CONSERVATION

High Value and Long Life—Double Jeopardy for Tunas and Billfishes

The first standardized, global assessment of these fishes, using Red List criteria, reveals threatened species needing protection.

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There is growing concern that in spite of the healthy status of several epipelagic (living near the surface) fish stocks (*1*), some scombrid (tunas, bonitos, mackerels, and Spanish mackerels) and billfish (swordfish and marlins) species are heavily overfished and that there is a lack of resolve to protect against overexploitation driven by high prices (*2*–*5*). Many populations are exploited by multinational fisheries whose regulation, from a political perspective, is exceedingly difficult. Thus, assessment and management is complicated and sometimes ineffective (*4*). Regional Fisheries Management Organizations (RFMOs) were created to manage and conserve scombrids and billfishes because of their transnational distributions and widespread economic importance (*6*). However, species-specific catch data for many scombrids and billfishes are not collected or are aggregated with other species. Even for the larger tunas, for which relatively rich data exist, population assessments and data are complex (*1*) and are difficult to combine across RFMOs, which prompts a need for alternative means of assessment.

We present here the first standardized data on the global distribution, abundance, population trends, and impact of major threats for all known species of scombrids and billfishes [see supporting online material (SOM) for details]. We used International Union for the Conservation of Nature (IUCN) Red List criteria, which focus on global threats to a species but have not previously been used for a commercially important group of marine organisms. This required synthesis of global data from numerous fisheries reports and scientific publications.

Our study is more optimistic than a previous, fundamentally different study using separate population data of 16 of the same species (*2*), as we show only five of those species meet the threshold for a threatened category. However, most of the long-lived, economically valuable species are considered threatened (see the figure). As these large-bodied scombrids and billfishes are at the top of the pelagic food web (*7*), population reduction of these predators may have significant effects on the upper trophic levels of the epipelagic ecosystem (*2*) and lead to cascading effects on lower trophic levels. Hence, there is an urgent need to establish the conservation status of this economically important group of species.

Red List Criteria Reveal Threats

The IUCN Red List Criteria provide a transparent, standardized, peer-reviewed means of global conservation status assessment (*8*). Red List assessments of fisheries species rely heavily on fisheries stock assessments, which provide reliable abundance data, and participation of scientists familiar with fishery management procedures and stock assessments. The IUCN criteria to determine population status are based on a risk-assessment theory that is different from standard fisheries assessments and include metrics based on the symptoms of population decline such as range size and threats other than fishery pressure (*8*). Red List assessments differ from the objectives of fisheries management in focusing on global threats to a species rather than management of a particular stock of the species.

Of the 61 scombrid and billfish species assessed, 11 (18%) lacked adequate data and were classified as Data Deficient by IUCN criteria, 39 (64%) were Least Concern, four (7%) were Near Threatened, and seven (11%) met the threshold for a threatened category (Critically Endangered, Endangered, or Vulnerable) (*9*, *10*). Five of the seven threatened species are tuna and billfishes: southern bluefin (*Thunnus maccoyii,* Critically Endangered, SBF on the chart); Atlantic bluefin (*T. thynnus,* Endangered, ABF); bigeye tuna (*T. obesus*, Vulnerable, BET); blue marlin (*Makaira nigricans,* Vulnerable, BUM); and white marlin (*Kajikia albida,* Vulnerable, WHM). All have relatively long generation lengths (e.g., greater than 4.7 years) and high economic value worldwide (see the chart). Generation length, the average age of reproducing individuals, is a measure of reproductive turnover and is longer for those species that are longer-lived and later to mature. Species with longer generation lengths would be expected to take longer to recover from population declines (*11*). Compared with most IUCN-assessed marine bony fishes, the proportion of threatened species among scombrids and billfishes is high, similar to other valuable and long-lived species such as marine mammals, marine turtles, sharks, and rays (SOM).

All three bluefin tuna species (southern bluefin, *Thunnus maccoyii*; Atlantic bluefin, *T. thynnus*; and Pacific bluefin, *T. orientalis*) are highly valued, long-lived, and large-bodied marine fishes, with geographically restricted spawning sites, as well as relatively short spawning periods of 1 or 2 months, all of which make them susceptible to collapse under continued excessive fishing pressure (*12*). Southern bluefin has already essentially crashed (its current adult biomass is about 5% of its estimated virgin biomass), a trend that is similar to the western Atlantic bluefin, whose popula-

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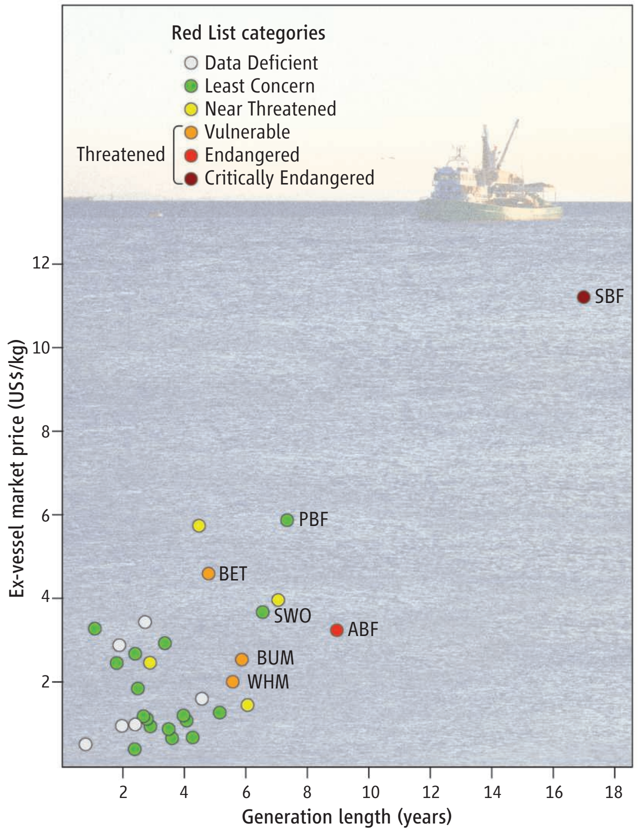
tion was greatly reduced in the 1970s, with little sign that the population is rebuilding. Per kilogram, bluefin species are among the most expensive fresh seafood in the world and can reach extreme values in global markets. Their high value makes them likely to be exploited far beyond the maximum sustainable yield (MSY, the largest catch that can be taken from a species' stock over an indefinite period), and in danger of an anthropogenic Allee effect (low population densities lead to reduction of reproductive success and increased possibility of collapse) (*13*).

The two other threatened species are Spanish mackerels, which in contrast to the threatened tuna and billfish have relatively short generation lengths and low global average market values. Yet Australian spotted mackerel (*Scomberomorus munroi,* Vulnerable) is highly valued locally and is estimated to have rapidly declined over the past 10 to 15 years in waters off eastern Australia (see SOM). Monterey Spanish mackerel (*Scomberomorus concolor*) has disappeared from ~80% of its historical range (Monterey, California, to southern Baja, Mexico) and is considered Vulnerable on the basis of continued fishing pressure within its restricted range in the upper Gulf of California.

Although swordfish (*Xiphias gladius,* SWO on the chart) and Pacific bluefin (*Thunnus orientalis,* PBT) are among the more highly valued species assessed, they are listed as Least Concern. The swordfish is considered well managed in nearly all parts of its range (*14*). However, the only population assessment available for Pacific bluefin is highly uncertain, and decreasing mean age may indicate that the population may not be as healthy as portrayed (*15*).



Endangerment of scombrids and billfishes. Generation lengths, average global ex-vessel price (1996–2006), and IUCN Red List categories for scombrids and billfishes. Prices received when landing catch, preprocessing. Both price and generation length data were available for only 32 of 61 species assessed; 29 remaining species, including threatened Australian spotted mackerel and Monterey Spanish mackerel, not shown. Details in SOM.

Successes

There are examples of successful management and recovery of scombrids and billfishes. Although the highly valued eastern population of Atlantic bluefin was recently exploited at three times the MSY, reduction of the total allowable catch, divided among country-specific quotas, and stricter monitoring and compliance measures have led to recent catch reductions of almost 75% over the past few years (*14*). The North Atlantic swordfish (*14*) and four populations of Spanish mackerels off the southeastern United States have also been rebuilt after years of overfishing.

The future of threatened scombrids and billfishes rests in the ability of RFMOs and fishing nations to properly manage these species. Southern and Atlantic bluefin populations have been so reduced that the most expeditious way to rebuild abundances and avoid collapse with great certainty is to shut down the fishery until stocks are rebuilt to healthy levels. This would cause substantial economic hardship and hinder the ability of RFMOs to control fishing because of the increased incentive for illegal fishing that would be created. Strong deterrents to illegal fishing are needed, such as controlled international trade through a listing on the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), although such a listing would not be a substitute for effective management by the RFMOs (*3*, *16*). Reducing fishing-induced mortality rates to well below MSY, to allow for uncertainties in the stock assessments, should allow recovery to begin. These IUCN Red List assessments, together with lessons learned from past failures and successes, should help RFMOs improve their management of some of the world's most valuable fishery resources.

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Supporting Online Material

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