Study sheds new light on dolphin coordination during predation

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Spinner dolphins have long been known for their teamwork in capturing prey but a new study using high-tech acoustics has found that their synchronization is even more complex than scientists realized and likely evolved as a strategy to maximize their energy intake.

The study, by scientists at Oregon State University and the University of Hawaii, found that dolphins engage in a highly choreographed night-time "dance" to enclose their prey, and then dart into the circle of confused fish in organized pairs to feed for about 15 seconds, before backing out and letting the next pairs in line take their turn.

Results of the study were published this week in the journal, *Acoustical Society of America*.

"Synchronized swimmers have nothing on spinner dolphins," said Kelly Benoit-Bird, a marine ecologist at Oregon State University and lead author on the study. "The degree of synchrony they display when feeding is incredible – especially considering that they're doing it at night, several meters below the surface where they can't see their prey or each other."

The study is important, scientists say, because it greatly expands knowledge of spinner dolphin behavior and it opens up new fields of scientific inquiry into underwater ecosystems made possible by technological advancements in acoustical monitoring. It was funded by the National Science Foundation and the Office of Naval Research.

Much of the knowledge about spinner dolphin feeding has been anecdotal because they are primarily nocturnal in their feeding, Benoit-Bird pointed out. However, acoustical eavesdropping allowed the scientists to "view" the dolphins' behavior without interrupting their routine with lights and underwater cameras. In their study off the coast of Oahu, Hawaii, the scientists used sonar readings from a "multi-beam echo-sounder" to monitor groups of spinner dolphins. The animals' systematic approach to feeding was eye-opening.

Initially a small group of about 20 dolphins would swim side-by-side in a straight line until finding concentrations of prey – in this case, lanternfish. When they got to within five meters of their prey, they would pull into a tight circular formation and sequentially swim up and down vertically, in essence, doing "the wave" like fans at a sporting event, Benoit-Bird said.

"They were using their bodies like a plow," she said. "We're not sure if they were creating a pressure barrier or trying to confuse the prey. But the result among the lanternfish was chaos."

As the lanternfish became concentrated, the dolphins tightened their circle and formed 10 pairs. The pairs at one o'clock and seven o'clock would move in, feed for 15 seconds, and retreat back to the circle. Then the pairs at two o'clock and eight o'clock would do likewise.

The feeding would last for about five minutes, during which time each dolphin got two opportunities to feed, and then the group rose as one to the surface to breathe, maintaining their circle. The dolphins would take one breath, Benoit-Bird said, and then dive down and begin the process anew.

"If one or two individual dolphins would break the circle or head to the surface to breathe, it breaks their whole system up," Benoit-Bird said.

"They never did. So then you have to ask: How do they communicate with each other, and how do they pass on that knowledge to their young?"

The researchers are still working on the latter puzzle, but their acoustical monitoring study found that much of what scientists had assumed about dolphin communication may, in fact, be wrong in this species. In a companion article also published in Acoustical Society of America, the researchers describe how they used underwater hydrophones to listen to the dolphins during their feeding forays.

Dolphins are often vocal and their use of frequency-modulated whistles was thought by many to cue their coordinated behavior. But the researchers found they didn't use those whistles at all while hunting prey – just during non-foraging times or when they were surfacing. Instead, they used a series of "clicks," with the highest click rates taking place just prior to foraging.

"Whistles are omni-directional, like turning on a light bulb in a room," Benoit-Bird said. "Clicks, on the other hand, are directional like a laser. We think it may be a strategy to communicate only within the group and not to other potential lanternfish predators. Tuna and billfish are looking for the same prey and they can hear the whistles but not the clicks because the frequencies are too high and so focused.

"If you're lined up to eat this great smorgasbord, would you want to tell the tuna next door about it?"

Benoit-Bird's co-principal investigator on both papers was Whitlow W.L. Au, from the University of Hawaii.

Spinner dolphins are found primarily in tropical and subtropical waters, offshore and near island chains. They grow to a length of about six to

seven feet, and feed on small, deep-ocean prey including lanternfish, shrimp and juvenile squid.

During their hunting forays, these athletic, acrobatic dolphins catch and consume a single fish at a time and each lanternfish may only be 3-5 inches long. To match their 3,200-calorie-per-day diet, they need to eat at least 650 fish each night – plus enough extra to fuel the energy they burn during the hunt, perhaps another 200 to 300 fish.

"To make that work, they need to eat about a fish a minute," Benoit-Bird said, "and we think that's why they've developed this elaborately complex system of group predation. Dolphins can't open their mouths like baleen whales and swallow large amounts of food at once. They have to target individual fish and it's too difficult and energy-consuming to hunt solo."

"It's tough to make a living in the subtropical ocean, which is something of a biological desert," she added. "They've had to adapt these unique behavioral methods to maximize their ability to capture prey."

Source: Oregon State University