Trustee Council Use Only Project No.______________ Date Received: _________

FY07 INVITATION
PROPOSAL SUMMARY PAGE
(to be filled in by proposer)

Project Title: Identification of Essential Habitat for Pacific Herring (*Clupea pallasi*) in Sitka Sound for Comparison to Prince William Sound i.e. Source vs. Sink Habitat– Submitted under the BAA

Project Period: October 1, 2006 – June 30, 2008

Proposal Submitted By: Sitka Tribe of Alaska, 456 Katlian Street, Sitka, Alaska 99835
Principal Investigator: Heather Meuret-Woody, Research Biologist, Sitka Tribe of Alaska, 456 Katlian Street, Sitka, AK 99835, (907) 747-3207, hwoody@sitkatribe.org.
Collaborator: Nate Bickford, PhD, Hydro-Geochemical-Ecologist, University of Alaska Fairbanks School of Fisheries and Ocean Sciences, P.O. Box 757220, Fairbanks, AK 99775, (907) 474-6469, nate@sfos.uaf.edu.

Study Location: Sitka Sound, Sitka Alaska
Key Words: Clupea pallasi, Pacific herring, essential habitat, otolith microchemistry, restocking, reclamation

Abstract: Once herring hatch and the larvae drift to retention areas, they begin metamorphosis. As juveniles, herring forage in productive waters of the North Pacific. Adult herring then return to natal beaches to spawn. What is unknown is where the herring go and if certain regions contribute more to the spawning population. Once we know which population contributes more to the spawning groups, we can then identify those variables that enhance the life histories of the source population. We can identify these groups and track their movements using otolith chemistry. The adult herring that return to spawn are the survivors. If most of the survivors come from a distinct population, then we need to know which population survive and why. This will allow managers to protect the most important populations and also identify those environmental variables needed to enhance other populations.

Funding:

EVOS Funding Requested for FY07: $166.4K
Includes 9% GA

Non-EVOS Funds to be used: $30,000

Sitka Tribe of Alaska

Identification of Essential Habitat for Pacific Herring (*Clupea pallasi*) in Sitka Sound for Comparison to Prince William Sound i.e. Source vs. Sink Habitat

Exxon Valdez Oil Spill Trustee Council
Submitted Under BAA
2007 Proposal for Funding

August 4, 2006

Sitka Tribe of Alaska

FY07 Invitation: Narrative Forms for Proposals

PROPOSAL SIGNATURE FORM

THIS FORM MUST BE SIGNED BY THE PROPOSED PRINCIPAL INVESTIGATOR AND SUBMITTED ALONG WITH THE PROPOSAL. If the proposal has more than one investigator, this form must be signed by at least one of the investigators, and that investigator will ensure that Trustee Council requirements are followed. Proposals will not be reviewed until this signed form is received by the Trustee Council Office.

By submission of this proposal, I agree to abide by the Trustee Council's data policy (*Trustee Council Data Policy**, adopted July 9, 2002) and reporting requirements (*Procedures for the Preparation and Distribution of Reports***, adopted July 9, 2002).

PROJECT TITLE: Identification of Essential Habitat for Pacific Herring (*Clupea pallasi*) in Sitka Sound for Comparison to Prince William Sound i.e. Source vs. Sink Habitat– Submitted under the BAA

Printed Name of PI: Heather Meuret-Woody
Signature of PI: ________________________________ Date __________

Printed Name of co-PI: ____
Signature of co-PI: ________________________________ Date __________

Printed Name of co-PI: ____
Signature of co-PI: ________________________________ Date __________

* **www.evostc.state.ak.us/Policies/data.htm**
** **www.evostc.state.ak.us/Policies/Downloadables/reportguidelines.pdf**

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Funding:

EVOS Funding Requested: FY07 $166.4K
TOTAL: $166.4K (includes 9% GA)

Non-EVOS Funds to be used: FY07
TOTAL: $30.K

Date: July 2006

I. PROJECT PLAN

A. Statement of Problem

Native peoples throughout coastal Alaska, including Sitka Sound and Prince William Sound (PWS) have relied heavily upon herring as a subsistence food source since time immemorial. Herring roe is one of the most prioritized traditional food sources for many Alaska coastal tribes, including Sitka Tribe of Alaska. Alaska Department of Fish and Game (ADF&G) surveys have documented the use of herring eggs by households of the Sitka Tribe. ADF&G has estimated 97% of Sitka Tribal households utilize herring eggs, and that an average household uses 177 pounds of subsistence herring eggs (Schroeder & Kookesh, 1990). The State Board of Fisheries set the amount reasonably necessary for subsistence use of herring eggs between 105,000 and 158,000 lbs as specified in 5 AAC 01.716(b), just for Sitka alone. Sitka Tribe has been conducting subsistence herring harvest surveys in subsistence households since 2002, to document the importance of herring to native people's diet and culture. The estimated harvest of herring roe by subsistence users in Sitka in 2003 was 278,799 pounds harvested on hemlock branches, hair seaweed and *Macrocystis* kelp (Turek, 2004).

Since the early 20th century, Pacific herring stocks have been heavily targeted by a massive commercial fishing industry and a bounty of herring reduction plants. Elsewhere, once healthy herring populations have been challenged by habitat loss or environmental degradation, as in the case of Prince William Sound herring. In March 1989, during a period of high biomass, the tanker vessel *Exxon Valdez* ran aground on Bligh Reef in northeastern PWS and spilled 42 million liters of crude oil. Immediately following the oil spill, herring spawned in PWS. In 1989, herring embryos and larvae had low survival, morphologic and genetic damage and herring larvae had slow growth rates (Hose et al., 1996; Kocan & Hose, 1995; Kocan et al., 1996; Norcross et al., 1996). Estimates of spring spawning herring biomass from 1989 through 2000 ranged from 102,481 metric tons in 1992 to 14,378 metric tons in 1994 (Morstad et al., 1998; Wilcock & Funk, ADFG, pers. comm.). Herring catches were reduced in 1993 (Funk, 1995; Marty et al., 1998, 1999), and the fisheries were closed from 1994 to 1996. The harvest prior to the collapse was 48,317 metric tons in 1992; the highest catch since 1993 was 10,979 metric tons in 1997. However, the population of herring in PWS again collapsed in 1999 (Marty et al., 2003).

As a comparison to the PWS herring stock, Sitka's herring stocks remain healthy and relatively intact, and can in fact be used as a control group, providing baseline data to compare to other depleted herring stocks around the region. Estimates of Sitka's spring spawning herring biomass from 1989 through 2000 ranged from 73,425 metric tons in 2004 to 19,700 metric tons in 1995 (Davidson, 2004). The highest commercial sac roe catch since 1989 was 12,515 metric tons harvested in 2006 (Davidson et al., 2006). Sitka's herring population is stable and supports one of Alaska's largest subsistence herring harvests as well as one of the largest commercial herring sac-roe fisheries in the world.

The Trustee Council has classified Pacific herring in PWS as a non-recovering injured resource based on population trends that became evident four years after the *Exxon Valdez* oil spill. One of the Council's long-term goals is to restock Pacific herring in Prince William Sound. The factors that continue to impede herring recovery in PWS are not well understood. To date, there has been no satisfactory answer to explain the lack of recovery of herring in PWS.

This proposal is being submitted to address herring restoration in PWS by using trace elements in herring otoliths as markers to identify successful spawning and juvenile habitats in a control population, such as the healthy and intact herring population located in Sitka Sound. The identification of essential herring habitat in Sitka Sound can be compared to PWS essential herring habitat. Restoration and enhancement of herring in PWS cannot take place without knowledge of location of successful spawners and of productive nursery areas.

B. Need for the Project

The reasons for the herring populations in Prince William Sound to remain as a non-recovered status sixteen years after the *Exxon Valdez* oil spill is unknown. One of the Trustee Council's recovery objectives for Pacific herring in PWS is a highly successful year class that is recruited into the population, and when other indicators of population health are within normal bounds. Herring are an important part of the marine ecosystem, as forage fish they are the staple source of food for many marine mammals, birds and fish. In Sitka Sound, herring is the food for thousands of congregating Steller's sea lions (*Eumetopias jubatus*) and hundreds of humpback whales (*Megaptera novaeangliae*), both of which are endangered species. Once herring decline, species that rely on herring as a food source will more than likely decline as well.

It is important to investigate and understand the limiting factors that are preventing herring populations from recovering in Prince William Sound. A major factor effecting herring is their habitat preference during all life stages. Essential fish habitat is difficult to identify, much less conserve or improve. Therefore, it is critical to protect those habitats that contribute a disproportionate large number of recruits to future generations. It is quite often difficult to identify these source habitats and distinguish them from those habitats that may contain significant biomass but produce few recruits (sink habitats). In the case of Pacific herring in PWS, recruitment success has been measured by comparing the abundance of spawning adults in different habitats thereby approximating the relative importance of different natal and nursery habitats (Norcross et al., 2001a). The technology of otolith chemistry allows researchers to investigate survivorship, and as a result, identify essential spawning habitats. Trace element chemistry preserved by the otoliths provides powerful insight into the environmental life history of fishes. For example, otolith chemistry has been used to determine population structure and dynamics at both large (between estuaries) and small spatial scales (between sea grass habitats within an estuary) (Thorrold et al., 2001; Dorval et al., 2002). Chemical analysis of trace element concentrations in otoliths can be used to identify the geographic signatures of natal habitats used by fishes captured either as juveniles or adults (Bickford et al., 2003).

This investigation will use otolith microchemistry to identify the essential habitat of Pacific herring in Sitka Sound (Figure 1.) for comparison to the essential habitat of Pacific herring in Prince William Sound (PWS). The proposed research will explore the utility of otolith (fish ear stone) chemistry in the reconstruction of past habitat use, the identification of essential habitat, and the connectivity between Pacific herring populations within Sitka Sound for comparison to herring populations in PWS. During a stock identification project, Sitka Tribe collected herring otolith samples from adults and larvae in Sitka Sound in 2005 and 2006 from six different zones (Figure 2.). The adult herring otolith samples were analyzed for trace element concentrations at the Advanced Instrumentation Laboratory at the University of Alaska Fairbanks. Preliminary data shows that there is a slight difference between core and edge chemistries from adult herring collected in Zone 1 (Figure 3.). The core to edge chemistries are chemically distinct for most fish in Zone 2 and Zone 3 (Figure 4. and Figure 5.). There is some site fidelity in Zone 1 (Figure 6.). These archived otolith samples can be used to compare microchemistry signatures with juvenile herring otoliths, as stated in the objectives of this proposal. In Sitka Sound, the identification of essential habitat utilized by a control population will have profound consequences for the Pacific herring reclamation in PWS.

To date there has been no way to correlate larval, juvenile, and adult populations for Pacific herring. Otolith microchemistry offers researchers a way of identifying the temporal and spatial migrations of larval, juvenile, and adult herring. The use of otoliths to describe the potential transport of herring larvae from spawning sites to nursery areas, and the identification of the most important areas, will aid researchers in understanding the recovery status of herring and achieve the goals of the 1994 Restoration Plan (Bickford et al., 2003).

The lifecycle of Pacific herring in Sitka Sound is conducive to otolith chemical analysis. In Sitka Sound, herring mature at 3-4 years old and annually migrate to coastal waters to consistently spawn on tidal and sub-tidal shores. Adult herring migrate in mid March to spawn on 40 - 104 nautical miles of coastline in Sitka Sound (Davidson, 2004) (Figure 2.). Spawning in Sitka Sound usually occurs in the third week of March and continues into mid-April, and sometimes can occur through May in some areas. Sitka Sound herring eggs incubate in these spawning areas for about 14 days before hatching as larvae in May and June. The planktonic herring larvae tend to drift to the northern end of Sitka Sound, which serves as a retention area (Haldorson & Collie, 1990). Metamorphosis of the larval herring begins to occur in June of that same year (Stokesbury et al., 2002). The herring then become nektonic and swim to favorable habitats and are no longer at the mercy of the currents. In August, the young herring begin to form schools and aggregate at the heads of bays far from coastal waters (Brown et al, 2002; Stokesbury et al., 2000). These populations stay isolated in their respective nursery bays until June of their second year (Stokesbury et al., 2000). At that time this cohort of herring leaves the bays and joins adult schools (Stokesbury et al., 2000).

Throughout the life of a herring, as it migrates among Sitka Sound fjords and bays, the trace element content of the water is recorded in the otolith. This creates a permanent record of habitat use by an individual fish. Otolith bands are accrued during the fish's time of residence in the spawning areas, thus recording the unique spatial chemical signatures. Otoliths are formed in the latter part of the egg stage. The initial deposition of material becomes the core of the otolith (Wright et al., 2002). As the juvenile herring grows it accretes bands of new material, which surrounds its original core deposit. Daily bands, monthly bands, and yearly bands are accrued as layers. Growth is recorded as assorted bandwidths inside the otolith, much as a tree accumulates annual rings. The daily, monthly, and annual bands have long been used as detectors of age and growth rate in fish (Campana & Thorrold, 2001). In recent years the chemical compositions of individual bands have been used to identify past habitat use of the fish (Rooker et al., 2003; Campana & Thorrold, 2001; Thresher, 1999). The incorporation and the concentration levels of trace metals in the otoliths are a function of abiotic (i.e., temperature, salinity) and biotic (i.e., diet, fish growth rate) conditions (Thresher, 1999).

C. Relevance to 1994 Restoration Plan Goals and Scientific Priorities

The Exxon Valdez Oil Spill Restoration Plan of 1994 set recovery objectives, strategies and goals for Pacific herring in PWS. One of the Trustee Council's recovery objectives for Pacific herring in PWS is a highly successful year class that is recruited into the population, and when other indicators of population health are within normal bounds. This project meets the objective and will provide information needed to improve the management and recovery of this important commercial and subsistence species. Exxon Valdez Oil Spill Trustee Council has identified Pacific herring as not recovered to a healthy and productive state and the Council stated herring do not exist at pre-spill abundance. This project will focus on the reproductive success and identification of essential fish habitat that supports large amounts of recruits using a healthy herring population, located in Sitka Sound, as a control group. This project will contribute greatly to the knowledge of herring recovery in Prince William Sound.

The project will determine chemical trace metal signatures found in rearing and spawning areas. Through otolith chemical analysis, the spatial and temporal description of where herring spend their early life history can be identified. This technique is necessary to identify those habitats where enhancement of the herring population is needed. The first step would be to protect the population that would be considered the source group, with the hopes that more fish would be added to the environment. The second part would be to identify similar habitats without herring and seed new herring into the environment. To do any of these steps we will need to identify source and sink habitats that control herring population numbers (Bickford et al., 2003).

The data can also be used to consider the effect the *Exxon Valdez* oil spill continues to have on the recovery of herring populations in PWS. Using the data, we hope to identify where herring were spawned (natal), where they spent time after spawning (nursery), where they go to spawn, and whether or not they spawn at their natal beach. This data can tell us about survival between the life stages, and which habitats contribute more to the population.

II. PROJECT DESIGN

There has been a consistent downward trend in the biomass of Pacific herring in Prince William Sound. These sub-tidal and tidal spring spawners have distinct spawning strategies, as well as unique habitat needs and life histories. Currently the methods applied to identify spawning habitats and recruitment successes include spawn deposition dive surveys, which allocates habitat based on the presence of spawning adults. The proposed research will explore the utility of otolith chemistry in the reconstruction of past habitat use, the identification of essential habitat, and the connectivity between herring populations within Sitka Sound for comparison to PWS. The identification of essential spawning habitat, and the ability to assess recruitment within major herring populations, will have profound consequences for these forage fish. The results will assist in the prioritization of restoration of essential habitats, as well as in the continued management and sustainability of herring fisheries.

A. Objectives

The primary objective is to obtain information leading to better identification of essential fish habitat in Prince William Sound. By using trace element signatures of edge portions of juvenile herring otoliths, we will identify the otolith chemical signature of individual rearing bays within Sitka Sound.

Objective 1. Use trace element signatures of edge portions of adult herring otoliths to identify the otolith chemical signature of spawning areas within Sitka Sound.

Objective 2. Use trace element signatures of core portions of juvenile and adult herring to identify source and sink habitat in Sitka Sound.

Objective 3. Compare the source and sink habitats of Sitka Sound to the source and sink habitats of Prince William Sound.

Otolith chemical analysis can be used to identify spawning grounds, and nursery grounds of herring. The chemical ratios found in the edge portions of the herring otoliths will be distinct to the area of collection. Thus a comparison between the core portions of the adult and juvenile herring otoliths can be made. Sitka Tribe will be able to identify where the adult spawning survivors originate, which habitats contribute more biomass, and which nursery grounds contribute the most to the adult populations.

B. Procedural and Statistical Methods

Collection

Sitka Sound herring migrate to shallow spawning beaches around March and April. Sitka Tribe will use their 24’ aluminum boat for transportation to and from the sample sites. A 5’ diameter monofilament cast net, thrown from the boat or from shore, will be used to capture spawning herring. When herring are wadded up against rocks, a 1/8” white mesh minnow net, with a 16” x 24” bow and a 6’ extendable aluminum handle will be used for collection. The herring will be placed in 5-gallon buckets and transported to town for biological sampling and otolith collection. A water sample will be collected at each site following the University of Alaska Fairbanks (UAF) Advanced Instrumentation Laboratory water sampling protocols: collect a surface sample of 250 ml in a plastic Nalgene bottle already prepared with an acid mixture. The bottles will be properly labeled, kept cold, and transferred to a refrigerator unit for storage. The water samples will be delivered to Dr. Nate Bickford at UAF for analysis and compared with the adult herring otoliths, as well as the juvenile herring otoliths. Water temperature and salinity will be sampled at 1 fathom at each collection site using an YSI 85 hand-held meter. A Garmin eTrex Legend hand-held GPS unit will be used to record coordinates of collection locations, and the coordinates will be downloaded into maps created in ArcMap GIS 9.2.

A random sample of 50 (per year) captured spawning adult herring from each collection site will be sampled for otoliths, scales, weight, length, sex, and maturity. The fish will be lightly rinsed and each fish will be wiped down to remove excess slime and debris. Each fish will be weighed to the nearest .01 g using an Ohaus Scout Pro digital scale. Each fish will be measured from snout to hypural plate to the nearest .01 mm using Tesa IP65 waterproof digital calipers. Two scale samples will be removed from the ADF&G Mark, Tag and Age Laboratory preferred area (located just below the dorsal fin) on the left side of the fish. Scales will be mounted on glass slides using diluted white glue, creating a duplicate scale slide for each fish. The slides will be etched with the appropriate sampling information following ADF&G Mark, Tag and Age Laboratory herring AWL sampling instructions. Sex will be determined by a visual inspection and will be classified as mature, spent, or immature. Sagittal otoliths will be extracted from herring in a clean environment using standard techniques (Bickford et al., 2003; Campana, 1999; Campana, et al., 1995). Otolith pairs will be removed from each fish by cutting the head off, slicing along the top of the brain cavity, removing the brain and exposing the otolith-containing cavities. Super fine point tweezers will be used for otolith removal. The otolith pairs will be placed in a 96-cell plastic tray with a lid, temporarily until they are cleaned, stored, and labeled in micro centrifuge tubes. All adult herring otolith pairs will be sent to Dr. Nate Bickford at UAF for trace metal analysis.

All juvenile herring will be collected with several methods: seine, mid-water trawl, and jigging. The local ADF&G samples herring during the winter test fishery, and many juveniles are observed during this time. ADF&G hires commercial boats to seine, jig and mid-water trawl for herring samples in January. Sitka Tribe will have access to the winter test fishery herring for sampling juveniles.

A random sample of 50 juvenile herring from each sample area will be collected from the winter test fishery. The juvenile herring will be placed in 5-gallon buckets and transported to a processing station for biological sampling and otolith collection. All juvenile fish are lightly rinsed of excess debris and slime. Each individual juvenile fish is then wiped off using paper towel. The fish are identified as 1-50 according to date and sample site. The digital scale is wiped clean and zeroed before weighing each juvenile fish. All juvenile fish are placed on the Ohaus Scout Pro digital scale, weighed to the nearest .01 g, and then placed in a dissecting pan. All juvenile fish are then measured to the nearest .01 mm from the snout to the hypural plate using Tesa IP65 waterproof digital calipers. Two scales are then removed from the ADF&G Mark, Tag and Age Laboratory preferred area (located just below the dorsal fin) on the left side of the fish. Each scale is dipped in a diluted white glue mixture, and placed on a 2 x 3 inch glass slide, creating 2 sets of archived scales per fish. The slides are etched with the appropriate sampling information following ADF&G Mark, Tag and Age Laboratory herring AWL sampling instructions. All scale slides are then stored in a slide case. Because these are immature fish, they will not be sexed. Sagittal otoliths will be extracted from herring in a clean environment using standard techniques (Bickford et al., 2003; Campana, 1999; Campana, et al., 1995). Otolith pairs will then be removed from each juvenile fish by cutting the head off, slicing along the top of the brain cavity, removing the brain and exposing the otolith-containing cavities. Super fine point sterilized tweezers will be used for otolith removal. The otolith pairs will temporarily be placed in a 96-cell plastic tray with a lid. The otoliths are then rinsed and cleaned with distilled water, and placed in micro centrifuge tubes. Each tube is labeled with the fish identification number, date and collection site information. All juvenile herring otolith pairs will be sent to Dr. Nate Bickford at UAF for trace metal analysis.

Otolith Chemical Analysis

Sagittal otoliths will be thin sectioned using a Beuhler isomet low speed saw. This will expose the otolith core and edge for chemical analysis and aging (Campana, 1999). The sagittal otoliths will be analyzed for concentrations of trace metals using a laser ablation (LA; New Wave UP 213nm Nd:YAG) inductively coupled plasma – mass spectrometry (ICP-MS; Agilent 7500c) in the Advanced Instrumentation Laboratory located at the University of Alaska Fairbanks. These analyses will be performed on thin sections of otoliths on a transect extending from the core across to the otolith margin. All analyses will be calibrated using the external matrix-matched standard USGS MACS-1 (carbonate standard). Each sample measurement will be preceded by a gas blank measurement with re-calibration (gas blank and MACS-1) every 10 samples. Concentration of all elements will be calculated relative to MACS-1 after proper correction for gas blank, matrix, and drift effects. Elemental abundances will be compared to relative to Calicum content among otolith samples (Campana, 1999; Campana & Neilson, 1985).

C. Data Analysis and Statistical Methods

Statistical analysis will include analysis of variance (ANOVA $\alpha = 0.05$) to distinguish differences in the otolith chemical signature (Mg/Ca, Mn/Ca, Sr/Ca, Sr^{86}/Sr^{87}, and Ba/Ca):

- Juvenile edge (nursery) vs. juvenile core (natal) if the signature is the same then the fish has not left spawning grounds.
- Juvenile core (natal) vs. juvenile core (natal) if the signature is the same then the fish were spawned in the same area.
- Juvenile edge (nursery) vs. adult area just outside the core (nursery) if the signature is the same then the adult used the same nursery habitat as the juvenile.
- Adult edge (spawning area) vs. adult core (natal) if the signature is the same then the adult returned to spawn in the same area it hatched in.
- Adult core (natal) vs. adult core (natal) if the signature is the same then the adults were hatched in the same area.

Linear discriminant analysis (LDA) explicitly attempts to model the difference between classes of data. The LDA results will distinguish geographically the distinct groups of herring and allow us to classify the individuals into groups (i.e., natal group, nursery group).

D. Description of Study Area

The collection of adult and juvenile Pacific herring otoliths and the associated biological and oceanographic data will be in Sitka, Alaska, located in northern Southeast Alaska, 57.046, -135.333. Sitka Sound is located on the outermost coast of Baranof Island and is a slightly enclosed sea separated from the Gulf of Alaska by a myriad of barrier islands (Figure 1.). The rocky coastline is similar to the coastline in Prince William Sound, and it consists of numerous islands, inlets, bays, and deep fjords. At 57° N, Sitka Sound produces strong spring phytoplankton blooms with a short growing season. In this northern location the combination of light and temperature restrictions create environmental conditions for Pacific herring that are somewhat different from those experienced by Atlantic herring (*Clupea harengus*) or by Pacific herring found in more southerly regions of the west coast of North America (Norcross et al., 2001). Sitka Sound supports one of the world's largest commercial herring sac-roe fisheries, which harvests 20% of the biomass each year, as well as supporting Alaska's largest subsistence herring egg harvest. Sitka Sound herring generally spawn on 40 to 80 miles of coastline each spring.

Figure 1. Sitka Sound, Sitka Alaska includes over 80 miles of shoreline.

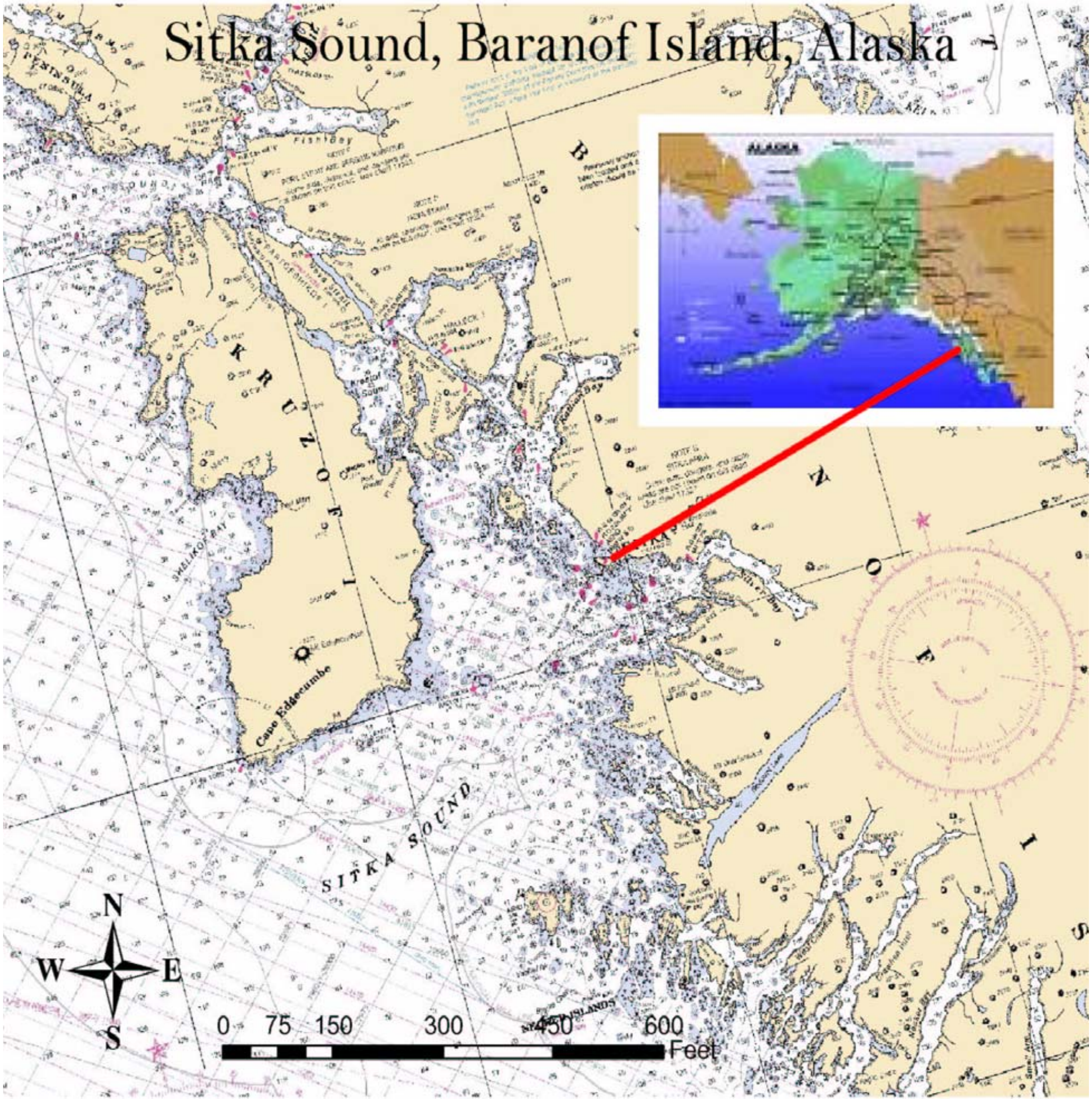


Figure 2. Sitka Tribe of Alaska's 2005 and 2006 herring otolith collection sites in Sitka Sound.

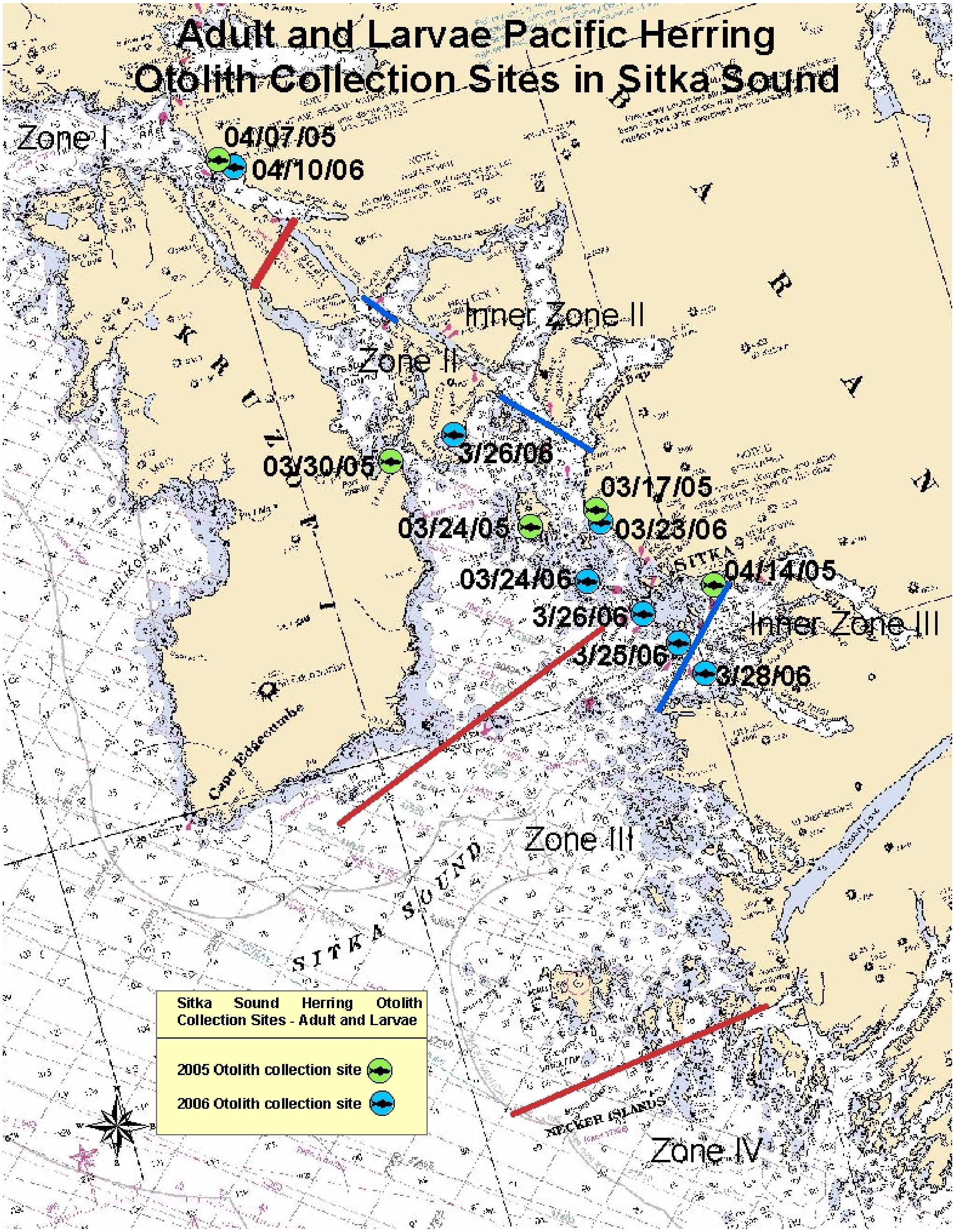


Figure 3. Ba/Ca chemistries of adult herring otoliths core vs. edge from Zone I in Sitka Sound.

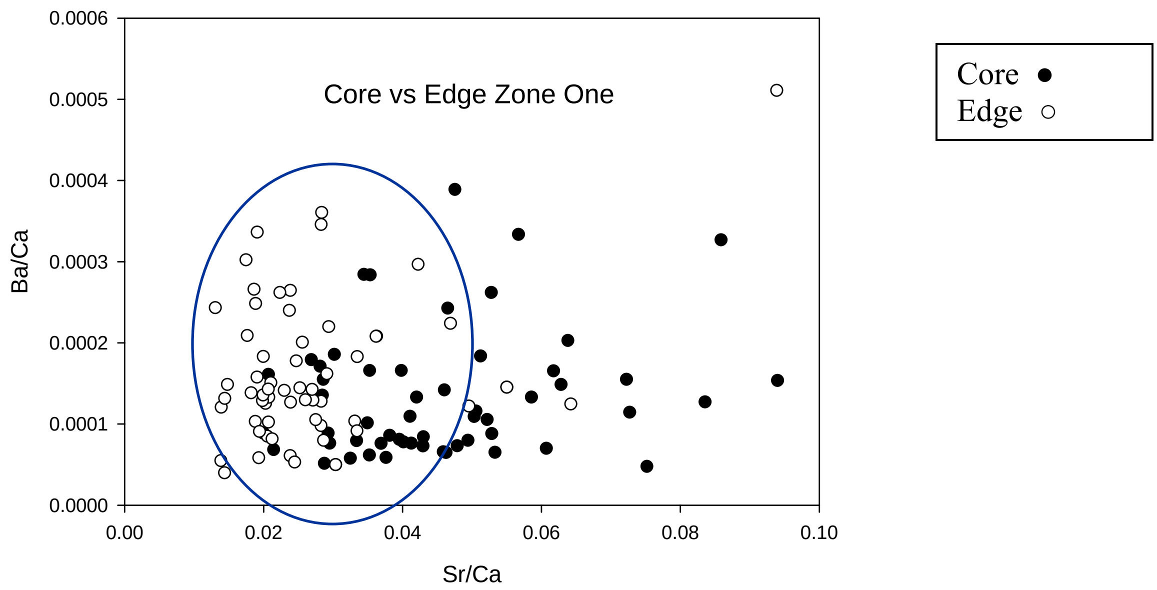


Figure 4. Ba/Ca chemistries of adult herring otoliths core vs. edge from Zone II in Sitka Sound.

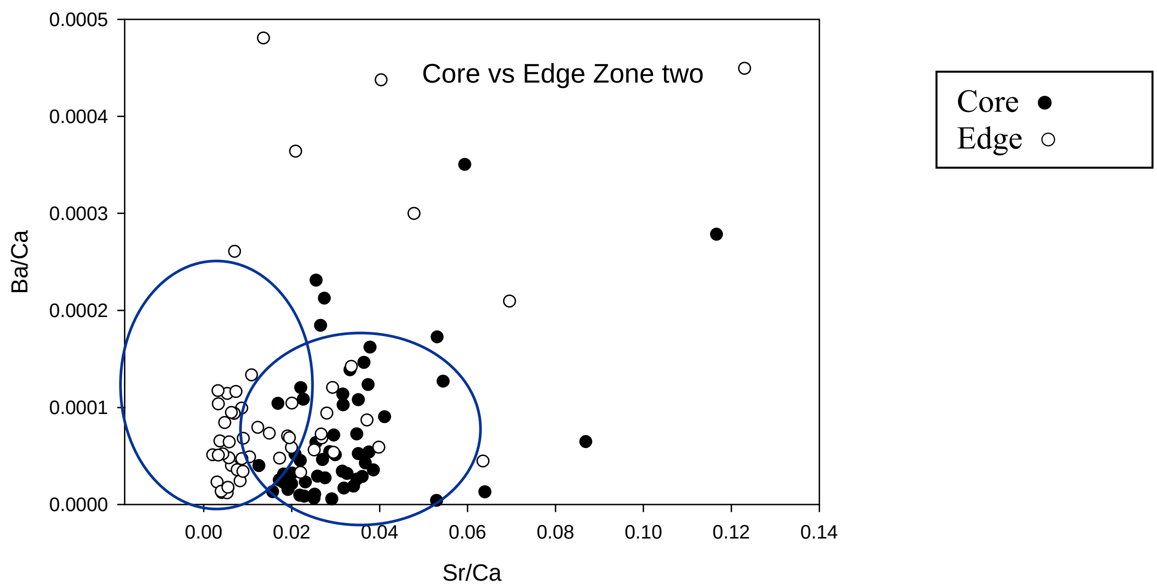


Figure 5. Ba/Ca chemistries of adult herring otoliths core vs. edge from Zone III in Sitka Sound.

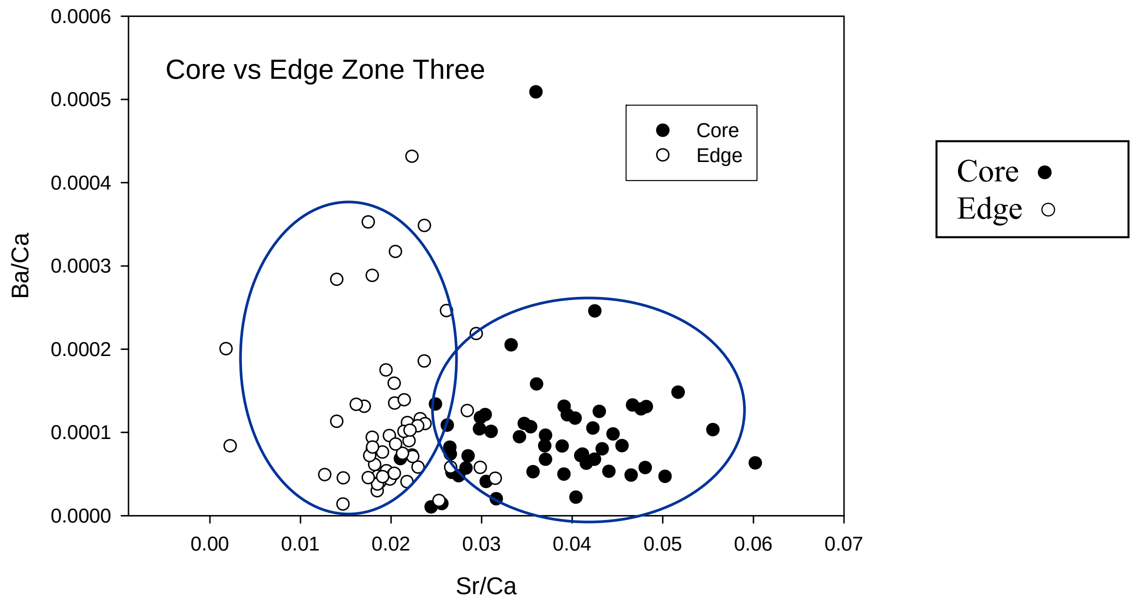
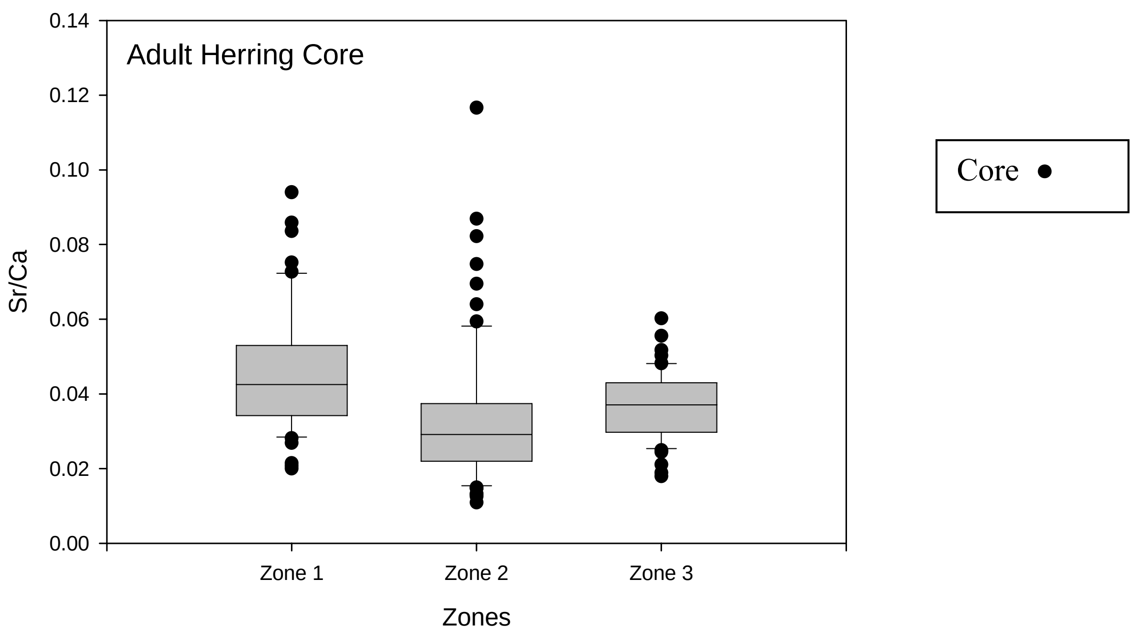


Figure 6. Sr/Ca chemistries of adult herring otolith cores from Zone I, Zone II and Zone III in Sitka Sound. ($p<0.001$)



E. Coordination and Collaboration with Other Efforts

Sitka Tribe of Alaska's project proposal complements the University of Alaska Fairbanks proposal, "Identification of essential habitat for Pacific herring (*Clupea pallasi*) in Prince William Sound i.e. source vs. sink habitat," submitted by Dr. Nate Bickford and Dr. Brenda Norcross. Dr. Nate Bickford will collaborate with Sitka Tribe on this project. Sitka Tribe of Alaska will coordinate a contract with the University of Alaska Fairbanks to conduct otolith microchemical analysis on the healthy herring population in Sitka Sound, using adult and juvenile herring to identify essential habitat. A comparison of Sitka's identified source and sink herring habitat will be compared to Prince William Sound's identified source and sink herring habitat.

III. SCHEDULE

A. Project Milestones

Objective 1. Analyze trace elements of edge and core portions of juvenile herring otoliths as indicator of nursery grounds and natal areas.
To be met by September 2007.

Objective 2. Analyze trace elements of edge and core portions of adult herring otoliths as indicator of spawning area.
To be met by September 2007.

Objective 3. Use otolith data to identify source and sink habitat in Sitka Sound.
To be met by March 2008.

Objective 4. Use the identification of source and sink habitat in Sitka Sound to compare with source and sink habitats in Prince William Sound.
To be met by May 2008.

B. Measurable Project Tasks

FY 07, 1st quarter (October 1, 2006 - December 31, 2006)

October 1:	Project funding approved by Trustee Council
October 31:	Begin planning juvenile herring otolith collection
December 1:	Collect juvenile herring otoliths during winter trawl

FY 07, 2nd quarter (January 1, 2007 - March 31, 2007)

March 1:	Finish winter trawl collection and otolith extraction
March 15:	Begin adult herring otolith collection
May 15:	Finish adult collection and otolith extraction

FY 07, 3rd quarter (April 1, 2007 - June 30, 2007)

April 1:	Begin analyzing edge portion of otoliths
April 1:	Begin analyzing core portions of otoliths

FY07, 4th quarter (July 1, 2007-September 30, 2007)

July 30:	Finish analyzing edge portion of otoliths

July 30: Finish analyzing core portions of otoliths
September 2-6: American Fisheries Society meeting in San Francisco

FY07, 1st quarter (October 1, 2007 – December 31, 2007)
October: Annual report for Trustee Council due
October 31: Visit Tribal Organization in PWS

FY07, 2nd quarter (January 1, 2008 – March 31, 2008)
January 23-27 Annual Marine Science Symposium
March 31: Preliminary draft report

FY07, 3rd quarter (April 1, 2008 – June 30, 2008)
June 30: Submit final report

IV. RESPONSIVENESS TO KEY TRUSTEE COUNCIL STRATEGIES

A. Community Involvement and Traditional Ecological Knowledge (TEK)

The Sitka Tribe biologist proposes to visit a community and/or Tribal organization in Prince William Sound by October 31, 2007 to share with them the research project and data collected in Sitka Sound, and how this information relates to herring in Prince William Sound. Sitka Tribe hopes to involve other interested Tribes in otolith microchemistry and fisheries research. The identification of essential herring habitat from this research would be available to PWS Tribes.

B. Resource Management Applications

By examining otoliths from adult herring, we can identify survival from egg through juvenile stages, and survival from juveniles to adults. Survivorship of juveniles is defined as successful transport of healthy larvae from specific spawning beaches to nursery grounds. By examining otoliths from a control population, such as the healthy and intact herring population located in Sitka Sound we will be able to determine what the natural source habitats are that recruit the most survivors into the biomass, and the connectivity between Pacific herring populations within Sitka Sound. We will find out what makes a healthy population of herring work. Thus we can apply this information to herring populations in Prince William Sound to assess why the herring have not rebounded since the 1989 *Exxon Valdez* oil spill. The identification of essential herring habitat from this research would be available to agency managers.

V. PUBLICATIONS AND REPORTS

Sitka Tribe of Alaska will report to the Exxon Valdez Oil Spill Trustee Council on the proposed research project in one annual report and one final report. The final report will reflect peer review comments. Sitka Tribe is also prepared to provide oral briefings of their findings to the Trustee Council.

VI. LITERATURE CITED

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Norcross, B. L., & Brown, E. D. (2001b). Estimation of First-Year Survival of Pacific Herring from a Review of Recent Stage-Specific Studies. Alaska Sea Grant College Program, AK-SG-01-04, 535-558.

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VII. RESUME OF PRINCIPAL INVESTIGATOR

Heather Meuret-Woody
Sitka Tribe of Alaska ▪ 456 Katlian Street ▪ Sitka, AK 99835 ▪ (907) 747-7501 ▪ email: hwoody@sitkatribe.org

Education
Sheldon Jackson College, Sitka, Alaska. **Bachelor of Science, Aquatic Resources**, December 1996. **Emphasis: Marine Biology**

- Grade Point Average: graduated with: **4.0**; in major: **3.32** (4.0=A)
- Graduated with a Bachelor of Science degree in three years

Scholarships and Honors: Dean's List (3 semesters), Java Loft Scholarship (1 year), Honor Roll (3 years), Academic Achievement Scholar, Advanced Placement credits (8): Biology I & II, Life Experience credits (3): Photography.

Professional Experience
Research Biologist, *Sitka Tribe of Alaska*, Sitka, Alaska, July 2004 to present. Conducting a three-year study, funded by the US Fish and Wildlife Service on the otoliths of sockeye salmon (*Oncorhynchus nerka*) and Pacific herring (*Clupea pallasi*). The otoliths will be analyzed for trace metals and stable isotope ratios of Oxygen 18 and Carbon 13. The goal of the sockeye salmon project will be to provide an otolith profile for four specific lakes located around Sitka that will serve as a natural chemical marker of the individual stocks, and to document the life histories of the stocks in both freshwater and marine phases of life. The goal of the herring project will be to identify differences between spawning grounds and spawning stocks in six specific areas in Sitka Sound. Authored two successful grants under this position, as well as writes technical papers and federal reports. Reviews Department of Natural Resources and US Army Corps of Engineers permit applications for the Sitka area. Staff support for several Tribal Committees. Also participates in: Environmental Impact Statement team for the Federal Flight Administration Sitka airport expansion project, Blue Lake hydro electric dam Federal Energy Regulatory Commission relicensing team, and WWII memorial site working group.

Department of Defense Lands Investigator, ***Sitka Tribe of Alaska***, Sitka, Alaska, December 2003 to July 2004. Investigated Formerly Used Defense Sites located in the Sitka Sound area to determine if the site was eligible for funding under the Department of Defense Native American Lands Environmental Mitigation Program. Position acted as a liaison for the Sitka Tribe of Alaska and the United States Army Corps of Engineers and the Department of Defense. Duties included: researching and investigating, writing and submitting Site Assessment Reports, federal reports, applying for funding through a grant process, developing a Strategic Project Implementation Plan, developing a Lead Communication Cable Removal Feasibility Plan, traveling, and attending meetings. Authored a successful cooperative agreement with the Department of Defense for the Sitka Tribe of Alaska to receive an additional two years of funding beginning in Fall 2004.

Trail Crew Coordinator, *Sitka Trail Works, Inc.*, Sitka, Alaska, April 2003 to October 2003. Recruited, trained, and supervised crews of volunteers and paid workers in trail maintenance, trail construction, and hikes. Staff photographer; documenting trail conditions and trail designs, and events. Helped construct the Sea Lion Cove trail across Kruzof Island. Designed databases, and assisted the Executive Director with grants, accounting, newsletters, schedules, community events.

Owner, *Spruce Islands Research and Development, L.L.C.*, Sitka, Alaska, June 2002 to present. Small research and development company that owns and operates a Southeast Alaska salmon power troller. Contractor for biological sampling, data collection, landscaping and trail construction, fisheries projects, and seafood processing. Hires up to 3 independent contractors for seasonal work during the year. The company recently started a local catering venue.

Fish Culturist and Research Assistant, *University of Alaska School of Fisheries and Ocean Sciences*, Little Port Walter, Alaska, October 1999 to December 2002. Remote National Marine Fisheries Service biological research station. As the Fish Culturist, I was responsible for all aspects of fish culture. Updated and prepared brood books and feed schedules. Reared Chinook salmon, steelhead, and pink salmon. Pit tagged and CWT all hatchery and wild fish. Collected data on Chinook fry and smolt, and steelhead adults and fry. Spawned steelhead and Chinook. Maintained experimental research technology, designed and maintained artificial habitats, and monitored fish health. Other duties included: daily notes, creating spreadsheets and data bases, processing biological samples, sampling yolk-sac percentages, recording water data, maintaining water systems, maintaining electric fences, fabrication of culture technology, retrieving and reading of CWT, recording and quantifying fish behavior in aquarium lab using *Observer* computer program. Operated Sashin Creek weir, included: enumerating wild stocks of out- migrating steelhead smolt, rainbow trout, Dolly Varden, and coho salmon; and enumerating returning runs of wild adult fish. Observed and quantified spawning behaviors of endangered steelhead in stream channels. Designed a computer-based fish culture program to generate feed data. Supervised and trained other employees and graduate students.

Fish and Wildlife Technician II, *Alaska Department of Fish and Game*, Sitka, Alaska, June 1998 to August 1999. CREEL Sampling for Division of Sport Fish. I implemented new ideas for acquiring data and taking data. I helped increase Sitka's sampling rate by 30% in first season, and 50% in second season. Also worked as an observer for the Chatham area commercial black cod fishery. Observed fish for clipped fins and ADF&G tags, counted total catch for each harvest, recorded data daily.

Fish Technician II, *Armstrong-Keta, Inc.*, Port Armstrong Hatchery, March-May, and September 1999.

Fish Technician, *Northern Southeast Regional Aquaculture Association*, Sitka, Alaska, September-October 1998.

Publications

Meuret-Woody, H. 2005. Tribal Wildlife Sockeye Salmon and Pacific Herring Otolith Research 2005 Field Season Report and Collection Site Maps. Sitka Tribe of Alaska.
Meuret-Woody, H. 2004. Phase I Site Assessment Report: Cape Burunof Defense Site,

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Meuret-Woody, H. 2004. Phase I Site Assessment Report: Sitka Naval Operating Base, FUDS No. F10AK0496. Sitka Tribe of Alaska.
Meuret-Woody, H. 2004. Strategic Project Implementation Plan for Department of Defense Environmental Mitigation. Sitka Tribe of Alaska.
Meuret-Woody, H. 2004. Lead Communication Cable Removal Feasibility Plan for Department of Defense. Sitka Tribe of Alaska.

Manuscripts in preparation

Meuret-Woody, H. and N. Bickford. Trace Element and Stable Isotope Analysis of Pacific Herring Otoliths. In preparation for submission to a fisheries journal.
Meuret-Woody, H. Stock Assessment of Salmon Lake Sockeye Salmon, 2004. In preparation for submission to US Fish and Wildlife Service Office of Subsistence Management.

Other projects

Thedinga, J. et al. 2005 Resistance of Naturally Spawned Pink Salmon Eggs to Mechanical Shock. Alaska Fisheries Research Bulletin 11 (1): 37-43. Field Technician for project, 2001.
Meuret, H. and B. Norcross. 1995. Juvenile recruitment of Pacific flatfishes and microhabitat partitioning. University of Alaska Anchorage, Anchorage, AK. Lead investigator for undergraduate project, 1995.

Presentations at Scientific Meetings

Meuret-Woody, H. and G. Bennett, Sr. Local Climate Changes Observed by Sitka Elders. American Fisheries Society, Alaska Chapter, Sitka, AK. September 2005.

Grants

Department of Defense- 2004-2006 Cooperative Agreement and Lead Communication Cable Removal $400,000 (author and former P.I.).
US Environmental Protection Agency- 2005-2007 Indian General Assistance Program, Coastal Monitoring Grant $220,000 (co-author).
US Fish and Wildlife Service- 2004-2006 Tribal Wildlife Grant, Sockeye Salmon and Pacific Herring Otolith Research Grant $250,000 (P.I.).
US Fish and Wildlife Service- 2006-2009 Tribal Wildlife Grant, Sockeye Salmon and Pacific Herring Otolith Research Grant $250,000 (author and P.I.) not funded.

VII. BUDGET JUSTIFICATION: $166.4K

The proposed budget for this research is for $166.4K for FY07, which includes $13.7K for the Trustee Council's General Administration (9% G&A). This includes one full-time biologist and the necessary equipment to perform the work plan, as well as contracting fees for analytical services and Sitka Tribal Administration. Sitka Tribe proposes to in-kind match $30.K for this research.

Personnel: $83.8K

The proposed budget of $83,800 includes one full-time biologist at $3,500 per month for 19 months, plus the associated fringe benefits at 26% ($17,290).

Travel: $3.0K

The proposed budget of $3,000 includes travel fees, hotel and per diem for: Sitka to Anchorage to attend the annual Marine Science Symposium in 2007, travel from Sitka to PWS to visit with community members and local Tribal organizations to discuss project.

Contractual: $25.K

The proposed budget includes a $25,000 contract between Sitka Tribe of Alaska and the University of Alaska Fairbanks to conduct microchemical analysis on herring otoliths and provide data interpretation. The contract fee includes the cost of supplies and equipment use. Each otolith costs $10 for microchemical analysis. A laboratory technician will be paid $15.82 per hour to process and prepare the otoliths for the analysis. This contract fee also covers the cost of a laboratory technician to prepare samples, and Dr. Nate Bickford's time to analyze samples and interpret data.

Commodities: $3.3K

The proposed budget includes $3,000 for sampling supplies, office supplies, postage, and boat operation expenses.

Equipment: $0.0K

No equipment will be purchased with this funding.

In-Kind Match: $30.K

The proposed budget includes an in-kind match of $30,000 provided by Sitka Tribe of Alaska. The in-kind match includes office space rent, the use and maintenance of two vessels for sample collection plus the vessel operator's time, YSI oceanographic equipment, hand held GPS unit, digital balance and calipers, field microscope, and other sampling and dissecting supplies. This match fund also includes the use of Arc View GIS 9.2 mapping software.

Indirect Costs: $51.3K ($37.6K Non-EVOS; $13.7K EVOS)

The proposed budget includes $37,600 of indirect costs. Sitka Tribe's current approved indirect cost rate is 32.7% for January 1, 2006 through December 31, 2006. Sitka Tribe's indirect rate is approved by the US Department of the Interior, National Business Center. Sitka Tribe's indirect costs are fax and phones, internet services, administrative supervision, and accounting services.

General Administration

The proposed budget includes 9%, or $13.7K to cover the costs of Trustee agencies through the Trustee Council's general administration.

VII. DATA MANAGEMENT AND QUALITY ASSURANCE/QUALITY CONTROL

This proposal seeks the support to start a study on Pacific herring. Chemical analyses of herring otoliths can be used to consider the effect the *Exxon Valdez* oil spill continues to have on the recovery of the herring population in PWS. Studying the regional elemental signatures within the core of the herring otolith enables researchers to identify the otolith chemical signature of individual rearing bays (Objective 1), and the edge of the otolith will identify spawning areas (Objective 2), and identify source and sink habitat in Sitka Sound (Objective 3) for comparison to source and sink habitat in PWS (Objective 4). With this otolith chemical data fishery managers will have the tools necessary to better predict recruitment and estimate herring spawning habitat recovery.

<u>1. Describe the study design, including sample type(s) and location requirements, all statistical analyses that were or will be used to estimate the types and numbers of physical samples required or equivalent information for studies using survey and interview techniques. Include a description of the metadata essential to interpretation of the results of your work.</u>

Using UnifyPow, a SAS module for sample-size analysis, the power test has shown that we will need to analyze the chemical signature of at least 25 herring otoliths from each area to have significant results. Statistical analysis will include analysis of variance (ANOVA α =0.05) to distinguish differences between the chemistries:

- Juvenile edge (nursery) vs. juvenile core (natal) if the signature is the same then the fish has not left spawning grounds.
- Juvenile core (natal) vs. juvenile core (natal) if the signature is the same then the fish were spawned in the same area.
- Juvenile edge (nursery) vs. adult area just outside the core (nursery) if the signature is the same then the adult used the same nursery habitat as the juvenile.
- Adult edge (spawning area) vs. adult core (natal) if the signature is the same then the adult returned to spawn in the same area it hatched in.
- Adult core (natal) vs. adult core (natal) if the signature is the same then the adults were hatched in the same area.

Linear discriminant analysis (LDA) explicitly attempts to model the difference between classes of data. The LDA results will distinguish geographically the distinct groups of herring and allow us to classify the individuals into groups (i.e., natal group, nursery group).

<u>2. Discuss criteria for determining acceptable data quality in terms of the activities to be performed or hypotheses to be tested.</u>

Data will be measured using a laser ablation (LA; New Wave UP 213nm Nd:YAG) inductively coupled plasma – mass spectrometry (ICP-MS; Agilent 7500c) in the Advanced Instrumentation Laboratory on the UAF campus. The analysis will be preformed on thin sections of otoliths on a transect extending from the core across to the otolith margin. All analyses will be calibrated using the external matrix-matched standard USGS MACS-1 (carbonate standard). Each sample measurement will be preceded by a gas blank measurement with re-calibration (gas blank and MACS-1) every 10 samples. Concentrations of all elements will be calculated relative to MACS-1 after proper correction for gas blank, matrix, and drift effects. Software used for analysis also contains QA/QC measures, which will halt analysis if data starts to drift.

3. Discuss the characteristics of the data that your project is going to be producing. Part (a) describes the production of a minimally compliant FGDC metadata record which needs to be submitted by all proposers. Part (b) is specific to projects producing quantitative data and provides specifications for categorizing quantitative data into one of three data groups: physical measurements, species-specific measurements, and taxonomic sampling.

(a) Copy of planned metadata file is attached.

(b) This project will collect chemical measurements and compare the data to previous work. The chemical measurements will consist of calcium, strontium, barium, magnesium, etc using inductively coupled plasma – mass spectrometry (ICP-MS; Agilent 7500c). Historic data will come from data used from previous publications by Norcross et al., 2001.

4. Define each algorithm to be used to convert signals from sensors to observations. Examples of algorithms of interest would be the conversion of pressure to depth and the conversion of integrated voltages to biomass at depth. When conversion algorithms are lengthy (i.e., computer programs) substitute a source location, such as an ftp site, for the full text. In the case of proprietary conversion algorithms, identify the proprietor and describe how the accuracy of conversion is verified under calibration (see #6 below).

No algorithms will be used in this project.

5. Describe the procedures for the handling and custody of samples, including sample collection, identification, preservation, transportation and storage.

All fish will consistently be collected, handled, and sampled in the same way throughout the herring season by Sitka Tribe's biologist. A random sample of 50 spawning adult fish from each sample area will be collected using a cast net. Because herring spawn along coastal shores, they are wadded up and easy to catch using a cast net thrown from a boat. All adult herring will be placed in 5-gallon buckets and transported to a processing station for biological sampling and otolith collection. All adult fish are lightly rinsed of excess debris and slime. Each individual adult fish is then wiped off using paper towel. The fish are identified as 1-50 according to date and sample site. The digital scale is wiped clean and zeroed before weighing each adult fish. All adult fish are placed on the Ohaus Scout Pro digital scale, weighed to the nearest .01 g, and then placed in a dissecting pan. All adult fish are then measured to the nearest .01 mm from the snout to the hypural plate using Tesa IP65 waterproof digital calipers. Two scales are then removed from the ADF&G Mark, Tag and Age Laboratory preferred area (located just below the dorsal fin) on the left side of the fish. Each scale is dipped in a diluted white glue mixture, and placed on a 2 x 3 inch glass slide, creating 2 sets of archived scales per fish. The slides are etched with the appropriate sampling information following ADF&G ADF&G Mark, Tag and Age Laboratory herring AWL sampling instructions. All scale slides are then stored in a slide case. Each adult fish is then sexed by cutting open the body cavity and visually inspecting. Usually the adult fish are actively spawning when they are captured so a visual inspection is necessary to determine if the fish had already spawned or not. Sagittal otoliths will be extracted from herring in a clean environment using standard techniques (Bickford et al., 2003; Campana, 1999; Campana, et al., 1995). Otolith pairs will then be removed from each adult fish by cutting the head off, slicing along the top of the brain cavity, removing the brain and exposing the otolith-containing cavities. Super fine point sterilized tweezers will be used for otolith removal. The otolith pairs will temporarily be placed in a 96-cell plastic tray with a lid. The otoliths are then rinsed and cleaned with distilled water, and placed in micro centrifuge tubes. Each tube is labeled with the fish identification number, date and collection site information. All adult herring otolith pairs will be sent to Dr. Nate Bickford at UAF for trace metal analysis.

All juvenile herring will be collected with several methods: seine, mid-water trawl, and jigging. The local ADF&G samples herring during the winter test fishery, and many juveniles are observed during this time. ADF&G contracts commercial boats to seine, jig and mid-water trawl for herring samples in January. Sitka Tribe plans on having access to the winter test fishery herring for sampling juvenile. A random sample of 50 juvenile herring from each sample area will be collected from the winter test fishery. The juvenile herring will be placed in 5-gallon buckets and transported to a processing station for biological sampling and otolith collection. All juvenile fish are lightly rinsed of excess debris and slime. Each individual juvenile fish is then wiped off using paper towel. The fish are identified as 1-50 according to date and sample site. The digital scale is wiped clean and zeroed before weighing each juvenile fish. All juvenile fish are placed on the Ohaus Scout Pro digital scale, weighed to the nearest .01 g, and then placed in a dissecting pan. All juvenile fish are then measured to the nearest .01 mm from the snout to the hypural plate using Tesa IP65 waterproof digital calipers. Two scales are then removed from the ADF&G Mark, Tag and Age Laboratory preferred area (located just below the dorsal fin) on the left side of the fish. Each scale is dipped in a diluted white glue mixture, and placed on a 2 x 3 inch glass slide, creating 2 sets of archived scales per fish. The slides are etched with the appropriate sampling information following ADF&G Mark, Tag and Age Laboratory herring AWL sampling instructions. All scale slides are then stored in a slide case. Because these are immature fish, they will not be sexed. Sagittal otoliths will be extracted from herring in a clean environment using standard techniques (Bickford et al., 2003; Campana, 1999; Campana, et al., 1995). Otolith pairs will then be removed from each juvenile fish by cutting the head off, slicing along the top of the brain cavity, removing the brain and exposing the otolith-containing cavities. Super fine point sterilized tweezers will be used for otolith removal. The otolith pairs will temporarily be placed in a 96-cell plastic tray with a lid. The otoliths are then rinsed and cleaned with distilled water, and placed in micro centrifuge tubes. Each tube is labeled with the fish identification number, date and collection site information. All juvenile herring otolith pairs will be sent to Dr. Nate Bickford at UAF for trace metal analysis.

A water sample will be collected at each site following the University of Alaska Fairbanks (UAF) Advanced Instrumentation Laboratory water sampling protocols: collect a surface sample of 250 ml in a plastic Nalgene bottle already prepared with an acid mixture. The bottles will be properly labeled, kept cold, and transferred to a refrigerator unit for storage. The water samples will be delivered to Dr. Nate Bickford at UAF for analysis and compared with the adult herring otoliths, as well as the juvenile herring otoliths.

Oceanographic data such as water temperature and salinity will be collected at 1 fathom, using a Yellow Springs Instrument 85 model and recorded. Collection sites will be recorded using a Garmin eTrex Legend GPS unit and downloaded into maps created in ArcMap GIS 9.2.

6. Describe the procedures that will be used in the calibration and performance evaluation of all analytical instrumentation and all methods of analysis to be used during the project.

The instrument must be calibrated before analysis of any samples with at least a blank and multiple standards. A Linear through zero curve type is used for all analytes. The calibration blank will be run as a blank, before the analysis of any actual calibration standards. MACS-1 will be used (Table D.1; Trace Elements in calcite) as an external standard to monitor precision. In addition, a calibration gas blank monitored the process and re-calibration will be done every 6 samples. Concentrations of all elements will be calculated from the calibration curve after proper correction for control blank, matrix and drift effects using the New Wave Glitter software. Based on measurements of MACS-1 the reported values will be better than 3% error for all elements of interest. The following isotopes will be monitored with isobaric correction equations built-into the analytical method as specified by EPA 200.8: $^{24,25,26}Mg$, ^{44}Ca, ^{55}Mn, $^{86,87,88}Sr$, $^{135,137,138}Ba$, and $^{235,238}U$. Whole element concentrations will be calculated based on calibrations and relative abundance of isotopes. In the case of multi-isotope elements the reported concentration represents an average of the measured concentrations calculated independently for each isotope. All multi-isotope concentrations will be within 1% of each other.

7. Discuss the procedures for data reduction and reporting, including a description of all statistical methods, with reference to any statistical software to be used, to make inferences and conclusions. Discuss any computer models to be designed or utilized with associated verification and validation techniques.

Using UnifyPow, a SAS module for sample-size analysis, my power test has shown that we will need to analyze the chemical signature of at least 25 herring otoliths from each area to have significant results. Statistical analysis will include analysis of variance (ANOVA α =0.05) to distinguish differences between the chemistries of the core and edges of the otoliths of juvenile herring at each site and among sites. Linear discriminant analysis (LDA) explicitly attempts to model the difference between classes of data. The LDA results will distinguish geographically the distinct groups of herring and allow us to classify the individuals into groups (i.e., natal group, nursery group).

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Once herring hatch and the larvae drift to retention areas, they begin metamorphosis. As juveniles, herring forage in productive waters of the North Pacific. Adult herring then return to natal beaches to spawn. What is unknown is where the herring go and if certain regions contribute more to the spawning population. Once we know which population contributes more to the spawning groups, we can then identify those variables that enhance the life histories of the source population. We can identify these groups and track their movements using otolith chemistry. The adult herring that return to spawn are the survivors. If most of the survivors come from a distinct population, then we need to know which population survive and why. This will allow managers to protect the most important populations and also identify those environmental variables needed to enhance other populations</abstract>
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2007 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2006 - June 30, 2008

Budget Category:		Authorized FY 2006	Proposed FY 2007						
Personnel			$83.8						
Travel			$3.0						
Contractual			$25.0						
Commodities			$3.3						
Equipment			$0.0						
Subtotal		$0.0	$115.1						
Indirect	32.7%		$37.6						
Project Total w/o G&A			$152.7						
EVOS 9% G&A			$13.7						
Project Total w/G&A			$166.4						
Full-time Equivalents (FTE)			1.6						
		Dollar amounts are shown in thousands of dollars.							
Other Resources			$30.0						

Comments:

Travel has been removed in the amount of $1,700 in the proposal review processes for the trip to the American Fisheries Society Annual Meeting in San Francisco. Links were fixed on this summary page, as well as the percentage of indirect, thus resulting in an increase to this proposal.

Sitka Tribe proposes to in-kind match $30K in funding using existing equipment and current STA staff to accomplish work plan.
Sitka Tribe of Alaska's current approved Indirect Rate is 32.7% for 01/01/2006 through 12/31/2006.
Personnel costs includes the salary of one full-time biologist for 19 months, plus 26% for associated fringe benefits.
Project total is $145.9K plus 9% of total project direct expenses for Trustee Council general administration.

FY07

Prepared:
July, 2006

Project Number: 070834
Project Title: Identification of essential habitat for Pacific herring (*Clupea pallasii*) in Sitka Sound for comparison to PWS
Name: Sitka Tribe of Alaska

2007 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2006 - June 30, 2008

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 2007
Heather Meuret-Woody	PI, Research Biologist		19.0	4410.0		83.8
						0.0
						0.0
						0.0
	$37.64					0.0
	29.8					0.0
	$7.84					0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		19.0	4410.0	0.0	
					Personnel Total	$83.8

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2007
Marine Science Symposium- Anchorage 2007	650.0	1	5	180.0	1.6
Prince William Sound Tribal Organization- PWS 2007	700.0	1	4	170.0	1.4
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$3.0

FY07

Prepared:
July, 2006

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2007 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2006 - June 30, 2008

Contractual Costs:	Proposed
Description	FY 2007
Herring otolith trace element analysis at Advanced Instrumentation Laboratory University of Alaska Fairbanks	25.0
Contractual Total	$25.0

Commodities Costs:	Proposed
Description	FY 2007
Outboard fuel, oil and maintenance expenses	2.0
Postage	0.4
Office supplies	0.2
Water bottles for samples (1 case)	0.1
Batteries for sampling equipment (AA, 3V)	0.1
Cast net	0.1
Scalpel blades sterile (1 pack)	0.1
Latex gloves (1 box)	0.1
Micro tubes for otolith storage	0.1
Slide holder box	0.1
Commodities Total	$3.3

FY07

Prepared:
July, 2006

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2007 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2006 - June 30, 2008

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2007
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	
24' aluminum boat with 90 hp outboard	1	
36' fiberglass seine boat	1	
YSI oceanographic instrument	1	
Sampling and dissecting equipment	1	
Arc View GIS 9.2 mapping software	1	
Garmin Etrex GPS unit	1	
Ohaus Scout Pro balance	1	
Tesa-Cal electronic digital calipers	1	
Field microscope	1	
Diamond scribe pen with refills	1	
3 x 2" Micro slides (pack of 72)	2	

FY07

Prepared:
Jul-06

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