An Introduction to the Region
Marybeth Holleman

...Prince William Sound lies at the apex of the bend in the North Pacific coastline where the Arctic to the North, Aleutians to the west, and Inside Passage to the south all intersect. It is one of the most active seismic regions in the world. The 1964 Earthquake centered in the Sound spread its effects farther than any North American earthquake ever recorded. The Sound is encircled by three mountain ranges that feature the sharp ruggedness of geologic youth—the Kenai, Chugach, and St. Elias. Among the peaks that range from 4,000 to 14,000 feet lies the most extensive system of valley glaciers and the largest ice fields in North America.

Prince William Sound forms a circling eddy of the mainstream of Alaska’s coastal current. This westward-moving current carries some of the most biologically productive waters in the world, as nutrients and long summer daylight hours create vast blooms of plankton that swirl around the bend of the Gulf of Alaska and into Prince William Sound by way of Hinchinbrook Entrance. Here, water circulates spirally rather than passing straight through, creating a counterclockwise gyre in the center. This gyre, in conjunction with the ice discharged from tidewater glaciers and the hundreds of freshwater streams feeding the Sound, makes this body of water a unique fjord-estuary.

As the water currents circle through, the Aleutian low-pressure system and the North Pacific high pressure system intermingle. Precipitation is high but locally variable: A beach on Montague Island might get 80 inches a year, while an upland forest 5 miles away might receive 300 inches a year.

Located on the southeastern edge of the Sound is the Copper River Delta, the largest contiguous wetland on the Pacific Coast. From late April to early May, more than 20 million migrating birds pass through the Delta, creating the greatest concentration of birds in the world. Also in abundance are species that are rare or locally extinct elsewhere; the numbers of bald eagles in Prince William Sound exceed their total population in the Lower 48 states. Threatened species, from humpback and fin whales to Steller sea lions, marble murrelets and short-tailed albatross, find an abundance of food and make this place home..." Excerpt from “Alaska’s Prince William Sound: A Traveler’s Guide”, by Marybeth Holleman, published by Alaska Northwest Books.

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Welcome to our home!
We’re excited to publish this first edition of Delta Sound Connections, an annual newspaper to inform you about Prince William Sound (PWS) and the Copper River Delta regions. Our home is rich in diversity of resources and its beauty is hard to beat.

The Prince William Sound Science Center (PWSSC) conducts research to answer questions about the general ecology, oceanography, and food webs. As a community-based science center, we encourage residents and scientists to exchange their knowledge and work together to assure the long-term health and productivity of the fish and wildlife that make this place home.

Articles within this paper will introduce you to the region and also the myriad of research and education programs being conducted by a variety of entities. We thank the many authors who generously contributed to this publication.

We are busy compiling materials for next year’s edition, and welcome your comments, ideas or contributions to help us make sure this publication is informative, accessible and a “must-have” for visitors to our home. By becoming a member of our organization, you will receive all future publications of Delta Sound Connections. Please contact us at deltasound@pwssc.org for more information or to submit your comments.

Thanks for taking the time to learn more about this special part of the world and enjoy your travels!

Nancy Bird, President
Prince William Sound Science Center

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www.aoos.org
Salmon species in Alaska

KING (Chinook): The first species to return to the region, Copper River king salmon are prized for their color, high oil content, firm texture and succulent flesh. Average weight is approximately 20 pounds and length ranges from 30 to 40 inches.

SOCKEYE (Red): The second most abundant species, sockeye have a distinct, deep red flesh, rich flavor and firm texture. Average weight is approximately six pounds and they can grow to almost three feet in length.

COHO (Silver): The second largest of the species, coho have orange-red flesh, firm texture and delicate flavor. Average weight is 12 pounds and they range from 25 to 35 inches in length.

PINK (Humpy): Pinks are the smallest and most abundant of the species. Pinks are distinguished by their light, rosy pink-colored flesh, tender texture and delicate flavor. Average weight is two to three pounds.

KETA (Chum): Keta have a firm texture, orange-pink color and delicate flavor. Average weight is eight pounds and they can grow to be 25 to 27 inches long.

Commercial Fishing Gear & Techniques

GILNETTING: The greatest number of Alaska Salmon are caught in gillnets. Drift and set gillnetting involves laying a net wall in the water 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 and prevent the fish from escaping. Most gillnetters are small and two-man boats. All five species of salmon are caught in gillnets.

PURSE SEINING: 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 seine to “wrap up” 250 to 1500 fish or more with one set. Pinks and chums are caught by the seine fleet.

TROLLING: Trollers are small fishing vessels operated by one or two people who fish with a number of lines and hooks baited with herring or artificial lures. Coho, King and Pink Salmon are caught by the troll fleet.

For more information on local salmon research, visit the websites or offices of the Native Village of Eyak (www.eyakfish.com), the Prince William Sound Science Center (www.pwssc.org), Alaska Department of Fish and Game (http://www.adfg.state.ak.us/) and the US Forest Service, Cordova Ranger District.

Artificial reefs deployed

Artificial reefs support marine colonies in the Sound.

Brad Reynolds, PWS Science Center

Near the port of Whittier in western Prince William Sound, researchers from NOAA and the Prince William Sound Science Center are studying the development of the marine community surrounding Alaska’s first artificial reef. At fifty feet below the water’s surface in a small embayment known as Smitty’s Cove, 180 concrete reefs are attracting the attention of many sea creatures.

The reefs were deployed in May 2006 as part of an effort to test restoration and habitat enhancement options for altered or damaged fish habitat. The reefs are designed to mimic natural reefs in that they add complex, vertical structure to the sea floor which fosters the settlement of kelp and invertebrates, and creates structure to the sea floor which fosters the settlement of kelp and invertebrates that, in turn, provide a food source for fish.

Additionally, each reef is fabricated with portals to allow fish access to interior reef space which serves as refuge from predation. Researchers relied on SCUBA diving and remote cameras to document fish, kelp, and invertebrate colonization of the reefs. What they found was that fish communities at the artificial reef were similar to communities established at local natural reefs. Lingcod and several rockfish species including quillback rockfish and copper rockfish were observed inhabiting the artificial structures.

In addition to fish, invertebrates including spot prawns, crabs, sea stars, octopuses, and sea cucumbers were found on reef surfaces or nestled in folds of sugar wrack kelp attached to the reefs. The success of the artificial reef in providing fish habitat provides researchers with a potential tool for maintaining productive habitat in Alaska’s nearshore waters.

For more information about this topic, contact Brad Reynolds at breynolds@pwssc.org or visit www.pwssc.org.
Water bugs abundant on the Delta

Bug Boys investigate Copper River Delta pond productivity.

Ken Hodges, Cordova Ranger District, US Forest Service

Duke Busch from Michigan State and Ryan Van Duzor from Loyola University spent this past summer studying the aquatic invertebrates of the Copper River Delta. Their work is one component of a pond ecology project sponsored by the USDA Forest Service and universities across the United States. Busch is investigating the relations between invertebrates and different vegetation types, while Van Duzor is looking at invertebrate production. In the future, other graduate students will study how these factors affect the bird species and populations. This information will be used to help manage the wetland areas – a challenging task given the constantly shifting glacial channels, vegetation succession, and pond drainage caused by the tectonic uplift along the 1964 earthquake.

Busch and Van Duzor still have 500 to 600 samples to sort through, but the low invertebrate diversity in these ponds already stands out. "We’ve only found (specimens from) six to eight different families in these ponds, as opposed to 20 or more in one net in a diverse pond in the lower 48," Busch says. "But even though there’s not a lot of variety, there are a lot of them."

Van Duzor feels that the sheer abundance of invertebrates is the most significant finding so far. "One of the important things that people may not understand is that the small insects like midges – those swarms of tiny microscopic insects – are the base structure where a lot of the energy comes from in the system. It’s mind boggling how many midgets are in one small patch of mud. Birds, other insects like beetles, dragonflies, and damselflies, are all eating these midges, both as adults and larvae."

So when you’re out on the delta bird watching or fishing, don’t curse the bugs crawling down your collar or up your shirt sleeves. Without the bugs, you wouldn’t have the birds or fish. As Van Duzor says, “As much as they’re annoying, they have to be there.”
Humpback whales stay longer in winter

John Moran, NOAA/Auke Bay Lab

During the short, stormy days of winter, scientists from NOAA’s Auke Bay Laboratories, the University of Alaska Southeast (Sitka) and the University of Alaska Fairbanks are studying the waters of Prince William Sound (PWS) looking for humpback whales. At the time of year when most whale biologists are thinking about shifting their efforts to warmer latitudes, humpback whale activity in the Sound is heating up. These researchers, funded by the Exxon Valdez Oil Spill Trustees Council, want to know how many whales use the Sound during the winter months and how these whales are impacting local herring populations. Humpback whales can be identified by the unique markings on the underside of their flukes. Knowing individuals allows scientists to study migration, reproductive success, longevity, and estimate abundance.

During eight research cruises conducted in the winters of 2007/2008 and 2008/2009 over 175 individual humpbacks were identified using the waters of PWS. The whales were generally concentrated around herring “hot spots” such as Port Gravina, Sawmill Bay and Prince of Wales Passage. Whales were abundant from September through late January, with a few individuals still present in March.

It is possible a few of these “March whales” decided to skip the annual migration to Hawaiian breeding grounds and spend the winter in Alaska. Why delay a trip to Hawaii? Good food, Humpbacks are lingering in the Sound to feed on the dense aggregations of energy rich herring. When the tourists are gone, humpback whales are still plying the icy waters of Prince William Sound and scientists are trying to understand their ecological role through out the darkness of the Alaskan winter.

For further information on this topic, or to contact the scientists, see: http://www.afsc.noaa.gov/ABL/Humpback/default.htm.

Photographs taken under Scientific Research Permit No.473-1700-01.

Steller sea lions forage on herring

Dr. Richard Thorne, PWS Science Center

The objectives of this study, funded by the National Marine Fisheries Service, were to document the abundance and distribution of herring available as prey to Steller sea lions in Prince William Sound (PWS) and around the Kodiak Archipelago during winter and to investigate the factors that affect Steller sea lion foraging behavior. The study duration was slightly more than four years, from October 1, 2004 to December 31, 2008. During this time 32 cruises were conducted in PWS and off the Kodiak Archipelago. The cruises focused on measurement of herring biomass and associated predators. In addition there was an extensive examination of historic databases, some modeling of Steller sea lion foraging behavior, experiments on herring location and behavior using passive acoustic systems, and studies of herring energetics.

“Steller sea lions were very good at finding and tracking the large herring schools”
- Dr. Richard Thorne

Steller sea lions in PWS were found to be strongly associated with herring schools. Foraging activity increased as herring congregated prior to spawning. Herring were attractive as prey to Steller sea lions because they were distributed near surface in sheltered areas and in large schools. Those same characteristics were attractive to other predators, including humpback whales and many seabirds. Other potential prey, such as walleye pollock, required much more effort to capture since they were much deeper and more dispersed. Steller sea lions were very good at finding and tracking the large herring schools.

The study suggested that the numbers of herring were important to Steller sea lions, and that herring population declines, like the one following the Exxon Valdez Oil Spill, had adverse effects on the Steller sea lion population.

For more information, contact Dr. Richard Thorne rthorne@pwssc.org or visit www.pwssc.org.

Decline of Pacific herring investigated

Staff, PWS Science Center

In the decades prior to 1990 there was a robust Pacific herring population in Prince William Sound. It supported a lucrative early season commercial fishery that brought the communities of the Sound to life. By 1993 that fishery was closed and has only briefly been reopened twice. The current 10,000 tonne biomass is tiny compared to the peak value of 150,000 tonne or the long term average around 65,000 tonne.

What caused the dramatic decline in this fishery is still hotly debated. Was it the 1989 oil spill, disease, climate change, or just natural cycles? Researchers at the Prince William Sound Science Center (PWSSC) have been working to answer this question. PWSSC’s Dick Thorne concludes that several factors connect their decline to the 1989 Exxon Valdez oil spill.

First, he points out that Pacific herring routinely migrate to the surface at night to gulp air. This makes herring at high risk to an oil spill. The herring likely surfaced into the oil or were blocked from the surface by the oil which would cause them to sink and die. This would lead to a higher mortality than previously thought. In support of the high mortality hypothesis Dr. Thorne points to a close relationship between herring biomass and an index known as mile-days of spawn. Based on the relationship of these two data-sets between 1993 and 2007, Dr. Thorne hindcast the herring biomass from 1973 to 1993. The results show the herring decline starting in 1989. Another indication that the herring decline started in 1989 is that population counts for Steller sea lions, an efficient predator on herring, also began decreasing in 1989.

The cause of the collapse remains controversial to other scientists. Of greater importance is to understand why the herring have not recovered. Today, researchers from multiple institutions and disciplines are working to determine why herring populations remain depressed. Funds to support this research are primarily from the Exxon Valdez Oil Spill Trustee Council, which oversees funds from a settlement between the government and Exxon.

For further information, contact either Dick Thorne at rthorne@pwssc.org or visit www.evostc.state.ak.us.
Mixed health report for the Sound’s Orcas

Craig Matkin, North Gulf Oceanic Society

The Prince William Sound killer whale study had its origins in the early 1980s. Since that time the North Gulf Oceanic Society has annually collected identification photos of each individual in the major pods and groups of killer whales that use Prince William Sound and Kenai Fjords National Park. This monitoring allowed us to assess the devastating effect of the Exxon Valdez oil spill.

The AB pod of fish eating (or “resident”) killer whales lost 13 of 26 members following the spill and the AT1 population of marine mammal eating (or “transient”) killer whales lost 9 of 22 members. Residents and transients behave like two different species and do not associate or interbreed. Unfortunately, neither group has recovered from these losses… AB pod is slowly recovering, while we expect the AT1 group is headed for extinction. Other groups of fish eating resident whales are doing well, so the news is not all bad! We also take biopsies of the whales to study their genetics, contaminant levels and feeding habits. Lately we have attached small satellite transmitters to study their movements and determine important habitat. All our work, though, is based on identifying individuals so we can monitor changes year after year.

For more information on this topic, visit www.whalesalaska.org.

Exxon Valdez Oil Spill

On March 24, 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 resumed 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 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. 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 and click on education and oil spill education.

20 years later...

Continued from Page 1

9000 pits later: A summer long study to assess oil was initiated to find out how much oil was remaining. A crew of 8 dug over 9000 pits, sampled from over 90 sites in Prince William Sound, and found oil in over half the places they sampled. All of these sites were heavily oiled in 1989, but only 20% of the original heavily oiled beaches were sampled in this study. Scientists from the Auke Bay Lab estimated that 20,000 gallons of oil remained below the surface of the beach, about 5 or so inches below the surface to about a foot below. The oil was often relatively fresh, and was equivalent to the oil that came ashore after about two weeks of weathering in 1989. Without access to air or water penetrating the pools of oil, weathering and dissolution processes do not happen. The subsurface oil always fingerprinted back to the Exxon Valdez oil spill.

On the beach surface, there was sometimes traces of oil, and rocks stained by oil- this oil was highly weathered (exposed to air and water), and did not have a liquid consistency (more like asphalt). This oil is not common, does not have a lot of volume, and is not bioavailable to the fauna.

Linkage to effects: The subsurface oil that remains is often liquid and toxic. About a third of this volume was found in the lower intertidal zone, where mussels, clams, worms and other prey are found. Sea otters dig foraging pits in this area, and harlequin ducks will poke around looking for prey; both species have struggled in the area of northern Knight Island, where the probability of encountering subsurface oil is most likely.

Sea otter recovery specifically in the northern Knight Island area was nil well into the second decade, and in the last two years, a positive trend in recovery is evident. For the last 20 years, the small population of 65 sea otters in this area have dug an estimated 2 million pits in the lower intertidal zone, and would have encountered oil numerous times. Never enough to kill the sea otters outright, but enough of an exposure periodically so that their numbers were not increasing like otters in areas without oil.

When will Prince William Sound fully recover? The Sound has made remarkable progress since the spill 20 years ago; most visitors would never encounter oil or even realize there had been a spill. The cleaning was intense in the first years following the spill, and mother nature was active with winter storms to aid in the natural cleaning of beaches. The loss rate of oil from the beaches was relatively rapid at first, but in the last decade, those loss rates have declined greatly. If a pocket of oil persists today, it is likely to persist for many years to come. More cleaning is contemplated, but we worry about doing more harm than good. We do not know if we should, or shouldn’t do more.

One major force will continue: Those 65 sea otters in northern Knight Island will continue to dig pits in the intertidal zone, making patches of oil available to water and air, and helping the habitat recover. It will take another couple of decades or more before we will be satisfied that the sound is truly clean as it was prior to the spill.
IT’S 3am and a FISHERMAN NEEDS TO KNOW WHAT the WEATHER WILL BE LIKE for PRINCE WILLIAM SOUND OVER the next 48-HOUR FISHING WINDOW.

Mariners need solid weather forecasts—especially when conditions turn marginal. But National Weather Service weather modeling data are scaled for the entire Sound, making accurate forecasts difficult for smaller areas.

Alaska Ocean Observing System (AOOS) forecasts can be better scaled to the needs of mariners in Prince William Sound. Its weather data come from one of the world’s densest networks of observation platforms—with more than 20 weather stations operating within an area of 40 square miles.

With such a dense network, these stations can deliver the real-time measurements of actual weather conditions so important to anyone going out on the water.

Prince William Sound and Surroundings

All instruments operate in the Sound year-round except for ALVs and gliders, which will be used only during the 2009 Field Experiment.
The Alaska Ocean Observing System and the Oil Spill Recovery Institute will evaluate regional forecast models for their effectiveness in predicting wind, waves, and ocean circulation in Prince William Sound.

We will deploy drifting buoys throughout the Sound to measure the speed and direction of surface currents, and measure how well the forecast model predicts ocean conditions. We will follow the tracks of buoys that mimic Coast Guard Search and Rescue targets and oil spill trajectories. We will also deploy autonomous vehicles to fly and swim the Sound, collecting data as they go.

**Goals of the Ocean Observing System**

To provide physical and biological information to the people of the Sound, and to learn more about what drives its ecological variability.

Accurate and precise wind, wave and ocean current forecasts will translate to better weather forecasts for vessel and aircraft operators, enhancing safety. It also links resource programs and managers such as hatcheries and the Alaska Department of Fish & Game make better decisions on food supply, predation, and fishing.

Ecologically, if we can better understand circulation patterns and the dynamics of water exchange in the Sound, we will have a solid scientific foundation for addressing fisheries management and ecosystem needs related to long-term ocean and climate variability.

**Instruments**

- **SNOWT weather stations**

  Snowpack Telemetry (SNOWT) stations measure precipitation, snow depth, wind speed and direction, air temperature and pressure, and solar radiation. The station on Mt. Eyak, near Cordova, also measures the water content of the snowpack. Stations at Esther Island, Port San Juan, Tatitlek, and Pachek send images to the Internet to show actual weather conditions.

- **NDBC weather buoys**

  National Data Buoy Center (NDBC) buoys carry instruments that measure wind speed and direction, air temperature, air pressure, and sea surface temperature. Data are used to predict ocean circulation.

- **Tide gages**

  Tide gages measure sea level by continuously recording the height of the water level with respect to a height reference surface close to the Earth's mean ocean surface.

- **High-frequency radar**

  The ten-foot mean tidal range in the Sound can create powerful currents. When winds and the velocity of these currents can magnify waves to dangerous heights. High-Frequency (HF) radar uses Doppler frequency shifts to determine the speed of surface currents. In 2004, two HF radar stations were set up at Knollies and Shelter Bays to transmit and receive radio waves traveling as far as 37 miles across the Sound.

- **C-MAN weather stations**

  Coastal Marine Automated Network (C-MAN) stations measure barometric pressure, wind speed and direction, air and sea temperatures, wave level, waves, relative humidity, precipitation, and visibility.

- **Oceanographic moorings**

  Water exchange between the Gulf of Alaska and the Sound is thought to influence the abundance and distribution of plankton, which form the base of the marine food web. Anchored to the ocean floor, moorings continuously measure temperature, salinity, and current velocity.

**AUVs and gliders**

During the 2009 Field Experiment, we will use two autonomous underwater vehicles (AUVs) to collect nearly continuous measurements of temperature and salinity. We will also program a glider to fly through the center of the Sound. It will travel along a 45-mile line starting south of Naked Island and ending north of the midpoint of Hunkass Island, and should be able to transit this line at least four times during the experiment.

**Drifters**

Surface current information is critical to oil spill response and search and rescue efforts. Different types of drifters will be deployed to gather surface current data. Argophores and Surface Velocity Program drifters are designed to track floating oil. Micro-star drifters track mean current at a depth of about three feet. U.S. Coast Guard self-locating data marker buoys allow search and rescue personnel to locate current vectors from sequential marker buoy positions to establish ocean surface motion. This enables them to better predict the motion of vessels and people during search and rescue operations.

**Visit aoos.org and find...**

- Data and information products from remote observation platforms, enhanced for local needs
- Processed satellite data on sea-surface temperature, ocean color (chlorophyll) and wind
- Surface current maps
- Biological data on fish, birds and marine mammals, the environmental effects of human activities, and any other information that can be used with the physical data to predict changes to the ocean ecosystem
Plankton ride the Alaska Coastal Current

**Surface current travels from Northern British Columbia along the coast to the Aleutians**

Dr. Rob Campbell, PWS Science Center

The oceanography of PWS is extremely dynamic: strong winds drive surface currents, strong tidal currents flow twice daily, and water from large annual rain and snowfalls enters the ocean from countless streams and rivers.

The massive amount of water entering the margin of the Gulf of Alaska from all the surrounding mountain ranges drives the Alaska Coastal Current (ACC), a surface current that begins in northern British Columbia and travels all along the coast of Alaska to the Aleutians.

The ACC is like a giant firehose whipping around outside of PWS; sometimes it flows directly into the Sound through Hinchinbrook Entrance, bringing with it abundant oceanic plankton from the inner and outer shelf. Oceanic plankton is generally large and lipid-rich, and when imported into PWS by the ACC and surface currents, can be important for the growth and survival of young fish. At other times, the ACC travels offshore from Kayak Island, and silty Copper River water flows along the coast and through Hinchinbrook Entrance, resulting in a different planktonic ecosystem.

Production within PWS can also be very important, and many nearshore species have larvae that spend at least part of their lifetime in the plankton.

In summer, if winds are favorable, nutrient-rich water can be upwelled from the depths and stimulates production at the surface.

The Prince Williams Sound Science Center is actively studying the interrelationship between plankton and oceanography in PWS using a variety of methods, including remote sensing from satellites, instruments mounted on various platforms throughout the Sound, and research cruises aboard local ships.

For more information on this topic, contact Dr. Rob Campbell at rcampbell@pwssc.org or visit www.pwssc.org.

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**New salinity measurements help validate models**

Dr. Steve Okkonen, University of Alaska Fairbanks and Dr. Claude Belanger, PWS Science Center

A multi-sensor instrument installed on Cordova fisherman Andy Craig’s boat, the F/V Alena K, acquired surface temperature and salinity measurements during twelve surveys conducted along a 300 kilometer (180 mile) long track throughout Prince William Sound between March 2006 and January 2008.

At selected locations along the survey track, a second instrument measuring the same parameters was lowered to a depth of 100 meters (330 feet) or more to acquire water column profiles of temperature and salinity. These measurements were used to identify the seasonal changes in temperature and salinity of Prince William Sound waters.

The surveys showed that temperatures were coolest and salinities were lowest in the northern and western portions of the Sound.

**“temperatures were coolest and salinities were lowest in the northern and western portions of the Sound”**

- Dr. Steve Okkonen

The salinity measurements are of particular practical value because they represent a decision support tool for the use of dispersants in the event of an oil spill in the Sound.

This project was supported by NASA and the Prince William Sound Science Center.

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**SNOTEL weather stations installed**

Dr. Steve Okkonen, University of Alaska Fairbanks and Dr. Claude Belanger, PWS Science Center

The eight climate sites were located to give the variance of weather, precipitation (rain and snow), wind speed and direction, solar radiation, barometric pressure and air temperature across Prince William Sound. Beyond knowing the weather, the climate sites are useful to boaters, environmental researchers, and oil spill response teams.

Four sites, Esther Island, Port San Juan, Tatitlek and Nuchek are located where power is available and have web cameras producing images every 15 minutes along with the above listed sensors. Three sites are SNOTEL sites (SNOW TELemetry). Two of the SNOTEL sites, at approximately 1400 ft elevation, are also reporting snow water content and snow depth. These sites are Sugarloaf Mountain, near Valdez and Mt. Eyak, above Cordova. The third SNOTEL site, Strawberry Reef is located at the mouth of the Copper River and has no snow sensors. The Seal Island site is located on a small island in the middle of the Sound halfway between Naked Island and Green Island. A wealth of data is collected for model development to predict the ocean currents in Prince William Sound that are driven by the fresh water input to the Sound by stream flow runoff from snow melt, glacier melt and rain, as well as for scientific purposes. The ocean model will be used for potential oil spills, predicting the direction of the currents and thus where to put out equipment to keep it from spreading. The data will also give information to the fisheries resource managers for determining the type or runs they may expect from one year to the next. The webcams give visual information to boaters and pilots for determining traveling conditions. The web site for the data and cameras is available at http://ak.aoons.org/pws/web_cams.php.

The eight climate sites were installed in Prince William Sound starting the summer of 2005. The climate data collection sites are sponsored by the Prince William Sound Science Center and the Alaska Ocean Observing System. The USDA’s Natural Resources Conservation Service (NRCS) maintains and oversees the sites.
New mapping system completed

ShoreZone provides habitat maps
Jodi Hamey, Coastal & Ocean Resources, Inc.

The land-sea interface is a crucial realm for terrestrial and marine organisms, dynamic processes, and human activities. ShoreZone is a habitat mapping system that collects low-altitude, oblique aerial imagery during low tide, and uses the imagery to produce a searchable inventory of geomorphic and biological features of the coastal and nearshore zones. Attributes mapped include sediment type, eelgrass, wetlands, wave exposure, and man-made features. ShoreZone data and imagery are used as tools in science, education, management, and oil spill response planning.

The ShoreZone mapping program in Prince William Sound began in 2004 and took five years to accomplish. It depended on the collaboration of many groups, including the Exxon Valdez Oil Spill Trustee Council, the Prince William Sound Regional Citizens’ Advisory Council, NOAA Fisheries, the Alaska Department of Fish and Game, and Coastal and Ocean Resources Inc. of Sidney, British Columbia, who conducted the image collection and mapping.

On March 24, 2009, the 20th anniversary of the oil spill, the complete set of data and imagery for Prince William Sound (5,585 km of shoreline) was posted for public access and use on the Alaska ShoreZone website, hosted by NOAA: www.alaska fisheries.noaa.gov/maps.

On this website, users can “fly” the coastline, save images, and query and download data. A video tutorial on using the web site will also soon be available.

The data and imagery are of higher resolution and greater spatial extent than what was available at the time of the Exxon Valdez oil spill, and will improve response planning in the future.

Completion of the Prince William Sound data set brings the total length of ShoreZone mapping to 85,000 km of coastline in Alaska, British Columbia, and Washington. The data and imagery provide a spatial framework for coastal habitat assessment and management on local to regional scales.

More information, protocols, and imports are available online at www.fakr.noaa.gov/maps/szintro.htm.

Subsistence uses surveyed

Tatitlek and Chenega Bay residents continue long tradition
William E. Simeone, Alaska Dept. of Fish & Game

Tatitlek and Chenega Bay are Alaska Native communities in Prince William Sound. These communities have a long tradition of harvesting wild foods. Between 1984 and 2003 the Alaska Department of Fish and Game, Division of Subsistence conducted periodic surveys in these communities to measure the harvest and use of wild resources.

Information collected from these surveys made it clear that subsistence foods are an important addition to household economies. Every household in both communities reported using some subsistence resource and over 80% of households said they harvested some wild food. Replacing these foods with those from a grocery store would be expensive. For example, the average Tatitlek household used 788 pounds of wild foods in 2003. Replacing that food at $5 a pound would cost each household $3,940. In Chenega Bay the mean household harvest was 1,323 pounds, so replacement costs would be $6,615 for each household.

One characteristic of village subsistence economies in Alaska is the wide variety of wild resources that households harvest, use, and share. Households in Chenega Bay and Tatitlek said they harvested anywhere from between 12 and 13 different kinds of wild foods and used up to 24 different kinds of resources.

One reason households reported using more resources than harvesting them was because some households shared food after participating in successful hunts. In both communities, salmon were the most widely harvested resource, followed by seals and sea lions, deer, and halibut, and to a lesser extent birds and eggs, marine invertebrates, and berries.

For further information on this topic, see ADF&G technical papers 218, 264, 181, 159 and 199 on the website: http://www.subsistence.adfg.state.ak.us/geninfo/publctns/subabs.cfm?region=sc.

For information about the harvest and use of subsistence resources in Tatitlek and Chenega Bay, as well as hundreds of other Alaska communities, visit the Community Subsistence Information System at http://www.subsistence.adfg.state.ak.us/CSIS/.

Tracking trends between tides

Mears Rock over time
Dr. Alan J. Mearns, NOAA

Snug Harbor, at the southeast corner of Knight Island, has a feature known to marine scientists as “Mears Rock”. The rock and the adjacent shoreline were oiled in 1989, but not cleaned. The shoreline is one of a dozen unoiled, oiled or cleaned sites used by NOAA Emergency Response Division scientists to study recovery and long-term variability of shoreline marine life. The NOAA scientists have now photographed these sites every year for 20 years, during mid-summer low tides.

The photographs of the “Mears Rock” site clearly show that the abundance of the Sound’s intertidal marine life varies greatly from one year to the next. Popweed, the conspicuous seaweed everywhere in the Sound, “recovered” from oil spill injury within three years after the spill. Then it nearly disappeared for several years and then again returned to nearly 100% cover two more times during the past 20 years, even at sites that were not oiled.

During the first “cycle” of declining popweed absence, mussels (black material in the 1994 photo) colonized part of the rock and shoreline but then disappeared again over the next several years as popweed cover increased. Mussels were rare for nearly 15 years. Then, in 2007 there was a huge settlement of mussels throughout western Prince William Sound. Last year (2008) the popweed cover nearly disappeared from the rock revealing a new set of young mussels and barnacles.

The lesson is clear: there are great long-term variations in the abundance of shoreline marine life in Prince William Sound. And “recovery” means “return to within the natural range of variation”. Now we have a sense of what that variation can be like on the Sound’s shorelines.

When you go ashore during a spring or summer low tide, pay attention to the seaweeds, mussels, barnacles and other creatures around you. They will most likely not look the same next year or the year after! For more information, or to view the rest of the timeseries, visit http://response.restoration.noaa.gov/ and search for “Mears Rock.”
Sound is summer home for Kittlitz’s Murrelet

Andrew Allyn, University of Massachusetts Amherst

The Kittlitz’s murrelet (Brachyramphus brevirostris), a small diving seabird, is one of the rarest seabirds in North America. An estimated 95% of the Kittlitz’s murrelet global population is found in Alaska. Prince William Sound is one of the core population centers for Kittlitz’s during the summer months, accounting for 10-20% of Alaska’s total population. Surveys by the U.S. Fish and Wildlife Service (USFWS) indicated that as of 2007, about 2,400 birds breed in the Sound. Kittlitz’s nest on high altitude steep slopes up to 70 miles inland, and their at-sea distributions in Prince William Sound suggest a preference for tidewater glacier habitats. Documented population declines of 18% per year during the 1990’s in Prince William Sound, as well as declines in other breeding areas throughout Alaska, prompted their current status as a candidate for the Endangered Species List.

With funding from the National Fish and Wildlife Federation, the USFWS, US Geological Survey, US Forest Service and Northern Forum Inc., will be conducting research on Kittlitz’s murrelets in Prince William Sound. This research will update the population estimates of Kittlitz’s in Prince William Sound, last assessed specifically for Kittlitz’s in 2001. The research will also further our understanding of the link between Kittlitz’s and preferred tidewater glacier habitats through extensive sampling of physical and biological habitat characteristics in conjunction with bird surveys.

Much of the Kittlitz’s murrelet ecology is still fairly unknown, and reasons behind their decline remain unanswered. By gaining a better understanding of Kittlitz’s murrelet ecology and habitat preference, we hope our results may aid in future management and conservation plans to preserve this rare and declining seabird species.

Black-Legged Kittiwake studies provide insight into seabird declines

Aly McKnight, US Fish & Wildlife Service

Between 40,000 and 50,000 black-legged kittiwakes (Rissa tridactyla) breed at 26 colonies in Prince William Sound. Although kittiwakes belong to the gull family, they differ from typical seagulls in several important ways: they are strict fish-eaters, they nest on cliffs, and they spend most of the year at sea. Kittiwakes proved very valuable to researchers following the 1989 Exxon Valdez oil spill, as they were one of the few wildlife populations in Prince William Sound that had been studied extensively prior to the spill, thus providing an opportunity to compare conditions pre- and post-spill. During the 1990s, Prince William Sound kittiwakes also provided the data for several important studies on seabird survival, foraging behavior, and costs of reproduction.

Most recently, we have been studying the winter dispersal of kittiwakes from the Sound. We began this work in 2006, coincidentally, the first year of the study happened to be an “El Nino” year, while the second year corresponded to a “La Nina” climate event. We found marked differences in kittiwake wintering locations between those two years. We will be retrieving more winter data this season from tags we deployed in August 2008. Work like this provides much-needed insight into the pressures faced by seabirds during the non-breeding season and may help explain recent declines in some seabird populations.
Shorebirds visit Barrier Island

**Egg Island surveys record shorebird species**

Staff, PWS Science Center

The barrier islands that stretch along the Copper River Delta protect the sensitive mudflats from powerful waves generated by the Gulf of Alaska. They also provide refuge for migratory shorebirds. In 2005 and 2006, the Prince William Sound Science Center initiated a comprehensive study of shorebird use of the outer barrier islands. Aerial surveys were conducted along the 80 km stretch of beaches. Field surveys were conducted on Egg Island, an uninhabited barrier island on the western edge of the Delta. Though it is only 16 km long and 3 km wide, it hosts a variety of shorebird habitats. These include the outer sandy beach, the dune system (the uplands and wetlands that lay between the primary and secondary dunes), and the estuary. A total of 35 shorebird species were recorded during Egg Island surveys, including 30 species each on the outer beach and in the estuary. Twenty-four species were recorded in the dune system. In the spring, Sanderling was the most abundant species observed during the aerial surveys and field transects of the outer beaches. The dune system transects were dominated by Pectoral Sandpiper and Least Sandpiper. Western Sandpiper was the most abundant species in the estuary. Compared with spring, fewer shorebirds were recorded during the southbound migration. The most abundant fall shorebirds on the outer beaches were Least Sandpiper and Semipalmated Plover, which breed locally on the upland dune system. In 2006, we initiated a program to monitor the breeding and post-breeding behaviors of both species. For more information, contact mbishop@pwssc.org or visit www.pwssc.org.

**Bird and Wildlife Checklist**

<table>
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<th>Leons and Grebes</th>
<th>Common loon</th>
<th>Red-throated loon</th>
<th>Pacific loon</th>
<th>Yellow-billed loon</th>
<th>Horned grebe</th>
<th>Red-necked grebe</th>
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<td>Harlequin Ducks stay in the Sound year-round</td>
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Dan Rosenberg, Alaska Dept. of Fish & Game

Harlequin Ducks pair. Photo by Dan Rosenberg

Aerial photo of Egg Island showing line transects. Courtesy of USFS.

**Harlequin Ducks**

Harlequin ducks are small sea ducks that live throughout Prince William Sound (PWS) where they prefer shallow intertidal rocky shorelines. Males are identified by their slate blue bodies with striking black, white, and chestnut markings on their head, neck, back and sides. The smaller females are an inconspicuous brown with white facial markings. They feed by diving for a variety of invertebrates such as small clams, mussels, and snails that live among the algae, rocks, and in the bottom sediments of intertidal and shallow subtidal areas. When not feeding they “haul-out” on intertidal rocks often in small groups of 2-20 birds.

Harlequins spend their winters along much of the Alaskan coastline to southeast Alaska including Prince William Sound and as far south as Oregon. In spring the majority of birds migrate to interior and coastal breeding areas where they nest along the banks of fast-flowing streams. Many young and non-breeding birds remain in Prince William Sound all year.

Breeding males soon return to Prince William Sound leaving the females to incubate the eggs and rear the young. Once back to the coast by late-June or early July males join non-breeding birds and all birds grow new flight feathers. During this period, referred to as “molting” the birds are flightless for 3-4 weeks until new feathers emerge. Unsuccessful females (nest destroyed, broods killed by predators) soon follow and are the next to molt. The last to return to the ocean to molt are the females that successfully fledged broods. Family groups return together. By mid-September most birds have returned to Prince William Sound. PWS birds travel as far as eastern Russia to nest while others nest on mountain streams within Prince William Sound. Since 1994 the Alaska Department of Fish and Game has been monitoring the recovery of harlequin ducks in PWS. Harlequins are especially vulnerable to oil spills because of their tendency to use the same intertidal molting and wintering areas year after year. These habitats were subjected to the most severe and persistent oiling. When the oil spill occurred in March, the entire population was in Prince William Sound. Several hundred to over 1,500 ducks may have been killed by the initial effects of the spill. Twenty years later harlequin populations appear close to recovering from the spill though it is uncertain if all effects have abated. The population is increasing slowly but ducks are still exposed to residual oil that remains in some intertidal beach and subtidal sediments. However, the outlook for full recovery looks promising.

Late 1800s

Lethcoe or visit local crude oil into Prince William Sound Alaska on April 22nd, spilling at least 11 million gallons of Exxon Valdez at the history of Prince William Sound. 

The Alaska National Interest Land Claims Act passed, creating Native Land Claims. Exxon Valdez delivers first copper ore to Alaska National Parks and preserves such as Wrangell St. Elias National Park and Preserve and Alaska and Preserve. 

Native and regional fisheries established. 

1920s

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Native and regional fisheries established. 

1930s

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1940s

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1950s

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1960s

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1970s

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