

REPORT OF THE WORKING GROUP ON ENTANGLEMENT OF MARINE LIFE

(William R. P. Bourne, Chair)

TERMS OF REFERENCE

It was reported at the first conference on marine debris in 1984 that individual seals, turtles, birds, and fish, some belonging to endangered species, become entangled at times in marine debris. The frequency and severity of these interactions were usually unknown, and no conclusive evidence was demonstrated for any effects on populations. This working group was asked to review the problem and identify the information needed to fill the gaps in current knowledge, notably by devising a model in the light of which current information could be assessed. This should include 1) age, 2) sex, 3) population, 4) numbers, 5) distribution, 6) legal status of victims, 7) activities and materials causing problems, 8) information that is needed to complete the picture and monitor its future development, and 9) the priority that should be given to different aspects of the investigations.

THE WORKING GROUP

The findings at the 1984 conference still seemed valid, so in order to avoid repeating preconceived ideas, the working group first considered materials which cause problems and their impact on different animals. The previous working group reports were then reviewed to see what progress has been made. The first conclusion is that, despite the accumulation of circumstantial evidence that marine debris may have an adverse effect on all sorts of marine wildlife (including cetaceans, which did not receive much attention previously), the information is still insufficient to show clearly the magnitude of the problem.

LIMITATIONS OF THE DATA

Care is needed in the interpretation of the available information. It is substantial only for the most common species of two out of the four main groups affected, pinnipeds and birds. These spend long periods on land at breeding sites, where they can be counted and marked. Even here information is deficient for the important period spent at sea. Much less is known about the turtles, which spend most of their time at sea, and the cetaceans, which never come ashore at all. Owing to the way in which the information is collected, it still remains difficult to distinguish between the effects of a variety of interacting factors. These include oceanic fluctuations, disturbance while breeding, the impact of fishing on both the animals and their food supply, disease, and pollution.

THE NATURE OF THE PROBLEM

Human artifacts must have caused hazards for wildlife since man first went to sea. They cause two types of problem: killing animals in unpleasant ways, a problem whose nature is self-evident so it will not be discussed further here, and harming the status of species and ecosystems. Both uncontrolled hunting or fishing and the incidental capture of unintended animals while taking other species (by-catches) potentially cause conservation problems. Although such factors lie outside our terms of reference, it must be remembered that not only may the losses of marine animals from hunting and fishing be only a fraction of the losses from natural causes, but losses due to marine debris may also be only a fraction of those from hunting and fishing. In such cases, entanglement may be important as a separate entity only to man, because the animals that it kills are deducted from his catch. The situation starts to acquire a wider significance only when the mortality of any animal becomes large enough to affect the welfare of the species and the ecosystem as a whole as well.

Nets

In the past, netting was made of natural materials which were not very durable, so that lost nets were noticed to cause a problem only by fouling vessels. Following the introduction of nylon and other synthetic netting after World War II, there have been growing problems with both lost or abandoned nets and the fragments torn from them by obstructions, discarded during repairs, or used to make small traps which subsequently disintegrate. Some reference collections of different types of netting have been made in the hope of identifying their origin--for example, where strange net which presumably comes from the tropical Atlantic washes ashore in the West Indies. It was thought that it might be useful to consult the fishing industry about the preparation of a guide to different types of fishing gear and its likely origin.

It was considered whether nets should be constructed of, or fastened together with, more rapidly degradable material, so that they would break up and sink sooner when lost. However, it was thought that this would lead to the production of more small fragments of net on the sea floor and along the shore, which would add to the problem. Experiments suggest that, if left intact, whole nets tend to bunch up and may cause less problem for wildlife. Thus it may be better to try and keep the net in one piece so that it is more easily removed or immobilized. It has been reported that floats of unequal size drift at different rates with the wind and current, keeping the net open, so the effect of the buoys and weights used on the performance of nets may deserve more attention.

There still appears to be a need for further study of the way in which animals are caught in nets and the fate of lost nets, using marked trial specimens to see how long they continue ghost fishing at sea and whether they catch more or different animals as they come ashore.

Hooks and Line

These are one of the commoner agents ensnaring wildlife and, occasionally, people. Discarded angling gear often hooks or ensnares birds. Fishing has been banned from some North Sea oil platforms because lost gear has caused problems for divers. Here also the situation has been made worse by the adoption of durable nylon line. It seems likely that the longlines used at sea, which may extend for up to 96.5 km (60 mi), with several thousand hooks and few buoys, may present a more serious problem. Little appears to be known about this, and it deserves more study.

Loops, Sheets, and Sharp Objects

Other potentially dangerous objects may appear occasionally at sea. They range from wrecks and heavy machinery and construction material discarded by the oil industry, through nautical gear and packing materials and containers, to clothing and household equipment. It seems easier to consider the nature of the hazard that they present than the identity of the object concerned.

Anything which incorporates a loop or ring is potentially hazardous. This includes knotted rope, uncut packing bands, containers with holes, loose webbing or fabric, plastic sheeting, and, of course, netting. These present lethal threats to any marine animal up to the largest whale, should their head, jaws, or limbs become ensnared while hastily seizing mobile prey, or hunting and playing around drifting material. Such objects should be disposed of ashore or by incineration.

Anything which includes, or can break down to form, a sharp point or cutting edge also presents a hazard, especially if it is concealed among innocuous materials. Such objects include wrecks and dumped heavy equipment which may catch nets on the sea floor, lesser metalwork, woodwork with projecting nails, tins opened to leave sharp edges, and fragile glass containers. In addition to being a threat to wildlife, these are also a threat to people who are diving, hauling nets which have collected debris, or walking along the shore. All such objects should also be disposed of carefully.

It seems desirable to redesign some objects which regularly cause serious problems. These include perforated plastic six-pack yokes, cans which normally have sharp edges when opened, and openers which leave cans with sharp edges.

VULNERABLE ANIMALS

There is accumulating anecdotal evidence that virtually all marine animals are occasionally entangled in debris, but quantitative data are available for few of them. The main cases where it appears important follow.

Cetaceans

Entanglement appears to be unusual and to be reported most often among the smaller species which are found near the shore. Its impact might be most serious with the North Atlantic right whales, *Eubalaena glacialis*. This is a large whale population reduced to a remnant of a few hundred by commercial fishing which has failed to recover despite half a century of protection, and some are known to be entangled occasionally in nets (Report of the International Whaling Commission, Special Issue 10, p. 116-119, 1986). Nearly a third are also said to be scarred from unknown causes, which might include other whales (notably killer whales), rocks, collisions with ships, and fishing gear, since they frequent areas with concentrations of plankton and these areas are often important fisheries. It seems time that these whales received more study.

Phocid Seals

While these seals are occasionally entangled in netting, the incidence is not usually high. It appears to be worst in the endangered warm water monk seal, *Monachus* sp. The only surviving species in the Mediterranean and North Pacific are both reduced to hundreds. A number of Hawaiian monk seals, *M. schauinslandi*, are known to have been killed by net fragments along the shore, and nearly a quarter of the mortality reported in Greece was also found to be due to fishing gear (J. Jacobs and A. Panou, Conservation of the Mediterranean monk seal, *M. monachus*, in Kefalonia, Ithaca and Lefkada Islands, Ionian Sea, Greece, Institute of Zoology, University of Munich, Seidlstrasse 25, D-8000 Munchen 2, Federal Republic of Germany, 221 p., 1988, per D. E. Sergeant). These species clearly deserve more attention.

Otariid Seals

While many populations of these seals were reduced by exploitation for skins and oil in the past, most now appear to be recovering. Possibly owing to their large numbers, their tendency to feed in areas with important fisheries, and their active behavior and slender physiques, they are also among the marine mammals most prone to entanglement. Young animals which play around nets seem particularly vulnerable. While most species are maintaining their numbers, the northern fur seal, *Callorhinus ursinus*, has been declining in some areas in recent years. A number of other factors which are difficult to study, such as overfishing and climatic change, may also be involved. It seems desirable to continue monitoring the breeding populations, investigate the animals' movements and relationship to nets at sea, and compare the results with those for increasing populations.

Chelonians

Most of the turtles now appear to be endangered, but while they do become entangled occasionally, there appears to be no evidence that this is having any impact on their numbers comparable to such factors as over-exploitation for shell, meat, and eggs, disturbance of the breeding

habitat, losses in fishing nets, and ingestion of plastic material. Pelagic ridley turtles, *Lepidochelys* sp., may be the most vulnerable. The depleted Kemp's ridley turtle, *L. kempii*, is confined to one breeding beach in the Caribbean; the olive ridley turtle, *L. olivacea*, has been found entangled in the Pacific.

Birds

Birds become entangled in nets, hooks and line, and other debris occasionally, and the reported incidence in British Trust for Ornithology (BTO) banding recoveries of the common guillemot or murre, *Uria aalge*, has increased from 5% before 1970 to 37% since 1987 (C. Mead, BTO News 163, 1989). There is no evidence yet, however, that entanglement is having an important impact on bird numbers when compared with disturbance by man and introduced predators at the breeding places, or losses due to active fishing gear or oil pollution. Some species, especially the Pelecaniformes, are also vulnerable when, to make their nests, they collect floating material which may ensnare either the old birds or their young. The species for which there is the most evidence of damage from pollution of all kinds, the northern gannet, *Sula bassana*, is nonetheless increasing explosively in most areas, even at a small colony on Flamborough Head, England, where more than half the nest material is composed to nylon netting, and where many birds also become entangled at sea.

Fish and Shellfish

While other marine animals may become entangled in debris occasionally, there is no evidence that the resulting mortality amounts to more than a small fraction of that due to fishing. Debris-related mortality therefore seems most important as a loss from fisheries, as discussed by the working group on ghost fishing.

PRIORITIES

The group was asked to arrange its recommendations in order of their importance. Of highest priority is the collection of more information, arranged to cover as many areas and aspects of the subject as possible. There are still many important gaps in the available information, including several inadequately studied major groups of animals where the losses may be important, such as the cetaceans, sirenians, and chelonians. There are also several inadequately studied potential problems, such as long-lines and sharp objects. A large part of the world is still inadequately covered--this conference has lacked any direct representation from not only the Communist and developing nations, but also South America and Australia.

Organization

It was thought that a more permanent organization is required to obtain information from more places. This should be composed of a limited number of representatives who are active in research on different animals, on different aspects of the problem, and in different areas. Its purpose

should be to expand the sphere of activity and maintain more continuity and consistency in recording methods. This would require the identification and enlistment of suitable people, whether in government organizations with their own resources, or voluntary bodies. Providing limited help with administrative expenses and the cost of attending meetings would be useful.

Information

Even in areas where there is already an interest in problems caused by marine debris, there is still a need for more means of circulating information and advice. This could include such matters as the identification of the materials and species encountered, the examination of stranded animals, and the best ways to record comparable observations. It would be useful to have a simple field guide to introduce more people to the subject, supplemented with a newsletter to report further progress and results. (The Marine Pollution Bulletin would be happy to assist.)

Research and Conservation

For purposes of economy it seems desirable to devise proposals that will cover several objectives simultaneously. These should include as far as possible the most vulnerable species in each of the main groups of animals, the most sensitive areas, the most critical threats, and mitigating measures. Five projects which between them might cover most aspects of the subject are monk seals, fur seals, right whales, sea turtles, and man.

Monk Seals

The marine animal for which entanglement appears to pose the worst threat is the Hawaiian monk seal in the Northwestern Hawaiian Islands (NWHI), where several are known to have died as a result of entanglement in stray fragments of net along the shore and where there appears the best chance of practical action to alleviate the threat of entanglement. This area is also important in several other respects. It is one of the first nature reserves of international importance. In addition to studying the impact of entanglement on this most vulnerable phocid seal, investigations there could also cover the impact of debris on a variety of other wildlife, including entanglement of sea turtles and ingestion by albatrosses and other seabirds, in a remote situation in the tropical Pacific. Measures should include the regular collection, evaluation, and destruction of debris on both the beaches and outlying reefs, the liberation of all live entangled animals, and studies of dead ones. The situation of the even rarer Mediterranean monk seal also needs further study, which could also be integrated with a study of related issues in a much more heavily developed area.

Fur Seals

The other marine animal where there is already evidence of serious mortality from entanglement is the northern fur seal. It also inhabits

established nature reserves of international importance. The recovery of its original vast numbers was previously a cause for general satisfaction, and any continuation of its recent decline would cause wide concern. It differs from the preceding species in its more migratory behavior, and may be encountering its most serious problems at sea away from the breeding places. At present it still has a much larger population than the endangered phocids, representing the other main group of otariid seals, so it can be studied more actively with less risk of serious disturbance and might provide interesting comparative results. It is important to continue monitoring the breeding populations, and investigations should be extended out to sea on a larger scale, both tracking animals on their feeding movements and migrations (notably by satellites), and studying their reaction to nets at sea. Such investigations should also yield useful general information about the welfare of other wildlife and the impact of marine debris further north in the Pacific.

Right Whales

The cetaceans for which there is possibly most cause for concern are the North Atlantic right whales (though most right whale stocks are depleted). These provide an instructive contrast to the previous species, since they are much larger, yet feed on plankton in an area with active fisheries in another ocean. Although they were originally very numerous, they were the first species seriously reduced by modern whalers and have failed to recover after half a century of protection. A certain amount is already known about them, such as the location of a small population with many scarred individuals, some of which are occasionally killed in nets. Humpback whales are regularly caught (and sometimes killed) in coastal nets in the same area, so the right whales may be encountering similar problems out at sea. It therefore seems desirable to learn more about the extent to which entanglement is a problem for this species. This might also reveal useful general information about the impact of marine debris on the most important fishing grounds in the northern Atlantic.

Sea Turtles

It is doubtful that entanglement is as important a cause of mortality for turtles as ingestion of debris, and it might be better to investigate the two problems together. One approach might be to study the behavior of turtles in captivity when confronted experimentally with debris. It might also be useful to try to trace individuals from satellites. The most vulnerable species, which might merit attention at an early stage, appear to be the ridley turtles. Any investigation of Kemp's ridley turtle might also yield useful general information about debris-related problems in the Caribbean. It might also be possible to integrate any investigation of the green turtle with research on the Hawaiian monk seal to obtain a better picture of events at sea in actively exploited tropical waters.

Man

It is surprising that there seems to have been little attention paid to the animal whose welfare is of the widest general interest. A certain

amount of harm must be caused to people by marine debris such as netting, hooks, lines, and sharp objects. It seems time for an assessment of the risks posed by various categories of debris on beaches, in shallow waters, and brought up by trawls. It might prove instructive to carry out a trial survey among medical personnel, sailors, fishermen, and divers to discover whether they can supply any information about the incidence, nature, and cost of human injuries due to marine debris. It is possible that marine debris may also cause occasional human fatalities, either directly or by disabling boats, and if so it seems desirable to assess their frequency.

RECOMMENDATIONS

Specific recommendations included:

- Continued monitoring, removal, and destruction of lost or discarded nets and other debris presenting a hazard to monk seals, green turtles, and other wildlife in the NWHI, extending the work to the outlying reefs.
 - Continued monitoring of the numbers, survival, breeding success, and incidence of entanglement of northern fur seals, extending the observations out to sea.
 - Investigation of the impact of entanglement and other possible hazards on right whales in the northwest Atlantic and Kemp's ridley turtles in the Caribbean.
 - A review of the long-term evidence for entanglement provided by bird banding and beach surveys.
 - A survey of the injuries caused to man by marine debris.
 - Observations of the movements and behavior of seals and turtles at sea using satellites.
 - Collection of more information about net use and losses, and means of identifying the origin of different types of net.
 - Studies of the movements and fate of marked debris, including nets, with further observations of the way in which animals react to debris at sea.
 - Reviews of experience with voluntary beach cleaning, artificial reefs, and material left on the sea floor by the oil industry.
 - The use of models to determine the population dynamics of different animals, the way in which processes affecting them are likely to operate, and the best data to collect to elucidate them.
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- The formulation of standard recording techniques for different types of debris and victims of entanglement in order to facilitate the more systematic collection of records of entangled animals and fouled vessels.
- The preparation of a guide to types of lost or discarded nets and other debris, and the best ways to examine and treat entangled animals and record observations.
- The dissemination of warning against the particular hazards posed by rings and loops, especially uncut packing bands.
- The redesign of six-pack can yokes, so that they are broken up in use, and methods of opening cans, so that they do not leave sharp edges.
- It was concluded that, in view of the number of problems that require investigation and the wide area that needs to be covered, there is a growing need for the establishment of a representative international organization to coordinate the systematic collection and circulation of information about the occurrence and impact of artificial marine debris and possible conservation measures to mitigate its ill effects.

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