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COASST

Science Update

Who's at Risk When Oil Spills?

Photo: Kevin Mack

Overview

Science Update is a special publication of the Coastal Observation and Seabird Survey Team (COASST) highlighting recent research and scientific publications.

In this issue, we look at how COASST data helped determine who's safe and who's sorry when oil spills in the marine environment.

Photo: Courtesy of Julia Parrish

Starting Points

In July 1991, COASST founder Julia Parrish was actively engaged in seabird colony work on Tatoosh Island, part of the Makah lands at the northwest tip of Washington State. Tatoosh, a summering grounds for Makah fishing and hunting expeditions since time immemorial, is also home to Washington's largest colony of Common Murres. These two-pound, penguin-esque birds nest cheek-to-jowl in crevices cut into the vertical cliff faces on the south and west sides of the island, as well as piling onto island-top nesting areas hosting hundreds to low thousands of birds. It's a noisy, smelly, active place. In July, the long-mated pairs were gathered in preparation for the chick-rearing season, as were the members of Julia's research team.

"I remember that the fog was dense on the island, the way it usually is in July; impossible to see more than 30–40 feet, but somehow still

bright with sun," remembers Julia. "The water was calm, there was no wind. We'd gotten a call from the Coast Guard that a Japanese fishing vessel, the *Tenyo Maru*, had gone down in a crash with a freighter and that oil was leaking from the sunken ship. Everyone was out in the intertidal looking for signs of the spill. That first morning, I'll never forget walking along the rocky shore peering out into the fog, watching the kelp stems slide across each other as the water lapped the island. None of the usual cacophony of bird calls, just silence. It was eerie."

"And then there was the sound of slapping. Like seals hitting the water with their flippers, only smaller and lighter, and more regular. Slap, slap, slap. I realized I was hearing the sound of bird wings on the water as a murre came into view swimming butterfly stroke, covered in oil, struggling to make it to shore."

Soon there were ten, then dozens of murres that had dragged themselves out of the cold coastal Pacific and onto shore. Many more would die at sea and wash up as carcasses. Over 3,000 murres were found moribund or dead during the spill, recovered from beaches from Washington to northern Oregon. At 73%, murres made up the vast majority of the marine birds oiled by the *Tenyo Maru* spill.

Oiled Common Murre.

The researchers at Tatoosh couldn't help but wonder: is that normal? Are murres more susceptible, or are they just more abundant in the area? What normally washes ashore? What carcasses might already be beached along the Washington coastline?

Those questions were one of the starting points of COASST, the monitoring program that now provides the definitive baseline against which a catastrophe, like an oil spill, can be measured in the Pacific Northwest. But COASST didn't get started in Washington until 1999, too late for the victims of the *Tenyo Maru* spill.

A Data-Driven Approach

Or was it? In 2020, COASST graduate student Jazzmine Waugh picked up on an analysis started by former COASST graduate student Kate Litle to explore whether the COASST baseline could not only be used to assess future spills, but also to explore the impacts of past spills. The reasoning is fairly simple—unless the spill was so cataclysmic as to permanently change the ecosystem, the baseline COASST recorded after the spill should be just as good at indicating what is "normal" relative to past spills as it would be against future ones.

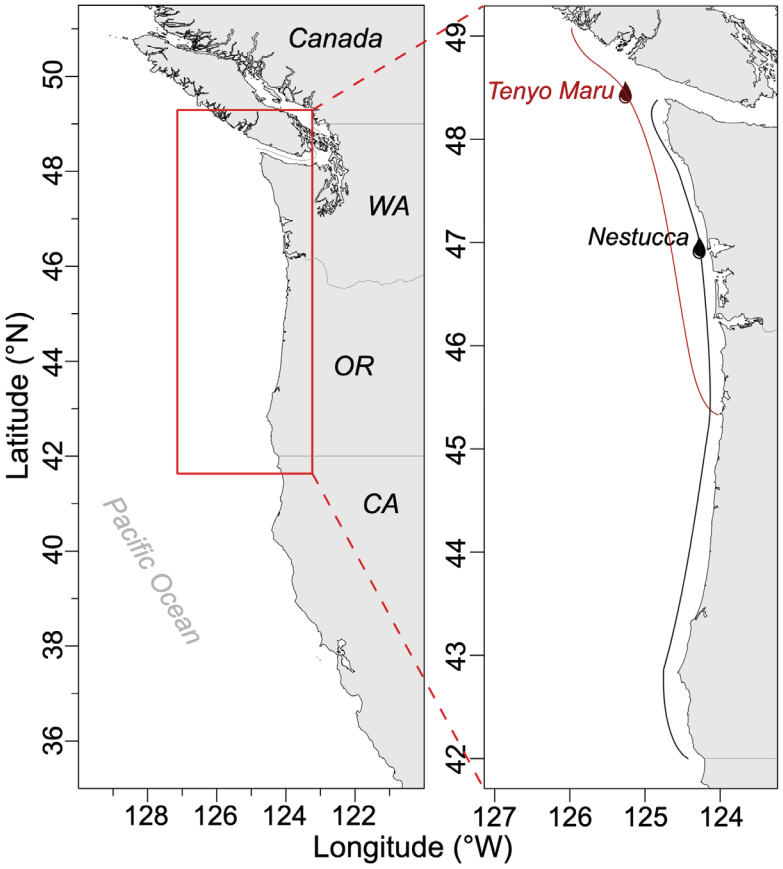
The problem was one of apples and oranges. To compare impacts, what's really needed is calculation of encounter rate, or a body count for the same swath of coastline searched by the same number of people in the same way. In COASST, we standardize encounter rate to a kilometer of beach, so we can compare different months, different beaches, or different regions directly.

Following an oil spill, we'd like to ask how the number of beached birds compares to a normal year in that location. It's a simple question that is impossible to answer. And that's because even though COASST data are collected in a standardized manner, where we know the number of people searching and the length of beach surveyed, that is not true during an oil spill. In those tense, fraught times, recording the number of searchers, or kilometers walked, is overlooked in the

rush to retrieve carcasses and rescue injured birds. In the end, what we're usually left with is a table of numbers—the final body count by species or higher taxa—making direct comparison of the rate at which carcasses wash ashore between oil spill counts and COASST survey data impossible.

What both Kate and Jazzmine realized is that it might be possible to look at the relative contribution of each species to the whole. That is, to ask whether the percent of the total body count made up of murres (or puffins, or whoever) in the spill dataset was similar (or not!) to the percent of murres in the baseline dataset. Apples to apples!

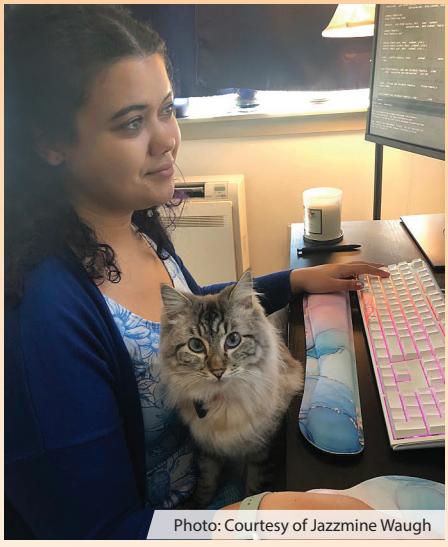
Armed with these insights, Jazzmine went to work examining two historical spills that had occurred in the COASST geography: the *Tenyo Maru*, which smeared oil along the entire coast of Washington down into northern Oregon, in July 1991; and the older *Nestucca* spill in December 1988, which reached from Washington to southern Oregon.



Map showing the source locations and spill extent for two historic oil spills, named for the damaged vessels that leaked oil: Tenyo Maru (1991) and Nestucca (1988).

Data Science for Good

While a PhD student, Jazzmine Kalila Waugh used quantitative approach to study the natural and human-caused forces impacting seabird populations. She's been bird-focused since her undergraduate days at Portland State University, where she looked at nesting behaviors of Spotted Towhees. Beyond her mathematical modeling, Jazzmine has centered her work in science equity. She contributed to the COASST Code of Conduct, mentored undergraduate students who haven't had the chance to "see" themselves as science-bound to become successful scientists, and authored a paper with some of them on patterns of demographic diversity in citizen and community science. Of course, she is aided in all her efforts by her furry research assistants!



Jazzmine with her pussycat, Riri.

Similarities and Differences

When she looked at the raw data, Jazzmine found that some of the most common birds in the COASST baseline dataset were also common in the oiled bird dataset. For instance, murres predominated in the *Tenyo Maru* spill, and were also abundant in the matching late summer COASST baseline.

On the other hand, there were also "opposites." Some species—like Sooty Shearwaters or Northern Fulmars—were fairly abundant in the baseline but virtually absent in the spill dataset. Others—like Tufted Puffins and Marbled Murrelets—were more common in the spill dataset than in the baseline. The same held true for the winter *Nestucca* spill: Northern Fulmars and gulls were relatively common in the baseline dataset, and all but absent in the spill dataset; whereas Common Murres and scoters were abundant in the spill dataset but relatively rare in the baseline.

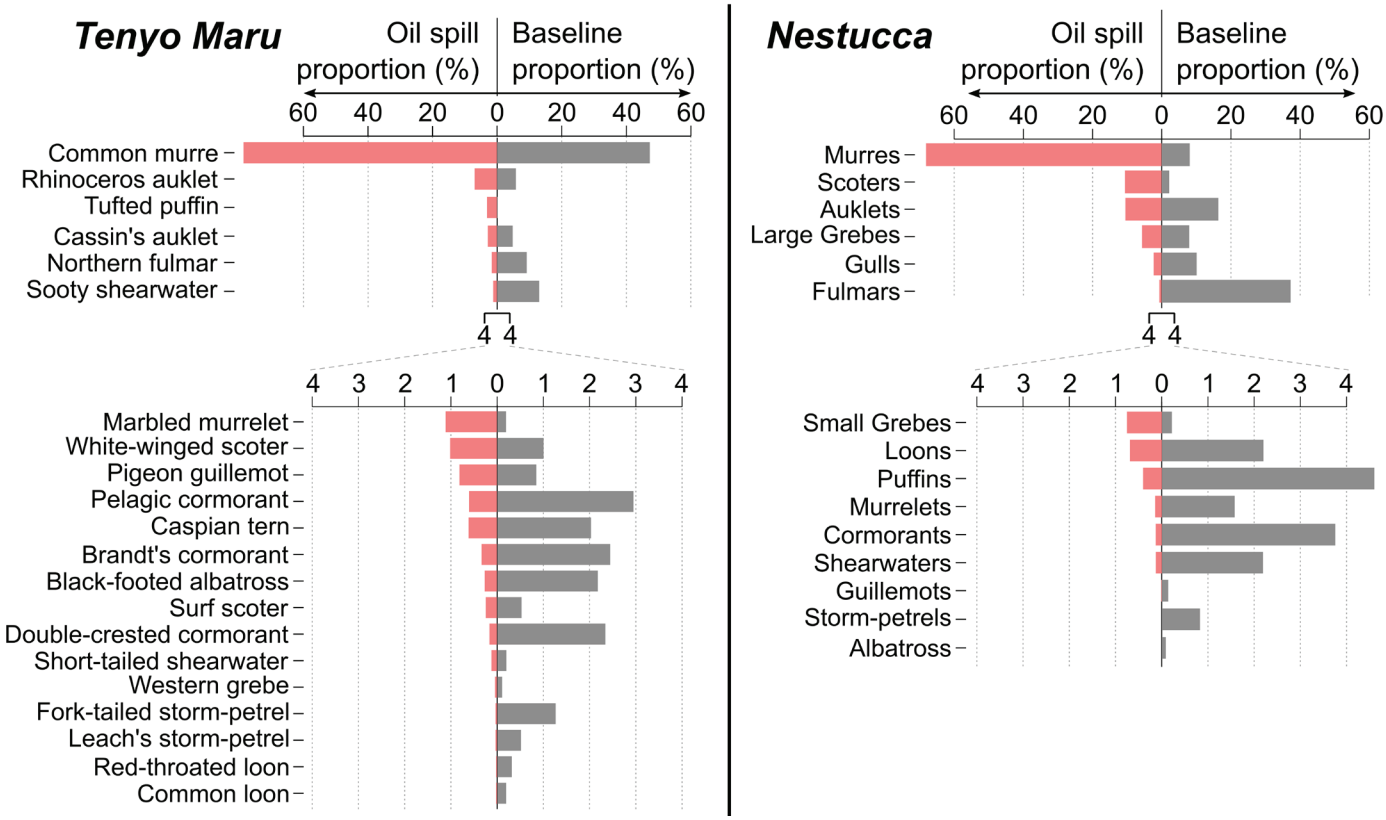
Jazzmine also discovered that not all baseline years were the same. In fact, there was quite a bit of variability from year to year. One way of saying this is that it takes quite a few years to fully encompass the baseline—to tell the whole story of what's normal. Good thing COASST has been building a baseline on Pacific Northwest shores for more than 20 years!

Calculating Reliable Susceptibility

Using some statistical techniques to corral the variability in the data, Jazzmine constructed two metrics for each of her focal taxa:

- *susceptibility*: how far above, or below, the baseline is the spill value?
- *reliability*: in how many baseline years did the spill value exceed the baseline?

These two concepts allowed Jazzmine to figure out which species were more commonly found during a



Proportions of the 'body count' for common species found in the oil spill reports (red) and COASST baseline data (gray) for both the Tenyo Maru and Nestucca spills. Less common species (making up less than 10% of the total body count) are detailed in the bottom of the figure.

spill than in any baseline year, which species were the opposite—more common across the baseline years than in the spill dataset, and which species fell in the "unreliable middle," with highs and low in the baseline years straddling the oil spill percentage.

Murres and scoters are "reliably susceptible." After an oil spill, these species are likely to make up a higher proportion of the body count than they do in the comparison baseline in most-to-all years.

Tubenoses (Northern Fulmars, shearwaters, albatrosses and storm-petrels) and cormorants represent taxa that are "reliably safe" from oil spill impacts because their proportion of the baseline dataset is almost always higher than their relative occurrence in the oil spill body count.

Why this happens isn't totally understood, but many seabird experts think it has something to do with natural history and behavior. Nearshore diving birds—like murres, scoters, or grebes—that sit on the water often in rafts of hundreds to thousands, might be more susceptible to coastal oil spills than marine birds that avoid the coastline, don't dive for their food, and tend to stay on the wing, like fulmars and shearwaters. But this pattern isn't 100%. For instance, Jazzmine found that the coastal cormorants were as "safe" as the offshore tubenoses.

Jazzmine's analysis is one of the first to use an independent dataset—data that are totally unconnected to the spill dataset—to assess oil vulnerability in marine birds. One value of that is the ability to authenticate the "natural history approach" described above, where traits or characteristics of a species are used to explain why it does/doesn't make up a high percentage of a post-spill body count. Now, using citizen science data, seabird science has a method to support some of these claims.

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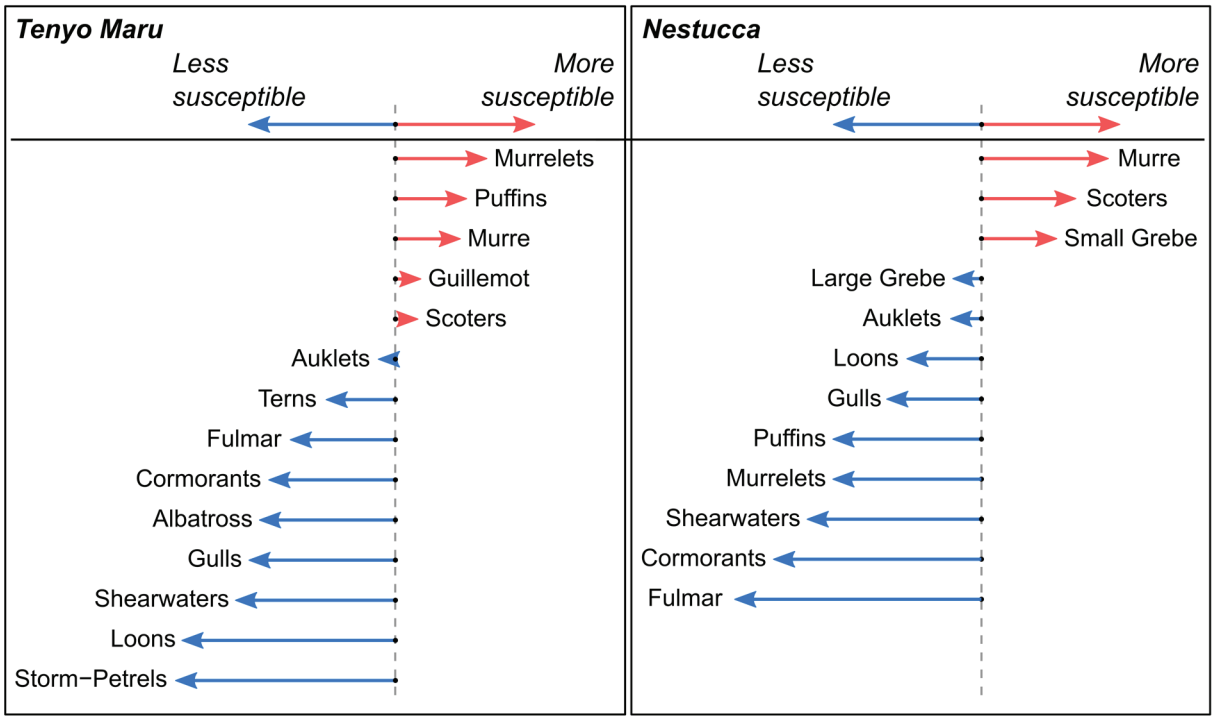

Jazzmine's analysis demonstrates which species were "reliably safe" (blue) and "reliably susceptible" (red) to the Tenyo Maru and Nestucca oil spills. Those in the "unreliable middle" have the shortest arrows of both colors.

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Written and edited by
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Here's what's cool about this approach:

- It doesn't just point the finger at the abundant birds likely to be harmed. For instance, even though Tufted Puffins are pretty rare—especially relative to Common Murres—Jazzmine's analysis shows that true puffins (Tufted, Horned, and Rhinoceros Auklets) are highly susceptible. This finding could direct restoration funds towards these rarer, and oil impacted, birds.
- It also allows a focus on the species that are doing something that appears to take them out of harm's way, like the tubenoses or the cormorants.

Photo: J. Parrish

View of Tatoosh Island from mainland.

Mission

The Coastal Observation and Seabird Survey Team (COASST) is a citizen science project of the University of Washington in partnership with state, tribal and federal agencies, environmental organizations, and community groups. COASST believes citizens of coastal communities are essential scientific partners in monitoring marine ecosystem health. By collaborating with citizens, natural resource management agencies and environmental organizations, COASST works to translate long-term monitoring into effective marine conservation solutions.

Vision

Realizing the pressing needs of marine natural resource management and coastal conservation, and the twin benefits of increasing science literacy and an environmental stewardship ethic among citizens, COASST sees a future in which all coastal communities contribute directly to monitoring their local marine resources and ecosystem health through the establishment of a network of citizens engaging in science, where all collect rigorous and vital data. Through their collective efforts and the translation of their individual data into baselines against which any impact—from human or natural origins—can be assessed, nearshore ecosystems worldwide will be actively known, managed and protected.

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