

RESILIENCE: OUR PATH TO THE FUTURE



CLAY KOPLIN
Mayor
City of Cordova



KATRINA HOFFMAN
President & CEO
Prince William Sound Science Center

The theme of this edition of *Delta Sound Connections* is resilience. While it has recently become a bit of a buzzword, it is more relevant than ever. Resilience is central to the Prince William Sound Science Center’s mission to advance community resilience and the understanding and sustainable use of ecosystems, and resilience has long been a defining characteristic of the community of Cordova, where we live and work.

Anyone who travels or lives in rural Alaska grows to appreciate the privilege of spending time in the wilds of this majestic state. They also come to respect the sudden and often violent nature of the challenges posed by forces of humans and nature.

Cordova has endured—and succeeded—despite many such challenges. From a vibrant Native Alaskan culture devastated by European disease and aggression, to the abrupt closure of the mines that supplied copper ore by train and steamship to a growing nation. From a devastating fire that destroyed most of the historic business district, to the catastrophic Good Friday Earthquake of 1964. From the rapid decline of the once-notable razor clam fishery, to the infamous and lingering impacts of the *Exxon Valdez* oil spill; this is a community that has confronted a succession of social, economic, ecological, and psychological shocks. We are geographically close to some communities that no longer exist, their remnants barely perceptible to passers-by. But Cordova has persisted, and we attribute that to its resilience.

We can observe resilience in society, in systems, and in nature. What does it mean to be resilient? Resilience is the ability of a system to maintain key functions and processes in the face of pressure and change, either through resistance or adaptation. Complex systems

tend to be more resilient: even if you remove or alter an element, a complex system is less likely to collapse. Too many disturbances, and a system may recover slowly or lose diversity. But moderate disturbance can also instigate diversity or promote changes in a system that might ultimately result in positive outcomes. We’re experiencing a new set of disturbances in Cordova right now. The state budget is in distress, affecting communities throughout Alaska—ours included. Changing conditions like The Blob in the North Pacific Ocean threaten to negatively affect the fisheries that are foundational to our local economy. But amidst the evidence that these disturbances are radiating impacts through the systems we rely on, we also see these disturbances inciting adaptive responses in the region’s ecosystems—including the humans who wish to thrive in balance with this place. We must continue to hope, for our own sake, for our community, and for the ecosystems we respect and rely on, that resilience will carry us successfully into the future.

WHAT DOES RESILIENCE MEAN TO YOU?



MARC CARREL
Commercial Fisherman
Cordova, Alaska

As a commercial fisherman I’ve seen boat machinery break and fail in the most bizarre ways, and often in the worst possible moment. No matter how many spare parts and tools we carry there are always some problems that are just beyond our own abilities. This is when we need the help of someone who happens to be carrying the random part that we now so badly need or who can give that helpful pointer that lets us solve the problem. Through this I have learned that in order to be resilient we absolutely need a community of people with diverse skills and assets who are willing to help each other. Alone we are all too easily stranded.



AARON LANGE
Owner, Wilderness Birding Adventures
Homer, Alaska

Nothing is static nor permanent. Change is constant. I think of resilience as the ability and the willingness to adapt to changing conditions and forces. For humans, our livelihoods, and our communities, resilience is determined by our resourcefulness and our attitudes. It requires looking at setbacks as course adjustments, potentially even new opportunities, but not as failures.

All of us and our communities, depend on a resilient environment which is able to change but still thrive. To be able to adapt to change, the environment depends on ecosystems with their biodiversity largely intact. It is absolutely beyond argument to say that each and every one of us depend on the resilience of the natural world, and therefore we depend on its conservation and on the maintenance of a healthy environment.



KATE MOHATT
Ecologist, U.S. Forest Service
Chugach National Forest
Girdwood, Alaska

A resilient ecosystem to me means a fully functioning, intact system with a diverse suite of species that has the capacity to overcome threats such as invasive species, climate change, wildfire, and other human caused or natural disturbances. While these disturbances may temporarily alter the system or even leave lasting effects, overall a resilient ecosystem is able to continue to function and provide key services. Systems that are permanently compromised lose their resilience, and become much more vulnerable to changes and disturbances over time.



GAYLE GROFF
Principal, Mt. Eccles Elementary School
Cordova, Alaska

To me, a resilient person is able to look their hardships and setbacks in the face, grieve what they have lost, and then move on past it, creating a better place for themselves in the process. At Mt. Eccles, my hope is that we provide an environment where resilience can thrive—a place where students are given permission to acknowledge and feel their feelings while looking ahead and taking steps toward a place of satisfaction and contentment. An important part of building resilience may very well be teaching kids to get over fear of failure. In the words of the Magic School Bus’s Ms. Frizzle, “Get messy! Take chances! Make mistakes!” We want to create a place that makes those things safe in daily learning. We want to model and build healthy relationships. It may be the teacher, the kitchen lady, the janitor, or the playground helper that connects with your child at school. Who is your special person? And to whom are you that special person? We can and should be intentional in talking about and modeling resilience. So spread it around, starting with your own little corner of the world!

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COMMUNITY



Copper River/PWS Marketing Association

Rotator cuff injury often occurs as a result of extending an arm while holding a load, a movement often used in commercial fishing.

PIONEERING HEALTH RESEARCH FOR COMMERCIAL FISHERMEN

TORIE BAKER

University of Alaska Fairbanks/Alaska Sea Grant Program
torie.baker@alaska.edu

In commercial fishing, fatality statistics have led to increased safety measures and mariner training. But the long hours, repetitive physical work, fatigue, and cold conditions experienced by this workforce contribute to health issues not well understood.

Alaska Sea Grant's Cordova office supported researchers and local fishermen in a recent pilot study to chart health habits and chronic health challenges. This kind of analysis of U.S. seafood harvesters has not been done before.

Nearly 100 Copper River gillnet salmon fishermen participated in the study. University of Washington School of Public Health personnel surveyed fishermen's health habits before and during the season, tested remote health monitoring equipment such as Fitbits, and recruited volunteers for in-season physical exams.

Researchers found a prevalence of shoulder rotator cuff damage, significant evidence of undiagnosed sleep apnea (possibly further compounding fatigue management on vessels), and widespread noise-induced, non aging-related hearing loss. In general, the sample group exhibited higher than normal fitness levels.

The team shared study results with the community as well as local health providers. Interest in continuing this investigation is high among the researchers, funders, and the local fleet. The National Institute of Occupational Health and Safety funded the project.



Teams working on their ROVs.
Photo: Lisa Matlock

ROVING IN 2017

STEFANIE TSCHAPPAT
Prince William Sound Science Center
stschappat@pwssc.org

Always a big hit at the National Ocean Science Bowl, aka the Tsunami Bowl, is the ROV Challenge hosted by the Prince William Sound Science Center. This year, four teams from around the state participated in the challenge: Seizing Seals, Eliimaq Maklak, Jolly Fish, and Chickens of the Sea.

After a brief introduction to the history of Remotely Operated Vehicles (ROV) and their use, each team was given a bag of PVC pipes of various lengths, electrical tape, zip ties, nippers, and a battery and motor. Teams had one hour to design and build an

ROV that would compete in five underwater tasks, held in the Seward High School pool.

Each team launched their ROV and got the chance to "fly" them for practice. Once the ROV was in the water, no further adjustments were permitted. If they ran into any problems, they could ask for help from the "seal" in the water, but would have to take a point deduction. The teams were judged on each task, and required they work together and have fun.

This year, every team finished the challenge in good cheer, and while the snow piled up on a cold February day, we were barefoot, poolside, and flying ROVs.



RESILIENCE: A HISTORY OF CORDOVA

CATHY SHERMAN
City of Cordova
acm@cityofcordova.net

Cordova sits at the ebb and flow of the waters of Orca Inlet and Prince William Sound. For over a century, this hard-working fishing community has been at the mercy of the natural resources that sustain it.

The cyclic nature of life in Cordova has made it one of the most resilient communities in Prince William Sound. Starting out as home to the Eyak people, life revolved around the seasons and the

harvest of the salmon. As other people discovered these resources, the community of Cordova began to grow with canneries, a railroad, a mining industry, and busy port. A boomtown in the 1920s and 1930s, the town became worried when the mine and railroad closed in 1938. What was to become of the community?

A word often used to describe this feisty little coastal village is resilient. Cordova's mainstay of commercial fishing continued to sustain the community as it prospered and grew with aviation, U.S. Coast Guard, a movie theater, and bowling alley. But once again, a shattering event led many to wonder

how Cordova would recover. In May of 1963, a devastating fire eliminated an entire city block of the community, the heart of the business district.

Cordova rebuilt, and within one year, was back in business...just in time for the Good Friday earthquake that raised the land around the coast an average of six feet, affecting the harbor and clam fishery. Twenty-five years later, as the fisheries boom hit its peak, the Exxon Valdez hit Bligh Reef putting an end to the herring fishery and the influx of early income to this fishing community.

Today, Cordova remains a vital coastal town investing in and diversifying its economic base with the addition of the Cordova Center, a multi-purpose facility that adds a new economic driver with conference space and cultural amenities, as a reward for the resilient residences that call this place home.

FAR LEFT: The 1964 earthquake affected Cordova by raising the land an average of six feet, toppling houses into the sloughs, collapsing the saw mill and creating havoc with large fissures in the Copper River Highway.

CENTER: When the Exxon Valdez tanker ran aground on March 24, 1989, efforts to clean the beaches of the crude oil were extensive and not all that successful.

RIGHT: The 1963 fire that devastated an entire city block of Cordova's business district began when a fuel tank exploded inside the Club Bar. Residents worked to save all the store merchandise and belongings of apartment residents as the fire roared through the town.

Photos courtesy of Cordova Historical Society

OIL-RELATED

LOCAL FISHERMEN HELP CLEAN UP OIL SPILLS

AMANDA JOHNSON
Prince William Sound Regional Citizens' Advisory Council
amanda.johnson@pwsrcc.org

Alaskans learned many lessons from the 1989 *Exxon Valdez* oil spill. We now put more emphasis on the protection of shorelines and wildlife. Sensitive areas, such as fish hatcheries, are identified ahead of time and response tactics are prepared to protect them from spilled oil. These tactics, called “nearshore response,” are a major component of modern spill response in Alaska. Fishing vessels form the backbone of nearshore response.

After the spill, local fishermen’s expert knowledge about the region became a valuable resource for the response. Today, Alyeska Pipeline Service Company’s oil spill response organization, Ship Escort/Response Vessel System, or SERVS, contracts with approximately 400 fishing vessels to respond and help clean up if an incident occurs. These fishing vessels are based in communities in Prince William Sound, the Kenai Peninsula, and Kodiak



Tangled oil spill boom from the *Exxon Valdez* oil spill. Photo: Charles N. Ehler, courtesy of Alaska Resources Library and Information Services.

Island, and can be on scene very quickly.

SERVS trains the vessels’ crews in response tactics every year. The training includes classroom instruction on equipment and tactics for collecting oil, plus on-water activities where crews have a chance to deploy and tend oil spill skimmers and boom.

In April 2016, the Council sponsored a tour of the training for Seward residents. A Cordova tour is planned for May 2017, Whittier in 2018, and other local communities in future years.



Seward residents watch responders practice deploying oil spill containment boom and skimmers in April 2016. Photo: Cathy Hart

PORT VALDEZ CIRCULATION AND DRIFTER EXPERIMENTS

SHELTON M. GAY III
Prince William Sound Science Center
smg3tx@gmail.com

In June and September 2016, two of three circulation experiments were performed in Port Valdez, Alaska using drifters at the surface, and 1-meter, 10-meter, and 40-meter depths. Data on currents, temperature, and salinity were also collected using an acoustic Doppler current profiler (ADCP) and a conductivity, temperature and depth (CTD) profiler respectively. The goals of the study are to figure out what conditions cause spilled oil, with dispersants applied to it, to either remain within the Port or be flushed out into Prince William Sound.

The two experiments showed that variations in water density (which is af-

fectured by temperature and salinity) creates a background circulation around Port Valdez that interacts with the tides to form moderate currents of 10 to 15 centimeters per second in the upper 15 meters in June. In September, those currents increase in both speed (25 to 35 centimeters per second) and depth (25 to 30 meters). This is due to partial mixing and deepening of the seasonal changes in the water column temperature and salinity.

In contrast, the surface and 1-meter currents are primarily driven by combinations of estuarine flow (where freshwater meets up with sea water) and either up-fjord sea-breeze winds in June or by down-fjord winds in September. The ADCP also showed persistent counterclockwise currents at 7 to 15-meter depths that were



▲ A 150 kHz ADCP used to measure currents housed in a depressor fin. Photo: Dave Janka

traced by the 10-meter drifters. Rapid and lengthy excursions of the surface and 1-meter drifters indicate that materials at these depths may quickly disperse within the Port, whereas the deeper flows would move material in slower eddy motions.

EXXON VALDEZ A TIMELINE

MARCH 23, 1989:

On March 23, 1989, the oil tanker *Exxon Valdez* left the Valdez Marine Terminal at 9:12 p.m., bound for California with a full load — approximately 53 million gallons — of North Slope crude oil.

The tanker Captain, Joe Hazelwood, was granted permission to change course to avoid icebergs from nearby Columbia Glacier. He gave orders to the Third Mate to maneuver the tanker to the new course and then retired to his quarters. For reasons that remain unclear, the tanker was never returned to its proper course.

MARCH 24, 1989:

Just after midnight on March 24, the *Exxon Valdez* oil tanker grounded on Bligh Reef, spilling at least 11 million gallons of crude oil into Prince William Sound, the largest oil spill in U.S. waters.

The initial response to the spill was slow, uncoordinated, and ineffective. Seas and winds were calm for three days, but almost no response equipment was available.



MARCH 27, 1989:

On March 27, a storm blew in with winds up to 70 mph, spreading the oil spill to the southwest along at least 1,400 miles of shoreline (see figure, above).




More information on the immediate and long-term impacts of the spill, as well as links to other oil spill resources can be obtained from the legacy organizations established after the spill.

- ▶ The *Exxon Valdez* Oil Spill Trustee Council oversees the 1991 \$900 million civil settlement for restoration of injured resources and services. The restoration plan includes habitat protection, research and monitoring, and direct restoration.
www.evostc.state.ak.us
- ▶ The Oil Spill Recovery Institute was established by Congress in 1990 to focus on improved technologies and ecological research related to oil pollution in the marine environment of Arctic and Subarctic regions.
www.pws-osri.org
- ▶ The Prince William Sound Regional Citizens' Advisory Council is an independent nonprofit organization whose mission is to promote environmentally safe operation of Alyeska Pipeline's Valdez Marine Terminal and associated oil tankers.
www.pwsrcc.org

OCEANS

MARINE DEBRIS

CLEANUP AND RECYCLING PROJECT



CHRIS PALLISTER
Gulf of Alaska Keeper
chris@goak.org

During a 2016 project funded by the government of Japan through the Alaska Department of Environmental Conservation, Gulf of Alaska Keeper (GoAK) crews removed 1,200 Super Sacks and loose items totaling 300 tons of plastic debris from ten miles of shoreline on Montague Island and Kayak Island. The collected debris was slung by helicopters onto a barge and shipped to the North Star Terminal & Stevedore yard in Anchorage. Over a five-day period, up to 100 volunteers sorted the debris for recycling. Parley for the Oceans partnered with GoAK and funded the successful recycling effort that filled 12 shipping containers with recyclable plastic.

This was the ninth consecutive season of cleanup work on Montague Island and the third on Kayak Island. The long-term cleanup project along the shore of heavily-fouled Montague Island is expected to take up to another eight years to complete, if adequate funding is secured. An estimated 1,500 tons of plastic debris remain on the uncleaned portion of Montague Island's Gulf of Alaska shoreline. Plastic debris density along this remote coast is 20 to 30 tons per mile, posing a serious threat to both marine and terrestrial wildlife. Wildlife will recover if habitat is rehabilitated.

▲ Montague Island's Gulf of Alaska coast has immense deposits of plastic marine debris ranging between 20 and 30 tons per mile. *Photo: Erik Pallister*

◀ Paradigm Marine tug and barge loaded with 1,200 Super Sacks of plastic debris removed from Montague and Kayak Islands; departing Montague Island for Anchorage. *Photo: Scott Groves*

▲ Two Alpine Air helicopters sling plastic marine debris from Montague Island's Gulf of Alaska shoreline. *Photo: Erik Pallister*

SAY CHEESE, PLANKTON! A PROFILING PLANKTON CAMERA IN PRINCE WILLIAM SOUND

ROB CAMPBELL
Prince William Sound Science Center
rcampbell@pwssc.org

Plankton form the base of the marine food web. Tiny single-celled plant plankton (phytoplankton) grow and are consumed by animal plankton (zooplankton) grazers. Zooplankton are in turn prey for larger animals like fish, birds and whales. The amount and type of plankton change over time, and measuring them is not easy. Going out and collecting them on ships costs thousands of dollars per day. After that, much more money is needed to pay heroic taxonomists to identify everything that is in the sample. But new technologies are in development to estimate plankton abundance.

In 2016, researchers at the Prince William Sound

Science Center and the Scripps Institution of Oceanography developed an in-water plankton camera that was installed on an autonomous robotic profiler that is deployed every year in central Prince William Sound. The 2016 deployment included almost 500 twice-daily profiles from 60 meters (200 ft) to the surface. It collected just over 1.6 million images of individual plankters. Work in 2017 is ongoing to identify the type of plankton in each image, using Deep Learning techniques similar to those used by Google to automatically identify images on the internet.

Figure: A selection of images of plankton captured by the plankton camera in 2016. ►



PRINCE WILLIAM SOUND

“WILDERNESS CHARACTER” TRENDS IN WESTERN PRINCE WILLIAM SOUND

TIM LYDON

U.S. Forest Service Chugach National Forest
tlydon@fs.fed.us

The first assessment of “wilderness character” trends is underway for lands in western Prince William Sound, covering a five-year period ending in 2016.

Chugach National Forest lands in western Prince William Sound fall within the Nellie Juan-College Fiord Wilderness Study Area, designated by Congress in 1980 through the Alaska National Interest Lands Conservation Act. The two million-acre area includes lands in Columbia Bay, Knight Island, Harriman Fiord, Port Bainbridge, and nearby areas.

“Wilderness character” is derived from the 1964 Wilderness Act. Nationally, the Forest Service and other agencies define it to include the four qualities referenced below. Chugach National Forest policy is to preserve the wilderness character of the Wilderness Study Area.

Chugach National Forest is using nationally developed protocols to analyze trends in the following qualities of wilderness character:

- ▶ **UNTRAMMELED QUALITY** (natural processes are free from intentional manipulation).
- ▶ **NATURAL QUALITY** (natural condition of air, water, and plant/animal populations).
- ▶ **UNDEVELOPED QUALITY** (amount of structures or motorized uses).
- ▶ **SOLITUDE QUALITY** (remoteness from people or modified lands).

Importantly, data describe specific lingering impacts to wilderness from the 1989 *Exxon Valdez* oil spill (EVOS). The Wilderness Study Area remains listed as an injured resource by the EVOS Trustee Council. The analysis currently underway can inform continued restoration of the area.



▲ Chugach Children's Forest crew after working to remove a collapsed and abandoned structure in the Wilderness Study Area. Photo: Chugach National Forest

CHUGACH CHILDREN'S FOREST CONNECTS YOUTH TO SCIENCE

TIM LYDON

U.S. Forest Service Chugach National Forest
tlydon@fs.fed.us

The Chugach Children's Forest is a partnership between Alaska Geographic and Chugach National Forest. In 2017, for the seventh year, they will sponsor three expeditions connecting young people to science and stewardship in Prince William Sound. The program provides hands-on experience—and lifetime memories—for students from across Alaska, who are nominated for the program by their teachers.

Two of the expeditions are ten-day kayak trips in the Wilderness Study Area of western Prince William Sound. Students will accomplish work projects from Eshamy Bay to Harriman Fiord. The projects, developed and supervised by Chugach National Forest specialists, include removing marine debris and invasive species and collecting visitor trend data.

The third expedition entails six days aboard the *M/V Babkin*, under the leadership of Lisa Matlock of Prince William Sound Regional Citizens' Advisory Council. Students will gain experiential knowledge of retreating glaciers, hatchery fish production, seabird research, and lingering oil from the *Exxon Valdez* oil spill.

Consistent with the goals of the Chugach Children's Forest, the expeditions connect youth from Alaska's diverse communities with science, stewardship, and career and leadership opportunities, all while providing an opportunity to explore the public lands.

- ▶ Visit the Chugach Children's Forest at www.chugachchildrensforest.org, Twitter @ChugachCF and Facebook @chugachchildrensforest.



Camping with a view in the Wilderness Study Area. Photo: Chugach National Forest

FOR MARINE LIFE ON THE SOUND'S ROCKY SHORES, THE CONSTANT IS CHANGE

ALAN MEARNS

NOAA
alan.mearns@noaa.gov

During summer 2016, volunteers returned to six shoreline sites in western Prince William Sound, adding photographs to a 27-year visual story of changes in the abundance of marine life. The photos clearly show how much the abundance of seaweeds, mussels, and barnacles

changes from year to year. At each site, marine life has gone from nearly 100-percent cover in some years to nearly zero in others, at intervals of four to ten years.

Volunteers include scientists who visit the site while conducting other oceanographic and marine ecology monitoring studies, and citizens, such as a resort manager and a charter boat skipper. Photos are emailed

to Dr. Mearns at NOAA who compares the images, estimating and graphing the cover of seaweeds and mussels as they change from one year to the next.

2016 was a very low year for seaweed cover at the six sites visited. Heavy seaweed abundance occurred several years earlier in 2013 and 2014. This is the fourth time in a quarter-century that the abundance of seaweeds has declined, testifying to the great year-to-year variability.

Shorebirds and mammals, such as sea otters, feed on these shores and raise their young nearby. In some years, there is food aplenty. In other years there is hardly anything to eat, so they must move on.

Find your own rock! If you have

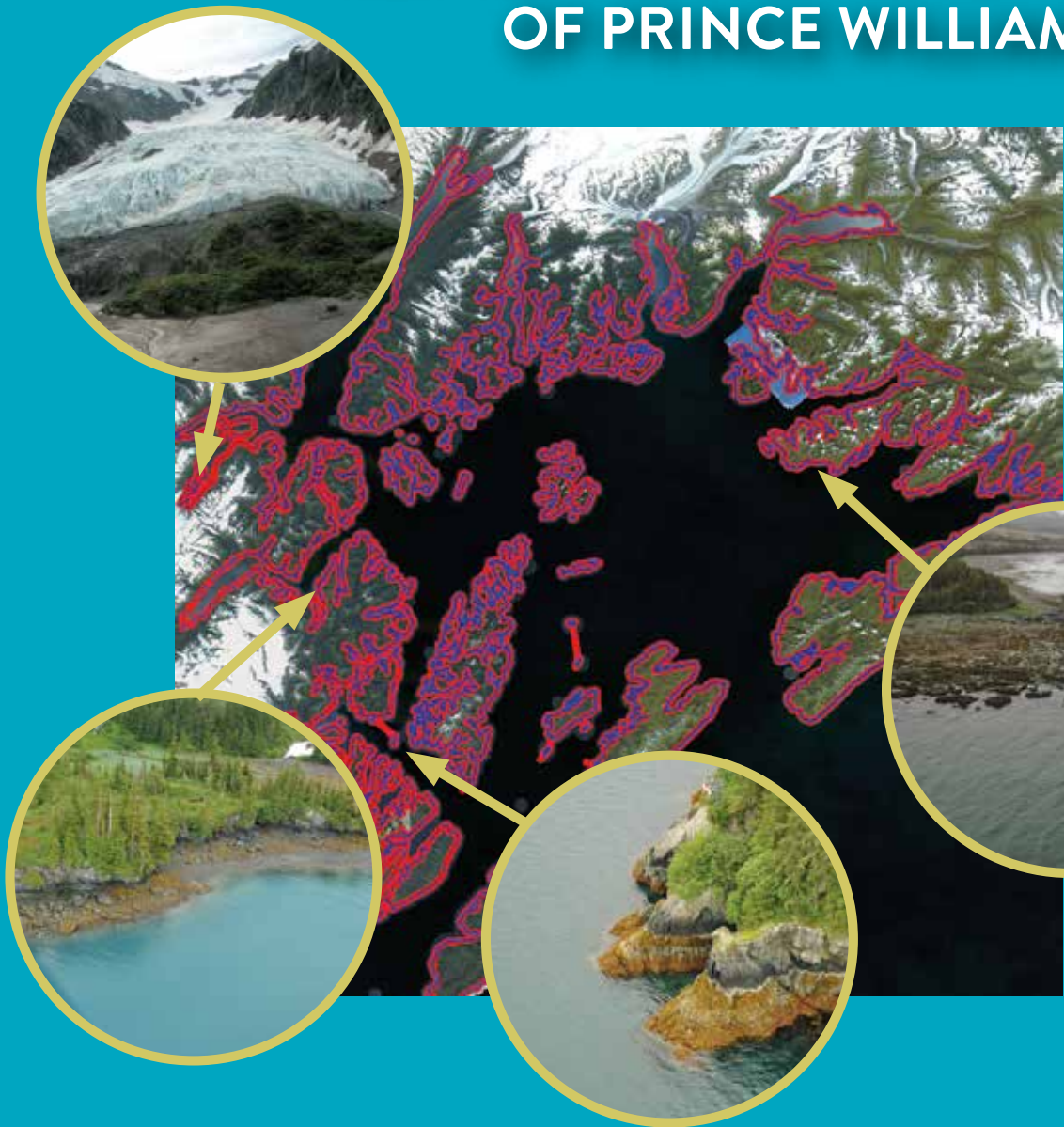
a beach or shoreline you like to visit every year, start taking photos during low tide. Note your GPS position. Save the photos and in a few years compare them. You may be surprised at the changes!

Photos: The changing faces of marine life-on-a-rock between the tides in Shelter Bay, Evans Island. 1990 was a year of heavy barnacle cover. 1993 was a mussel year. 2013 was a barnacle and seaweed year. 2016 was a year of very little cover. Left photos: Alan Mearns; right photos: Rob Campbell. ▼



ALASKA OCEAN OBSERVING SYSTEM

LEARN MORE ABOUT THE ECOSYSTEMS OF PRINCE WILLIAM SOUND



◀ Shorezone is a coastal mapping and classification system provided as a series of layers that can be viewed on the AOOS data portal, Ocean Data Explorer, at AOOS.org.

These layers describe many ecological features on the shoreline like wave exposure, salt marsh vegetation, shore stability, kelp bands, and more.

Additionally, you can view and download high resolution aerial photos and videos taken anywhere in Prince William Sound, and in fact, the entire coastline of Alaska!

It's easy to get more information on an area by going to the Ocean Data Explorer, adding the Shorezone layer, and clicking on the interactive map at the location you want to see or learn more about.

AOOS is seeking short films highlighting Alaska's coast and oceans.

AOOS 2017 Film Contest

Submission Deadline: September 15, 2017

Award categories for both youth and adults

Films must be under 10 minutes

AOOS
Alaska Ocean Observing System

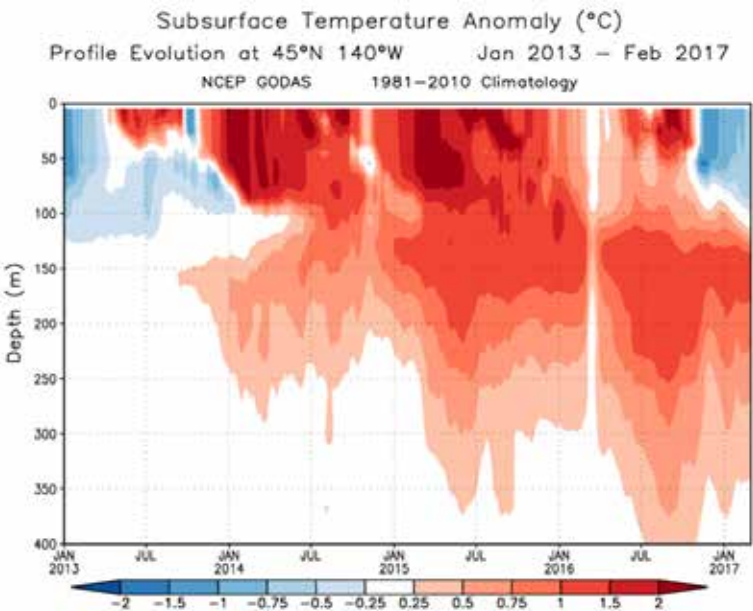
Visit aoos.org for more information

Contact kent@aoos.org with more questions

CHECK OUT THE BLOB

Since 2013, there has been a lot of talk about this thing called The Blob. This refers to a large pool of unusually warm water that developed in the North Pacific Ocean, reaching as far north as the Gulf of Alaska. It describes an area of the ocean where sea surface temperatures have been higher than normal—what scientists call “anomalous”—and, in the Gulf of Alaska, these temperatures have climbed as high as 5 degrees F (3 degrees C) above average during The Blob's peak in 2015.

The Alaska Ocean Observing System's Alaska Blob Tracker blog offers a one-stop status report on The Blob (and El Niño). The blog entries not only cover the story for Alaskan waters but also for waters south to Baja California. Found on the Alaska Ocean Observing System website (AOOS.org), the blog is updated approximately every two weeks. It provides links to science publications and workshops, as well as to the latest news stories on The Blob and its interactions with the more well-known climate event known as El Niño. Local scientific experts also contribute to the blog, adding their findings on how these oceanic conditions are affecting the surrounding region's weather, marine life, and overall environmental conditions.



► For the latest news about The Blob and its effects on Alaska, visit Alaska Blob Tracker at: alaskapacificblob.wordpress.com

ALASKA OCEAN OBERVING SYSTEM

ALASKA'S INFORMATION HUB FOR OCEAN ACIDIFICATION



AOOS established the Alaska Ocean Acidification Network in 2016 to engage with scientists and stakeholders to expand the understanding of ocean acidification (OA) processes and consequences in Alaska.

Why is ocean acidification a concern for Alaska?

Some of the species most susceptible to OA often include the basis of the food chain, so researchers expect the effects of OA to be felt throughout the marine ecosystem. This could dramatically affect the lives and livelihoods of Alaskans, including many who rely on wild foods and the \$5.8 billion Alaska seafood industry. OA in Alaska is happening faster than other region due to its cold ocean waters and distinct circulation patterns.

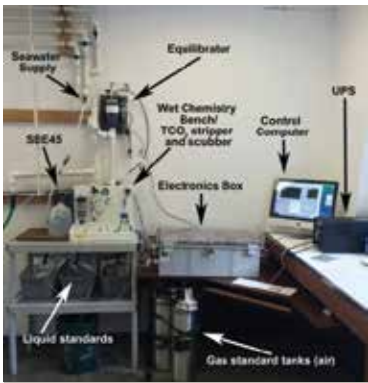
How can you get involved?

- Browse the website to learn more about OA, including the current state of the science;
 - Find information on monitoring projects close to you;
 - Use the Expert Database to connect with researchers working on OA issues; and
 - Join the monthly list serve to learn about OA-related news and findings.
- www.aos.org/alaska-ocean-acidification-network



Alaska Ocean Acidification Network

▲ Fixed moorings provide continuous data throughout the water column. The "GAKOA" mooring, shown here, is located at the mouth of Resurrection Bay near Seward, and has been collecting real-time, year-round data on ocean acidification since 2011.



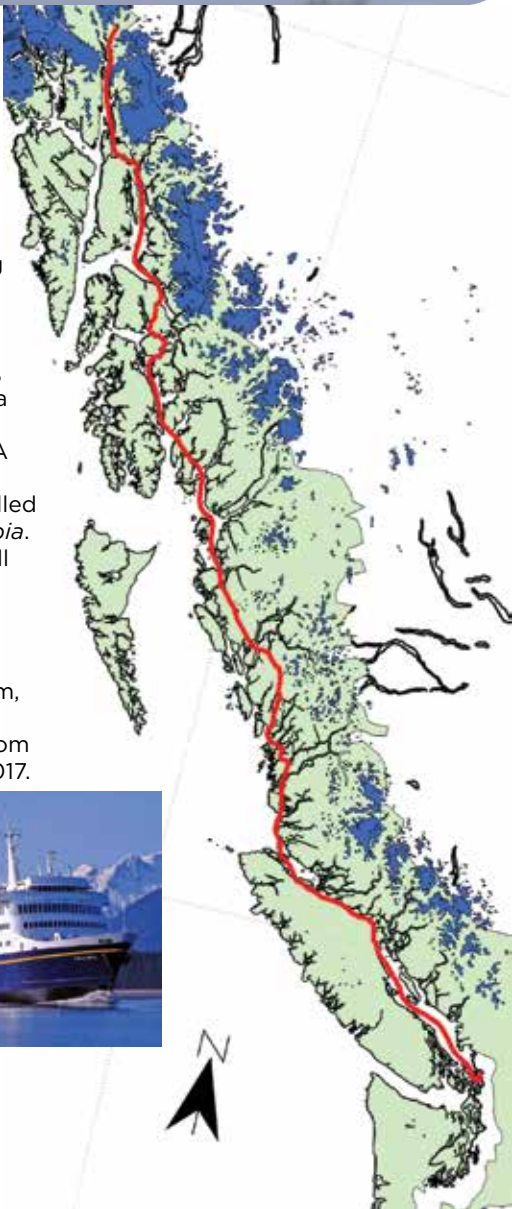
Burke-O-Lator systems measure multiple parameters in the carbon system, providing a clear picture of ambient ocean conditions in real time. While usually connected to a shore-side, flow-through system onsite, they can also analyze discrete water samples collected from around the region. Burke-O-Lators are currently located at the Alutiiq Pride Shellfish Hatchery in Seward and Oceans Alaska hatchery in Ketchikan, and will be installed in Sitka and Kodiak in 2017.



▲ Autonomous vehicles can monitor large geographic areas over weeks or months at relatively low cost. The wave glider (right) was used during a multi-faceted study in Prince William Sound in 2014 in concert with shipboard surveys, fixed platforms, an instrumented tour boat, and an underwater glider (above) to better understand the effects of currents and glacial outflow on seawater corrosivity.



AOOS is partnering with the Alaska Marine Highway, the Hakai Institute in British Columbia, University of Alaska Southeast and NOAA on a new OA monitoring system that has been installed on the *M/V Columbia*. This ferry vessel will collect important OA data during its twice-weekly 1,600 kilometer trips between Bellingham, Washington and Skagway, Alaska from April to October 2017.



GULF WATCH ALASKA

GULF WATCH ALASKA MONITORS ECOSYSTEM HEALTH

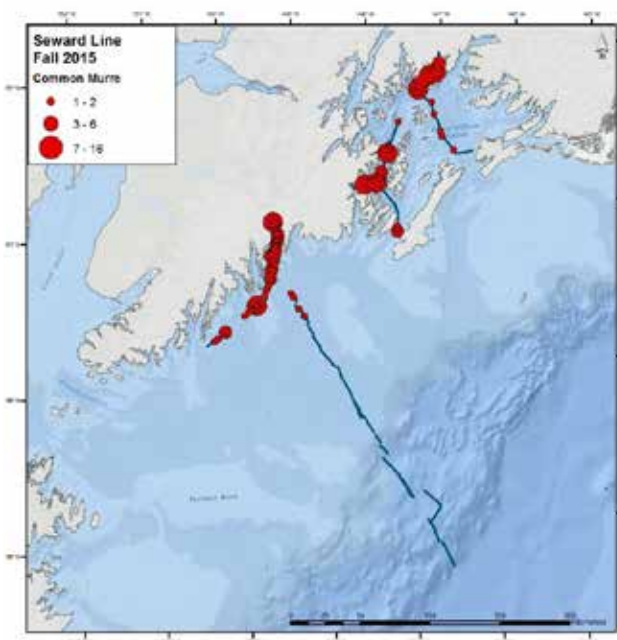
DONNA ADERHOLD
Gulf Watch Alaska
Donna.aderhold@noaa.gov

Just as people see doctors for annual health checkups, Gulf Watch Alaska scientists monitor the health of the Gulf of Alaska ecosystem via projects that measure physical oceanography, marine species ranging from plankton to whales, and nearshore species ranging from seaweed to otters. Gulf Watch Alaska is in year six of a twenty-year program, and scientists are already discovering information important to marine resource management. For instance, Gulf Watch Alaska tracked the Pacific warm anomaly, also known as The Blob, from its start in late 2013 and documented its effect on the Gulf of Alaska shelf, Prince William Sound, and lower Cook Inlet through 2016. As water temperatures rose, phytoplankton and zooplankton shifted to species more common in warmer waters, harmful algal blooms occurred, the distribution of small fish that form the base of the marine food chain changed (see forage fish article), large numbers of Common Murres died and Black-legged Kittiwakes failed to nest (see seabird article), and humpback whales changed their movement patterns as they searched for herring schools.

Some projects included in Gulf Watch Alaska originated following the 1989 *Exxon Valdez* oil spill, including the nearshore and killer whale projects. The longevity of the nearshore project has allowed scientists to document a decline in some clam species that are harvested by humans and important prey for birds and marine mammals (see clam article). Killer whales, long-lived and slow to reproduce, were affected differently by the spill; some populations are recovering while others are not (see killer whale article).

Gulf Watch Alaska is the long-term ecosystem monitoring program of the *Exxon Valdez* Oil Spill Trustee Council, and is a collaboration of 13 projects, 10 organizations, and more than 30 scientists with diverse areas of expertise.

- Visit us at:
<http://www.gulfwatchalaska.org/>
- Find data at the Gulf of Alaska Data Portal:
<http://portal.aaos.org/gulf-of-alaska.php>



◀ During September 2015 surveys conducted as part of the Seward Line project, Common Murres were found in inshore waters more than typical for that time of year, particularly in Resurrection Bay and Prince William Sound. The Seward Line project is funded by the North Pacific Research Board and led by Dr. Russ Hopcroft (University of Alaska, Fairbanks), with Dr. Kathy Kuletz the principal investigator for the seabird component.

UNUSUAL OBSERVATIONS OF SEABIRDS IN THE GULF OF ALASKA FOLLOWING THE 2015-2016 MASS DIE-OFF

BY ROBB KALER AND KATHY KULETZ
U.S. Fish and Wildlife Service
robert_kaler@fws.gov; kathy_kuletz@fws.gov

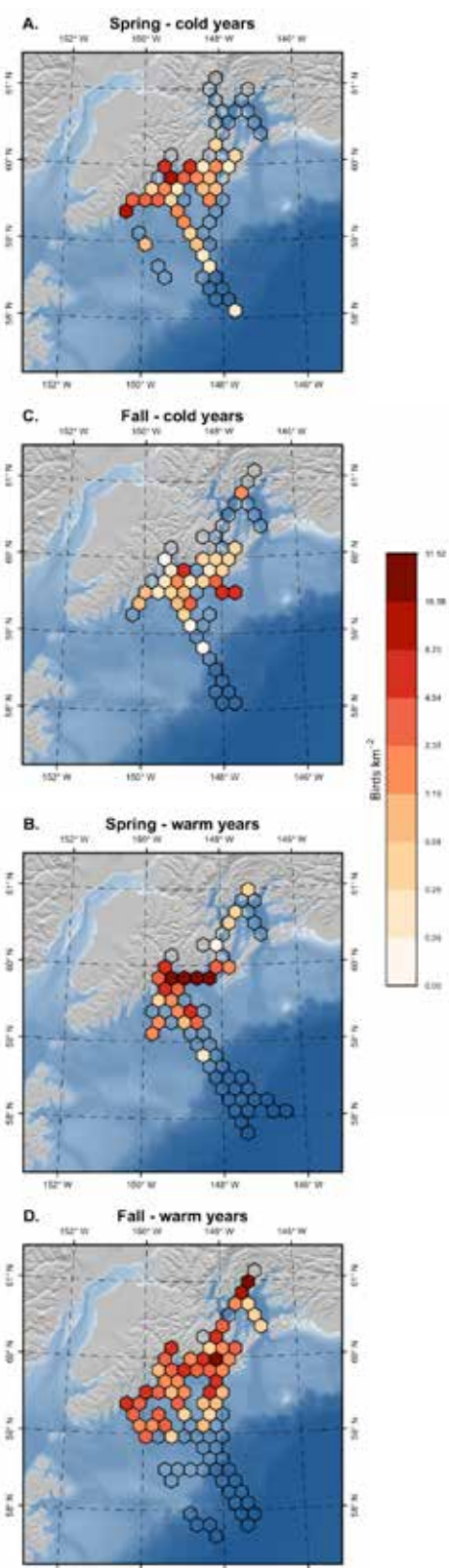
DON DRAGOO AND HEATHER RENNER
Alaska Maritime National Wildlife Refuge
don_dragoo@fws.gov; heather_renner@fws.gov

The 2015-2016 seabird mortality event observed in the Gulf of Alaska (GOA) was unprecedented in duration, geographic scale, and magnitude compared to previous Alaskan seabird die-offs. Based on surveys and necropsies of birds washed ashore, at least several hundred thousands of birds starved and died. Additionally, 2015 was the first time in over 40 years of colony monitoring by biologists at the Alaska Maritime National Wildlife Refuge (AMNWR) that complete breeding failure was observed at several Common and Thick-billed Murre colonies in the GOA. Biologists were eager to see if effects of the mass winter die-off would be detectable at summer breeding colonies in 2016, either in number of birds observed at colonies or breeding success. Unfortunately, Common Murre and Black-legged Kittiwake population trends declined at monitored colonies in the GOA in 2016. Furthermore, AMNWR biologists noted breeding failure at several colonies across the state, including colonies in the GOA.

Seabirds are highly mobile, and one way they can respond to changes in prey availability is to search for food elsewhere. Thus, biologists were also interested in changes in distribution of seabirds at sea, which can be an indication of changes in the marine system. Marine bird surveys conducted as part of the Gulf Watch Alaska program found that in contrast to most years, in 2015 and 2016 species typically found across the GOA shelf were concentrated closer to the coast. Murres and kittiwakes primarily eat small fish, and the observed shift in distribution of these seabirds indicates that prey were not available throughout most of the GOA shelf. Shifts were most notable for Common Murres, with large numbers observed in the upper bays and fjords of the Kenai Peninsula and Prince William Sound. Murres were even found at large inland lakes and rivers, presumably searching for food.

The widespread starvation, lack of breeding, and changes in at-sea distribution, are likely linked to record-breaking high sea surface temperatures associated with a strong El Niño event, and The Blob of unusually warm water observed in the North Pacific Ocean. Continued monitoring and collaborative research are crucial to understand the relationship between marine predators (birds) and their prey.

Distribution and abundance of Common Murres during warm (2010, 2014, 2015) and cold (2007, 2008, 2009, 2013) years during spring and fall. Density values of 3-kilometer transects were averaged using 20-kilometer hexagonal grid cells (spring 2010 was not surveyed). These surveys were conducted as part of the Seward Line project, which is currently funded by the North Pacific Research Board and led by Dr. Russ Hopcroft (University of Alaska, Fairbanks), with Dr. Kathy Kuletz the principal investigator for the seabird component. ►



GULF WATCH ALASKA

FORAGE FISH IN HOT WATER CONTRIBUTE TO SEABIRD DIE-OFF

MAYUMI ARIMITSU, JOHN PIATT,
SARAH SCHOEN AND BRIELLE HEFLIN
U.S. Geological Survey Alaska Science Center
marimitsu@usgs.gov; jpiatt@usgs.gov;
sschoen@usgs.gov; bheflin@usgs.gov

Forage fish are sensitive to changes in their environment, especially ocean temperatures. Changes in prey abundance also influence marine predators. For example, following an extended period of warming in the Gulf of Alaska (A.K.A. the The Blob), in the winter of 2015-16 there was a widespread seabird die-off in the North Pacific. This event included more than 16,000 beach-cast Common Murre carcasses in Prince William Sound alone. Researchers at the U.S. Geological Survey Alaska Science Center conducted necropsies of dead murrelets from the Sound and found the birds were emaciated. Food supply was an important contributing factor to the die off.

Ongoing research in Prince William Sound by the Gulf Watch Alaska forage fish team identified several middle trophic level signals

during summer of 2015 that may have contributed to the seabird die-off later that winter. Capelin, a small pelagic fish species that is especially sensitive to ocean warming, had lower body condition in 2015 compared to 2012 to 2014. Capelin also experienced recruitment failure by summer 2016 when the previous year class was absent from summer acoustic-trawl surveys in the Sound. Additionally, acoustic indices of forage fish abundance were lowest in 2015 compared to 2014 or 2016. This was largely driven by low abundance of age-0 walleye pollock, which were widely distributed and abundant within the system in other years, especially 2012. Many of the forage fish patterns observed in Prince William Sound reflect those of the larger Gulf of Alaska ecosystem, and continued monitoring provides important information on this key ecosystem component.



▲ A killer whale swings past the boat to investigate the hydrophone we have deployed over the side. Photo: Craig Matkin

TRACKING WHALES WITH REMOTE HYDROPHONES

CRAIG MATKIN
North Gulf Oceanic Society
comatkin@gmail.com

The resident (fish eating) killer whales in Prince William Sound like to talk. More accurately, they have a distinctive set of calls they use to communicate when feeding and socializing. They also produce echolocation clicks when searching for the fat, oil-rich salmon that are their primary food. Over the years, by recording the different pods that use the Sound, we have discovered that each pod produces its own distinct calls (or dialect) that can be used to identify them, even when we can't photograph them. The North Gulf Oceanic Society and Prince William Science Center recently began a program to track these whales and examine their year-round use of the Sound—using sound. We are deploying and retrieving self-contained SoundTrap hydrophones that preserve the acoustic record of areas where they are deployed.

The locations for these hydrophones include Hinchinbrook Entrance and Montague Strait and mid-Sound—areas we have identified as important for resident killer whales. Previously, a long-term tracking program using tags that transmitted whale locations to satellites determined the range of the pods and the habitats important to them. Based on this knowledge, we can use the less invasive passive listening provided by our SoundTrap hydrophones to monitor whale presence or absence year-round. Hydrophones can be placed on the ocean bottom, and preferably, on oceanographic buoys. We will use recently developed software to sort the killer whale calls, saving many hours listening to recordings. Our first trial deployments provided exciting results, encouraging us to move forward with the project. The hydrophones also monitor vessel traffic and provide data on intensity of manmade underwater noise at the deployment locations. The project is a collaboration with oceanographer Rob Campbell at the Prince William Sound Science Center.



◀ Graeme Ellis (left) and Dr. John Ford (right) ready to deploy one of the SoundTrap hydrophones, which is encased in PVC pipe. Photo: Craig Matkin

UNHAPPY AS A CLAM?

BENJAMIN WEITZMAN
U.S. Geological Survey Alaska Science Center
bweitzman@usgs.gov

Clams are important resources for a plethora of nearshore residents, from sea otters and sea stars, to sea ducks, bears, and humans. Historically, clams were more abundant, supporting Alaskan commercial and sport fisheries. However, major declines in clam abundance have resulted in fisheries closures, except for limited subsistence and sport harvest. Researchers with the Gulf Watch Alaska nearshore component are monitoring clam abundances in Katmai National Park & Preserve, Kachemak Bay, Kenai Fjords National Park, and Prince William Sound to better understand



▲ A researcher holds a handful of clams from a beach in Katmai National Park. All bivalves found on a beach are collected for identification and measurement. This handful depicts the diversity of clams potentially observed during a sampling event. Photo: Jim Pfeifferberger

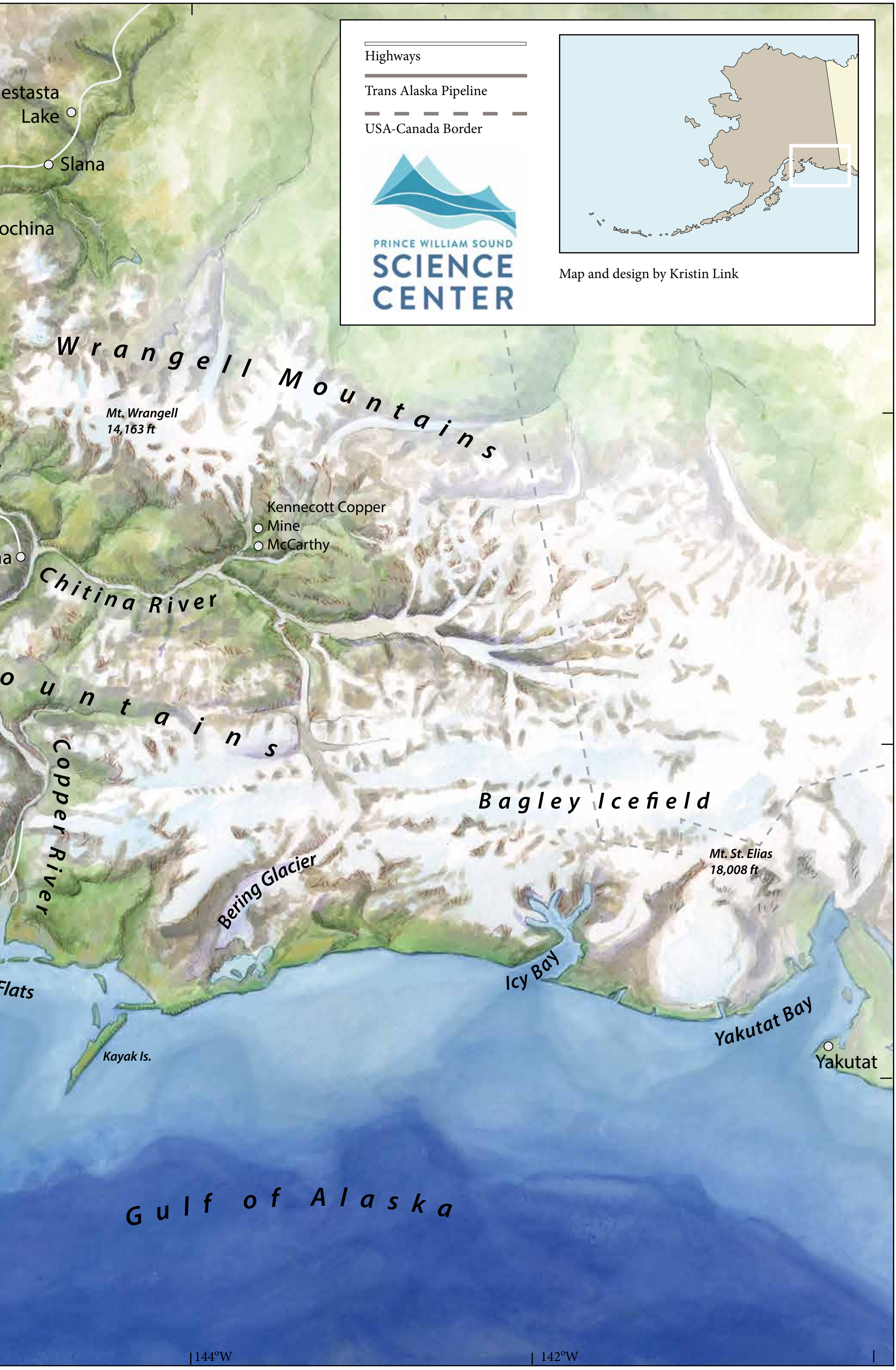
how and why clam abundance changes over space and time.

Declines of clams across the north Pacific occurred synchronously, around the early 2000s, and declines were apparent

in both adult and juvenile clams. While it is easy to assume that human harvest combined with increasing sea otter predation could be the cause, it is possible that the story has just as much to do with changing environmental conditions. These changing conditions could be limiting survival of clams in their early life stages. Clams have a complex life cycle: beginning as planktonic larvae in the water column until settling on a beach, metamorphosing into a juvenile clam, and surviving and growing to become a reproductive adult. Therefore, the number of adults can be limited by effects on early life stages, when clams are most sensitive to changes in temperature or ocean chemistry. The scope of observed declines suggests that large-scale environmental drivers may be at play, but more research is necessary. With continued monitoring of clams and their environment as part of Gulf Watch Alaska, scientists and the community will have a better understanding of the factors shaping clam abundance in the Gulf of Alaska.

Underwater image
of a capelin school.
Photo: Jonathan Felis





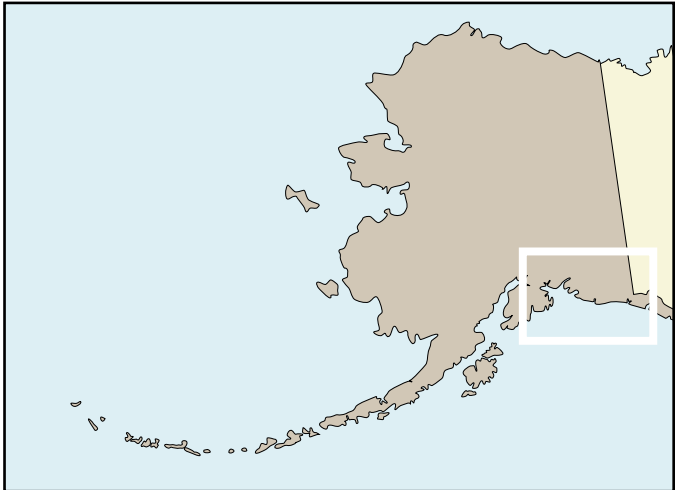
Highways

Trans Alaska Pipeline

USA-Canada Border



PRINCE WILLIAM SOUND
**SCIENCE
CENTER**



Map and design by Kristin Link

Mt. Wrangell
14,163 ft

Kennecott Copper
Mine
McCarthy

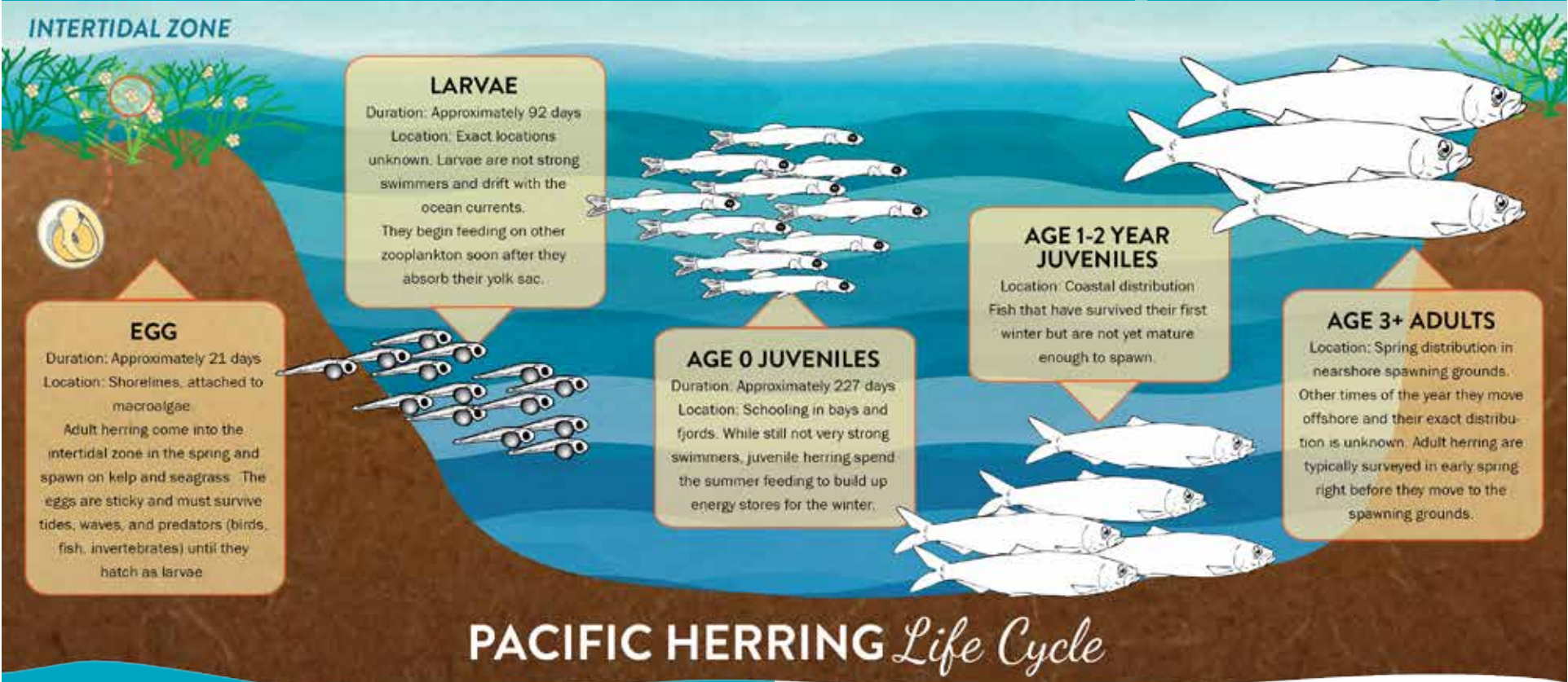
Mt. St. Elias
18,008 ft

Yakutat

| 144°W

| 142°W

HERRING RESEARCH & MONITORING



THE NEED FOR HERRING RESEARCH AND MONITORING

HAYLEY HOOVER
Prince William Sound Science Center
hhooover@pwssc.org

In the decades prior to 1990, there was a large and healthy Pacific Herring population in Prince William Sound. Not only are these forage fish a key link in the complex food web of the Sound, they once supported a lucrative commercial fishery that brought the region to life each spring. By 1993, that fishery had closed. The current stock of nineteen thousand tons is well below the historical peak of 130 thousand tons.

The cause of this dramatic stock decline is still being debated. Was it the *Exxon Valdez* oil spill, or could the decline be attributed to disease, climate change, predation, natural cycles, or a combination of these factors? While the reason for the decline is still undetermined, it is more important to understand what is preventing the herring population from recovering.

Today, researchers from multiple institutions are working to determine why stocks of herring in the Sound remain depressed. With funds from the *Exxon Valdez* Oil Spill Trustee Council (which oversees settlement funds between Exxon and state and federal agencies), a group of research and monitoring projects were designed to improve predictive modeling of herring stocks. This work is complementary to the Gulf Watch Alaska program, which examines the nearshore and pelagic ecosystems, as well as lingering oil and environmental drivers. Together, these programs give us a better idea of what is going on in our waters.



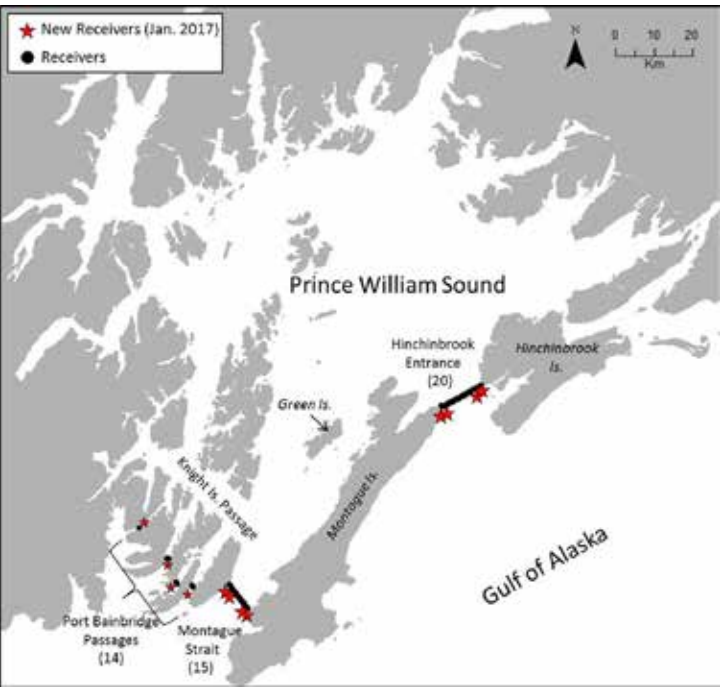
ONCE DONE SPAWNING WHERE TO NEXT?

MARY ANNE BISHOP
Prince William Sound Science Center
mbishop@pwssc.org

Ask any local fisher what their favorite time of year is and most will tell you—spring herring season. That is when Prince William Sound comes alive with humpback whales, sea lions, porpoises, and lots of gulls and murre. They all feast on huge herring schools as they move to more shallow waters and then into shore to spawn. Herring are iteroparous—that is, they reproduce (spawn) several times during a lifetime. After spawning, herring typically migrate to summer feeding areas. We wanted to know where those feeding areas were. In 2013, with funding from the *Exxon Valdez* Oil

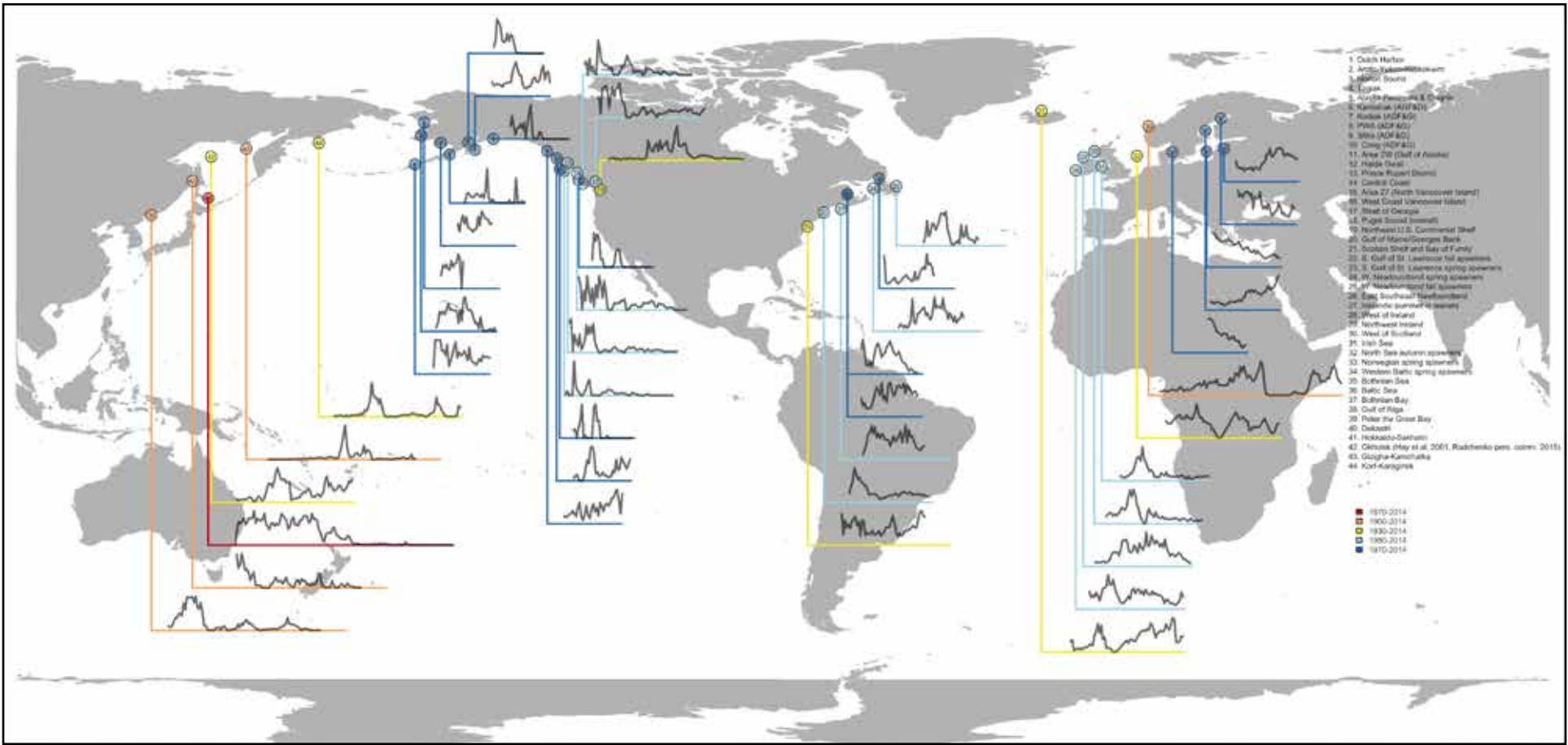
Spill Trustee Council, we internally implanted acoustic-tags into 69 herring just prior to spawning. Interestingly, we found that after spawning, over 60 percent of the herring went to the major entrances connecting Prince William Sound to the Gulf of Alaska. Their movements were also relatively fast—most herring arrived at the entrances within ten days of their last detection at the Port Gravina spawning grounds! While we detected the fish at the entrances using the Ocean Tracking Network's underwater arrays, we could not tell if they then went out into the Gulf of Alaska or stayed in Prince William Sound.

In February 2016, with funding from the *Exxon Valdez* Oil Spill Trustee Council, we added more receivers that will allow us to determine if herring are leaving the Sound after they spawn. For the next three springs, we will be tagging fish on the spawning grounds. In addition to learning if herring leave the Sound, our tags have improved battery life that will allow us to see if herring come back to spawn in the same area the following year.



◀ There are currently six acoustic receiver arrays at the entrances between the Gulf of Alaska and Prince William Sound that are part of the Ocean Tracking Network. Several new receivers were added in 2017 (denoted by stars). The receivers “listen” for tagged herring and record the individual herring and the date and time detected.

HERRING RESEARCH & MONITORING



▲ Pacific and Atlantic herring relative catch trends for populations around the globe. The different colored lines represent the different time frames each record covers.

COMPARING AND CONTRASTING HERRING COLLAPSE

JOHN TROCHTA
University of Washington
johnnt23@uw.edu

TREVOR BRANCH
University of Washington
tbranch@uw.edu

Abundance of Pacific Herring (in Prince William Sound remains low since their initial decline around 1993. Aside from understanding why herring remain low, it is also important to frame herring collapse in the context other herring population trends. How unusual is it for herring to remain this low for this long? To answer this, data on both Pacific and Atlantic Herring populations across the globe were collected and compared.

Records on historical catches, adult abundance, and abundance of juvenile herring, which is an important measure of the production of new adults, reveal that most herring populations experienced collapse in the past 50 years. However, very few of these collapses lasted nearly as long at the collapse of Prince William Sound herring (i.e. >20 years). The worst cases occurred in the largest herring populations (i.e. catches peaked near one-million tons in a single year); more than 50 years for the Hokkaido-Sakhalin herring off northern Japan and about 30 years for the herring in the Norwegian Sea. In both instances, climate and overfishing are the implied causes of collapse. Furthermore, production of new herring in Prince William Sound has remained low unusually long compared to other populations. Altogether, the recent trends in Prince William Sound herring are highlighted as an exceptional case among other herring populations and may suggest unique circumstances occurring here.



▲ Wild Pacific Herring that died during a VHS outbreak. Photo courtesy of Garth Traxler, DFO Canada.

ASSESSING THE IMPACTS OF DISEASE IN PACIFIC HERRING

PAUL HERSHBERGER
U.S. Geological Survey Marrowstone Marine Field Station
phershberger@usgs.gov

Although all animals are susceptible to the impacts of infectious and parasitic diseases, documenting those impacts to wild marine fishes is extremely difficult. Unlike in terrestrial animals, mortalities in marine fishes are extremely difficult to observe. In Pacific herring from Prince William Sound, annual population assessments can effectively deduce periods of elevated mortalities, but these assessments are not capable of identifying the cause(s) of mortality. When investigating the possible contribution of disease to these observed mortality patterns, fish health professionals typically assess the prevalence and intensity of pathogens once a year when herring aggregate to spawn. Unfortunately, some diseases (e.g. viral hemorrhagic septicemia or VHS) occur so rapidly that an annual assessment of infection prevalence and intensity is ineffective at identifying disease impacts.

To address this inherent problem, scientists recently developed an antibody test that is capable of deducing the exposure history of Pacific herring to the virus that causes this disease. We have determined that not only can we detect and quantify these antibodies, but the antibodies persist for extended durations in herring that have survived the disease. These novel findings represent a major advancement in disease surveillance techniques, as this diagnostic tool is capable of deducing whether pre-spawn Pacific herring survived a disease outbreak at any time during the previous year. When paired with annual population assessment data, these new antibody data are capable of determining whether low herring returns may be associated with a prior disease outbreak. Further, because these antibodies render surviving herring completely protected against future outbreaks of the disease, the assay also provides the ability to forecast the potential for future disease outbreaks in Prince William Sound herring.

FISH & WILDLIFE



▲ The Great Sculpin, one of the many sculpins that live nearby. It can reach lengths up to 30 inches. Photo: Stacy Vega

SCULPINS UNSUNG DENIZENS OF THE DEEP

BEN GRAY
Prince William Sound Science Center
bgray@pwssc.org

At the bottom of the sound, among the sand, rock, and kelp, there's a group of armored, spiny, camouflaged, and prehistoric-looking fishes known as sculpins. There are at least 16 species swimming nearby that you probably haven't heard much about because there is no sculpin fishery, and most species are generally not encountered using conventional fishing gear. However, if you've ever fished for halibut, you've likely encountered some of our largest sculpins—the Great Sculpin or the Irish Lord. Each can engulf halibut jigs with ease. Most species are much smaller and are only captured using smaller-meshed nets. So why care about sculpins? Apart from them looking simultaneously bizarre yet positively charming, they play an important role in the food web. Smaller sculpins feed on bottom-dwelling invertebrates, while the largest sculpins consume other fishes, including younger herring. Because sculpins spend most of their lives at the sea bottom, they consume some prey that midwater forage fishes do not normally eat. When sculpins are eaten by other fishes, sea otters, seals, sea lions, or seabirds, they are effectively linking the bottom-dwelling invertebrates to these predators. This process would not be as efficient without these unsung denizens of the deep.



COLLARED BEARS PROVIDE INSIGHTS



▲ Black bear fishing in Prince William Sound stream. Harvest of black bears tripled between 2000 and 2006, and many user groups report seeing fewer bears. Photo: Milo Burcham

**ADAPTED FROM ARTICLE
BY RILEY WOODFORD**
Alaska Fish and Wildlife News
www.wildlifeneews.alaska.gov

Black bear numbers in Prince William Sound aren't what they used to be. Human activity in Prince William Sound, including hunting, has increased dramatically in the past two decades. People who hunt, fish, and photograph wildlife in the area are seeing fewer bears, and they want to know why. Last summer, biologists collared 20 black bears with GPS devices to better understand the area's bears.

The project is a partnership between the U.S. Forest Service and the Alaska Department of Fish and Game (ADFG). Milo Burcham, a wildlife biologist for the Chugach National Forest subsistence program and Charlotte Westing, Prince William Sound Area Biologist with ADFG, outlined the goals: can a boat-based trapping effort capture a representative sample of bears? Are bears using habitats that make them vulnerable to hunting or do they avoid these habitats? Are males and female black bears using these habitats differently?

"On the first question we were pleasantly surprised," Burcham said. "After two trapping sessions in the Sound last summer we captured 25 bears and fitted 20 of those bears with radio collars."

The partnership between the state and federal agencies will continue for several more years.

► Full article can be seen here:
www.adfg.alaska.gov/index.cfm?adfg=wildlifeneews.view_article&articles_id=801



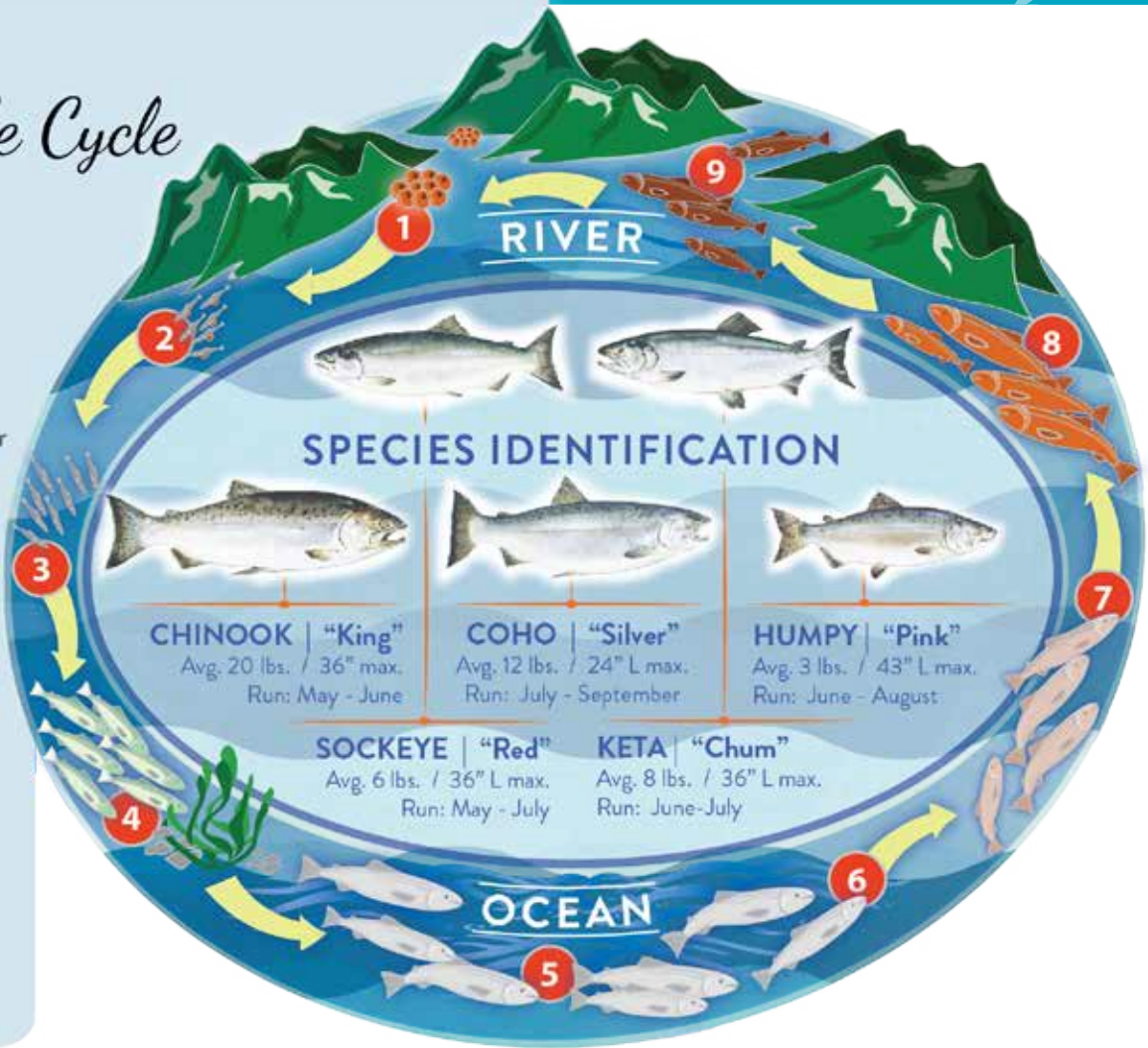
◀ Researchers take measurements and samples as they equip a tranquilized black bear with a satellite GPS collar. Photo: USFS/ADFG

TOP: A black bear walks along the shoreline in Prince William Sound stream. Photo: Milo Burcham

FISH & WILDLIFE

PACIFIC SALMON *Life Cycle*

- 1 Eggs incubate
- 2 Alevins emerge
- 3 Fry migrate to rearing areas and grow into parr
- 4 Smolt leave rivers and adapt in estuaries
- 5 Adults eat and grow
- 6 Mature adults migrate to spawning areas
- 7 Salmon spawn
- 8 Salmon die after they reproduce
- 9 Carcasses recycle nutrients



SALMON FACTS

- Pacific salmon are anadromous, which means they are born in fresh water, migrate to the ocean (salt water) and return to fresh water river systems to reproduce, also known as spawning.
- Salmon change color throughout their lifetimes, particularly as they transition from fresh water to salt water and back again.

CAN YOU SPOT THE BIG 10?

- ☐ Killer whale (*arlluk*)
- ☐ Steller sea lion (*wiinaq*)
- ☐ Sea otter (*ikaamaq*)
- ☐ Harbor seal (*qaigyaaq*)
- ☐ Harbor porpoise (*mangaq*)
- ☐ Sitka black-tailed deer (*pekaa*)
- ☐ Brown bear (*laq-la*)
- ☐ Mountain goat (*sepaaq*)
- ☐ Beaver (*shniq*)
- ☐ Moose (*tunturpak*)



Bird and wildlife checklist

Recommended bird/mammal guide: *Sibley's Field Guide to Birds of Western North America* by David Allen Sibley and the *Guide to Marine Mammals of Alaska* by Kate Wynne. List compiled by the Prince William Sound Chapter of the Audubon Society. u - uncommon | s - seasonal

LOONS AND GREBES

- ☐ Common loon (*tullek*)
- ☐ Red-throated loon
- ☐ Pacific loon (s)
- ☐ Yellow-billed loon (s,u)
- ☐ Horned grebe
- ☐ Red-necked grebe

SHEARWATERS AND PETRELS

- ☐ Fork-tailed storm-petrel
- ☐ Sooty shearwater (u)

CORMORANTS (*agayuq*)

- ☐ Pelagic cormorant
- ☐ Double-crested cormorant

HERONS

- ☐ Great blue heron

WATERFOWL

- ☐ Surf scoter (*unanirllat saqulet*)
- ☐ White-winged scoter
- ☐ Long-tailed duck
- ☐ Barrow's goldeneye
- ☐ Common goldeneye (*qatert'snat*)
- ☐ Bufflehead
- ☐ Harlequin duck
- ☐ Mallard (*ungusaq*)
- ☐ Canada goose (*temngiaq*)
- ☐ Common merganser (*paiq*)
- ☐ Red-breasted merganser

SHOREBIRDS

- ☐ Black oystercatcher
- ☐ Semipalmated plover
- ☐ Least sandpiper
- ☐ Yellowlegs (lesser and greater)
- ☐ Red-necked phalarope (s)

- ☐ Surfbird (s)
- ☐ Black turnstone (s)
- ☐ Dunlin (s)
- ☐ Western sandpiper (s)

GULLS/TERNS (sea gull = *naruyaq*)

- ☐ Glaucous-winged gull
- ☐ Herring gull
- ☐ Mew gull
- ☐ Bonaparte's gull (s)
- ☐ Black-legged kittiwake
- ☐ Parasitic jaeger
- ☐ Pomarine jaeger
- ☐ Arctic tern (s) (*nerusiculiq*)
- ☐ Aleutian tern (s,u)

SEABIRDS

- ☐ Tufted puffin (s) (*ngaqnga*)
- ☐ Horned puffin (s) (*ngaqnga*)
- ☐ Marbled murrelet
- ☐ Kittlitz's murrelet (u)
- ☐ Parakeet auklet (u)
- ☐ Pigeon guillemot
- ☐ Common murre

RAPTORS

- ☐ Bald eagle (*kuckalaq*)
- ☐ Peregrine falcon

HUMMINGBIRDS

- ☐ Rufous hummingbird (s)

KINGFISHERS

- ☐ Belted kingfisher

PASSERINES

- ☐ Tree swallow
- ☐ Violet green swallow

- ☐ Bank swallow
- ☐ Chestnut-backed chickadee
- ☐ Winter wren
- ☐ Common raven
- ☐ Northwestern crow
- ☐ Black-billed magpie
- ☐ Steller's jay
- ☐ Hermit thrush
- ☐ Varied thrush
- ☐ American robin
- ☐ Wilson's warbler
- ☐ Orange-crowned warbler
- ☐ Song sparrow
- ☐ Fox sparrow
- ☐ Savannah sparrow

MAMMALS

- ☐ Humpback whale (*qulamaq*)
- ☐ Minke whale (*qulamaq*)
- ☐ Dall's porpoise (*mangtak*)
- ☐ Black bear
- ☐ Land otter (*kep'arka*)
- ☐ Marmot
- ☐ Mink
- ☐ Weasel

Sugcestun/Alutiiq language words (following English names) provided by the Chugachmuit Heritage Preservation Project. For more information on the Sugpiaq (Alutiiq) people and their language, visit www.chugachmiut.org. To learn more about the Eyak language of the region, visit www.eyakpeople.com.

BIRDS



▲ Glaucous-winged Gulls claim a dock as their own during summer 2016 in Cordova. Photo credit: Anne Schaefer

AVIAN INVASION!

ANNE SCHAEFER
Prince William Sound Science Center
aschaefer@pwssc.org

Thousands of Glaucous-winged Gulls invaded the commercial fishing town of Cordova, Alaska during summer of 2016. Gulls typically visit the town during the summer months when cannery waste from commercial fishing activities provides a reliable source of food. Gull numbers usually peak at the end of July after chicks have fledged from the nest and before birds depart for their fall migration.

However, the inundation experienced during the summer of 2016 was different. Biologists at the Prince William Sound Science Center conducted 11 gull surveys around town between June and October to track the overwhelming numbers of birds. The researchers found that gull abundance peaked during late June and early July (a month earlier than normal) with an estimated 11,600 birds—outnumbering the summer population of Cordovans by over 2:1!

So why were there so many gulls in town last year? The abnormally warm water temperatures in the northern Pacific Ocean are probably to blame. Glaucous-winged Gulls normally breed in May on the barrier islands of the Copper River Delta. However, the warm ocean temperatures likely changed the abundance or distribution of the gulls' normal food supply during the breeding season. As a result, gulls either withheld from laying eggs or destroyed their eggs after hatching. Without nests or chicks keeping them tied to breeding areas, the gulls left the barrier islands and headed to Cordova in search of an easy and reliable meal of fish offal.

BRINGING BACK THE DUSKY CANADA GOOSE: CELEBRATING HABITAT ENHANCEMENT ON THE COPPER RIVER DELTA



▲ Adult Dusky Canada Goose. Photo: Ron Niebrugge/Niebrugge Images LLC

◀ Wildlife biologist Melissa Gabrielson replants a nest island. Photo courtesy of USFS, Julia Reihs



ERIN COOPER
U.S. Forest Service
ecooper@fs.fed.us

The Dusky Canada Goose is an enduring symbol of the Copper River Delta, our very own goose subspecies that nests primarily on the Delta. Each year from spring through the fall, you can see them flying overhead and hear their familiar calls. While they have been a consistent summer resident through the years, their fate is still uncertain. In the mid-80s the Dusky Canada Goose population started to decline rapidly, reaching record lows of less than 10,000 individuals.

Agencies and organizations concerned with the conservation of Dusky Canada Geese, such as the U.S. Forest Service, Ducks Unlimited, U.S.

Fish and Wildlife Service, and Alaska Department of Fish & Game came together to develop a program that would help the geese by enhancing nesting opportunities. In 1984, the result of this collaborative effort was the advent of the Dusky Canada Goose artificial nest island program on the Copper River Delta. Artificial nest islands are twice as successful as natural sites and help promote nest success on the Delta. To date, there have been a variety of types of islands and fine tuning of the program. Visitors can see examples of this successful habitat enhancement project on Alaganik Road near the boardwalk (look for the goose silhouette on the island if you have binoculars).

TERNs ON THE DELTA: TOO WET OR TOO WARM?

MARY ANNE BISHOP
Prince William Sound Science Center
mbishop@pwssc.org

With a black crest that reminds one of their young brother's crewcut and a call that sounds more like a scream, Caspian Terns are a bird

you cannot help but notice. They are also interesting because they are rapidly expanding up the Pacific coast and are now found in Alaska. Currently, North America's northernmost, sizable colony is located on a low-lying barrier island in the Copper River Delta.

Located at the mouth of the Copper River,

this barrier island appears to be flooding more often during summer than in years past. Since 2012, terns have steadily shifted their nests from the ground up into grass-covered dunes. Considering current and projected climate change, long-term suitability of this barrier island as tern nesting habitat is questionable. Even more striking has been the dramatic swings in tern numbers.

When first discovered in 2006, just over 100

pairs nested. By 2014 more than 400 pairs were observed! But last summer—only one lone pair was observed nesting. What happened? We suspect that persistent warm oceanic waters, known as The Blob, have resulted in reduced forage fish and the terns foregoing breeding attempts. Stay tuned to see if this colony rebounds or moves elsewhere.



◀ Caspian Terns nesting in the dunes on a barrier island on the Copper River Delta. Photo: Oregon State University

OUT & ABOUT

DELTA RESTORATION GETS DiRTy

LAUREN BIEN

Prince William Sound Science Center
lbien@pwssc.org

Eight campers from all over the country descended on Cordova in August 2016 to participate in Prince William Sound Science Center's first ever Delta Restoration Team. The eight-day, service-learning camp, nicknamed DRT Camp, focused on restoration projects, leadership development, and ecosystem stewardship. In close partnership with the U.S. Forest Service Cordova Ranger District, DRT campers restored nest islands for Dusky Canada Geese, improved over-wintering habitat for juvenile salmonids, revegetated and stabilized an eroding stream bank, and much more.

When campers were not setting fish traps to monitor abundance or rebuilding damaged bridges on recreational trails, they

worked together on team and leadership building exercises and discussed what it means to be a good steward. The ideas discussed and techniques practiced in the beautiful setting of Cordova are ideals the campers will return home with and hopefully carry for the rest of their lives. "The satisfaction I felt once I took a step back to admire the work we did was the best moment" wrote Sophia Crawford-Hayes, California. "I love this experience and I can definitely see myself doing these activities as a job" added Ben Wyman, Maine.

This program was made possible through a generous grant from National Fish and Wildlife Foundation and Wells Fargo. It could not have been possible without the support of the U.S. Forest Service Cordova Ranger District.

At Snag Lake, DRT campers work to build brush bundles, a mass of woody debris that when sunk in the water creates rearing and overwintering habitat for juvenile salmonids. *Photo: Lauren Bien*



PUBLIC USE CABINS ON YOUR NATIONAL FOREST

ERIN COLE

U.S. Forest Service
ecole@fs.fed.us

Remote cabins have been in use on public land for over a century, beginning with the first fire towers around 1910. Today, while fewer of these cabins are used for their original purposes, many remain as popular venues for recreation, wilderness exploration, hunting, and fishing. Prince William Sound hosts 23 of the Chugach National Forest's 42 public-use cabins, available to anyone year-round.

Staying at these sites is an incredible opportunity to relax in a secluded shelter warmed by a wood stove. The glow of cabin windows and landscapes veiled in morning mist create a worthwhile destination that anyone can enjoy, whether calling the Chugach home or just passing through. These rustic structures are accessible by varying combinations of water, air, road, and foot travel, and each location provides an abundance of adventure and serenity.



Green Island Cabin in Prince William Sound is a fully ADA-compliant structure providing exceptional views and boating access.

Here, as John Muir said, "Nature's peace will flow into you...while cares will drop off like autumn leaves."

Whether traveling from afar or exploring your local area, visit recreation.gov or call 877-444-6777 for reservations. To reflect rising costs, cabin rates are increasing incrementally over three years. Current rates range from \$30-\$85 a night forest-wide.



Jack Bay Cabin near Valdez is nestled at the head of the bay bearing its name.

Photo Credits: US Forest Service

Without continued financial support the cabins program may not be possible. Each dollar spent is reinvested directly into Chugach National Forest cabin maintenance and improvement, providing for the use of future generations.

Visit a local Forest Service office for information and assistance. Plan well, be prepared, and always keep exploring!



MOVE YOUR LEGS, EXPAND YOUR MIND

If you want to learn more about our amazing ecosystems, look no further than the Prince William Sound Science Center. We offer free, year-round education programs geared towards adventurers of all ages.

DISCOVER CORDOVA

These programs are designed to engage our younger audience. Half-day programs encourage hands-on exploration of different local organisms or ecosystems.

Bring your magnifying glasses and meet us on the Ski Hill for a Bug Safari, don your rubber boots to tide pool with us at Orca beach, or become an artist while sketching plants on a wildflower walk.

FESTIVALS

Come see the Science Center's table or join in our educational activities at many of our local festivals!

Learn what it takes to be a migrating sandpiper at the annual Copper River Delta Shorebird Festival in May.

Get your hands wet in our touch tank at the Cordova Health Fair in April. Make a fish print at the Small Fry activities during Cordova's summertime celebration: Copper River Wild! Salmon Festival.



DISCOVERY PACKS

To inspire our community towards exploration and understanding of our dynamic ecosystems, we offer educational Discovery Packs free for borrow. Each backpack comes equipped with guidebooks, natural history information, educational games and activities, and even hand lenses to get a closer look at whatever treasures you find! To borrow a pack, swing by the Science Center!

Themes include: Exploring the Intertidal Zone, Geology Rocks!, Wandering Among the Wildflowers, Making Tracks, and For the Birds.

WEEKLY LECTURE SERIES

Prince William Sound Science Center and partners, Alaska Sea Grant Marine Advisory Program and PWS Audubon, host a weekly lecture series for experts from Cordova, the state of Alaska, and around the world to share their research and findings with the community of Cordova. Can't make it? Our lecture recordings are posted on our website and YouTube channel throughout the lecture season, September through April.

STAY CONNECTED

Sign up for our weekly, community-outreach emails on our website pwssc.org, and follow us on Facebook, Twitter, and Instagram!

KIDS' CORNER

CLOUD IN A JAR

LEARN HOW CLOUDS FORM WITH THIS SIMPLE, AT-HOME EXPERIMENT

FAST FACTS

The Pacific temperate rainforest extends from Northern California all the way to Southcentral Alaska. What does that mean for us here in Prince William Sound? We get a lot of rain! Lots of rain means lots of clouds. But how do those clouds form?

Three things are needed to make a cloud: water, cool air, and condensation nuclei.

Condensation nuclei (or cloud seeds) are tiny particles in the air and help water vapor condense into clouds. Examples of cloud seeds are sea salt aerosols, dust, smoke, and air pollution.

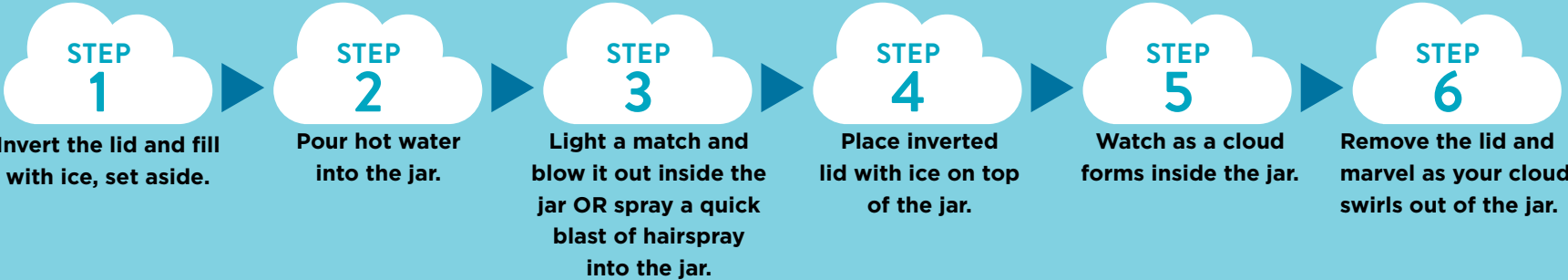
As water evaporates from the ocean, vapors rise up into the atmosphere where the air is colder. The cool air cannot hold as much water vapor as warm air, so the water vapor condenses. The cloud seeds provide a surface for the vapors to condense onto.



YOU'LL NEED

- ▶ Clear jar with a lid
- ▶ Ice
- ▶ Matches or hair spray
- ▶ ½ cup, nearly boiling water

(Young children will need adult supervision)



WHAT'S GOING ON? ▶

Water vapor is created and contained by adding hot water to a jar. The smoke or hairspray acts as a cloud seed. When the lid of ice is placed on top, it cools the warm vapor that rises to the top of the jar. Water droplets condense onto the cloud seeds and create a cloud! Watch the cloud swirl inside the jar as the warm air rises and cold air sinks.

NATURE HUNT GO ON A QUEST TO SEE HOW MANY OF THESE ITEMS YOU CAN FIND!

1	2	3	4	5	6	7	8	9	10
<input type="checkbox"/> A ROCK. Can find one that reminds you of something, such as this heart-shaped rock?	<input type="checkbox"/> A STICK. Can you find one that can be made into something useful, such as a slingshot or a marshmallow roasting stick?	<input type="checkbox"/> A MUSHROOM. Look, but don't touch! Many mushrooms are beautiful, but very poisonous.	<input type="checkbox"/> A SHELL. Who do you think used to live inside?	<input type="checkbox"/> A FEATHER. Can you identify what kind of bird it came from?	<input type="checkbox"/> SOMETHING PRICKLY. Be careful and don't get poked!	<input type="checkbox"/> SOMETHING WITH SIX TO EIGHT LEGS. Be gentle, please. Nothing should get hurt during your nature hunt.	<input type="checkbox"/> SOMETHING NOT FROM NATURE. Is it a new treasure to take home or something that needs to go in the trash? Either way, it's always a good idea to remove anything that doesn't belong in nature.	<input type="checkbox"/> SOMETHING FLUFFY. What could you find in the summer? What about winter?	<input type="checkbox"/> A BONE OR TOOTH. What animal is it from? What part of the body did the bone come from?

KIDS' CORNER

SPOT THE DIFFERENCES!

Compare these two shorebirds. Circle 10 things that are different.

IMAGE CREDIT: ERIN COOPER



- ANSWER KEY:**
1. Line on bill
 2. Additional lines on chest
 3. Different color
 4. Snail on grass on right side of bird
 5. Golden beetle on grass on left side of bird
 6. Black on cap extends to turquoise line
 7. Additional white dot in eye
 8. Red dot added to center of the white circle with black outline
 9. White dot added to center of the circle with white, orange, grey, and pink
 10. Extra blade of blue grass to right of bird

SCIENCE + ART = CURIOSITY + CREATIVITY

You may have heard of STEM (science, technology, engineering, mathematics), but have you heard how people are turning it into STEAM?

A IS FOR ART

Combining STEM with art is a valuable tool for learning more about your subject, sharing information, and creating beauty.

Erin Cooper, a wildlife biologist and program manager for the U.S. Forest Service, is also an artist! She created the shorebird drawings to the left.



"I currently manage the PWS Terrestrial Program that covers Ecology, Vegetation Management, and Wildlife. My love of the outdoors and specifically birds has meshed well with my artistic pursuits. I spend my free time working on watercolor, printmaking, and most recently digital art. Both wildlife biology and art are disciplines of observation and ideas that complement each other and push each other in directions not possible without the other."

Kristin Link is a science illustrator, who works in painting, drawing, and digital media. You can see her work on interpretive signs throughout the Copper River Watershed, in Delta Sound Connections (the centerfold map), and around McCarthy—her home.



"I am inspired by the surrounding natural environment and enjoy studying and illustrating plants, animals, rocks, and ecosystems. I really enjoy the time it takes to slow down and observe my subject. In the time it takes to create a drawing or painting, I build a relationship with whatever I am working on. Science illustration plays an important role in helping people interpret their surroundings. Illustrators are artists that can craft an image to tell the story that is most important. For example sometimes it is more important to capture the movement of a fish than what each and every scale looks like."

Caitlin McKinstry is a research assistant for the Prince William Sound Science Center. She uses photography to share what she sees under the microscope.



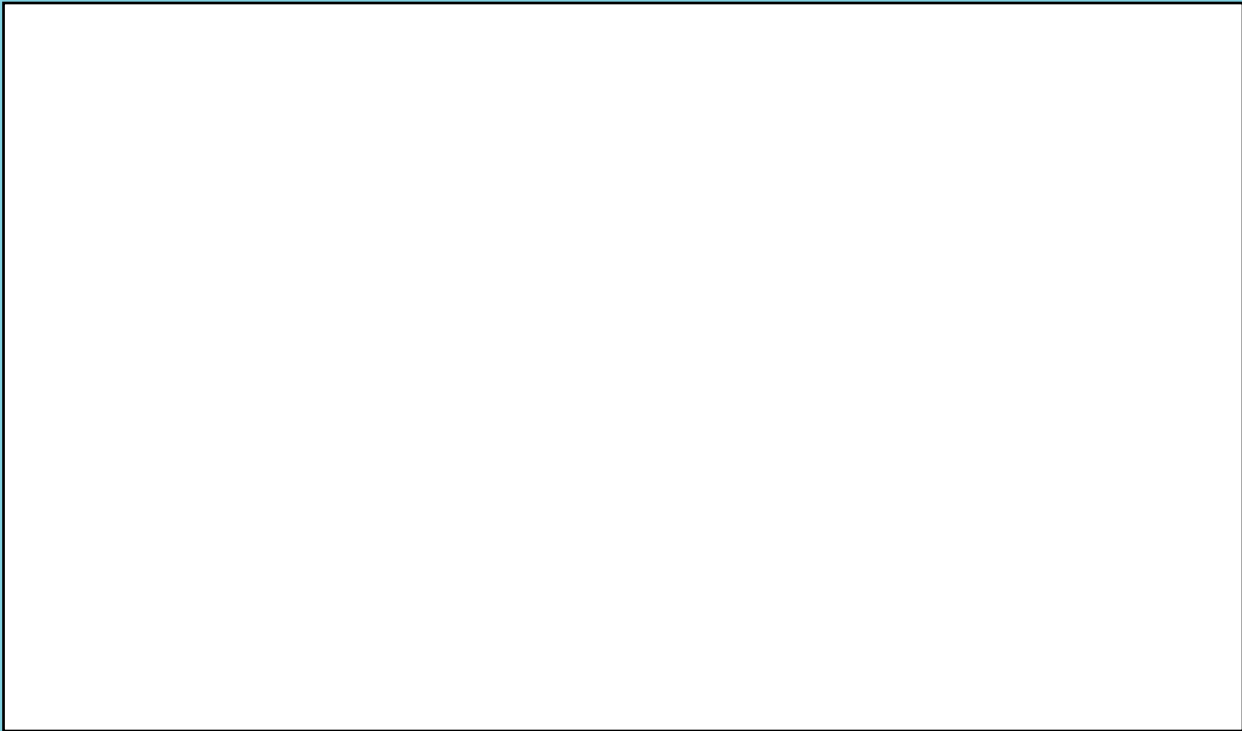
"Zooplankton are creatures of unearthly appearance with strange bodies adapted for living in a dark, boundless world. Smaller than a period on this page, these alien creatures are rarely observed by those without microscopes. This is somewhat disheartening, as zooplankton, in one way or another, supply nutrients to almost all the animals in the ocean. Taking photographs through the microscope hopefully inspires viewers to ask "what are these things?" and "why are they important?" in a way graphs, tables, and scientific jargon cannot."



▲ An egg-bearing female copepod collected from Prince William Sound and photographed through a microscope by a process called focus stacking. This photo is featured in the 2017 North Pacific Research Board calendar. Photo by Caitlin McKinstry

CREATE + SHARE + WIN!

We want to see your science art! Draw a picture of yourself exploring the outdoors; your favorite wild animal, plant, or nature scene, or draw yourself doing science. **WHATEVER INSPIRES YOU!**



Send your artwork to PWSSC, PO Box 705, Cordova, AK 99574

You'll be entered to win a t-shirt and we may share it on our social media channels! Entries for contest are due by October 1, 2017.

THE NEXT GENERATION A CHANGING WORLD

What happens here in the world’s
richest waters influences the globe.
We’re the region’s nonprofit with boots
on the ground, boats in the water,
and students in the field
12 months per year.

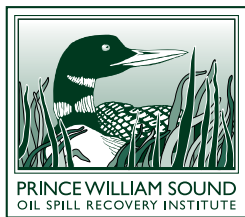


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