

Researchers observe unexpected flipper flapping in humpback whales

July 10 2017



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When Jeremy Goldbogen, an assistant professor of biology at Stanford University, affixed recording devices to humpback whales, it was with the hope of learning more about how the animals move in their natural

environment - deep underwater and far from human's ability to observe.

However, in the process of reviewing footage of the [whales](#) feeding in groups, he and his team noticed something unexpected. In rare instances, the cameras caught whales flapping their foreflippers like penguins or sea lions, but completely unlike anything seen before in whales.

"Whales power their swimming by using their muscular tails," said Paolo Segre, a postdoctoral researcher. "However, in this case we have documented the first example of a whale flapping its flippers to move forward, using a motion similar to a bird flapping its wings."

This novel movement, detailed July 10 in *Current Biology*, helps the researchers understand more about the abilities and anatomy of these mysterious animals and could also inform bio-inspired design.

Unique flippers

The foreflippers of humpbacks are bumpy and slender compared to the much shorter, smoother front flippers of other whales. They are so distinctive, in fact, that the scientific name for humpback whales, *Megaptera novaeangliae*, means "big-winged New Englander."

Because scientists have thought foreflippers were mainly involved in steering, it makes sense that the unusual flipper shape could explain the humpback's famously skillful maneuvering. Video tagging technology, like that developed by the Goldbogen Lab, is relatively new, so scientists have only recently had the opportunity to test and expand on this hypothesis.

"In the past, researchers have looked at the structure of the whale flipper from dead animals," said Goldbogen, who carries out his research at Hopkins Marine Station and is senior author of the paper. "But for the

first time we can see how this structure actually is used in a living whale - in its natural environment."

From their footage, the group estimated the hydrodynamic forces produced by the flapping and found the whales were generating a significant amount of thrust. They also found this behavior was extremely rare. In hundreds of hours of video, some of which included groups of about 200 whales, they only saw the foreflipper flapping twice, which may be why they're the first to report it.

"It is likely very energetically expensive and only used for short bursts of acceleration," said Segre, who is lead author of the paper. "It is probable that humpback whales are the only species that can do this because of the length and extensive range of motion of their flippers."

The [humpback whale](#) is the most studied of all the whales, said Goldbogen, but, by revealing a new purpose for its namesake appendage, this work demonstrates we have much more to learn about this species.

Bio-inspiration

In addition to telling us more about these mysterious giants of the sea, research on whale biomechanics could be used by scientists in other fields. Even our best aquatic technology has yet to catch up to whales' ability to move their enormous bodies quickly and precisely or their extremely efficient long-distance migrations.

"By understanding how the body flexes, and how the flippers and flukes are used to maneuver, we will have a better understanding of the mechanisms used by the largest animals to attain high-performance locomotion," Goldbogen said. "Therefore, our research has implications for the biomimetic design applications from enhanced performance of animals to mechanized submersibles."

The group's next step is to create a 3-D movement and 360-degree panoramic video version of their tag that would capture a whale's entire body along with the environment around it.

Provided by Stanford University

Citation: Researchers observe unexpected flipper flapping in humpback whales (2017, July 10) retrieved 26 April 2024 from <https://phys.org/news/2017-07-unexpected-flipper-humpback-whales.html>

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