Overfishing large sharks impacts entire marine ecosystem, shrinks shellfish supply

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Fewer big sharks in the oceans mean that bay scallops and other shellfish may be harder to find at the market, according to an article in the March 30 issue of the journal *Science*, tying two unlikely links in the food web to the same fate.

A team of Canadian and American ecologists, led by world-renowned fisheries biologist Ransom Myers at Dalhousie University, has found that overfishing the largest predatory sharks, such as the bull, great white, dusky, and hammerhead sharks, along the Atlantic Coast of the United States has led to an explosion of their ray, skate, and small shark prey species.

"With fewer sharks around, the species they prey upon – like cownose rays – have increased in numbers, and in turn, hordes of cownose rays dining on bay scallops, have wiped the scallops out," says co-author Julia Baum of Dalhousie.

"This ecological event is having a large impact on local communities that depend so much on healthy fisheries," says Charles Peterson, a professor of marine sciences biology and ecology at the Institute of Marine Sciences, University of North Carolina at Chapel Hill and co-leader of the study.

The research builds upon an earlier study by Myers and Baum, published in Science in 2003, which used data from commercial fisheries to show rapid declines in the great sharks of the northwest Atlantic since the

mid-1980s. Now, by examining a dozen different research surveys from 1970-2005 along the eastern U.S. coast, the research team has found that their original study underestimated the extent of the declines: scalloped hammerhead and tiger sharks may have declined by more than 97 percent; bull, dusky, and smooth hammerhead sharks by more than 99 percent.

"Large sharks have been functionally eliminated from the east coast of the U.S., meaning that they can no longer perform their ecosystem role as top predators," says Baum. "The extent of the declines shouldn't be a surprise considering how heavily large sharks have been fished in recent decades to meet the growing worldwide demand for shark fins and meat."

Sharks are targeted in numerous fisheries, and they also are snagged as bycatch in fisheries targeting tunas and swordfish in both U.S. and high seas fisheries. As many as 73 million sharks are killed worldwide each year for the finning trade, and the number is escalating rapidly.

Ecologists have long predicted that the demise of top predators could trigger destructive consequences. Researching such effects, however, has been a challenge.

"This is the first published field experiment to demonstrate that the loss of sharks is cascading through ocean ecosystems and inflicting collateral damage on food fisheries such as scallops," says Ellen Pikitch, a professor at the University of Miami Rosenstiel School of Marine and Atmospheric Science and executive director of the Pew Institute for Ocean Science. "These unforeseen and devastating impacts underscore the need to take a more holistic ecosystem-based approach to fisheries management."

As great shark populations plummeted, their elasmobranch prey—rays,

skates, and smaller sharks—increased considerably, according to research surveys looking at the past 16 to 35 years. Cownose rays are most conspicuous among the 12 species showing increases because of their near-shore migrations. With an average population increase of about eight percent per year, the east coast cownose ray population may now number as many as 40 million. The rays, which can grow to be more than four feet across, eat large quantities of bivalves, including bay scallops, oysters, soft-shell and hard clams, in the bays and estuaries they frequent during summer and migrate through during fall and spring.

In the early 1980s when Peterson sampled bay scallops in North Carolina sounds in late summer before and after the cownose rays passed through, he found that most scallops survived the ray predation, allowing the scallop population to support a fishery and still replenish itself each year. In contrast, sampling by Peterson and co-author Sean Powers in recent years—after the cownose ray population explosion—showed that the migrating rays consumed nearly all adult bay scallops in the area, except those protected inside fences that the researchers had put up to keep the rays out. By 2004, cownose rays had completely devastated the scallop population, terminating North Carolina's century-old bay scallop fishery.

"Increased predation by cownose rays also may inhibit recovery of oysters and clams from the effects of overexploitation, disease, habitat destruction, and pollution, which already have depressed these species," says Peterson, noting shellfish declines in areas occupied by cownose rays and examples of stable or growing shellfish populations in areas beyond the ray's northernmost limit.

Ecosystem effects of increases in the other ray, skate, and smaller shark species are unknown, but like the cownose ray, may also be cascading down to species lower in the food web.

"Despite the difficulty of piecing together ecosystem impacts of overfishing," co-author Travis Shepherd of Dalhousie emphasizes, "the real challenge will be to move beyond retrospective analyses and instead prevent ecosystem-wide changes from happening in the first place."

"Our study provides evidence that the loss of great sharks triggers changes that cascade throughout coastal food webs," says Baum. "Solutions include enhancing protection of great sharks by substantially reducing fishing pressure on all of these species and enforcing bans on shark finning both in national waters and on the high seas."

"Maintaining the populations of top predators is critical for sustaining healthy oceanic ecosystems," says Peterson. "Despite the vastness of the oceans, its organisms are interconnected, meaning that changes at one level have implications several steps removed. Through our work, the ocean is not so unfathomable, and we know better now why sharks matter."

Source: University of Miami Rosenstiel School of Marine & Atmospheric Science