LENFEST OCEAN PROGRAM

SUMMARY

Calculating tradeoffs: putting ecosystem-based management into practice

Richerson, K. et al. 2009. "Accounting for indirect effects and non-commensurate values in ecosystem based fishery management (EBFM)" in Marine Policy, doi: 0.1016/j.marpol.2009.05/001.

Many scientists, policymakers and environmentalists recommend that ecosystem-based management replace single-species fisheries management in order to maintain healthy ocean environments. An ecosystem-based approach to fishery management assesses the impacts of removing fish both directly on their population and indirectly on other living organisms, such as predators that eat the fish. Ideally this approach allows managers to account for potential tradeoffs among species when setting catch limits for a fishery, but in practice, calculating these tradeoffs can be difficult. For example, the number of fish caught is not easily compared to the number of young produced by birds that rely on the fish for food. Researchers Kate Richerson, Phillip S. Levin and Marc Mangel developed a method to account for such tradeoffs in setting catch limits, demonstrating with a case study that a modest reduction in fish catch can significantly boost numbers of seabird chicks.

Single-species Management vs. Ecosystem-based Management

Under single species fisheries management, scientists typically determine the "maximum sustainable yield" – the most fish that can be removed each year and still maintain a viable population – and use it as a benchmark in setting catch levels. In contrast, ecosystem-based fisheries management requires that the total amount of fish allowed to be caught by a fishery be set at a level that incorporates additional ecological factors, such as leaving enough fish for predators that depend on them.

Case study: Sandeels, Terns and Kittiwakes

The authors developed a population model for the Shetland Islands fishery for sandeels (*Ammodytes* spp.). Using existing data on the relationship between sandeel populations and numbers of chicks produced by black-legged kittiwakes (*Rissa tridactyla*) and Arctic terns (*Sterna paradisaea*), they calculated how fishing levels indirectly affect seabird chick production. In order to compare the ecological value of the predators' breeding success to the economic value of the fishery, the scientists developed a method for converting the two values (tons of fish caught, chicks produced) into measures that could be compared.

The scientists used this method to calculate sandeel fishing rates that maintain relatively high fishing yields and seabird chick production. According to the authors' model, where sandeels are caught at the levels set by single-species fisheries management, kittiwake and tern breeding success in the Shetland Islands would decline by 25 and 80 percent respectively. The scientists also found that when the fishery's catch level was reduced by 20 percent, the relative breeding success of terns, the more sensitive predator, would nearly double. Thus, the researchers were able to quantify the trade-offs between reductions in fisheries catch and increases in the breeding performance of birds.

Research implications
The researchers' new approach can be applied both by government fisheries managers and private, market-based programs which evaluate fisheries sustainability.

First, this approach can help fisheries managers set catch limits – needed to implement catch share and other fisheries management systems – by putting fishery catch levels and predator impacts on a comparable scale. By quantifying the indirect effects of fishing, fishery managers can set catch levels that account for the needs of predators, such as seabirds and marine mammals. With some modification, the authors' approach could also be used to address tradeoffs from other indirect effects. Potential examples include whether a fishery leaves the right size distribution of fish for predators to consume, or the negative impacts of fishing gear on ocean habitat.

Second, the approach could be applied by private sector eco-labeling programs, such as that of the Marine Stewardship Council (MSC), which certify fisheries as ecologically preferable. Although it requires consideration of ecosystem impacts, the MSC has yet to provide a quantitative methodology for doing so. Richerson et al.'s approach provides a consistent method for their consideration.

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The Lenfest Ocean Program was established in 2004 by the Lenfest Foundation and is managed by the Pew Environment Group.