Guardians of the reef: How parrotfish promote coral health

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Top: A male spotlight parrotfish. Bottom: A female spotlight parrotfish. Credit: Joshua Manning/CU Boulder

Neighbors can be annoying. They may be loud or intrude on your space. But is it worth fighting with them? Parrotfish choose not to.

In a new study published Aug. 28 in the journal *Ecology*, a CU Boulder researcher and his collaborator revealed that the spotlight parrotfish, a brightly colored species found in the shallow waters off Florida and in the Caribbean Sea, behave more tolerantly toward neighboring parrotfish but aggressively toward strangers.

The researchers spent days underwater observing the colorful fish, providing key insight into a species that plays a critical role in both maintaining healthy coral reefs and contributing to the white sand beaches of the Caribbean.

"Parrotfish are an important part of the coral reef ecosystem and the ecological functions it provides," said Joshua Manning, the paper's first author and a postdoctoral researcher in the Department of Ecology and Evolutionary Biology. "Understanding their behavior will help us evaluate whether and how they can buffer the effects of climate change on coral reefs."

Dear enemy

The spotlight parrotfish is one of the largest parrotfish species in the Caribbean reefs, measuring about 1.5 feet long. They have strong, beak-like teeth that allow them to spend up to 90% of the day munching on microscopic organisms that grow on and within the calcium carbonate structures created by corals. As the fish remove coral skeletons, they create space for new corals to grow and produce white sand as their digestive waste.

As highly territorial animals, male spotlight parrotfish defend territories as big as two tennis courts, where they forage and mate with a small group of female followers. But not every parrotfish has a territory. Some "floaters," as Manning calls them, constantly scout the reefs, ready to claim space that becomes available.

As a seasoned diver, Manning spent more than 400 hours underwater during his doctoral studies trying to understand how the spotlight parrotfish behave and interact with each other. He noticed the fish might be smarter than what many people thought.

He followed 10 spotlight parrotfish off the coast of Bonaire, a Caribbean island. He noticed that every time a floater swam by an occupied territory, the territory holders would puff up, display their fins and aggressively chase the floater away.

But when parrotfish from neighboring territories swam close to the boundary lines, territory holders were much less aggressive. When parrotfish did behave aggressively toward their neighbors, it was most often because they had strayed too far into another parrotfish's territory while chasing another parrotfish, resulting in retaliation.

Scientists have observed this "dear enemy" effect—when territory holders exhibit less aggression toward neighbors than strangers—in squirrels, sparrows, frogs and other animals. Manning and his collaborator, Sophie McCoy, a marine biologist at the University of North Carolina, Chapel Hill, described the phenomenon for the first time in parrotfish.

Manning said that parrotfish might be more aggressive toward floaters because they are more likely to try to oust territory holders and take over their territories. While territory-holding males have better mating opportunities, their constant patrolling and defense efforts take a toll on their body condition. As a result, they must focus their energy on fighting off the most significant threats.

A male parrotfish chases another parrotfish. Credit: Joshua Manning/CU Boulder

To the team's surprise, floaters seemed to recognize territorial boundaries. Manning noticed that floaters often swam across the reefs using the buffer zones between established territories to avoid aggression.

"These fish may be smarter than what we give them credit for. They seem to recognize neighbors, find the boundaries of territories, and have the capacity to learn and use information," Manning said.

Coral heath

Due to climate change, coral reefs are declining rapidly. Between 2023 and mid-May 2024, scientists have confirmed mass coral bleaching in at least 62 countries and territories worldwide. Coral bleaching happens when corals expel the algae living in their tissues under stressful conditions, such as high ocean temperatures, causing them to turn completely white.

Parrotfish depend on coral reefs for food and shelter. Losses in corals—due to ocean acidification and warming—can have significant impacts on their habitat and populations. At the same time, parrotfish can accelerate reef recovery from bleaching events by creating bare space for new coral larvae to settle and grow.

"Reefs are a vital source of food for us and support immense biodiversity, including species with significant medical potential. By studying how parrotfishes use space and how their grazing influences coral recruitment patterns, we can better understand how reefs can recover from disturbances and adapt to climate change," Manning said.

More information: Joshua C. Manning et al, Dear enemy effects in the stoplight parrotfish, Sparisoma viride, *Ecology* (2024). DOI: 10.1002/ecy.4407

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