

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 a mass mortality event of Tufted Puffins in Alaska, in 2016–2017.



Photo: Hillary Burgess



Photo: iStock.com/pilipenkoD

Trouble in Paradise

Aaron Lestenkof was born on St. Paul, and has spent his life on this small, beautiful, windswept island perched on the edge of the coastal shelf, in the middle of the Bering Sea. He likes the remoteness—no long commutes or traffic—and the abundance of wildlife that living by the sea provides. An Island Sentinel within the Ecosystem Conservation Office of the Aleut Community of St. Paul Island (ECO), Aaron's job is to keep his finger on the pulse of the island ecosystem.

From reindeer management to rat prevention, responding to a marine mammal stranding or gathering samples during the annual sea lion and fur seal harvests, Aaron is out and about monitoring, counting and collecting.

And so it's no surprise that community members walking the

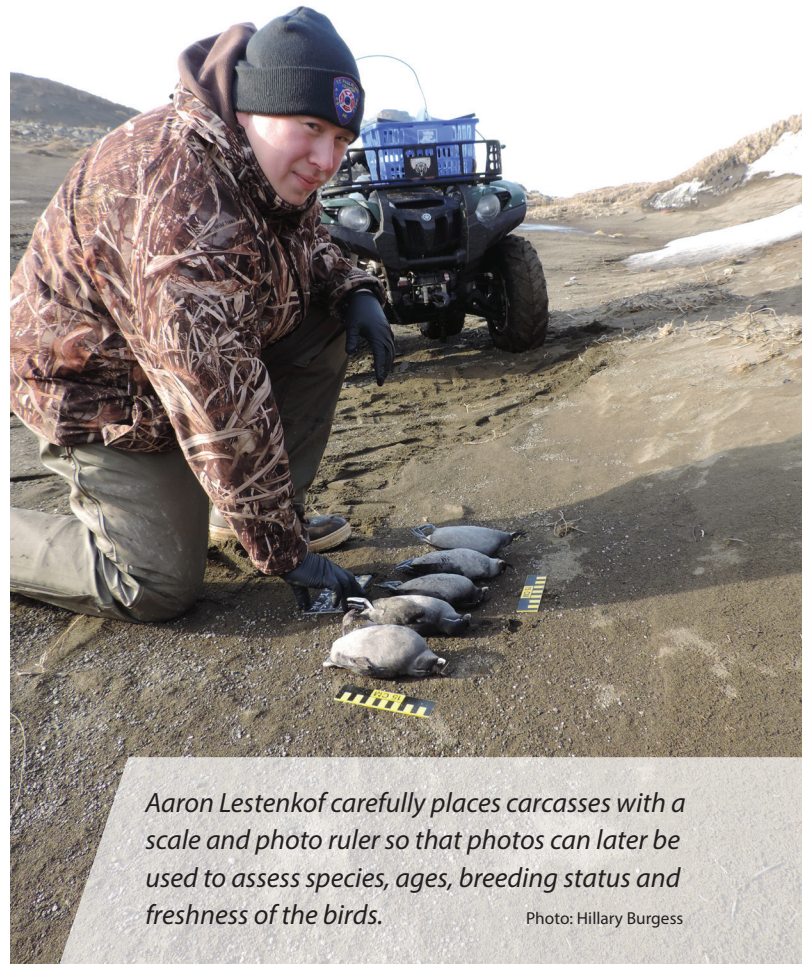
beach called Aaron. After all, he had done beached bird surveys for years. But October 2016 was different.

"We were alerted to the die-off by a local who reported many puffins on the beach. Instead of doing a regular COASST 1 km survey, I used an ATV to survey the entire beach. In fact, all four beaches. That was when we realized that this was a major die-off by the number of puffins we pulled from the beaches."

As Aaron's first photograph came into the COASST office, we knew he was right.

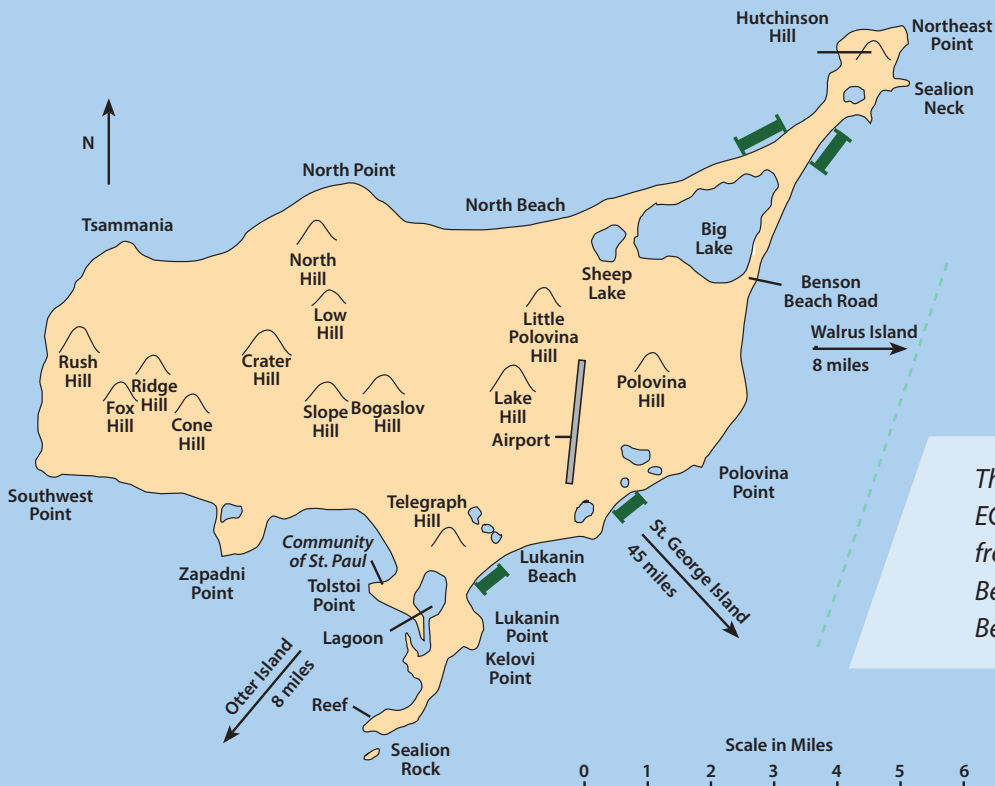
Over the next three months, Aaron and Island Sentinel partner Paul Melovidov would scour the beaches when breaks in storms would let them safely survey. In 25 surveys Paul and Aaron discovered 359 carcasses, 79% of which were Tufted Puffins; and 92% of those were adults. Crested Auklets, Horned Puffins and Murres made up the remainder. To put these numbers in perspective, in the 10 years Island

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Aaron Lestenkof carefully places carcasses with a scale and photo ruler so that photos can later be used to assess species, ages, breeding status and freshness of the birds.

Photo: Hillary Burgess



The four beaches monitored by ACSPI-ECO are marked in green, clockwise from upper-left: North Beach, Benson Beach, Polovina Beach, and Lukanin Beach.

Monitoring the Ocean—BeringWatch

<https://www.beringwatch.net>

In the Aleut Community of St. Paul Island, the Ecosystem Conservation Office conducts a vast array of monitoring protocols, all housed within an even larger effort they spearhead—BeringWatch. Aleut Community of St. Paul Island Ecosystem Conservation Office Director Lauren Divine explains: “BeringWatch is an online database and linked tools (mobile apps, protocols, training, technical assistance, quality control) to facilitate monitoring efforts in native villages in our region. We seek to enable non-scientists in remote locations to record

and communicate environmental and ecological events.” And COASST is one of the BeringWatch protocols.”

We partner with other Alaska Native Tribes to implement BeringWatch in their communities, and we always take COASST with us to trainings to offer for other communities to participate in. After the Tufted Puffin die-off, we helped COASST rework their monthly protocol into a fast, easy and highly efficient protocol anyone can do during a mass mortality event—Die-off Alert.”



DIE-OFF ALERT

Include this 15 centimeter ruler and information in the photo frame.

Beach _____

Location (city, coordinates of start and endpoints) _____

Date _____



Die-Off Alert is a partnership between COASST, BeringWatch, USFWS & AMBCC

► BRING

- Camera or smartphone
- This sheet
- Grease pencil

► STEPS

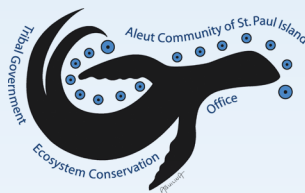
1. **Record** date and location information; start and stop points
2. **Gather** all carcasses
3. **Sort** by look-alikes; fresh/whole from wounded/decayed
4. **Arrange** up to 16 look-alikes belly side up neatly
5. **Photograph** with ruler page showing, then flip to back side up, photograph again—repeat as necessary
6. **Remove** carcasses from beach
7. **Send** photos, counts and other info to: Email: coasst@uw.edu Text: 424-262-7781

► SAFETY

- Only touch carcasses with gloves. Exercise caution.



A great photo: ruler and info card are visible, birds are arranged in rows and positioned so they can be identified.





Paul Melovidov and Aaron Lestenkof enter North Beach, one of four beaches that they survey for beached birds twice a month.

Photo: Hillary Burgess

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Sentinels have conducted COAST surveys on St. Paul, only 6 puffins had ever been found.

The puffins' plight was also reflected in a dramatic increase in the proportion of wholly intact carcasses—from 17% normally to 75% during the die-off. Daily arrival of so many birds quickly satiated the island's population of Arctic foxes who can often be seen patrolling the beaches in search of food. All indicators pointed to a mass mortality event, with encounter rates (carcasses per kilometer) 65–75x higher than normal!

Putting together the puzzle

When a mass mortality event of marine birds or marine mammals occurs, there are important immediate questions—is there a health risk? Can

handling these animals be unsafe? Could this spread to hunted species? Answering these questions quickly is especially important in places where animals affected animals are harvested for food.

Within days, Aleut Community of St. Paul Island Ecosystem Conservation Office Director Lauren Divine had fresh, intact carcasses collected, bagged, tagged and shipped out to the National Wildlife Health Center in Madison, Wisconsin who evaluated the birds for cause of death. The necropsies revealed no disease, and no toxins from harmful algae or other sources. Instead, the smoking gun appeared to be starvation. Examined carcasses were gravely underweight, with empty stomachs, no body fat and shrunken flight musculature. Clearly, they had starved.

Adding insult to injury, COASST verification expert Charlie Wright noted that 95% of the adult Tufted Puffins died in flight-feather molt. A “catastrophic molter,” puffins lose all of their flight feathers simultaneously, rendering them flightless and making their usually agile foraging dives that much more difficult. So these birds, already weak, must have been pushed over the edge by this added stress.

non-breeding season will waterlog and sink because they are simply too far from land to float to shore. As a result, total mortality is higher, often orders of magnitude (10x, 100x) higher than the final body count.

Sometimes, as in the Cassin’s Auklet die-off of 2014–15 along the Pacific Northwest coast, COASST scientists can take advantage of precisely detailed models of ocean circulation, and independent at-sea



This well-arranged photo documents species, plumage variation, freshness and molt status of 39 birds.

Photo: ACSPI-ECO

Working Backwards

If 359 carcasses were counted on the beaches, how many puffins died? Being found and counted literally means a carcass “survived” scavengers, burial in wind-blown sand, or recapture by waves long enough that it could be found by Aaron and Paul. And washing ashore in the first place is totally dependent on where at sea a bird died, or became too weak to resist the pull of currents and the push of the wind. Most marine birds that die during the

surveys of live bird distribution. These sources of data greatly assist in estimating how many birds died at sea.

No such luck for this event.

Instead, COASST postdoc Tim Jones used wind data collected from the Earth System Research Laboratory at NOAA to create a clever “computer experiment.” Marine birds have high “windage”—about like a floating soccer ball—such that the force of the wind moves them faster than any surface

current. Basically, if you know the direction and magnitude of the wind, and a starting location, you can predict whether and where a carcass will float to shore.

Tim “populated” his computer model with Tufted Puffin carcasses arranged in concentric circles around St. Paul Island during each day of the die-off event. Then he simply allowed the wind to blow and watched as each carcass sank, moved offshore of the island, or landed on the beach. For ease, he grouped sequential days into different “wind periods”: winds from the north, winds from the south, and mixed winds.

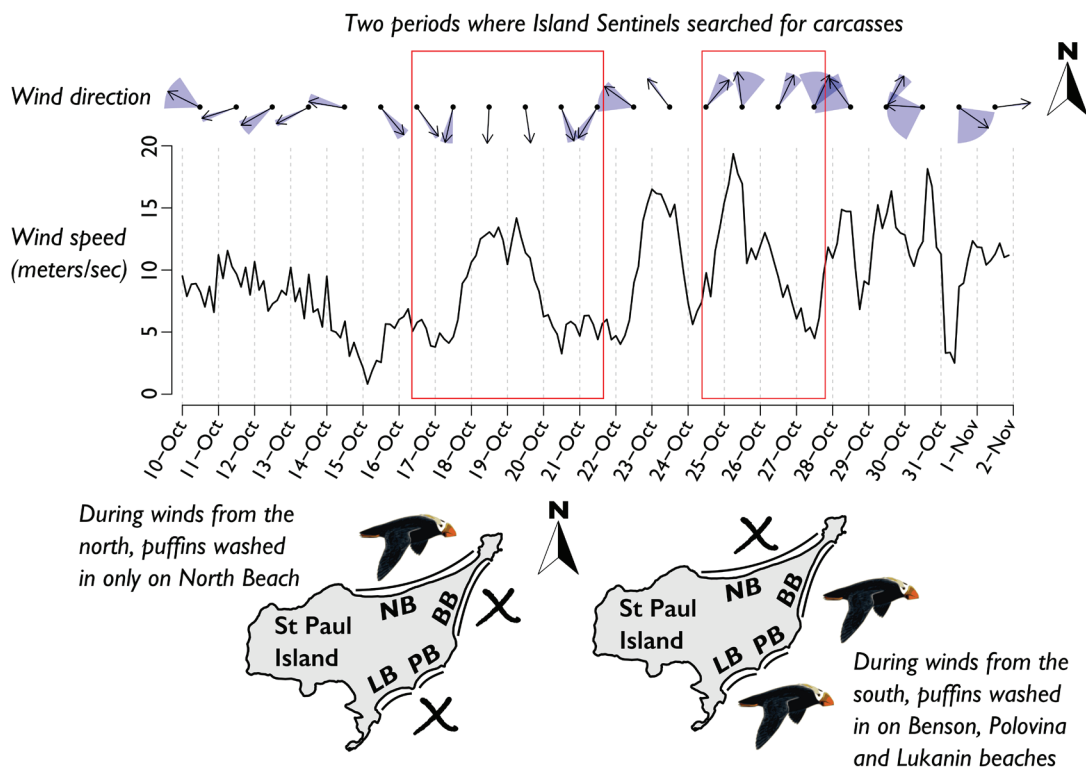
The first “reality check” was to compare the model results against what Aaron and Paul actually found. Turns out there is a pretty good match. That is, when the model winds blew from the north, Tim’s computer carcasses ended up on North Beach, but not on the other three beaches which face southeast —just like they did in reality! Ditto for wind shifts to the south. These results suggest that using the wind data to calculate mortality estimates is a valid approach.

Neighboring Pribilof Island St. George provided the second reality check. A mere 39 miles to the southeast, St. George was not deluged by puffins. Although island residents did report a few oddly behaving birds in the harbor, the two beaches that COASST monitors on St. George were carcass-free during fall of 2019. Tim used this information to tune how far away from St. Paul moribund birds could have been in order to:

- end up on St. Paul beaches
- not end up on St. George

The maps on the next page answer that question for the three wind periods. St. Paul is at the center of each map, and the concentric rings around the island are set at 5, then 10 km distances. And they show exactly what you would expect:

1. the closer to an island a carcass starts from, the higher the probability of beaching.
2. when the wind blows from the north, carcasses wash up on the north shore of an island.
3. the farther away from St. Paul a carcass started, the more likely it was to float to St. George instead, and particularly during the mixed wind period.



Question: If a bird had died at-sea around the Pribilof Islands, what are the chances of it floating ashore?

Darker shades indicate a higher chance of beaching

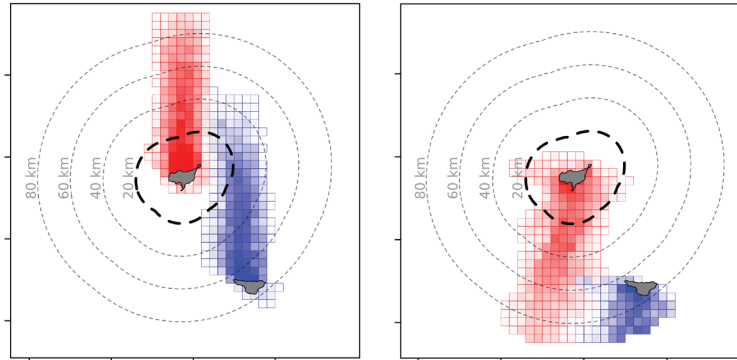
Red squares: beached on St. Paul

Blue squares: beached on St. George

Winds blowing from the

North

South



Answer: if puffins had died beyond ~20km, they may have also beached on St. George.

In short, Tim's computer experiment suggested the maximum distance from the island puffins could have been. And that information, together with wind direction and sink rate data, allowed a calculation of total mortality. For Tufted Puffins, this is between 2,740 and 7,600 birds (with outer limits based on 95% confidence intervals of 2,100 to 13,100). For all species—that is, the entire die-off—Tim calculated between 3,150 and 8,800 birds lost their lives.

A World Without Puffins?

Heather Renner, lead Biologist at the Alaska Maritime National Wildlife Refuge (AMNWR), helped put these numbers in context. AMNWR personnel fan out to seabird colonies throughout Alaska during the summer months, counting birds, checking nests and generally attempting to get a handle on the health of seabird populations. They even do COASST surveys! Refuge data indicate that the entire Tufted Puffin breeding population on the Pribilofs (St. Paul + St. George) is only about 7,000 birds. This means that the upper-end mortality estimates would have killed all of the Pribilofs puffins, and then some. What's going on?

Tufted Puffins migrate from their breeding colonies out to the edge of the Bering Sea shelf and

south to passes in the Aleutian Islands on their way to the open North Pacific Ocean. Breeding colonies are located throughout the Bering Sea, with a large colony (~80,000 breeders) to the east of the Pribilofs on Shaiak Island.

Although no one will ever know for sure, it's likely that the puffins that died on St. Paul came from a variety of colonies in the Bering Sea, and that colony extinction due to this event is unlikely.

Looking Towards the Future

The marine waters around Alaska have experienced tremendous shifts over the last several years, most notably in temperature, as melting Arctic ice and a warming North Pacific have both created warmer than normal conditions. A warmer ocean shifts the balance of which species survive and thrive, and which are not so lucky. In the Bering Sea in 2016, at-sea surveys recorded fewer forage fish in the size range suitable for seabirds like puffins, and a northward shift in energy-rich prey including krill and large copepods. For southward migrating birds, these changes could have spelled trouble. As warmer becomes the new normal, the number of Tufted Puffins the ecosystem can support, and where birds will be able to successfully breed and survive, could

COASST



Photo: iStock.com/Joesboy

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shift too.

Estimating how many birds died, and understanding what factors contributed to this mass mortality event is the stuff of COASST science. And it all starts with on-the-ground surveys that set the baseline pattern and allow coastal residents and seabird scientists alike to anticipate what is normal. In the middle of the Bering Sea, this event may have gone unrecorded, at least by the scientific community, were it not for the longstanding partnership between ECO and COASST. In remote coastal Alaska, where the effects of a warming ocean have threatened culture, livelihood and property, bearing witness to the impacts on iconic species like Tufted Puffins is important. As Aaron says, “We aren’t in the middle of nowhere, we’re in the middle of it all. Bearing witness to the impacts on iconic species like Tufted Puffins—sentinels of the ocean—is important.”

*Jones T, Divine LM, Renner H, Knowles S, Lefebvre KA, et al. (2019) Unusual mortality of Tufted puffins (*Fratercula cirrhata*) in the eastern Bering Sea. PLOS ONE 14(5): e0216532. <https://doi.org/10.1371/journal.pone.0216532>*

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.