Source of nutrients for ecosystem lost as coastal fisheries decline

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A new study by researchers at the University of Georgia and Florida International University has found that the elimination of large marine predators through overfishing and habitat alteration removes a vital source of nutrients for coastal ecosystems.

The study, currently in press in the journal Ecological Applications, shows that the influence of these large marine species goes far beyond their role as predators.

“The effects are not just top-down,” said study co-author Jacob Allgeier, a doctoral student in the UGA Odum School of Ecology who led the study with Craig Layman of Florida International University. “When you eliminate these large predators, you also eliminate a major source of nutrients for algae and plants in the food web, especially in tropical and sub-tropical coastal areas.”

Working at study sites on Andros Island, the largest island in the Bahamas, the team, which included UGA associate professor of ecology Amy Rosemond, compared populations of gray snapper – an abundant and economically important species – from areas that experience varying levels of human impact, specifically overfishing and habitat alteration. One group of sites was located on the west coast of Andros, an area with virtually no human impacts. The other sites were on the island’s east coast, home to most of Andros’s population. Those sites were affected by fishing and habitat fragmentation in the form of roads that cut off interior wetlands from the ocean. The study sites, deep tidal creek

mouths lined with mangrove trees, were otherwise similar.

Allgeier said that tropical and sub-tropical coastal waters are typically low in nutrients. “That’s why places like the Bahamas have such clear water,” he said. “That’s also why the fish are so important there. They recycle the nutrients they take in from the food that they eat, making them available for lower-level organisms, like algae, that form the base of the food web.”

The researchers found significantly higher fish densities at the sites that experienced no human impacts, which led to much higher quantities of nutrients being recycled at these sites: 4.6 times more nitrogen and 5.4 times more phosphorus.

“We were surprised at the quantity of nutrients supplied by the fish,” said Allgeier. “The density of the fish is high, but still it was surprising that this one species does so much.”

Not only that, they found that the size of the fish differed greatly between impacted and unimpacted sites. Unimpacted sites had eleven times more snapper that were over twenty-five centimeters in length than did impacted sites. According to Rosemond, reduced fish size is a hallmark of high fishing pressure.

The team’s findings point to the complexity of nutrient cycling in coastal ecosystems. “The implications of fish in nutrient cycling may not be as important in nutrient-rich environments,” Allgeier said. “But a lot of people live in areas with nutrient-poor coastal waters, near the equator and along the coasts.”

Allgeier said that the east coast of Andros is home to roughly 10,000 people. “What that means is that these are conservative estimates, compared to what you would see in more populous areas like Jamaica or

Haiti. We need to learn a lot more about how the ecosystem will function as fisheries in these areas continue to decline."

In a related paper currently in review in the journal *Ecology*, Allgeier and Layman continue their investigation into the mechanisms by which fish excretion enhances algal growth through a series of experiments using artificial reef habitats.

Provided by University of Georgia