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Oil Impairs Ability of Coral Reef Fish to Find Homes and Evade Predators

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Damselfish, Chromis species Jacob Johansen

AUSTIN, Texas — Just as one too many cocktails can lead a person to make bad choices, a few drops of oil can cause coral reef fish to make poor decisions, according to a paper published today in Nature Ecology & Evolution. A team of fisheries biologists led by Jacob Johansen and Andrew Esbaugh of The University of Texas Marine Science Institute have discovered that oil impacts the higher-order thinking of coral reef fish in a way that could prove dangerous for them—and for the coral reefs where they make their home.

Examining six different species of coral reef fish, Johansen and the team found that exposure to oil consistently affected behavior in ways that put the fish at risk.

During several weeks when coral reef fish go through their juvenile stages of development, they are especially vulnerable. Even in healthy populations of reef fish, typically less than 10 percent of embryos and larvae reach adulthood. Those who survive must learn to identify friend from foe and adopt protective behaviors, such as traveling in groups, minimizing movement in open waters and swimming away quickly from danger.

In experiments, the scientists found that juvenile fish exposed to oil struggled on all these counts.

“In several different experiments, the fish exposed to oil exhibited very risky behavior, even in the presence of a predator,” said Esbaugh, an assistant professor of marine science.

The scientists also found that oil exposure negatively affected the fishes’ growth, survival and settlement behaviors (their ability to find a suitable habitat).

Oil concentrations are found in oceans worldwide, but until now little has been known about the impact of oil exposure on coral reef fish. Earlier research that explored how oil affects the physiology of fishes has demonstrated developmental heart deformities and associated cardiac functions, but this is the first study to demonstrate that oil exposure affects behavior in a way that increases predation and reduces settlement success.

The finding could be bad news for reefs, as well, since many coral reefs depend on fish to remove algae that can restrict their growth and development. Coral reef ecosystems are the oceans’ most diverse ecosystems—and the most threatened. Hundreds of millions of people depend on coral reefs and their fish for income or food, but widespread coral bleaching and overfishing threaten this way of life. The new study indicates that limiting oil-based industrial activities near reefs may be critical for reef preservation.

“Over the past 35 years, almost one-fifth of the world’s coral reefs have been lost and half of what’s remaining is either expected to disappear or be under severe threat in the next few decades,” Johansen, the lead researcher, reflected. “Still, many governments continue to allow industrial activities, including oil drilling and exploration, in sensitive reef habitats. If a spill were to occur, this study suggests there could be major consequences for the fish, for coral reefs and for people working in fisheries and tourism.”

“We used oil concentrations that are already present in many industrialized regions worldwide — concentrations that ranged from two to five parts per billion, the equivalent of a couple of drops in a swimming pool,” Johansen said.

Exposure to these oil concentrations caused higher rates both of immediate death and more latent death, in addition to the behavioral shifts and cognitive changes in coral reef fish. These results suggest that future studies of oil in sensitive environments, such as coral reefs, should account for behavior in addition to the toxic effects when trying to capture the overall ecological health of the system or make predictions about fish populations.

Along with Johansen and Esbaugh, researchers Bridie Allan from The Institute of Marine Research in Bergen, Norway and Jodie Rummer of the Australian Research Council Centre of Excellence for Coral Reef Studies in James Cook, Australia assisted with the findings.

This research was supported by the Gulf of Mexico Research Initiative, Australian Research Council and Lizard Island Reef Research Foundation.

Read the paper “Oil exposure disrupts early life-history stages of coral reef fishes via behavioural impairments”, after the embargo lifts: http://dx.doi.org/10.1038/s41559-017-0232-5

For more information, contact: Marc Airhart, College of Natural Sciences, 512-232-1066.

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