European Commission

29 October 2015
Issue 433

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Source: Juan-Jordá, M., Mosqueira, I., Freire, J. & Dulvy, N. (2015). Population declines of tuna and relatives depend on their speed of life. *Proceedings of the Royal Society B: Biological Sciences*, 282(1811), p.20150322. DOI: 10.1098/rspb.2015.0322

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Science for Environment Policy

Speed of life linked to population decline in tuna

The numbers of fish in the world's oceans are plummeting. Past studies have shown that populations of larger fish tend to decline more steeply. This study assessed the effects of both body size and speed of life (measured by growth rate) on population declines in the tuna family. Analysis of population trends and life history data showed that speed of life better explained population decline than body size.

Species are declining at an unprecedented pace across the globe, yet different patterns of decline underlie different species. As well as exposure to harmful factors, intrinsic sensitivity (based on life history, habitat and behaviour) also influences vulnerability to decline. Larger-bodied species are known to decline more steeply and are at higher risk of extinction than smaller-bodied species. Traits related to speed of life, such as growth rate and age at maturity, also influence population decline.

In this study, researchers investigated the relative importance of body size and speed of life for population declines in the Scombridae family, which includes tuna and mackerel. They used 50 years (1954–2006) of scombrid population trajectories, in which stock assessments were used to reconstruct trends in biomass and the numbers of fish killed as a result of the fishing industry for 26 populations. This information was taken from a dataset of global scombrid population trajectories previously published by the lead author. Populations in which biomass decreased were selected for further analysis, in order to study the role of life history in population decline.

After calculating metrics to describe changes to biomass, the researchers extracted life history traits (including maximum body size, age at maturity and body growth rates) from a global database of scombrid life histories also published by the lead author. For each trait, the researchers calculated a population-level estimate of the life-history trait by combining information from multiple studies. They then matched the data on biomass changes with the life-history trait data.

They found that time-related traits, such as growth rate, were more closely related to population declines than maximum body size. The growth rate of populations (which effectively describes speed of life) better explained variation in the rate and extent of decline than maximum body size. This was determined by models identifying agreement between three metrics of vulnerability to decline (rate of decline, extent of decline and exploitation status) and life-history traits (growth rate and maximum body size) after controlling for differences in fishing mortality.

Those populations with slower body growth rates were found to decline faster, more steeply and to a greater extent than those with a larger body size. They were also more likely to be overfished. Overall, populations with slower growth rates (as opposed to larger body sizes) were four times more likely to have experienced faster population declines, 14 times more likely to have experienced larger extents of population declines, and 15 times more likely to be overfished.

This presents strong evidence for a link between population decline and growth rate. Because growth rates scale with temperature, populations with slower growth rates (found at higher, cooler latitudes) have declined most and are more likely to be overfished than those with faster life histories, found at tropical latitudes.

Temperature-driven gradients in growth may explain global patterns of population declines in fish, fisheries collapses and extinctions. Furthermore, traits related to speed of life like growth rate and age at maturity may be an effective way of identifying which populations are most vulnerable to exploitation.

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The authors recommend that traits related to speed of life serve as the main measure of vulnerability to decline, while body size should be secondary. They say understanding the link between habitat and life history could help to explain patterns of fisheries yield, sustainability and vulnerability, and provide important information for fisheries policy.