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Widespread diversity deficits of coral reef sharks and rays

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Abstract

A global survey of coral reefs reveals that overfishing is driving resident shark species toward extinction, causing diversity deficits in reef elasmobranch (shark and ray) assemblages. Our species-level analysis revealed global declines of 60 to 73% for five common resident reef shark species and that individual

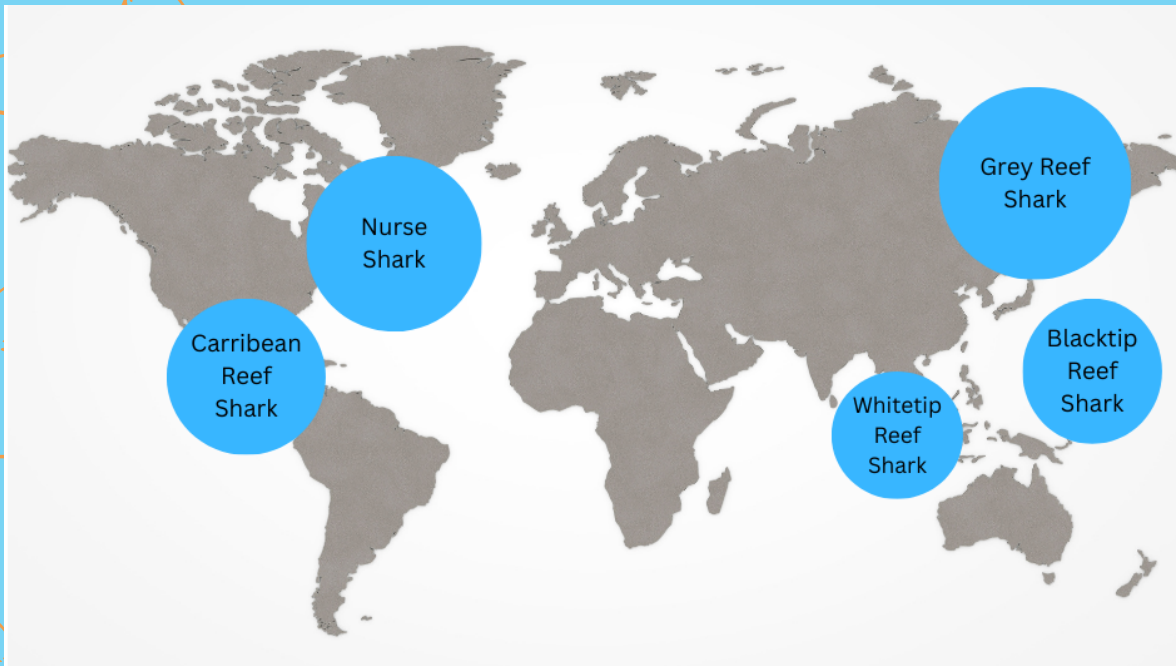


shark species were not detected at 34 to 47% of surveyed reefs. As reefs become more shark-depleted, rays begin to dominate assemblages. Shark-dominated assemblages persist in wealthy nations with strong governance and in highly protected areas, whereas poverty, weak governance, and a lack of shark management are associated with depauperate assemblages mainly composed of rays. Without action to address these diversity deficits, loss of ecological function and ecosystem services will increasingly affect human communities.

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In IUCN assessments before the availability of this global survey, all reef-resident shark species were considered at lower risk of extinction (Near Threatened). Grey reef shark had the highest level of global decline [$69.8\% \pm 1$ standard error (SE) 62.6 to 77.1], followed by nurse shark ($68.6\% \pm 49.7$ to 87.4), Caribbean reef shark ($64.8\% \pm 42.0$ to 87.5), blacktip reef shark ($64.5\% \pm 58.7$ to 70.4), and whitetip reef shark ($60.4\% \pm 51.2$ to 70.2) (Simpfendorfer et al, 2023).

Summary

Coral reefs are under intense human-induced pressure due to fishing, degraded water quality, and climate change, which can cascade into negative effects on species that serve important ecological roles within the ecosystem. Sharks and rays (elasmobranchs), in particular, have extremely important roles within coral reef ecosystems as predators and prey at multiple trophic levels and in cycling nutrients. Overfishing drives population declines and, in a previous study, it was found that sharks were not observed on 20% of surveyed reefs. This study categorized elasmobranch assemblage structure on coral reefs across a gradient of human-induced pressure to estimate local levels of declines and the global extinction risk of the most common reef species. This study revealed that human and environmental factors influence shark assemblage structure and lead to a loss of predator diversity that could affect reef ecological function.

Using BRUVs (Baited Remote Underwater Videos), this group of scientists evaluated species richness, species composition, and relative abundance. They observed how shark assemblages change in response to human pressures in different locations across the globe. In reviewing the footage, the scientists observed 104 distinct elasmobranch species and more than half of those were rarely observed. Nine key resident elasmobranch species represented 77.7% of all elasmobranchs observed in this study, and were identified as those that serve important ecological roles and contribute to local's livelihoods through fishing and dive tourism.

In general, species depletion that was observed on the footage followed overall decline in elasmobranch abundance. Resident reef species are at a much higher risk of extinction than previously thought. Assemblages were significantly related to certain socioeconomic and management factors, such as whether the reef occurred in a marine protected area (MPA) or whether a reef was within a nation where all targeted shark fishing and trade is prohibited, known as a "shark sanctuary."

In good news, the declines observed at one reef will have little effect on farther reefs and have a high potential to rebuild with protected areas or strong fisheries management. Species specific and direct management is critical to maintaining and rebuilding populations of diverse elasmobranch assemblages. If this is not addressed, these human-induced pressures will continue and will result in the loss of species, ecological functions and ecosystem services that support the livelihoods of millions.



Check Your Understanding

What is needed for successful management of reef shark species moving forward?

Lined area for writing the answer to the first question.

What human pressures have the most damaging effects on coral reef shark species?

Lined area for writing the answer to the second question.

As shark species decline on coral reefs, what ecosystem level effects may later be observed?

Lined area for writing the answer to the third question.

Did you know....
This study surveyed 391 coral reefs in 67 nations and territories using 22,756 baited remote underwater video stations (BRUVS).

Glossary of Key Terms

Species relative abundance- MaxN; the maximum number of each species observed in a single frame of each 60-min deployment then averaged across all deployments on one reef

Species richness - the number of species within a defined region.

Fisheries management- management used to produce sustainable biological, environmental and socioeconomic benefits from renewable aquatic resources.

Extinction risk- the difference between the current number of species and the future number of species equates to species' extinctions.