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ECOLOGY

Should Whales Be Culled to Increase Fishery Yield?

We examine the scientific evidence for the assertion that commercial fisheries are negatively impacted by whales in tropical breeding areas.

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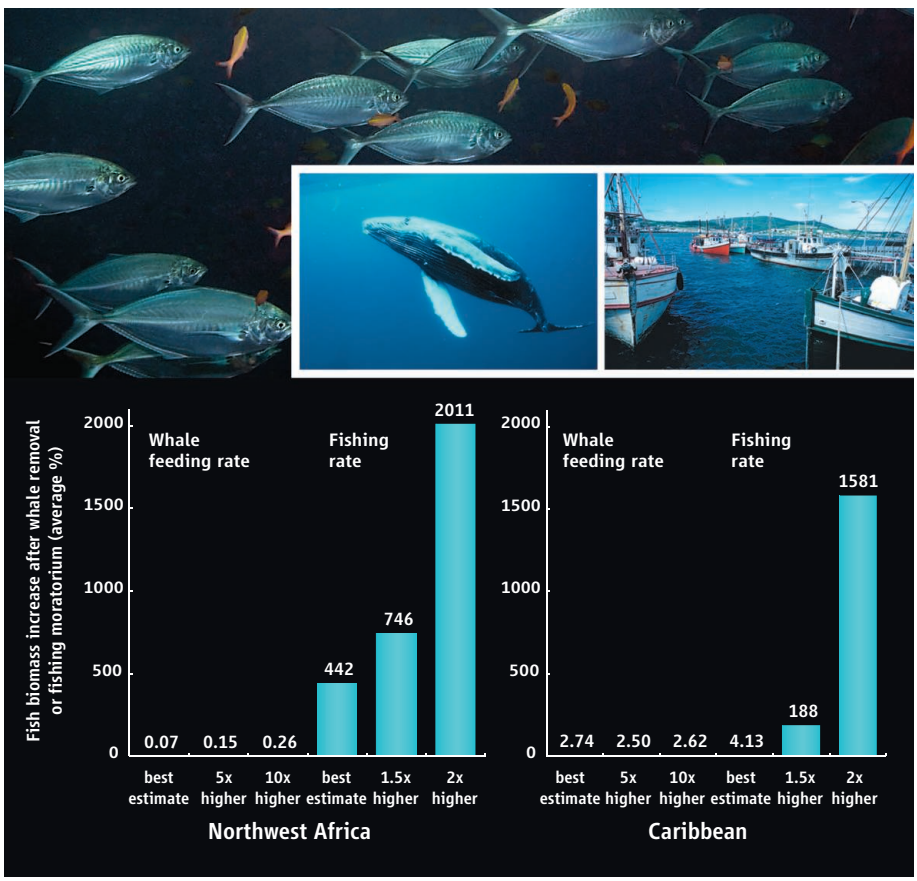
Science and international politics play complicated roles in the global arena of whale conservation and the management of the resources of the world's oceans. The International Whaling Commission (IWC), charged with the global conservation of whales and the management of whaling, introduced a moratorium on commercial whaling in 1986 because of the widespread depletion of whale species and stocks. Despite a lack of scientific data to indicate that many whale stocks have recovered, every year a heated debate takes place at the IWC meeting about the future of commercial whaling. Recently, whaling countries have introduced a new argument for resuming whaling by blaming whale populations for the decline in commercial fish stocks.

Couched in terms of "ecosystem management," whaling countries, including Japan, advocate the culling of whales as a solution to recover overexploited fish stocks and to increase fishery yield (*1*, *2*). Some developing countries, which may benefit economically and politically by supporting pro-whaling nations at IWC (*3*–*7*), have also supported the "whales-eat-fish" assertion. The Caribbean-driven St. Kitts Declaration at the 58th Annual Meeting of the IWC stated: "scientific research has shown that whales consume huge quantities of fish making the issue a matter of food security for coastal nations" (*6*). This issue was also claimed to be one of global concern at a 2008 symposium of IWC members in the Northwest Africa region (*8*).

When scientific information about the role of whales in marine ecosystems and for the economies of developing nations are considered, it becomes clear that delegates from developing countries who support the pro-whaling nations at the IWC may in fact be acting against the best interest of their countries. Whaling does not provide direct benefit to the fisheries that these countries closely depend on (*9*), but rather leads to the loss of species that are important for the structural integrity of their ecosystem (*10*–*12*). Living whales, on the other hand, may actually represent an alternative source of income through whale watching (*13*, *14*).

The rationale for whaling as the solution to depleted fisheries has been questioned by many in the scientific community in light of documented overfishing in oceans globally (*15*), a lack of spatially explicit overlap of resource exploitation between fisheries and whales (*2*), and the unpredictable consequences of culling (*16*, *17*). Based on stomach content analyses of whales caught during the Japanese scientific whaling program and available data on whale abundance, Japanese scientists estimate that whales consume several times as much food as the combined global fisheries catch in recent years (*18*). However, the methodology used by Japanese researchers to support their claim that whales' consumption of fish is an important component of fish declines has been repeatedly criticized (*19*–*22*). Although these discussions have been insightful, they have not stimulated movement within the IWC to break the current deadlock.

One of the obstacles in scientific studies of whales is that there are few data and models available to inform policy discussions. This is particularly true in the tropical waters bordering many of the developing countries that support the resumption of commercial



Negligible effects of removing whales on commercial fish biomass relative to the effect of a fishing moratorium. Estimated increases in fish biomass for best estimates of whale feeding and fishing rates, 5- and 10-fold underestimates of whale feeding, and 1.5 and 2-fold underestimates of fishing. For details, see (*9*).

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whaling, although these areas are known to be primarily breeding (not feeding) grounds for baleen whales (*23*–*27*). We conducted an extensive literature search to compile and make use of all available sources of local data to provide a scientific starting point to the discussion (*9*). We also sought to actively involve scientific advisers of delegates who support Japan's position at the IWC meetings and to foster regional collaboration and active dissemination of our findings to inform discussions in local communities among scientists, managers, and other local experts (e.g., 2008 "Whales-Eat-Fish" regional workshops held in Senegal and Barbados, http://lenfestocean.org/whales_fisheries.html).

Using data available from the literature, and, e.g., the Sea Around Us Project (www.seaaroundus.org) and obtained during our regional stakeholder workshops, we developed ecosystem models to examine the potential increase in the biomass of commercially important fish stocks that would result from a reduction in whale abundance in the Northwest African and Caribbean ecosystems (*9*). Any discussion about the interactions between whales and fisheries must be considered in an ecosystem context, which allows investigation of the complex indirect effects of trophic relationships that would otherwise be very difficult to study. Although the IWC Scientific Committee maintains that "Ecosystem modelling cannot be used to predict interactions between marine mammals and fisheries" (*28*–*30*), other studies provide evidence to the contrary that mammals and fisheries can be studied with ecosystem models (*31*–*32*).

Our approach to addressing concerns about scientific uncertainty was to conduct extensive sensitivity analyses to explore the results emerging from a range of assumptions about ecosystem structure and the quality of our input data (table S2). For a wide range of assumptions about whale abundance, feeding rates, and fish biomass, even a complete eradication of baleen whales in these tropical areas does not lead to any appreciable increase in the biomass of commercially exploited fish. In contrast, just small changes in fishing rates lead to considerable increases in fish biomass (see figure, p. 880). We found little overlap between fisheries and whale consumption in terms of prey types, and we also found that fisheries remove far more fish biomass than whales consume (*9*). Moreover, because some whale prey species compete with commercially targeted fish for plankton and prey occupying a lower trophic level in the food web, it is possible that removing whales from marine ecosystems could result in fewer fish available to the fisheries (*9*).

Today, the majority of fish stocks (*33*) and many whale populations (*34*) are seriously depleted, but most available evidence points toward human overexploitation as the root of the problem. When developing tropical countries are encouraged to focus on the notion that "whales eat fish," they risk being diverted from addressing the real problems that their own fisheries face, primarily, overexploitation of their marine resources by distant-water fleets (*35*).

Here, we offer a set of recommendations for rational decision-making by effectively applying ecosystem management concepts to managing whales.

First, the question of "who is eating our fish" should be considered in a larger context (with respect to foreign fleets, ecosystem collapses, and climate change). Indirect social and economic benefits of whales in tropical ecosystems [e.g., tourism (*36*, *37*)] should also be taken into account.

Second, despite complicated politics, science should be an integral component of the discussions about managing whale and fishery interactions. An effort must be made to actively engage scientists and managers from countries that support Japan's claims (*3*–*5*) to help them investigate this issue within an ecosystem context in their own regions. In many cases, fisheries officers in tropical areas, such as the Caribbean, do not necessarily believe the whales-eat-fish arguments. Rather, the arguments are endorsed for reasons related to their aid relationship with Japan, especially in the fisheries sector.

Third, ecosystem modeling tools should be developed in order to bring the best available science to decision-making about the conservation of whales. Research aimed at filling the gaps on key scientific parameters (e.g., abundance, consumption rates, and diet information for key marine organisms) should be supported.

Finally, it is important to recognize that the goal of ecosystem-based management is to manage the whole system for long-term sustainability rather than modifying particular trophic levels in an attempt to maximize fishery yield (*38*). Broad-based, ecosystem management can and should increase an ecosystem's value so that it can provide benefits for future generations.

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Supporting Online Material

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