable fields.

5. The green plants in nature, including the phytoplankton in the sea, contribute to the global supply of oxygen in the air, without which man could not survive.
6. It is especially the small and very small organisms in the natural environment that play an important part in the biodegradation of wastes of various natures. Recently, for example, it has been demonstrated that poisonous carbon monoxide gas is rapidly broken down by special types of soil fungi, which explains why the air over the oceans contains more of it than that over the continents (Inman et al., 1971).
7. Both amateur and professional naturalists experience pride and joy in tracking, observing, photographing, and collecting rare specimens. It is nature which offers by far the best chances to enter upon these joys.
8. Man is conscious of guilt when he can rightly be accused of having been instrumental in the disappearance from the globe of still another species of animal or plant, even though he knows that the extinction of a species has been a normal phenomenon in the course of evolution, long before man participated in this game, and that it did not lead as such to a catastrophic collapse of the equilibrium in nature.
9. Nature is of great importance for the recreation of man, especially when he lives in urban agglomerations, and this not only because of nostalgic feelings for a pastoral past not so many generations ago. "Pastoral recreation" is considered to be an element of vital importance for man's well-being.

This impressive list of pleas makes clear that it is invariably the direct and indirect interests of man himself that make him worry when something goes wrong in nature. The first six items may affect man's material needs, the others rather belong to the realm of his well-being. Man wishes now, and in the future, to find or to grow the food he needs in adequate quantities, and cannot do so without the help of nature. In addition he wishes to use nature for his pastoral recreation, enjoying a sojourn in an interesting landscape, not defaced by the ugly results of his own activities. Such an undisturbed landscape

should, if appropriate, be duly adorned with the trees that belong there, and with a variety of flowering plants and birds, perhaps also with some conspicuous mammals and butterflies, but not necessarily with the countless small and inconspicuous creatures, nor with those displaying nocturnal habits.

The list of pleas makes clear why man is willing to protect nature, even when this requires considerable financial sacrifice: his own interests are at stake!

Which of those pleas hold good for the sea, as they do for the land?

1. The sea as source of food. In sharp contrast to the situation on the continents, the sea can provide a wealth of food for man and his domestic carnivores. This food is harvested by the fishing industry and has to be selected from the existing diversity of species of vertebrates and invertebrates. Activities comparable with agriculture and animal husbandry are carried out on some scale in the marine environment, but their total yield falls far short of that of fishing in a strict sense. Since the marine environment contributes a noteworthy percentage of the animal protein in man's food, protective measures seem to be a must. To avoid overexploitation many countries have framed sets of rules to prevent wasteful exploitation of the living resources of the sea. Such rules can, however, only be enforced in the territorial waters of the countries concerned. It was not until after the Second World War that regional fisheries conventions such as ICNAF (International Commission for the Northwest Atlantic Fisheries) and NEAFC (North East Atlantic Fisheries Commission) came into being in an effort to exploit the living resources of international waters in a rational way, by collecting only the "interest" of this natural "capital" and not touching upon the capital itself. Evidently these efforts are purely utilitarian and have little in common with the protection of nature. Since the fishing industry became mechanized one wondered whether the sea would be able to continue to yield the huge tonnages of fish, taking into consideration that rich fishing grounds are of very local occurrence only, on continental shelves and in areas with upwelling water. Biologists have wondered whether the "natural equilibrium" would

not be destroyed by fishing. They surmised that despite the large numbers of eggs produced, very few juveniles reach the adult phase, under fully natural conditions just enough to compensate the natural losses among the older fishes. When a fishery would begin to take its toll, the stock would theoretically decline, which process could not be stopped, since the usual number of "recruits" would no longer be sufficient to compensate for the extra losses now suffered among the adult specimens. Still, fishing did not lead to annihilation of the stocks. Initially the stock will show a decline but, peculiarly enough, the decline comes some day to a standstill if the fishing pressure remains constant. This not because fishes will produce a greater offspring when being fished upon, but simply because predators other than man will find it increasingly difficult to take their share. It is fishery science which has taught that the "natural equilibrium" should not be seen as a house of cards which collapses when a single card is taken away somewhere, but that nature is very resilient and can frame a great number of equilibria, very dynamic in pattern, with greater or smaller numbers of participating species. Fishery scientists have demonstrated that even in an intensely fished sea like the North Sea, the total tonnage of fish taken can remain constant over a long series of years, even when species of great economical value become seriously overfished. Evidently the basic productivity of the sea is hardly touched upon by taking away so many fishes, but the pattern of the fish stock composition may change drastically by the impact of man. When precious species are on the decline, other species will take their place, for in nature a table well provided with food will not remain untouched for long.

The fishing industry will never lead to eradication of fish species, at most it brings the stock of valuable species down to such a low ebb that it is no longer profitable to fish on them. Therefore it is wise to frame and to enforce international measures in an effort to come as close as possible to the optimum sustainable yield. For economic reasons a yield as constant as possible, both in tonnage and in species composition, is highly to be preferred over great fluctuations from year to

year and from decennium to decennium. This ideal can be achieved when the fishery harvests from a series of year-classes, and not from one single year-class.

If it is not the fishing industry itself which could destroy the fish stocks, is it then perhaps one of man's other activities which may lead to disaster in the marine environment, for instance the use made of the sea for dumping and discharging of wastes of various descriptions? That could be so, and locally man has already destroyed some sections of the marine environment this way, or made it impossible to use as food the fish and shellfish from such grossly polluted waters. A sea like the North Sea, surrounded by highly industrialized countries, produces, however, still the same tonnage of fish as it did before. Where untreated domestic sewage is discharged, shellfish may be unfit for human consumption and occasionally one comes across a batch of fish tainted by oil, by phenols or by other chemical waste. If a sea like the North Sea is not yet grossly endangered by pollution, there is little need to talk about pollution of the oceans. Cousteau's sweeping and exaggerated statement that 40% of life in the ocean is destroyed by pollution is not based on scientific data, and not backed by fishery biologists, but it is nevertheless greedily absorbed by an uncritical public. Oil pollution, caused by faulty navigation, can locally lead to disaster and even to death of countless creatures which cannot flee fast enough, but the nett result is like that of a forest fire: after an unsightly beginning nature recovers, first by recolonization by opportunistic species, which are usually of small dimensions, and then by the reestablishment of the flora and fauna as was found there before the disaster.

Heavy metals may give reasons for concern in bays and inlets of industrialized countries, but not in the open sea. The mercury scare which swept around the world a couple of years ago, banning fishes like tuna and swordfish from certain markets, and leading to serious financial losses in the fishing industry, had no reasonable background. The species mentioned live far away from sources of pollution. Their mercury content, like that of seals and other creatures at the end of a long

food chain, has always been much higher than that of organisms low in the food chain, and man's activities have nothing to do with it. Therefore one should not speak of pollution here. The same holds good for radioactive waste. It cannot affect the sea as a whole, but care is required in inshore waters. It will not destroy life in the sea but might locally lead by bio-accumulation to an unacceptably high content of certain radioactive isotopes in man's food.

Large quantities of acids can be dumped in the sea, without being the cause of any harm, since the chemical composition of sea water makes it very resilient against acids.

Of greater concern is pollution by xenobiotic substances, originating from man-made chemical compounds which do not occur at all in nature. Among those are pesticides and products like P.C.B.'s and the like, widely used in industry. They may be both toxic and persistent in sea water, and when dissolving readily in oil and only very little in water, they may become accumulated in organisms at the end of the food chain, man included. Growing concern about marine pollution led in recent years to international conventions, like that of Oslo, regulating dumping of dangerous waste from ships, and that of Paris, by which discharge of poisonous waste via rivers and pipelines will be placed under strict supervision.

In this field one should always realize that for man it is the individual that counts and which should not be adversely affected by pollution of any sort, whereas in the marine environment it is the species and not the individuals one should be apprehensive for.

2. The sea as an area for fundamental biological research. The oceans are of great importance for scientific research, but hardly for the type of studies which are at the basis of agriculture and animal husbandry. Still, there is no reason to fear that areas unaffected by man's activities will soon become scarce in the marine environment. One of the criteria used in studies on nature protection is species diversity. In the sea the diversity is usually incredibly great, especially where the waters are of high and constant salinity and temperature. Coral reefs are renowned for their great species diversity, but even in the North Sea the

diversity is so great that nobody can grasp the thousands of species of smaller organisms living there. In brackish waters species diversity is greatly reduced, since not many species can endure life in brackish water with its often fluctuating salinity; but the number of individuals may be incredibly great there. The total productivity determines primarily the biomass, and only indirectly the species diversity. Brackish water bodies demonstrate that a "natural equilibrium" is also possible with a much smaller number of participating species than in the open sea. Phytoplankton research in Dutch coastal waters where the salinity is a measure for admixture with the grossly polluted water of the River Rhine has thus far not led to the conclusion that the diversity of species is reduced here to any extent (Hagel & Van Rijn van Alkemade, 1973; Kat, 1975).

3. The sea as a resource for man's agriculture and animal husbandry. Whereas it seems desirable to undertake the animal husbandry of the marine organisms of potential economic value, no one has as yet ascertained the value of selective breeding and rearing of any of the farmed creatures. Farming the sea is carried out on some scale, predominantly with bivalve molluscs, and with a few species of red seaweeds, shrimps and fishes. Farming marine fish begins invariably with young fry collected in nature. No selection or hybridization is then possible. The bivalves grown on a commercial scale (oysters and mussels) are procured from larvae produced under natural conditions. There are now hatcheries in operation which make it possible to produce offspring of well-selected parents and even to hybridize, in order to combine desired hereditary factors, but thus far this procedure, so important in agriculture and animal husbandry, has not been applied in the shellfish industry. It is still doubtful whether one will ever utilize this technique, considering the great number of generations required to produce homozygotic populations of the desired hereditary pattern.

It is interesting to note that the hatcheries came too late into being to take advantage of the existence of a population of the European Flat Oyster, *Ostrea edulis*, known for its ability to breed successfully at water temperatures of about 15° C. This population, which once flourished in the Firth of Forth, in the Wad-

densea and on the coast of Schleswig-Holstein, is now extinct.

4. Buffering capacities are of practical importance in the sea. After local disasters such as a major oil spill, erosion of the benthonic fauna by gales, or kills by severe winters, specimens from elsewhere will sooner or later migrate into the affected area. It need not be feared that species may become extinct by oil spills or other disasters, for marine species invariably have a great geographical range, whereas pollution is a local and usually reversible phenomenon. When an area is seriously overfished one should not expect, however, that large schools of fish will migrate to that area from the open ocean. The open ocean is over most of its area rather poor in fish and the species on which the fishing industry is largely based are typical denizens of shallow water in need of the bottom for foraging and/or for deposition of the eggs. Fishing has not yet eradicated a single marine species, nor will do so in the future, but it can reduce a stock to a low level.
5. Oxygen produced by the green plants. It has often been surmised that the oxygen produced by the carbon-dioxide assimilation of the green plants contributes materially to the oxygen content of the atmosphere, on which man depends for breathing. It has even been supposed that this was originally the source of all the oxygen in the air. It is true that this biochemical reaction produces oxygen, but it is just as true that most of the organic matter produced that way is sooner or later combusted again for which just as much oxygen is required than was originally produced. Part of the organic matter may, however, be temporarily set aside as coal or oil. This has led to an extra supply of oxygen in the atmosphere, but calculations made clear that only a small percentage of the oxygen in the air can be accounted for this way (Poldervaart, 1955). From observations made with the aid of satellites it is now evident that most of the oxygen in the air springs from photolysis of water in higher atmospheric layers (Rönicke, 1973). The fear spread by "doomsday prophets" that we will once lack oxygen to breathe when marine pollution hinders the photosynthetic activities of the marine phytoplankton has no scientific background at all.

6. Microbiological degradation of dead organic matter in the marine environment is a process of unmistakable importance. Bacteria and other microorganisms are omnipresent in the sea, be it in greater numbers where their favourite food, dead organic matter, is amply available, and where a suitable substratum, usually fine sediment particles, abounds. Waves, tides and sea currents see to distribution of the organic matter and to good aeration.

Biodegradation leads on the one hand to mineralization, yielding nutrients on which the phytoplankton can thrive again when there is a sufficient amount of light, whereas on the other hand rapid multiplication of well-fed microorganisms leads to a wealth of food for filter feeders of various descriptions. Even resistant material like mineral oil is broken down by microorganisms, rapidly at high water temperatures, somewhat slower under arctic conditions. The fact that where seepage of mineral oil occurs on the north coast of Alaska, oil does not accumulate in the sea, and that the sea is full of life there (Claude E. Zobell, pers. comm.), demonstrates that biodegradation of oil is even performed smoothly at low water temperatures.

The more easily degradable organic material gives no reason for concern. Even if all the waste from the modern bio-industries of the whole world were to be spread quite evenly in the North Sea, no deleterious effects such as decline in the oxygen level, or serious eutrophication, would be expected (Korringa, 1973).

Xenobiotic chemical compounds, by definition not to be found under natural conditions, are often resistant to the attacks of microorganisms. Therefore they are persistent when their chemical breakdown is a very slow process, and may accumulate in the food chain. When of toxic nature they endanger the higher links in the food chain, man included. Protection of the biodegradation processes in the marine environment is taken care of by the international conventions on waste disposal. Airborne waste is, however, still a matter of concern. Even in the far away Antarctic one could find traces of DDT in penguins and other organisms at the end of the food chain, brought thither via the strato-

sphere.

7. For the fun of tracking, observing or collecting rare specimens the marine environment does not seem to give much opportunity. The variety of fishes and invertebrates is incredibly great in the sea and to identify the rarer species is rather a specialist's job. The average naturalist will confine himself to collecting shells, which means the hard remains of dead molluscs, on the beach, by which activity he cannot possibly affect the natural equilibrium. Equipped with diving apparatus of some sort he can go some distance offshore and may collect live specimens. Rare species are also collected from stomachs of fishes specializing on a diet of molluscs.

When a species is rare, its survival may be endangered since it may become a collector's item, especially when it is quite large and beautiful. Birds have disappeared from whole countries as a result of the activities of avid egg collectors, butterflies run the same risk, and several mammals have become extinct because indefatigable trophy hunters could not leave the last few specimens in peace. It is a peculiar quality of man to collect specimens just for the sake of building up a collection. Thereby he distinguishes himself from his fellow-man in the crowd, and this may contribute to his happiness. Pains nor money are spared to reach this goal.

From the marine environment it is especially molluscan shells that form collector's items. Rarity itself does not suffice, for small and inconspicuous species are not collected so arduously as are the larger handsome ones. Some species are renowned for their rarity and large sums of money are paid to acquire them. *Conus gloriamaris*, *Strombus violaceus*, *Scaphella junonia*, *Thatcheria mirabilis*, *Cypraea aurantium*, *Epitonium scalare* are names which make a collector's blood beat faster. Still, it is questionable just why these species are so rare. The verdict "rare species do not exist, the point is where to look for them" seems to hold good for creatures in the marine environment, for several once priceless shells have recently lost their value since one discovered sites where they abound (Tucker Abbott, 1972). There is no longer need to assume that an earthquake had swallowed up the living grounds of *Conus gloriamaris*. There seems

little chance that marine specimens become extinct because of collector's ardour. Not one case is known of a marine invertebrate eradicated by man, or threatened to be eradicated.

Still, it is advisable to keep an eye on the effects of collector's activities on the marine environment, especially when dynamite and crowbars are used to search for rare specimens in coral reefs, either by the collectors themselves or by those who hope to sell specimens to collectors and tourists.

8. Many feel ashamed that the greed of man has led to complete eradication of interesting species such as the Great Auk and Steller's Seacow and to such a serious reduction of the stocks of Bowhead Whales and Blue Whales that it seems questionable whether these species will be able to eke out their existence. These are, however, warm-blooded animals, breathing air. Of the primary denizens of the sea, the fishes and the invertebrates, no case is known that man has by whatever means led to their extinction or that he threatens to make any species disappear from the marine fauna in the near future. Therefore no special action is required to prevent such regrettable events.
9. At first sight the sea does not seem to offer many opportunities for the so-called "pastoral recreation". On the sandy beaches one will usually only find dead remains of denizens of the sea, whereas the rocky shores offer an opportunity to observe life in the fringe of the marine environment with species adapted to the intertidal zone. A trip with a fishing boat may give a glance at other denizens of the sea, but will not show the natural underwater landscape.

Still, there are opportunities to see the underwater habitat, adorned with elements of flora and fauna. It is especially the larger creatures and among those by preference the brightly coloured ones displaying diurnal habits, which interest the naturalist, amateur and professional. That means that only a very small minority of the thousands of species of marine plants and animals falls within this group, most of the others just being too tiny to be observed with the naked eye, being too inconspicuous, or living a life out of sight. Glass-bottomed boats, snorkel equipment and aqua-lungs make it nowadays possible to enjoy the submarine landscape, adorned with in-

teresting and colourful creatures such as seaweeds, corals, molluscs, sea anemones and fishes. Only where the water is sufficiently clear one can enjoy this type of pastoral recreation, and without special protective equipment only warmer waters lend themselves to it. Above all it is the coral reefs that can be a tremendous joy for the pastoral recreationist, and modern transportation brings this scenery within reach of an increasing number of naturalists, both amateur and professional. The great variety of colourful corals themselves and of the many gay coloured fishes which can easily be observed are, together with a diversity of invertebrates, a sight of such overwhelming beauty that protection of such landscapes should be furthered wherever possible. Good measures have already been taken for the coral reefs near Eilat (Israel) and for those in some sites on the east coast of Africa, but in many other regions there is still reason to fear that the beautiful reefs will be destroyed by pollution of some sort, by engineering works, or by dynamite and crowbars used in the search for rare specimens to be sold as souvenirs. Since coral reefs occur in the territorial waters it is the countries concerned that should take measures to avoid deterioration of their coral reefs. A good system of control against poachers and trespassers is indispensable, and whenever possible one should arrange for guides to take tourists along to the coral reef reserves. Strict prohibition of the hunting of fishes should be included in the terms for access. Since tourism is a source of income for many tropical countries, there is even from an economical point of view every reason to arrange due protection of their coral reefs.

But still, even with the best protective measures one cannot be too sure that nothing will happen. The often misquoted natural equilibrium is not as static as one often assumes. Events in recent years, in which the Crown-of-thorns Starfish *Acanthaster planci* suddenly began to destroy coral reefs in large areas, may sound a warning. One has tried to explain the almost astronomical propagation of this devastating starfish in terms of certain activities of man (Talbot & Talbot, 1971), such as collecting one of the starfishes' enemies, the conch *Charonia tritonis*, or by pollution of

the waters of the South Pacific, but it does not seem to be a plausible explanation that man has been instrumental in the explosion of starfishes. It seems more probable that such events belong to the caprices of nature; the "equilibrium" is dynamic in character, and serious deviations in the one or the other direction are always possible when some species or other experiences a following wind. Animals producing very many, but extremely tiny eggs, have such a chance to escape. It happened, for instance, a few years ago to the Cod in the North Sea. A year-class 40 times the normal strength was produced, soon playing havoc among the local stocks of Brown Shrimp (*Crangon crangon*) which in its turn led to starvation of the weaned seal cubs.

In the subtropical zone it is especially the rocky shores that invite this type of pastoral recreation, though the landscape is less colourful than that where coral reefs abound. Still, many enjoy observing the underwater world, though one does already complain about scarcity of the larger fishes which used to adorn this landscape. Here too, one should advise to substitute shooting of fish by photographing, just as is done for nature reserves ashore.

In the temperate zone the possibilities for pastoral recreation under the surface of the sea are more limited, but even in The Netherlands, situated beyond 50° North, there is an area which would be worth while to turn into a nature reserve: the Oosterschelde with its very clear water of high and constant salinity, with its great diversity of species of plants and animals. It is still questionable whether this landscape will escape from encroachment by engineering works in the cadre of the Delta Project. If so, strict prohibition to hunt indiscriminately for interesting creatures such as lobsters would be very advisable, together with a good system to enforce such measures.

It seems safe to draw the conclusion that the items listed as 1 to 6, all related to the material needs of man, now and in the future, are either already duly taken care of by existing international bodies, or hardly require any action at all. On the other hand, it is items 7 to 9, operative in the field of man's well-being, that could require special attention. Especially in the case of item 9 international studies and advice are welcome indeed, but since the marine areas to be protected are invariably to be found within the territorial waters, it is the countries concerned that should take legislative action.

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