Harbor porpoises can thank their worst enemy, the killer whale for their success

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Harbor porpoises manage very well in coastal and busy -- and potential dangerous -- waters. This photograph is from Denmark. Credit: Rune Dietz

The harbor porpoise (*Phocoena phocoena*) is a whale species that is doing quite well in coastal and busy waters. They are found in large numbers throughout the Northern Hemisphere from Mauritania to Alaska, and now researchers from the University of Southern Denmark explain why these small toothed whales are doing so well: The harbor porpoise can thank their worst enemy, the killer whale, for their success.

Coastal areas are more challenging and potentially dangerous for a small whale. There is a risk of beaching and being caught in a fisherman's net, but there are also benefits. Fish are plentiful and easier to find in coastal waters than in the open sea.

Therefore, coastal waters are attractive for porpoises, and they are extremely skilled at navigating, locating prey and avoiding hazards near the coast. Like other toothed whales porpoises use echolocation for orientation and to detect prey. They emit a constant stream of sonar clicks, which, when these hit a rock, a fish or a ship nearby an echo is sent back to the porpoise. From the echo, the porpoise can distinguish the location of the object and often also can identify the object.

Porpoises can locate even small fish and small objects such as net floats and fine fishing nets. This ability sets them apart from many other toothed whales, which do not have such sophisticated echolocation abilities. The secret of this ability is that the porpoise uses very short clicks and these are higher in frequency than those of many other toothed whales, explains Lee Miller from the Institute of Biology, University of Southern Denmark (SDU).

Porpoise clicks last just a hundred-millionth of a second, and are about 130 kHz. For comparison, a human can hear up to 20 kHz and a dog up to about 60 kHz.

Lee Miller and his colleague Magnus Wahlberg, also from the Institute of Biology, SDU, now believe that they have found an explanation why porpoise clicks are so high in frequency. They point at the porpoise's greatest enemy: the killer whale. This is one of their conclusions in a research article in the journal Frontiers in Physiology.

"Over millions of years the porpoise has evolved its ability to emit very high frequency click sounds that killer whales have difficulty hearing

since they cannot hear sounds that are much higher than about 100 kHz. Killer whale hearing is best at around 20 kHz, so it is hard for them to detect a porpoise", explains Lee Miller.

The ancestor of whales emerged about 50 million years ago, and the first toothed whales began to use echolocation about 30 million years ago.

"5-10 million years ago the killer whale emerged and then evolution began to favor the toothed whales that could avoid being captured by killer whales. One way to avoid being eaten was to emit echolocation sounds that were difficult for killer whales to detect – thus an ability favored by evolution, "concludes Lee Miller and Magnus Wahlberg in their research article.

Strange as it may sound, porpoises can thank their worst enemy, the killer whale, that they are doing so well in coastal and busy waters.

But why do many species of porpoises and other small toothed whales emit echolocation sounds at about 130 kHz? Why not click at even higher frequencies?

"These frequencies are the most effective for porpoises. Besides avoiding killer whales, there is another advantage: It is also at these frequencies that natural noise in the ocean is the lowest. Thus porpoises can better hear the echoes from objects and prey when using these clicking sounds, "explains Lee Miller.

More information: Ref: Miller, L. A. and Wahlberg, M. (2013). Echolocation by the harbor porpoise: Life in coastal waters. In Frontiers in Integrative Physiology, vol 4 (ML Melcón ed.), pp. 1-6: Frontiers.

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