Blue whale foraging and reproduction are related to environmental conditions, study shows

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A New Zealand blue whale surfaces in the South Taranaki Bight. Credit: Dawn Barlow, Marine Mammal Institute, Oregon State University

A new study of New Zealand blue whales' vocalizations indicates the

whales are present year-round in the South Taranaki Bight and their behavior is influenced by environmental conditions in the region.

The findings are a significant advancement in researchers' understanding of the habitat use and behavior of this population of blue whales, which Oregon State University researchers first identified as genetically distinct from other blue whale populations less than a decade ago.

"We went from not knowing 10 years ago whether this was a distinct population to now understanding these whales' ecology and their response to changing environmental conditions," said the study's lead author, Dawn Barlow, a postdoctoral scholar in OSU's Marine Mammal Institute. "These findings can inform conservation management of this blue whale population and their habitat."

The patterns and intensity of the whales' calls and songs over two years showed strong seasonality in their foraging and breeding behavior, and the vocalizations changed based on environmental conditions such as a documented marine heatwave, Barlow said.

"During the marine heatwave, feeding-related calls were reduced, reflecting poor foraging conditions during that period," Barlow said. "But we also saw changes in vocalizations in the next breeding period, an indication that they put less effort into reproduction following a period of poor feeding conditions."

The study was published in the journal *Ecology and Evolution*. Barlow conducted the research as a doctoral student in the Geospatial Ecology of Marine Megafauna Laboratory at Hatfield Marine Science Center in Newport, led by associate professor Leigh Torres, a co-author of the new paper.

Blue whales are the largest of all whales and are found in all oceans

except the Arctic. Their populations were depleted due to commercial whaling in the early 1900s, and today they are listed as endangered under the International Union for Conservation of Nature's Red List of Threatened Species.

The New Zealand whales' habitat overlaps with a wide range of commercial activities, including oil and gas exploration and extraction, vessel traffic, fisheries, wind energy development and possible seabed mining.

Torres first hypothesized in 2013 that the South Taranaki Bight, between New Zealand's North and South Islands, was an undocumented blue whale feeding ground. Following comprehensive data collection efforts, and using multiple lines of evidence, Torres, Barlow and colleagues were able to document in 2018 that the population in this region was genetically distinct from other blue whale populations.

Previous research was primarily based on observations researchers made during visits to the region in the summer months. But the researchers wanted to know more about the whales' behavior during other parts of the year. They placed five hydrophones—a type of underwater microphone—that recorded continuously between January 2016 and February 2018, with only brief gaps to retrieve data every six months.

New Zealand blue whale. Credit: Leigh Torres, Marine Mammal Institute, Oregon State University

"Unlike many other baleen whales, this population stays in this region year-round," Barlow said. "That means we can monitor what they are doing from one location. Listening is an effective way to do that."

The hydrophone recordings showed that the whales' "D" calls were strongly correlated with oceanographic conditions related to upwelling in the spring and summer. Upwelling is a process where deeper, cooler water is pushed toward the surface; the nutrient-rich water supports aggregations of krill that the blue whales feed on. The whales' D calls were more intense during periods of strong upwelling.

The recordings also showed that the whales' song vocalizations, which are produced by males and associated with breeding behavior, followed a highly seasonal pattern, with peak intensity in the fall. That timing aligns with past whaling records' estimates of conception, Barlow said.

The hydrophone evidence of the breeding behavior and the whales' presence in the region year-round can influence the animals' national threat classification status, which impacts management practices, the researchers said.

Blue whales in New Zealand had been classified as migrant, but as a result of the research by Torres, Barlow and colleagues, the classification of has changed from migrant to data deficient. If the whales are reclassified as a resident population, that could impact management practices, but evidence of breeding in New Zealand is needed for that change to occur, the researchers said.

"Although no one has actually documented blue whales mating—it is hard to observe that directly—the increase in song during the expected time of mating is a strong indication of breeding in New Zealand waters," Torres said. "Our study adds more evidence that these are resident New Zealand blue whales."

Once the researchers were able to make the link between the whales' behavior and their calls, they could then look at the calls and behavior relative to environmental patterns. Specifically, they noted how the whales' foraging and breeding behavior changed during and after a 2016 marine heatwave.

During the marine heatwave, there were fewer aggregations of krill for the whales to feed on, which the researchers documented in a previous study. The reduction in foraging behavior correlated to less intense D calls during that period, and in the next breeding season, the breeding

songs were also less intense.

The findings raise additional questions about how changing ocean conditions and human activity in the region are impacting the New Zealand blue whale population and reinforce the need for continued monitoring, the researchers said.

"We have come so far in 10 years in our knowledge of these blue whales—from not knowing this population existed to now understanding their year-round use of this region for feeding, mating and nursing," Torres said. "New Zealanders should be excited and proud that their country is home to its own unique population of blue whales. We hope our work helps Kiwis manage and protect these whales."

Additional co-authors are Holger Klinck, director of the Cornell University K. Lisa Yang Center for Conservation Bioacoustics, who also is affiliated with OSU's Marine Mammal Institute; Dimitri Ponirakis of Cornell; and Trevor Branch of the University of Washington. The Marine Mammal Institute is part of Oregon State's College of Agricultural Sciences.

More information: Dawn R. Barlow et al, Environmental conditions and marine heatwaves influence blue whale foraging and reproductive effort, *Ecology and Evolution* (2023). DOI: 10.1002/ece3.9770

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