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Review Article

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Fishes in the Ocean are affected by Biological Disorders

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Abstract

In this article, we examine how the biology of marine fishes interacts with external threats to influence how populations and species react to such challenges. Less than 5% of the world's approximately 15, 500 marine fish species, the majority of which are significant commercially, have information on their status. Marine fish breeding biomass had decreased by an average of 65% from known historic values by 2001, according to data from 98 populations in the North Atlantic and Northeast Pacific; 28 populations had decreased by more than 80%. According to international threat standards, the majority of these decreases would be sufficient to justify a threatened with extinction designation. It is widely believed that marine fishes have a variety of life cycle traits, such as high fecundity and wide geographic distributions, which may impart better resilience than that displayed by terrestrial vertebrates. Nevertheless, this view is somewhat contentious. We examine 15 comparative studies that investigated these and other life history variables of vulnerability in marine fishes. Regardless of how fishing mortality varies among taxa, the empirical evidence points to large body size and late maturity as the greatest indicators of sensitivity to fishing; there is no indication that high fecundity increases resilience. The information examined here is directly relevant to the various standards used by various authorities to evaluate the threat status of fishes at the national and international levels. Simple life history features can be used as early screening criteria for assessment of the approximately 95% of marine fish species whose status has not yet been assessed by conservationists or fisheries scientists. They can also be used to change the conclusions of quantitative analyses.

Keywords: Biology of marine fishes; Populations; Fishing mortality; Geographic distributions

Introduction

Fish species outnumber all other vertebrate groups combined in terms of diversity. Fishes may rank among the most endangered vertebrate groups when freshwater and marine species are taken into account. In light of these two findings, one may assume that conservation biologists should give fish species great priority [1]. But compared to birds and animals, they get far less attention, with the exception of the commercially harvested species that are evaluated by fisheries agencies. Although maximum population losses of 83% from known historical levels have been seen in commercially harvested fish populations over the past two to three decades, many fisheries biologists believe that the risk of extinction for these species is actually rather low. This view had a significant role in the significant challenges encountered when the first marine fishes were included to CITES's Appendix 2 in November 2002.

This review's goal is to outline the state of the science about the threats facing marine fish species, including brief parallels with other vertebrate phyla. This point emphasises how little known on a national or regional is level. The biological correlates of vulnerability are then discussed, with a focus on life history traits that are predicted to have a direct impact on demographic responses to human impacts [2]. With the use of this knowledge, national and international priorities for conservation can be improved. This information is used to evaluate how a greater understanding of the biology of vulnerability might address ongoing disputes over the standards that can be used to quantify extinction danger.

Relevance to extinction risk assessment

When prioritising species for conservation assessments, it might be helpful to have a thorough grasp of the pattern and process of vulnerability in fishes. This can also help to increase the precision of those assessments. We have only just started to evaluate the status of marine fishes worldwide, as seen by the data we have compiled here [3]. In addition, a lot of the assessments that have been done have been questioned due to disagreements over the biology of vulnerability. Since many nations are required by law to identify and conserve threatened species, this issue is not only academic. It is becoming more and more important for the biologists who make these judgments to defend and explain their decisions. Four major disagreements in such assessments are clarified by an understanding of vulnerability biology.

As seen by the inclusion of fecundity in assessments of danger status by some organisations, it has been argued that highly fecund species should be able to sustain greater population decreases [4]. Both the theory and the actual data examined here disagree with this. Even though there is ample proof that extremely fecund fish have huge bodies, "slow" life histories, and some of the most susceptible species, we have found it difficult to dispel this persistent notion.

Second, it's been claimed that many fish populations experience significant natural population size changes, which makes it difficult to link sharp drops in population size to issues with conservation [5]. Even though this is the case for a number of species in the Clupeidae family, comparative studies have revealed that, on general, fish species do not experience larger temporal swings in adult population levels than do avian and terrestrial mammal species. In connection with this, comparative studies have discovered minimal correlation between the high fecundity of teleost Fish recruitment inter-annual variation.

Third, whether the threat criteria's thresholds are likely to trigger

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false alarms when used on economically harvested species has been the subject of heated dispute. The population may theoretically be reduced by 50% in a few years with a well-managed fishery; however this could result in the IUCN designating the species as "Endangered." For species when "the causes of the loss in population size are clearly reversible, known, and have halted," the IUCN developed an additional series of thresholds in 2001 to avoid this anomaly [6]. The decline thresholds are higher in situations where these criteria are met. If IUCN standards are used, the majority of the populations would still be classified as threatened. Whether such threat criteria conflict with the common reference point criteria employed in fisheries management is the crucial question from a management perspective [7]. According to a recent empirical study of European fisheries, there is no conflict for reductions of at least 50% within the longer of 10 years or three generations. IUCN criteria classify stocks as "vulnerable to extinction" at this point, and European fisheries management organisations classify them as "beyond safe biological boundaries." To put it another way, maintaining fish supplies within safe biological limits should prevent them from going extinct, therefore environmentalists' concerns about extinction risk need not contradict with those of fisheries managers [8]. In fact, the American Fisheries Society and CITES' steepest decline thresholds (99 and 95%), which are permissible in some situations, are not sufficiently precautionary because they run the risk of delaying the listing of populations and species as threatened until their likelihood of extinction is excessively high or their likelihood of recovery excessively low.

The question of whether species that have had enough decreases to be considered vulnerable are actually in danger of going extinct when there may still be millions of adults in existence is the last unresolved problem in terms of extinction risk. For instance, during the course of around three generations, the North East Atlantic population of the small shark Squalus acanthias, also known as the spurdog in Europe and the spiny dogfish in North America, has decreased by nearly 78% [9]. According to the IUCN's criteria for decline, this decline would be sufficient to qualify the species for endangered classification, although there are still tens of millions of adults. For many animals, the same is true. We believe that this is the most challenging question to respond to. Before we can accurately estimate if they are genuinely facing a strong risk of extinction, we need a far better understanding of minimum viable population levels, from both the genetic and demographic perspectives [10]. We still have a lot to learn about how these factors interact to affect persistence and recovery, even though life histories and ecology can account for a large portion of the heterogeneity among fish species in decreases.

When measuring population status, the information stated above has been applied using three essentially different methods: I prioritising which species to assess, (ii) modifying the findings of quantitative assessments, and (iii) direct integration into quantitative assessments. Each of these will be briefly discussed in turn.

The material that has been distilled points to straightforward guidelines that may be used to quickly screen species and establish priorities for carrying out more formal analyses. As an illustration, consider the statement that a large species is more likely to face problems than smaller species that are connected to it if individuals are being killed by fishermen [11]. This reasoning can be very effective, as demonstrated by a study of body size and geographic spread that identified skaters that may be in danger of going extinct. In a significant recent development, it was possible to quantify fish species' inherent extinction vulnerabilities by combining different vulnerability correlates using a powerful fuzzy logic expert system. Without employing official stock assessments, this strategy was evaluated against some of the studies and shown to be quite effective at predicting population status.

The second method, which modifies formal quantitative analyses using life histories, is demonstrated by COSEWIC, Canada's national science advisory body on species at risk (Committee on the Status of Endangered Wildlife in Canada) [12]. Instead than using them as hard standards for establishing status, they employ the IUCN quantitative criteria as guides. By taking into account the effects of age at maturity, body size, and distribution on extinction risk, this enables "sober second thinking." Based on life histories and ecology, this procedure may result in a lowering or, rarely, an upgrading of threat status [13, 14]. Although this adds more subjectivity to the quantitative criteria, experts generally agree that the benefits of utilising expert judgement to assess a wider variety of evidence outweigh the disadvantages of subjectivity as long as documentation is unambiguous. The COSEWIC's use of body size and age at maturity to adjust their rankings is supported by the comparative evidence examined. It would also be beneficial to measure the degree to which fishes are habitat-specific and the significance of dispersion traits for persistence and recovery.

The American Fisheries Society (AFS) and CITES have found that direct integration into quantitative evaluations is the best way to use life histories. These are more debatable since it might be challenging to estimate important productivity or process-related intrinsic rates of rise, r. For instance, the AFS categorises species or populations according to their intrinsic rates of natural increase (r), age at maturity, rate of body growth, lifespan, or fecundity [15]. Highly productive populations are permitted to experience declines of up to 99% before they are labelled susceptible to extinction. In comparison to IUCN criteria, this is noticeably less preventative. We would further argue, in light of the information discussed here, that fecundity ought to be disregarded when determining extinction danger [16-18]. The new CITES criteria are comparable to the AFS criteria in that they reserve the lowest threshold for species with the highest maximum rate of intrinsic growth or productivity and depend on life history in determining the decline threshold.

Conclusion

We still know a lot more about marine fishes than we do about most of the world's biota, despite the fact that most of their status has not yet been determined. Fishes sit in between the more well-known vertebrates and the less well-known "everything else." But since the 1990s, when the conservation movement only slowly caught on, they have frequently become the focus of contentious custody disputes between resource managers worried about stock recovery and conservationists worried about extinction risk. The substantial disturbances to the ecology of the oceans caused by human activities, which are beyond dispute, should not be obscured by current discussions about extinction risk. According to the research discussed here, marine fishes do not fundamentally differ from other species in how their populations react to the interaction between external hazards and internal life history characteristics. It is almost clear that the extreme reductions brought on by fishing pressure will result in local extinctions in a way that can be foreseen from fundamental characteristics of their biology. The ability to evaluate the condition of marine fishes and determine the highest priority conservation measures would improve with a better understanding of these processes.

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