How a huge school of sharks 'flips the food pyramid'

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Ecologists have discovered a food web beneath the waves of French Polynesia that is both unusual and spectacular.

A small channel hosts up to 700 sharks - far more than it can support based on the number of fish living there.

The predators survive by feasting every winter on huge numbers of grouper fish, which swim into the channel to spawn.

Those mobs of spawning fish concentrate prey from multiple reefs and the sharks lurk in the channel to take advantage of them, instead of hunting elsewhere.

The findings, published in the journal Current Biology, are an example of an "inverted trophic pyramid": the average biomass in the channel is skewed towards predators rather than prey.

It is only the convenient, seasonal meal delivery of spawning groupers into the Fakarava atoll's southern pass that sustains its rare concentration of gray reef sharks - the highest density of this species ever recorded.



Groupers gather in huge numbers to spawn during June and July / Laurent Ballesta

"We went there, in the beginning, to study the groupers, because we heard about these spawning aggregations that happen every year," said Dr Johann Mourier, who led the study for CRIOBE in French Polynesia but is now based at Macquarie University in Sydney.

"And we found this huge population of sharks. Up to 700 gray reef sharks - about two to three times higher density than found in any other reef, worldwide."

With colleagues from France and the US, Dr Mourier tagged and tracked 13 sharks using remote transmitters, to understand their behaviour; they also did regular surveys of the channel with underwater cameras and completed a census of different shark and fish species.

The team discovered that gray reef sharks in the channel, which is just 100m wide and 30m deep, fluctuated in number from about 250 in the summer to 700 in the winter.

That winter peak coincided with the spawning of the groupers, which brought together some 7,000 of the smaller fish at a time, from habitats up to 50km away.

"That's about 30 tonnes of fish; that's a big amount of food," Dr Mourier told BBC News.



Easy meal: spawning swarms of groupers deliver tonnes of food at a time / Andromede Oceanologie

The researchers witnessed the sharks taking aggressive advantage of this meal delivery, and also observed that the density of the sharks and the length of time they spent in the channel were significantly higher when the groupers were spawning.

It might sound incredibly convenient, but previous findings had suggested that when sharks live together in large groups like this - and risk tipping the balance of the trophic pyramid - they would simply travel further afield to find food.

"The idea was that sharks must make foraging excursions outside their area. They have to move to find food to survive," Dr Mourier explained.

"But in this case, we find that the spawning aggregations bring the food to them. They just can stay at the reef and save their energy."



The atoll of Fakarava, part of French Polynesia in the South Pacific, is a UNESCO biosphere reserve / Getty

Images

The discovery has implications for conserving these species, he added. Laws to stop people fishing for sharks might not be enough to protect them - because huge spawning aggregations of fish are attractive to humans as well as to sharks.

"It's quite easy to catch your fish if they're in these huge aggregations - they're just concentrating on spawning," Dr Mourier said.

But overfishing those tempting crowds of fish could threaten the sharks themselves.

"Maybe that's why we don't find such shark densities in other reefs - because those spawning aggregations have been overfished."