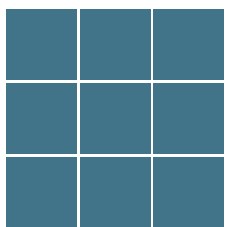




Above: A rare sight. Two North Pacific right whales in the Gulf of Alaska. *Photo Credit: NOAA under MML permit #20465. Image credit: Jessica Crance.*



RIGHT ON THE EDGE: CAN THEIR PACIFIC COUSINS BE SAVED?

JESSICA CRANCE

Their dark history
They once numbered in the tens of thousands throughout the North Pacific. Today, fewer than 500 exist; in the U.S., only around 30

Top Right: A North Pacific right whale lunging, in the waters off Kamchatka. Image credit: Vladimir Burkanov.

Page 51: Another image of the same two North Pacific right whales in the Gulf of Alaska. Photo Credit: NOAA under MML permit #20465. Image credit: Jessica Crance.



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animals are thought to remain. Two distinct stocks are currently recognized: the western stock, thought to number in the low hundreds, and the eastern stock, that has only tens of individuals remaining. The tale of the North Pacific right whale (*Eubalaena japonica*) is dark; and for the eastern stock, the outlook is bleak. Once abundant in Alaskan and eastern North Pacific waters, they are now so rare that single observations have warranted publication.

So named for being the “right” whale to kill (being slow, having thick blubber, and floating when killed), right whales in all oceans quickly became the target of commercial whaling. Hunted for oil, meat, and baleen (used for corset stays, umbrellas, carriage springs, and other accessories), it is estimated that between 21,000 - 30,000 right whales were taken in the North Pacific in a single decade. By 1900 they were already considered commercially extinct – meaning their numbers were so low they weren’t worth the effort of trying to catch. Although low numbers of catches continued into the early 20th century, they weren’t protected by law until 1935.

Although not numerous, reasonable numbers of right whales continued to be seen in the North Pacific, particularly in the Bering Sea, Aleutian Islands chain, and the Gulf of Alaska, until 1964 when their numbers dropped dramatically, seemingly overnight. Despite an increase in searching effort, there were only 60 sightings total in the entire eastern North Pacific from 1964 to 2001. And for decades, the cause of their disappearance remained unknown.

Then in 1993, Professor Alexei Yablokov, then the Special Advisor for Ecology and Health to Russian President Boris Yeltsin,

gave a presentation at the 10th Biennial Conference on the Biology of Marine Mammalogy in which he revealed to the world the fact that the Soviets had been conducting large scale illegal whaling in all the world’s oceans since 1948. While some scientists had suspected several countries of falsifying their catch records, the extent of the Soviet harvest was unknown until that moment. Traveling across the world’s oceans, they took anything that crossed their bow, leaving “a desert in their wake”. When they moved their fleet into the North Pacific in the early 1960s, they decimated what remained of the North Pacific right whales, dropping numbers in the eastern population to the tens of animals, making them the most critically endangered large whale population in the world. While the western population of North Pacific right whales is doing slightly better, even their numbers remain in the low hundreds.

The Problem

Despite being ESA-listed as Critically Endangered and having federally designated critical habitat, there are no regulatory measures or management policies in place. Several legislative policies (e.g., vessel speed restrictions) have been implemented for the congeneric North Atlantic right whale (*Eubalaena glacialis*) that have aided conservation efforts. The North Atlantic right whale, however, is widely in the public’s eye. Thanks to their preferred coastal habitat and ease of access, scientists have a keen understanding of the population status and trends of “the urban whale”, and the overlap between this population and various human activities is well understood. And importantly, it is comparatively easy to understand the cause of North Atlantic right whale injury or

mortality; their coastal distribution means animals that are struck or entangled often wash up on shore.

For their North Pacific counterparts, the picture isn’t nearly as clear. There are only an estimated 30 individuals left in US waters, and that number was based on data that are now 15 years old. With only 30 individuals remaining, finding North Pacific right whales would be a challenge even if they were right along the west coast in plain view. But when their historical distribution is in a remote region with notoriously bad weather, finding even a single animal becomes a search for the proverbial needle in a haystack. With re-sights of individuals happening at most every few years (or at worst, never happening), it’s impossible to say whether this critically endangered population is remaining stable, rebounding, or declining. While researchers have seen very little evidence of entanglement or ship strike scars in images collected of North Pacific right whales to date, given its location it is unlikely that any incident would be noticed. Either the animal washes up on shore somewhere along the hundreds of miles of uninhabited coastline, or it sinks – taking with it any knowledge of the direct impacts of human activities on the population. And with the small population size and an estimated 2:1 male-biased sex ratio, the loss of even a single animal, especially a female, would be detrimental.

The eastern population of North Pacific right whales can be found in summer months in the productive waters of the Gulf of Alaska and Bering Sea, where they feed on the abundant zooplankton. But where they go when they leave these productive waters remains a mystery.



Being commercially extinct prior to the keeping of many scientific records, scientists must rely heavily on old whaling logbooks for information on their pre-whaling distribution. But even the most comprehensive of whaling logbooks did not note sightings of calves or mating behavior, some going so far as to say “there was little to no evidence of breeding grounds”. While this could be a result of biased effort at certain times of year, no calves have been sighted since 2004. It’s assumed that North Pacific right whales migrate south to lower latitudes in the winter like other baleen whale species, but very little evidence of migratory pathways exists.

In recent years, there have been more sightings of right whales off the coast of British Columbia, Canada, occurring in May or June and October. Perhaps these sightings correspond with animals migrating to and from the Gulf of Alaska or Bering Sea. In April of 1997, a North Pacific right whale was sighted off Hawaii; three months later, that same individual was seen in the Bering Sea. While an exciting discovery, this remains the first and only high to low latitude match of an individual since the beginning of photo-ID records in the late 1970’s. There have been about a half dozen sightings off southern California and Baja Mexico over the past several decades that also suggest these animals may move south for winter. Unfortunately, these are usually sightings of a single adult animal, and are so few and far between that they are often identified as other species. This was the case with a right whale sighted off La Jolla, California in 2017; originally misidentified as a gray whale, it wasn’t until drone footage circulated around social media that it was correctly identified as a right whale.

The Research

Given the lack of knowledge about even the basic life history of this population, much of the research being conducted is simply trying to answer the *where*—where are their migration routes or breeding grounds, and where is their current distribution relative to their historic distribution. Unfortunately, answering even these most simple of questions is difficult. But despite the challenges, several surveys over the past couple decades have been successful in locating, photographing, biopsying, and deploying satellite tags on right whales. Detailed movement data were collected from the satellite tags, which provided great insight into habitat use in the Bering Sea. Unfortunately, all tags fell off before the animals left the southeastern Bering—leaving the question of where they go (or if they leave) unanswered.

While large scale surveys are the best way to obtain population structure and individual-specific information (i.e., from photo-ID photographs or biopsy samples), they have often been cost-prohibitive. Passive acoustics, however, provides a relatively inexpensive means of monitoring the population year round, during times when vessel surveys are not possible. Right whales make several stereotyped calls, most notably the gunshot and the upcall, so by detecting these call types at various locations throughout the year, we can determine the spatio-temporal distribution of right whales. Currently, the NOAA Fisheries - Marine Mammal Laboratory (MML) at the Alaska Fisheries Science Center has 20 long-term bottom mounted recorders deployed throughout Alaskan waters, where we’ve been able to monitor for right whales since 2007. These data have shown that right whales are

being detected farther north in the Bering Sea than in years previous, a fact which is supported by recent sightings of a right whale near St. Lawrence Island that was re-sighted two weeks later in Chukotka. Whaling logbooks do show a few takes of right whales in the northern Bering in June and July (in both Russian and U.S. waters), although there is some question as to the validity of species ID and whether they may have actually been bowhead whales misidentified as right whales. Whether correct or not, it remains to be seen whether these detections and sightings are a sign of a return to pre-whaling distribution grounds, or a shift in distribution as a result of climate change. The Bering Sea oscillates between two different environmental states, shifting from cold regimes where extensive remnant winter water in the bottom layer (referred to as a cold pool) concentrates prey in the southeastern Bering Sea, to warm regimes where there is reduced sea ice and a reduced or absent cold pool, resulting in prey being more widely distributed. Right whales tend to utilize a more spatially constricted habitat during cold pool years. It’s possible, therefore, that the recent detections and sightings in the northern Bering are a result of a shift to a warm pool, and perhaps indicative of how the population may respond to climate change and the increased reduction in sea ice.

The passive acoustic monitoring, while providing invaluable data on changes to their spatio-temporal distribution, does come with its own complications. Not only do both humpback (*Megaptera novaeangliae*) and bowhead whales (*Balaena mysticetus*) make similar upcalls, bowheads also make gunshots—and overwinter in the southeastern Bering. When the calls from both species are aurally and spectrographically indistinguishable, how do you differentiate between the two and ensure accurate species attribution? We’re hopeful that a recent discovery will help with that. A couple years ago, we made an unexpected recording of a North Pacific right whale singing. Comprised almost entirely of gunshots, these songs have a hierarchical structure and a stereotypy (a patterned repetition) on par with the songs of humpbacks. Interestingly, however, right whale songs have a temporal stability that is unheard of with humpback songs. The four song types described for North Pacific right whales thus far have remained constant over eight years of recordings. And to date, these songs are unique to

North Pacific right whales. While this undoubtedly raises more questions than it answers (why does the most critically endangered population of right whales sing?), it does mean that if these songs are detected, that is an unequivocal sign of a vocalizing right whale, and therefore can be used to detect right whales outside their known habitat. If detections occur in the eastern North Pacific, or along the west coast of the US, that may provide insight into their migration routes or overwintering grounds.

Although aurally and spectrographically similar, species identification may be possible using novel techniques to analyze propagation characteristics of call types. Current research being conducted by Aaron Thode of Scripps Institution of Oceanography, Julien Bonnel of Woods Hole Oceanographic Institution, and Dana Wright, Ph.D. candidate with Duke University, is looking at determining the calling depth of an animal based on varying arrival times of modes evident in propagation distortion effects. By using a technique called nonlinear dynamic time warping, the estimated source depth of a call can be determined. Preliminary results from this study showed that right whale gunshots were typically produced in only a few meters depth. These results coincide with what is known about North Atlantic right whale calling behavior; bowhead whales, however, are thought to call at greater depths. By comparing calling depths of gunshots from the two species, we hope to see a separation in gunshot calling depth between the two species that can then be used to attribute gunshots to species and determine whether right whales are remaining in the Bering Sea overwinter.

To help identify possible migration routes, MML is currently working with the Department of Fisheries and Oceans Canada (DFO) in a collaborative study to detect right whale calls along the British Columbia coast using custom call detection and classification software (INSTINCT) designed by Dan Woodrich. Because right whales have been seen more frequently in recent years off British Columbia, DFO and MML are working together to analyze data from the DFO long-term recorders deployed along the BC coast to determine if right whales are using this area as a migratory corridor.

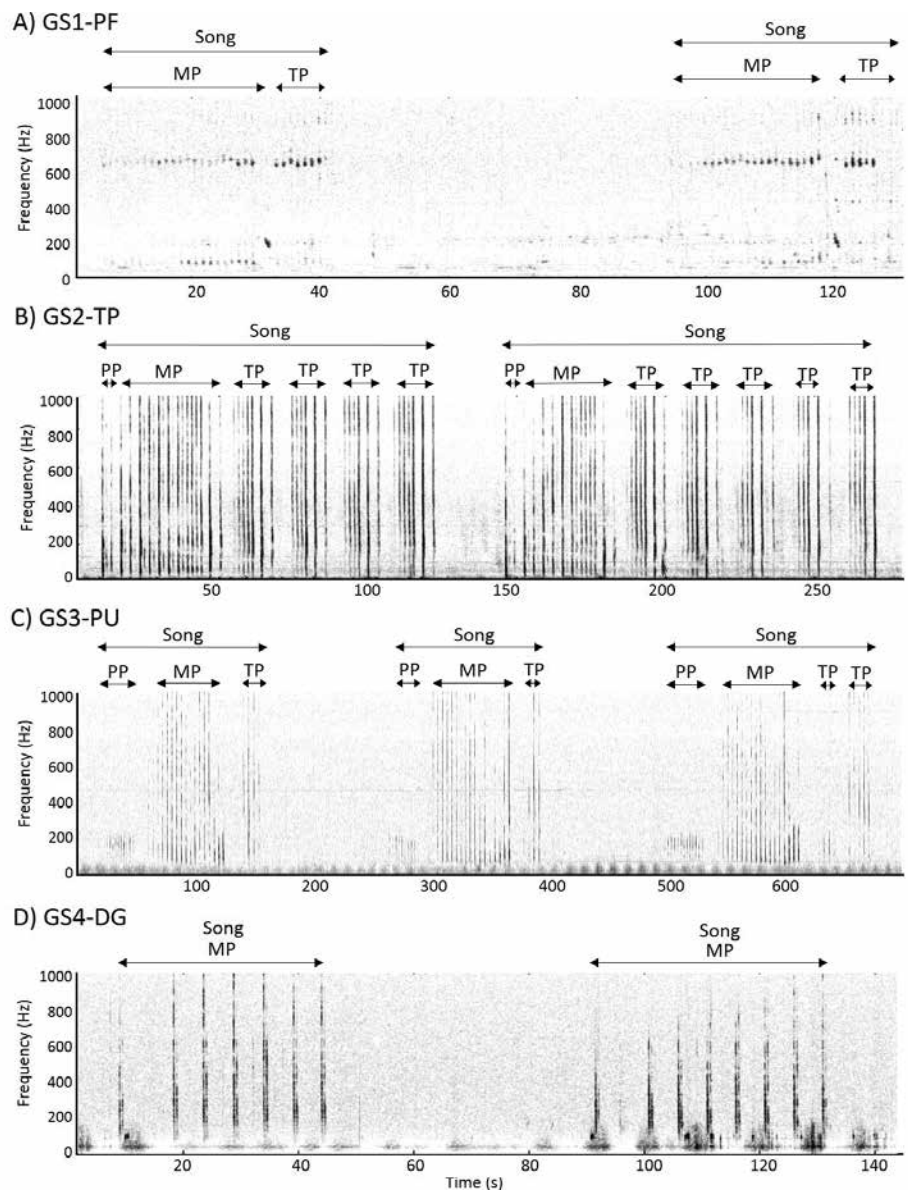
In another attempt to shed light on the mystery of their breeding or overwintering

grounds, Dana Wright is conducting research involving biogeochemical tracers, called stable isotope ratios, in museum specimens of baleen plates from the whaling era. These plates are sheets of inert keratinous tissue, made from compounds similar to those in our hair and fingernails, that grow from the upper jaw of baleen whales and allow them to filter feed small organisms from the water column. Just like our hair, baleen grows continuously throughout the animal's life and due to their length (150+ cm) can record a time-series of the last 5+ years of ecological history of an individual North Pacific right whale. Consequently, this tissue may shed light on a myriad of poorly known information about this species, including migratory patterns and site fidelity, diet and trophic

level reconstruction, as well as physiological inference. In addition to baleen, Wright is also analyzing stable isotope ratios from skin samples collected via remote biopsy starting in the early 2000s. Together, the skin and baleen data provide an opportunity to compare historical and contemporary right whale niche and habitat use, which may aid management and conservation efforts for this species.

While these studies help us gain insight into migration and movement patterns, vessel-based surveys are still the best means for obtaining information on individuals and population structure. In 2017, the International Whaling Commission's Pacific Ocean Whale and Ecosystem Research (POWER) cruise surveyed the eastern Bering Sea, and

NPRW SONG TYPES





Top Right: Two North Pacific right whales in the Gulf of Alaska
Photo Credit: NOAA under MML permit #20465. Image credit: Jessica Crance.

included passive acoustics (via sonobuoys) for the first time to aid in the detection of North Pacific right whales. During the 60 day survey, a total of twelve different right whales were photographed (an estimated 15 were seen), and biopsy samples were collected from three animals. This was the largest number of right whales seen during a single survey since 2004. The 2018 POWER survey in the Central Bering added three additional right whales to their total, with three accompanying biopsy samples. All told, four right whales were confirmed new and added to the catalog, with two other animals also possibly new individuals. And remarkably, all six biopsy samples were from individuals of previously unknown sex. Unfortunately, analysis results of the six biopsy samples collected during those two years resulted in five males and only one female. These bleak results indicate that the sex ratio in this population may be far more male-biased than the current estimated 2:1 ratio would suggest. But despite having all the odds stacked against them, there is still reason for hope.

The Glimmer of Hope

The first right whale sightings off British Columbia in over six decades occurred in June and October of 2013. In the past four years alone, three additional sightings have occurred off Haida Gwaii and Vancouver Island. Could this be indicative of an increase in numbers, or perhaps a return to their historical range? Or are these animals a different sub-population than those in the Bering Sea, and utilizing different migratory routes? In either case, the increase in sightings in recent years, plus the 15 different right whales sighted in only two years (2017, 2018) provides hope that all is not yet lost. This is perhaps best illustrated by the sighting of two non-adults. The June 2013 sighting off Haida Gwaii and one of the individuals seen during the 2017 POWER survey were estimated to be a juvenile; even more exciting, the Haida Gwaii animal was a female. Despite their critically low

population size, at least one female is still reproducing; because of this, we named the 2017 juvenile “Phoenix”.

I’m currently out at sea in the Gulf of Alaska as I write this. It’s taken four different surveys over the past eight years, but I finally saw right whales in the Gulf of Alaska. Four right whales were seen in two separate encounters, which is the most sightings ever in a single survey in the Gulf of Alaska. One of the animals, sighted in Barnabas Trough, was sighted off Haida Gwaii just two months ago in June by James Pilkington and Jared Towers of DFO. Another individual (seen just south of the Trinity Islands) was matched to the MML right whale catalog and identified as MML 71, an individual first seen in Barnabas Trough in 2006. And amazingly, two of the four animals were confirmed new individuals. Even after decades of looking, we are still finding new individuals. And with each new sighting comes another surge of hope, and a renewed determination.

But most importantly, with more sightings in recent years has come more articles in the news, more press releases, and more exposure. The more the general public is aware of this species, the more extralimital sightings we will get – which could be instrumental in helping understand the migration routes of these rare animals. As such, increasing awareness about this species is a key step in the conservation of a population. Because people save what they love, and they love what they know, we need to make the North Pacific right whale as common a household name as their North Atlantic cousins. And by continuing our important research, we can hopefully fill in some of the current gaps in knowledge regarding the spatial distribution of the most critically endangered large whale stock, and help guide research and conservation efforts to give these animals their best chance at recovery.

The scientific results and conclusions, as well as any views or opinions expressed herein, are those of the author and do not necessarily reflect those of NOAA or the Department of Commerce.

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