Seafood extinction risk: Marine bivalves in peril?

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Marine bivalves are an important component of our global fishery, with over 500 species harvested for food and other uses. Our understanding of their potential vulnerability to extinction lags behind evaluation of freshwater bivalves or marine vertebrates, and so Shan Huang and colleagues, in analyses presented at the annual meeting of the Geological Society of America, used insights and data from the fossil record to assess extinction risk in this economically and ecologically important group. Their findings suggest that among all today's shallow-marine bivalves (~6,000 species), harvested species tend to be widespread along major coastlines and are able to tolerate wide ranges of environmental conditions (e.g. sea-surface temperature). This is good news, they note, because the fossil record shows that these broad ranges can help them survive "mild" changes in the environment.

Because little is known about the direct human impact on these harvested species, this study by Huang and colleagues studied species' intrinsic risk of extinction, laying the groundwork for efficiently managing these natural resources and conserving marine biodiversity. Having confirmed the ability of their method to predict how intrinsic characteristics interact with external pressures to yield high extinction rates in the past, the next step will be to estimate extinction risk in the future bivalve population. This goal highlights the urgent need for more complete data on the capture and harvesting of these bivalves, which would enable a comprehensive investigation on the direct effects of exploitation.

Overall, this study by Huang and colleagues showcases an integrative approach of combining paleontology and biogeography to study species' intrinsic risk of extinction, which is essential to efficiently managing our natural resources and conserving biodiversity.

Q: What kind of bivalves are you talking about here? How does this relate to what people are eating?

A: We studied all bivalve species that live in the sea from the shoreline to 200 meters deep (most bivalves living deeper than this aren't readily harvested). We find that only 500+ of almost 6,000 marine bivalve species are harvested, but we were surprised to find that many of those species come from evolutionary groups outside the ones we commonly eat—mussels, oysters, scallops, and cockles. People also use bivalves as sources of pearls, a kind of "silk" that can be woven into cloth, and even windowpanes!

Q: Does human consumption contribute to them being in peril, or is it changes to the environment?

A: Previous studies of marine fish have shown that a combination of human harvesting and climate change is negatively impacting a number of species and that such declines depend in part on the biological attributes of individual species. Comparable analyses are lacking for shellfish despite their biological and economic importance. In fact, global catch data are available for only a very small proportion of harvested bivalves. So in this study, we used the fossil record and today's geographic distribution of species to identify the harvested bivalves that are intrinsically more prone to extinctions. We found that many of the evolutionary lineages (here, taxonomic families) containing harvested bivalves were subject to high extinction rates during the past 65 million years. On the other hand, many of the harvested species within those lineages are sufficiently widespread today, suggesting that, all things

being equal, they should be fairly extinction-resistant. But we urgently need more information on the extrinsic pressures being applied to those species—global catch, pollution, and regional climate changes, to determine their future vulnerabilities. This finding calls for further investigation on how external pressures have interacted with family-specific characteristics to yield high extinction rates in the past, which could improve estimates of extinction risk in bivalves, particularly those of economic value.

Q: How does the fossil record tell us about the future of marine bivalves?

A: All bivalve lineages at the taxonomic level of families, including the harvested ones, have been around for tens of million years, and their evolutionary history is preserved in a rich fossil record. From this history, we can see that some families tended to have, on average, higher extinction rates throughout the last 65 million years. This suggests that these families might have biological properties that made them more extinction-prone, although we do not yet always know the immediate causes of these extinctions. The PERIL metric incorporates this information into an estimate of intrinsic extinction risk, and we were encouraged to find that this relatively simple metric successfully predicted extinctions over the past five million years in two regions with especially well-studied fossil records. Putting modern seafood bivalves into this historical framework, including their family-specific risk, gives us a better-informed estimate of their relative robustness to external pressures.

More information: Talk: Seafood Extinction Risk Estimated from Biogeography and the Fossil Record: Marine Bivalves in Peril D16: 196-6: Thursday, 29 Oct., 2:50 p.m. EDT, Geological Society of America 2020 Connects Online, gsa.confex.com/gsa/2020AM/meet … app.cgi/Paper/353217