

New research unlocks mysteries of soupfin shark migration and reproduction

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Soupfin sharks schooling in the shallows off La Jolla, Calif. Scripps and USD researcher Andy Nosal found that these sharks return to the same warm waters every three years, presumably to help gestate their embryos. Credit: Trystan Snodgrass

A seven-year study of California's soupfin sharks sheds light on their

migration and reproductive cycles, laying the groundwork for potential management strategies amid conservation concerns. The findings were published March 3 in the *Journal of Applied Ecology* by researchers at Scripps Institution of Oceanography at UC San Diego and the University of San Diego (USD).

Analyzing the tracking data from 34 female soupfin [sharks](#) (*Galeorhinus galeus*) tagged with acoustic transmitters, Scripps Oceanography researcher and USD professor Andrew Nosal discovered these sharks exhibit a triennial migratory cycle, returning to the tagging site off La Jolla, Calif. every three years.

This is the first conclusive evidence in any animal of triennial philopatry, a term meaning 'home-loving,' referring to the periodic return of an animal to the same location.

"During the first three years of tagging, none of the sharks returned to La Jolla after leaving," said Nosal. "We figured the sharks were simply wide-ranging and did not exhibit philopatry. Then, in the fourth year, we detected sharks tagged in the first year, and in the fifth year detected sharks tagged in the second year. This indicated a three-year cycle of migration and philopatry, which coincides with their three-year reproductive cycle."

In sharks, the cycle of philopatry is typically linked to that species' reproductive cycle. For instance, species whose females give birth every two years often exhibit biennial philopatry, returning to the same preferred feeding, nursery, or pupping grounds every two years. In species with annual reproductive cycles, females usually exhibit annual philopatry. Nosal's previous research on female leopard sharks, guitarfish, and bat rays revealed annual philopatry to the warm waters off La Jolla, consistent with those species' annual reproductive cycles.

Nosal and his colleagues tagged these soupfin sharks over five summers (2013 to 2017) off La Jolla, San Diego, where the sharks are commonly seen congregating in large numbers in the warm shallows. Using field ultrasound examinations, Nosal confirmed these sharks were pregnant females, likely using the warm water to incubate their developing embryos, as hypothesized for other shark and ray species. The team tracked the sharks' movements using a large coastal array of more than 300 underwater acoustic receivers positioned along the U.S. West Coast. Most sharks left La Jolla in the fall or winter after tagging, spending the next two years between the Northern Channel Islands and San Francisco Bay, with a few travelling as far as the Pacific Northwest. In these areas, Nosal believes the sharks give birth, feed, and mate, before returning to La Jolla, where they ovulate and undergo gestation in the warmer waters. One individual even completed two three-year cycles after being tagged in 2014, returning to La Jolla in 2017 and 2020.

Of the sharks tagged, at least 15 percent were captured by artisanal gillnet fishers in Mexico. Last year, soupfin sharks were elevated to critically endangered status globally by the International Union for Conservation of Nature (IUCN), due to heavy fishing pressure and steep population declines worldwide. In the eastern North Pacific, the soupfin population was hit hard by a fishery boom in the 1930s and 1940s, which targeted the sharks for their meat, fins, and livers, which are rich in vitamin A. With the advent of synthetic vitamin A, this fishery lost steam and the population is believed to have partially recovered in the decades since. Additionally, soupfin sharks were listed on Appendix II of the United Nations Convention on the Conservation of Migratory Species (CMS) in 2020. Nosal hopes his research, combined with these recent uplistings, leads to improved monitoring and cooperative international management of the Eastern North Pacific soupfin shark population.

"Currently, soupfin sharks are not actively managed in U.S. waters and

there has been no stock assessment, unlike in other countries," Nosal said. "Given the recent CMS listing and IUCN status elevation to Critically Endangered globally, as well as the highly migratory behavior we report along the U.S. West Coast, the current management scheme should be revisited by the U.S. Pacific Fishery Management Council."

Soupin sharks, also known as tope and school sharks, are found worldwide in temperate coastal waters, growing to a length of over six feet and feeding mainly on fish and invertebrates. There are five main populations: off Australia and New Zealand, the Eastern North Pacific, Southwest Atlantic, Europe, and Southern Africa.

Nosal is hopeful that this research may inform any future management strategies, particularly in the U.S.

"Suppose managers are monitoring female soupfin shark abundance at some location, such as La Jolla. High shark abundance three years in a row may suggest a stable population, but, given the triennial migration [cycle](#), these may actually be three different breeding cohorts within the population." he said. "Managers could only compare apples to apples at this location every three years to track population trends."

Nosal suspects the other populations of soupfin sharks also demonstrate triennial philopatry, but future long-term tracking studies would be needed to confirm this. These studies, he stresses, are only possible through strong collaborations among scientists and their institutions.

"I only maintain a handful of acoustic receivers off La Jolla," he said. "The rest of the acoustic receivers that detected tagged soupfin sharks are managed by other researchers along the coast. This study would not have been possible without strong collaborations among scientists and their willingness to share detection data recorded by their receivers."

This study also underscores the importance of long-term animal tracking studies. For example, other shark species, such as tiger sharks, also give birth every three years. Future studies like this one could reveal triennial cycles of migration and philopatry similar to soupfin sharks.

More information: Andrew P. Nosal et al, Triennial migration and philopatry in the critically endangered soupfin shark *Galeorhinus galeus*, *Journal of Applied Ecology* (2021). [DOI: 10.1111/1365-2664.13848](https://doi.org/10.1111/1365-2664.13848)

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