MAY 2018 ISSUE 3

COASST

Science Update

What Killed Cassin's Auklets 2014-2015? Sleuthing the Perfect Storm

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 what killed so many Cassin's Auklets in 2014–2015.

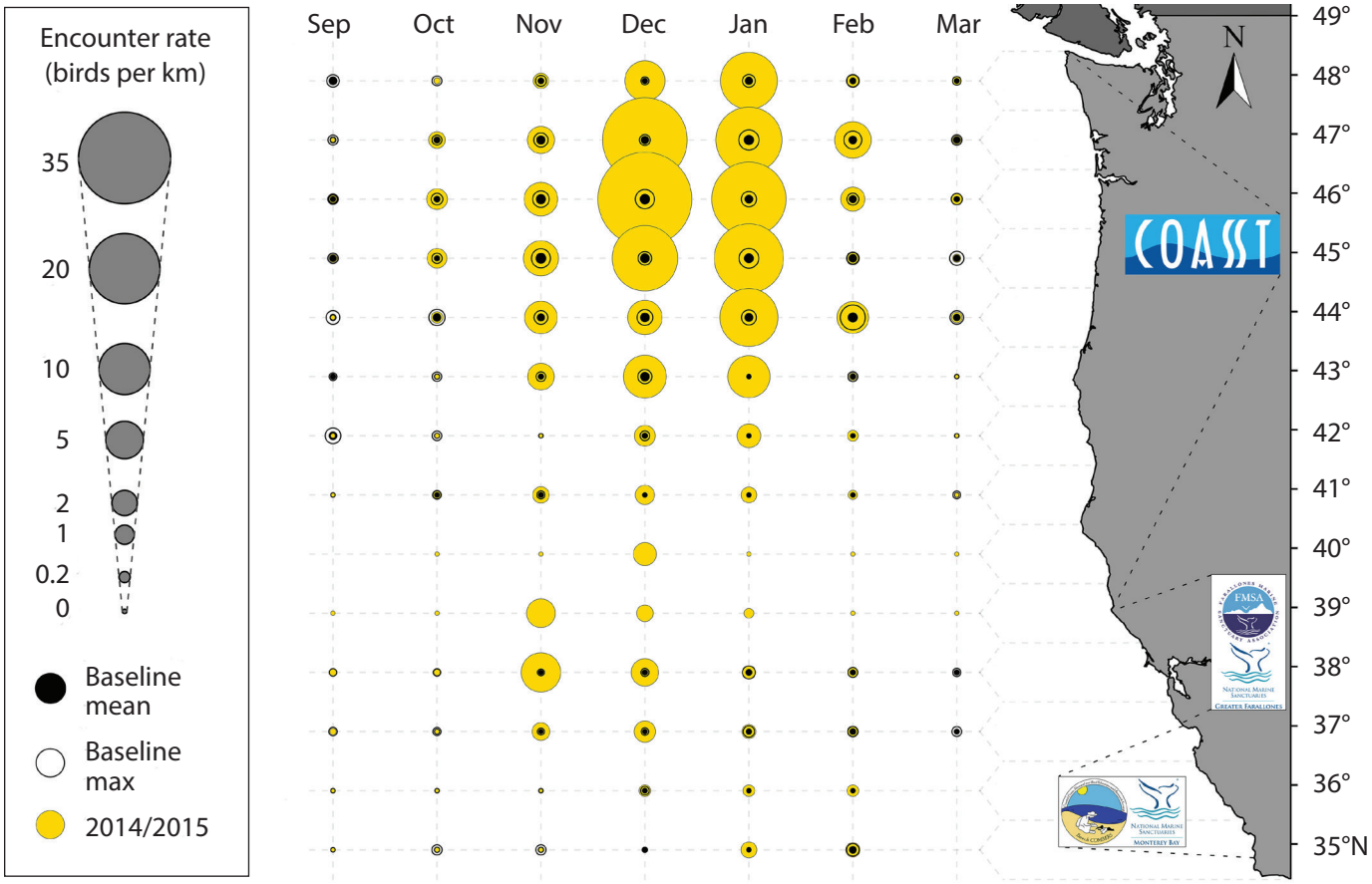
First Alert!

On 22 December 2014, Virginia walked out onto Pacific Beach, WA for her sixth survey ever. She was in for a surprise. More than 400 Cassin's Auklets, a diminutive relative of Tufted Puffins and Common Murres, had washed ashore, making the carcass encounter rate (that is, carcasses found per kilometer of beach length searched) a whopping 300 birds per km. Between October 2014 and March 2015, COASSTers from all along the Pacific Northwest outer coast would post exceedingly high numbers of Cassin's Auklets: 544 at Peter Iredale North, 200 at Tsoo-Yess North, 145 at North Surfside—the list was endless.

Photos: top: W. Williams, left: Tom Johnson

Caren, on Roads End Beach in northern Oregon, attempts to make it through droves of Cassin's Auklets. Notice how many of these carcasses are intact, a sure sign of recent arrival on the beach.

Photo: L. Doyle



A "bullseye" plot comparing the average monthly number of Cassin's Auklets beached bird surveyors encountered in 2014/2015 (yellow circles) to the long-term baseline values (black circles). Yellow and black about the same size? —not a wreck. Yellow a lot larger? —a big wreck. Each column is a month, from September 2014 to March 2015. Each row is a slice of coastline. COASST data include Washington, Oregon and northern California. Sister program Beach Watch runs from Mendocino Count to south of San Francisco, and sister program BeachCOMBERs picks up Monterey Bay south to Los Angeles.

Like a shipwreck, a wreck of marine birds litters the beach with casualties. Any COASSTer who has experienced these phenomena cannot but help feeling awe, shock, and even helplessness. In 2014–2015, the wreck story was all Cassin's Auklets, all the time. Collectively, hundreds of thousands of these birds died in the nearshore waters off Oregon, Washington and British Columbia.

Pixabay_CreativeCommons; inset: COASST

A stocky "football with wings," Cassin's Auklets can look almost sardonic with their white eyebrow cocked.

A Football with Wings

Cassin's Auklets are small (about the size of a robin) Alcids. This foot type family (3 webbed) is typified by deep-diving birds that "fly" underwater, chasing down small fish and shrimp-like krill. Rather subtly toned in gray-brown plumage and pale belly, Cassin's Auklets sport a white eyebrow and matching spot at the base of the bill. Seasoned beached-bird identifiers can tell this species even from a single wing, as the outstretched underwing has a distinctive dark-light-dark striped pattern. And, of course, there are the electric blue feet...

Breeding along the West Coast of North America, Cassin's Auklet colonies can be found from Mexico to Alaska, with the population centered in the Scott Islands off the northwest tip of Vancouver Island, British Columbia. On Triangle Island, the fifth and outermost island in the Scott archipelago, Environment and Climate Change Canada researchers led by Mark Hipfner have documented 1.1 million breeders. Altogether, the Scotts support a stunning 60% of the world's population. Where do these birds go post-breeding? Wherever the cold, productive waters of the North Pacific serve up a diet of their favorite copepods (bug-like organisms) and krill (small shrimp-like).

A Sleuth at Work

Tim Jones, the COASST quantitative postdoc, is drawn to wreck events, not only to estimate how many birds died, but also to attempt to sleuth out the causes. To help solve the mystery of the Cassin's wreck, Tim turned to scientists throughout the marine community, from seabird experts like Canadian colleague Mark Hipfner and NOAA Fisheries Division Director Lisa Ballance, to climate scientist Nick Bond, and biological oceanographers Bill Peterson and Eric Bjorkstedt. All in all, 18 scientists would contribute their data and expertise to the story.

Hillary Burgess

Tim Jones, COASST quantitative postdoc, enjoying a break from computer modeling with his dog Freya.

The Power of a Baseline

Figuring out whether something is different requires that you have a standard to measure against. In COASST, this is our long-term baseline. For each of Tim's hypotheses,

Four Hypotheses for Massive Mortality Event

The team of scientists put together four hypotheses to explain the massive mortality event. In fact, these theories are not exclusive—they could all be happening at once.

1 Amount & Type of Food

copepod: Hopcroft/UAF/CoML; krill: Øystein Paulsen - MAR-ECO, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=225249

Cassin's Auklet favorite foods include shrimp-like krill (top left) and large, fatty copepods (bottom right). Did the die-off result from a loss of good food, or from increasing amount of "bad" food (smaller krill and energy-poor copepods)? We tested both.

2 Young from the Colonies

Jo Smith

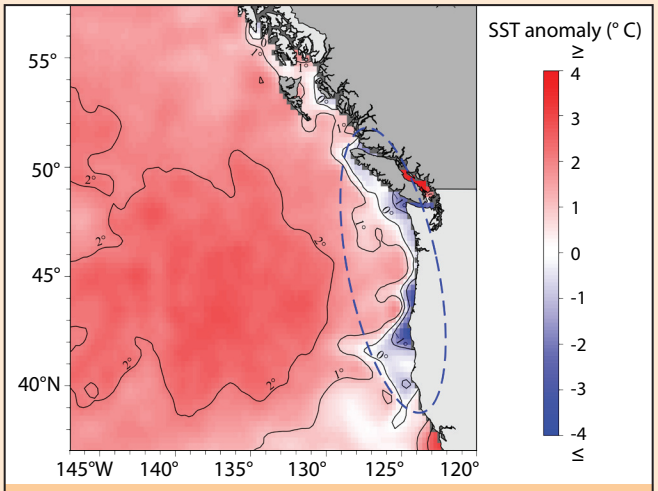
In an average year, the Triangle Island colony alone produces an impressive 350,000 fledglings. Could "surplus" production throughout the British Columbia population center have put so many young of the year into coastal waters that they just couldn't compete?

3 Storminess

WestWindGraphics/iStock/Thinkstock

Winterkill is a well-known phenomena to beached bird surveyors worldwide, resulting in ~25% of COASST finds annually. We used the average height of the waves—measured at off-shore buoys—as a proxy for the duration and severity of fall and winter storms.

4 The Blob



NOAA High Resolution SST data provided by the NOAA/OAR/ESRL PSD, Boulder, Colorado, USA, from their Web site at https://www.esrl.noaa.gov/psd/

A color-coded view of "The Blob" as a huge red water-mass inundating the North Pacific. Only a thin coastal strip of cooler-than-normal (blue) water is visible (see dashed oval), associated with seasonal upwelling typical of the Pacific Northwest.

collaborating scientists contributed both the data from the year of the event, and also from all of the other years beforehand—they all had baseline data. Tim used that information to create data points for each year (2001–2014), and then put all of that information into a statistical process that allowed him to "compete" datasets against each other to see which ones were the best at explaining why 2014 was so off-the-charts for Cassin's Auklets.

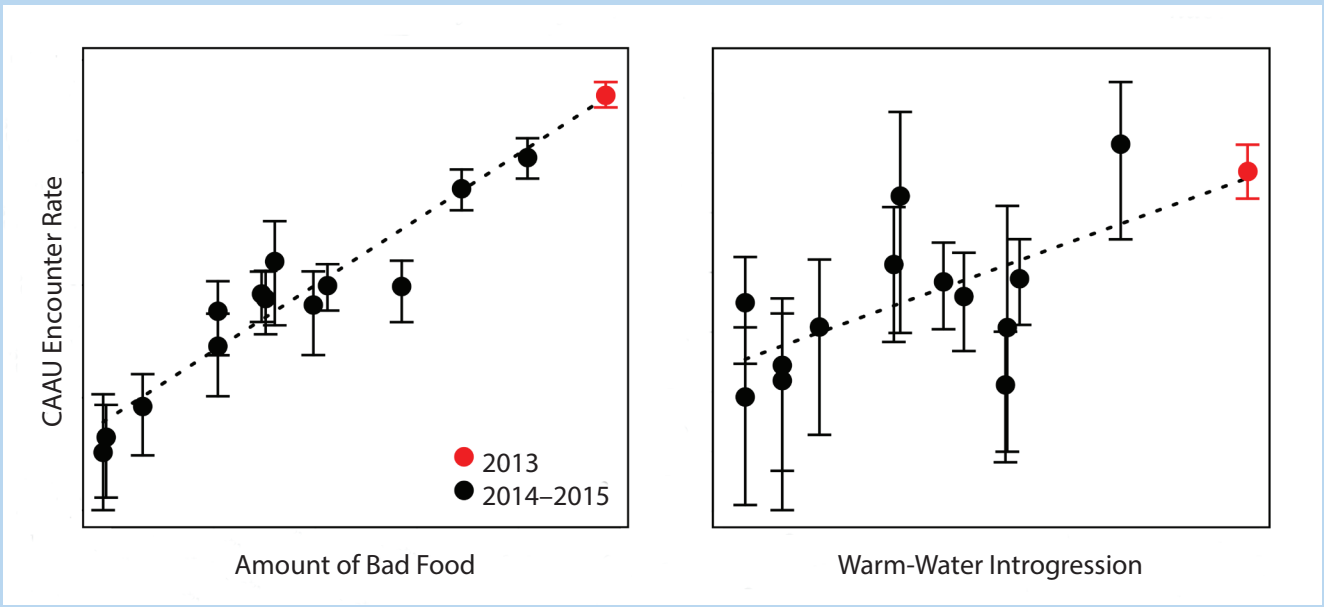
The answer? The amount of "bad food" (small, energy-poor copepods and smaller-than-normal krill) in the nearshore ocean was the strongest predictor of whether Cassin's Auklets would wash ashore, followed by the degree to which that same nearshore habitat was compressed by offshore warmer-than-normal water. In 2014, both of these conditions—lots of bad food and extreme compression of cold-water habitat in the nearshore—were overwhelming.

But it turns out that even before this massive mortality event, the number of Cassin's Auklets washing ashore in the fall–winter was predicted by our "bad food" indicator! In those (baseline) years, there was also a measurable impact of storminess—stronger, longer and more frequent storms also spelled trouble for these birds. What about colony production? Two lines of evidence suggest this effect wasn't important. First, there was no relationship between breeding success and the number of Cassin's Auklets washing up in the post-breeding season. And second, necropsies of Cassin's Auklets collected from Canadian beaches during the wreck showed that the vast majority of these birds were adults.

Putting the Story Back Together

This is a story about the impact of "The Blob" also referred to as a "marine heatwave." At the peak of this heatwave, the warmer-than-normal water in the North Pacific occupied an area the size of Canada.

And in that warm water? Bad food. Small copepods usually resident in southern California had moved north



Two graphs from Tim's analysis appearing in the Geophysical Research Letters article. Each dot is a year, with the wreck year in red. The T bars above and below each point indicate degree of statistical similarity. These are "residual plots" showing the annual difference from long-term average values (with the vertical axis on a log scale). We've removed the units for simplicity. The point? When bad food is abundant in coastal waters, and cold-water habitat is compressed shoreward by physical warming like The Blob, COASSTers can count on finding Cassin's Auklets.

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into this newly available habitat. Cold-water, energy-dense species were relegated to colder "refuges" – north towards Alaska and along a ~100km wide strip of coastal ocean from Oregon north to British Columbia. And that coastal strip is exactly where post-breeding Cassin's Auklets dispersing off of their Canadian colonies flocked to—by the millions. Unfortunately for them, this cold-water refuge disappeared as fall storms rolled in, pushing the heatwave literally onto the beach. And even though those storms were mild, the food stress was too much for these birds.

What's the moral? The last paragraph of Tim's paper provides a sober summary:

"As the world's oceans continue to warm, it is likely that large-scale temperature anomalies will increase in frequency, magnitude and duration, raising the likelihood of more frequent mass mortality events and correspondingly rapid, and potentially irreversible, changes to marine ecosystem structure and functionality. Breeding populations of Cassin's Auklets have declined significantly at both the population center on Triangle Island and towards the southern periphery of their breeding range, with studies implicating lower reproductive success and lower survival during warm water years. Thus for Cassin's Auklets, marine heatwaves of the scale of the NE Pacific event may well represent a global population precipice."

Jones, T., Parrish, J. K., Peterson, W. T.,Bjorkstedt, E. P., Bond, N. A., Ballance, L. T., Bowes, V., Hipfner, M. J., Burgess, H. K., Dolliver, J. E., Lindquist, K., Lindsey, J., Nevins, H.M., Robertson, R. R., Roletto, J., Wilson, L., Joyce, T., Harvey, J. (2018). Massive mortality of aplanktivorous seabird in response to amarine heatwave. Geophysical ResearchLetters, 45, 3193–3202.

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.

COASST
University of Washington
Box 355020
Seattle, WA 98116
coasst@uw.edu
206-221-6893
www.coasst.org