Pollock Conservation Cooperative Research Center

Research Summaries 2009

What Is the Pollock Conservation Cooperative Research Center?

The PCCRC was established in February 2000 to improve knowledge of the North Pacific Ocean and Bering Sea, through research and education relevant to the commercial fisheries of the Bering Sea and Aleutian Islands.

The Center provides grants to faculty and research stipends to graduate students, and also supports marine education, technical training, and equipment acquisition.

Through 2008, the PCCRC has put $9 million into marine research and education at the University of Alaska Fairbanks School of Fisheries and Ocean Sciences, and is the largest single contributor to the marine science program.

This publication is a summary of each of the PCCRC-funded projects completed to date.

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PCCRC-Funded Research Projects

Cover: This photo of a lion's mane jellyfish, *Cyanea capillata*, was shot in 2007 at Adak Island during a survey of 50 coastal sites in the Aleutian Islands. The UAF School of Fisheries and Ocean Sciences and the Alaska Department of Environmental Conservation conducted the survey to assess nearshore ecology, water quality, and biodiversity.
Credit: Heloise Chenelot, UAF/SFOS

Photo Left: Low tide at Fossil Beach, Kodiak Island. Credit: Kurt Byers, Alaska Sea Grant

Factors Affecting Nearshore Survival and Production of Juvenile Sockeye Salmon from Kvichak Bay, Phase I: Important Habitat, Migration Routes, and Food Resources

Pollock Conservation Cooperative Research Center
Project Synopsis

Epilabidocera, a calanoid copepod, is important prey for sockeye salmon.
Credit: Russell Hopcroft, UAF/SFOS

Funding Summary

Principal Investigators

Stephen C. Jewett
University of Alaska Fairbanks
School of Fisheries and Ocean Sciences

Paul C. Rusanowski
The Shipley Group

Collaborators

Max K. Hoberg
T. Christopher Stark
Milo Adkison
Franz Mueter
University of Alaska Fairbanks
School of Fisheries and Ocean Sciences

Year Funded

2001

Research Period

2001-2002

Budget

$36,000

What salmon need to survive

Low returns of sockeye salmon to Bristol Bay in 1997 and 1998, and the failure of the peak sockeye run on the Kvichak River in 2000, generated concern for the health and continued viability of the Kvichak River stock of sockeye salmon. These events have caused renewed interest in determining factors that affect survival of sockeye salmon throughout their life cycle, and particularly the early marine phase of that cycle.

Why Is PCCRC Interested?

Resource users want to know more about the biology of sockeye salmon smolt once they pass the sonar fish counters within rivers of origin. The greatest mortality in the ocean is believed to be associated with the first few months in the life of smolt, and juvenile salmon as they migrate to offshore rearing grounds.

What Scientists Did

In 2001, during the period of sockeye smolt outmigration (mid May to mid June), juvenile sockeye salmon were sampled along several transects in Kvichak Bay, from shore to 50 km offshore. Researchers determined the essential estuarine habitat utilized by juvenile sockeye salmon as they migrated to offshore rearing habitat in Bristol Bay and the Bering Sea. They also identified the major prey items in the diet of juvenile sockeye salmon, and assessed the relative abundance and biomass of major juvenile sockeye prey species in the bay.

Objectives

Provide detailed information not presently available on the migration of sockeye salmon smolt through Kvichak Bay.

Identify key nearshore marine habitat and prey species preferred by sockeye salmon smolt.

Bottom Line

Suitable nearshore habitat and abundant populations of preferred prey species is critical to survival of outmigrating salmon smolt.

Sockeye salmon smolt are most vulnerable to predation soon after they enter the ocean from their natal streams.
Credit: Stephen Jewett, UAF/SFOS

Photo Left: Pink salmon in the Iliuliuk River at Unalaska. Credit: Kurt Byers, Alaska Sea Grant

What Scientists Learned

Sockeye salmon at the end of their upriver spawning migration from the North Pacific Ocean. Credit: Thomas Kline, PWSSC

Abundances of sockeye salmon tended to decrease from shallow, nearshore areas with higher temperatures, higher turbidity, and lower salinities to deeper, offshore areas with colder, more saline, and less turbid waters. Bottom depth, temperature, salinity, Secchi depth, and distance from shore are all strongly confounded, thus their potential effects on the distribution of salmon are difficult to separate. Sockeye abundances were not correlated with total zooplankton density or biomass; however, sockeye were correlated with selected zooplankters, such as the calanoid copepods *Eurytemora* and *Epilabidocera*. *Eurytemora* was the most important prey item in terms of frequency and number eaten. Mysid crustaceans dominated the prey in terms of biomass. There was some evidence that fish nearshore are feeding less than fish offshore in deeper, less turbid water.

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School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
P.O. Box 757220
Fairbanks, AK 99775-7220
(907) 474-7210
http://www.sfos.uaf.edu/pcc/

Developing DNA Markers for the Analysis of Chum Salmon Bycatch in Alaska Trawl Fisheries (Phase 1)

Chum salmon, *Oncorhynchus keta*. Credit: W.W. Smoker, UAF/SFOS

Funding Summary

Principal Investigator

Anthony J. Gharrett
University of Alaska Fairbanks
School of Fisheries and
Ocean Sciences

Graduate Student

Michael Garvin
M.S. Candidate
University of Alaska Fairbanks
School of Fisheries and
Ocean Sciences

Year Funded

2004

Research Period

2004-2005

Budget

$78,230

What are the origins of the chum salmon in the North Pacific?

Chum salmon returns to Western Alaska river systems, such as the Yukon and Kuskokwim, are critical to the livelihood and culture of rural Alaskans. Chum salmon bycatch in the Gulf of Alaska and Bering Sea has created problems for Bering Sea pollock trawl fisheries, as well as rural Alaskans who rely on chum salmon. In addition, chum salmon are the focus of international treaties between the United States and Canada. To reduce bycatch and improve Western Alaska chum fisheries, scientists need better information on just where these salmon come from and where they are headed.

Why Is PCCRC Interested?

Knowing where bycaught chum salmon come from is valuable to fishery managers, salmon fishermen, and the pollock trawl fleet, who would like to further reduce the incidental catch of salmon.

What Scientists Did

Substantial effort has been devoted to using genetics to trace the origins of North American chum salmon stocks to their natal rivers or streams. An extensive allozyme baseline exists to help in this regard. Unfortunately, because of the logistics and increased costs of storing and processing the samples, most labs have ceased their allozyme operations. In addition, allozymes may not provide the fine-scale resolution needed to address some chum salmon questions.

An alternative approach is to use DNA variation. However, there are no baselines for DNA markers. In this project, researchers sought to develop DNA markers, particularly single nucleotide polymorphism

Objectives

Develop new, cost-effective, and accurate genetic techniques to determine the origin of all chum salmon.

Bottom Line

Researchers developed genetic techniques that hold the promise of being a useful tool in the management of Western Alaska chum salmon stocks.

(SNP) markers, for application to trawl fishery chum salmon bycatch. The challenge has been to discover the variation, design the specific molecular tool, and verify its utility in separating stocks. In the first phase of the project, researchers developed markers. In future efforts, researchers plan to survey the variability in much of the geographic range of chum salmon and evaluate the success that the markers can be expected to have in resolving populations in mixtures, for example, between or within the Yukon and Kuskokwim drainages.

Chum salmon are critical to the livelihood and culture of rural Alaskans.
Credit: Jason Heskew

What Scientists Learned

Researchers modified a genetic sequencing technique called ecotilling to rapidly screen DNA fragments for variation at the single nucleotide level, and detect natural polymorphisms in chum salmon DNA. Such polymorphisms can be used as markers to determine the natal origin of salmon.

The investigators also modified a method that is a variation on ecotilling. This method allows researchers to detect simple mutations and polymorphisms in large genomic regions without using a sequencer and expensive labeled primers. The researchers call the method decotilling (double strand cleavage ecotilling). The advantage of the method is that it allows the user to look for genetic variation in numerous genes both cheaply and rapidly.

Further Study

Researchers plan to demonstrate their genetic methods on a sample of chum salmon bycatch.

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School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
P.O. Box 757220
Fairbanks, AK 99775-7220
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http://www.sfos.uaf.edu/pcc/

DNA Analysis of the Origins of Chinook Salmon Bycatch in Alaska Trawl Fisheries

A pollock fisheries observer records data from bycaught king salmon.

Credit: North Pacific Fisheries Observer Training Center

Funding Summary

Principal Investigator

Anthony J. Gharrett
University of Alaska Fairbanks
School of Fisheries and Ocean Sciences

Graduate Students

Zhouzhou Li
Sharon Hall
M.S. Candidates
University of Alaska Fairbanks
School of Fisheries and Ocean Sciences

Collaborator

V.A. Brykov
Russian Academy of Sciences
Institute of Marine Biology
Vladivostok, Russia

Year Funded
2006

Research Period
2006-2007

Budget
$67,409

Determining the natal origin of chinook salmon

Salmon bycatch, by the Bering Sea trawl fishery in the Gulf of Alaska and Bering Sea, poses problems for both pollock fishermen and for Western Alaska subsistence and commercial fishermen dependent on healthy stocks. Genetic analysis offers researchers the opportunity to determine the origins of salmon bycatch in the trawl fleet. A better understanding of the origins of bycatch salmon is critical to effective management of pollock and salmon.

Why Is PCCRC Interested?

The commercial trawl fleet would like to limit their bycatch of salmon stocks deemed important to commercial and subsistence fisheries in Western Alaska. Research to determine where these salmon stocks come from is valuable to fishery managers, salmon fishermen, and the trawl fleet.

What Scientists Did

Researchers obtained samples from 20 chinook salmon populations: six populations from the Kamchatka region of the Russian Far East, and populations ranging from central California to the Yukon River. They examined the genetic divergence between Russian populations and North American chinook salmon lineages, and quantified genetic variation using both microsatellite and mtDNA to determine if there are markers that could assist in separating Russian salmon from North American fish in groundfish bycatch.

Objectives

Quantify genetic variation using both microsatellites and mtDNA to determine if there are markers that would assist in separating Russian salmon from North American fish in groundfish bycatch.

Use the data to examine the recent evolutionary history of chinook salmon.

Bottom Line

Results show a genetic basis for resolving stock mixtures, including estimating the contribution of Asian chinook salmon to groundfish bycatch.

Chinook (king) salmon, *Oncorhynchus tshawytscha*, are the largest of the five Pacific salmon species.

Credit: David Brenner, Alaska Sea Grant

What Scientists Learned

Analysis of mtDNA shows that chinook salmon have a much deeper "haplotype tree" than other species of Pacific salmon. The southeastern populations from Yakutat to California exhibit substantial divergence, which indicates that they have been isolated for a long time and little gene flow connects them.

Genetic studies are used to determine the natal origin of chinook salmon.
Credit: David Brenner, Alaska Sea Grant

These populations are generally distinct from Western Alaska and Asian populations. It appears that the two Asian populations emerged much more recently than the southern North American populations and may be related to Western Alaska populations.

Further Study

The development of chinook salmon microsatellite baseline information by Alaska Department of Fish and Game, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and Department of Fisheries and Oceans Canada, will provide the baseline for addressing the issue.

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University of Alaska Fairbanks
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Analysis of Hydrographic Data Collected by the Pollock Conservation Cooperative Research Center in the Bering Sea

A seawater conductivity-temperature-depth (CTD) recorder. Credit: David Leech, UAF/SFOS

Can oceanography be used to curb bycatch?

Bycatch of salmon is a vexing problem for Alaska's pollock fisheries. Insights into key oceanographic features and variables may help fishermen better target intended fish species, while avoiding nontarget species.

Why Is PCCRC Interested?

A better understanding of ocean conditions may be a guide to avoid certain areas useful to pollock fishermen who seek a decrease in salmon and other bycatch.

What Scientists Did

Researchers used salinity and temperature data collected from conductivity-temperature-depth (CTD) recorders attached to the fishing nets of three pollock fishing vessels during their normal fishing operations in 2000 and 2001. The researchers evaluated the utility of using water mass characteristics to identify regions of high catch and bycatch.

What Scientists Learned

There was a strong relationship between bottom depth and fish abundances. At approximately 90 m and 300 m there were clusters of high pollock catch weights, chinook numbers, and other salmon numbers. The majority of fish were caught in two regions: in waters shallower than approximately 100 m, and in waters approximately 300 m deep. Longer trawl tows did not increase the likelihood of increased pollock catch.

A researcher monitors oceanographic data transmitted from a CTD recorder. Credit: Thomas Kline, PWSSC

Objective

Analyze records of salinity and temperature collected on pollock fishing vessels in the southeastern Bering Sea during the 2000 and 2001 fishing seasons, to discover possible correlations between water mass structure and catch and bycatch data.

Bottom Line

The analysis shows that water masses as identified by temperature and salinity may be useful in some regions and at some times for identifying regions of large catch and bycatch. However, with this data set, which only extended over two years, a definitive relationship is not obvious.

Funding Summary

Principal Investigators

Dave Musgrave
University of Alaska Fairbanks
School of Fisheries and Ocean Sciences

Graduate Student

Hank Statscewich
M.S. Candidate
University of Alaska Fairbanks
School of Fisheries and Ocean Sciences

Year Funded
2000

Research Period
2000-2001

Budget
$23,133

The area surrounding the shoaling bank due west of St. George Island exhibited the highest per trawl catch for pollock. This suggests that the bank may be the most productive region in the southeastern Bering Sea, even though fewer than 1,000 trawls were conducted there in August 2000. The Bering Canyon and Pribilof Canyon exhibited more chinook per trawl than any other region. The Bering Canyon also accounted for the highest numbers of other salmon caught by the trawlers. This suggests that the trawl activity in these regions did not effectively minimize salmon bycatch.

Scientists deploy a rosette of Niskin bottles, used to collect water samples, with a CTD recorder mounted underneath the bottles.
Credit: Thomas Kline, PWSSC

Further Study

A generalized additive model may be able to tease out more relationships between physical variables and catch-bycatch with these data. More data over additional years may help to develop relationships between water masses and catch-bycatch.

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Sinking Particles and Pelagic Food Web of the Southeastern Bering Sea

Pollock Conservation Cooperative Research Center
Project Synopsis

Krill, such as *Euphausia pacifica*, are key planktonic components of the North Pacific food web.
Credit: Russell Hopcroft, UAF/SFOS

Funding Summary

Principal Investigator

Susan Henrichs
University of Alaska Fairbanks
School of Fisheries and Ocean Sciences

Year Funded
2001

Research Period
2001-2002

Budget
$36,202

Sinking particles offer clues to changing ocean

The composition, abundance, and distribution of phytoplankton and zooplankton reflect changes in the pelagic food web. Sinking plankton (a component of "sinking particles") collected by sediment traps mainly reflects the extent of grazing on primary production by zooplankton, and productivity variations over time. The material collected by the sediment traps indicates which materials are being supplied to the deep ocean and seafloor.

Why Is PCCRC Interested?

Changes in oceanography in recent years have been linked to climate warming influences on sea, air, and sea-ice ecosystems. Such changes may be altering the ocean's ability to support some fish and marine mammal species, and may have impacts on fish stock composition, abundance, and distribution.

What Scientists Did

Since 1995, NOAA researchers have used instruments on an oceanographic mooring over the Bering Sea middle shelf near 56°N to measure temperature, salinity, chlorophyll content, current speed, and meteorological conditions.

Researchers added a time-series sediment trap, which collected particles sinking out of the surface waters from 1997 to 2003, with the last two years being supported by the Pollock Conservation Cooperative Research Center.

A parallel time series of zooplankton samples was also collected. The carbon and nitrogen stable isotope composition and selected lipids,

Objective

Scientists used sediment traps to monitor the role of plankton and other particles in changes occurring in the oceanography of the Bering Sea.

Bottom Line

The data indicate that the spring bloom may not be the predominant source of organic matter to the Bering Sea middle shelf.

Amphipods are among billions of zooplankton that fuel the marine food web.
Credit: Russell Hopcroft, UAF/SFOS

including fatty acids, fatty alcohols, and sterols, have been measured in the sediment trap and zooplankton samples. The composition of sinking organic material collected by the trap has reflected changes in oceanographic conditions and the Bering Sea ecosystem from 1997 to 2003.

Skeletons (frustrules) from diatoms like these were among the particles collected in Bering Sea sediments. Credit: Stacy Smith, UAF/SFOS

The particles collected by Bering Sea sediment traps consist of intact phytoplankton, diatom frustules, coccoliths, zooplankton fecal pellets, and other detritus resulting from food web processes. Using microscopic examination and chemical and stable isotopic analysis of the material, information was obtained on nutrient availability, phytoplankton and zooplankton communities, the timing of phytoplankton blooms, relative extent of phytoplankton grazing by zooplankton, and other ecological data.

What Scientists Learned

From 1997 to 1999, the amount of organic matter accumulated by traps in the fall were comparable to levels observed in spring, when the annual plankton bloom occurs.

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School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
P.O. Box 757220
Fairbanks, AK 99775-7220
(907) 474-7210
http://www.sfos.uaf.edu/pcc/

Jellyfish Impact on Food Web Production and Ecosystem Structure in the Southeastern Bering Sea

Pollock Conservation Cooperative Research Center
Project Synopsis

Lion's mane jellyfish, *Cyanea capillata*, are common in the Bering Sea.
Credit: Heloise Chenelot, UAF/SFOS

Funding Summary

Principal Investigators

Alan M. Springer
Steven R. Whitney
University of Alaska Fairbanks
School of Fisheries and
Ocean Sciences

Year Funded
2002

Research Period
2002

Budget
$16,350

A jellyfish dilemma

Jellyfish biomass in the Bering Sea increased gradually between 1979 and 1989. During the following decade, jellyfish biomass increased tenfold. At the same time, fishermen and managers noticed that important stocks of salmon and other fish were declining.

Why Is PCCRC Interested?

The conservation of pollock requires an increased understanding of ecosystem health issues affecting pollock and other groundfish stocks.

What Scientists Did

Scientists conducted a field study of diet, distribution, abundance, and other parameters of jellyfish in the southeastern Bering Sea in summer 2000 with the goal of learning more about the role of jellyfish in food web production and ecosystem dynamics.

What Scientists Learned

While the data are by no means conclusive, it is possible that jellyfish now have a larger biomass than eastern Bering Sea pollock and have displaced pollock as the dominant consumer of secondary productivity on the eastern Bering Sea shelf, especially in the middle shelf domain.

Researchers also found inverse correlations between jellyfish biomass and recruitment success of flathead sole, Alaska plaice, and salmon in the eastern Bering Sea.

While declines in pollock recruitment are not significantly correlated with the increase in jellyfish biomass, pollock eggs accounted for over seventy and ninety percent of the fish eggs in stomachs of the two dominant

Objective

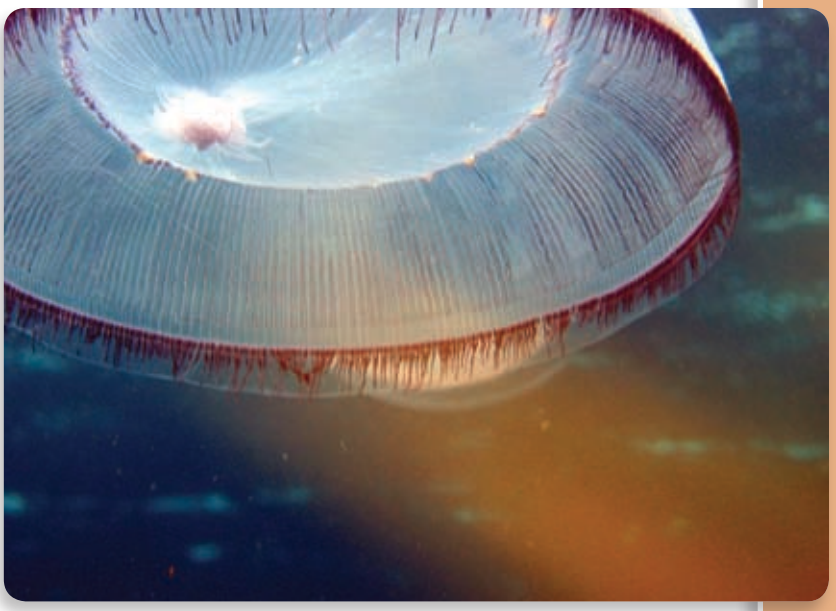
Understand the role of jellyfish in food web production and ecosystem dynamics in the southeastern Bering Sea.

Bottom Line

Jellyfish in the Bering Sea prey upon fish eggs and compete with juvenile and adult fish for prey. Thus, they may have direct and indirect negative impacts on stocks of commercial fish, including pollock and salmon.

The sea nettle, *Chrysaora melanaster*, is found throughout the Pacific Ocean.
Credit: Russell Hopcroft, UAF/SFOS

species of jellyfish: fish eggs were among the most important dietary components of both species. Because the density distribution of jellyfish on the southeastern shelf overlaps extensively with the distribution of spawning pollock, predation on fish eggs may be an important factor in the dynamics of pollock and other fish stocks on the southeastern Bering Sea shelf. Moreover, zooplankton that are important prey of pollock, salmon, and other species were also consumed in large numbers by jellyfish, raising the possibility that competition with jellyfish, in addition to predation by jellyfish, could be a factor in dynamics of fish populations.



Crystal jellyfish, *Aequorea*, are abundant in the Bering Sea. They feed on soft-bodied animals and zooplankton. Credit: Heloise Chenelot, UAF/SFOS

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University of Alaska Fairbanks
P.O. Box 757220
Fairbanks, AK 99775-7220
(907) 474-7210
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Shallow Water Nearshore Fish Assemblages around Steller Sea Lion Haulouts near Kodiak, Alaska

Steller sea lions near Kodiak Island.
Credit: David Brenner, Alaska Sea Grant

Funding Summary

Principal Investigators

Brenda Konar
Kate Wynne
Sue Hills
University of Alaska Fairbanks
School of Fisheries and Ocean Sciences

Graduate Student

Catherine Hegwer
M.S. Candidate
University of Alaska Fairbanks
School of Fisheries and Ocean Sciences

Year Funded
2002

Research Period
2002-2003

Budget
$6,000

Are waters around Steller sea lion haulouts important foraging areas?

Pups and juvenile Steller sea lions are most at risk for mortality associated with changes in prey abundance and availability. Understanding the role of haulouts to the survival of Steller sea lions is a critical issue facing scientists and fishery managers.

Why Is PCCRC Interested?

Commercial fisheries harvests have the potential to interact with Steller sea lions. Further understanding of these interactions is important to maintaining the fisheries and protecting endangered and threatened Steller sea lions.

What Scientists Did

Nearshore fishes around haulouts are potential prey for Steller sea lions, especially pups, as they learn to forage and supplement their milk diets during weaning. Scientists conducted spring, summer, and winter scientific diving surveys around two Steller sea lion haulouts and two control sites on Kodiak Island to determine the abundance and composition of forage fishes. Concurrent habitat surveys were used to quantify substrate, macroalga, and benthic invertebrate cover.

What Scientists Learned

The area within 90 meters of Steller sea lion haulout sites had fewer fish than control sites, but similar species richness and species composition. Two notable differences between haulout and control sites were that greenling were more abundant around haulouts and rockfish were more abundant

Objectives

Determine the abundance and composition of forage fishes around two Steller sea lion haulouts and two control sites. Concurrent habitat surveys were used to quantify substrate, macroalgae, and benthic invertebrate cover.

Bottom Line

Results do not indicate that fish assemblages at haulouts are substantially different from other headland sites. The only notable differences were that greenling were more abundant around haulouts and rockfish were more abundant around controls.

Rock greenlings are often found in Alaska's rocky nearshore habitats.
Credit: Heloise Chenelot, UAF/SFOS

around controls. In winter, fish were fewer but more evenly distributed. Habitat characteristics were not significantly different between Steller haulouts and control sites. All sites had seasonal cover of canopy-forming kelp, and overstory algal cover was heavy down to 21 m. At approximately 27 m the habitat changed abruptly from kelp covered bedrock to bare gravel and shell hash. While nearshore fish were an important component of Steller diets, results from this study do not indicate that fish assemblages at haulouts are substantially different from other headland sites, other than the greenling and rockfish populations.

Bull kelp, *Nereocystis luetkeana*, provides nearshore habitat for Steller sea lion prey. CREDIT: HELOISE CHENELOT, UAF/SFOS

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School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
P.O. Box 757220
Fairbanks, AK 99775-7220
(907) 474-7210
http://www.sfos.uaf.edu/pcc/

Validating the Use of Satellite-Linked Mortality Transmitters in Rehabilitated California Sea Lions

A life history radio tag implanted in a sea lion.

Credit: Markus Horning, under MMPA permit 1034-1658

Funding Summary

Principal Investigators

Markus Horning
Texas A&M University
Laboratory for Applied Biotelemetry and Biotechnology

Donald Calkins
Alaska SeaLife Center

Year Funded

2000

Research Period

2000-2003

Budget

$60,460

Eye in the sky tracks endangered Steller sea lions

Despite years of scientific studies, researchers know little about the long-term fate of individual Steller sea lions. Data are needed on seasonal changes in forage efforts and causes of mortality in threatened and endangered juvenile sea lions, which are likely most at risk for survival. Scientists in this study developed sophisticated tracking sensors to monitor sea lions through their entire lives and determine causes of mortality.

Why Is PCCRC Interested?

Information regarding juvenile Steller sea lion life history, biology, activities, and causes of mortality is critical to understanding their decline, and managing recovery.

What Scientists Did

Scientists originally funded by the North Pacific Marine Research Program tested and refined custom-built implantable life history tag prototypes jointly developed and fabricated by Wildlife Computers and Texas A&M University's Laboratory for Applied Biotelemetry and Biotechnology. In this study, researchers implanted the devices in four rehabilitated California sea lions to refine surgical implantation procedures and determine possible post-surgical complications. Researchers then tested the device's feasibility as a lifelong data collection platform.

What Scientists Learned

- Ventral intraperitoneal (abdominal) implant procedures are feasible, and can be conducted by a trained team in suitable settings with minimal equipment, in fewer than two hours.

Objective

Test the feasibility of using implanted, satellite-linked, delayed transmission life history transmitters for lifelong monitoring of free-ranging Steller sea lions.

Bottom Line

By following proper surgical protocols for implantation and post-surgical recovery, an animal implanted with this transmitter can be released within 24 hours of surgery.

- Animals recovered well following surgery. There was evidence of some pain and discomfort at the incision site and favoring of the affected area during the first 24 hours. After 24 hours, there was no apparent indication of pain or discomfort. Appetite appeared normal within less than 24 hours, and eating habits did not appear affected.

Scientists use radio tracking devices, such as the one attached to the sea lion above, to monitor the location of animals they study.
Credit: Markus Horning, under MMPA permit 1034-1658

- There was no evidence of impaired mobility following surgery. Wounds healed well, even when the animal had unrestricted access to saltwater within 24 hours.
- There were no signs of peritonitis, or of any inflammation or infection within the blubber, subcutaneous layers, or on the skin. Blood samples indicated normal blood chemistry.
- There were no indications that implanted animals behaved differently from non-implanted, rehabilitated animals, before or after their release.
- Dual intraperitoneal implants did not create problems for the implanted animals in terms of gastric functions, motility and mobility, wound healing, and general recovery from the procedure, and behavior before or after their release.

Further Study

With funding from the North Pacific Research Board, the Pollock Conservation Cooperative Research Center, the National Marine Fisheries Service Steller Sea Lion Research Initiative, and the Alaska SeaLife Center, a long-term research plan for the application of this technology to free-ranging Steller sea lions has been developed.

This study led to the first implants on Steller sea lions in 2005. Since then, fifteen Steller sea lions have been released with implanted life history transmitters, and an additional twelve are scheduled for 2008-2009. This will be the first study to directly determine causes of mortalities in juvenile Steller sea lions, and will relate body condition and other indicators of overall health and immune system competence to individual survival and mortality in the wild.

Pollock Conservation Cooperative Research Center

School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
P.O. Box 757220
Fairbanks, AK 99775-7220
(907) 474-7210
http://www.sfos.uaf.edu/pcc/

An Investigation into the Possible Relationship between Killer Whale Predation and the Continuing Decline of the Steller Sea Lion Population

Prey's-eye view of a killer whale.
Credit: David Ellifrit, NGOS

Funding Summary

Principal Investigators

Graham A.J. Worthy
University of Central Florida

Markus Horning
University of Alaska Fairbanks
School of Fisheries and
Ocean Sciences

Marilyn E. Dahlheim
NOAA National Marine
Mammal Lab

Year Funded
2001

Research Period
2001-2002

Budget
$27,142

A stellar debate: Are killer whales eating Steller sea lions?

Over the years, numerous hypotheses have been proposed to explain the dramatic decline of Steller sea lions in the Bering Sea and Gulf of Alaska. Most hypotheses have been ruled out or lack convincing evidence. Recently, some researchers have suggested that killer whale predation on sea lions may be slowing their recovery.

Why Is PCCRC Interested?

Alaska commercial groundfish fishermen have been operating under state and federal restrictions aimed at protecting Steller sea lions, and remain interested in determining the natural factors affecting sea lion mortality and recovery in the Bering Sea and Gulf of Alaska.

What Scientists Did

Researchers used biopsy darts to collect shallow-depth tissue and blubber samples from killer whales in Prince William Sound during the summer in 1994 and 1995. Tissue biopsies of killer whales were taken in summer 2001 in waters around Steller sea lion rookeries and major haulouts along the central Alaska coastline from Resurrection Bay to Seguam Pass.

In all, 17 tissue biopsies were obtained from 11 different groups of whales including 11 suspected resident whales from six groups, four suspected transient whales from four groups and two suspected offshore animals from one group. A small amount of skin and underlying blubber were collected and frozen for stable isotope and fatty acid analysis.

Full-depth skin and blubber samples were obtained from fresh-dead adult killer whales as they became available. Researchers assessed the gross lipid and water

Objectives

Describe the characteristics of killer whale blubber and skin, with the goal of further understanding the feeding ecology of this species, and in particular how killer whales might impact Steller sea lions.

Assess the stable isotope signatures of killer whale skin samples to determine the trophic level at which killer whales are feeding.

Analyze killer whale blubber samples using fatty acid signature analysis to determine whether killer whales are feeding on Steller sea lions.

Bottom Line

Resident killer whales are fish eaters, and transient killer whales prey on marine mammals. For transient whales, Steller sea lions could account for between seven and thirteen percent of their diet and sea otters could account for between seven and twenty percent of their diet.

content of each sample, and lipid class and fatty acid composition was analyzed.

Dall's porpoises are favored prey of transient killer whales in Prince William Sound. Credit: Thomas Kline, PWSSC

What Scientists Learned

Stable isotope analysis of skin samples revealed different feeding habits for the different ecotypes (fish eating vs. mammal eating) of killer whales found in the region. Prince William Sound (PWS) resident whales fed exclusively on fish, a finding consistent with long-term observational data. PWS transient whales consumed predominantly marine mammals, preying primarily on Dall's porpoises, but also harbor porpoises, northern fur seals, harbor seals, Steller sea lions, sea otters, and river otters. A subset of PWS transient whales preferred harbor porpoises, followed by harbor seals, sea otters, and Steller sea lions.

Resident killer whales of the Aleutian Islands specialized on fish, but with regional variability. Analysis of Aleutian offshore whales provided some insights into the biology of this poorly known ecotype. These offshore killer whales have been described as moving huge distances from the Bering Sea to central and southern California and this makes interpretations of potential diets for this ecotype very difficult. Due to the complexities of annual movements for this ecotype, a lack of data on appropriate isotopic signatures, and the small sample size, we feel that while this ecotype is clearly different from residents and transients, and no assessment of diet can be made at this time.

Further Study

Estimates of diet are still in development and suggest future lines of investigation, especially with regard to the offshore killer whale ecotype.

Pollock Conservation Cooperative Research Center

School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
P.O. Box 757220
Fairbanks, AK 99775-7220
(907) 474-7210
http://www.sfos.uaf.edu/pcc/

Thyroid Hormones and Plasma Leptin Concentrations during Food Deprivation and Satiety Use as an Index of Metabolic Condition in Free-Ranging Steller Sea Lions

Pollock Conservation Cooperative Research Center
Project Synopsis

A female Steller sea lion and its pup.
Credit: Lorrie Rea, ADFG, under MMPA permit 358-1888

Looking for the signs of stress

Species in decline or struggling to recover from a decline are often under stress. Gaining a better understanding of the physiological signs of stress may offer clues to the health of Alaska's threatened and endangered Steller sea lions.

Why Is PCCRC Interested?

Industry members are interested in aiding the recovery of Steller sea lion populations. This research has the potential to offer a new tool that scientists and managers can use to gauge the health of this important marine mammal and monitor its recovery.

What Scientists Did

Scientists assessed the usefulness of a suite of hormones associated with stress and metabolism to evaluate the body condition and overall health of Steller sea lions. Researchers collected 460 blood samples from juvenile sea lions, and measured a set of thyroid hormones (called total and free T3 and T4), the stress-regulating hormone cortisol, and the energy-regulating hormone leptin.

What Scientists Learned

Most of the thyroid hormones (TT4, TT3, and fT3) were highest in the first year of life, and decreased to relatively level concentrations by age three. Cortisol followed the same pattern. Leptin varied by season with concentrations highest in the winter and spring. When individual hormones were plotted against body mass, a significant increase in tT3 and leptin occurred at around 100-150 kg body mass. Sea lions in this weight

Researchers collect physiological data from a Steller sea lion.
Credit: Lorrie Rea, ADFG, under MMPA permit 358-1888

Objective

Investigate the suitability of analyzing Steller sea lion blood samples for leptin and other hormone concentrations as an indicator of fitness in free-ranging Steller sea lions.

Bottom Line

Preliminary results indicate that thyroid hormones and leptin may be a useful indicator of Steller sea lion body size and condition.

Funding Summary

Principal Investigator

Shannon Atkinson
University of Alaska Fairbanks and Alaska SeaLife Center

Graduate Student

Matt Myers
Ph.D. Candidate
University of Alaska Fairbanks

Collaborators

Lorrie Rea
Alaska Department of Fish and Game

Kendall Mashburn
University of Alaska Fairbanks

Year Funded

2000

Research Period

2000-2003

Budget

$51,388

class tended to be around 18 months old. The increase in tT3 indicates an elevation in metabolic rate of these animals. This finding could be due to weaning, molt, or the inability of the animal to regulate its internal temperature.

Further Study

The physiology of juvenile Steller sea lions needs additional study to understand the impact of environmental change on metabolic homeostasis in young, developing sea lions.

Steller sea lions, some with brands applied by scientists to help monitor individual animals from year to year.
Credit: Lorrie Rea, ADFG, under MMPA permit 358-1888

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University of Alaska Fairbanks
P.O. Box 757220
Fairbanks, AK 99775-7220
(907) 474-7210
http://www.sfos.uaf.edu/pcc/

Do Steller Sea Lions Have Enough to Eat?

Pollock Conservation Cooperative Research Center
Project Synopsis

Atka mackerel at Seguam Island, Aleutians.
Credit: Robert R. Lauth, NOAA Fisheries

Funding Summary

Principal Investigators

Alan M. Springer
University of Alaska Fairbanks
School of Fisheries and
Ocean Sciences

Alexander S. Kitaysky
University of Washington

Year Funded
2000

Research Period
2000-2003

Budget
$87,051

Food and Stress in Steller Sea Lions

A dominant theory to explain the decline of Steller sea lions centers on the nutritional quality of prey. A possible indication of whether sea lions are receiving inadequate prey is increased levels of stress hormones. A study is needed that combines a survey of sea lion prey quality around rookeries and haulouts, as well as stomach content analysis and measurements of stress hormones.

Why Is PCCRC Interested?

Understanding the food requirements of Steller sea lions is important to industry sectors that harvest fish species thought to be an important part of sea lion diet.

What Scientists Did

Researchers surveyed the nutritional quality of Steller sea lion prey by analyzing information on diets collected from Aleutian/Pribilof Island haulouts and rookeries. Measurements of nutritional quality (based on lipid and protein content) were correlated against levels of corticosteroid stress hormones in sea lions as observed in feces collected on rookeries and haulouts, and compared to changes in the abundance of sea lions at rookeries.

What Scientists Learned

Adult pollock, Pacific cod, yellow Irish lords, and rock sole were lean, while subadult king salmon were fat, as were adult Atka mackerel, which were extremely fat in late winter. Young age classes of Atka mackerel have been found to be lean, and in the absence of

Objective

Correlate the nutritional quality of Steller sea lion prey with stress hormones found in sea lion scat.

Bottom Line

Preliminary results support the hypothesis that physiological stress in sea lions may have contributed to population declines. However, nutritional quality of prey does not appear to be the cause of stress. If these results hold up after refinement and scrutiny, they imply that conditions during the past that precipitated the decline and prevented the recovery of the Western Alaska stock still exist.

Atka mackerel are an important prey species for Steller sea lions.
Credit: Kimberly Rand, NOAA Fisheries

data for appropriate sized individuals, the species has been considered to be of comparatively low nutritional value to sea lions.

Yellow Irish lord sculpins, *Hemilepidotus jordani*, are among prey of Steller sea lions. Credit: Heloise Chenelot, UAF/SFOS

The rates of decline were proportional to increased corticosterone levels in animals. In addition, there was a strong negative relationship between levels of stress hormones and progesterone, a measure of female reproductive function. However, there was no relationship between levels of stress hormones and diet quality. The results suggest that physiological stress might have contributed to the population decline of sea lions, but that diet is an unlikely cause of that stress.

Pollock Conservation Cooperative Research Center

School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
P.O. Box 757220
Fairbanks, AK 99775-7220
(907) 474-7210
http://www.sfos.uaf.edu/pcc/

Assessing the Extent of Competition between Steller Sea Lions and Commercial Fisheries

Pollock Conservation Cooperative Research Center
Project Synopsis

Steller sea lion.
Credit: Kate Wynne, under MMPA permit 1049-1886.

Funding Summary

Principal Investigators

Edward J. Gregr
Facet Decisions Systems, Inc.
Vancouver, British Columbia, Canada

Andrew W. Trites
North Pacific Universities Marine Mammal Research Consortium
Vancouver, British Columbia, Canada

Zohrab Mawani
Facet Decisions Systems, Inc.
Vancouver, British Columbia, Canada

Alan Springer
University of Alaska Fairbanks
School of Fisheries and Ocean Sciences

Year Funded
2001

Research Period
2001-2002

Budget
$56,000

Sea lions and fishermen—can they coexist?

Much of the debate over the impact of commercial groundfish fisheries and Steller sea lions centers on the belief that fishermen catch too many fish at critical times and in places that conflict with the needs of Steller sea lions. In response, federal regulations have imposed no-fishing buffers of as much as 20 miles wide around sea lion haulouts and rookeries, and closed critical habitat areas to commercial fishing.

Why Is PCCRC Interested?

Analysis of how groundfish fisheries and Steller sea lion foraging overlap in space and time has never been undertaken. Such analysis is needed to determine the effectiveness of fishery management measures intended to minimize impacts on Steller sea lions.

What Scientists Did

Researchers used data on sea lion distribution and commercial fisheries activities to assemble maps that show how commercial groundfish fisheries overlap in space and time with Steller sea lions in the Gulf of Alaska and Bering Sea. Fisheries catch, effort, and location data were combined with sea lion counts and foraging distance information to produce maps and identify the potential overlap and probability of commercial fisheries encounters with sea lions.

What Scientists Learned

Findings suggest very few interactions between groundfish fisheries and Steller sea lions during summer, and significantly more interactions during winter. However, many of the potential interactions during winter have likely been mitigated by closures or reductions in fishing effort within regions designated by NOAA Fisheries as critical habitat.

Objective

Evaluate the extent of space and time overlap between groundfish fisheries and Steller sea lions in the Gulf of Alaska and Bering Sea.

Bottom Line

Interactions between groundfish fisheries and Steller sea lions were few during summer, and more frequent during winter. Some regions designated as critical habitat appear to be little used by sea lions, while other areas used by sea lions have no official designation. A first of its kind model to predict sea lion habitat–fishing interaction probabilities was developed.

Pollock aboard a Bering Sea trawler. Credit: © Natalie Fobes / www.fobesphoto.com

Researchers also discovered that some regions designated as critical habitat appear to be little used by sea lions, while other areas that are likely heavily used by sea lions have no official designation. Results also suggest that the Gulf of Alaska is more important in terms of sea lion habitat than the Bering Sea.

Sunset at Dutch Harbor–Unalaska, the nation's top seafood port in annual volume landed. Credit: Kurt Byers, Alaska Sea Grant

Further Study

Continued development of the Steller sea lion habitat model is needed, as well as development of analytical methods to test its validity and evaluate the degree of overlap between sea lion habitat and commercial fishing effort. The tools being developed to accomplish these research objectives are evolving into a software system capable of evaluating management decisions regarding commercial fisheries and Steller sea lions.

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School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
P.O. Box 757220
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(907) 474-7210
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Interactions among Steller Sea Lions, Pollock, and Herring and an Examination of Variability Associated with Acoustic Surveys of Pollock

Pacific herring, *Clupea pallasii*.
Credit: Alaska Sea Grant

Funding Summary

Principal Investigators

John J. Goering
University of Alaska Fairbanks
School of Fisheries and
Ocean Sciences

Richard E. Thorne
Prince William Sound
Science Center

Gary L. Thomas
Prince William Sound
Science Center

Year Funded
2000

Research Period
2000-2002

Budget
$40,000

Infrared scanners monitor nighttime raids on herring

During herring surveys conducted in March 2000, an infrared scanner detected intense nighttime foraging activity by Steller sea lions on overwintering herring schools. These observations indicated that Steller sea lions in Prince William Sound targeted herring schools during the overwinter period to the exclusion of pollock. This project explored the implications of these observations on the recovery of herring stocks in Prince William Sound.

Why Is PCCRC Interested?

A better understanding of Steller sea lion foraging preferences is important to the management and recovery of herring in Prince William Sound, and the recovery of threatened and endangered Steller sea lions.

What Scientists Did

Researchers used an infrared scanner to monitor Steller sea lion nighttime winter foraging behavior on well-known herring concentrations in Prince William Sound, and on pollock stocks.

What Scientists Learned

During March 2000, prior to the PCCRC project, aerial and boat surveys found Steller sea lions foraging in three major areas of herring concentration: St. Matthews Bay, Rocky Bay, and Northwest Montague Island. No Steller sea lions were observed with pollock concentrations in Port Bainbridge, Montague Trench, and Hinchinbrook Entrance.

During early and late March 2001, aerial and boat surveys, including infrared scanning, showed the same result as the previous year except that the concentration of herring in Rocky Bay had disappeared, and the concentration of Steller sea lions

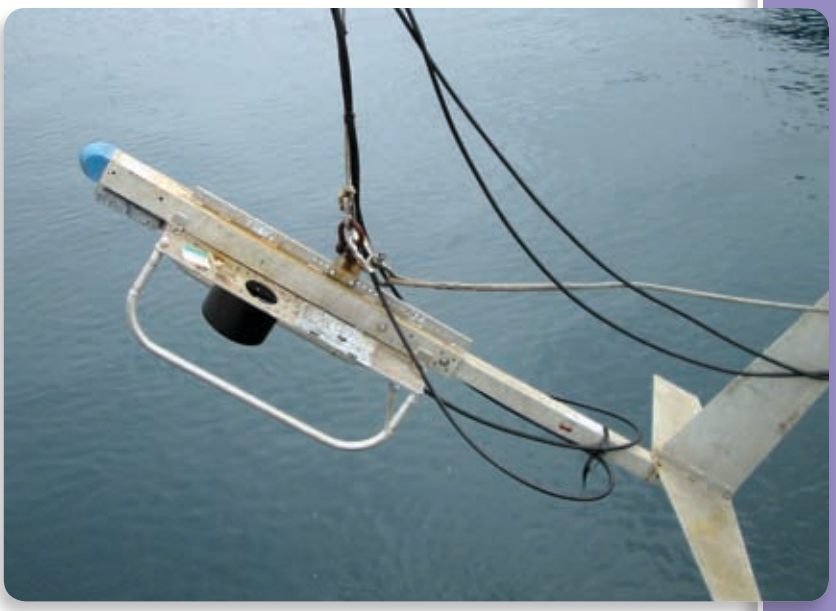
Objective

Evaluate the feasibility and effectiveness of infrared scanners to monitor nighttime foraging behavior of Steller sea lions in Prince William Sound. Determine the impact of Steller sea lion foraging on declining herring stocks in the sound.

Bottom Line

Infrared scanners worked well to monitor Steller sea lion behavior at night, although the device had limitations in bad weather. Steller sea lion predation has been an important factor in the precipitous decline of herring in Prince William Sound. The decline of herring and Steller sea lions in the sound are linked.

in that location had also disappeared. Despite two intensive, day and night surveys on pollock concentrations, not a single Steller sea lion was observed above any pollock concentration.



From a boat, researchers deployed this "tow fish" device with an acoustic scanner attached to detect schools of herring relative to the presence and number of Steller sea lions.
Credit: Richard Thorne, PWSSC

As a result of the PCCRC study, researchers concluded that marine mammal foraging on herring in Prince William Sound has contributed to precipitous declines in the herring population. Further, they believe that declines in both herring and Steller sea lion populations in the sound are closely linked.

Researchers found that infrared scanning technology is an effective tool for nighttime detection of Steller sea lion foraging activity.

Pollock Conservation Cooperative Research Center

School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
P.O. Box 757220
Fairbanks, AK 99775-7220
(907) 474-7210
http://www.sfos.uaf.edu/pcc/

Deployment of an Acoustic Data Logger on Commercial Fishing Vessels to Evaluate the Potential of Fishing-Induced Declines in Local Pollock Abundance

Pollock Conservation Cooperative Research Center
Project Synopsis

Pollock processing.
Credit: Kurt Byers, Alaska Sea Grant

Fishermen take part in study to measure their impacts on local pollock stocks

Large-scale commercial fishing is often blamed for reducing the availability of food for marine mammals such as Steller sea lions. However, the relationship between commercial fishing and the depletion of local fish stocks has not been well-studied and little is known about these impacts.

Why Is PCCRC Interested?

A better real-time understanding of pollock fishing impacts on local fish stocks may allow fishermen and managers to determine and modify any effect.

What Scientists Did

The project developed a prototype data logger that interfaces with the ship's 38 kHz echo sounder and captures the acoustic backscatter returns. In 2002, the system was installed on three catcher/processors. The backscatter data were post-processed and integrated with observer and logbook data. The trial period was used to test and debug the systems, and to investigate the feasibility of data collection and the quality of data collected. In 2003, an additional four vessels were equipped with acoustic data logging systems, bringing to seven the total number of pollock vessels equipped.

What Scientists Learned

The system was tested and implemented, and found to work satisfactorily. The preliminary findings indicate that the devices record information that is correlated with pollock catches.

Objective

Conduct a "proof of concept" project to evaluate the feasibility of installing acoustic data loggers on catcher/processors in the eastern Bering Sea pollock fishery to study localized depletion of pollock.

Bottom Line

Shipboard acoustical data loggers may be an effective tool to determine the localized depletion of pollock.

PCCRC researchers examined the utility of new electronic sensing devices on large catcher-processor vessels, aimed at improving catch data.
Credit: © Natalie Fobes / www.fobesphoto.com

Funding Summary

Principal Investigators

Terrance J. Quinn II
University of Alaska Fairbanks
School of Fisheries and Ocean Sciences

Martin Dorn
NOAA Alaska Fisheries Science Center

Graduate Student

Haixue Shen
Ph.D. Candidate
University of Alaska Fairbanks
School of Fisheries and Ocean Sciences

Collaborators

James Ianelli
Stephen Barbeaux
NOAA Alaska Fisheries Science Center

Vidar Wespestad
Pacific Whiting Conservation Cooperative

Tony Booth
Rhodes University
Grahamstown, South Africa

Year Funded

2001

Research Period

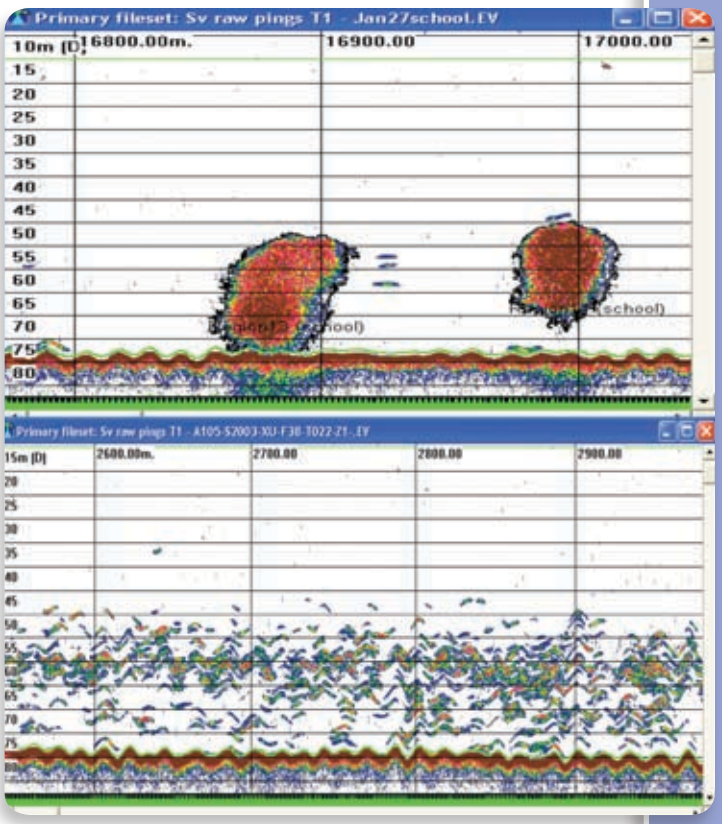
2001-2005

Budget

$251,528

Further Study

Work since 2005 has concentrated on the analysis phase of the project. This work includes classifying and searching behavior of the vessel, integrating the acoustic biomass, identifying pollock aggregations detected while searching, and evaluating what inferences, if any, can be made concerning the rate at which those aggregations are reduced in abundance. The project is moving forward in developing more sophisticated analytical tools for inferring the temporal dynamics of pollock spatial pattern using multiple data sources.



These echograms were recorded aboard a factory trawler off Unimak Island in the Aleutians. The top figure reveals two schools of pollock during the day. The lower panel depicts pollock spread out in a loose, layered aggregation near the seafloor, typical of their behavior at night. The size of the layer of pollock can spread to several kilometers. Credit: Haixue Shen, UAF/SFOS

Pollock Conservation Cooperative Research Center

School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
P.O. Box 757220
Fairbanks, AK 99775-7220
(907) 474-7210
http://www.sfos.uaf.edu/pcc/

Maturation of Walleye Pollock, *Theragra chalcogramma*, in the Eastern Bering Sea in Relation to Temporal and Spatial Factors

Jennifer Stahl samples maturity condition of pollock.
Credit: Courtesy ADFG

Funding Summary

Principal Investigator

Gordon Kruse
University of Alaska Fairbanks
School of Fisheries and
Ocean Sciences

Graduate Student

Jennifer Paige Stahl
M.S. Candidate
University of Alaska Fairbanks
School of Fisheries and
Ocean Sciences

Collaborator

Vidar G. Wespestad
Resource Analysts International

Years Funded
2002, 2003, 2004

Research Period
2002-2005

Budget
$92,491

How many fish are there to catch?

Acceptable biological catches (ABCs), for the world's largest fishery for walleye pollock in the eastern Bering Sea, are based on harvest rates applied to the annually estimated total pollock spawning biomass. Size at maturity, which may vary annually and geographically, determines the proportion of total pollock biomass accounted for by spawning (mature) fish targeted by the fishery.

Why Is PCCRC Interested?

Accurate estimates of pollock maturity are an integral part of the annual catch specification process. The current size of pollock at maturity used in annual stock assessments is based on a single study conducted in 1976. If size at maturity has changed over the past 30 years or if it varies over the wide geographical range of this stock, then variability in maturity size should be used to generate accurate estimates of spawning biomass for purposes of fishery management.

What Scientists Did

Samples of maturity condition and fish length were collected during the commercial fishery in 2002 and 2003, and supplemented by similar data collected by the National Marine Fisheries Service (NMFS) during assessment surveys in 1989-2002. Length at fifty percent maturity was estimated spatially (within subareas) and temporally (annually) by logistic regression using maximum likelihood methods.

A fisheries observer samples pollock aboard a trawler.
credit: North Pacific Fisheries Observer Training Program

Objectives

The overall goal of this study was to estimate spatial and temporal variability in the maturity size of walleye pollock in the eastern Bering Sea.

Bottom Line

Spatial and temporal patterns in size at maturity were found. Also, we developed a new descriptive guide for maturity staging of pollock ovaries for use in future assessments. Changes in maturity size should be incorporated into annual stock assessments for accurately setting annual catch specifications.

What Scientists Learned

Fish matured at smallest sizes north of the Pribilof Islands and in years 1989, 1991, and 1995. Fish matured at largest sizes south of the Pribilofs and in years 2001 and 2002. Size at maturity is directly related to fish growth and appears to be density dependent—that is, fish mature at smaller sizes when pollock stock biomass is greater. Failure to use accurate estimates of size at maturity may have led to a 1.8 percent underestimate of spawning biomass in 2002 and a 9.7 percent underestimate in 2003.

Further Study

Additional study of variability in maturity size is warranted, particularly given ongoing climate changes in the Bering Sea. Annual sampling by NMFS would provide a means for periodic adjustments in maturity size estimates for purposes of spawning stock biomass calculations. Additional research is needed to resolve uncertainties about the schedule of ovarian development for pollock in the Bering Sea.

The Alaska pollock fishery yields the largest catch of any single species inhabiting the 200-mile U.S. Exclusive Economic Zone.
Credit: © Natalie Fobes / www.fobesphoto.com

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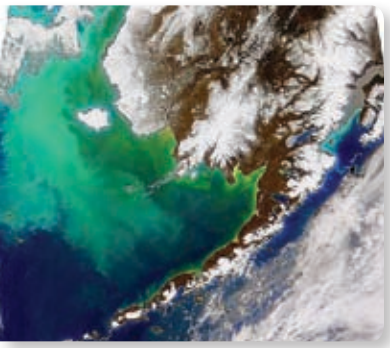
School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
P.O. Box 757220
Fairbanks, AK 99775-7220
(907) 474-7210
http://www.sfos.uaf.edu/pcc/

Environmental Predictors of Walleye Pollock Recruitment in the Eastern Bering Sea

Pollock Conservation Cooperative Research Center
Project Synopsis



Turquoise area represents a plankton bloom in the Bering Sea. Credit: NASA GSFC, SeaWIFS

Funding Summary

Principal Investigators

Franz J. Mueter
Research Scientist
Sigma Plus Consulting

Brenda L. Norcross
University of Alaska Fairbanks
School of Fisheries and Ocean Sciences

Year Funded
2003

Research Period
2003-2004

Budget
$42,837

Understanding oceanographic effects on walleye pollock

Changes in the climate and oceanography of the Northeast Pacific influence the recruitment of walleye pollock and other groundfishes in the Bering Sea. But relationships between environmental variability and recruitment in the Bering Sea are not well understood and incorporated into the assessment of groundfish stocks.

Why Is PCCRC Interested?

Relationships between environmental variability and recruitment in the Bering Sea are not well understood and are currently not incorporated into the assessment of groundfish stocks. A better understanding of the impact of oceanographic and other environmental factors will improve the management of groundfish fisheries important to commercial fishermen.

What Scientists Did

A number of empirical relationships between oceanographic variability and pollock recruitment have been established or proposed by various authors. Based on these, the researchers assembled and processed data to construct a comprehensive set of biological and environmental indicators that relate directly or indirectly to these relationships.

1. Winter ice conditions and the cold pool.
2. Timing of ice retreat and the spring bloom.
3. Mixed layer dynamics and summer production.
4. Advection.

Researchers then examined the impacts of these environmental conditions on pollock survival and

Objectives

Develop statistical models linking walleye pollock recruitment in the eastern Bering Sea to climatic and oceanographic conditions at regional and larger spatial scales.

Develop new environmental indicators that best reflect the potential mechanisms driving pollock recruitment.

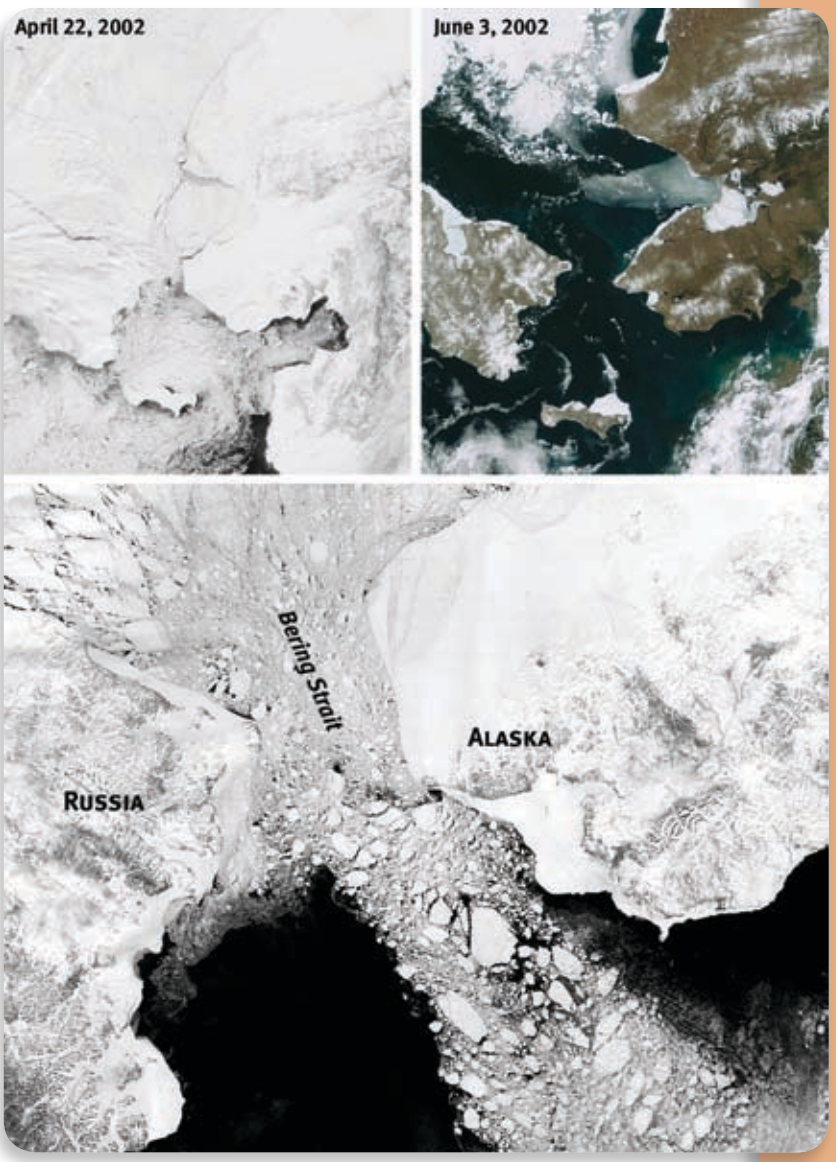
Bottom Line

Several relationships between environmental conditions and pollock recruitment were identified that may explain up to forty percent of the observed variability and can help predict effects of future climate changes on pollock.

recruitment using statistical models, with the goal of quantifying the proportion of variability in recruitment that may be accounted for by environmental variability.

What Scientists Learned

The survival of juvenile pollock tends to be enhanced during warm years with an early ice retreat and an early onset of the non-ice-associated spring bloom. In contrast, larval and juvenile survival appears to be reduced when thermal stratification and hence the phytoplankton bloom are delayed. A delayed bloom, which may result from intense mixing due to stormy spring conditions, presumably delays the availability of suitable prey for larval and juvenile fish that feed in the water column. Survival of juvenile pollock was enhanced at intermediate to high levels of wind mixing during summer, possibly because of increased mixing of nutrients into the surface layer, which can enhance production in the water column.



Top: Satellite images depict the extent of sea ice in the Bering Strait region in April and June, 2002. Bottom: Satellite image depicts the southward flow of ice through the Bering Strait.

Credit: SeaWiFS, NASA GSFC, and ORBIMAGE

In addition to environmental effects on recruitment, much of the variability in pollock recruitment can be explained by effects of cannibalism on the survival of juveniles. Therefore, both bottom-up effects (environmental) and top-down effects (such as predation and fishing) are important in regulating the abundance of walleye pollock in the eastern Bering Sea.

The Outlook for Russian Pollock Supply

Pollock Conservation Cooperative Research Center
Project Synopsis

Pollock fillets.
Credit: Kurt Byers, Alaska Sea Grant

Funding Summary

Principal Investigator

Gunnar Knapp
University of Alaska Anchorage
Institute of Social and
Economic Research

Year Funded
2001

Research Period
2001-2002

Budget
$15,984

The global market for Russian pollock

Russian pollock stocks are undoubtedly large, and could play a significant role in global pollock markets, posing serious competition for Alaska pollock. But little reliable information is available about Russian pollock harvests and markets.

Why Is PCCRC Interested?

As an organization largely centered on the harvest of groundfish, primarily pollock, the Pollock Conservation Cooperative is interested in furthering its members' understanding of global pollock markets.

What Scientists Did

The researcher reviewed publicly available data and information, and conducted interviews during a visit to Vladivostok in September 2001.

What Scientists Learned

Limitations imposed by language, out-of-date data, and unreported/illegal harvests, make it difficult to reach any definitive conclusions about Russian pollock harvests in 2001 or what harvests would be in 2002. Nevertheless, it appeared likely that Russian pollock quotas would be substantially reduced in 2002 by 748,000 metric tons, from about 1,678,000 tons to 930,000 tons. Even if this quota were fully harvested, which seemed unlikely given recent harvest rates of about eighty percent of total quotas, Russian harvests were predicted to decline substantially in 2002, presumably by several hundred thousand tons.

Objectives

What is the outlook for Russian pollock harvests in 2002?

How can the American pollock industry assess the outlook for the future Russian pollock supply?

Bottom Line

The Russian pollock harvest quota likely will decline in 2002. U.S. federal fisheries managers should build on their current relationships with Russian fishery regulators to improve the quality of fisheries data being compiled and shared with the United States.

These refrigerated containers at Dutch Harbor each hold up to 40,000 pounds of frozen pollock, cod, and crab, most destined for Seattle.
Credit: Kurt Byers, Alaska Sea Grant

Further Study

The United States should plan and hold formal and informal information-sharing meetings with their Russian counterparts, and make the proceedings of these meetings available to U.S. interests.

Dutch Harbor–Unalaska in the Aleutian Islands is a hub for international shipping, including shipment of pollock and crab harvested from the Bering Sea. The ship in the background is likely bound for East Asia with a load of frozen groundfish.

Credit: Kurt Byers, Alaska Sea Grant

Pollock Conservation Cooperative Research Center

School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
P.O. Box 757220
Fairbanks, AK 99775-7220
(907) 474-7210
http://www.sfos.uaf.edu/pcc/

Producer Co-ops and Producer Organizations

Pollock Conservation Cooperative Research Center
Project Synopsis

Pollock trawler in the Bering Sea. Credit: Todd Warshaw

Toward fisheries self-governance

Increasingly, commercial fishermen are creating formal and informal arrangements to govern themselves. These agreements serve to improve their political position, eliminate inefficiencies, and increase their harvest's economy of scale that in turn results in bargaining power and higher prices for the catch. The Bering Sea Pollock Conservation Cooperative is one of many examples of fisheries self-governance entities in the United States.

Funding Summary

Principal Investigator

Gunnar Knapp
University of Alaska Anchorage
Institute of Social and Economic Research

Year Funded
2002

Research Period
2002-2003

Budget
$25,000

Why Is PCCRC Interested?

PCCRC has an interest in furthering the understanding of how cooperatives and other vehicles for fisheries self-governance are constructed and how they operate to benefit both the resource user and the resource itself.

What Scientists Did

A workshop was convened June 23-24, 2003, that brought together participants from universities, governments, and industry to discuss fisheries self-governance around the world. Among the fisheries discussed were Bering Sea pollock, Alaska weathervane scallop, Chignik salmon, Oregon whiting, New Zealand orange roughy, New Zealand scallop, New Zealand lobster, Atlantic Canada offshore scallops, British Columbia geoducks, Matjes herring, Oregon Yaquina Bay herring, and Hawaii lobsters.

The workshop also was attended by fishery managers from NOAA Fisheries, the North Pacific Fishery Management Council, and the

Objective

Convene a workshop to discuss self-governing cooperatives in world fisheries.

Bottom Line

Fisheries cooperatives offer benefits to fishermen in areas of improved efficiencies and regulatory and economic bargaining power. For fishery managers, benefits include lower regulatory costs. There is some evidence that cooperatives result in improved environmental conditions that benefit both managers and fishermen.

This ship, known as a "catcher-processor," is used in the Bering Sea to both harvest and process pollock. Pollock roe, fillets, and surimi are processed within hours of the fish being caught. Credit: American Seafoods

Commercial Fisheries Entry Commission, as well as some members of the industry.

Overseen by the U.S. Department of Commerce, the massive Alaska pollock fishery is managed at a sustainable level by the North Pacific Fishery Management Council (NPFMC), which heavily relies on input from a Science Advisory Board.

Credit: Dan Lamont. Courtesy of Genuine Alaska Pollock Producers

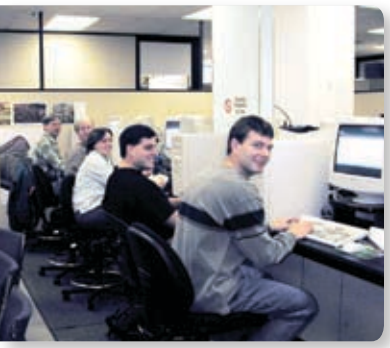
What Scientists Learned

Virtually all forms of fisheries self-governance arose within some kind of limited entry/property rights management program. Self-governance usually involved contracting among the limited set of participants, using traditional contract law. Most cases involved relatively small numbers of fishermen, probably because the transactions costs of negotiating and enforcing contracts increase with the number of participants. The advantage that drives self-governance is that the industry can negotiate rules more efficiently and can enforce rules at lower cost.

Pollock Conservation Cooperative Research Center

School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
P.O. Box 757220
Fairbanks, AK 99775-7220
(907) 474-7210
http://www.sfos.uaf.edu/pcc/

Pollock Conservation Cooperative Research Center
Project Synopsis



Students apply computer analysis techniques in fisheries management decision-making.
Credit: Peggy Merritt, UAF/SFOS

Funding Summary

Principal Investigator

Margaret F. Merritt
University of Alaska Fairbanks
School of Fisheries and Ocean Sciences

Year Funded
2001, 2003, 2006

Research Period
2001, 2003, 2006

Budget
$17,750

Enhancing fisheries education at the University of Alaska Fairbanks

Fisheries management is a decision-making process where there is often incomplete or suspect information, and managers must choose among risks and benefits to address conflicting goals. However, most tasked with addressing this need lack training in the techniques that would allow simultaneous consideration of multiple and conflicting viewpoints.

Why Is PCCRC Interested?

Policy-makers need training to integrate scientific, economic, social, and political components to create comprehensive approaches for finding solutions to fisheries research and management problems.

What Scientists Did

The researcher taught a two-credit, upper-division course called Decision-Making Techniques in Resource Management: Focus on Quota-Based Management. Class time was divided between lectures and computer lab. Lectures included guest speakers and had two parts. In part 1, students developed an understanding of the history and rationale for implementing Individual Fisheries Quota (IFQ) management, overviews of the science, economics and social issues associated with IFQ management, and case studies. In part 2, students were introduced to prominent philosophies of planning, group decision-making techniques, stakeholders and their combinations, and a systems approach to planning—the Analytic Hierarchy Process—and associated software. Readings from a textbook and selected articles were assigned. Students selected a current IFQ problem anywhere in the world, and applied principles learned in lectures and reading material to structure and prioritize components of the problem during lab, and propose a ranked list of options to address the problem.

Objectives

Launch a college level course on decision-making techniques with an emphasis on a systems approach to solving fisheries-related problems. The course would provide instruction in fisheries management and address issues related to the science, socioeconomics, politics, and ethics of Individual Fisheries Quota (IFQ) programs.

Bottom Line

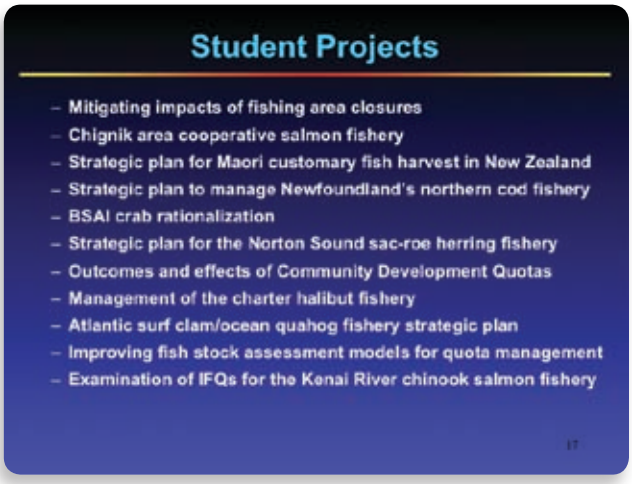
This course provided instruction in group decision analysis techniques to existing and future participants in fisheries management to (1) ensure stakeholder participation in the management process; (2) develop long-term strategies with measurable objectives; (3) blend various sources of information; (4) make explicit the decision-making process; and (5) increase the likelihood of finding an optimal solution to a management problem.

What Scientists Learned

Graduate and undergraduate students in the fisheries program at the University of Alaska Fairbanks, and fisheries professionals with the Alaska Department of Fish and Game, interested in continuing education, have been the primary students in this course.

UAF professor of fisheries, Peggy Merritt, and fisheries doctoral student, Jodi Pirtle, applied the Analytic Hierarchy Process in a workshop with stakeholders in Anchorage to help prioritize marine and coastal issues that should be studied in the Aleutian Islands.

Credit: Kurt Byers, Alaska Sea Grant



Students pursued a wide variety of topics in this upper level, two-credit fisheries education class at the University of Alaska Fairbanks, aimed at helping them gain the knowledge, skills, and perspective necessary for solving fishery management problems.

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Integrating Science and Tradition: Ecosystem Monitoring through the Subsistence Harvests of the Pribilof Islands, Alaska

Pollock Conservation Cooperative Research Center
Project Synopsis

A bull fur seal and females.
Credit: Jo-Ann Mellish, UAF/SFOS

Funding Summary

Principal Investigator

Jo-Ann Mellish
University of Alaska Fairbanks
School of Fisheries and Ocean Sciences and
Alaska SeaLife Center

Collaborators

LGL Alaska Research Associates, Inc.

Aleut Community of St. Paul Island Tribal Ecosystem Conservation Office

Year Funded
2006

Research Period
2006-2007

Budget
$24,867

Connecting subsistence and science

Integrating traditional knowledge and modern scientific research is a critical step toward understanding changing ecosystems such as the Bering Sea. Subsistence harvests, oral natural history, and local experiences and culture offer valuable tools for the investigation of the current role of contaminants in species declines.

Why Is PCCRC Interested?

A fundamental goal of the Pollock Conservation Cooperative is creating networks and connecting people to improve the collection of important scientific data, leading to enhanced understanding of the ecosystem.

What Scientists Did

Researchers engaged subsistence hunters on St. Paul Island, and developed a sampling protocol that hunters used to collect more than 100 tissue samples from fur seals, sea lions, and seabirds, including muscle, liver, blubber, and kidney tissues. The samples were analyzed to determine concentration of polychlorinated biphenyls (PCBs), a human-made chemical known to have significant adverse effects on organ function and reproduction.

A scientist demonstrates how to record data from a porpoise.
Credit: Lianna Jack, Alaska Sea Otter/Steller Sea Lion Commission

Objectives

Collaborate with subsistence hunters to collect biological samples from the subsistence harvest of marine mammals and seabirds on the Pribilof Islands.

Provide opportunities to augment scientific knowledge with traditional knowledge and vice versa.

Measure contaminant levels in multispecies tissue samples collected during subsistence hunting events, including marine mammals and seabirds.

Bottom Line

The project effectively demonstrated the ability of different interest groups and backgrounds to work toward a single goal, resulting in the collection of tissues that would otherwise be unavailable due to logistic and financial constraints to researchers.

What Scientists Learned

Analyses suggest that PCB contamination could cause a decrease in the northern fur seal population. The project proved that scientists and local subsistence users can work together to better understand natural systems, and share information that would otherwise be unavailable to researchers due to logistic and financial constraints.

Alaska hosts the world's largest population of northern fur seals. They spend 7 to 10 months at sea, coming ashore once a year to breed on Bogoslof Island in the Aleutians and on St. George and St. Paul islands in the Bering Sea. Credit: Jo-Ann Mellish, UAF/SFOS

Further Study

The species examined in this study are sentinels of a changing ecosystem, and represent an important traditional food source for rural communities. Climate change and environmental pollution may be responsible for some of the unexplained developments in traditional food consumption. Continued monitoring of subsistence foods for both academic and local knowledge is necessary.

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School of Fisheries and Ocean Sciences

America's Arctic University

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Project management and photo research/captions by Kurt Byers
Written by Doug Schneider
Edited by Sue Keller
Designed by Jen Gunderson