



2011

Natural history and science news from Prince William Sound and the Copper River Delta

# DELTA SOUND CONNECTIONS

## Glacial waters help trigger abundance

**Headwaters to ocean connection drives the region's productivity**

**RJ Kopchak,  
PWS Science Center**

Welcome to the Prince William Sound/Copper River Delta Bioregion, the northernmost corner of the Pacific coast, and northern boundary of the coastal temperate rainforest. Over 250 inches of precipitation fall on portions of Montague Island in Prince William Sound. On the Copper River Delta annual precipitation exceeds 170 inches. Winter temperatures average from 17° to 32°F; summer temperatures average 49° to 63°F. The region supports all five species of Pacific salmon, along with halibut, cod, and other valuable commercial species. Marine and land mammals and bird populations are diverse.

The Copper River is 290 miles long, and is the single largest source of fresh water to the Gulf of Alaska. The sediment-laden waters flow out into the northern Gulf of Alaska, and are swept into Prince William Sound by the westward-flowing Alaska Coastal Current. These glacial waters contain minerals that help trigger plankton blooms, making the northern gulf region the world's richest waters.

Over thousands of years, the sediment from the river system has created barrier islands and delta systems. The 700,000-

acre Copper River Delta is the largest contiguous wetland on the Pacific coast of North America, and the largest site in the Western Hemisphere Shorebird Reserve system.

Annually it serves as staging grounds for millions of migrating shorebirds and waterfowl, one of the largest seasonal assemblies of birds in the western hemisphere. During the peak of migration, on a single day there may be over 1,200,000 shorebirds along the 75 miles of Delta habitat. Two hundred and thirty-five species of birds have been identified on the Delta, including 42 species of shorebirds.

In Prince William Sound over 20 glaciers terminate at sea level; numerous others cling to steep mountainsides. There are hundreds of bays, fjords and islands with over 3,000 miles of shoreline. The complex assembly of shore zone types provide diverse intertidal and kelp habitats for shellfish and sea otters, and spawning grounds for herring. The Sound supports transient and local populations of marine mammals such as federally endangered Steller sea lions, harbor seals, baleen whales, and orcas. Benthic habitats support large populations of herring, salmon, rockfish, and halibut.

Commercial fishing is the region's largest employer. The port of Cordova is listed as supporting the 12th largest



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*By returning from the ocean to spawn in their home stream or lake, salmon deliver valuable ocean nutrients to the entire river system.*

fishery in the United States, with landings in excess of 100 million pounds and an ex-vessel value exceeding \$50 million. Another estimated 50 million pounds of fish harvested in the region are processed in ports outside the bioregion.

The Chugachmiut and Eyak peoples lived here long before the arrival of the first Europeans in the mid-1700s. By 1800, Russia dominated the region in the trade of sea otter pelts. Trapping, gold and copper mining, fox farming, logging and fishing have each played a

role in the region's economic and social development. Today, the Port of Valdez in Prince William Sound is the terminus for the Trans-Alaska Oil Pipeline. Twenty percent of the Alaska oil pipeline transects the bioregion, transporting about 15% of the total US domestic oil production.

Visitors also support a significant part of our local economies. Thanks for coming to explore and enjoy our region! It is truly one of the world's great places.

## Receding ice sheets influence oceanography

**Linking climate changes in the Copper River Watershed to the coastal Gulf of Alaska**

**Rob Campbell,  
PWS Science Center**

The waters of the Gulf of Alaska (GoA) are some of the most productive in the world and are home to some of the United States' most important commercial and recreational fisheries. Alaska's Copper River drains an area over 7.3 million hectares (about the size of West Virginia) and is the single largest source of freshwater to the GoA, receiving the cumulative meltwater from the vast glaciers and ice sheets of the Wrangell and Chugach mountains. One of the main drivers of productivity in the region is the availability of

nutrients: river inputs bring in new nutrients, and oceanographic processes operating on freshwater layers at the surface bring up nutrient-rich water from the depths. Beyond the continental shelf, productivity is limited by the availability of micronutrient iron, which is transported to the open ocean in dissolved forms from rivers, as well as in dust during windstorms.

As the regional climate shifts, we can expect to see changes throughout the watershed: ice sheets will recede (as they have already been doing for many years), which will change the hydrology of the watershed. The new habitats exposed by receding glaciers present opportunities for colonizing plants, which will in turn change the type, timing and abundance of nutrients released into river waters. Those changes will be telegraphed to the coastal GoA by the Copper River, with changes in productivity in the coastal ocean, which has implications for the many plankton and fish seaward of the Copper River Delta.

Predicting changes in the region is tricky, because it has not been well studied in the past. In 2010, a large multidisciplinary team began a joint study of the watershed-ocean system, funded by the US Geological Survey. Studies include cataloging ice mass in

*Snust, a mix of snow and dust, funnels down the Copper River corridor, providing important nutrients that drive production in the Gulf of Alaska. Photo courtesy of NASA.*



*Melting water from glaciers and icesheets meanders across the Copper River Delta before emptying into the Gulf of Alaska. Photo by Milo Burcham.*

Continued on Pg. 2

## Welcome!

We're pleased you're reading this third edition of *Delta Sound Connections* to learn about our home, the Prince William Sound and Copper River Delta regions. Established in 1989, the non-profit Prince William Sound Science Center (PWSSC) investigates questions about the biology, general ecology, and oceanography of these incredibly rich ecosystems.

The Center's educators offer diverse, informative and fun science programs throughout the year. Articles within this paper will introduce you to the many research and education programs being conducted by PWSSC and other organizations, universities and agencies. We thank the many authors who generously contributed to this publication.

We also thank our business and other sponsors (see their names on the back page)! It's their support which makes this publication possible.

Please consider joining as a member of PWSSC to help ensure the sustainability of the Sound and Delta resources. We value individual memberships because they demonstrate our community support base. You'll find a membership form on the back page.

Thank you for taking time to learn more about this very special part of the world. Please share your thoughts on our publication by completing a short survey at [www.surveymonkey.com/s/DSC2011](http://www.surveymonkey.com/s/DSC2011). You will be entered into a drawing for PWSSC goodies. Enjoy your travels!

*Nancy Bird, President  
Prince William Sound Science Center*

SUMMER 2011

# Moorings monitor the exchange of waters

**Sub-surface oceanographic moorings monitor exchange between PWS and Gulf of Alaska**

Mark Halverson,  
PWS Science Center

Ocean circulation in Prince William Sound is partly driven by what happens at its two major connections to the Gulf of Alaska: Hinchinbrook Entrance and Montague Strait. The water flowing through these entrances also impacts the local ecosystem by importing and exporting organisms such as juvenile fish



Unloading the M/V Auklet following a mooring retrieval in April 2010. Photo by Auklet.com.

and zooplankton, and pollutants such as crude oil. For example, water from the Copper River can enter the Sound through Hinchinbrook, making this a true Delta-Sound connection!

The Oil Spill Recovery Institute and the Alaska Ocean Observing System funded an oceanographic mooring program to monitor the exchange of water between the Gulf of Alaska and Prince William Sound from 2005 – 2010. The moorings were equipped with sensors fixed at strategic depths to measure ocean currents, temperature, and salinity.

The current-measuring instruments work by sending pulses of high frequency sound waves. When the waves reflect from moving water, their frequency changes – a phenomenon known as the Doppler effect (think of how an ambulance siren changes pitch as it whizzes past). The instrument determines the water speed by measuring how much the frequency changed. The temperature/salinity sensors measure electrical conductivity to determine salinity.

We've learned many interesting things from the moorings. For example, in summer, a "river" of dense water



Map showing the mooring locations labeled, HE1, HE3, MS1, and MS3.

flows into Prince William Sound via an indentation in the continental shelf which leads to Hinchinbrook Entrance (see figure). However, in winter, the deep inflow disappears altogether.

In the future, we will study how the

exchange varies between seasons, and also how it differs between years in response to climate oscillations such as El-Nino.

For more information, contact Dr. Mark Halverson at the PWS Science Center, [mhalverson@pwssc.org](mailto:mhalverson@pwssc.org).

## Mixed layer depth varies seasonally

**Lack of solar heating and freshwater runoff allows for deeper mixing in water**

Dave Musgrave,  
Musgrave Oceanographic Analysis

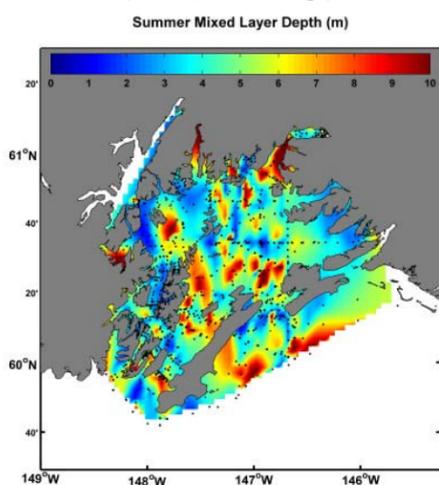
Ever wonder how deep oil or oil dispersants would mix down into the water if there was an oil spill at the surface in Prince William Sound? Well, the Prince William Sound Regional Citizens' Advisory Council did, and they asked the Prince William Sound Science Center to help them in answering this important question.

Mark Halverson and Scott Pegau of the PWSSC and Dave Musgrave of Musgrave Oceanographic Analysis used data collected in the Sound since the early 1970s to look at the Mixed Layer Depth (MLD), which is the depth over which surface properties are mixed. They found that fresher and warmer water near the surface in the summer creates a layer that is much less dense than the water just below the mixed layer.

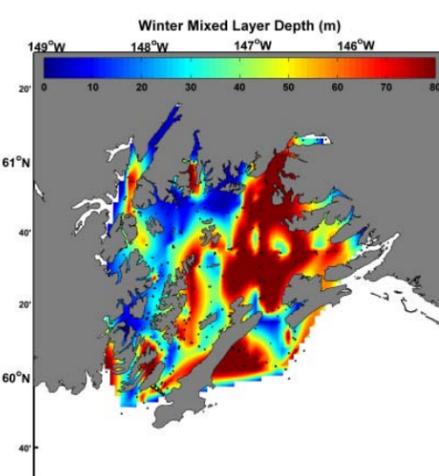
The light winds in the summer cannot provide enough energy at the surface to mix the light water down into the denser water, which leads to shallow MLDs of about 5 meters (15 ft). In the winter, there is less solar heating at the surface, and there is no freshwater runoff from the shore since all the precipitation is

tied up as snow and ice. So the warmer, fresher layer that develops near the surface in the summer is not present. The strong winter winds can easily mix the water to great depths leading to MLDs of 30 to 75 meters (90 to 225 feet) deep.

For more information contact Dr. Dave Musgrave, [fbksdave@gmail.com](mailto:fbksdave@gmail.com).



Summer (top) and winter (bottom) mixed layer depth (in meters) are contoured in color. The color scale is at the top in both figures, ranging from 0 to 10 meters.



Please take a few minutes to give us some feedback on this publication!

Be entered to win PWSSC goodies.

[www.surveymonkey.com/s/DSC2011](http://www.surveymonkey.com/s/DSC2011)

Thank you!

Contact: [deltasound@pwssc.org](mailto:deltasound@pwssc.org)

## Ice sheets (cont'd from pg 1)

the watershed from historical images, measuring hydrologic changes and nutrients in river waters, and measuring the type and availability of iron in the watershed and in the marine waters off the Copper River Delta. The study is also describing the oceanography and nutrients in the marine plume of the Copper River and making first observations of plankton and fish in the zone where fresh and marine waters meet. All the data are being fed into oceanographic and ecosystem models that will be used to predict how the coastal ocean will change as the climate continues to shift.

Preliminary results show large changes in nutrient availability attributable to watershed type and time of year, and suggest that we can expect to see large changes in the nutrients that make their way into the rivers as glaciers recede. Fish catches in the plume suggest that juvenile salmon may make use of very specific parts of the plume as they migrate out from the Copper into the ocean.

Field work continues in 2011, as a complimentary NASA project comes on line that will add: work on atmosphere-terrestrial-freshwater links

near receding glaciers, satellite remote sensing of the coastal ocean, and measurements of aerosol dust transport from the watershed to the ocean as well as the amount and type of iron in that dust. For more information contact Dr. Rob Campbell, [rcampbell@pwssc.org](mailto:rcampbell@pwssc.org).



As glaciers recede, early colonizing plants and lichens work to make these sites more hospitable by fixing nitrogen in the soil and breaking down the rock. Photos by Auklet.com.



# Sensitive plants documented living in PWS

*Plant inventory for PWS more than doubles after 2009 survey*

**Kate Mohatt, Erin Cooper & Betty Charnon,**  
**Chugach National Forest**

Prince William Sound (PWS), Alaska is known worldwide for its amazing wildlife and scenery, but the wide varieties of plants that inhabit this area are little understood.

In 2009, the Glacier and Cordova Ranger Districts on the Chugach National Forest collaborated to inventory plant species along PWS shorelines. Results from the survey have greatly increased the understanding

of the presence and distribution of sensitive plants in PWS and will be useful for a variety of natural resource and human use project assessments.

During the surveys of 100 random points, a total of 364 plant species were documented. Prior to this project, 181 plants were known in PWS, and through this survey we identified an additional 200 distinct plants bringing the total number in PWS to at least 381.

Of particular importance are new sightings of sensitive plant species, including four distinct populations of Sessileleaf scurvygrass and a single collection of Unalaska mist-maid. Sessileleaf scurvygrass has never been

documented before on National Forest System lands and this is only the third documented occurrence of Unalaska mist-maid on the Chugach National Forest, which only has 29 occurrences world-wide. Additionally, we found three species designated as rare by the Alaska Natural Heritage Program, including two orchids and Pacific buttercup. Range extensions were also documented for three species including

the Pacific buttercup.

In 2010, we conducted more targeted surveys in areas with unique geologies or habitats that were under-represented, such as sandy or recently de-glaciated gravely sites to yield an even greater understanding of the plant species and their distribution in PWS.

*For more information on this project, contact Kate Mohatt, kmohatt@fs.fed.us.*

## The year of forests

*Welcome to the International Year of Forests, 2011!*

**Chugach National Forest,**  
**United States Forest Service**

Welcome to the International Year of Forests, 2011.

That United Nations declaration means that people all over the world are working to raise awareness of important issues on our forests: not only about the forests' essential resources, but also about increasing political, social, and environmental pressures they face.

International Year of Forests is an opportunity to reflect on how forests affect our lives and what we gain by protecting these valuable resources.

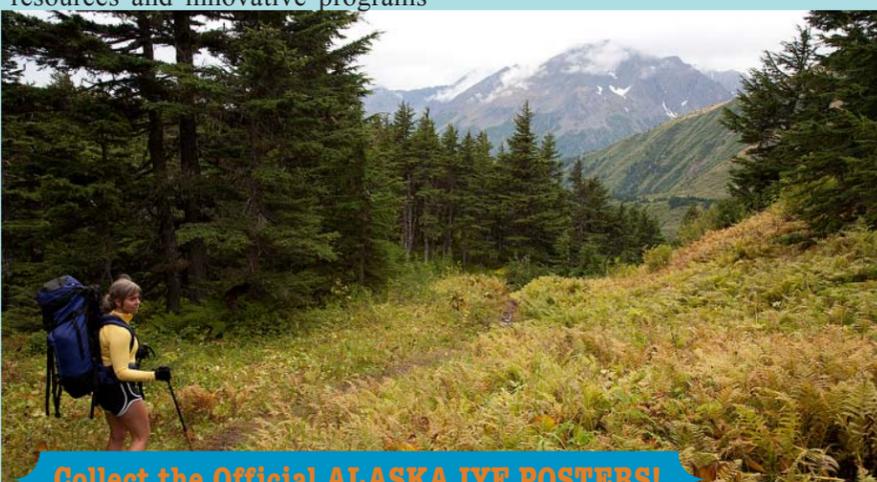
The Chugach and Tongass National Forests, the two largest single forests in the National Forest system, are working together throughout 2011 to bring attention to the critical resources and innovative programs

that allow individuals to explore their backyard, celebrate their heritage and find their inspiration every day. Today, Alaska's Forests, like those around the world, are reframing the way people look at them. Our forests are a critical part of our state's important cultural, natural and historical resources, as well as home to world-class recreational opportunities.

In southcentral Alaska, the Chugach provides a critical nesting ground for more than 16 million migrating shorebirds in the western hemisphere and is a critical habitat for world-renowned Kenai, Russian, and Copper River wild Alaskan Salmon.

In 2011, International Year of Forests, take a fresh look at all that your forest has to offer and celebrate with us.

*To see all that we have planned for the year, visit myalaskaforests.com.*



**Collect the Official ALASKA IYF POSTERS!**



Collect all four posters throughout the year. Pick them up at any Chugach or Tongass Forest Service office.

*Above: A typically picturesque day on Lost Lake Trail, Kenai Peninsula. Right: Prime Beach front at Double Bay cabin in Prince William Sound. Photos by USFS.*



*Above: Botanist Helen Cortes-Burnse identifies plants in a Prince William Sound fen. Inset are English sundew, *Drosera anglica* (top), and wild iris, *Iris setosa* (bottom). Big photo by Erin Johnson. Inset photos by Kate Mohatt.*

*Below: Sprucetips are a good source of vitamin C. Photo by Auklet.com.*



## Looking at plants around the Sound

*Plants in the Sound are some of nature's best gifts.*

**Patience Andersen Faulkner,**  
**Native Village of Eyak**

Welcome to the land of wonderful plants!

Visiting the Sound is so delightful with all the green surrounding us. Figuring out how to identify plants can be a challenge. Let me make it easy so that you are not just picking a bouquet which fades in a day but harvesting some of nature's best gifts.

I harvest about ten plants to make massage oil, balm and lip balm. I don't overharvest an area so I can preserve some for the coming years. I also stay off the trafficked paths as the purest live there. I piggyback a harvesting session when traveling

about for other purposes; it only takes fifteen minutes. Take advantage of the peaceful harvesting time. It makes the trip worthwhile.

The season starts with cottonwood buds, then flows into dandelion and elderberry blossoms, on to plantain, alder, willow, spruce tips, fireweed, wormwood, chamomile and berry leaves/blossoms. Select one plant and get to know it well. It has many uses and you will readily be able to identify its many life stages. Using fresh or drying for later use is an option.

There are many good resource books available to take the mystery out of making your own herbal products. How to process these dried plants into essential oil can be addressed by contacting me at: andersenpatc@ctcak.net. Happy harvesting!

# Bands document hummingbird migration

*Chenega Bay, Alaska Rufous Hummingbird banding project*

**Kate McLaughlin,**  
**McLaughlin Environmental Services**

The North Gulf Coast of Alaska is the northern edge of breeding habitat for Rufous Hummingbirds (*Selasphorus rufus*). From their home on Evans Island, Kate and Andy McLaughlin began the Chenega Bay Rufous Hummingbird Banding Project in 2007, banding over 900 hummingbirds since the project began.

Arriving in the Sound in early May, the birds hit the feeders hard for a few weeks before disappearing to incubate eggs. By mid June, the adult birds are regulars on the feeders again, and the fledgling hummingbirds start squabbling over drinking spots by the end of the month. By the end of July, the males head south; the females and fledglings remaining behind until the first week of August.

The 2010 season was the most successful season yet with 212 birds banded and 51 recaptures, and a record foreign recapture. A recapture is a bird that has been banded by another birder.

On June 28 a mature female Rufous Hummingbird was caught banded with a foreign number sequence. Expecting to find that this bird was banded in the SW U.S., it was a surprise to learn that she was banded as a first year adult in Tallahassee, Florida on January 13, 2010. This capture stands to be the world's distance record for a banded hummingbird of any species to be caught on both sides of its migration - a distance of over 3,500 miles in a straight line.

By early August, barely more than three months since they arrived, the hummingbird feeders hang abandoned. It's nice to think of these tiny flying jewels enjoying the sunshine and warmth of the southeastern U.S. as I



*Mature male on a feeder. Photo by Kate McLaughlin.*

slog through the rain putting the feeders away until next year.

For more information contact Kate McLaughlin, [mclenvironmental@yahoo.com](mailto:mclenvironmental@yahoo.com).

# Exploring river otter social behavior

*When the planet warms up, will social relationships cool down?*

**Merav Ben-David,**  
**University of Wyoming**

Following the 1989 *Exxon Valdez* oil spill in Prince William Sound our studies of coastal river otters revealed a unique social organization. Most males in our study were highly social, with groups of up to 18 individuals, whereas most females were solitary. Using a variety of methods we set out to uncover "why are males more social than females?"

Social males were not all related, did not have increased reproductive success, or reduce their risk of predation by killer whales, sea lions, or Bald Eagles. Instead, social otters had a different diet than solitary ones, feeding on schooling pelagic fishes (such as salmon and herring) whereas solitary ones feed on intertidal fishes (such as rockfish, greenling, and ronquils). Our research suggests that otters form groups for the benefits of cooperative foraging on schooling fishes.

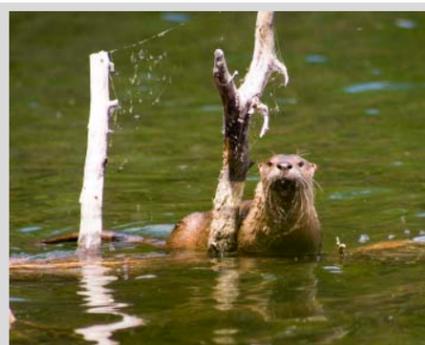
When schooling fishes arrive in the nearshore environment, most females are raising young and restricted to the area of their natal den, while locations of fish schools are unpredictable. Male groups are able to follow the fish but females are unable to leave their young for extended periods.

With increasing temperatures, we expect to see an increase in sea surface temperatures in the nearshore of the North Pacific that will decrease prey abundance. Because otter sociality is solely driven by the benefits of foraging on schooling fishes, we expect sociality in otters to decline as well.

Should we care whether river otters are social or not? All otters visit their activity sites, called latrines, with

different frequencies. They deposit their waste and fertilize terrestrial vegetation such as spruce trees. We found some trees growing on latrines with nearly 2.5 times higher photosynthetic capacity than those growing on non-latrine sites. They also produced larger quantities of seeds, an important contribution to the seed bank beyond the latrine boundaries. Changing otter sociality will alter latrine site use and subsequently affect the surrounding landscape and the coastal forest's resiliency in adapting to future climate changes.

*This research is sponsored by the PWS Oil Spill Recovery Institute. For more information contact Dr. Merav Ben-David, Department of Zoology and Physiology, University of Wyoming, [bendavid@uwyo.edu](mailto:bendavid@uwyo.edu).*



*River otters forage along the edge of rocky shorelines (above) and deliver important marine nutrients (below) that boost photosynthesis in nearby plants. Photos by Nate Bowersock (above) and Kaiti Ott (below).*



*Surfbirds and Black Turnstones feed on intertidal invertebrates on the rocky shoreline. Photo by Ivan Kuletz.*

# Rocky coast aids shorebird migration

*Geolocators will reveal information about Black Turnstone migration*

**Mary Anne Bishop,**  
**PWS Science Center**

Most people associate shorebirds with mudflats or sandy beaches. But have you ever seen a shorebird on a breakwater or on a rocky shore? Black Turnstone and Surf-bird are two species that inhabit these somewhat inaccessible habitats, making them difficult birds to study! Both species have been rated as "species of high concern". Global sea level rise, increasing human development, and spills associated with the production and transportation of oil on the Pacific coast are potential threats to both species during the nonbreeding season when they live on rocky coastlines.

Very little is known about where Surf-bird or Black Turnstone stop during spring and fall migration. Historically, Montague Island in Prince William Sound has been the most important known spring stopover for both species, so in 2010 we set out to Montague Island in spring in order to monitor migrant shorebirds.

We found dramatically lower numbers for both Black Turnstone and Surf-bird compared with surveys conducted in the

mid-1990's at Montague Island. This suggests that either their populations are declining or the birds are now stopping at different areas.

Light-level geolocators are a relatively new technology now available for tracking movements of small birds such as shorebirds. Originally developed by the British Antarctic Survey engineers for recording the behavior of the Wandering Albatross, geolocators record the change in light levels at different latitudes and longitudes, enabling scientists to determine where the bird has been. In spring 2011, a pilot study by the Prince William Sound Science Center and Windbird Resources will capture Black Turnstone wintering in Puget Sound and attach geolocators. The birds will be recaptured in fall 2011 at the same site allowing researchers to determine where, when, and for how long birds are stopping during spring and fall migrations.

*The 2010 project was funded by Alaska Department of Fish & Game Wildlife Diversity Program, National Fish & Wildlife Foundation, and PWS Oil Spill Recovery Institute. For more information contact Dr. Mary Anne Bishop, [mbishop@pwssc.org](mailto:mbishop@pwssc.org).*

# Caspian Terns expand their range northward

**Copper River Delta colony of Caspian Terns discovered on barrier islands**

**Mary Anne Bishop,  
PWS Science Center**

With a massive, bright red bill and a wing-spawn approaching 17 inches, the highly vocal Caspian Tern is a relatively new species to Alaska. This species first appeared in Prince William Sound and on the Copper River Delta in 1983. Despite numerous attempts to locate Caspian Tern nests, it was not until June 2005 that local fishers first discovered a breeding colony on one of the Copper River Delta's barrier islands. Since 2008, researchers from the Prince William Sound Science Center and Oregon State University

have been monitoring this colony. In summer 2010, more than 180 nests were counted. Interestingly, Caspian Terns previously color-banded while nesting at colonies in Oregon and in California have been observed at the Copper River Delta colony. Currently, the largest Caspian Tern breeding colony in North America is located on Oregon's Columbia River. Scientists predict that in the near future, the Copper River colony will continue to grow as a result of intensive management practices being used to displace terns at the Oregon colony.

*This project sponsored by the U.S. Fish and Wildlife Service Coastal Program. For more information on this project, please contact Dr. Mary Anne Bishop at [mbishop@pwssc.org](mailto:mbishop@pwssc.org).*



*Caspian Tern arriving at the Copper River Delta colony with a Pacific herring. Photo by Adam Peck-Richardson, Oregon State University.*

## Brrrrrrrr... surveying seabirds in winter

**Boat surveys provide insight into winter use of Prince William Sound by seabirds**

**Neil Dawson,  
PWS Science Center**

The vast majority of marine science is focused on events of summer – plankton blooms, spawning fish and breeding seabirds. Yet the cold winter, when food may be scarce and conditions extreme, has the potential to regulate wildlife populations. Studying seabirds in winter is not easy because they are not tied to breeding sites and few ever touch land.

The Prince William Sound Science Center has been conducting winter seabird surveys regularly since 2007 to determine seabird densities in relation to herring abundance and to understand seabird habitat associations in the Sound. Numbers of Common Murre, the most abundant seabird in winter, peak in March. Winter storms in the Gulf of Alaska during January and February appear to be driving the murre to fly inshore.

Glaucous-winged Gull, is the most common winter gull but their numbers can fluctuate dramatically. During some winters, this bird will almost disappear from the Sound in March, especially in years when eulachon (a smelt) are running up the rivers of the Copper River Delta to spawn. During winter in Prince William Sound you never know what the next day will bring – a social gathering of orcas with a red sunrise, or a new hotspot for feeding seabirds, or just a big snowstorm..... it's all very memorable.

Winter seabird surveys are part of the Prince William Sound Herring program, sponsored by the Exxon Valdez Oil Spill Trustee Council.

## Marbled Murrelet population declining in the Sound

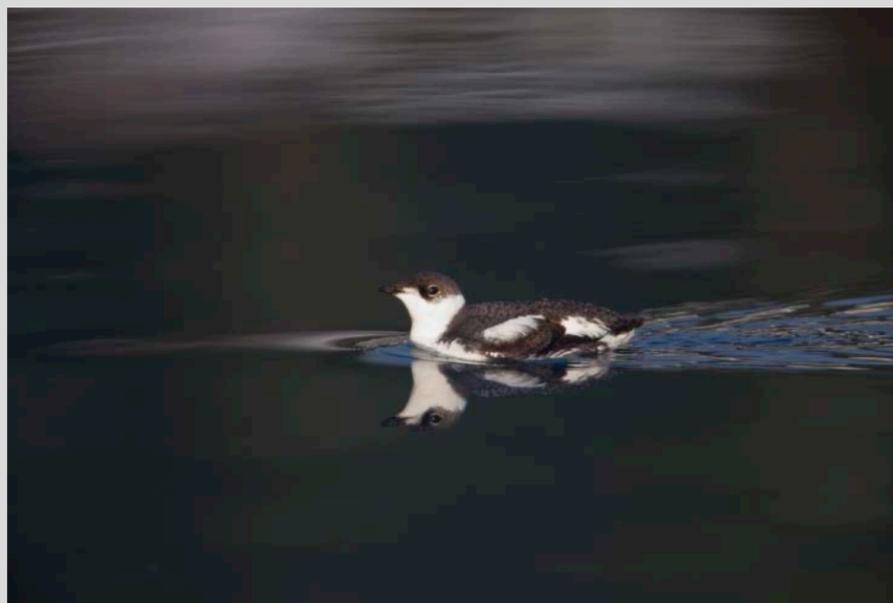
**Are birds at risk during winter months?**

**Allen Marquette,  
PWS Science Center**

Marbled Murrelets are robin-sized seabirds that have a short neck and tail and are brown above and light brown with gray marbled colors below in the summer. In the winter they are black above and white below with a white wing patch and collar.

During both summer and winter, Marbled Murrelets are one of the most numerous seabirds in Prince William Sound. In the 1970's, more than 235,000 Marbled Murrelets resided in Prince William Sound during summer. Since then, the murrelet population has declined 85%.

The crash of adult herring population stocks in the Sound in the mid 1990's affected many species of mammals and seabirds. Juvenile herring are critical to the Marbled Murrelets' diet. Studies conducted between 1977-1999 indicated weights of these small birds decreased during summer months. If this is still the case, it could put them at risk going into winter.



*Marbled Murrelets are robin-sized seabirds that are black above and white below with a white wing patch and collar in the winter. Photo by Milo Burcham.*

During winter, Marbled Murrelets in Alaska are almost entirely confined to marine waters and face extreme weather conditions, including increased daily food requirements, reduced food abundance and shorter days for foraging.

Dr. Mary Anne Bishop, a Research Ecologist with the Prince William Sound Science Center and Dr. Kathy Kuletz a Seabird Biologist at the U.S.

Fish and Wildlife Service, have been studying Marbled Murrelets to document the diet, body condition, and physiological stress levels of murrelets in winter.

*This research is sponsored by the North Pacific Research Board. For more information, please contact Dr. Mary Anne Bishop, [mbishop@pwssc.org](mailto:mbishop@pwssc.org) or Dr. Kathy Kuletz, [Kathy\\_kuletz@fws.gov](mailto:Kathy_kuletz@fws.gov).*



*Left: Birds flock near spawning herring in spring in PWS. Photo by Auklet.com. Above & Right: Common Murres are the most abundant winter resident, often seeking shelter inshore to escape winter storms in the Gulf of Alaska. Photos by Milo Burcham.*

*For more information, please contact Dr. Mary Anne Bishop at [mbishop@pwssc.org](mailto:mbishop@pwssc.org) or Dr. Kathy Kuletz at [Kathy\\_kuletz@fws.gov](mailto:Kathy_kuletz@fws.gov).*

SUMMER 2011

## Resident killer whales outnumber transients

*A look at the diets of Prince William Sound orcas*

**Craig Matkin,**  
**North Gulf Oceanic Society**

Prince William Sound is prime habitat for killer whales, particularly Hinchinbrook Entrance and Montague Strait, although they may be seen anywhere. It's incorrect to assume that most are chasing harbor seals, Dall porpoise and seal lions. The "transient" type of killer whale does specialize in eating mammals, but they are far less numerous than the fish eating "resident" killer whales. Occasionally resident killer whales are found in large socializing/feeding groups of over 100 whales. Surprisingly, these two types of killer whales do not associate or interbreed and live very different lives while swimming in the same waters.

What is so attractive about the Sound for these fish eating resident killer whales and why would they occasionally form large socializing/feeding groups? It's the same thing attracting thousands of visitors..... the Pacific salmon. Large, spread-out groups of whales communicating with their calls may be better able to find schools of fish and alert the other whales.

Resident killer whales can be picky about the salmon they consume. In spring, they target Chinook or king, the biggest salmon with the highest oil content. After Chinook, they favor chum, whose numbers have been enhanced by hatchery production of fry. Finally, the arrival of Coho salmon in mid-summer feed them all through the fall as they prepare for the lean winter months. In winter only a few Chinook



*Orcas breaching in Prince William Sound. Photo by Craig Matkin.*

salmon are around and the whales may feed on other fish. Resident killer whales are never seen taking the small,

low oil content pink salmon, even though there may be millions of them returning to the Sound.

To determine what the whales are eating, researchers use a fine mesh net to collect scales from the water just after a kill. Biopsy samples (small cores of skin and blubber) are taken from the whales where chemistry also indicate their feeding habits. Without a doubt, the society of resident killer whales that use Prince William Sound is dependent on the salmon.

*For more information on killer whales, visit [www.whalesalaska.org](http://www.whalesalaska.org).*



*Winter 2010 had a bonus for hungry resident whales as there were a large number of "winter" Chinooks feeding in the eastern Sound, good for both the whales and the residents of Cordova! Photo by Kate Alexander.*

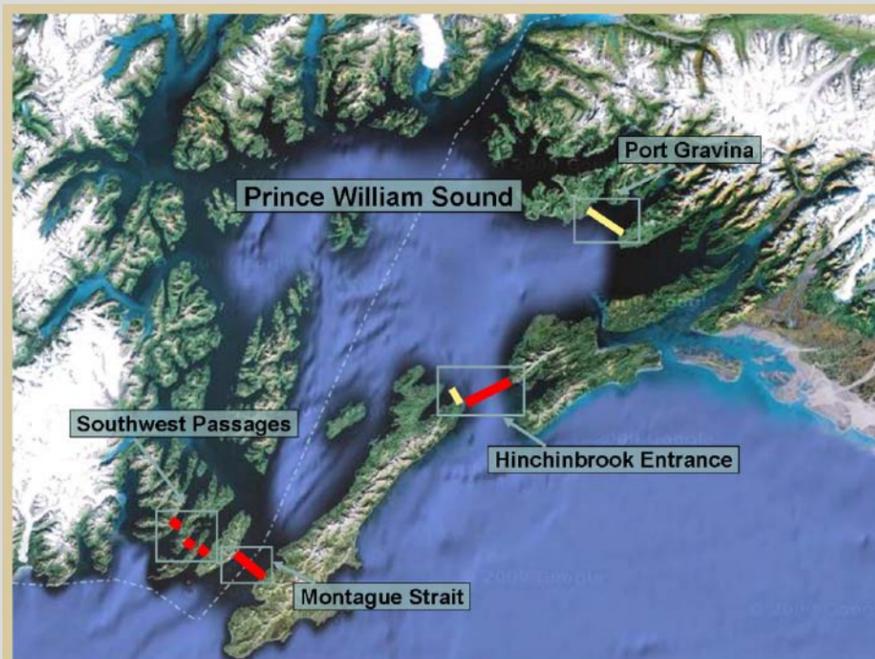
## Arrays to monitor fish movement

*New hydroacoustic arrays will record fish movements in and out of Prince William Sound*

**Brad Reynolds,**  
**PWS Science Center**

During 2011, the Prince William Sound Science Center is collaborating with the Pacific Ocean Shelf Tracking Project (POST) and the Ocean Tracking Network (OTN) to install hydroacoustic arrays across the entrances to Prince William Sound. Arrays will be deployed across the mouths of Hinchinbrook Entrance and Montague Strait. Three, smaller arrays will also be installed in the southwest Prince William Sound passages (see map). Each array consists of 2 to 16 acoustic receivers moored on the seafloor. The arrays work by forming a seamless listening line capable of detecting fish tagged with acoustic transmitters. When a tagged fish comes within range of, or crosses a receiver line, a unique fish identification number and time of detection are recorded and stored by the receiver. Depending on the tag, other data including swimming depth and temperature can also be recorded. Detection data are later uploaded to a surface vessel via an underwater modem. Since 2008, we have recorded nearly five million detections for 68 lingcod tagged in Prince William Sound. The Alaska Department of Fish and Game has worked with the Tagging of Pacific Predators (TOPP) research program to tag 24 salmon sharks in Port Gravina. With the installation of the POST/OTN arrays, we expect that more researchers will utilize this technology and develop studies to increase our understanding of the movements and migration timing of marine animals. A video of how an acoustic array works can be accessed at [www.postcoml.org](http://www.postcoml.org)

Brad Reynolds is a fish ecologist at the Prince William Sound Science Center. *For more information on this project contact Dr. Mary Anne Bishop at [mbishop@pwssc.org](mailto:mbishop@pwssc.org).*



*Locations of the acoustic receiver arrays. Red lines show future installation sites, yellow lines show the location of existing arrays at Port Gravina and Zaikof Bay.*

## Tags monitor lingcod movements

*The mystery of young lingcod movements revealed*

**Brad Reynolds,**  
**PWS Science Center**

When we tagged our first lingcod with acoustic transmitters in 2008, my inner fisherman could not help but be disappointed by their small size. Apologetically, I would return to report that most of my lingcod were a measly 18 to 20 inches in length. If you have angled lingcod, then you understand my frustration. A desirable catch is typically larger than 36 inches and up to 52 inches!

Nonetheless, for two years we tracked the movements of these lingcod within the array of acoustic receivers installed in Port Gravina as part of the Pacific Ocean Shelf Tracking project. We didn't expect much excitement; however, as we analyzed the movement data, our disappointment quickly waned as novel patterns began to emerge.

We discovered that three and four year old lingcod disperse within a five week

period during either winter or spring. We believe that winter departures may be related to sexually immature lingcod or newly-mature male lingcod being displaced when larger males establish territories prior to spawning. In Alaska, lingcod spawn from January through March, but males establish territories as early as November. Spring departures may be indicative of the onset of migratory behavior where lingcod move out into Prince William Sound and possibly the offshore waters of the Gulf of Alaska. Our study was the first to document a pattern in the migration timing for this life stage in lingcod. While this phenomenon is assumed to occur for many species, confirmation has been difficult without the application of acoustic monitoring.

On subsequent tagging trips I have seen my original disappointment made manifest every time a new fisher reels a small lingcod to the surface. "It's okay", I say, patting them on the back, "this is great data!" However, even to the fisherman-scientist, it's hard to get



*Researcher Matt Ajemian from University of South Alabama unabashedly displays the source of novel data on lingcod life history, a 20 inch, acoustic-tagged lingcod. Photo by Brad Reynolds.*

too excited about catching such a small datapoint!

Brad Reynolds is a fish ecologist at the Prince William Sound Science Center. *For more information on this project contact Dr. Mary Anne Bishop at [mbishop@pwssc.org](mailto:mbishop@pwssc.org) or Dr. Sean Powers at [spowers@usouthal.edu](mailto:spowers@usouthal.edu). The full findings of our research can be accessed online at [www.plosone.org](http://www.plosone.org).*

# HERRING

SUMMER 2011

## Lack of herring recovery spurs research program

**Major research program to study lack of herring recovery**

Staff,  
PWS Science Center

In the decades prior to 1990 there was a robust Pacific herring population in Prince William Sound. Not only are these forage fish a key link in the complex food web of Prince William Sound, but they supported a lucrative early season commercial fishery that brought the communities of the Sound to life each spring. By 1993, that fishery had been closed and only briefly been reopened for two years. The current approximately 20,000 tonnes biomass is tiny compared to the peak value of 150,000 tonnes or the long-term average of around 65,000 tonnes.

The cause of this dramatic decline in this fishery is still hotly debated. Was it the 1989 Exxon Valdez oil spill, disease, climate change, predation, natural cycles, or some combination of these factors? While the question of the reason for the decline remains debated, it is more important to understand what is preventing the herring population from recovering.

Today, researchers from multiple institutions and disciplines are working to determine why herring populations remain depressed. The purpose of this multi-faceted study is to identify juvenile rearing bays; measure factors that limit juvenile herring growth and recruitment; and ultimately provide recommendations for

future herring restoration and monitoring efforts in the region. Below are brief summaries for 2 of the projects. More information for this effort funded by the Exxon Valdez Oil Spill Trustee Council can be found at <http://www.pwssc.org/herringsurvey>.

### Physical Oceanographic Characteristics of Herring Nursery Habitats

Prince William Sound herring spend most of their first two years of life in small, sheltered 'nursery' bays, where physical conditions such as temperature and salinity greatly affect their survival. For example, colder water temperatures in the winter reduce metabolism, which may enhance overwinter survival of juvenile herring by lowering energy demands. In the summer, an influx of fresh water helps to trap nutrients in the surface layer, leading to higher plankton productivity and more food availability. To better understand these and other factors, Shelton Gay of the Prince William Sound Science Center and Texas A&M University is installing moorings at the heads of four nursery bays in Prince William Sound to monitor temperature and salinity. The data will give scientists a better idea of the variation of these properties throughout the year and the role they play in determining herring survival.

**Plankton and oceanographic observations in PWS:** Herring survival is dependent on availability of zooplankton,



Humpback whales feast on herring that gather to spawn in near-shore areas of Prince William Sound, surprising nearby boaters. Photo by Milo Burcham.

their primary food source. Zooplankton abundance in Prince William Sound can be affected by a variety of environmental conditions such as ocean temperatures, salinity, and availability of nutrients. To monitor these environmental conditions, Dr. Rob Campbell of the Prince William Sound Science Center is conducting monthly surveys at twelve sites in Prince William Sound. By measuring temperature, salinity, chlorophyll, turbidity, and nitrate, as well as collecting zooplankton, Dr.

Campbell will be able to estimate the amount of zooplankton food available to juvenile and adult herring throughout the year. When combined with the results from other herring studies, these surveys will help provide a comprehensive picture of the factors affecting herring survival and how they change through space and time.

## Pacific Herring Life Cycle

### EGG

Duration: approximately 21 days  
Location: shorelines attached to macroalgae  
Adult herring come into the intertidal zone in the spring and spawn on kelp and seagrass. The eggs are sticky and will have to survive tides, waves, and predators (birds, fish, invertebrates) until they hatch as larvae.

### LARVAE

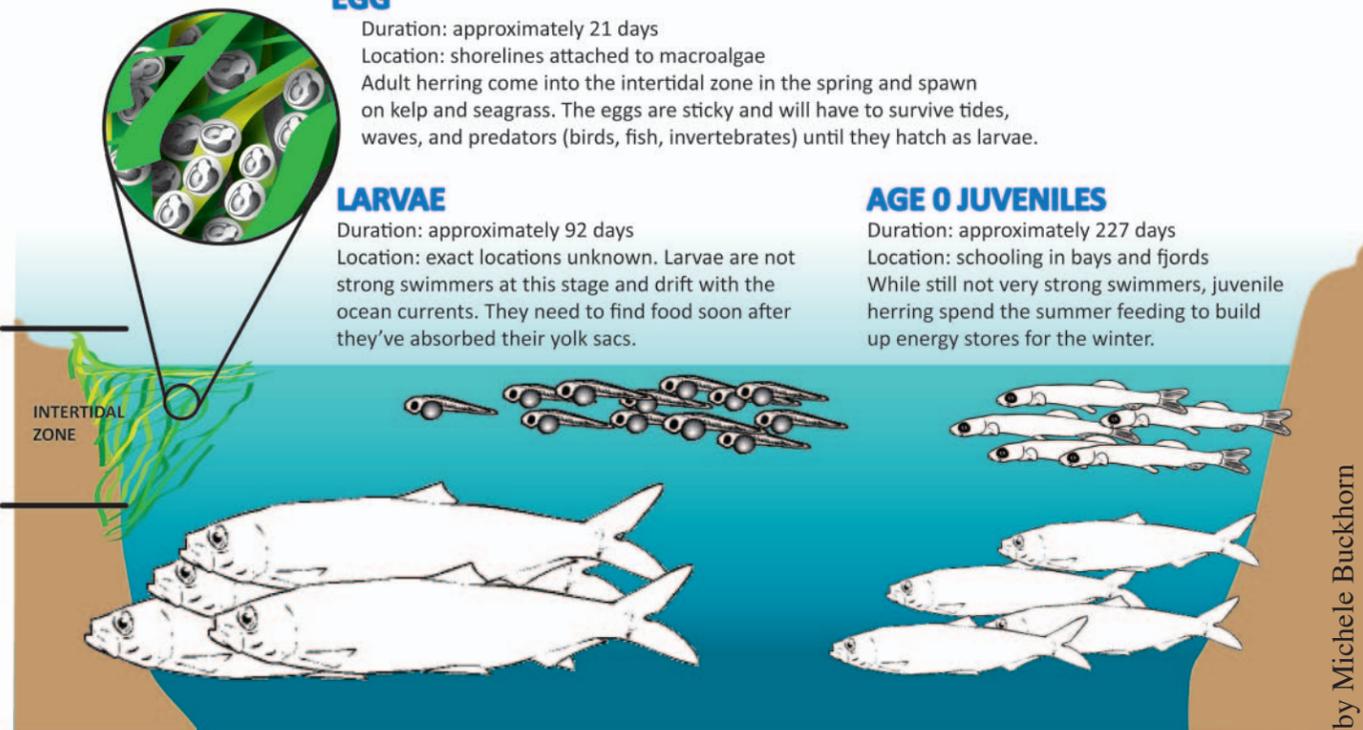
Duration: approximately 92 days  
Location: exact locations unknown. Larvae are not strong swimmers at this stage and drift with the ocean currents. They need to find food soon after they've absorbed their yolk sacs.

### AGE 0 JUVENILES

Duration: approximately 227 days  
Location: schooling in bays and fjords  
While still not very strong swimmers, juvenile herring spend the summer feeding to build up energy stores for the winter.

### AGE 1-2 YEAR JUVENILES

Location: coastal distribution in spring and summer  
Fish that have survived their first winter but are not yet mature enough to spawn spend the springs and summers feeding to build up energy stores for the winter.



### AGE 3+ ADULTS

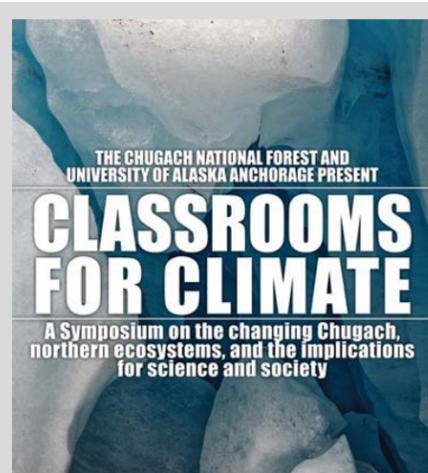
Location: spring distribution in near-shore spawning grounds. Other times of the year they move offshore and their exact distribution is unknown. Adult herring are typically surveyed in early spring right before they move to the spawning grounds.



Herring spawn and a herring ball in a small bay off of Port Etches on Hinchinbrook Island, PWS. Photo by Allen Marquette.



The Prince William Sound Science Center partnered with former commercial herring fishermen through Cordova District Fishermen United to conduct winter and spring herring surveys. One participant explained, "We wanted to participate in this project because of our concern for the fishery. My wife and I do herring for a living. We would love to see the resource rebound." -Rob, Deb, Eli & Dane Eckley pictured onboard F/V Cape Fear.



The Chugach National Forest and University Alaska Anchorage partnered with the Alaska Coastal Rainforest Center, Alaska Geographic, Northern Forum, Alaska Youth for Environmental Action, and the Institute of the North on the Classrooms for Climate conference held at the UAA campus May 4-7, 2011. This diverse array of collaborators came together in recognition that the Chugach and neighboring landscapes are an extended classroom for researchers, educators, and students around the world seeking to better understand the potential physical, biological, cultural, and socio-economic impacts of Climate Change.

Through multiple plenary and over 20 breakout sessions, the Conference examined current knowledge of regional climate, natural and managed ecosystems, socioeconomic conditions, and traditional cultural values of Alaska's coastal forests and surrounding areas. It also created an educational opportunity for students, agencies, and the public. Northern climate scientists and experts shared their research, perspectives and insights. The conference featured a public key-note address, paper and poster sessions, and a youth participation component with an emphasis on 1) biophysical systems, 2) their relevance to economic and cultural values, 3) their

importance to advancing knowledge, and 4) utility for education, policy, and adaptation.

In addition to cutting edge science centered on northern climates, the conference was kicked off by keynote speaker, Majora Carter, in a public address. Majora is one of the nation's pioneers in successful urban green collar job training and placement. She addresses public health, poverty alleviation, and climate change. To see highlights of the Conference, review abstracts and poster sessions, and listen to posts from the sessions, visit [www.uaa.alaska.edu/classroomsforclimate](http://www.uaa.alaska.edu/classroomsforclimate).

# Exchanging oil spill lessons learned

## Local citizen's group hosts Gulf of Mexico visitors

Linda Robinson,  
PWS Regional Citizen's Advisory  
Council

The *Deepwater Horizon* oil rig explosion in the Gulf of Mexico (GOM) on April 20th, 2010 was a grim reminder to Alaskans of the *Exxon Valdez* oil spill in March, 1989. Residents of the GOM, suddenly faced not only with the deaths of oil workers, but also spreading oil and damage to their marsh environment, looked north for help. While Alaska has a fairly strong oil spill prevention and response system in place – the Gulf does not.

To try to understand how to respond to this disaster, GOM residents wanted to visit Alaskans to see what happened in the aftermath of the *Exxon Valdez* spill and how they can be better prepared

for preventing and responding to an oil spill in the future. Over two dozen visitors came on trips coordinated with the Prince William Sound Regional Citizen's Advisory Council (PWSRCAC), representing community leaders, fishermen, travel organizations, response centers and local parishes. Several news groups were also on these trips, including WWLTV in New Orleans, the Washington Post, and CNN.com.

Guests visited with PWSRCAC board members and staff. They were able to meet and exchange information with Alyeska Pipeline Service Company, the U.S. Coast Guard, Alaska SeaGrant, Shoreside Petroleum, Copper River Seafoods, Prince William Sound Science Center, the Ilanka Cultural Center in Cordova as well as the Prince William Sound RCAC. They also toured the Solomon Gulch Hatchery

in Valdez. Community meetings were held to discuss issues and ask questions.

Most visitors left with the intent of organizing citizens' oversight in the Gulf. This will be challenging due to minimal funds, but after the President's *Deepwater Horizon* Report was released, which included recommendations for citizens' oversight not only in the Gulf but also in the Arctic, this may eventually become a reality.

The goal for the *Exxon Valdez* oil spill affected area, written in the Oil Pollution Act of 1990 is "to promote partnership and cooperation among local citizens, industry, and government, and to provide citizen oversight of environmental compliance by oil terminals and tankers."

For more information on this topic please contact Linda Robinson, [robinson@pwsrca.org](mailto:robinson@pwsrca.org), or visit our website at [www.pwsrca.org](http://www.pwsrca.org).



Top: Russell Dardar enjoys Alaska oysters while visiting in Soldotna. Bottom: Cordova fisherman Bill Lindow visits with Gulf of Mexico visitors. Photos courtesy of PWSRCAC.

# Balloons improve oil spill detection

## Balloons tested as a way to improve detection of oil spills

Scott Pegau,  
PWS Science Center

Our ability to clean up an oil spill depends on being able to find it. Currently we rely on aircraft overflights to direct vessels to the thickest portion of a spill. However, weather and fuel often limit how often aerial observations are available. The Oil Spill Recovery Institute is testing an alternative approach to providing aerial observations. The approach uses a balloon tethered to a spill response boat. The balloon carries a visible and infrared camera that transmits its video to the surrounding vessels. The balloon can be sent up to an altitude of five hundred feet without any special permits and is rated to 80 knots of wind. The infrared system allows detection at night and helps to identify the thickest patches of oil during the day. Use of this system would allow 24/7 observations around a response vessel at a relatively low cost.



The balloon and camera system being deployed in Prudhoe Bay. Photo courtesy of Alaska Clean Seas.

Test deployments of the system are scheduled in the Valdez area in April of 2011.

For more information contact Dr. Scott Pegau, [wspgou@pwssc.org](mailto:wspgou@pwssc.org).



# Exxon Valdez oil spill

On March 23, 1989, the oil tanker *Exxon Valdez* left the Valdez Marine Terminal at 9:12 pm, 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.

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 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. 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.

For more information on the

immediate and long-term impacts of the spill, as well as links to other oil spill resources, visit [www.pwssc.org](http://www.pwssc.org) and click on education-> oil spill education. Additional information can be obtained from the legacy organizations established after the spill including:

The **EVOS 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](http://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 sub-Arctic regions. ([www.pws-osri.org](http://www.pws-osri.org))

The **PWS Regional Citizen's Advisory Council** is an independent non-profit organization whose mission is to promote environmentally safe operation of Alyeska Pipeline's Valdez Marine Terminal and associated oil tankers. ([www.pwsrca.org](http://www.pwsrca.org))

# New book announcement!

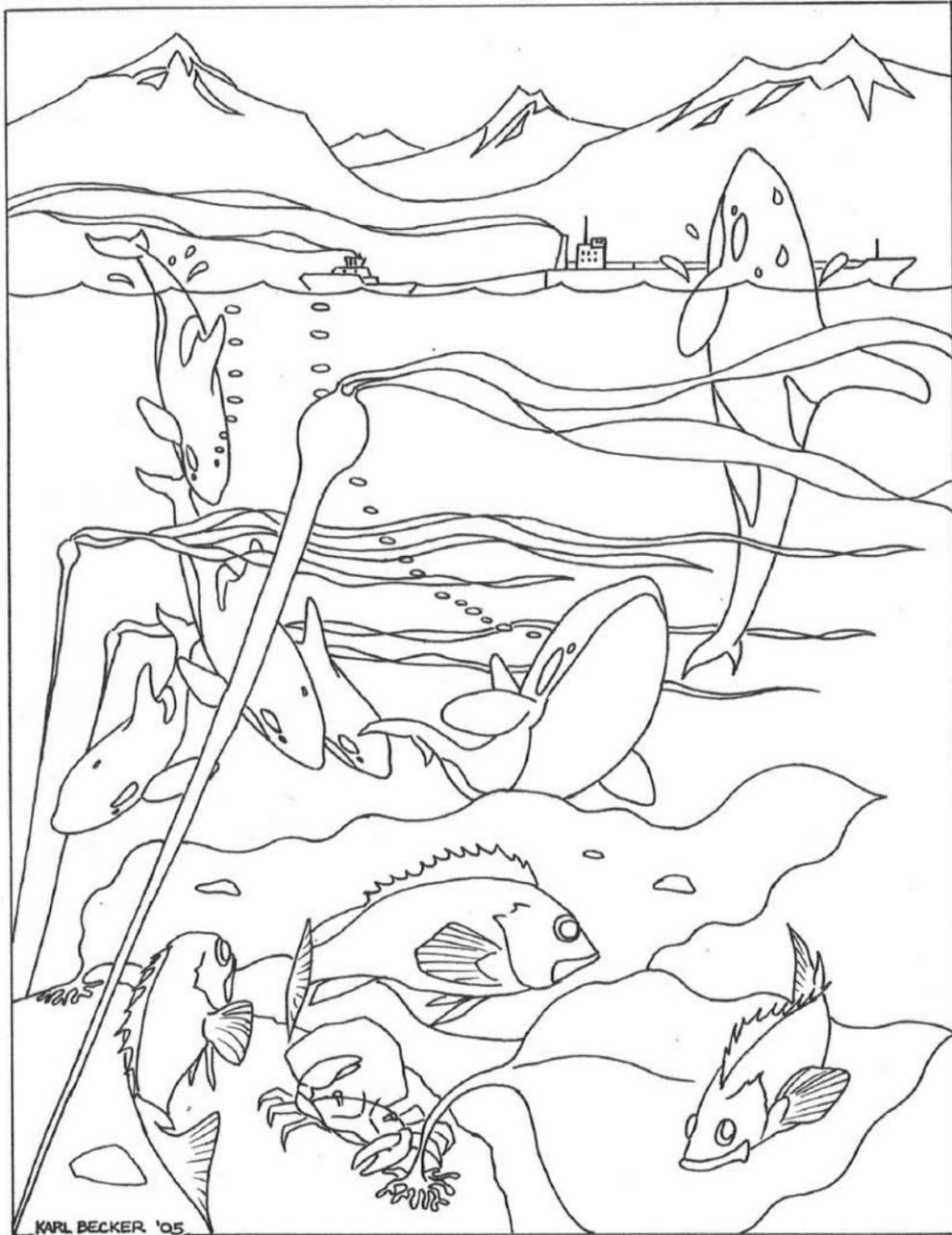
The Chugach National Forest and the University of Arizona are excited to announce an upcoming book documenting human use research and management efforts in the 21 years since the *Exxon Valdez* oil spill. The compilation entitled: Sustainable Wildlands: A Prince William Sound Case Study of Science and Community-based Strategies for Managing Human Use will include stakeholder voices from around the region published alongside technical chapters compiled by dozens of authors.

The volume is edited by Dr. Randy Gimblett from the School of Natural Resources at the University of Arizona & Aaron Poe from the Chugach National Forest. Portions of this volume will be interactive where stakeholders and

managers can further the discussion online! Publication is scheduled for Fall of 2011. Find out more at: <http://www.snr.arizona.edu/~gimblett/newbookannouncement.htm>

This effort is being funded by the *Exxon Valdez Oil Spill Federal Trustees*. For more information contact Aaron Poe, Partnerships and Community Engagement Specialist for the Chugach National Forest: email: [apoe@fs.fed.us](mailto:apoe@fs.fed.us) phone: 907-743-9568.





## Students catalogue salmon in pond

Thanks to Cordova's 7th grade science class, Odiak Pond has been added to the State of Alaska's *Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes*.

This catalog is maintained by Alaska Department of Fish & Game and establishes extra protection for listed waterways in order to sustain the State's anadromous fish populations, primarily salmon.

Over the 2009-2010 school year, Cordova 7th graders collected the data necessary to prove that Odiak Pond is important spawning and rearing habitat for coho salmon.

Thanks to the 7th grade class for their hard work, and to our project partners for their help, including Cordova School District, US Forest Service Cordova Ranger District, Native Village of Eyak, Alaska Department of Fish & Game and Prince William Sound Science Center.

Visit [www.copperriver.org](http://www.copperriver.org) to view the films created by the students. Follow links to "watershed education."



## Can You Hear Me? Learn About Seals and Alutiiq Bentwood Hats



Illustration from the publication Chugach Legends, copyright Chugach Alaska Corporation

- What sounds can you hear during the day? When are the sounds louder or quieter? How can you hear sounds better? How do you think the Alutiiq hunters traditionally located animals when hunting?
- In the old days, the Alutiiq hunters in the Chugach region used bentwood hats when hunting for seals. The hats amplified sound so that the hunter could hear the seals better when kayaking. The hats also kept the elements off the hunters head and eyes, and prevented the seal from seeing the hunter's eyes. The hats are traditionally made from wood by bending it to shape by steaming.

### LEARN SUGGESTION WORDS!

Arrow	rruq
Boat	palagg'uutaq
Fire/campfire	keneq
Fish spear	kapsuun, kapsuutaq
Fish hook	iqsak
Hunt/hunting	pisurluni
Kayak, bidarka	qayaq
Loud	kallagtuluni
Oar, paddle	pakiu'un
Ocean	Imaq
Rain	qiteq
River	kuiq
Seal	qaigyaq
Sound	nepa
Fish spear	tuqsiiq
Water	meq
Whale	arwaq

(Vocabulary from Nanwalegmiut Paluwigmiut-Ilu Nupugnerit - Conversational Alutiiq Dictionary, Kenai Peninsula Alutiiq by J. Leer, 1978.)

### SEAL FACTS

Seals are mammals and they weigh about 24 pounds (10.9 kg) at birth and gain weight rapidly during a month-long suckling period, doubling their weight. Adults may weigh up to 300 pounds and males are somewhat larger than females. They are covered with short, stiff, bristle-like hair. There are three different kinds of seals in Alaska (bearded, ringed and harbor) and only harbor seal (*Phoca vitulina*) lives in the Prince William Sound. Their coloration varies, but two basic patterns occur: a dark background with light rings, or light colored sides and belly with dark blotches or spots. Harbor seals molt annually, usually in late summer. They eat a variety of fish such as salmon and herring, and crustaceans and squid. You can find them near coastlines, fresh water river systems, on remote intertidal sandbars, rocky shores and ice. (ADFG, 2011) Baby harbor seals sound like "maa" and adults' sound is almost like barking.

### SOUND

- is a mechanical vibration that travels through matter as a waveform.
- consists of longitudinal or compression waves in matter.
- sound wave moves at approximately 1130 feet/sec. or 770 miles per hour at room temperature or 70 degrees Fahrenheit.
- the frequency of sound is the rate at which the waves pass a given point; the relationship between velocity, wavelength and frequency is: velocity = wavelength x frequency.



Chugach Regional Resources Commission's "Iqsak K-12 Science Curriculum Project" is a 3-year US Department of Education funded project to develop a K-12 science curriculum for the Chugach region that reflects Alaska Native beliefs, values and understandings of the natural world with science education standards. Chugach Regional Resources Commission believes that a culturally-based natural resource science curriculum would enhance Alaska Native Students' education

and motivation to pursue post secondary degrees and careers in the sciences and natural resource management. The goal of the Curriculum is to introduce students to the relationships, diversity, and communities in the ecological and cultural environment of the Chugach Region, exploring Alutiiq and scientific perspectives and the connections between the two. For more information visit us online at [www.iqsak.com](http://www.iqsak.com) or [chugachk12.blogspot.com](http://chugachk12.blogspot.com).

# RESOURCES

SUMMER 2011



The Chugach National Forest launched an innovative endeavor in 2008 in an attempt to tell the story of Prince William Sound using the voices of the people who live and work and play in this internationally significant region. Stories collected for this website will become the foundation of a **virtual visitors center for Prince William**

**Sound.** We hope these stories will help educate people who care about



Specialist for the Chugach National Forest: email: [apoe@fs.fed.us](mailto:apoe@fs.fed.us) phone: 907-743-9568



the Sound to conserve and enjoy the area in a responsible way. Visit: [www.exploresound.org](http://www.exploresound.org) to learn more about this amazing region and possibly even contribute your own Sound Story! For more information contact Aaron Poe, Partnerships and Community Engagement



## Marine debris survey

This chart was created by participants in the Prince William Sound Science Center's Ocean Science and Leadership Expedition, a 10-day field course in ocean sciences. On the 2010 trip, participants completed a marine debris survey and cleanup of 17-Mile Beach in Valdez Arm.

Marine debris refers to any material found on shore or in the ocean that does not occur naturally. This debris comes from many sources: overspill from boats, objects forgotten or left on beaches, and even garbage from city storm drains. Most marine debris washes ashore after drifting through the oceans for many miles.

74% of the debris found on 17-Mile Beach was plastic or foam, which are especially harmful to the marine ecosystem because they never biodegrade. Sun, wind, and wave action break them down into a "plastic dust" which remains in the ocean environment and can be ingested by marine organisms, making their way up the food chain and bioaccumulating in long-lived predator species such as halibut, seals and whales. Larger pieces of plastic can harm



sea life when they are mistaken for food and ingested, or when animals become entrapped in plastic rings, lines and old fishing nets. Do your part to prevent plastics from entering the ocean! Reduce, Reuse, Recycle and Repair!

## Bird and Wildlife Checklist

u - uncommon  
s - seasonal

Recommended bird/mammal guide: "Sibley's Field Guide to Birds of Western North America" and the "Guide to Marine Mammals of Alaska" by Kate Wynne. List compiled by the PWS Chapter of the Audubon Society.

### Loons and Grebes (*loon = tullek*)

- Common loon
- 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 (*agayuuq*)

- Pelagic cormorant
- Double crested cormorant

### Hérons

- Great blue heron

### Waterfowl

- Surf scoter (*unanirrlat saqulet*)
- White-winged scoter
- Long-tailed duck
- Barrows goldeneye
- Common goldeneye (*qapugnaq*)
- Bufflehead
- Harlequin duck
- Mallard (*ungusaq*)
- Canada goose (*temngiaq*)
- Common merganser (*paig*)
- Red-breasted merganser

### Shorebirds

- Black oystercatcher
- Semipalmated plover
- Least sandpiper
- Yellowlegs
- Red-necked phalarope (s)
- Surfbird (s)
- Plovers (s)
- Turnstone (s)
- Dunlin (s)
- Sandpipers (s)

### Gulls/Terns (*sea gull = naruaq*)

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

### Seabirds

- Tufted puffin (s) (*ngaqngaq*)
- Horned puffin (s) (*ngaqngaq*)
- Marbled murrelet
- Kittlitz's murrelet (u)
- Parakeet auklet (u)

### Seabirds (cont'd)

- Pigeon guillemot
- Common murre

### Raptors

- Bald eagle (*kuckalaq*)
- Peregrine falcon

### Hummingbirds

- Rufous hummingbird (u)

### 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

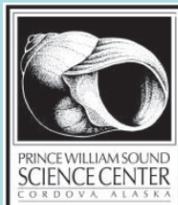
### Mammals

- Killer whale
- Humpback whale
- Minke whale
- Steller sea lion (*wiinaq*)
- Sea otter
- Harbor seal (*qaigyaq*)
- Dall's porpoise (*mangtak*)
- Harbor porpoise (*mangtak*)
- Sitka black-tailed deer (*pekaa*)
- Black bear
- Brown bear
- Land otter (*kep'arka*)
- Coyote
- Mountain goat (*sepa*)
- Marmot
- Mink
- Weasel
- Beaver (*sniq*)

Sugcestun/Alutiiq language words (in *italics* following English names) provided by the Chugachmuit Heritage Preservation Project. For more information on the Sugpiaq (Alutiiq) people and their language, visit [www.chugachmuit.org](http://www.chugachmuit.org). To learn more about the Eyak language of the region, visit <http://sites.google.com/site/eyaklanguageproject>.

## Friends of Prince William Sound & Copper River Delta

Thanks to our generous sponsors for their contributions. Please support these businesses and organizations who support our education efforts.



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Cordova Ranger District

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Exxon Valdez Oil Spill  
Trustee Council  
Salmon for Alaska

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Alaska Good Time Charters  
Auklet Charter Services  
Cordova District Fishermen United  
Ecotrust  
von Wickman Family & Babkin Charters

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Leisure Time Charters  
Pangaea Adventures  
CR/PWS Marketing Association  
Whittier Marine Charters  
Stan Stephens Glacier and  
Wildlife Cruises



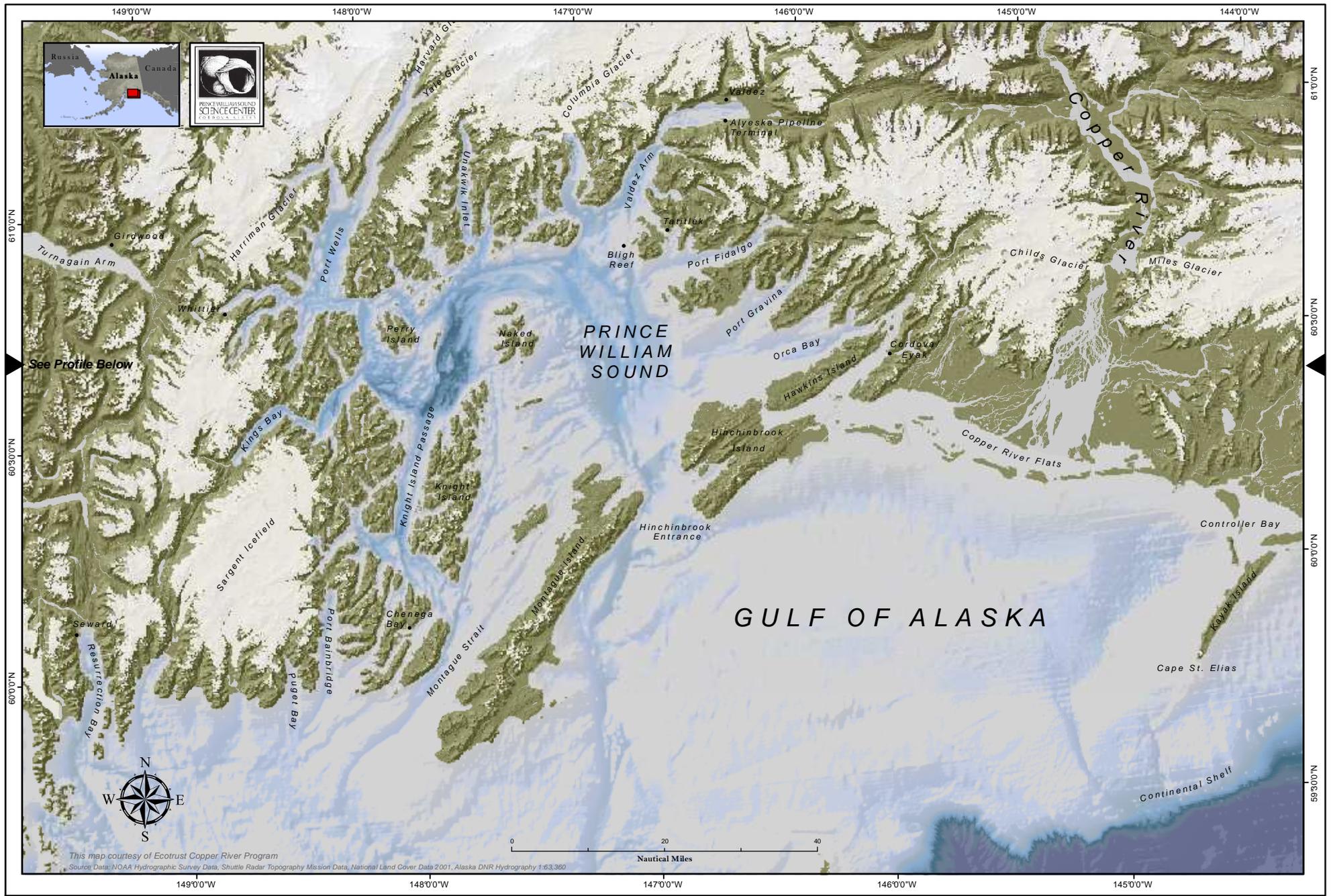
- \$10 - Student
- \$25 - Individual
- \$50 - Family
- \$100 - Chinook
- \$250 - Eagle
- \$500 - Grizzly
- \$1000 - Orca

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The PWS Science Center is a 501(c)3 nonprofit research and education organization based in Cordova, Alaska



# HATCHERIES

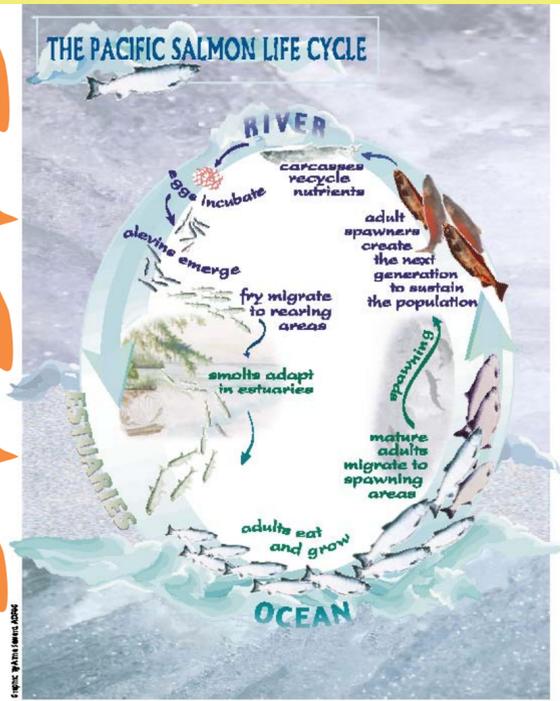
From its origin in 1974, the salmon enhancement program of the State of Alaska was intended to protect the fisheries from cyclical weaknesses in the wild salmon returns. The Alaska Department of Fish & Game created the Fisheries Rehabilitation, Enhancement and Development (FRED) division and a constitutional amendment provided the basis for passage of the private, non-profit Hatchery Act in 1974.

Prince William Sound hatcheries use the "ocean ranching" method of aquaculture, where eggs collected each summer and fall from wild brood stock are incubated in the controlled environment of the hatchery during the Sound's harsh winter months. In the spring, fry emerge from their incubators and are released into the Sound. Salmon return to PWS to spawn after spending between 1-5 years in the Pacific ocean, depending on the specific species of salmon.

There are 6 hatcheries operating in PWS region. Annually, approximately 600 million pink, 133 million chum, 30 million sockeye, and 6 million coho salmon smolt are released. On average, this provides approximately 30 million pink, 4 million chum, 1.2 million sockeye and 600,000 coho adult salmon for the

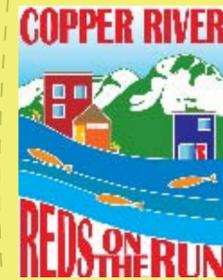
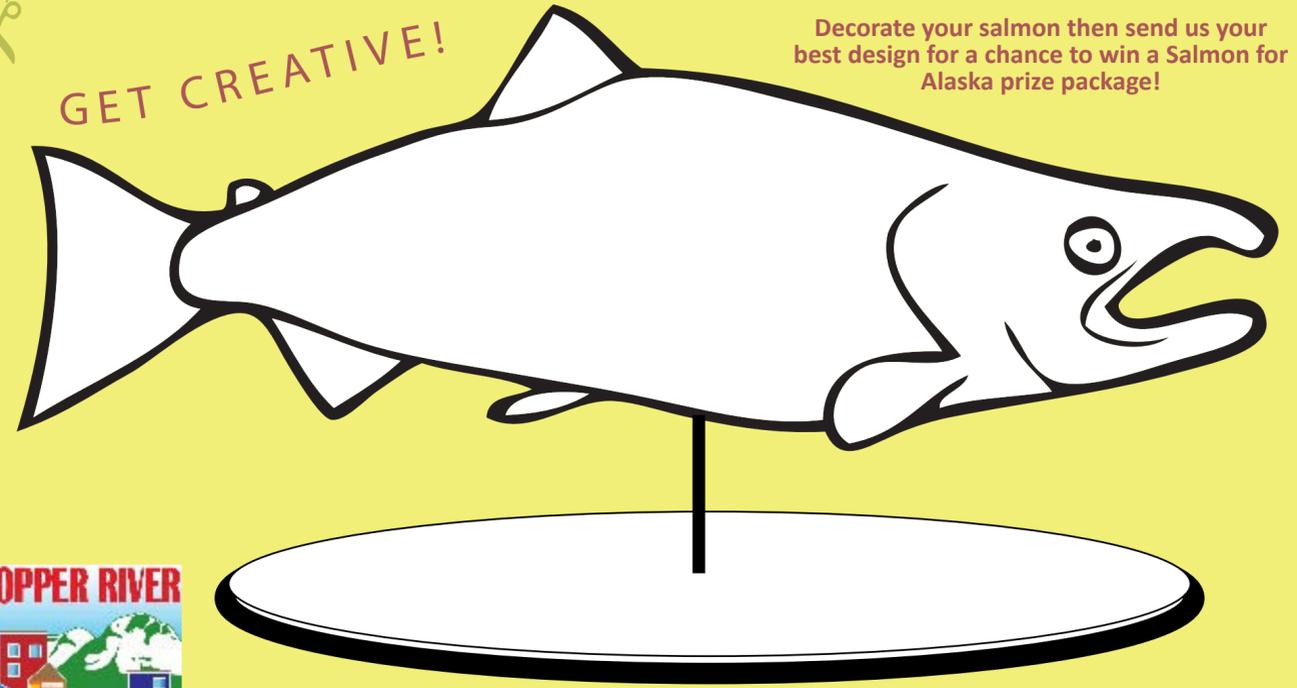


For more information:  
www.pwsac.com or  
www.adfg.alaska.gov/  
index.cfm?adfg=fishing  
Hatcheries.main



GET CREATIVE!

Decorate your salmon then send us your best design for a chance to win a Salmon for Alaska prize package!



Each year, local artists decorate salmon molds, which are then auctioned off to raise money for student scholarships. If you're an artist interested in participating next year, email: [beth@copperrivermarketing.org](mailto:beth@copperrivermarketing.org)

Mail your entry to:  
Salmon for Alaska || P.O. Box 199, Cordova, AK 99574

YOUR NAME:  
POSTAL ADDRESS:  
CITY:  
STATE:  
ZIPCODE:  
EMAIL:

# TEST YOUR KNOWLEDGE!

Test your knowledge of fish species that reside in Prince William Sound:  
SCALLOP HALIBUT PINK SALMON (Humpy) COHO SALMON (Silver) CHINOOK SALMON (King) PACIFIC HERRING ROCKFISH PACIFIC COD CHUM SALMON SOCKEYE SALMON (Red) SKATE LING COD SPOT PRAWN

1. Name: \_\_\_\_\_

2. Name: \_\_\_\_\_

3. Name: \_\_\_\_\_

4. Name: \_\_\_\_\_

5. Name: \_\_\_\_\_

6. Name: \_\_\_\_\_

7. Name: \_\_\_\_\_

8. Name: \_\_\_\_\_

9. Name: \_\_\_\_\_

10. Name: \_\_\_\_\_

11. Name: \_\_\_\_\_

12. Name: \_\_\_\_\_

13. Name: \_\_\_\_\_

ANSWERS:  
1. Pacific Herring 2. Halibut 3. Pacific Cod 4. Chinook Salmon 5. Coho Salmon (Silver) 6. Spot Prawn 7. Rockfish 8. Scallop 9. Chinook Salmon (King) 10. Lingcod 11. Sockeye Salmon (Red) 12. Coho Salmon (Silver) 13. Skate

## Salmon feeds Alaska.

It fills bellies with some of the finest wild protein in the world. It provides jobs and income to thousands of commercial permit holders and crew across the state. It brings commerce and infrastructure to communities and tax revenue to local and state coffers. It supports a spirit and way of life that is as wild and natural as Alaska's coastline is long.

You may not realize all the ways that Alaska's commercial fishing industry benefits the state and its residents. Revenues from commercial fishing not only support individual jobs, but seafood taxes also boost the state's general fund and help support schools, hospitals and infrastructure in communities throughout Alaska. Inbound freight costs to the state are reduced up to 10c/lb due to seafood that is shipped out reducing the cost of food and merchandise you purchase in Alaska.

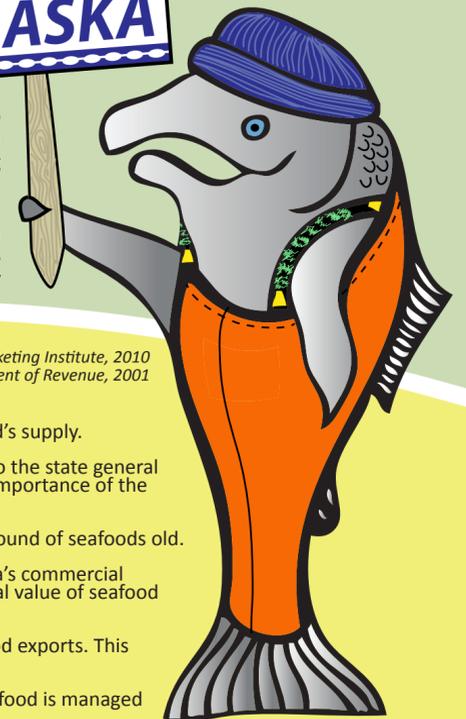
Whether you harvest commercially, for subsistence, sport or personal use, wild Alaska salmon feeds us all and we all benefit from this shared resource. We invite you to join us in celebrating all the ways that Alaska's salmon industry supports our economy, community and culture.

\* Alaska Seafood Marketing Institute, 2010  
\* Alaska Department of Revenue, 2001

## Facts about Alaska's commercial fishing industry\*

- Alaska is the top producer of wild, high-value salmon, producing nearly 80% of the world's supply.
- The seafood industry is Alaska's largest private sector employer. Seafood contributions to the state general fund over the past 6 years have totaled over \$151 million. A testament to the longtime importance of the seafood industry in Alaska, the 1913 fisheries business tax is the oldest tax in the state.
- Due to high quality initiatives and increased demand Alaska is realizing more value per pound of seafoods old.
- Alaska is the #1 ranked state for volume of commercial landings and over 55% of America's commercial seafood is caught in Alaska. Alaska State commercial landings amount to 39% of the total value of seafood across the USA, at \$1.7 billion.
- It is estimated that inbound freight costs are reduced \$0.10 per pound because of seafood exports. This subsidizes food and merchandise you purchase in Alaska.
- Alaska seafood held second place among food brands on U.S. menus in 2008. Alaska seafood is managed for sustainability, in fact it's even written into the state constitution.

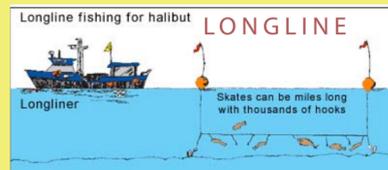
Learn all the ways that salmon feeds Alaska. Visit us and share why Alaska's salmon industry is important to you: [facebook.com/Salmon4AK](https://facebook.com/Salmon4AK)



The greatest number of Alaska salmon are caught in gillnets. Gillnetting involves laying a net wall in the path of the fish and waiting for it to put its head into the mesh. When it does, the gills become entangled in the webbing which prevents the fish from escaping. Gillnets are deployed in two ways: from a vessel that is drifting (Drift Gillnet) or from an anchored system out from a beach (Setnet).



A purse seine is a net which is set in a circle and can be drawn closed at the bottom. Because salmon migrate in tight schools, it is not unusual for an Alaskan seiner to "wrap up" 250 to 1500 fish or more with one set.



Longline gear is composed of groundline, buoy lines, and gangions, which are short pieces of line with hooks on the end. Longlines are set along the seabed, with baited hooks every few yards that are retrieved one at a time. Halibut, sablefish and cod are caught using longlines.

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