Marine Pollution & Cetaceans - Implications for Management

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". . . as the whales go, so go the oceans, and as the oceans go, so goes the environment, causing the whales to become the symbol of the international environment movement". (Governor of Colorado, 1976).

Introduction

Over the last eighty million years or so a number of separate groups of mammals, originally terrestrial animals, returned to the oceans to live. Although the oceans posed special problems for air-breathing, warm-blooded mammals, they also presented numerous advantages as a habitat. Environmental perturbations associated with climatic change, which so stress terrestrial animals, are buffered by the oceans, and the continuous, buoyant medium offers far greater support, mobility and access to abundant food supplies. Such factors, coupled with the possibility of escape from terrestrial predators, were perhaps the driving evolutionary forces behind the re-entry of mammals to the Earth's seas.

Early humans were probably familiar with some of their aquatic relatives. They realised that the whales and dolphins were different from the fishes, and also learned that these animals were good sources of food, clothing, fuel and other useful things. For at least five thousand years, human societies developed which both hunted and revered them. Dolphins were among the first symbolic animals of the maritime cultures of western civilisation, and the large whales have stimulated imagination, awe and myth since before biblical times.

Humans had, at first, little power to affect the marine mammals. Then, gradually, as the range of vessels was extended, whaling began to affect populations in ways visible to the hunters themselves. With the advent of mechanical power, the muscle of explosives and freezing, extraction and reduction methods, accompanied by the opening up of world markets, drastic reductions in the numbers and ranges of many species had occurred by the mid 20th century. This seriously threatened the very survival of some species of large whales, and even caused extinctions amongst some smaller species.

Fortunately, the ongoing developments in technology which allowed increasingly more "efficient" exploitation of whale resources, was accompanied by an increasing interest, concern and action by environmental and ethical lobby groups, the general community and some governments. This resulted in the gradual introduction of controls and scientific management of whaling through the International Whaling Commission (IWC), which culminated in a complete moratorium on whaling in 1986, with some allowance for "research" kills and indigenous/traditional hunting.

In general, the state of the Earth's whale populations has significantly improved since the introduction of management regimes by the IWC. However, unfortunately, human population, industrial development and production of wastes and pollutants has continued to grow at an exponential rate. This growth is posing a new, indirect threat to the Earth's marine mammals, a threat far more ominous and insidious, but just as real, as that presented by direct exploitation. This threat is marine pollution.

The very aspect of the marine environment that offered so many advantages to those early terrestrial mammals re-entering the sea, its continuity, may also be a great disadvantage. Pollutants are carried throughout the seas with no respect for boundaries drawn on maps by marine managers.

This paper provides a brief overview of some of the effects of marine pollution on whales and dolphins, with comments on implications for cetacean management. It does not purport to be a thorough scientific treatment of the subject, but simply attempts to demonstrate and reinforce, through a limited number of examples, some general concepts and principals that are vital to the successful conservation of whales as part of the broader global biosphere.

What is Marine Pollution?

Clark (1992) states "Everybody knows that pollution is a 'bad' thing, but in what way is it bad? Bad for what and for who? How bad?" The words 'marine pollution' are commonly used with a variety of meanings, including:

. the environmental damage caused by wastes in the sea

. the occurrence of wastes in the sea

. the wastes themselves

Such multiplicity of meanings is confusing and does not allow for a clear analysis of the issue. It is therefore necessary to first provide a precise definition of 'marine pollution'. The United Nations Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) has recommended that the wastes themselves be referred to as 'inputs', the occurrence of them in the sea to be referred to as 'contamination', with the damaging effect that they have being defined as 'pollution'. Marine pollution may therefore be defined as:

"deleterious effects resulting, either directly or indirectly, from the introduction by humans of substances or energy to the marine environment".

Sources of Marine Pollution

Sources of marine pollution (inputs) can be divided into three main categories; terrestrial sources, atmospheric sources and ship sources.

Terrestrial sources

There are a number of inputs that come from terrestrial sources. These include:

. point-source sewage discharges from urban areas (includes degradable organic wastes, nutrients such as phosphates and nitrates, heavy metals and other chemicals)

. point-source waste discharges from industrial facilities (includes dioxins, cyanide, heavy metals, radioactivity and heat)

. diffuse source stormwater run-off from urban areas (usually discharged at point source and includes heavy metals, hydrocarbons, other chemicals and garbage)

. runoff of sediment, fertilisers and agricultural chemicals from rural areas (includes nutrients such as phosphates and nitrates, and herbicides and pesticides containing DDT, polychlorinated biphenyls (PCBs) etc)

Atmospheric sources

Wastes that are discharged to the atmosphere such as emissions from industrial facilities and vehicle exhausts are eventually returned to the sea via rain (eg. acid rain), or if particulate, as fallout. Atmospheric inputs are believed to be a fairly significant source of marine pollution. For example it is estimated that half of the total input of lead to the marine environment comes from vehicle exhausts (Clark, 1992).

Ship sources

Shipping generates a range of wastes that may be input to the marine environment:

- sewage
- garbage (including plastics, loss of fishing nets and other marine debris)
- waste oil
- accidental spills of cargo (including oil and hazardous chemicals from tankers)
- disposal of spoil from dredging

Although public attention is often galvanised by shipping accidents that cause major, acute pollution incidents such as oil spills, shipping constitutes a minor source of marine pollution in comparison with terrestrial and atmospheric sources.

With so many inputs of wastes to the world's oceans there are numerous areas where examples of both low-level and severe marine pollution are evident. Enclosed bays and waterways adjacent to all major cities now exhibit levels of pollution that in many cases even affect human health, and enclosed seas such as the Baltic and Mediterranean today suffer severe chronic pollution.

The Effects on Cetaceans

Research into marine pollution and cetaceans did not seriously begin until the mid 1970's, and even today relatively little work is done is this area. Most studies concentrate on fisheries-type stock assessments, broad ecological studies or detailed work on ethology and physiology. However the work that has been done has revealed a number of serious actual and potential impacts of marine pollution on cetaceans.

Effects on Distribution and Range

Although many species of cetaceans range over large areas of the ocean in search of food, and undertake large migrations for reproductive and other purposes, some depend critically on the continued existence of certain limited habitats for their survival, and re-visit the same areas as part of regular, cyclic migration patterns. Such areas may be bays and lagoons used for feeding, mating and calving. An outstanding example is Hervey Bay in Queensland and parts of the inner route of the Great Barrier Reef that are used annually by humpback whales (*Megaptera novaeangliae*). While conventional scientific thought is that humpbacks do not feed during the annual, winter mating and calving visits to tropical waters, anecdotal observations from big-game boats report what appear to be humpbacks feeding on the large schools of bait-fish that congregate off Cape Bowling Green, south of Townsville, during the game-fishing season. Such coastal areas are the most easily affected by marine pollution. Should low-trophic order organisms such as baitfish ever become contaminated, they may cause pollution of whales feeding on them. Any reduction in food sources caused by marine pollution can force whales to go elsewhere in search of food.

Decreases in the abundances of certain species of whales have been clearly documented in correlation with increasing pollution in several areas around the world, notably the North Sea, the Sea of Azov, the Bay of Fundy and Tokyo Bay. It is not known whether these decreases are the result of an actual decrease in the total numbers of whales, or whether the whales have altered their range to avoid the polluted areas.

A classic example of cetacean numbers fluctuating in relation to pollution levels can be found in San Diego Bay, California. Until the mid-1960's, herds of bottlenose dolphins (*Tursiops truncatus*) were seen on almost a daily basis riding ferry bow-waves. However, between the 1950's and mid 1960's pollution levels in San Diego Bay rose dramatically, and by 1966 bottlenose dolphins were only sighted twice just inside the entrance to the Bay. By 1970, discharge of sewage and dredging in the Bay had stopped, and by 1972 bottlenose dolphins were again seen on a regular basis (FAO, 1978).

Such apparent effects of pollution are not only of significance to the cetaceans themselves, but also to human industries such as whale-watching that rely on the presence of the animals.

Effects on Reproduction

A direct effect of marine pollution on reproduction has been identified in the Californian sea lion (not a cetacean), where increased levels of DDT and PCB's correlated with increased numbers of premature births and mortality of new-born pups. PCB's are known to induce pathological changes in the reproductive organs and interfere with reproductive hormones in mammals in general. While data is unavailable on similar effects in whales and dolphins, small cetaceans have been shown to have a very poor capability to metabolise PCBs compared to birds and terrestrial mammals, and very high levels of DDT, PCBs and other chemicals have been found in the environment and tissues and organs of many small cetaceans (Borrel, 1993).

Any interference with the reproductive capability of cetaceans can have serious implications for the overall population. The reproductive cycle of cetaceans is basically adapted to environments which undergo seasonal change but are, in general, otherwise relatively constant. Populations of cetaceans are vulnerable to unnatural disturbances such as pollution by virtue of their universally low birth rates, late sexual maturity and relatively close and prolonged dependence of the young on adults (FAO, 1978).

Increased Susceptibility to Disease

PCB's are a recognised immuno-depressant and many researchers believe that high levels of these and other pollutants can significantly reduce the resistance of cetaceans to disease. Widespread and often unexplained dolphin deaths have been recorded throughout the world in recent years, a notable example being the large numbers of dead and dieing striped dolphins (*Stennella coeruloalba*) found on Mediterranean beaches during the summer of 1990 (Jones, 1991).

Direct Mortalities

Should contamination levels be high enough, it is possible for marine pollution to cause outright death of whales and dolphins. In the St Lawrence Estuary, Canada, where a marine reserve has been established to protect a resident population of the unusual beluga whales (*Delphinapterus leucas*), about one beluga corpse a week is being washed up. The dead whales are showing symptoms of depressed immune systems, complications with digestive systems and carcinogenic tumours. Testing of the whales' flesh has revealed levels of contamination so high that the corpses must be treated as toxic waste under Canadian legislation (Jones, 1991).

The St Lawrence flows through the industrial heartland of North America, and contains a cocktail of chemicals including PCBs, DDT and a range of polycyclic aromatic hydrocarbons (PAHs). This tragedy clearly demonstrates the inadequacy of attempting to manage populations for conservation based on artificial marine reserve boundaries and management regimes that do not recognise "upstream" sources of impact.

Oil spills

Although major marine oil spills receive significant media and public attention, their impacts on cetaceans are not believed to be severe, mainly due to the high mobility of these animals and the fact that oil floats on the surface of the ocean and is biodegradable. Whales and dolphins inadvertently surfacing through an oil slick to breath may become oiled and inhale hydrocarbon vapours. This may result in eye irritation, possible short-term baleen fouling, possible blowhole fouling, respiratory stress and lung damage, especially in young, and oil ingestion. A review of the literature indicates that mortality due to an oil spill has not been verified for any cetacean. Indirect impacts may occur should oil pollution contaminate or reduce food sources.

Marine Debris

In the last thirty years, the use of plastics and other synthetic materials has expanded at a rapid pace, and the quantity of plastic debris entering the marine environment has undergone a corresponding increase. Many of these products degrade extremely slowly, and can persist in the marine environment for long periods, posing significant threats to marine mammals and other sea-life. The threats are straightforward and primarily mechanical, with animals either becoming entangled, trapped or somehow fouled in the debris, or ingesting it. This can retard mobility and/or feeding and can eventually result in death.

In addition to general plastic debris, lost and discarded fishing gear is a major problem in many areas. In the North Pacific, for example, there is an estimated 380 000 kilometres of fishing net and associated gear available for use in the major fisheries (Laist, 1987).

There is obviously potential for small cetaceans, especially dolphins, to become entangled in such marine debris. Detailed data does not exist on dolphin mortalities from such causes.

Conclusion and Recommendations - Implications for Cetacean Management

Marine pollution represents a significant threat to cetaceans. While the human species may applaud itself for having reversed the downward slide of major whale populations caused by direct exploitation through hunting, we still have a long way to go to ensure the continued existence of these magnificent creatures through maintenance of clean, healthy seas.

The future of whales does not depend upon whether whale watchers keep their boats 300 or 500 metres from the animals, but on whether continuing exponential growth in human population, and the spiralling increase in consumption of resources and production of wastes, can be managed sustainably.

Conservation plans for whales and dolphins, such as that being developed by the Queensland Department of Environment and Heritage, must include reference to the need for sound management of the marine environment as a whole. The tragic failure of the St Lawrence Estuary marine reserve to safeguard the conservation of its resident population of beluga whales, exemplifies the need to take a whole-systems approach where management regimes extend to the very boundaries of catchments.

The problem of protecting the whales is the problem of protecting the health of the ocean itself.

It is recommended that:

- Long-term, ongoing marine pollution monitoring programs be developed and implemented, including adequate sampling of significant cetacean habitat areas
- sampling for chemical contamination of blubber, flesh, organs and blood, and analysis of gut content for marine debris, be included as standard procedure during autopsies of dead stranded cetaceans,
- the data from the above two programs be recorded and maintained on a readily accessible centrally coordinated national/regional database,
- cetacean management plans recognise and identify inputs of pollution to the environment, adopt a whole ecosystem approach and extend to the boundaries of catchments, linking wherever possible with other environmental management plans and seeking to eliminate pollution at source.

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