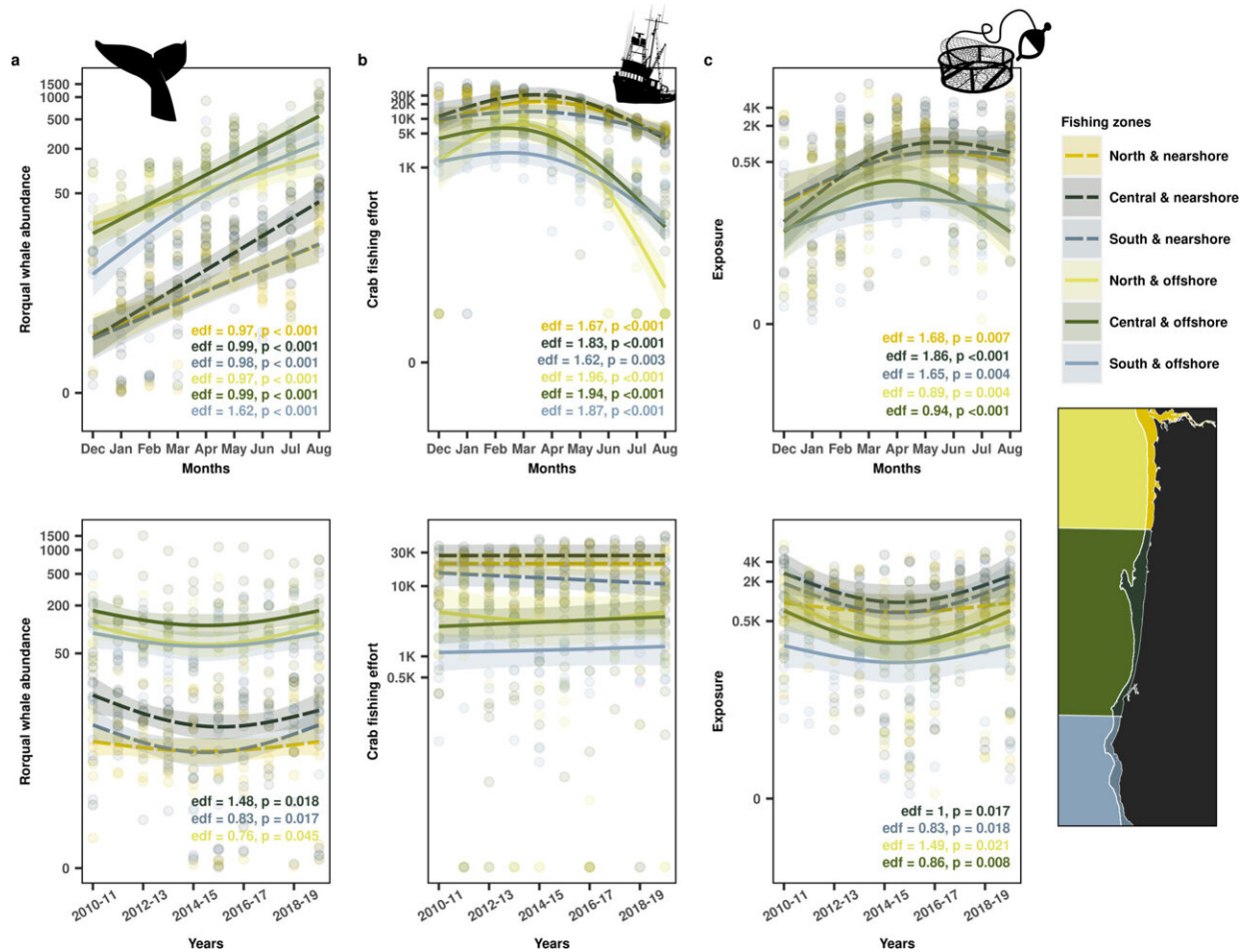


# Researchers begin to unravel whale entanglement risk factors off Oregon Coast

March 20 2023



Fitted relationships between predicted local rorqual whale abundance (a;  $M_{\text{whale}}$ ), crab fishing effort (b;  $M_{\text{crab}}$ ) and exposure to entanglement risk (c;  $M_{\text{exposure}}$ ) with month (top) and fishing year (bottom) predictors. GAMs were fitted to each response type in each of the six study zones represented on the map. Solid and dashed lines represent the marginal effect of month and fishing year by zone,

and shaded areas represent approximate 95 % confidence intervals. The estimated degrees of freedom (edf) and the approximate smooth significance of predictors is indicated in each panel when the p-values were below a 0.05 threshold. Data points are represented in light shades. Y-axes are presented on a log scale. Credit: *Biological Conservation* (2023). DOI: 10.1016/j.biocon.2023.109989

New research by an Oregon State University-led team is beginning to unravel the times of year and locations where whales are at greatest danger of entanglement in fishing gear on the Oregon Coast.

"We've been able to geographically locate some areas where the risk of [entanglement](#) for [whales](#) is higher," said Solene Derville, a postdoctoral fellow at Oregon State's Marine Mammal Institute. "We've also discovered that risk varies with time. It's a very dynamic thing. And it varies with responses to ocean conditions."

The research, outlined in a recently published paper in the journal *Biological Conservation* and conducted in collaboration with scientists at the Oregon Department of Fish and Wildlife, is important because it provides better tools to manage fisheries, the researchers said.

In this case, the research focused on the Dungeness crab fishery, the most economically important in Oregon. According to the National Oceanic and Atmospheric Administration, commercial Dungeness crab pot gear is one of the most frequently identified gear types involved in entanglements along the West Coast of the United States.

"The more knowledge we have about when and where whales are, and how that overlaps with the fishery distribution, the better," said Troy Buell, a state fishery management program leader for ODFW and co-

author of the paper. "It helps us design more targeted management measures that are most effective for the whales, while having the least amount of impact on the fishery."

In 2020, [ODFW adopted new regulations](#) for the commercial Dungeness crab fishery to address whale entanglement concerns. Several key provisions of those rules end after the current Dungeness crab season.

ODFW will take into account findings from this just-published paper to evaluate their effectiveness and by fall recommend to continue or adjust the regulations for future seasons, said Kelly Corbett, ODFW's commercial crab project leader and a co-author of the paper.

Entanglement in fishing gear presents a major threat to whales because it can drown individuals, cause long-term injuries that impact individual health by limiting their ability to eat, travel and reproduce, and potentially affect population abundance. Entanglement is a pressing concern for whales off the West Coast of the United States, where documented entanglements have risen sharply during the past decade.

During an eight-year period ending in 2021, an average of about 35 entanglements were reported annually in West Coast waters of the United States, according to [NOAA data](#). That is roughly three times more than the average from the previous eight years. Scientists agree that these counts likely represent only a small fraction of the actual number of entanglements since some may never be observed or reported.

For the new paper, the researchers focused on humpback whales, which include humpback, fin and blue whales, along the entire Oregon Coast. Humpback whales are most frequently reported as entangled with Dungeness crab gear on the West Coast. To a lesser extent, endangered blue and fin whales are also at risk of entanglement, although neither species have been confirmed entangled in any Oregon fishing gear, the

researchers note.

The researchers drew on [past work by the Oregon State team](#) that estimated orca whale density, including via monthly helicopter flights along the coastline. This work is conducted by 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.

The research team predicted monthly whale densities in Oregon based on variation in ocean and climate conditions for the period 2011-2020. The team then overlaid these maps with data on Dungeness crab fishing locations to determine where and when whales were most at risk of entanglement with crab gear.

Among their findings:

- Entanglement exposure was higher on average in nearshore waters (less than about 240 feet deep) off Astoria, off Garibaldi, north of Newport, north of Charleston, north of Port Orford and at the southern border of Oregon waters.
- Exposure peaked in April, when whales were predicted to occur in greater numbers and closer to shore due to the onset of the upwelling season. Upwelling is the process where deeper, cooler water is pushed toward the surface where it encounters light to support productivity and aggregations of krill that whales feed on.
- Exposure remained constant until the end of the crab season in nearshore waters and decreased past these depths.
- Exposure was lower during the marine heatwave event from 2014-2016 when fishing was more active nearshore and whales were predicted to be less abundant.
- Exposure was higher before (2011-2013) and after (2017-2020)

the heatwave, which corresponds with stronger upwelling periods.

Fluctuations in climate and ocean conditions, such as the upwelling events and marine heat waves, appear to be the main drivers of entanglement risk to whales in Dungeness crab [fishing gear](#), the researchers conclude. When this information is combined with time of year and location data, the researchers believe that their findings can support decision making by fishery managers.

"Although there can be inherent tension between commercial fishing and whale entanglements, no one wants to catch a whale and we all want a thriving, sustainable Dungeness crab fishery," Torres said. "We feel our findings are an important step toward simultaneously achieving both these goals and relieving any tension."

**More information:** S. Derville et al, Exposure of whales to entanglement risk in Dungeness crab fishing gear in Oregon, USA, reveals distinctive spatio-temporal and climatic patterns, *Biological Conservation* (2023). [DOI: 10.1016/j.biocon.2023.109989](https://doi.org/10.1016/j.biocon.2023.109989)

Provided by Oregon State University

Citation: Researchers begin to unravel whale entanglement risk factors off Oregon Coast (2023, March 20) retrieved 19 July 2024 from <https://phys.org/news/2023-03-unravel-whale-entanglement-factors-oregon.html>

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