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The Risks of Overfishing

Current global fisheries jeopardize not only individual species but also the overall integrity of marine ecosystems.

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On page 517 of this issue, Costello *et al.* (*1*) paint a dismal picture of the state of the world's fisheries. The authors report that globally, the vast majority of exploited fish populations have been depleted to abundance levels well below those recommended by conventional management guidance. Of even greater concern, most species are on a continuing trajectory of decline. These insights were gleaned from analyses of data from previously unassessed fish populations. These poorly understood fisheries, which represent about 80% of the world's fish catch, are in much worse shape than the relatively well-studied fisheries on which previous global status reviews have relied (*2*, *3*).

Cascading effects of overfishing. Predators that feed on commercially exploited fishes have seen substantial declines. Costello *et al.* now report on the state of global fisheries. They show that poorly understood fisheries are in much worse shape than relatively well-studied fisheries, and that the vast majority of fisheries are deteriorating. These trends potentially have far-reaching effects on marine ecosystems.

The substandard and deteriorating condition of the preponderance of fisheries is ample cause for concern. However, Costello *et al.*'s findings are even more alarming in the context of the evolving understanding of fishing and its ecological effects.

First, the authors measured the status of fish stocks relative to conventional fishery management benchmarks. Traditionally, fishery assessments have focused on individual target fish species; many, including Costello *et al.*, have concentrated on guidance aimed at obtaining maximum sustainable yield (MSY). However, MSY-based reference points are increasingly viewed as upper limits rather than goals. Modern fishery assessment and management advice increasingly sets target reference points far below MSY reference points, providing a buffer to guard against the ecological, economic and social risks of overfishing that can result from uncertainty (*3*, *4*).

Tiered management approaches, in which larger buffers are set in situations with less certain information, are increasingly recommended and applied (*3*, *5*). For example, Restrepo *et al.* have recommended that default fishing rates in the United States be set at no more than 75% of the level that would produce MSY yields, and that more risk-averse solutions be adopted in cases where data are poor (*3*). Australia, New Zealand, and other nations have adopted similar rules. Had Costello *et al.* considered such buffers in their analysis, the status of global fisheries would appear far worse than the already dismal picture portrayed.

Another important trend in fisheries management is the movement away from single-species management toward an ecosystem-based approach (*6*). The latter approach reverses the usual order of management priorities by making the goal of sustaining healthy ecosystems paramount. It takes into account the profound impacts that fishing can have on habitat, nontarget species caught as bycatch, genetic diversity and integrity, competition and predation, and other aspects of the structure and function of marine ecosystems. In this approach, it may be necessary to curtail fishing of a target species substantially below that indicated by an MSY approach to avoid unacceptable impacts to other species and the overall ecosystem (*6*).

Empirical and modeling evidence provides support for the view that fishery depletions often have cascading effects (see the figure). The loss of apex predators nearly always results in further marine ecosystem degradation (*7*). Empirical and modeling studies have shown that depletions of lower–trophic level species such as sardines, anchovies, herring, and krill can induce population declines in dependent predators such as seabirds (*8*) and larger fishes and marine mammals (*5*, *9*). For example, Pikitch *et al.* (*6*) found that the impact of forage fishing at MSY levels on their predators varied among species and across ecosystems, with median biomass declines of 54% for seabirds and 27% for all predators combined. On the basis of these and other observations, the Lenfest Forage Fish Task Force recommended that catches of many forage fish species be cut in half relative to conventional guidance, and that no new forage fish fisheries should be instituted in low-information circumstances (*5*).

Dayton (*10*) argued for a shift in the burden of proof for fisheries management decisions, in line with that applied in other natural resource and human health and safety policy arenas. This shift in the burden of proof would require demonstration of no serious impact before fishing could proceed. It is justified not least because the risks of continuing fishing when it results in serious negative consequences are generally much greater than the risks of curtailing fishing when it does not have a deleterious impact.

As Costello *et al.* show, the probability of making a mistake that leads to overfishing and depleted fish populations is higher in the information-poor circumstances that dominate contemporary global fisheries. At the same

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time, emerging research is highlighting the danger of irreversible effects of current fisheries on overall ecosystems. These insights provide forceful arguments for a more precautionary approach to fisheries management, in which fishing is restricted to those places and amounts where it can be conducted safely and with minimal risk of jeopardizing the integrity of marine ecosystems.

References

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