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A Natural Fertilizer

It’s long been known that sharks help nourish coral reefs, but exactly to what extent has never been scientifically mapped out — until now.

A pioneering study — led by scientists from Imperial College London in collaboration with marine biologists from UC Santa Barbara — found that the predators, through their fecal material, transfer vital nutrients from their open ocean feeding grounds into shallower reef environments, contributing to the overall health of these fragile ecosystems. The researchers specifically examined the role of grey reef sharks (Carcharhinus amblyrhynchos), a predatory species commonly associated with coral environments but whose wider ecological role has long been debated. The international team’s findings appear in the journal Proceedings of the Royal Society B.

“Our study shows that large mobile predators such as sharks may be a very important source of nutrients for even the smallest reef creatures, such as corals,” said co-author Jennifer Caselle, a research biologist at the Marine Science Institute. “The role of sharks as top predators is well understood, but their role as nutrient vectors is far less studied.”

Working in the waters surrounding Palmyra Atoll — a national wildlife refuge managed by the U.S. Fish and Wildlife Service and the Nature Conservancy and situated 1,000 miles south of Hawaii — the scientists used acoustic tags to map the sharks’ movements across the atoll. They combined these insights with existing knowledge about the sharks’ feeding habits in open ocean (pelagic) environments

where they consume much of their prey.

The researchers then analyzed this tracking data as a spatial network of movements and were able, for the first time, to estimate the quantities of nitrogen deposited around the remote unfished reef of Palmyra Atoll via the sharks' fecal material. Results estimate that this specific population of grey reef sharks — believed to number approximately 8,300 individual animals — contributes a combined total of 94.5 kg (208.3 pounds) of nitrogen to the reef ecosystem per day, an amount that likely contributes substantially to reef primary productivity.

By foraging for prey in deep pelagic waters often miles offshore, these mobile predators can act as vital "nutrient vectors" to shallow reefs. They bring with them precious sources of nutrients like nitrogen, which in turn effectively act as a fertilizer for the thousands of other species that call these reef environments home.

These research findings have implications for the scientific understanding of fragile coral reef ecosystems as well as for the ecological significance of grey reef sharks. The species is currently classified as "near threatened" on the International Union for the Conservation of Nature Red List.

"Coupled with their better-known role as predators, our study underlines another, less obvious role played by reef sharks in improving the resilience of these fragile habitats and underscores the vital importance of conserving these and other wide-ranging predators," said senior co-author David Jacoby of the Zoological Society of London's Institute of Zoology.

Other co-authors are Darcy Bradley of UC Santa Barbara, Jessica Williams of Imperial College London and Yannis Papastamatiou of Florida International University.

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