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Kodiak Archipelago Youth Area Watch

Project Number:	02610
Restoration Category:	General Restoration
Proposer:	Kodiak Island Borough School District
Lead Trustee Agency:	ADFG
Cooperating Agency:	Kodiak Island Borough School District
Alaska SeaLife Center:	Yes
Duration:	3rd year, 3-year project
Cost FY 02:	$119.9 (project cost) + $8.4 (ADF&G GA) = $128.3 (total)
Cost FY 03:	$53.9
Geographic Area:	Kodiak Archipelago
Injured Resources/Services:	Harbor seals, sub-tidal and inter-tidal communities, subsistence, and commercial fisheries

ABSTRACT

The Kodiak Archipelago Youth Area Watch will engage students in projects with goals aligned with the general restoration efforts of the Trustee Council. Students and site coordinators will conduct interviews with local experts and document TEK, publishing it in a District oral history magazine. Participation of KAYAW adults and students in the annual Academy of Elders/Science Camp will be strongly recommended. Such participation will serve as another avenue for more tribal members to learn about restoration efforts, scientific monitoring techniques, and occupations related to such work. The value and implications of TEK will be strongly emphasized throughout the implementation of the KAYAW project.

INTRODUCTION

In FY 99, Chugach Regional Resources Commission collaborated with the Kodiak Island Borough School District to institute an internship program within the Community Involvement Project. This internship program chose one student in the communities of Akhiok, Larsen Bay, Old Harbor, Kodiak and Ouzinkie. In FY 00 this project was expanded to develop the Kodiak Archipelago Youth Area Watch Program. The program collaborated with four research projects in FY 00, including EVOS-sponsored 00482, PSP Field Testing Kit; EVOS-sponsored 00245, Harbor Seal Bio-Sampling; intensive monitoring with the Fisheries Industrial Technology Center and National Oceanic and Atmospheric Administration; and an algae testing project with Dr. Gerry Plumley.

During FY 01 the project included the expansion into two additional communities, Chiniak and Port Lions; site teacher training in collaboration with the Kodiak College; the construction of a web site for students, teachers, administrators, and project scientists to collaborate, share, and coordinate projects, as well as post data; additional equipment for monitoring activities; and, participation by students, teachers and scientists in the annual Science Camp held at Afognak.
All these steps will continue the project in the direction of student oceanographic monitoring in collaboration with the Fisheries Industrial Technology Center, continued beach monitoring for PSP and algal blooms, harbor seal bio-sampling, and hands-on training for a select number of students within the Kodiak Island Borough School District with western scientific knowledge and traditional ecological ways of knowing. A project with the National Marine Fisheries Service to investigate the presence of sandlance and capelin has been integrated as well.
The Youth Area Watch program instituted in the Prince William Sound and lower Cook Inlet has been one of the most popular and supported projects that the Trustee Council has implemented. The spill area does not strictly include only those areas; it also encompasses the Kodiak Archipelago and the Alaska Peninsula.

During the spring of 1998 Kodiak Island Borough School District personnel and the Chugach Regional Resources Commission personnel began to discuss the development of the Kodiak Youth Area Watch. In September 1998 CRRC was funded through the EVOS Trustee Council to implement the KYAW project. The KIBSD and the CRRC later signed a Memorandum of Agreement.

In January 1999 KYAW applications were sent to all eight communities in the Kodiak archipelago to prompt student, teacher, and community participation. The village of Larsen Bay had one intern, the village of Karluk had one intern and one alternate, the village of Old Harbor had one intern and one alternate, and the village of Akhiok had one intern. Each of the six student interns researched, locally, the effect of the 1989 oil spill in their village by interviewing elders and other community members. Students also participated in the 10^{th} year Symposium held in March 1999 where they reported on the status of their research activities within the KYAW Program.

During the remainder of the spring of 1999, CRRC and KIBSD personnel researched possible projects for the KYAW and sought to increase the number of students participating. CRRC later

submitted a proposal to continue the KYAW for FY 00. Once the proposal was approved, CRRC and the KIBSD signed a Memorandum of Agreement.

In FY 00, the KIBSD and CRRC were successful with implementing four core research projects, two of which were funded by the Trustee Council. These projects included 1) 00482, Field-Testing of PSP Test Kits for Subsistence Use; 2) 00245, Harbor Seal Bio-sampling, will train and involve KYAW participants in the program. They were trained in how to conduct a bio-sample, where to ship the sample, and what the uses of the seal are for research: 3) Dr. Gerry Plumley, University of Alaska-Fairbanks, received funding from the Alaska Science and Technology Foundation to test algae for a possible connection to the infection of PSP to shellfish. He has involved KYAW participants in FY 00 and will continue to utilize them in FY 01; and 4) the Fisheries Industrial Technology Center and National Oceanic and Atmospheric Administration have been working closely with the program to develop and implement a long-term, consistent monitoring program that will focus on salinity, water temperature, and a host of other oceanographic indicators. Comprehensive monitoring kits were purchased for the participants in each of the communities to use.

Increased involvement by students, teachers and community members was realized during the 1999-2000 school year to include: four students from Ouzinkie, one teacher and one community member; two students from Old Harbor, one teacher, and several community members; two students from Larsen Bay, one teacher, and one community member; two students from Kodiak, and one teacher; and two community members from Akhiok. Total involvement for 1999-2000 school year included ten students, four teachers, and over five community members.

During the 1999-2000 school year many KAYAW project activities took place. In the fall of 1999 a KAYAW orientation meeting took place in Kodiak to connect the District teachers with the scientists and their projects. During the Kodiak Island Borough School District Rural School's Science Fair the community members from Akhiok performed seal bio sampling with seals that had been harvested for a community dinner. A number of students from throughout the region, as well as their teachers, were exposed to the data collection and purpose of this project. Orders were taken to purchase equipment for the students to use. This was done through the recommendations given by the scientists, and coordinated by Brian Himelbloom and Bob Pfutzenreuter of University of Alaska-Fairbanks and the Fisheries Industrial Technology Center located in Kodiak. In December another meeting was held to further the development and organization of the KAYAW.

In 2000 a student/teacher orientation meeting took place to train participations in the use of the equipment and process data collection and reporting. Old Harbor School began to redesign their High School Science studies in order to integrate the KAYAW into their general requirements. During the 2000-01 school year the teachers plan to focus more of their curriculum on marine studies school-wide. Students began to collect data pertaining to ocean water temperature, presence of algae, general weather conditions, marine mammal sightings, and seal bio sampling. Students also began research regarding PSP and its presence in the Kodiak waters. In June of 2000 another training session took place that introduced participants to the collection of samples and use of the PSP testing kit created by Jellet Biotek.

During FY 01 we continued the efforts of the previous years of this program. The Alaska Native Harbor Seal Commission, through 01245, Harbor Seal Bio-sampling continued to support the program through bio-sample training in Old Harbor and Kodiak and included students and hunters from throughout the region. The Fisheries Industrial Technology Center and National Oceanic and Atmospheric Administration, and the National Marine Fisheries Service continue to collaborate with the project and students to collect oceanographic monitoring data. This information will be used to assist the Trustee Council with the Gulf Ecosystem Monitoring Plan. Data collected through this program will fill a hole of oceanographic information that will be necessary for the formation of a 100-year data set. Continued work with 01482, Field-Testing of PSP Test Kits for Subsistence Use was achieved in FY01 regarding beach monitoring and chronic PSP site identification. Students have begun to work on mapping traditional use areas, which include Sugtestun terminology. The Chiniak site is working to determine the presence and abundance of sandlance and capelin along some Chiniak Bay beaches, as well.

In addition, students and site coordinators selected local projects to conduct and expand. Connections to traditional knowledge with integration of TEK data were made to enhance project reports and individual projects. Individual projects were developed and many were entered into the Kodiak Regional Rural Science Fair that is coordinated with the Alaska Rural Systemic Initiative with support from the Alaska Federation of Natives. Teri Schneider, Alutiiq Studies Coordinator for KIBSD and Aleut Regional Coordinator for AKRSI is very interested in pursuing this continued integration. It has proven to be a factor to motivate students to pursue individual or small group investigations that make sense to where and how they live. Student projects were expected to be presented at the March 2001 TEK Conference and CRRC Annual Gathering, but because of a conflict with scheduling, KAYAW students were unable to attend. Students will report their projects directly to the tribal council in their community. A number of KAYAW students, however, presented their projects to local and regional Elders and western science judges during the Kodiak Regional Science Fair. Five of our students, including three who were working with the PSP testing, won honors to present their projects at the Alaska Native Science and Engineering Society's Statewide Science Fair and the Alaska Science and Engineering Science Fair.

NEED FOR PROJECT

A. Statement of Problem

Kodiak Archipelago Youth Area Watch shares much of the same values and objectives as the original Youth Area Watch in the Chugach region. The KAYAW participants are committed to assisting in the restoration of the spill area through the collection and requisite samples and data for principal investigators of research projects. Research dollars are often scarce – the assistance of labor through this project to the four core projects is an invaluable asset to the overall restoration effort.

The public aspect of this is also invaluable to the Trustee Council. Youth involved in science, especially Alaska Natives, has been difficult to achieve in many cases. This project gives students hands-on experience and an avenue to achieve goals that may have once seemed impossible. The Youth Area Watch projects have received tremendous support throughout the

spill area and beyond and the benefits of this project are felt in many different arenas. The Trustee Council would be supporting a win-win situation by funding this project again.

It is not sufficient for our KAYAW to wait for interested scientists to ask for help from the students, as has happened to some extent in Prince William Sound. Instead, the KAYAW will begin to create some of its own activities, building upon the special projects that some sites have already begun in previous years. Because they can't guarantee if or when outside scientists might become interested in the product of their efforts, students and site coordinators will begin to focus on addressing local interests and concerns. This will also help to build local support and give the students a sense of contributing to something substantive immediately, rather than just completing homework assignments and filing monitoring information for possible future use.

Given the need to have the tribes involved in GEM and in work related to documenting, learning and applying traditional knowledge, the KAYAW coordinator, site coordinators and student participants will organize a joint workshop with the tribes and the school district to outline a long term KAYAW program that draws upon traditional knowledge to develop a local environmental assessment and monitoring program. There are great resources among the students, the teachers, school district staff, and the Elders. Bringing them together on a collaborative project that focuses on the ecology, natural history and cultural perspectives of each could accomplish great things.

This work will begin with a traditional and scientific inventory of the local ecosystems around each community. The students will interview Elders, read scientific publications, and describe what exists in their area. The description will include species, how they interact, how they are affected by the physical environment, how humans have and could use them, what impacts those uses would have, and where and when the species is particularly sensitive. A thorough inventory will take the form of a series of reports on various species or areas, and together the series would make a natural history encyclopedia of the region. These reports can be integrated into the student-developed website that each community has already established. Additional communication will be enhanced through a monthly KAYAW newsletter that will be disseminated throughout the region. By understanding how the local system works from the local perspective, the community will then be able to design a monitoring program that looks at parameters they find relevant to their interests and observations.

Such a program will take some time to set up and get going, but will be well worth the effort, capitalizing on the opportunity that exists in Kodiak by giving some structure to the enthusiasm that persists for KAYAW.

B. Rationale/Link to Restoration

The Kodiak Archipelago Youth Area Watch will work in primarily three areas. First, harbor seals disastrously affected by the oil spill are being studied under 02245. KAYAW participants would assist in this recovery effort of the Alaska Native Harbor Seal Commission and Trustee Council. Secondly, the enhancement of safe shellfish to eat would benefit the use of subsistence greatly; consequently, assisting in the recovery of the subsistence service by providing a

replacement subsistence resource for harvesters. The field test and algae project both will assist in making shellfish safer for everyone. Finally, the Fisheries Industrial Technology Center, the National Marine Fisheries Service, and the National Oceanic and Atmospheric Administration have ongoing oceanographic monitoring that is being done with KAYAW students. The eagerness of these organizations has been confirmed through their commitment in the development of the current monitoring data into a long-term KAYAW project.

The public/youth involvement through this project in the restoration process will assist the Trustee Council in their mission to inform and involve the public regarding the restoration program. A more direct line of communication between the Trustee Council and the Kodiak Archipelago communities will be established through the gathering, the newsletter and the website.

C. Location

Kodiak Archipelago Youth Area Watch will take place in the Kodiak Island communities of Akhiok, Old Harbor, Port Lions, Ouzinkie, Chiniak, and Kodiak (Larsen Bay and/or Karluk may participate depending upon fluctuating student enrollment.) Site coordinators and students will be continually trained through the school district, Kodiak College, the Fisheries Industrial Technology Center, the National Marine Fisheries Service, the Alaska Native Harbor Seal Commission, and the National Oceanic and Atmospheric Administration, and as other opportunities present themselves with visits to our island communities from the many scientists that travel there. Teri Schneider will serve as the coordinator and principal investigator for the program for the school district, with outreach to tribal councils through the Kodiak Archipelago. Additionally, traditional ecological knowledge will be integrated into the program with the assistance of TEK Specialist, Dr. Henry Huntington.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

In addition to assisting in research, community involvement and the utilization of traditional ecological knowledge are at the heart of this program. Tribal councils, schools, communities, regional organizations, and researchers will all be collaborating to ensure that this project is a success. KIBSD will work closely to ensure that each of the tribal councils where there are KAYAW participants will have a voice in the research and curriculum of the program. Cooperation and communication will be enhanced between the Principal Investigator and Kodiak area community facilitator, Paul Panamarioff. Traditional ecological knowledge will be integrated into the projects that students and communities design and collaborating researchers will be encouraged to utilize TEK on their particular projects. As KIBSD resurrects the oral history magazine, *Iluani*, it will become an additional avenue to communicate the importance and application of local knowledge with regards to the environment and natural resources. Highlights from Elder interviews will also be featured in the monthly KAYAW newsletter and the already established weekly Kodiak Daily Mirror feature developed by the Native Educators group, "Sugtestun Voice."

PROJECT DESIGN

A. Objectives

Selected students in the identified communities will participate in the project to accomplish the following objectives:

1. Communicate KAYAW activities to each site, local agencies, and tribal councils.
2. Identify all research and data collection activities.
3. Orient researchers on working with students.
4. Conduct research with the four projects with cooperating scientists.
5. Purchase additional monitoring and research equipment for expansion and maintenance of area-wide monitoring, as needed.
6. Complete site teacher training in cooperation with the Kodiak College, the Fisheries Industrial Technology Center, the National Marine Fisheries Service, and the Alaska Native Harbor Seal Commission regarding science monitoring, research, and traditional ecological knowledge.
7. Conduct school orientations for KAYAW students.
8. Maintain the Kodiak Archipelago Youth Area Watch web site to store data, provide information regarding all activities, and coordinate efforts of staff, students, researchers, and community members.
9. Involve KAYAW students, scientists and Elders in the annual Science Camp to be held in July and August of 2002.
10. Complete student project training with tribal council and site teacher.
11. Facilitate project follow-up training with site teachers.
12. Organize and host an annual workshop with the tribes and the school district to outline a long term KAYAW program that draws upon traditional knowledge to develop a local environmental assessment and monitoring program.
13. Conduct interviews with Elders and community members with regards to developing a traditional and scientific inventory of the local ecosystems around each community.
14. Host scientific researchers to present findings, research, and their understandings of the Kodiak Archipelago to school and tribal communities.
15. Continue KAYAW efforts throughout the summer months when school is not in session.
16. Identify and develop individual and small group student research projects that are relevant to their community.

B. METHODS

The Kodiak Island Borough School District's Alutiiq Studies Coordinator will communicate directly with tribal councils throughout the island to ensure their meaningful involvement in the project. Researchers involved will sign agreements to ensure their follow-through to involve the youth in their projects.

Teri Schneider, Alutiiq Studies Coordinator and support staff of the Kodiak Island Borough School District will work cooperatively to plan the involvement and logistics of youth, tribal

councils and researchers fieldwork. Additionally, training will take place with all involved parties to ensure that this project will work for everyone.

We have selected methods to choose students based on academic standing, personal interest, and potential for improvement. Approximately 50 students will be participating in the third year of the project. While distribution varies according to interest and ability of students that apply, it is expected that the distribution will be as follows: 14 from Old Harbor, 14 from Ouzinkie, 2 from Larsen Bay and Karluk, 12 from Port Lions, 2 from Chiniak, 2 from Akhiok, and 4 from Kodiak. Fourteen of these students will be designated as interns. These students will be the primary ones to travel to special events and will be the 'leaders' of the projects. The rest of the students will participate to a lesser degree but will be actively involved in the local implementation of the projects. The communities with a large number of students participating have chosen to integrate the KAYAW Project into their science curriculum, allowing all high school and/or middle school students to participate in either all, or part of the projects.

Early in the school year, participating KAYAW teachers will congregate in Kodiak to conduct a two-day training on what the program will encompass. We will ask that researchers attend as well. Protocols from principal investigators and program details will be discussed. In addition to the site teachers, we will invite tribal council representatives.

All of the coordinating projects, field test PSP kit, algae testing, bio-sampling, and oceanographic monitoring will take place geographically close to the participant's communities. It will be the responsibility of the site teacher and participants to determine field schedules. Harbor seal bio-sampling will require two training sessions and coordination with local seal harvesters. The oceanographic monitoring project will require coordinated efforts on contracted vessels and such. This will be negotiated between the individual licensed boat operators and KIBSD. Schedules will be determined when appropriate. Quarterly, students and support staff will congregate via audio-conference or in person in a chosen community to discuss progress, brainstorm ideas, and evaluate the program. Written reports describing the students' activities and the progress of the program will be submitted to EVOS quarterly. Training will be on going and project objectives will be met.

Ongoing projects will include:

1. PSP Field Testing, 02482 – Jellet Biotek – Dr. Jellet and Dr. Roberts are selecting sites throughout the spill area to field test their PSP testing kit to be used in place of the existing mouse bioassay. Students in the program will continue to do beach monitoring to determine patterns, high-risk beaches, and precautions to consider when harvesting shellfish. Also, information collected may be used to develop local aquaculture programs that would supply jobs and boost the economy in the villages.
2. Harbor Seal Bio-sampling, 02245 – Alaska Native Harbor Seal Commission – KYAW will work with local harvesters involved in the program to bio-sample harbor seals caught for subsistence purposes. Mitch Simeonoff, Akhiok, will work with CRRC and the school district to train and involve students.

3. Algal PSP Testing – Dr. Gerry Plumley – University of Alaska Fairbanks – Dr. Plumley will train students in how to test algae in their area for algal PSP infection. This project will provide data to Dr. Plumley regarding where PSP originates.
4. Fisheries Industrial Technical Center and National Oceanographic and Atmospheric Administration - This will involve utilizing the monitoring kits we have acquired in establishing and continuing a long-term oceanographic monitoring program. Indicators to be monitored will include ocean temperature, salinity, alkalinity, tides, and other information as it pertains to the project.

In addition to these four core projects, students will work with their tribal council or local site teacher to identify a local research project to implement that is achievable. We will encourage the tribal councils to identify an area of TEK that may be of interest and integrate that with western science methods. TEK Specialist Henry Huntington will be called upon to assist in this effort.

The participation of the students in the annual Science Camp will be an additional component of this year's program. The annual Science Camp is an opportunity for students, teachers and community members from across the Island to learn from Elders and other culture bearers how traditional ways of knowing can be incorporated into western science. This camp will allow students to present their work to the other camp participants, educating and enlarging the support and momentum of the project. The Science Camp will be an opportunity for youth to recap that activities of the year and plan for the coming year. The KAYAW student participants will have the opportunity to provide some introductory training while showcasing their skills in water monitoring, seal bio-sampling and traditional observational skills to younger students and interested community members.

The development of a web site that will be integrated into the Kodiak Island Borough School District will be maintained, as well. The Kodiak School District's Technology staff will work with project staff to continue construction and maintenance of the site. The formation of this web site is seen as a necessary step to bring the program to a new level of communication, coordination, and information transfer. There will be links created between this site and each of the community's websites. The KAYAW website will continue to be a place to post oceanographic data, PSP and algae data and results, capelin and sandlance presence, and harbor seal bio-sample information, as well as appropriate TEK.

School credit for the youth involvement in this project is strongly encouraged. High school juniors and seniors are strongly encouraged to integrate a KAYAW project into their junior or senior project. Other school credit may be earned in integrated math, science, technology, Alutiiq studies, social studies, or language arts. This will encourage even more participation and give credibility to the project among site teachers and students who are thinking about applying to the project. Students and site coordinators will be contracted to continue their work when school is not in session to guarantee the continuity of their monitoring and documenting efforts.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

The Kodiak Island Borough School District will serve as the administering agency for this project. The KIBSD and the Chugach Regional Resources Commission have worked together in past years to begin the KAYAW. KIBSD, however, is confident that proposing directly to EVOS will help to streamline our efforts and alleviate communication challenges that have existed in previous years. KIBSD will work hard to coordinate and collaborate with tribal councils, site coordinators, researchers, and students on the successful implementation of the project.

Partnerships with the Fisheries Industrial Technology Center, the National Marine Fisheries Service, and the National Oceanographic and Atmospheric Administration will continue to perpetuate the marine mammal monitoring and ocean-monitoring components of the project. Staff from each of these organizations has already integrated our KAYAW students into their research and outreach component of their programs.

Henry Huntington will be contracted to consult with the KAYAW coordinator and provide training to KAYAW students and tribal councils in the skills needed to conduct TEK investigations.

Individuals with 6-pack licenses may be contracted to provide transportation to remote sites in the monitoring and documentation processes.

SCHEDULE

A. Measurable Project Tasks for FY 02 (October 1, 2001 - September 30, 2002)

October 15:	Confirm research and data collection activities
October 31:	Site teacher, tribal, and researcher orientation
October 31:	Monthly newsletter is developed and distributed
November 15:	Students selected and preliminary site research plan is developed
November 31:	Individual or small group projects submitted to regional science fair
December 15:	School site orientations
December 15:	Student orientation and training
May 15:	Regional workshop is conducted
May 15:	Summer plans for continued work by students and site coordinators are submitted to Principal Investigator
May 25:	Students and site coordinators for summer work to be completed sign Contracts
July 15 - August 15:	Students, site coordinators and researchers participate in Science Camp

On-going activities will include:

October 1 - September 30:	Students collect shellfish samples and conduct field-testing
October 1 - September 30:	Students analyze algae

October 1 - September 30:	Students conduct harbor seal bio-samples
October 1 - September 30:	Students conduct their local research project

B. Project Milestones and Endpoints

Ongoing:	Communicate KAYAW activities to each site, local participating agencies, and tribal councils.
October 1:	Identify all research and data collection activities.
Annually and as needed:	Orient researchers on working with students.
Ongoing:	Conduct research with the four projects.
Annually:	Purchase additional monitoring and research equipment for expansion of area-wide monitoring, as well as replacing consumable materials, such as test strips.
Biannually:	Complete site teacher training in cooperation with the Kodiak College, the Fisheries Industrial Technology Center, the National Marine Fisheries Service, and the Alaska Native Harbor Seal Commission regarding science monitoring, research, and traditional ecological knowledge.
Annually:	Conduct school orientations for KAYAW students.
Ongoing:	Maintain the Kodiak Archipelago Youth Area Watch web site to store data, provide information regarding all activities, and coordinate efforts of staff, students, researchers, and community members.
Annually:	Involve KAYAW students, local scientists and knowledgeable Elders in the annual Academy of Elders/Science Camp to be held annually in July and August.
Annually:	Conduct student project trainings with tribal council and site teacher.
Annually:	Facilitate project follow-up training with site teachers.
Annually:	Organize and host a joint workshop with the tribes and the school district to outline a long term KAYAW program that draws upon traditional knowledge to develop a local environmental assessment and monitoring program.
Biannually:	Conduct interviews with Elders and community members with regards to developing a traditional and scientific inventory of the local ecosystems around each community.
Ongoing:	Host scientific researchers to present findings, research, and their understandings of the Kodiak Archipelago to school and tribal communities.

C. Completion Date

Objectives identified in the project design will serve as guidelines for community involvement within the civil settlement throughout the life of the restoration effort. It is expected that the KAYAW will be completed upon termination of the restoration and monitoring effort.

PUBLICATIONS AND REPORTS

Project reports that will include a description of student activities and the progress of the program will be submitted to EVOS quarterly.

PROFESSIONAL CONFERENCES

Concentration of presenting project progress and results will be done locally in conjunction with gatherings pertaining to training opportunities and during the annual workshop in Kodiak.

NORMAL AGENCY MANAGEMENT

Not applicable.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will work closely with the Community Involvement and GEM Planning Project (02052) and the Harbor Seal Biosampling Project (02245). If funded, this project will work closely with PSP Field Testing (02482).

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

Many changes have been made in this DPD as compared to the previously funded DPD primarily in response to peer reviewer comments and lead agency suggestions. Reorganization of the KAYAW has been suggested to make it more efficient and effective. One full-time certified teacher would have one half of her duties specifically dedicated to the coordination and implementation of the project. The other half of this staff person's duties correlated well with the overall objectives and goals of KAYAW. The need for better island-wide communication will be met with a monthly newsletter that will be distributed through the region. Site coordinators and student participants will be contracted for their continued services through the summer months when school is not in session so that continuity of monitoring and communication will not be broken. The KAYAW students and adult participants will host an annual gathering focusing on TEK documentation and ecological assessments of each community of the Kodiak Archipelago. Publication and distribution of TEK documentation will be integrated into the KIBSD oral history magazine that is bi-annually distributed. Henry Huntington will continue his involvement as a TEK consultant, providing training for students and KAYAW tribes.

PROPOSED PRINCIPAL INVESTIGATOR

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PRINCIPAL INVESTIGATOR

Teri Schneider is the Alutiiq Studies Coordinator for the Kodiak Island Borough School District and the Aleut Regional Coordinator for the Alaska Rural Systemic Initiative. Teri has been in this position since 1997. She works closely with all KIBSD Native and rural educational programs and projects and many AKRSI statewide and regional educational projects with goals to integrate Native Ways of Knowing into the public school system. Teri, an Alaskan Certificated Educator, is a member and the advisor/coordinator of the Native Educators of the Alutiiq Region, a professional organization that works closely with the Alutiiq Elders Council to implement Native educational initiatives. She has experience in project development and administration, tribal relations, and managing budgets. Ms. Schneider will be responsible for all expenditures, contracts, and project management duties that are approved by KIBSD administrative staff.

OTHER KEY PERSONNEL

1. Katie Lyons, Administrative Assistant for KIBSD, will assist with logistical arrangements and communications.
2. Marie Barni, KIBSD Educational Support Services Administrator, will provide administrative oversight and guidance. She has extensive experience in developing and managing budgets.
3. Carla Lam, KIBSD part time Environmental Education Coordinator and Certificated Secondary Science Teacher will assist the Principal Investigator and site coordinators with student research and project design. Ms. Lam will also work to integrate aspects of the KAYAW research and procedures into the existing KIBSD science curriculum, which will eventually help to define how we "do" science education in our district.
4. Eric Waltenbaugh, KIBSD Itinerant Curriculum Specialist, will assist the Principal Investigator and site coordinators in the gathering reporting of TEK through his continued development of the oral history magazine, "Iluani."
5. Teachers from each of the KAYAW sites will fill the role as site coordinators. They are actively involved in building KAYAW into the school's curriculum while providing organization and communication for such activities in each of their communities.

FY 02 *EXXON VALDEZ* TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2001 - September 30, 2002

Budget Category:	Authorized FY 2001	Proposed FY 2002	LONG RANGE FUNDING REQUIREMENTS					
Personnel		$0.0						
Travel		$0.0						
Contractual		$119.9						
Commodities		$0.0						
Equipment		$0.0						
Subtotal	$0.0	$119.9	Estimated FY 2003					
General Administration		$8.4						
Project Total	$0.0	$128.3	$53.9					
Full-time Equivalents (FTE)		0.5						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

FY02

Prepared:

Project Number: 02610
Project Title: Kodiak Archipelago Youth Area Watch
Name: Kodiak Island Borough School District
Agency: ADF&G

FORM 3A
TRUSTEE
AGENCY
SUMMARY

FY 02 *EXXON VALDEZ* TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2001 - September 30, 2002

Budget Category:	Authorized FY 2001	Proposed FY 2002
Personnel		$33.9
Travel		$49.6
Contractual	$57.8	$31.0
Commodities		$1.0
Equipment		$4.4
Subtotal	$57.8	$119.9
Indirect	$4.0	
Project Total	$61.8	$119.9
Full-time Equivalents (FTE)		0.5
Other Resources		$78.9

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2003					
$53.9					
$78.9					

Dollar amounts are shown in thousands of dollars.

Comments:

*No indirect costs will be taken by the Kodiak Island Borough School District. Administrative oversight, secretarial support and general grants management will be absorbed as cost sharing contributions to this project. Total cost sharing contributions from KIBSD include 0.5 certified staff, facilities and utilities, miscellaneous commodities, site coordinator costs, additional costs for the coordination of the Science Camp, and expertise from the Native Educators organization and the Academy of Elders.

*Costs for the Principal Investigator to attend the annual restoration workshop is estimated at $700.00.

*Reorganization of the KAYAW is necessary to make it more efficient and effective. One full-time certified teacher will have one half of her duties specifically dedicated to the coordination and implementation of the project. The other half of this staff person's duties correlated well with the overall objectives and goals of KAYAW. The need for better island-wide communication will be met with a monthly newsletter that will be distributed throughout the region. Site coordinators and student participants will be contracted for their continued services throughout the summer months when school is not in session so that continuity of monitoring and communication will not be broken. An annual gathering focusing on TEK documentation and ecological assessments of each community of the Kodiak Archipelago will be hosted by the KAYAW students and adult participants. Publication and distribution of TEK documentation will be integrated into the KIBSD Iluani (an oral history magazine) bi-annual publication. Henry Huntington will continue his involvement as a TEK consultant, providing training for students and KAYAW tribes.

FY02

Prepared:04-10-01

Project Number: 02610
Project Title: Kodiak Archipelago Youth Area Watch
Name: Kodiak Island Borough School District

FORM 4A
Non-Trustee
SUMMARY

FY 02 *EXXON VALDEZ* TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2001 - September 30, 2002

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 2002
	T. Schneider	KAYAW Coordinator (0.5)	12.0	2.7	1.5	33.9
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	12.0	2.7	1.5	
					Personnel Total	$33.9

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FY 2002
	T. Schneider, two roundtrips to each rural KAYAW site	0.1	14	28	0.2	7.0
	Site coordinator and student travel to Kodiak for trainings	0.1	42	84	0.2	21.0
	Student, site coordinator, researcher and Elder travel to science camp	0.1	20	7	0.2	3.4
	Student, site coordinator, researcher and Elder travel to workshop	0.1	35	70	0.2	17.5
	T. Schneider, one roundtrip to the Trustee Council's Annual Restoration Workshop	0.3	1	2	0.2	0.7
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$49.6

FY02

Project Number: 02610
Project Title: Kodiak Archipelago Youth Area Watch
Name: Kodiak Island Borough School District

FORM 4B
Personnel
& Travel
DETAIL

Prepared:04-10-01

Contractual Costs:	Proposed
Description	FY 2002
Professional technical services from Huntington Consulting	6.0
Vessel charters	3.0
Printing of monthly newsletter	1.0
Communications	1.0
Professional technical services website development and maintenance	2.0
Summer site coordinators	6.0
Summer student participants	7.2
Elder honorarium for workshop attendance	4.8
Contractual Total	$31.0

Commodities Costs:	Proposed
Description	FY 2002
Replacement of consumable water monitoring materials such as test strips, slides, etc.	0.5
Audiotapes	0.3
videotapes	0.2
Commodities Total	$1.0

FY02

Prepared:04-10-01

Project Number: 02610
Project Title: Kodiak Archipelago Youth Area Watch
Name: Kodiak Island Borough School District

FORM 4B
Contractual & Commodities DETAIL

FY 02 *EXXON VALDEZ* TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2001 - September 30, 2002

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2002
Additional marine station monitoring kits for new KAYAW sites. Price estimate from previous purchase.	3	1.0	3.0
Additional seal bio-sampling kit for new KAYAW site. Price estimate from previous purchase.	1	0.2	0.2
Tape recorders with microphones. Price estimate from previous KIBSD purchase.	3	0.1	0.3
Digital camera. Price estimate from previous KIBSD purchase.	3	0.3	0.9
			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**	$4.4

Existing Equipment Usage:	Number
Description	of Units
Marine station monitoring kits	5
Seal bio-sampling kits	7
Portable computer	1

FY02

Project Number: 02610
Project Title: Kodiak Archipelago Youth Area Watch
Name: Kodiak Island Borough School District

FORM 4B
Equipment
DETAIL

Prepared:04-10-01

FY 02 *EXXON VALDEZ* TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2001 - September 30, 2002

Budget Category:	Authorized FY 2001	Proposed FY 2002	LONG RANGE FUNDING REQUIREMENTS					
Personnel		$7.0						
Travel		$5.2						
Contractual		$29.3						
Commodities		$0.0						
Equipment		$0.0						
Subtotal	$0.0	$41.5	Estimated FY 2003					
General Administration		$3.1						
Project Total	$0.0	$44.6						
Full-time Equivalents (FTE)		0.1						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

FY02

Prepared:

Project Number: 02612
Project Title: Ecosystem study of nutrient cycling in the Kenai River watershed
Agency: ADF&G

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Detecting and Understanding Marine-Terrestrial Linkages in a Developing Watershed: Nutrient Cycling in the Kenai River Watershed

Project Number:	02612
Restoration Category:	Research
Proposer:	William J. Hauser Alaska Department of Fish and Game
Lead Trustee Agency:	ADF&G
Cooperating Agencies:	
Alaska SeaLife Center:	no
Duration:	October 1, 2001 to September 30, 2002.
Cost FY 02:	$44.6
Geographic Area:	Kenai River watershed
Injured Resource/Service:	sockeye salmon, Commercial fishing, Subsistence, Recreation

RECEIVED
APR 13 2000
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

ABSTRACT:
This proposal will provide matching funding for a coordinator to serve a multidisciplinary team of agency-supported scientists that is designing a study of marine and terrestrial nutrient cycling in a watershed that was impacted by the *Exxon Valdez* Oil Spill (EVOS). The coordinator is a planner/writer who conducts public meetings, performs a literature review and develops, in cooperation with the team, a research plan to identify and measure nutrient sources, cycling, and pathways within the Kenai River watershed.

The Kenai River watershed provides a unique opportunity for research on a highly productive system that is comparatively small, largely accessible, and still reasonably undisturbed. The EVOS curtailed commercial fishing in 1989, causing changes in productivities of sockeye salmon and other species, in addition to allowing a massive input of marine nutrients born by the unharvested salmon. As a world-renowned fishing destination, the watershed is also at some risk from anthropogenic activities including habitat degradation, increased utilization and invasive species. Other studies concerning the contribution of marine nutrients to the ecosystem have examined watersheds of the Pacific Northwest that are now at lower than historic levels of salmon escapement. They suggest that there may be cascading impacts when marine derived nutrients normally supplied by salmon carcasses are diverted from an ecosystem. Terrestrial and aquatic insects and riparian vegetation also depend on nutrients derived from salmon. When nutrients normally supplied by salmon are withdrawn, productivity of the entire watershed is expected to be diminished.

INTRODUCTION

The Kenai River watershed is a rich, diverse ecosystem supporting a variety of fisheries and wildlife resources, which are important to the economy of the state and particularly the communities of the Kenai Peninsula. Nutrient pathways that sustain this rich ecosystem are complex and do not fit classic "River Continuum" models (Vannote et al. 1980). Nutrients such as nitrates, phosphates and reduced iron enter the watershed from a variety of marine, terrestrial and atmospheric sources. From the top of the watershed, inorganic materials enter the system from glacial meltwater (Koenings et al. 1986). Riparian habitats introduce organic nutrients, which are augmented with in river production of algal growth. The large lakes in the system (Kenai and Skilak Lakes) function as nutrient reservoirs from these sources, further modifying nutrient composition. Lower in the drainage, slow moving waters derived from wetland bogs bring in organic materials, offering a diversity to the upper glacial lake system. The hydrology of the system provides only one dimension of the nutrient pathways. Aquatic plants and microorganisms retain and process nutrients within the system. Resident and anadromous fish species in the ecosystem transport and redistribute nutrients. Nearly a million sockeye salmon enter the system annually to spawn and die, transporting marine derived nutrients up into the lakes and high reaches of the river system. Coho and chinook salmon transport marine nutrients in to the highest tributaries on their terminal spawning migrations. Pink salmon, smelt, lampreys are among other important anadromous species that contribute to additional marine nutrient loading and nutrient pathways.

The Kenai River watershed provides a unique opportunity for research on a highly productive system that is comparatively small, largely accessible and still reasonably undisturbed. However, it is also at some risk from anthropogenic activities including habitat degradation, increased utilization and invasive species. Cederhlom et al. (2000) suggested that, in the Pacific Northwest, there are cascading impacts when marine derived nutrients normally supplied by salmon carcasses are diverted from an ecosystem. A total of 137 species of vertebrates depended on salmon for nutrients. Terrestrial and aquatic insects and riparian vegetation also depend on marine nutrients derived from salmon (Piorkowski 1995, Kline et al. 1993, Bilby et al. 1996, Wipfli et al. 1998, 1999). When nutrients normally supplied by salmon are withdrawn, productivity of the entire watershed may decline (Hyatt and Stockner 1985, Stockner 1987, Koenings and Burkett 1987, Mathisen 1972, Schmidt et al. 1998). However, this decline in productivity may be confounded with other ecosystem effects such as overfishing (Pauly et al. 1998), fisheries interceptions or marine climatic effects (Beamish and Bouillon 1993, Francis and Hare 1994, Mantua et al. 1997, Hare et al. 1999, Finney et al. 2000). However, there is a large body of experimental evidence that suggesting that the impact of nutrients from fertilization (or fish carcasses) is highly dependent on the density of fry and food web structure (Mazumder et al. 1988, Leibold 1992, Sarnelle 1992, Power 1992, Mazumder et al. 1990, Mazumder and Lean 1994, Mazumder and Edmundson 2001)

In the Kenai River, escapements of most chinook and sockeye salmon are heavily regulated and maintained at optimal levels above the Maximum Sustained Yield (MSY) (Fox et al. 2000) to

maintain "high sustained yields" (Tarbox et al. 1999). Over the past two decades, studies of Alaskan lake and riverine physics (Koenings and Edmundson 1991, LaPerriere and Edmundson 2000, Edmundson and Mazumder 2001), water chemistry and nutrients (Edmundson and Koenings 1986, Litchfield and Kyle 1991, Edmundson and Carlson 1998), plankton (Edmundson and Koenings 1986, Koenings et al. 1990, Edmundson and Carlson 1998), and trophic interactions relative to salmon production (Koenings et al. 1986, Koenings and Burkett 1987, Kyle et al. 1988, Kyle 1994ab, Kyle et al. 1997, Edmundson et al. 1997, Schmidt et al. 1998, Edmundson and Mazumder 2001) have been ongoing by Alaska Department of Fish and Game. Evidence of broodyear interaction and density dependence has been observed in Skilak Lake (Schmidt et al. 1995) suggesting that consecutive years of high escapements may depress production of sockeye salmon. Kyle et al. (1998) showed that fry recruitment from consecutive large escapements overgrazed the forage base in Frazer Lake (Alaska) and led to decreased survival of sockeye juveniles in subsequent generations. A brood-year interaction model for Kenai River sockeye salmon explained about 70% of the variation in adult return-per-spawner (Carlson et al. 1998).

NEED FOR THE PROJECT

A. Statement of the Problem

Increasing human use throughout the Kenai River watershed holds the potential to shift the balance of this rich and diverse ecosystem. The fisheries resources of the watershed contribute to commercial, sport and personal use fisheries that are the vital to the economy of this area. These fisheries are and need to continue to be managed in a responsible and sustainable manner. Increasing land use and the use of the waterways, the risk of pollutants and loss of habitat all pose future threats to this system. The importance of marine nutrient relationships and implications on an ecosystem scale has been suggested (Cederholm et al. 2000, Mathisen 1972 Larkin and Slaney 1997, Gresh, et al. 2000). The Alaska Sustainable Fisheries Policy mandates that wild stocks and habitats should be maintained at levels of productivity to assure sustained yields (Alaska Administrative Code, Title 5, Chapter 39.222), but not all contributions to the productivity of Alaskan watersheds are fully understood.

A small group of individuals representing agencies and organizations with interest in the Kenai River watershed met to discuss these issues on March 21, 2001. Attendees included: ADF&G Sport Fish, Habitat and Restoration, and Commercial Fish Divisions, EPA, EVOS TC, Prince William Sound Science Center, The Nature Conservancy, Kenai Watershed Forum, Kenai River Sport Fishing Association, Kenai Peninsula Community College, and the Kenai Peninsula Borough. The group developed the following problem statement:

> "We need to understand food-web dynamics in the watershed and the role of marine derived nutrients in the ecosystem so we can develop better information for managing harvest, land use planning, watershed development, and resource use."

This group lacks the resources to independently start such a research initiative, but proposed to facilitate drafting of a research plan that might then be used to seek large scale funding for a

multi-year, multi-agency ecosystem research initiative. The study of nutrients from marine and terrestrial sources will be the primary focus, but it is important to continue to recognize that other factors affect productivity of the watershed as well.

The funding requested in this proposal would provide matching funds to hire a coordinator (planner/writer) to facilitate the planning process, complete a literature review, and to draft and develop the research plan and seek funding sources.

B. Rationale/Link to Restoration

Knowledge gained through work of this research initiative program will add to the understanding of factors that may limit recovery of injured resources and services and marine and terrestrial ecosystem linkages. In addition, it will create a model with subcomponents that will serve as models for many other drainages in the Gulf of Alaska.

After the *Exxon Valdez* Oil Spill, there was evidence of overescapement of sockeye salmon into the Kenai River (Schmidt, et al. 1995, Schmidt, et al. 1996). Research associated with this proposal will help to understand ecosystem effects of marine nutrients brought into the Kenai River from sockeye and other salmon escapements.

This project is also related to the Gulf Ecosystem Monitoring (GEM) program. The mission of the GEM program is "to sustain a healthy and biologically diverse marine ecosystem in the northern GOA and the human use of the marine resources in that ecosystem through greater understanding of how its productivity is influenced by natural changes and human activities." The goal of this project is to better understand the dynamics of nutrients in the Kenai River watershed ecosystem so that better land use and resource management decisions can be made in the future. Salmon provide a direct linkage between the Kenai River watershed and the GOA.

C. Location

Kenai River Watershed. The Kenai River Watershed provides a unique opportunity to provide insight into the recovery of salmon in rivers all along the west coast of North America. There are two primary reasons for this. The first is that in one system, the Kenai River Watershed, researchers can investigate nutrient dynamics in virtually all the settings that occur separately in other west coast systems. Glacial inputs, clear headwater streams, large and small lake settings, wetland derived brown water systems, a high order stream and large inputs of marine derived nutrients all occur in this one watershed. Secondly, and perhaps most important, the Kenai River system is relatively intact. Watershed processes are occurring relatively undisturbed and salmon runs are similar to what they have been over the ages. Yet most of the system is road accessible. Research can be conducted in a setting that reflects the state that models the recovery goals of other west coast rivers.

COMMUNITY INVOLVEMENT

Agencies and community organization and groups would participate in the development of the research plan through open public meetings.

PROJECT DESIGN

A. Objectives

Specific project objective is:

- Develop a plan for a multi-agency, multi-year study of the nutrient pathways in the Kenai River watershed.

B. Methods

Development of the plan will be guided by a steering committee composed of involved agencies, user groups and organizations. Facilitated planning meetings of a scientific technical team would develop and refine the elements of the plan. The literature review will consolidate and provide annotated summaries of published reports. Plan drafts would be presented to the public for periodic public review and comment to gain broad public support and acceptance.

C. Cooperating Agencies, Contracts and Other Agency Assistance

The following is a list of agencies that would be invited to participate:

Alaska Department of Fish and Game, Habitat and Restoration Division, Sport Fish Division, Commercial Fisheries Management Division, and Central Region Limnology Laboratory, Alaska Department of Environmental Conservation, US Environmental Protection Agency, US Forest Service, Alaska Department of Natural Resources, US Geological Survey, US Fish and Wildlife Service, and Kenai Peninsula Borough

Other organizations will include:
Kenai Watershed Forum, Kenai River Sport Fishing Association, The Nature Conservancy, Cook Inlet Aquaculture Association, Kenai Peninsula Fisherman's Association, Upper Cook Inlet Fisherman's Association, Gulf Ecosystem Monitoring Program (GEM), and North Pacific Research Board.

Other Matching Financial Contributions:

- The Nature Conservancy:	$2,500
- Kenai River Sport Fish Association	$15, 000
- Cook Inlet Aquaculture Association	$500

SCHEDULE

A. Measurable project tasks for FY01 (October 1, 2001 - September 30, 2002)

- Organize steering committee
- Hold organizational and planning meetings
- Hold public involvement meetings
- Complete literature review
- Develop Draft Research Plan
- Finalize Research Plan

B. Project milestones and endpoints

September, 2001 - Form agency and technical science teams, Initiate planning meetings, start public and team meetings

Feb, 2002 – Draft Plan distributed for public comment and review

April, 2002 – Finalize Plan

May – Sept, 2002 – Investigate funding sources

C. Completion Date

30 September, 2002

PUBLICATIONS AND REPORTS

The Final Research Plan will be submitted as a Draft Final Report.

PROFESSIONAL CONFERENCES

None.

NORMAL AGENCY MANAGEMENT

This proposed project is beyond the scope of normal agency management responsibilities. Never the less, information gained through a study of this nature would greatly enhance land use planning and resource management-related decisions.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Several Trustee Council agencies will be cooperators with this project.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

NA

PROPOSED PRINCIPAL INVESTIGATOR

Bill Hauser will serve as the PI of project 02612.

PRINCIPAL INVESTIGATORS

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FY 02 *EXXON VALDEZ* TRI E COUNCIL PROJECT BUDGET

October 1, 200 - September 30, 2002

Budget Category:	Authorized FY 2001	Proposed FY 2002	LONG RANGE FUNDING REQUIREMENTS					
Personnel		$7.0						
Travel		$5.2						
Contractual		$29.3						
Commodities		$0.0						
Equipment		$0.0						
Subtotal	$0.0	$41.5	Estimated FY 2003					
General Administration		$3.1						
Project Total	$0.0	$44.6						
Full-time Equivalents (FTE)		0.1						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

FY02

Prepared:

Project Number: 02612
Project Title: Detecting and Understanding Marine-Terrestrial Linkages in a Developing Watershed: Nutrient Cycling in the Kenai River Watershed
Agency: ADF&G

FORM 3A
TRUSTEE
AGENCY
SUMMARY

FY 02 *EXXON VALDEZ* TRU[illegible]E COUNCIL PROJECT BUDGET
October 1, 200[illegible] September 30, 2002

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2002
						0.0
W. Hauser	FB IV		1.0	7.0		7.0
C. Rosen**	Librarian		0.5	6.2		0.0
						0.0
** This cost is paid by ADF&G SF Division						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		1.5	13.2	0.0	
					Personnel Total	$7.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2002
					0.0
Anch - Kenai - RT a/	0.2	10	10	0.1	3.0
Anch - Seattle RT - for expert scientist	0.8	2	6	0.1	2.2
					0.0
					0.0
a/ includes 10 one-day RT for PI or non-supported meeting participant					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$5.2

FY02

Prepared:

Project Number: 02612
Project Title: Detecting and Understanding Marine-Terrestrial Linkages in a Developing Watershed: Nutrient Cycling in the Kenai River Watershed
Agency: ADF&G

FORM 3B
Personnel
& Travel
DETAIL

FY 02 *EXXON VALDEZ* TRU[illegible]E COUNCIL PROJECT BUDGET
October 1, 200[illegible] September 30, 2002

Contractual Costs:						Proposed
Description						FY 2002
Costs:	What	monthly rate		amount	cost	
	Contractor	6.0		6	36.0	
	office supplies	0.1		6	0.6	
	postage	0.1		6	0.6	
	copying	0.1		6	0.6	
	Subtotal				37.8	
	overhead		0.25		9.5	
				Subtotal	47.3	
Cooperators:	The Nature Conservancy:				$2.5	
	Kenai River Sport Fish Association				$15.0	
	Cook Inlet Aquaculture Association				$0.5	
	Sum of Contributions:				$18.0	
				Request from EVOS:	$29.30	
When a non-trustee organization is used, the form 4A is required.					**Contractual Total**	$29.3

Commodities Costs:	Proposed
Description	FY 2002
Commodities Total	$0.0

FY02

Prepared:

Project Number: 02612
Project Title: Detecting and Understanding Marine-Terrestrial Linkages in a Developing Watershed: Nutrient Cycling in the Kenai River Watershed
Agency: ADF&G

FORM 3B
Contractual & Commodities
DETAIL

FY 02 *EXXON VALDEZ* TRI E COUNCIL PROJECT BUDGET
October 1, 200 . eptember 30, 2002

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2002
			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	Inventory Agency

FY02

Project Number: 02612
Project Title: Detecting and Understanding Marine-Terrestrial Linkages in a Developing Watershed: Nutrient Cycling in the Kenai River Watershed
Agency: ADF&G

FORM 3B
Equipment
DETAIL

Prepared:

Collaborative Proposal: A monitoring program for near-surface temperature, salinity, and fluorescence fields in the Northeast Pacific Ocean

(Collaborating institutions: Institute of Marine Science, University of Alaska Fairbanks (lead institution) and Center for Coastal Physical Oceanography, Old Dominion University)

Project Number:	02614
Restoration Category:	Ecosystem Synthesis/GEM Transition/New Projects/ Innovative Tools and Strategies to Improve Monitoring
Proposer:	Stephen R. Okkonen Institute of Marine Science University of Alaska Fairbanks Fairbanks, Alaska 99775
Lead Trustee Agency:	ADFG
Cooperating Agencies:	
Alaska Sea Life Center:	No
Duration:	1st year, 2-year project
Cost FY 02:	$31.1
Cost FY 03:	$14.0
Geographic Area:	Northeast Pacific Ocean
Injured Resource/Service:	

RECEIVED
APR 13 2000
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

ABSTRACT

The objective for this proposed research is to a use a thermosalinograph and fluorometer, to be installed on a crude oil tanker, to acquire continuous, long-term measurements of the near-surface temperature, salinity, and fluorescence fields along the tanker route between Valdez, Alaska and Long Beach, California.

INTRODUCTION

The research proposed herein describes a two-year, proof-of-concept project to demonstrate the use of a crude oil tanker as a platform from which to acquire measurements of oceanographic field variables (near-surface temperature, salinity, and fluorescence) in the Northeast Pacific Ocean. The results from this project will be used as a basis to pursue GEM funding for long-term monitoring of oceanographic field variables from crude oil tankers.

NEED FOR THE PROJECT

A. Statement of Problem

In order to assess the long-term recovery of marine resources impacted by the *Exxon Valdez* Oil Spill against the background of climate-driven variability of those resources, long-term measurements of oceanographic conditions are required. Additionally, while the most significant spill-related impacts upon the marine environment occurred in coastal and near-shore domains, the long-term health of those marine ecosystems depends, in part, upon biophysical linkages to the shelf, slope, and open-ocean domains. Consequently, multi-decadal records of oceanic conditions within each of these domains is necessary to develop an understanding of natural and anthropogenic variability in the marine environment of the northern Gulf of Alaska.

B. Rationale

In recent years there has been increasing awareness of large-scale, multi-decadal changes in the climate of the world ocean. However, translating awareness of long-term climate variability into understanding the regional and local physical and biological consequences of a changing environment has been hampered by the dearth of long-term oceanographic measurements in the Northeast Pacific. Presently, the only multi-decadal time series of oceanographic conditions (temperature and salinity) in the region are for Ocean Station P/Line P and station GAK-1 near Seward, Alaska (Figure 1).

Commercial cargo vessels operating within established shipping corridors in the Northeast Pacific are potential ships-of-opportunity from which high-resolution measurements of oceanographic conditions could be acquired at regular intervals. Crude oil tankers, traveling between Valdez, Alaska and Long Beach, California, are particularly well suited for this purpose as individual tankers cross shelf, slope, and open ocean regimes every 10 to 14 days and will continue to do so for many years to come.

To demonstrate the suitability of tankers as a traveling platform, we propose to install a thermosalinograph (TSG) and fluorometer on a tanker to acquire high-resolution measurements of near-surface temperature, salinity, and fluorescence (a proxy for phytoplankton biomass).

Some might argue that satellites are better platforms from which to acquire these measurements of ocean surface conditions. However, ocean color and sea surface temperature sensors detect wavelengths in the visible and infrared portion of the electro-magnetic spectrum and are therefore

unable to detect sea surface features through the clouds which cover much of the Gulf of Alaska for much of the year. With respect to remote sensing of sea surface salinity, there are no satellite-borne salinity sensors at this time.

C. Location

Measurements of temperature, salinity, and fluorescence will be acquired along the tanker corridor between Valdez, Alaska and Long Beach, California (Figure 1).

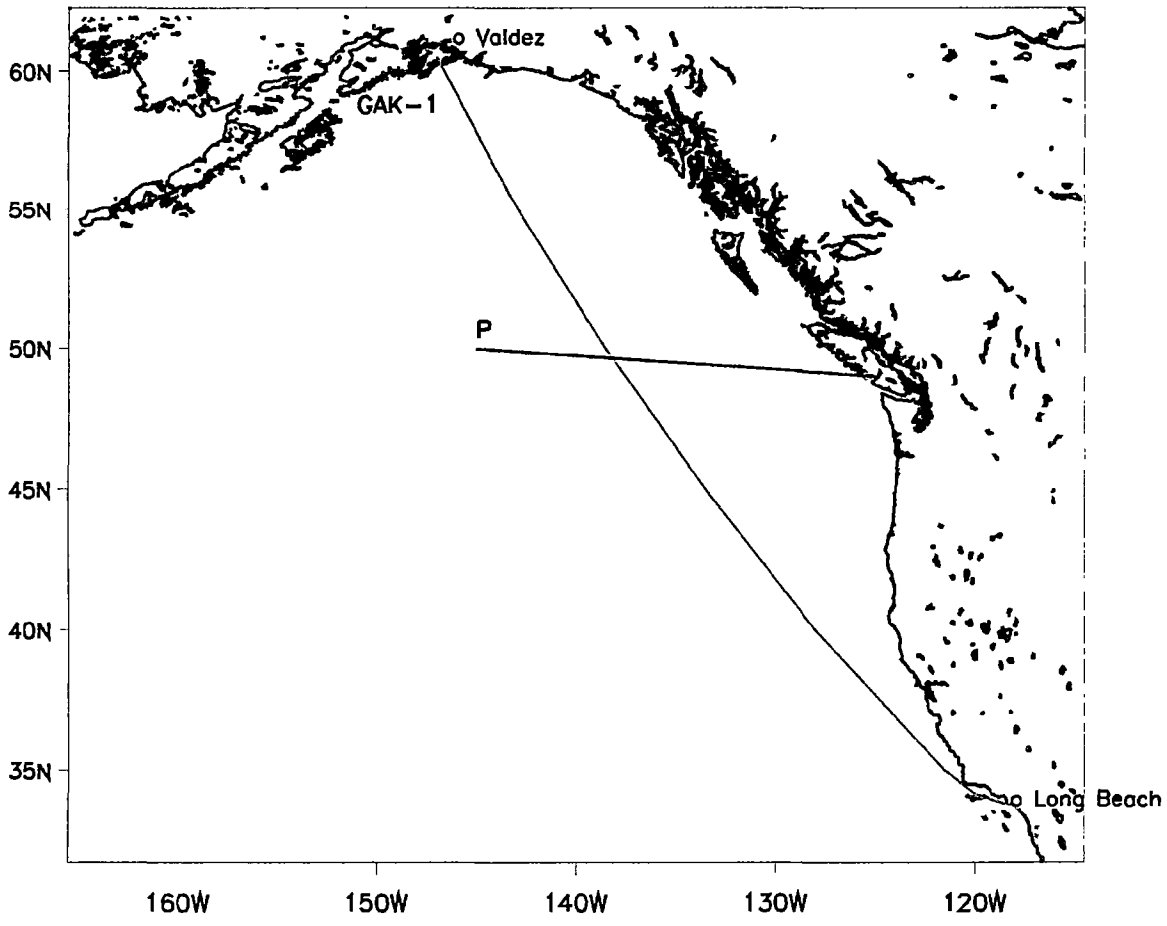


Figure 1

PROJECT DESIGN

A. Objectives

The objectives for this project are to:

1. Establish a working relationship with the crude oil tanker fleet to use individual tankers as platforms from which to acquire continuous, long-term measurements of oceanographic field variables (e.g. temperature, salinity, fluorescence) along the shipping corridor between Valdez, Alaska and Long Beach, California. Install a thermosalinograph and fluorometer on a tanker to acquire these measurements.

2. Identify the seasonal migration and evolution of frontal features associated with the Alaska Coastal Current (ACC), shelf break, and mesoscale eddies.

3. Identify the dominant length scales of variability (and seasonal modulation of those length scales) characterizing the near-surface temperature, salinity, and fluorescence fields along the shipping corridor. These scales of variability will likely differ between shelf and the open ocean.

4. Compare TSG/fluorometer measurements with TOPEX altimeter observations of the Gulf of Alaska eddy field.

5. Compare TSG/fluorometer data with contemporaneous NEP GLOBEC field data.

6. Provide temperature, salinity, and fluorescence field data to David Welch (Pacific Biological Station, Nanaimo, British Columbia) for comparison with coincident continuous plankton recorder (CPR) observations.

A. Methods

The TSG and fluorometer will be installed in the sea chest of a tanker. The sea chest draws seawater through an intake located a few meters below the sea surface. The exact depth of the intake water will depend on the particular vessel design and the amount of cargo and/or ballast carried. With approval of the ship's chief engineer, a remote temperature sensor will be installed as close to the intake as is practical to mitigate the biasing of the temperature measurements due to the ship's thermal inertia.

TSG and fluorometer measurements will be acquired once per five seconds (nominal). For a tanker traveling at 20 knots this translates to a sample spacing of ~50 m. This data stream will be merged will concurrent GPS navigation data and stored on the hard drive of a dedicated PC. Repeat measurements along the shipping corridor will allow time-space matrices of temperature, salinity, and fluorescence to be constructed. After a yearlong record of measurements is acquired, characteristic spatial scales of variability and their seasonal modulation will be determined from spectral and geometric analyses of the data matrices.

The seasonal evolution of frontal features associated with the ACC, the shelf break, and mesoscale eddies will also be monitored. Because of secondary circulation associated with frontal features, they tend also to be zones in which there are population aggregations across many trophic levels.

SCHEDULE

A. Measurable Project Tasks for FY 02 (1 October 2001 – 30 September 2002)

15 October 01:	Order instrumentation and ancillary hardware
15 December 01:	Install TSG and fluorometer on tanker
1 January 02 - 30 September 02:	Data acquisition

B. Project Milestones and Endpoints

1 Oct 2001 - ongoing	Project Design Objective 1
1 Dec 2001 - ongoing	Project Design Objectives 2, 4, 5, 6
1 Jan 2003 - 1 Mar 2003	Project Design Objective 3 (use first year of data)
1 Mar 2003 - 30 Apr 2003	Prepare manuscript(s), see Publications and Reports section below
15 Apr 2003	Submit annual report

C. Completion Date

30 September 2003	Completion of final report

PUBLICATIONS AND REPORTS

No publications are anticipated for FY 02.

Potential FY 03 publications: Seasonal evolution of frontal features in northern Gulf of Alaska; Comparison of TSG, fluorescence, and TOPEX altimeter observations of Gulf of Alaska eddies; Comparison of TSG, fluorescence and continuous plankton recorder observations in the Northeast Pacific Ocean (with David Welch, Pacific Biological Station, Nanaimo, British Columbia).

PROFESSIONAL CONFERENCES

Attend Trustee Council's annual workshop in Anchorage January 2002, 2003.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Data acquired for this project will be posted on the UAF/Institute of Marine Science web page.

Okkonen has an ongoing NASA-funded project to use the TOPEX altimeter to observe the mesoscale eddy field in the Gulf of Alaska and to share that data with collaborating NEP GLOBEC researchers (Tom Weingartner, UAF; Tom Royer, ODU)

Royer is a funded researcher with the NEP GLOBEC project for the next four years.

Existing collaborative relationships with NEP GLOBEC researchers will be exploited to:

(1) compare TSG surface field observations (this proposed research) with contemporaneous subsurface temperature and salinity measurements from within Prince William Sound and from the nearby shelf and

(2) use retrospective studies of historical VOS (XBT and XCTD) and GAK1 data to provide a historical context for consideration of the TSG data.

The opportunity also exists to make similar comparisons of the TSG data with historical and contemporaneous Ocean Station P/Line P data.

We also plan to share our data with David Welch, Pacific Biological Station, Nanaimo, British Columbia. He has a current project in which he has a continuous plankton recorder (CPR) deployed 5x/year on a tanker traveling between Valdez and Long Beach. The TSG/fluorometer/ CPR data sets would be highly complementary in that temperature, salinity, and fluorescence gradients could be directly compared with plankton distributions along the tanker route.

PROPOSED PRINCIPAL INVESTIGATOR

Stephen R. Okkonen
Institute of Marine Science
University of Alaska Fairbanks
Fairbanks, Alaska 99775
(907) 283-3234
okkonen@alaska.net

Okkonen will have primary responsibility for initial data processing, length scale analyses, frontal feature analyses, and comparison with TOPEX data.

CO-PRINCIPAL INVESTIGATOR

Thomas C. Royer
Center for Coastal Physical Oceanography
Department of Ocean, Earth and Atmospheric Sciences
Old Dominion University
768 W. 52nd St.
Norfolk, VA 23529
(757) 683-5547
(757) 683-5550 (FAX)
royer@ccpo.odu.edu

Royer will have primary responsibility for comparison of TSG data with GLOBEC data and with historical data.

OTHER KEY PERSONNEL

Dave Cutchin
San Diego, California

Dave Cutchin will be issued a sub-contract to install the thermosalinograph, fluorometer, and ancillary hardware on the tanker and to provide annual maintenance of the instruments. He was responsible for TSG installations on other VOS platforms both prior to and during WOCE.

2002 *EXXON VALDEZ* TRU : COUNCIL PROJECT BUDGET

October 1, 200 . eptember 30, 2002

Budget Category:	Authorized FY 2001	Proposed FY 2002						
Personnel		$0.0						
Travel		$0.0						
Contractual		$35.7						
Commodities		$0.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal		$35.7	Estimated FY 2003					
General Administration		$2.5						
Project Total		$38.2	$17.1					
Full-time Equivalents (FTE)		0.1						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

FY02

Prepared: April 2001

Project Number: 02614
Project Title:
Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2002 *EXXON VALDEZ* TRU COUNCIL PROJECT BUDGET

October 1, 200. eptember 30, 2002

Budget Category:	Authorized FY 2001	Proposed FY 2002	LONG RANGE FUNDING REQUIREMENTS					
Personnel		$4.8						
Travel		$0.4						
Contractual		$8.2						
Commodities		$0.2						
Equipment		$15.0						
Subtotal		$28.6	Estimated FY 2003					
Indirect		$7.1						
Project Total		$35.7	$17.1					
Full-time Equivalents (FTE)		0.1						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

The indirect rate is 25% TDC, as negotiated by the Exxon Valdez Oil Spill Trustee Council with the University of Alaska.

FY02

Prepared: April 2001

Project Number: 02614
Project Title: Monitoring Program: near-surface temperature, salinity, & fluorescence fields in NE Pacific Ocean
Name: University of Alaska Fairbanks

FORM 4A
Non-Trustee
SUMMARY

2002 *EXXON VALDEZ* TRU : COUNCIL PROJECT BUDGET
October 1, 200 . September 30, 2002

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 2002
	S. Okkonen	Research Assisant Professor	0.7	4.7		3.3
	Web page Technician	Web page Technician	0.3	5.0		1.5
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	1.0	9.7	0.0	
					Personnel Total	$4.8

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FY 2002
	Okkonen 1 R/T Kenai-Anchorage (attend Trustee Council workshop)	0.2	1	2	0.1	0.4
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$0.4

FY02

Prepared: April 2001

Project Number: 02614
Project Title: Monitoring Program: near-surface temperature, salinity, & fluorescence fields in NE Pacific Ocean
Name: University of Alaska Fairbanks

FORM 4B
Personnel
& Travel
DETAIL

2002 *EXXON VALDEZ* TRU . COUNCIL PROJECT BUDGET
October 1, 200 . eptember 30, 2002

Contractual Costs:	Proposed
Description	FY 2002
phone/fax/internet	0.2
software maintenance	0.1
shipping	0.9
Subcontact: D. Cutchins	7.0
Contractual Total	$8.2

Commodities Costs:	Proposed
Description	FY 2002
Project supplies	0.2
Commodities Total	$0.2

FY02

Prepared: April 2001

Project Number: 02614
Project Title: Monitoring Program: near-surface temperature, salinity, & fluorescence fields in NE Pacific Ocean
Name: University of Alaska Fairbanks

FORM 4B
Contractual & Commodities DETAIL

2002 *EXXON VALDEZ* TRU **COUNCIL PROJECT BUDGET**

October 1, 200[illegible] September 30, 2002

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2002
thermosalinograph	1	6.9	6.9
remote temp. sensor	1	1.5	1.5
mount kit	1	0.5	0.5
kill cell	1	0.1	0.1
Fluorometer	1	3.0	3.0
GPS	1	0.5	0.5
computer	1	1.5	1.5
misc. hardware	1	1.0	1.0
			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**	$15.0

Existing Equipment Usage:	Number	
Description	of Units	

FY02

Prepared: April 2001

Project Number: 02614
Project Title: Monitoring Program: near-surface temperature, salinity, & fluorescence fields in NE Pacific Ocean
Name: University of Alaska Fairbanks

FORM 4B
Equipment
DETAIL

Title: **Standing stock and secondary production of zooplankton in Prince William Sound**

Project Number:	02617
Restoration Category:	Monitoring
Proposer:	Russell R. Hopcroft and Kenneth Coyle Institute of Marine Science, University of Alaska Fairbanks
Lead trustee agency:	ADFG
Cooperating agencies:	
Alaska SeaLife Center:	No
Duration:	FY 02, October 1 to September 30
Geographic Area:	Prince William Sound
Injured Resource/Service:	Commercial Fisheries Transition to GEM

RECEIVED
APR 13 2000
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

ABSTRACT:

Understanding the seasonal cycles and inter-annual variability of zooplankton is essential for understanding the success of higher vertebrate trophic levels. Systematic sampling of the zooplankton in central waters of Prince William Sound was discontinued in 1997 with the completion of the SEA project, and although the Gulf of Alaska GLOBEC program began in that same year, its sampling techniques are not comparable to the SEA and earlier data sets. We propose to set the stage for GEM activities by enhancing current sampling within the GLOBEC program to allow direct comparison to earlier data sets, and integrate this with detailed analysis of recent near-shore zooplankton collected by PWSAC hatcheries.

INTRODUCTION

No two years are the same in terms of the success of fisheries or the recruitment at seabird colonies. These differences are driven by inter-annual differences in the environment that directly effect survival or by changes in the production of resources that feed these populations. Most species of fish, seabirds and marine mammals are ultimately influenced by both the standing stock and rates of production of the lowest marine trophic levels, such as zooplankton on which many feed directly. Thus, knowledge of the seasonal cycles and inter-annual variability of zooplankton – as determined by monitoring activities – is essential to understanding the success of higher vertebrate trophic levels.

For the past quarter century, hatcheries around Prince William Sound have relied heavily on monitoring of the volume of zooplankton present in order to release juvenile salmon at a time when their zooplankton prey are most abundant. The absolute quantity of zooplankton, the timing of its seasonal cycle, its rate of supply and its species composition all contribute to the survival of these salmon juveniles once released, as well at the survival of natural fish stocks, such as Pacific herring. A detailed time-series of the zooplankton communities in PWS can thus be of value in forecasting the future success of fisheries, and provide insight into the success (or failure) of previous years.

NEED FOR THE PROJECT

A. Statement of Problem

Planktonic populations are extremely variable in time and space. In order to establish seasonal patterns it is necessary to sample frequently, at several locations. Interannual comparisons require long time-series to establish the typical timing and magnitude of seasonal cycles. Only once what constitutes a "normal" year is established can one identify an atypical year or if a long- term change is occurring. Positive or negative changes in zooplankton production or its timing can then be used to predict a "good" verses "bad" year for higher trophic levels based on both theoretical grounds and historical success of fisheries when similar anomalies were observed.

Initial examination of the zooplankton communities in PWS began in the early 1970s (Cooney 1973; Damkaer, 1977). By 1977 the salmon hatcheries operated by the Prince William Sound Aquaculture cooperative (PWSAC) and in Valdez became convinced of the value of monitoring the seasonal cycles of near-shore zooplankton by measuring the total volume of organisms collected in a net (Cooney et al., 1981; Cooney & Coyle, 1988). Many of these samples have been processed in even greater detail (Jewett & Stark, 1994; Jewett & Blanchard 1997; Sturdevant et al., 1997; Willette et al., 1997,1999) to better establish what elements of the community appear most related to fisheries success. After the Exxon Valdez Oil Spill, from 1994-1997, more extensive and intensive sampling of zooplankton was undertaken in the sound under the SEA and APEX programs (Cooney et al., 2001a,b;). Although the Gulf of Alaska GLOBEC program began in the final year of the SEA and APEX projects, GLOBEC's priorities are sampling outside of PWS. Furthermore, the limited sampling maintained within the Sound by GLOBEC has utilized sampling techniques that are not comparable to those employed by the SEA, PWSAC, or earlier data sets due to differences in the mesh size of nets employed and the

depths over which they are fished. PWSAC has continued to collect samples since detailed taxonomic analysis ceased in 1997, however these near-shore samples may not be representative of deeper more central waters where larger copepods typically accumulate (see Cooney et al., 2001b).

To date, all research on zooplankton within PWS has focused simply on estimating the standing stock (=biomass) of the zooplankton. Few estimates have been made on the rates of production of the zooplankton. If the zooplankton biomass is rapidly removed as soon as its it produced – by grazing or wash-out to the shelf – then the true productivity of PWS and its importance to the coastal waters of Alaska may be severely under estimated. If PWS is a major exporter of production onto the shelf, then changes in productivity in the sound could have disproportionate effects on the coastal waters of Alaska.

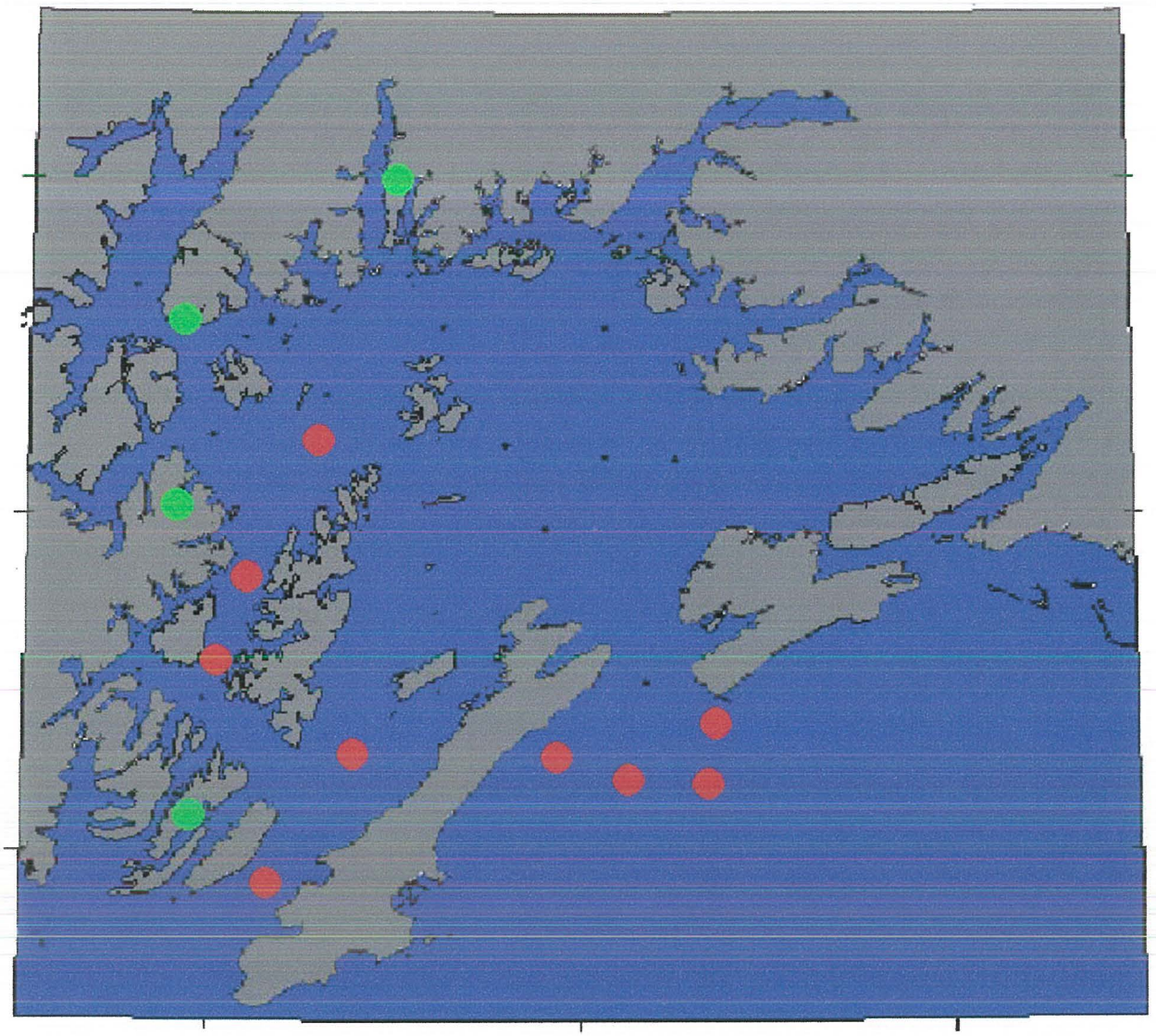
B. Rational/Link to Restoration

In order continue the valuable time-series begun in PWS and to set the stage for a more extensive monitoring program such as GEM, we propose to enhancing current sampling within the GLOBEC program to allow direct comparison to earlier data sets, and integrate this with detailed analysis of post 1997 near-shore zooplankton collected by PWSAC hatcheries. This dataset will be of value in examining the linkages between zooplankton production and year-to-year variability in fisheries and higher trophic levels.

This proposal provides a timely opportunity to link the GLOBEC Long Term Monitoring Program to previous and ongoing zooplankton sampling programs in Prince William Sound in a highly cost-effective manner. Although continued archiving of samples by PWSAC is almost a certainty, missed opportunities with respect to the GLOBEC program represent missing years in a time series cannot be replaced.

C. Location

Sampling will be undertaken in western PWS, in Montague Straight and Hinchinbrook Entrance. Benefits will be realized by the local hatcheries and fishing communities operating in the Sound.



Location of sites currently sampled for zooplankton by MOCNESS nets in PWS and its entrances by the GLOBEC program (red circles) and the location of the PWSAC hatcheries (green circles). Sites emphasis the western side of the sound because this is the primary habitat of large zooplankton and the conduit for juvenile salmon leaving the hatcheries.

COMMUNITY INVOLVEMENT AND TRADITIONAL KNOWLEDGE

This proposal will involve up to five hatcheries operated by PWSAC in the scientific exploration of zooplankton community biomass and production. This may lead to an improved local understanding of the linkages between organisms within the marine community, the impact of lower trophic levels on fisheries success, and their influence on higher trophic levels such as seabirds and marine mammals. Exploration of long-term data sets may yield correlations between traditional knowledge of historical changes and variability in ecosystem structure and productivity.

PROJECT DESIGN

A. Objectives

1. Determine the seasonal cycle of zooplankton in PWS in terms of composition, biomass and production at both central deepwater locations (GLOBEC stations) and near-shore (PWSAC stations).
2. Compare data to historical zooplankton observations in PWS.
3. Establish the importance of Prince William Sound as a source of zooplankton production for the adjoining shelf in the Gulf of Alaska.

B. Methods

Summary

On 7 cruises during 2001 & 2002 we will collect the entire size range of zooplankton in the upper 100m employing GLOBEC protocols and in the upper 20m using methods identical to weekly PWSAC collections. Zooplankton production will be directly measured on all cruises.

Details

Shipboard sampling protocols on GLOBEC cruises will follow the Northeast Pacific (NEP) Implementation Plan (U.S. GLOBEC Report Number 17, 1996) guidelines. We will sample zooplankton and micronekton at night at 9 standard stations within PWS or at its entrances (see preceding figure). Large zooplankton will be collected with a 1-m^2 MOCNESS equipped with 0.5 mm mesh nets, fished at 20 m depth intervals between 100 m and the surface. Concurrent data will be collected with a HTI model 224 digital echosounder (43, 120, 200 and 420 kHz; 15-second integration, 1 m depth intervals). This frequency range allows us to estimate densities of fish, micronekton and large calanoids. Split beam target strength data will also be collected at the lower three frequencies. The acoustic array will be towed beside the vessel at 3-5 m depth and six knots continuously at night between stations with distribution of organisms sensed acoustically inferred by cross-correlations determined from the MOCNESS collections. (Only the preceding activities are currently elements of the GLOBEC program).

At the deepest station in north-western PWS, where water depth is ~800 m and large bodied copepods accumulate at depth, an additional MOCNESS collection will be taken from 500 m to the surface in 100m depth intervals. At all 9 stations, smaller zooplankton will be sampled with a 25 cm diameter flow-metered bongo array equipped with 0.15 and 0.5 mm mesh nets, towed vertically from 100 m depth to the surface at these same stations (same methods as GLOBEC outside the sound). Additionally, a 0.5 m ring-net of 0.24 mm mesh will be hauled from 20m to

the surface to yield collections directly comparable to those employed by PWSAC to collection zooplankton for their Plankton Watch Program. All samples will be preserved in 10% formalin. Later, after subsampling with a Folsom splitter, 100-200 of the most abundant animals will be identified to the lowest taxonomic category possible, copepods will be measured, staged, and the abundance and wet weight biomass of each taxonomic category determined.

At the deep station, experiments will also be conducted during each cruise to determine the rates of growth and reproduction of the dominant members of the zooplankton community: the copepods and the euphausiids. Methods employed will be identical to those currently being employed by Hopcroft in a funded GLOBEC project in the Gulf of Alaska. In brief, we will determine the *in situ* rates by incubation techniques employing artificial cohorts and individual females (see Hopcroft et al. 1998, Hopcroft and Roff, 1998). Incubation techniques are the only appropriate methods for this region due to its highly advective nature. The proposed research will put the *in situ* rates in perspective by determining their maximal rates under food-saturated conditions in the laboratory. It will estimate the extent to which secondary production is food-limited in the field. It will determine the functional relationships of development, growth and egg production to body size, temperature and food regimes. Food regimes will be assessed in terms of chlorophyll and particulate organic carbon, plus the abundance and biomass of auto-trophic and heterotrophic protists. It will estimate the rates of local copepod production, along with their temporal and spatial variability.

PWSAC collects zooplankton by skiff at biweekly intervals from March to July at 2 locations near each of their 5 hatcheries using a 0.5 m ring-net of 0.24 mm mesh hauled from 20m to the surface. Normally, the settled volume displaced by plankton (phytoplankton plus zooplankton) in these collections is noted and no further analysis is conducted. In general these collections are archived, with many samples up to 1997 having been analyzed in detail (e.g. Cooney et al., 2001). We propose to analyze samples collected in 2002, and selected samples back to 1997, specifically looking for a signals from the 1997/98 El Niño, the 1999 La Niña, and the mild winter of 2000/2001. Samples will be analyzed and production calculated by identical methods to those employed in the GLOBEC program.

Finally composition, standing stock and production will be compared to the success of fisheries within PWS during the period of study.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Collection of GLOBEC associated samples will be undertaken by UAF, leveraging on the infrastructure and ship-time provided through NSF and NOAA. Near-shore samples will be collected by PWSAC at no-cost. All sample analysis will be conducted at UAF.

SCHEDULE

A. Measurable Project Tasks for FY02 (October 1, 2001 – September 30, 2002)

October 2001	GLOBEC cruise Gulf of Alaska shelf and PWS
	Analysis of zooplankton samples from GLOBEC & PWSAC begins
December 2001	GLOBEC cruise Gulf of Alaska shelf and PWS
March 2002	GLOBEC cruise Gulf of Alaska shelf and PWS
April 2002	GLOBEC cruise Gulf of Alaska shelf and PWS
May 2002	GLOBEC cruise Gulf of Alaska shelf and PWS
July 2002	GLOBEC cruise Gulf of Alaska shelf and PWS
August 2002	GLOBEC cruise Gulf of Alaska shelf and PWS
December 2002	Analysis of zooplankton samples ends
February 2002	Presentation of some aspect of results at ASLO meeting
April 15, 2003	A final draft report submitted to the Trustee council

B. Project Milestones and Endpoints

See section A above. Sample processing will lag behind cruises. PWSAC samples are collected over spring and early summer periods. Data analysis cannot begin until all samples are processed (by year-end 2002).

C. Completion Date

A final report will be submitted to the Trustee council by April 15, 2003.
Appearance of peer-reviewed publications in print will likely be during 2003.

PUBLICATIONS AND REPORTS

Results will be published in peer-reviewed journals, some in conjunction with concurrent GLOBEC studies and some as stand-alone publications. Subjects will relate to the description of the community composition, its biomass and its rates of production. Hopcroft and Coyle typically submit to Marine Biology, Marine Ecology Progress Series or Journal of Plankton Research. An internal data report is expected that will be posted on a UAF website and submitted to the Trustee council by April 15, 2003

PROFESSIONAL CONFERENCES

Both Hopcroft and Coyle normally attend at least one national meeting annually. Results from this research will likely be presented as an element of their research on such occasions.

NORMAL AGENCY MANAGEMENT

The University of Alaska does not directly support research in the absence of external funding to specific goals. The GLOBEC program funded by the National Science Foundation and the

National Oceanic and Atmospheric Administration specifically discouraged sampling efforts within PWS as compared to their target area on the shelf in the northern Coastal Gulf of Alaska.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This proposal's activities are coordinated with a number of other projects previously funded by the restoration effort (the SEA program #320), and a number of currently funded studies that also leverage on GLOBEC activities (e.g. Physical Oceanography – Weingartner #340; Stable Isotopes – Kline #311, 393, 541, part #320i). This proposal leverages extensively on logistics and infra-structure exploited at no-cost from the GLOBEC program: it effectively asks simply for the time required to process zooplankton collections, analyze data, and document the patterns and rates observed.

PROPOSED PRINCIPAL INVESTIGATOR

Dr. Russell R. Hopcroft
Institute of Marine Science
University of Alaska, Fairbanks, AK 99775-1220
Phone 907-474-7842 fax 907-474-7204 e-mail *hopcroft@ims.uaf.edu*
For qualifications of PI see CV at rear of proposal
Hopcroft will be involved in collection of samples and execution of production experiments. He will share responsibilities for data analysis and manuscript preparation with Coyle.

OTHER KEY PERSONNEL

Dr. Kenneth Coyle
Institute of Marine Science
University of Alaska, Fairbanks, AK 99775-1220
Phone 907-474-7705 fax 907-474-7204 e-mail *coyle@ims.uaf.edu*
For qualifications of co-PI see CV at rear of proposal
Coyle will be involved in collection of samples and supervision of laboratory technicians. He will share responsibilities for data analysis and manuscript preparation with Hopcroft.

Mr. Alexei Pinchuk
Institute of Marine Science
University of Alaska, Fairbanks, AK 99775-1220
Phone 907-474-7066 fax 907-474-7204 e-mail *ftaip1@uaf.edu*
For qualifications see CV at rear of proposal
Pinchuk will be involved in collection and analysis of samples and execution of production experiments.

Mr. Chris Stark
Institute of Marine Science
University of Alaska, Fairbanks, AK 99775-1220
Phone 907-474-7066 fax 907-474-7204 e-mail *fttcs@uaf.edu*
For qualifications see CV at rear of proposal
Stark will be involved in analysis of samples.

LITERATURE CITED

Cooney R. T. 1973. Zooplankton. In Hood, D. W., W. E. Sheils and E. J. Kelley (eds). Environmental Studies of Port Valdez. Institute of Marine Science Occas. Pub. No. 3, Univ. Alaska, Fairbanks, 495 pp.

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Hopcroft,R.R., & J.C. Roff. 1998. Zooplankton growth rates: the influence of female size and resources on egg production of tropical marine copepods. *Mar. Biol.* 132:79-86

Jewett, S.C. & T.C. Stark. 1994. Food and habitat utilization of juvenile hatchery pink salmon (*Oncorhynchus gorbushcha*) in Port Valdez, Alaska: 1989-92. Final Report to Alyeska Pipeline Service Company. 124 p.

Jewett, S.C. and A. Blanchard. 1997. Food and habitat utilization of juvenile hatchery pink salmon (*Oncorhynchus gorbushcha*) in Port Valdez, Alaska: 1989-95. Final Report to Alyeska Pipeline Service Company. 115 p.

Sturdevant, M.V., A.C. Wertheimer & L.M. Lum. 1996. Diets of juvenile pink and chum salmon in oiled and non-oiled nearshore habitats in Prince William Sound, 1989 and 1990. pp. 578-592. *In:* S.D. Rice, R.B. Spies, D.A. Wolfe & B.A. Wright (ed.). Proceedings of the *Exxon Valdez* Oil Spill Symposium.

Willette, M., M. Sturdevant, & S. Jewett. 1997. Prey resource partitioning among several species of forage fishes in Prince William Sound, Alaska. In Forage Fishes in Marine Ecosystems. Proceedings of the International Symposium on the Role of Forage Fishes in Marine Ecosystems. Alaska Sea Grant Program Report No. 97-01. University of Alaska Fairbanks, 1997

Willette, T.M., R.T. Cooney & K. Hyer. 1999. Predator foraging mode shifts affecting mortality of juvenile fishes during the subarctic spring bloom. Can. J. Fish. Aquat. Sci. 56:364-376.

2002 *EXXON VALDEZ* TRUS COUNCIL PROJECT BUDGET

October 1, 2001 - September 30, 2002

Budget Category:	Authorized FY 2001	Proposed FY 2002						
Personnel		$0.0						
Travel		$0.0						
Contractual		$80.4						
Commodities		$0.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal		$80.4	Estimated FY 2003					
General Administration		$5.6						
Project Total		$86.0						
Full-time Equivalents (FTE)		1.2						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

FY02

Prepared: April 2001

Project Number: 02617
Project Title: Standing Stock and Secondary Production of Prince William Sound Plankton
Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2002 *EXXON VALDEZ* TRUS COUNCIL PROJECT BUDGET
October 1, 2001 - September 30, 2002

Budget Category:	Authorized FY 2001	Proposed FY 2002	[redacted]
Personnel		$61.3	
Travel		$1.0	
Contractual		$0.0	
Commodities		$2.0	
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS
Subtotal		$64.3	Estimated FY 2003
Indirect		$16.1	
Project Total		$80.4	
Full-time Equivalents (FTE)		1.2	[redacted]
			Dollar amounts are shown in thousands of dollars.
Other Resources			

Comments:

The indirect rate is 25% TDC, as negotiated by the Exxon Valdez Oil Spill Trustee Council with the University of Alaska.

(Use this statement if there is a graduate student tuition and use proper resident or non-resident amount)
Student personnel costs include non-resident tuition of $6,048 per year.

FY02

Prepared: April 2001

Project Number: 02617
Project Title: Standing Stock and Secondary Production of Prince William Sound Plankton
Name: University of Alaska Fairbanks

FORM 4A
Non-Trustee
SUMMARY

2002 *EXXON VALDEZ* TRU COUNCIL PROJECT BUDGET

October 1, 2001 - September 30, 2002

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 2002
	R. Hopcroft	Assistant Professor	1.0	6.5		6.5
	K. Coyle	Research Associate	1.0	5.6		5.6
	Technician	Technician	12.0	4.1		49.2
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	14.0	16.2	0.0	
					Personnel Total	$61.3

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FY 2002
	Hopcroft 1 R/T Fairbanks-Anchorage	0.3	1	2	0.1	0.5
	(attend Trustee Council workshop)					0.0
	Coyle 1 R/T Fairbanks-Anchorage	0.3	1	2	0.1	0.5
	(attend Trustee Council workshop)					0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$1.0

FY02

Prepared: April 2001

Project Number: 02617
Project Title: Standing Stock and Secondary Production of Prince William Sound Plankton
Name: University of Alaska Fairbanks

FORM 4B
Personnel
& Travel
DETAIL

2002 *EXXON VALDEZ* TRUS' OUNCIL PROJECT BUDGET
October 1, 2001 - September 30, 2002

Contractual Costs:	Proposed
Description	FY 2002
Contractual Total	$0.0

Commodities Costs:	Proposed
Description	FY 2002
Project supplies	2.0
Commodities Total	$2.0

FY02

Prepared: April 2001

Project Number: 02617
Project Title: Standing Stock and Secondary Production of Prince William Sound Plankton
Name: University of Alaska Fairbanks

FORM 4B
Contractual & Commodities
DETAIL

2002 *EXXON VALDEZ* TRUS :OUNCIL PROJECT BUDGET

October 1, 2001 - September 30, 2002

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2002
			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:	Number	
Description	of Units	

FY02

Prepared: April 2001

Project Number: 02617
Project Title: Standing Stock and Secondary Production of Prince William Sound Plankton
Name: University of Alaska Fairbanks

FORM 4B
Equipment
DETAIL

BUDGET JUSTIFICATION

This proposal effectively only requests time for personnel to process and analyze zooplankton samples: most other collection costs are born by the GLOBEC program.

Hopcroft and Coyle request one month of funding each to oversee sample processing, analyze data, and prepare reports and manuscripts.

We have based our costs on 434 samples collected on seven GLOBEC cruises (27 samples per cruise requiring 3 hrs each, 8 MOCNESS samples per cruise requiring 4 hrs each) and 427 samples analyzed from selected 1997-2002 PWSAC collections requiring 3 hrs each.

A nominal cost is involved for containers to store samples.

Travel funds are requested for both Hopcroft and Coyle to attend one EVOS meeting.

Measurements of tide rip front variability in Cook Inlet, Alaska: Submitted under the BAA

Project Number:	02618-BAA
Restoration Category:	Ecosystem Synthesis/GEM Transition/New Projects/ Innovative Tools and Strategies to Improve Monitoring
Proposer:	Cook Inlet Regional Citizens Advisory Council 910 Highland Ave. Kenai, Alaska 99611
Lead Trustee Agency:	
Cooperating Agencies:	
Alaska Sea Life Center:	No
Duration:	1st year, 2-year project
Cost FY 02:	$10,890.00
Cost FY 03:	$3,500.00
Geographic Area:	Cook Inlet, Alaska
Injured Resource/Service:	

RECEIVED
APR 12 2001
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

ABSTRACT

The objective for this proposed research is to a use a vessel-mounted thermosalinograph to acquire long-term measurements of near-surface temperature and salinity to identify variability in the location and intensity of tide rip fronts in Cook Inlet, Alaska.

INTRODUCTION

This proposal is a request for funds to purchase a thermosalinograph (TSG) and ancillary hardware for installation on a response vessel operated by Cook Inlet Spill Prevention and Response, Incorporated (CISPRI). The TSG measurements of temperature and salinity in central Cook Inlet, acquired during the normal operations of the response vessel, will be used to identify variability in the locations and intensity of tide rip fronts. The results from this project will be used to improve local spill prevention and response capabilities, to provide to the developers of Cook Inlet spill trajectory models surface truth measurements for model improvement, and to assist in the development of future field programs to investigate the dynamics of tide rip fronts.

NEED FOR THE PROJECT

A. Statement of Problem

Cook Inlet, Alaska is a large estuarine embayment opening to the northern Gulf of Alaska. Extreme tidal currents dominate the circulation within the inlet. Representative tidal velocities range from about 5 m/sec near the head of the inlet to about 0.5 m/sec near the entrance. Bathymetric steering of these strong tidal currents contributes to the establishment of extensive, convergent, tide rip fronts (Figure 1). The tide rip fronts are ~100 km long and ~100 m wide. In the central inlet, current velocities associated with the tide rip fronts can exceed the background tidal flow by ~100 cm/sec and downwelling vertical velocities can reach 20 cm/sec over a depth range of 50 m (Johnson et al., 2000). These fronts are important because they are feeding zones for upper trophic level predators, they serve as migratory pathways for salmon returning to their spawning streams and, as was demonstrated during the 1987 *M/V Glacier Bay* oil spill, they collect spilled oil and move it rapidly along the front.

B. Rationale

While tide rip fronts are prominent and well-known features of Cook Inlet waters, there has been little published on their variability. What has been published (*e.g.* Burbank, 1977; Haley, et al., 2000; Johnson et al., 2000) can be characterized as "snapshots" of summer or early fall conditions. There are, however, three characteristic periods over which the location and intensity of tide rip fronts will likely vary: the semidiurnal tidal cycle (~12.4 hrs), the springs/neaps (fortnightly) tidal cycle (~14 days), and the seasonal cycle (associated with seasonal cycle of fresh water input to inlet; maximum freshwater input occurs during July to September and minimum fresh water input occurs during November to May).

From a prevention and response perspective, it would be prudent to identify and document the variability of these tide rip fronts. It is widely known among fishermen and other Cook Inlet mariners that temperature and salinity gradients are associated with these fronts. It is the location and strength of these gradients that we propose to measure with the TSG so as to be able to determine the mean locations of the tide rip fronts and to characterize their variability.

C. Location

Measurements of temperature and salinity will be acquired in central Cook Inlet, Alaska.

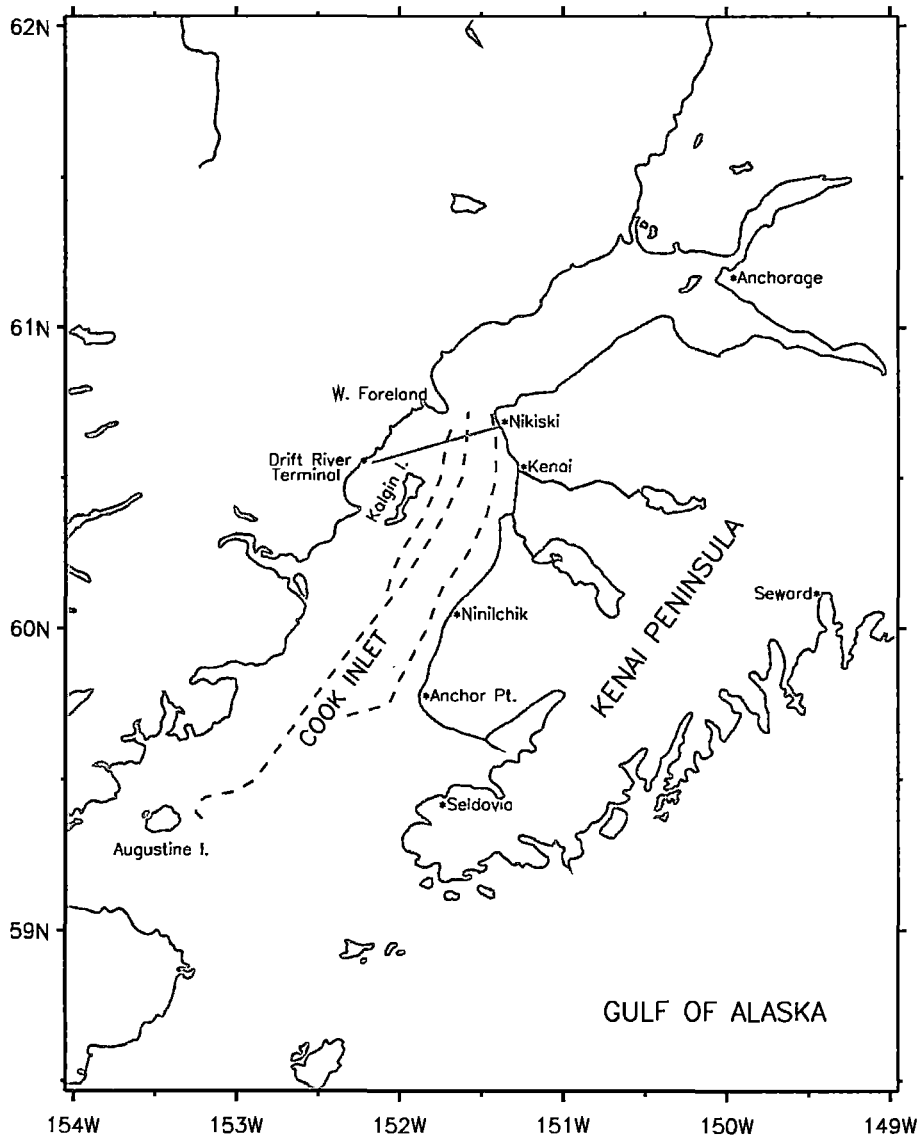

Figure 1. Location of general transect line crossing tide rip fronts in Cook Inlet.

PROJECT DESIGN

A. Objectives

The objectives for this project are to:

1. Install a thermosalinograph on the CISPRI response vessel *M/V Seabulk Montana* that operates in central Cook Inlet. Should the *M/V Seabulk Montana* be replaced with another response vessel, the TSG will be installed on the replacement vessel. Acquire long-term measurements of near-surface temperature and salinity from which the mean locations of tide rip fronts can be mapped.

2. Identify the fortnightly and seasonal variability in the surface manifestations of the tide rip fronts. If operations permit, identify the semi-diurnal variability of an individual tide rip front.

3. Identify the fortnightly and seasonal variability in the surface manifestations of the southwestward-flowing buoyancy current on the west side of Cook Inlet.

4. Provide temperature and salinity data and analyses to CISPRI and to developers of spill trajectory models.

B. Methods

The TSG will sample seawater drawn through an intake located a few meters below the sea surface using the vessel's existing seawater intake system. The TSG data stream will be merged will concurrent GPS navigation data and stored on the hard drive of a dedicated PC.

Repeat measurements (~36 round trip crossings per year) of temperature and salinity will be acquired along the primary track of the CISPRI response vessel between the dock at Nikiski and the Drift River Terminal (Figure 1) and will be used to construct time-space matrices of temperature and salinity in the central inlet. Local maxima in the along-track gradients of temperature and salinity will be used to identify the locations of tide rip fronts. The maximum sample rate of the TSG is 1 sample/second. For a vessel speed of 10 knots, this translates to a sample spacing of ~5 m, which is more than adequate to resolve 100 m wide frontal features. The vessel track crosses the three main tide rip fronts in central Cook Inlet as well as the western inlet buoyancy current and will enable the fortnightly and seasonal evolution of these features to be monitored.

The CISPRI response vessel will also make occasional trips to Anchorage (~2 trips per year), Homer/Seldovia (~8 trips per year), and western Cook Inlet (~8 trips per year) during which temperature and salinity measurements will be acquired. Although these trips are too infrequent to assess temporal variability of frontal features, the mean locations of

fronts (and spatial deviations from the mean positions) can be estimated. The statistical errors of these estimates will diminish as the number of observations increases over what are expected to be many years of data acquisition.

SCHEDULE

A. Measurable Project Tasks for FY 02 (1 October 2001 – 30 September 2002)

15 October 01:	Order TSG and associated hardware
15 December 01:	Install TSG on CISPRI vessel
1 January 02 - 30 September 02:	Data acquisition

B. Project Milestones and Endpoints

1 Oct 2001 - ongoing	Project Design Objective 1
1 Dec 2001 - ongoing	Project Design Objectives 2, 3, 4
1 Jan 2003 - 1 Mar 2003	Project Design Objective 2, 3 (use first year of data)
1 Mar 2003 - 30 Apr 2003	Prepare tide rip maps and report

C. Completion Date

30 September 2003	Completion of final report

PUBLICATIONS AND REPORTS

No publications are anticipated for FY 02.

FY 03 publication: Report on tide rip front locations and their variability

PROFESSIONAL CONFERENCES

Attend Trustee Council annual workshop in Anchorage

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Data acquired for this project will be posted on the CIRCAC website and be linked to the Cook Inlet Information Management and Monitoring System (CIIMMS) meta-database. A written report, summarizing the research conducted and results obtained, will be provided to the Trustees, to CISPRI (primary spill prevention and response contractor for Cook Inlet) and their member organizations, to NOAA/Hazmat (NOAA, in addition to CIRCAC, has a numerical spill trajectory model for Cook Inlet), and to the Kenai Peninsula Borough.

PROPOSED PRINCIPAL INVESTIGATOR (Project Manager)

Susan Saupe, Science Director
Cook Inlet Regional Citizens Advisory Council
910 Highland Ave.
Kenai, Alaska 99611
907-283-7222
saupe@circac.org

Ms. Saupe will provide project management duties. The analytical work and reporting will be conducted through a contractor who will be selected after funds are secured.

OTHER KEY PERSONNEL

Steve Russell
Cook Inlet Spill Prevention and Response, Inc. (CISPRI)
P. O. Box 7314
Nikiski, Alaska 99635
(907) 776-5129

CISPRI personnel will do the installation of the TSG at no cost to the project.

LITERATURE CITED

Burbank, D.C. 1977. Circulation studies in Kachemak Bay and lower Cook Inlet, Alaska, Dept. of Fish and Game, Anchorage, Alaska.

Haley, B., G. Tomlins, O. Smith, W. Wilson, M. Link. 2000. Mapping Cook Inlet Rip Tides Using Local Knowledge and Remote Sensing. OCS Study, MMS 2000-025, Environmental Studies Program, U.S. Department of Interior, Minerals Management Service.

Johnson, M., S. Okkonen, and S. Sweet. 2000. Modern velocity data from Cook Inlet. Cook Inlet Regional Citizens Advisory Council Report.

Budget Category:		Proposed FY 2002						
Personnel		$0.0						
Travel		$0.3						
Contractual		$2.5						
Commodities		$2.6						
Equipment		$4.5	LONG RANGE FUNDING REQUIREMENTS					
Subtotal		$9.9	Estimated FY 2003					
Indirect		$0.99						
Project Total		$10.9	$3.5					
Full-time Equivalents (FTE)		0.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources (CIRCAC)		$3.0	$3.0					

Comments: Funds are requested for the purchase of the following instruments and hardware:
--Sea-Bird Electronics model SBE 45 thermosalinograph. This model is the smaller of the two Sea-Bird thermosalinographs and is our choice due to space limitations in the sea chest of the M/V Seabulk Montana.
--Personal computer with 40GB hard drive and zip drive. The PC is required for storage of data from the thermosalinograph and GPS. Data will be periodically saved to zip disk to be made available for analysis.

We plan to issue a contract to a consulting firm to do the TSG data analysis and produce a report in FY03. We anticipate the cost of this contract to be $10000, $6000 of which will be paid for directly by CIRCAC and the remaining $4000 of which is requested from EVOS Trustees (2K in FY2002 and 2K in FY2003)..

This cost-sharing project, that will include considerable help through the use of a vessel-of-opportunity, will provide operationally useful information on Cook Inlet tide rip fronts and their variability at a very modest cost to the EVOS Trustee Council.

FY 02

Prepared: 8 April 2001

Project Number: 02618-BAA
Project Title: Measurement of Tide Rip Front Variability in Cook Inlet, Alaska--Submitted under the BAA
Name: Susan M. Saupe
Agency: Cook Inlet Regional Citizens Advisory Council

FORM 4A
Non-Trustee
SUMMARY

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 2002
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	0.0	0.0	0.0	
					Personnel Total	$0.0

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FY 2002
	AnchorageKenai R/T	0.1	1	2	0.1	0.3
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$0.3

FY 02

Prepared: 8 April 2001

Project Number:
Project Title: Measurement of Tide Rip Front Variability in Cook Inlet, Alaska-- Submitted under the BAA
Name: Susan M. Saupe
Agency: Cook Inlet Regional Citizens Advisory Council

FORM 4B
Personnel
& Travel
DETAIL

Contractual Costs:	Proposed
Description	FY 2002
Contractual costs for data analyses and report writing will be paid for in part by Cook Inlet RCAC (3K in 2002 and 3K in 2003).	2.0
Shipping	0.5
Contractual Total	$2.5

Commodities Costs:	Proposed
Description	FY 2002
Kill Cell for thermosalinograph	0.1
Miscelanneous hardware for computer and thermosalinograph	0.8
Fuel for CISPRI Vessel (1500 gallons)	1.5
Office Supplies	0.2
Commodities Total	$2.6

FY 02

Prepared: 8 April 2001

Project Number:
Project Title: Measurement of Tide Rip Front Variability in Cook Inlet, Alaska-- Submitted under the BAA
Name: Susan M. Saupe
Agency: Cook Inlet Regional Citizens Advisory Council

FORM 4B
Contractual & Commodities DETAIL

New Equipment Purchases:	Number of Units	Unit Price	Proposed FY 2002
Description			
			0.0
Thermosalinograph (SBE45)	1	2.5	2.5
GPS	1	0.5	0.5
Computer	1	1.5	1.5
			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**		$4.5

Existing Equipment Usage:	Number of Units
Description	
CISPRI Vessel (Vessel costs for CISPRI run ~8K per day, but data collection will be incorporated into their normal operations)	1

FY 02

Prepared: 8 April 2001

Project Number:
Project Title: Measurement of Tide Rip Front Variability in Cook Inlet, Alaska-- Submitted under the BAA
Name: Susan M. Saupe
Agency: Cook Inlet Regional Citizens Advisory Council

FORM 4B
Equipment
DETAIL

APR 1 2 2001

Kenai River Flats Conservation Easement and Public Education

Project Number:	02621
Restoration Category:	General Restoration/Land Acquisition
Proposer:	Mark N. Kuwada Alaska Department of Fish and Game
Lead Trustee Agency:	ADF&G
Cooperating Agencies:	
Alaska SeaLife Center:	No
Duration:	October 1, 2001 to September 30, 2002. First year of a one-year project.
Cost FY 02:	$141.0
Geographic Area:	Kenai Peninsula
Injured Resource/Service:	Pink salmon, recreation, intertidal habitat

ABSTRACT:

This proposal will protect approximately 600 acres of wetlands on the Kenai River Flats near the City of Kenai, Alaska. The acquisition of a conservation easement for the property and construction of a boardwalk will protect sensitive coastal wetlands, high value waterfowl habitat, two anadromous fish streams, and provide new educational and recreational opportunities for the public.

The conservation easement will be purchased by The Consevation Fund using funds from a North American Wetland Conservation Act grant. These funds have already been approved. The easement will specify that the property be preserved in a natural state and protected against incompatible development. The City will not sell the land in fee. A boardwalk and viewing platform will be constructed using EVOS funds to provide recreational birdwatching and educational opportunities. The boardwalk and viewing platform are essential for obtaining the City's support for a conservation easement, and they will be connected to a proposed Unity Trail system between the cities of Kenai and Homer.

INTRODUCTION

This proposal will allow the Alaska Department of Fish and Game to continue it's protection efforts in one of Alaska's most important waterfowl habitats. The Kenai River Flats, a major waterfowl use area for hundreds of thousands of birds, is under sustained pressure from development. The City of Kenai, which owns most of the Flats, has exempted itself from participating in the Kenai River Special Management Area (KRSMA). The KRSMA sets management policy and enforcement provisions for all public lands along the Kenai River. Increased levels of disturbance and habitat loss associated with high levels of recreational use and development can displace birds and diminish future use of the area. Development pressure on the Kenai River Flats can also compromise the various functions of tidal wetlands that support fish and wildlife populations in the area.

Background and Setting

The property is of generally level topography at five to ten meters in elevation. A tidal marsh community of sedges, horsetail, beach ryegrass and other plants of the coastal meadows predominate. The Soil Survey for the Kenai-Kasilof Area prepared by the U.S. Soil Conservation Service (issued June 1962) identifies the soil on the property as Tidal Marsh soils, which are fine-textured materials deposited by tidal waters on low poorly drained flats, near the mouths of the major rivers. Layers of peat and in some places layers of sand occur at any depth in the fine-textured material. The water table is almost always within a few inches of the surface. Since the ground water has a high content of minerals, the soils are typically neutral in reaction.

Tidal marshes in the Kenai River Delta are particularly valuable. In addition to providing general wetland functions, these wetlands display certain characteristics which make them both unique, and especially productive, biologically. Tidal marshes are classified as either estuarine or freshwater depending upon the presence or absence of ocean-derived salts. The property contains both estuarine and freshwater tidal wetlands.

The high biological productivity of tidal marshes is a result of the physical and biological processes which characterize these areas. Nutrient-rich estuarine waters periodically bathe these intertidal areas. In addition, dissolved organic nutrients and detrital materials enter these wetlands from inflowing river water. These influences continually fertilize the wetland, resulting in high plant productivity. Plant detritus and invertebrates produced on the Flats are in turn carried back into the river by retreating tide and floodwaters. This high productivity makes this habitat type especially valuable to fish and wildlife resources.

NEED FOR THE PROJECT

A. Statement of the Problem

The lands to be protected represent some of the highest value waterfowl and shorebird habitat on the Kenai River Flats. They contain two anadromous fish streams and are located adjacent to the Kenai Boat Launch Road, which services the City of Kenai's port and two recreational boat ramps. The port itself is a regional hub for the commercial salmon fishing fleet in Upper Cook Inlet. In addition, thousands of recreational boaters descend on the port each year to fish the Kenai River's legendary salmon runs. The port is under constant pressure to expand it's facilities and the lands in this proposal are the most logical location.

B. Rationale/Link to Restoration

The wetlands to be protected are located on the lower Kenai River, approximately one mile upstream from the river's mouth. In the spring this is one of the first locations in upper Cook Inlet to provide open water and feeding opportunities for thousands of migrating waterfowl and shorebirds. This can be critical depending upon thaw patterns in other upper Cook Inlet estuaries. Snow geese bound for Wrangell Island make this area internationally important. Cackling Canada geese, sandhill cranes and thousands of ducks bound for the Yukon/Kuskokwim Delta make the area continentally important.

Two anadromous fish streams transit the property providing a continuous source of freshwater input. The streams and possibly freshwater upwelling are responsible for the early snowmelt observed in the area.

Because of the concentrated waterfowl and shorebird resources, the area also receives high levels of recreational use including activities such as birdwatching and photography.

Birds: The Kenai River Flats provides habitat which is used heavily by a variety of waterfowl and shorebirds. The Flats are especially important to northward migrating snow geese. Snow geese are protected by international treaty and virtually the entire population of Wrangell Island (Siberia) snow geese pass through the Kenai River Flats each spring, usually between mid-April and May 1. Up to 6,500 snow geese per day rest and feed for a 3- to 10-day period, building fat reserves crucial to their migration to Wrangell Island.

Tavener's Canada geese, cackling Canada geese and white-fronted geese bound for the Yukon-Kuskokwim River Delta often remain longer than the snow geese. Black brandt and emperor geese have been observed on the Flats, but rarely. Some swans rest and feed on the Flats during the spring migration.

The most abundant migratory ducks utilizing the Kenai River Flats include northern pintail, mallard, green-winged teal, northern shoveler, and American widgeon. Other migrating duck species which commonly utilize the Kenai River Flats include bufflehead, common goldeneye, and common and red-breasted merganser. Less commonly observed migrating waterfowl include gadwall, harlequin duck, canvasback, Barrow's goldeneye, eurasian widgeon and teal, scoters and scaups. Nesting waterfowl include Tavener's Canada geese, mallard, pintail and green-winged teal. Sandhill crane arrive as the geese depart and hundreds have been observed on the Kenai River Flats during the spring and fall migrations. Most of these birds are migratory but some

remain to nest on the Flats.

Shorebirds nesting on the Kenai River Flats and wetlands upstream of the Flats include semi-palmated plover, greater and lesser yellowlegs, least sandpiper, short-billed dowitcher, red-necked phalarope and spotted sandpiper. Migratory shorebirds include pectoral sandpiper, western sandpiper, Hudsonian godwit, black-bellied plover, whimbrel, dunlin, common snipe and Pacific and American golden plover. Common snipe are most abundant in the fall and thousands of pectoral sandpipers have been observed on the Flats during fall migration.

Rare shorebird migrants include sharp-tailed and solitary sandpipers, and surfbirds. Predatory birds dependant upon the ducks and geese include the peregrine falcon and northern harrier. Large colonies of herring and mew gulls are present on the Flats and some glaucous-winged and Bonapart's gulls also nest there.

In all, over one hundred species of birds have been documented.

Mammals: Black bears occasionally use the area although automobile traffic and Port activities tend to make sightings fairly rare.

Moose are much more common. Moose surveys conducted on the Kenai Peninsula have indicated average densities within one mile of the Kenai River of 4.2 and 6.7 moose per square mile respectively.

Preferred moose browse varies by area and season. Willow is the favored winter food. Birch and aspen are also used as a food source and are found along both sides of the Kenai River. Moose will browse in early spring on emergent plants along rivers, bogs, and muskegs.

Caribou use the area frequently. Caribou were eliminated on the Kenai Peninsula by 1913, but were reintroduced north of the Kenai River in the mid-1960s. An important calving and summer range for the lowland caribou herd now exists in the Kenai River Flats and extends to wetlands north of the Kenai Airport.

Other mammals occasionally found in the area include wolf, wolverine, lynx, coyote, short-tailed weasel, red fox, snowshoe hare, and several species of voles and shrews.

Fish: The Kenai River supports 34 fish species representing 16 taxonomic families. Thirty species are native to the Kenai River and four are exotic species, which have been introduced. Twelve species are residents of the river, 11 are anadromous and 11 are found in the lower area of the river and associated with the marine or brackish water environment.

Salmon species include chinook (Oncorhynchus tshawytscha), coho (O. kisutch), sockeye (O. nerka), and pink salmon (O. gorbuscha). These species are the most important to humans in terms of consumptive use. Pink salmon occur predominantly during years ending in even numbers, but small numbers are also present during odd numbered years. Chum salmon (O. keta) are present, but are rarely observed in the Kenai River.

There are two documented anadromous fish streams on the property that support chinook, sockeye and coho salmon.

Human Use: The Kenai River is one of the most productive and economically important rivers in Alaska. It is road accessible to over 70 percent of the state's population and accounts for almost 19 percent of the total statewide sportfishing effort.

The river itself is 67 miles long and drains a watershed of approximately 2200 square miles. It is, for tens of thousands of Alaska residents and visitors alike, an essential recreation destination. The Kenai River is widely known for its chinook (king) salmon populations, which are among the largest of this species in the world. Additionally, the Kenai River produces millions of sockeye, coho, pink and chum salmon. Over the past 10 years, the Kenai River system has annually produced approximately 40 percent of the commercial sockeye salmon harvest in Cook Inlet and 30 percent of the commercial chinook salmon harvest. During this period, the chinook harvest ranged from 8,000 to 40,000 fish and the sockeye harvest ranged from 2.5 to 9.5 million fish. Combined, sport anglers and commercial fishermen provide as much as $78 million to the state's economy each year (Liepitz, 1994).

Because of the intensive commercial, recreational and personal use fisheries that occur in Cook Inlet and the Kenai River, the City of Kenai boat dock receives a high level of use during the summer.

Human use of the area is generally limited because of wet conditions. However, many local residents and an increasing number of visitors use the Boat Launch Road and Warren Ames Bridge Access Road for birdwatching and photography in the spring and summer.

In conclusion, the project area is heavily used by fish and wildlife but threatened by increasing levels of disturbance and port development. Acquisition of a conservation easement will provide perpetual protection and lasting educational and recreational benefits.

C. Location

T5N, R11W, Sec. 9, Seward Meridian. The property is bounded on the north by the City of Kenai's Boat Launch Road, and on the east by the Warren Ames Bridge Access Road. The remainder of the property consists of extensive wetlands situated adjacent to the Kenai River. Access may occur from either road, or the Kenai River.

COMMUNITY INVOLVEMENT

The City of Kenai will benefit from the proposal by connecting the planned boardwalk and bird viewing platform to the proposed Unity Trail system that is planned to connect the cities of Kenai and Homer, and communities in between.

PROJECT DESIGN

A. Objectives

The specific project objective is to acquire a protective conservation easement on approximately 600 acres of Kenai River Flats wetlands. As part of the process, an educational and recreational facility will be constructed and signage developed that describes the values of the protected property.

B. Methods

Upon commitment of EVOS funds the ADF&G will enter into negotiations with The City of Kenai to develop a conservation easement. Once the terms of the easement have been approved by all parties the ADF&G will commission a preliminary commitment for title insurance and an appraisal of the Kenai River Flats property. A hazardous materials inspection of the property will be conducted by the Alaska Department of Natural Resources. Once clear title to the property is established and an appraisal is completed the ADF&G will purchase a conservation easement at fair market value. Prior to closing, the Alaska Department of Law (ADOL) will draw up a warranty deed for the purchase. EVOS funds will be transferred to the City of Kenai Public Works Department through a cooperative agreement for design and engineering drawings of the boardwalk and viewing platform. After drawings have been approved by the ADF&G Project Manager additional funds will be released for construction of the boardwalk and viewing platform, which will begin in August and progress until completion. The entire project, including acquisition of a conservation easement on approximately 600 acres of wetlands, is expected to be completed within a year after receipt of funding.

C. Cooperating Agencies, Contracts and Other Agency Assistance

Contract with the City of Kenai to construct the boardwalk and viewing platform through its Public Works Department.

SCHEDULE

A. Measurable project tasks for FY01 (October 1, 2001 - September 30, 2002)

October, 2001 – Project approval and receipt of funds. Work begins on developing a conservation easement.

December, 2001 - Once an easement has been finalized, work will begin on a cooperative agreement with the City of Kenai to transfer $120,000 for construction of a boardwalk and viewing platform.

March, 2002 – Review design plans and approve construction schedules. Conduct title review.

May, 2002 – Commission appraisal. Conduct hazmat survey. Finalize closing documents.

August, 2002 – Begin constructing boardwalk and viewing platform.

September, 2002 – Complete acquisition of conservation easement, boardwalk and viewing platform.

B. Project milestones and endpoints

Completion of Conservation Easement agreement.
Completion of boardwalk and viewing platform design.
Completion of project construction.

C. Completion Date

September, 2002.

PUBLICATIONS AND REPORTS

The Kenai River Flats Conservation Easement project will produce draft and final copies of a project report.

PROFESSIONAL CONFERENCES

None.

NORMAL AGENCY MANAGEMENT

N/A

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The project will coordinate closely with the EVOS restoration office, Alaska Department of Natural Resources, Alaska Department of Law, and The Conservation Fund.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

N/A

PROPOSED PRINCIPAL INVESTIGATOR

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PRINCIPAL INVESTIGATOR

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EVOS TC Restoration Office

FY 02 *EXXON VALDEZ* TRU! COUNCIL PROJECT BUDGET

October 1, 2001 - September 30, 2002

Budget Category:	Authorized FY 2001	Proposed FY 2002
Personnel		$13.0
Travel		$1.0
Contractual		$115.0
Commodities		$2.0
Equipment		$0.0
Subtotal	$0.0	$131.0
General Administration		$10.0
Project Total	$0.0	$141.0
Full-time Equivalents (FTE)		0.2
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2003					

Dollar amounts are shown in thousands of dollars.

Comments:

Two month's salary to administer design and construction contract with the City of Kenai and develop a conservation easement. Conservation easement to be purchased using North American Wetlands Conservation Act (NAWCA) funds. Additional contractual funds used for survey, appraisal, title research, appraisal review and hazmat survey.

FY02

Prepared:

Project Number: 02621
Project Title: Kenai River Flats Conservation Easement and Public Education
Agency: ADF&G

FORM 3A
TRUSTEE
AGENCY
SUMMARY

FY 02 *EXXON VALDEZ* TRU COUNCIL PROJECT BUDGET

October 1, 2001 ptember 30, 2002

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2002
						0.0
Mark N. Kuwada	Principal Investigator - Project Manager	18/L	2.0	6.5		13.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		2.0	6.5	0.0	
					Personnel Total	$13.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2002
					0.0
RT Kenai/Anchorage	0.1	10	10		1.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$1.0

FY02

Project Number: 02621
Project Title: Kenai River Flats Conservation Easement and Public Education
Agency: ADF&G

FORM 3B
Personnel
& Travel
DETAIL

Prepared:

Contractual Costs:	
Description	Proposed FY 2002
Boardwalk/Viewing Platform - Design, Labor, Materials, Signage	110.0
Conservation Easement - Review Appraisal, Title Research, Hazmat	5.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$115.0

Commodities Costs:	
Description	Proposed FY 2002
Long distance charges, aerial photographs, copier, network and computer support	2.0
Commodities Total	$2.0

FY02

Project Number: 02621
Project Title: Kenai River Flats Conservation Easement and Public Education
Agency: ADF&G

FORM 3B
Contractual & Commodities DETAIL

Prepared:

FY 02 *EXXON VALDEZ* TRU COUNCIL PROJECT BUDGET

October 1, 2001 - September 30, 2002

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2002
			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:	Number	Inventory
Description	of Units	Agency

FY02

Project Number: 02621
Project Title: Kenai River Flats Conservation Easement and Public Education
Agency: ADF&G

FORM 3B
Equipment
DETAIL

Prepared:

Digital Map Product Development from existing Seasonal

Environmental Sensitive Area Maps

of Cook Inlet/Kenai Peninsula, Alaska

RECEIVED
APR 09 2001
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Project Number:	02622
Restoration Category:	General Restoration
Proposer:	Hazardous Materials Response and Assessment Division, National Oceanic and Atmospheric Administration (NOAA)
Lead Trustee Agency:	NOAA
Cooperating Agencies:	None
Alaska Sea Life Center:	No
Duration:	1st year, 1-year project
Cost FY 02:	$36,600.
Geographic Area:	Cook Inlet and Kenai Peninsula
Injured Resource/Service:	All resources and services injured by the *Exxon Valdez* spill, since it is a sensitive areas mapping project

ABSTRACT

A series of national standardized digital map products will be produced from the existing seasonal environmental sensitive index (ESI) maps for Cook Inlet/Kenai Peninsula made by NOAA in 1994. A four map seasonal series was originally developed for Cook Inlet by the NOAA Hazardous Materials Response and Assessment Division in the ArcInfo digital format with the output and distribution primarily being poster maps at a scale of 1:450,000. Since then, combined with the greater demand for digital products, NOAA's digital ESI products have greatly expanded. NOAA proposes to transform the existing Cook Inlet/Kenai Peninsula digital data into a four-tiered nationally standardized set of digital map products with the deliverable being 100 CD's. These will be the same products that were just recently provided for the Prince William Sound ESI mapping project for EVOS contract # 99368.

INTRODUCTION

One of the primary objectives of spill response, after protecting human life, is to reduce the environmental consequences of the spill and clean-up efforts. This objective is best achieved if the locations of sensitive resources are identified in advance of a spill so that protection priorities can be established and clean-up strategies identified. The most widely used approach to sensitivity mapping in the United States is known as the Environmental Sensitivity Index (ESI). This approach systematically compiles information in standardized formats for shoreline sensitivity, biological resources, and human-use resources. The strategy emphasizes standardization in the following areas: definitions of shoreline sensitivity rankings; data structures for organizing resource information; and map formats, for both electronic and hard copy output.

ESI maps have been prepared for Cook Inlet/Kenai Peninsula in two formats: 1) a detailed atlas consisting of 50 maps at a scale of 1:63,360 published in 1985; and 2) a series of four seasonal maps each at a scale of 1:450,000 published in 1994. The summary maps are a subset of the more detailed data included in the ESI atlas, focusing on the most sensitive resources. Summary maps have also been produced for Kodiak Island/Shelikof Straits in 1997, for the Beaufort Sea in 1999, for Prince William Sound in 2001, and for SE Ak in 1992, 1995, and 2001. Since 1992 all the products have been rendered digitally, and since 1998 the digital map products have been developed following national standardized formats.

NOAA proposes to update the Cook Inlet summary maps digital data to these new national standardized formats. These include the following:

1. Full GIS format
2. Desktop Mapping format
3. Free ESI Viewer format
4. PDF ESI Navigator format

All these above digital products were provided just this spring to EVOS as part of the Prince William Sounds ESI update project. It is also anticipated that minor content updates may be included in this Cook Inlet/Kenai Peninsula project as the result of new information learned from the numerous studies of the impacts of the Exxon Valdez oil spill and/or new information that may be available from the natural resource agencies since 1994. However, it is anticipated that no new seasonal summary poster-style maps of Cook Inlet/Kenai Peninsula will be printed.

NEED FOR THE PROJECT

A. Statement of Problem

The seasonal sensitivity maps of Cook Inlet/Kenai Peninsula have been shown to be a valuable tool for oil spill planning and response. At this point this data is only available in a poster-style format, and needs to be upgraded to a variety of digital map products for greater accessibility and usefulness.

B. Rationale/Link to Restoration

Updating the original digital files of the summary maps will satisfy several needs:

1) The existing maps are primarily available only as a series of four poster-style maps. Updating the digital files to all the above mentioned digital products will vastly expand the availability and usefulness of the ESI information. The information will be more readily accessible to decision makers, stake holders, resource managers and the public.

2.) Since the Cook Inlet ESI maps were last updated in 1994, a minor amount of new content data may need to be added to them.

3) The process of gathering data and reviewing the maps will provide the opportunity for resource agencies to discuss the concepts of what resources are most sensitive and require priority protection.

C. Location

The area to be covered by the seasonal sensitivity maps will be the same as the existing maps, that is, all of Cook Inlet and the outer Kenai Peninsula coast east to Day Harbor.

COMMUNITY INVOLVEMENT & TRADITIONAL ECOLOGICAL KNOWLEDGE

NOAA will work with the Cook Inlet Regional Citizen Advisory Council to make sure that the communities in Cook Inlet are aware of the mapping and digital update project and given the opportunity to participate and comment.

PROJECT DESIGN

A. Objectives

The objective of the mapping project is to:

Update the digital map output of the seasonal sensitivity map series for Cook Inlet/Kenai Peninsula, with the integration of minor content updates from the results of studies on the biological and human-use resources in the area since 1994.

B. Methods

NOAA has taken the lead in the U.S. in developing standards for sensitivity mapping for oil spill planning and response. Detailed guidelines for developing sensitivity maps have recently been revised and described in an October 1997 manual, *Environmental Sensitivity Index Guidelines, Version 2.0*, published as NOAA Tech. Memo. NOS ORCA 115, by the Hazardous Materials Response and Assessment Division. The Cook Inlet/Kenai Peninsula digital updates of the seasonal sensitivity map series will be produced in accordance with these guidelines, following the map content and format as used in the recent projects in the Kodiak Island/Shelikof Strait, in the Beaufort Sea, and in Prince William Sound.

The methods used for updating the 1994 summary Cook Inlet/Kenai Peninsula digital ESI data are basically in house procedures that will be carried out by our GIS staff. The output will be digital map data of Cook Inlet in four different digital formats. These include the following:

1. Full GIS format: double-precision ARC export files along with the relational database files

2. Desktop Mapping format: ArcView 3.x project and shape files where each major data element corresponds to a theme with links in place to the comprehensive flat file data structure. Data are also provided in single-precision MOSS format (MOSS is a simple ASCII format suitable for writing translators to other mapping software packages).

3. Free ESI Viewer: This freeware mapping and data base engine allows viewing, printing and simple query of the ESI data. Designed to run on either a PC or Macintosh platform, this program allows users without access to other mapping software to explore the digital ESI data. It is simple to install and a guided tour is provided on each CD.

4. ESI's in PDF format: Each of the four seasonal summary ESI maps will appear as a PDF file allowing zooming and panning. It is complete with an entire introduction which includes photos and descriptions of the shoreline types mapped. In this PDF format, the maps can be made available on the World Wide Web.

The 1994 summary ESI maps of Cook Inlet/Kenai Peninsula will be reviewed by the Alaskan Sensitive Areas Working Group (ASAWG) to determine if any minor content updates are necessary. The ASAWG consists of all the state;/federal natural resource agencies, the land management agencies, and the resource regulatory agencies. Also, primary data providers will be contacted, particularly for those databases that are regularly updated by management agencies. Examples include the USFWS digital database and colony status record files for seabird colonies and eagle nest sites, and the ADF&G catalog of waters important to anadromous fish.

Since NOAA has produced similar map products recently, we have good working relationships with all of the key data providers and technical experts who will be reviewing the maps. If any new data needs to be added or old data modified NOAA has established protocols for obtaining the necessary data from each source and for the review process.

Description of Sensitive Resources that are Shown on the Seasonal Maps

ESI atlases are comprised of three general types of information:

1) Shoreline Habitat Classification – Shoreline habitats are ranked according to a scale relating to biological sensitivity, natural persistence of oil, and ease of cleanup.

2) Biological Resources – Includes oil-sensitive animals and non-shoreline habitats such as submerged aquatic vegetation.

3) Human-Use Resources – Specific areas that have added sensitivity and value because of their use by humans, such as high-use amenity beaches, parks, marine

The seasonal maps show a sub-set of the most sensitive resources. Thus, only the most sensitive shoreline types are shown, namely:

ESI 5	Exposed Tidal Flats
ESI 8	Sheltered Rocky Shores
ESI 9	Sheltered Tidal Flats
ESI 10	Marshes

NOAA has developed a standard biological scheme which identifies seven major biological elements, based on major taxonomic and functional groupings. Each element is divided into groups of species, or sub-elements, with similar taxonomy, morphology, life-history, and/or behavior relative to oil spill vulnerability and sensitivity. Table 1 lists the biological resources that are included on the seasonal sensitivity maps for Cook Inlet. Table 2 lists the human-use resources to be included on the maps. This list will be reviewed based on meetings with community representatives, natural resource trustees, and response organizations.

TABLE 1. Biological resources to be included on the seasonal sensitivity map series for Cook Inlet/Kenai Peninsula.

Data element	Sub-element	Areas/Sites to be mapped
Marine Mammal	Pinniped (harbor seal and northern sea lion)	Haulouts, concentration areas
	Sea otter	Concentration areas
	Whale	Migratory or other concentration areas
Terrestrial Mammal	Deer	Intertidal concentration areas
	Small mammal (river otter)	Aquatic fur-bearer concentrations
Bird	Seabirds (see list in text)	Nesting colonies; concentration areas
	Raptor (bald eagle)	Nesting sites; concentration areas
	Shorebird	Migratory concentration areas
	Waterfowl	Wintering and migratory concentrations
	Passerine	Threatened/endangered or rare occurrences
Fish	Anadromous fish	Spawning streams
	Pacific herring	Spawning areas
Shellfish	Bivalve	Harvest areas; abundant beds
Habitat/Rare Plant	Rare plant	Threatened/endangered or rare species or communities
	SAV	Submerged aquatic vegetation

TABLE 2.Human-use resources to be included on the seasonal sensitivity map series for Cook Inlet.

Data element	Sub-element	Comments
Recreation/Access	Marina	Site
	Landing strip	Site
Management Area	National Park	Boundary
	State Park	Site
	National Forest	Boundary
	National Wildlife Refuge	Boundary
	State Critical Habitat Area	Boundary
Resource Extraction	Aquaculture site	Hatcheries
	Commercial fishery	Set-net sites
	Subsistence fishing	Designated key harvest sites
Cultural Resources	Archaeological site	Water-, coastal-, wetland-associated
	Historical site	Water-, coastal-, wetland-associated
Other Features	Oil facilities	
	Port facilities	
	Communities	
	Political boundaries	Boroughs
	Roads	
	Dispersant pre-approval zones	
	Annotation	

Final output products will consist of one hundred (100) CD's containing the updated digital map products for the summary Cook Inlet/Kenai Peninsula ESI maps.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Cooperating agencies who will provide information and review the digital map products include:

Alaska Department of Fish & Game

Alaska Department of Natural Resources

U.S. Fish & Wildlife Service

National Marine Fisheries Service

Communities of Tyonek, Nanwalik, Seldovia, Nikiski, Kenai, Soldotna, Homer and Seward

Cook Inlet Regional Citizens Advisory Council

Also, in-kind contributions have been obtained from a wide range of partners involved in oil spill planning and response.

Alyeska will provide access to their natural-resource databases for the Outer Kenai Peninsula and Lower Cook Inlet.

Alaska Department of Conservation has agreed to provide funding so that the state resource agencies can budget adequate time to review the existing ESI data for Cook Inlet/Kenai Peninsula and provide updates as necessary.

SCHEDULE

A. Measurable Project Tasks for FY 02 (October 1, 2001 - September 30, 2002)

The project schedule is outlined below.

October 1:	Review content of 1994 summary ESI maps of Cook Inlet/Kenai Peninsula and provide any new or updated data to NOAA
January 31:	Finalize the digital files of the Cook Inlet/Kenai Peninsula summary ESI maps
April 1:	Finalize the updated digital files into the four standardized digital map products
June 1:	Prepare and review CD's of the above
July 31:	Distribution of final CD of the updated digital data of the Cook Inlet/Kenai Peninsula summary ESI maps

B. Project Milestones and Endpoints

The milestones and endpoints for this project are straightforward: a digital database and CD's, completed within one year. The schedule is shown above.

C. Completion Date

The updated digital databases will be completed during FY02.

PUBLICATIONS AND REPORTS

There are no planned publications or reports, outside of the 100 CD's with the updated digital data map files and the associated metadata.

PROFESSIONAL CONFERENCES

None anticipated.

NORMAL AGENCY MANAGEMENT

Although NOAA HAZMAT is in the normal business of making ESI maps throughout the United States, updating the digital format of the Cook Inlet/Kenai Peninsula summary ESI map series would not normally receive attention until much later. The last edition was developed in 1994 and, as a result, retains adequate accuracy for use in oil spill response. Also, since 1989, Alyeska has developed a Graphical Resource Database (GRD) of the biological and human-use resources of a large portion of the Cook Inlet/Kenai Peninsula area that was last updated in 2000. This digital-only product has been made available to all the resource agencies in a read-only version (the files are in a rather proprietary, arcane format that makes that virtually inaccessible). In Alaska, NOAA is currently involved in a four-year program to complete the ESI mapping of Alaska's coastline, namely all of the western coastline. Nationally there is a drive to update and convert ESI maps to a digital format, and NOAA HAZMAT is heavily involved in this effort. Considering the vast amount of sensitive Alaska and U.S. coastline and the present status of the Cook Inlet/Kenai Peninsula resource data, NOAA would not be undertaking this digital ESI update of Cook Inlet/Kenai Peninsula as part of its normal activities in the near future. Yet we recognize the need for EVOS Restoration to make information from the EV spill area as available and accessible as possible to decision makers, stake holders, resource managers, and the public.

This ESI summary mapping project will allow us the unique opportunity to display all this data in several digital formats that are consistent and uniform, thus making the information more accessible to a much larger audience.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

There will be a high degree of coordination among Trustee and management agencies in all phases of this project: initial summary map content review, gathering updated data, and reviewing the digital products. Interaction will be initiated with the principal investigators of pertinent EVOS projects to ascertain new information that has been developed on locations and areas of concentrations of biological species that populate the Cook Inlet/Kenai Peninsula area. Since much of this data is not expected to change from the 1994 compilation, much of this project will be an internal computer exercise. Once digital prototypes of the final map products become available, a strong effort will be made to have resource managers and EVOS principal investigators "test out" the clarity, usefulness, and accuracy of these presentations.

PROPOSED PRINCIPAL INVESTIGATOR

John Whitney, Ph.D, NOAA HAZMAT, Anchorage, Alaska

PRINCIPAL INVESTIGATOR QUALIFICATIONS

Dr. Whitney is the NOAA Scientific Support Coordinator for Alaska. He has managed the last six seasonal sensitivity mapping projects conducted by NOAA and the U.S. Coast Guard, namely Kodiak Island/Shelikof Strait, the Prince William Sound ESI update, the Beaufort Sea, S.E. Alaska, the Aleutian Islands, and the Pribilof Islands.

OTHER KEY PERSONNEL

Robert Pavia, Ph.D, Acting Chief of NOAA HAZMAT and head of all NOAA HAZMAT ESI projects

Jill Petersen, HAZMAT Geographic Information System Specialist

Budget Category:	Authorized FY 2001	Proposed FY 2002
Personnel		$3.0
Travel		$1.0
Contractual		$30.0
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$34.0
General Administration		$2.6
Project Total	$0.0	$36.6
Full-time Equivalents (FTE)		0.1
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2003					

Dollar amounts are shown in thousands of dollars.

Prepared: 4/6/01

02622

Personnel Costs:		GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FY 2002
Name	Position Description					
Jill Petersen	NOAA GIS Specialist	GS/13/7	1.0			3.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		1.0	0.0	0.0	
					Personnel Total	$3.0

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 2002
Description					
Anchorage-Kenai-Homer-Seward-Anchorage	0.2	4	4	0.1	1.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$1.0

Prepared: 4/6/01

Contractual Costs:		Proposed
Description		FY 2002
Data collection, compilation, and digitization		15.0
Digital Map Preparation and Production		15.0
When a non-trustee organization is used, the form 4A is required.	**Contractual Total**	$30.0
Commodities Costs:		Proposed
Description		FY 2002
	Commodities Total	$0.0

Prepared: 4/6/01

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2002
			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	Inventory Agency

Prepared: 4/6/01

A CPR-Based Plankton Survey Using Ships of Opportunity to monitor the Gulf of Alaska "Submitted Under the BAA"

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APR 1 1 2001
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Project Number:	02624-BAA
Restoration category:	Monitoring
Proposer:	Sonia Batten (Sir Alister Hardy Foundation for Ocean Science) & David Welch (Pacific Biological Station, DFO, Canada)
Lead Trustee Agency:	
Cooperating Agencies:	
Alaska SeaLife Center:	No
Duration:	1st year, 1-year project
Cost FY 02:	$124,700
Cost FY 03:	$000,000
Geographic Area:	Prince William Sound, Gulf of Alaska, Bering Sea
Injured Resource/Service:	Pacific salmon, Commercial fishing

ABSTRACT

This proposal presents the rationale for developing a plankton monitoring program for the Gulf of Alaska using ships of opportunity. Plankton are a critical link in the marine food chain whose dynamics are poorly understood, but respond rapidly and unambiguously to climate change and form the link between changes in the atmosphere and valuable upper trophic level populations, such as salmon, herring, shrimp, and groundfish. We review the evidence that many of the most valuable marine resources in the Gulf of Alaska are strongly influenced by changes in ocean climate. SoOPs are a cost effective platform for large scale monitoring and this proposal builds on recent experience gained with the CPR in the N. Pacific to prepare for the GEM program.

INTRODUCTION

During 2000, and again in 2001, Continuous Plankton Recorders (CPR) have been deployed along an oil tanker route originating in Prince William Sound to initiate an ocean observing system for the Gulf of Alaska. This proposal seeks to make the experience gained during this study available to the GEM program. The current GOA CPR program was built on the long experience of using CPRs in the Atlantic where ships of opportunity have been towing them for over 70 years. The Sir Alister Hardy Foundation for Ocean Science (SAHFOS) has a long track record in working with a variety of commercial shipping companies, in some cases decades of collaboration with the same company, and operates CPRs on upwards of 20 different routes every month in its traditional sampling area. This experience was invaluable in setting up the north Pacific sampling (Fig 1 and described below) in 2000/2001 and successfully acquiring samples.

A cost effective monitoring program under GEM is likely to use ships of opportunity as the fundamental platform for collecting a wide variety of data because of the costs and time restrictions on using oceanographic vessels. Consistent timing in the scheduling of research ships over many years is unfeasible, and the costs of running special-purpose vessels prevents repeated sampling within a year. Repeat sampling is critical if changes in seasonal timing are to be identified. Our experience so far, which we describe so far, has been restricted to plankton and some basic physical data but this could be extended.

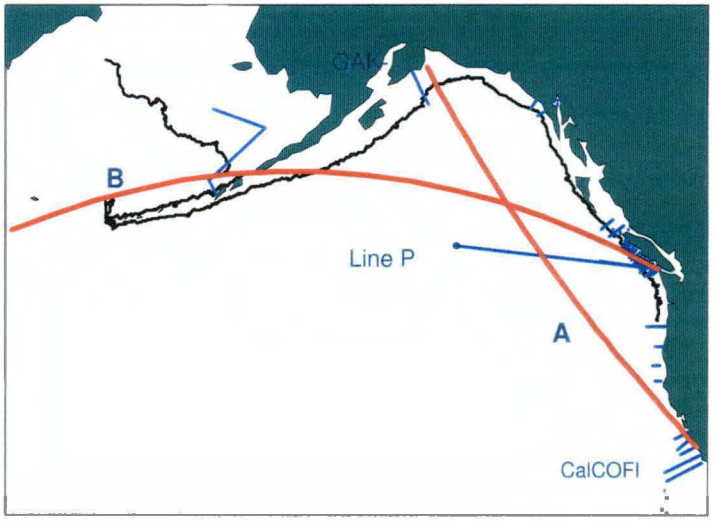

Fig. 1. The CPR plankton monitoring lines (A & B; in red), compared to other NE Pacific ocean monitoring locations (blue). The continental shelf edge is shown in black.

Zooplankton provide the link between primary production and higher trophic levels, providing food directly for some species such as herring, young salmon, and some whales and indirectly for all marine fish, birds, and mammals. They are sensitive to environmental change and because they have short life cycles (typically less than one year and often only months) provide a rapidly responding indicator of the state of the ecosystem and important scientific information on how climatic changes (such as regime shifts) alter ecosystems to affect marine fish populations. Furthermore, interpretation of their fluctuations is free from the considerations of fishing effort because they are not a harvested resource.

This proposal seeks funding for 2001/2002 to support the monitoring program recently begun under the North Pacific Marine Research (NPMR) fund. Significant progress towards a monitoring program for the Gulf of Alaska has been made with this two year project using ships of opportunity and the CPR. These data will provide some baseline information on plankton populations. However, if an optimum monitoring program is to be designed and implemented by GEM and other agencies it is necessary to continue this sampling and build on the approach. The NPMR project was advocated and supported by PICES and has been included as a pilot project

by the Living Marine Resources panel of the Global Ocean Observing System. Current funding finishes in Fall, 2001.

NEED FOR THE PROJECT

A. Statement of problem

Placement of oceanographic instrumentation packages on ships of opportunity has been proven as a cost effective means of acquiring useful data; however, implementing an effective program requires substantial expertise. The flexibility of the ship of opportunity platform needs to be considered so that appropriate measurements and the most suited instruments to obtain them can be used. The short-term objective of this proposal is to develop the sampling infrastructure, the spatial and temporal scales necessary to establish changes in the ocean distribution and abundance of plankton.

Monitoring of the physical environment to aid interpretation of the changes is in some ways simpler than acquiring the detailed biological information. The CPR is a proven (with quantifiable limitations), rugged, cost effective oceanographic instrument that provides species level information. GEM's mission is to *"sustain a healthy and biologically diverse marine ecosystem in the northern GOA and the human use of the marine resources in that ecosystem through greater understanding of how its productivity is influenced by natural changes and human activities"*. Our proposal will aid that mission by providing essential data and building a bridge to a much larger international monitoring effort for the North Pacific.

Large scale changes in Pacific salmon populations in all regions of western North America have been related to climate change in this century. Although best studied in salmon, similar influences are also thought to occur for other important upper trophic level organisms. The initial cause is likely due to changes in the structure of the atmosphere and then the ocean, which then pass up the food chain through the plankton to affect the fish and mammal populations at higher trophic levels. These changes are known to affect the abundance, productivity, and community structure of both continental shelf and open ocean plankton communities. The changes in plankton abundance have been related to the changes in salmon abundance, and reduced ocean productivity is probably the causal link leading to poor survival of salmon and other important resources in the ocean. These changes appear to have extended back centuries (e.g. Ware 1995), and to have affected a wide variety of Alaskan resources including shrimp and groundfish (e.g. Anderson and Piatt 1999) and salmon (e.g. Finney 1998).

Both the Pacific Ocean and Bering Sea lack the long-term monitoring necessary to detect changes in the ocean. This hampers our ability to detect and respond to either short or long-term climate change. Climate change seems to have driven the overall dynamics of Pacific salmon populations in the past, and to have been as important as the effect of commercial fisheries in determining population levels. Friedland (1998) has suggested that ignorance of decadal-scale changes in ocean productivity will doom salmon management efforts to failure in the Atlantic. Such comments probably apply equally to the Pacific. In addition, the effects of anthropogenic climate change due to global warming over the next few decades are expected to dwarf the climatic changes observed to date. To put the amount of future climate change expected in perspective, global warming is expected to successively add as much warming each following decade as has been observed over the entire 20th century. The cumulative change over the next

century is projected to be ten times that experienced in this century—and the changes in this century are the greatest in 1,000 years.

The climatic changes experienced in recent years are consistent with expectations from models for the early stages of global warming. In all regions of the West Coast of North America there have been abrupt changes in the productivity of salmon populations. These changes have not been expected from the standard fisheries management theories, nor could they be forecast from available data. However, the changes have had devastating economic impacts on coastal communities from Oregon to (most recently) Alaska. The pattern of failure in year-class strength of western Alaska chum and chinook populations or Bristol Bay sockeye salmon, as well as other many stocks and species in British Columbia and the Pacific Northwest demonstrates that the cause of the sudden downturn has a largely marine origin (e.g. Welch *et al* 2000). However, salmon spend part of their life history in both coastal and oceanic marine environments, and are therefore subject to environmental changes occurring in both regions.

An advantage of developing the CPR as oceanographic instrumentation on ships of opportunity for the GEM program is that it builds on existing work that has been endorsed by the scientific committee of PICES. Funding this proposal would put in place a monitoring framework that will build on the existing two years of baseline data collected using the CPR. At the PICES VIII annual meeting in October 2000 the PICES community struck a CPR Advisory Committee, which has begun moving towards developing a monitoring program that would eventually include a much broader range of environmental parameters using ships of opportunity (T, S, nutrients, Chl-a, photosynthetic rates from Fast Repetition Rate Fluorometry, and zooplankton size-structure (using OPCs (optical plankton counters)).

The changes that the Atlantic CPR program has documented in the 1990s are now being linked to the decline in Atlantic salmon populations, which are also experiencing substantially increased ocean mortality. Funding for our proposal would allow continued sampling of the plankton in multiple regions of the offshore and coastal regions of the eastern North Pacific and southern Bering Sea (Fig. 1). The monitoring lines would (a) sample the plankton along the coastal migration routes of the juvenile salmon in four locations, (b) quantify the distribution and abundance of plankton in the offshore (which appears to drive the abundance of shelf plankton populations in the Atlantic (Steele 1998); the relationship of shelf to offshore populations is unclear in the Pacific because of a lack of data), and (c) permit cross-comparisons with almost all existing eastern Pacific ocean surveys (CalCOFI in California; Line P in Canada; and GAK-1 near Seward, Alaska).

The lack of large-scale Pacific monitoring in the past has the advantage that setting up a proper basis for monitoring is not limited by worries about disrupting existing time series. Developing the new survey now, with the benefit of 70 years of experience in the Atlantic, is allowing us to tailor-make a survey specific to the ecosystem of the north Pacific that will take advantage of the revolution in automated monitoring sensors now occurring, and which will eventually complement the detailed zooplankton species identification possible with the CPR. This proposal seeks the support to extend the two year survey while we put in place the foundations of a long-term monitoring programme. Funding will also be sought elsewhere to broaden the survey and strengthen the involvement of other North Pacific agencies.

We are already in a time of apparently unprecedented climatic change. We relate the existing proposal to parallel initiatives to develop improved scientific monitoring and secure long-term

funding in a later section of the proposal. This initiative has been discussed by both the Monitoring Task Team at the PICES Annual Meeting in Hakodate Japan (October 2000), and designated as a GOOS-LMR pilot project for the North Pacific by the IOC Living Marine Resources Panel of the Global Ocean Observing System (GOOS), Third Session, Talcahuano Chile, in December 1999. This followed on an earlier LMRP report that noted: "In the PICES region, work was described in the north-west Pacific that could constitute an LMR (Living Marine Resources) pilot project, as could a north-east Pacific plan being developed for use of the Continuous Plankton Recorder (CPR)".

B. Rationale/Link to Restoration

The Trustee Council is planning the future of the oil spill restoration program through the formulation of a long-term research and monitoring effort, GEM. A ships of opportunity program originating in Prince William Sound using CPR technology makes a direct contribution to the development of GEM. The types of data acquired by CPR and other instruments that may be deployed using our approach would be appropriate to evaluating hypotheses regarding sources of change in productivity from earlier restoration projects (i.e. Sound Ecosystem Assessment, SEA). In particular, the role of changes in climate (i.e. "weather", when considered on decadal scale averages) in changing productivity would be amenable to evaluation by CPR and related data collected from ships of opportunity. Observations of climate change in the atmosphere and simple physical variables such as sea temperature and atmospheric pressure are readily available. These data show that large scale physical changes are evident which seem to be associated with changes in ocean productivity observed in upper trophic levels (i.e. fish production). However, correlative relationships frequently break down, and the lack of a mechanistic understanding of how the North Pacific can rapidly shift from one state to another ("regime shifts") limits our ability to manage these resources by setting harvest rates appropriate to the productivity of the populations. The data necessary to show directly that changes in primary or secondary plankton production are occurring have not been collected in a systematic fashion in the North Pacific, and have largely depended on opportunistic sampling from Japanese research ships sampling a series of transects only once a year.

The existing data linking intermediate trophic levels to the changes in the physical environment and to the changes in fish production are sporadic and based largely on mid-summer ocean sampling, and have not been collected in a way that allows identification of species composition changes. Mackas (1998) has demonstrated that the timing of the movement of the dominant zooplankton species to the surface mixed layer where they are available to salmon has shifted forwards by at least two months in the eastern North Pacific, emphasising the need for replicate sampling to establish seasonality. Neither the changes in seasonality observed in the Pacific (Mackas 1998) or the large changes observed in the Atlantic (Reid and Planque, 1999) would be identified by simply supporting the existing plankton collection framework in the Pacific Ocean; without the CPR survey the only repeated open ocean sampling of plankton in the eastern Pacific Ocean is the Canadian Line P, which is now typically occupied only 3 times per year (February, May-June and August-September). Batten *et al* (1998) used the Atlantic CPR data to evaluate the changes in the plankton before and after the Sea Empress oil spill in the Bristol Channel to see whether that oil spill had a measurable effect on the plankton community. Without similar data from baseline monitoring programs in the Pacific it will be impossible to address questions of how marine communities may change over time or whether specific anthropogenic effects have caused changes in the ecosystem.

It is important to study the ecosystem dynamics of regions outside of Prince William Sound or even the continental shelf region seaward of the Sound. The ocean outside Prince William Sound apparently forces plankton abundances within the sound (Cooney, *pers. comm.*). In the Atlantic, where much more plankton sampling has been carried out, shelf populations of *Calanus* are known to be driven by off-shelf populations. Steele (1998) comments "*The Calanus story described earlier, and corresponding work in the Pacific (Parsons and Lalli, 1988) indicates the need to consider the open ocean as the starting point for major shelf populations [of zooplankton]*".

In the Pacific Ocean, Cooney (1986) noted that "*The degree to which the* [Alaskan] *shelf is enriched by oceanic biomass can be estimated by measuring both the standing stocks and the rate of onshore surface flow. Cooney (1984) proposes that over an eight month period from March to November of each year, ~10x10^6 mt of zooplankton biomass are advected shoreward from the upper 50m of the bordering ocean. This biomass then moves into the outer edge of the Alaska Coastal Current along 1000 km of coastline in the northern Gulf of Alaska. This advected zooplankton biomass compares to the ~2x10^6 mt estimated as the production yielded by zooplankters resident in the Alaska Coastal Current. If this calculated contribution is at all accurate, the bordering ocean supplies an immense and significant amount of biomass to both shelf and coastal food webs each year*".

C. Location

For these reasons, it is important to place an ocean monitoring program in a broad context, and not to artificially restrict the study to only a small geographic area, since climatic change and environmental forcing may be expressed on much broader scales. Line A from our proposal would allow cross-comparison with historical plankton sampling done on the GAK-1, Line P, and CalCOFI lines (Fig. 1). Line B would provide comparison with the central Gulf of Alaska, the shelf on the south-western end of the Alaska Peninsula, and the southern Bering Sea and western Aleutians. These are all regions extensively used by Alaskan salmon during their ocean migrations, and therefore have relevance to Alaskans from many areas of the state.

COMMUNITY INVOLVEMENT AND TRADITIONAL KNOWLEDGE

With only one year it is not practical to set up a local analysis facility since training in plankton identification takes many months before sufficient proficiency is acquired. However, in the long term a local station where such analyses could be carried out, with quality control and exchange procedures facilitated by an organisation such as SAHFOS, would be sensible and desirable. The keen understanding of nature shown by many native communities suggests that in the future it may be possible to train local individuals as technicians in the art and practice of taxonomic identification.

PROJECT DESIGN

A. Objectives

1. To develop and apply the ship of opportunity approach to oil tankers and other large merchant vessels in order to obtain data on lower trophic levels for the Gulf of Alaska and adjacent waters.
2. To deploy the CPR from ships of opportunity on selected transects and to process the samples obtained for plankton species abundances. This third year of data would significantly enhance our understanding of the plankton communities of the Gulf of Alaska; determination of the extent of large scale spatial heterogeneity in the plankton of this region will aid the planning of the GEM sampling program and go some way towards establishing the expected degree of seasonal and interannual variability.
3. To further enhance the use of ships of opportunity by supplementing the biological data with physical sensors. The first year of data collection has identified large changes in plankton community composition and biomass within different regions of the Gulf of Alaska. A desirable long-term goal is to extend the sampling program to include a broader range of physical, chemical, and biological variables. As a first step, we suggest that sensors be installed to collect data on temperature, salinity, and fluorescence that can be compared with the zooplankton data from the CPR. A self-contained T-S-F unit that can be mounted on the towed CPR is available at modest cost (ca. $15,000 plus operating costs), but collaboration with the proposal by Okkonen and Royer to place a thermosalinograph and fluorometer internal to the ship would be preferable because of the scientific collaboration that would result. The ultimate goal of a ship of opportunity monitoring program would be to have a fully self contained suite of sensors either internal to the ship or on a towed body. This objective would go some way towards realising that goal.

B. Methods

Standard CPR methodology

CPRs are towed in the surface mixed layer at a depth of about 7m by commercial ships of opportunity on their regular routes of passage. Water enters the front of the CPR through a small square aperture (1.27cm), passes along a tunnel and through a silk filtering mesh (with a mesh size of 270μm) which retains the plankton and allows the water to exit at the back of the machine. The movement of the CPR through the water turns an external propeller which, via a drive shaft and gear-box, moves the filtering silk across the tunnel at a rate of approximately 10cm per 18km of tow. As the filtering silk leaves the tunnel it is covered by a second band of silk so that the plankton are sandwiched between these two layers. The silk and plankton sandwich is then wound on into a storage chamber containing preservative. At the end of the tow the machine is returned to the laboratory and the silks are processed in a routine way. The silk is cut into separate samples (each representing 18kms of tow and about $3m^3$ of seawater) which are randomly apportioned amongst the analysts for plankton analysis. (The $3m^3$ sample volume analyzed is comparable to that which would be measured by an OPC towed along the same track line).

The first step is the assessment of phytoplankton colour (the greenness of the sample) which is determined by comparison with standard colour charts. It is a representation of the total phytoplankton biomass and includes the organisms that are too fragile to survive the sampling process intact but which leave an impression on the silk. Hard-shelled phytoplankton are then semi-quantitatively determined under a microscope by viewing 20 fields of view and recording

the presence of all the different taxa in each field. Small zooplankton are identified and counted into categories of abundance from a subsample (1/50 of the sample) whilst all zooplankton larger than about 2mm are counted with no subsampling. Identification is carried out to the highest practicable taxonomic level and is a compromise between speed of analysis and scientific interest. Since copepods make up the vast majority of the zooplankton most copepods are identified to species level whilst rarer groups are identified to a lower level. Although CPR sampling is continuous, the midpoint of the sample is used to label it with latitude, longitude, time and date. All of this information is stored on a relational computer database so that the questions of when, where, and how much can be answered. All of the samples are archived after analysis so that they can be re-examined at any time, for example, if a scientist with an interest in a specific group wishes to study it in more detail, or an incident occurs which warrants closer examination of the samples from that area.

The CPR is a relatively simple, rugged piece of oceanographic equipment. It can withstand being deployed from large ships moving at speeds of around 20 knots and still function, and over 95% of tows successfully record plankton. It has the ability to carry instruments to record the physical environment of the plankton which can be invaluable supplementary information when distinguishing between communities. A high level of expertise is needed to carry out the taxonomic analysis but SAHFOS has an excellent team of analysts, some members with over 30 years of experience.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

We propose that the collection of temperature, salinity and fluorometric data be assigned to Drs Okkonen and Royer (UAF and Old Dominion Universities) under their proposed project, but in the event that they are unable to do so SAHFOS can arrange for the purchase and maintenance of a self-contained instrument to collect this data. Welch is employed by DFO in Canada and is chairman of the PICES *"Climate Change and Carrying Capacity"* program. PICES also sponsors the CPR research with its CPR advisory panel, which is constituted under the Monitoring Task Team of the 4Cs program. These agencies will contribute staff time and institutional resources to the project but do not require funding from this proposal.

SCHEDULE

A. Measurable Project Tasks for FY 02 (October 1, 2001 – September 30, 2002)

January 14-23:	Attend annual restoration workshop
January:	Liase with shipping company regarding 2002 schedule. Arrange and carry out any necessary davit transfer or testing.
February:	Ship equipment to vessel in Long Beach
Late March :	First sampling from Alaska to California
Late April:	Second sampling from Alaska to California
May:	Ship equpiment to vessel in Vancouver
Early June:	Third sampling from Alaska to California
Mid June:	Sampling from Vancouver to Kamchatka (coincident with Line P cruise)
Mid July:	Fourth sampling from Alaska to California
Mid August:	Fifth sampling from Alaska to California
Early October:	Attend PICES XI meeting, China.

B. Project Milestones and Endpoints

April:	Sampling schedule will be confirmed (although still subject to change according to requirements of the Shipping companies)
August 31st:	All 2002 sampling completed Integrate biological data with physical data acquired by Okkonen and Royer
September 30th:	Preliminary taxonomic processing complete. Quality control will be ongoing
October, 2002:	Attend PICES X meeting (China) and CPR Advisory Panel to present and review results and collaborate for development of broader scientific program.

C. Completion Date

All sampling will be completed during Fiscal year 02. Taxonomic processing will also be completed during FY02 although it is anticipated that quality control will be ongoing after September 2002, according to normal SAHFOS procedures. Analysis of the results and completion of the final report will be achieved by the deadline of April 15th 2003.

PUBLICATIONS AND REPORTS

It is not expected that publications will be submitted during FY02, since sampling will not be completed until the latter part of the year. However, at least one publication will be prepared upon completion of the analyses.

PROFESSIONAL CONFERENCES

Funding is already secured for attendance at the PICES X meeting which occurs just in FY02. Although the PICES XI meeting will be held just after the end of FY02 (in mid October 2002) we ask for support for one CoPI (Batten) to attend this meeting. PICES has been instrumental in the setting up of the Pacific CPR sampling and the results from this proposal will be reviewed at the CPR advisory panel and MONITOR task team meetings. Review and collaboration with the Pacific science community will be essential to strengthening future monitoring efforts.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Primary collaboration is most simply achieved by coordination of this project with the Okkonen & Royer proposal to collect basic physical oceanographic data on the same oil tankers, which will provide useful synergies and a broader base to the monitoring effort. The collected CPR data are freely available to other investigators and we have already had discussions with Weingartner et al's GAK-1 project (EVOS Project 340: Long-Term Oceanographic Monitoring), and the Canadian Line P program (Dave Mackas has also taken on the role as chair of the PICES MONITOR task team, and Charlie Miller of OSU is the chair of the PICES CPR Advisory Panel).

PROPOSED PRINCIPAL INVESTIGATOR

Dr Sonia Batten
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Telephone 44-(0)1752-221112
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Telephone 1-250-7556-7218
Fax 1-250-756-7053
Email welchd@pac.dfo-mpo.gc.ca

PRINCIPAL INVESTIGATOR

Sonia Batten –. Will oversee the sampling program, processing of samples and carry out statistical analyses of the acquired data. Will coordinate production of the final report and publications. Qualifications: PI on NPMR project, SAHFOS Assistant Director

David Welch – Will take responsibility for co-ordinating the broader scale monitoring effort, and developing a co-ordinated program amongst the Pacific science community. Welch is currently co-PI on the NPMR project, and chairman of the PICES 4Cs program and the Alfred P. Sloan Foundation's Census of Marine Life Pacific project, "POST".

Experience of SAHFOS

The Continuous Plankton Recorder (CPR) was devised in the 1920s by Sir Alister Hardy, who wanted a simple, cost effective way of sampling the plankton. He intended the CPR to provide information on plankton for the herring fishermen (then an important commercial North Sea fishing industry) to enable them to better assess fishing prospects on the basis of the type of plankton present. Right from the beginning Hardy intended that the results of the survey be used as an aid to understanding changes in stocks, to improve fishery management and help determine the potential productivity of the seas. He designed the CPR to be towed behind commercial ships on their regular routes of passage and so avoided expensive research ships. The first operational tow took place in 1931 and since then, apart from a break for the Second World War, the CPR survey has operated continuously in the seas around Britain and now world-wide. It is one of the longest running marine monitoring programmes in the world and since 1931 more than 200,000 samples have been analysed and CPRs have been towed for over 4 million miles.

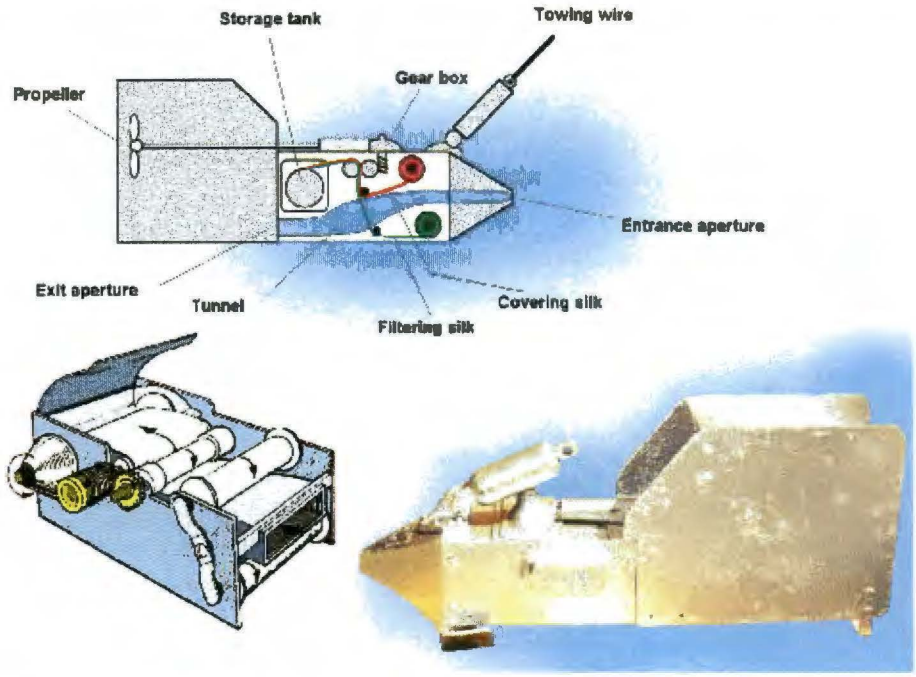


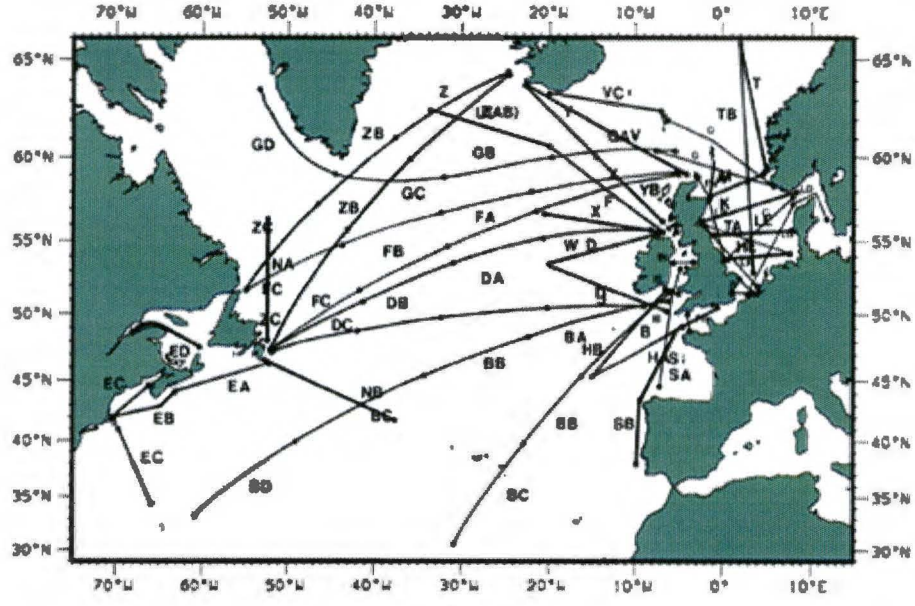
Diagram showing a cutaway view of the original CPR , the plankton filtering mechanism, and a photograph of the instrument.

The CPR survey today

Although originally publicly funded, a change in science policy forced the closure of the survey in 1989. International concern compelled a rescue package to be immediately set in place

to enable the team of analysts and technicians to stay together until the official establishment of the Sir Alister Hardy Foundation for Ocean Science (SAHFOS) which was set up as a charitable trust to operate the CPR survey. Since its inception in 1991 SAHFOS has grown into a dynamic research operation receiving funding from all over the world to maintain and deploy Hardy's device across the seas and oceans, to analyse and interpret the results and provide this information to the scientific community. The staff complement of around 18 includes two technicians who service the Recorders, administrative and logistics staff and a team of 13 analysts (including some part-time) who carry out the taxonomic analysis, manage the database and undertake research. SAHFOS also hosts students and researchers from all over the world who want to use the data for their own studies. The business of the Foundation is overseen by a Council of Management made up of a President, Vice-President, Treasurer and Trustees. Sponsoring Governors from each of the agencies contributing to the funding are also invited to participate in Council meetings.

At present, approximately 25 routes operate each month from the SAHFOS base in the UK (Fig. 2). These routes cover the North Sea and North Atlantic which has historically been the main area of coverage, however, in 1996 sampling began in the Gulf of Guinea, West Africa, during 1997 a Mediterranean survey began and in 1998 the Baltic was sampled for the first time.



Plankton survey routes in the North Atlantic. At present, equivalent monitoring of the eastern North Pacific Ocean does not exist, except for point samples taken 2-3 times per year along the Canadian survey, Line P.

OTHER KEY PERSONNEL

Captain Peter Pritchard is the operations manager of SAHFOS and has over 10 years experience in liasing with shipping companies to arrange towing of CPRs. Will be responsible for coordinating the sampling program through regular communication with shipping agents and Masters/crew and arranging dispatch and return of equipment.

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Accomplishments To Date

The first year of sampling with the CPR in the North Pacific went exceptionally well. Excellent co-operation and support for the program was achieved with two shipping companies who operated on the desired routes. Polar Tankers Inc. (originally ARCO Marine Inc.), who towed an initial pilot survey for SAHFOS in 1997, operated the crude oil carrier *Polar Independence* from Valdez to Long Beach throughout 2000. Seaboard International Shipping Company Ltd operated the container ship *Skaubryn* from Vancouver to Japan and offered to tow a CPR on any of these trips. Both companies gave considerable support and assistance to SAHFOS over and above helping with logistics by communicating ship schedules as soon as was practicable. All six deployments (Fig. 2) successfully collected samples and although a few samples were lost owing to mechanical glitches, over 95% of the target sampling was achieved.

Initial taxonomic processing of the 2000 samples is complete although quality control of some samples is still ongoing. Preliminary findings from these data show that *Neocalanus plumchrus*, the largest contributor to mesozooplankton biomass in the Gulf of Alaska, varies its developmental duration, and therefore the timing of its peak biomass, by as much as five weeks according to latitude (Batten *et al.,* in prep.). Much of this variability can be explained by

temperature differences, and is not surprising given that temperature is known to influence the duration of invertebrate development. However, the extensive CPR sampling enabled such a pattern to be described, and potentially quantified, for the first time. Understanding the variability of zooplankton biomass determined by ocean climate conditions is essential to interpreting the data collected through monitoring efforts.

The community composition of the samples collected on the single east west transect was examined and an ordination of the data (Fig 3) showed that distinct communities could be identified. This is an encouraging result, verifying that the CPR approach is capable of distinguishing different regional communities, and thus allowing changes in their distribution, or community composition, to be tracked.

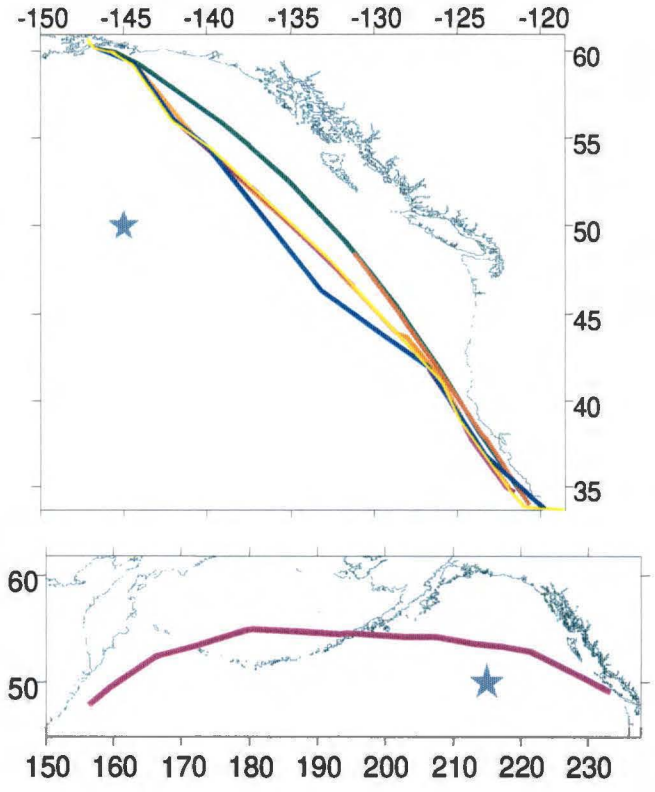

Figure 2. The positions of the transects operated in 2000. (a) Monthly N-S and (b) E-W in June. Key to colours: March (Green), April (Red), May (Brown), June (Violet), July (Blue), August (Orange). Station Papa is shown for reference (Star).

The sampling programme for 2001 is underway, as this proposal is submitted, with a similar sampling strategy to 2000. Further analyses of the 2000 data will be undertaken, including statistical determinations of the spatial variability (decorrelation length scales for example) and continued assessments of temporal variability as the 2001 data become available.

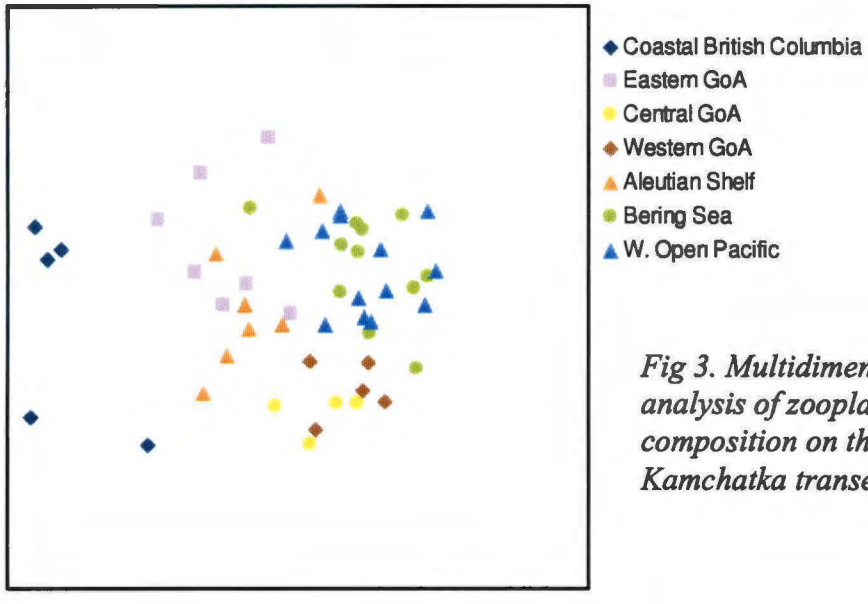

Fig 3. Multidimensional scaling analysis of zooplankton community composition on the Vancouver to Kamchatka transect in June/July 2000.

FY 02 *EXXON VALDEZ* TRU E COUNCIL PROJECT BUDGET

October 1, 200 - September 30, 2002

Budget Category:	Authorized FY 2001	Proposed FY 2002	LONG RANGE FUNDING REQUIREMENTS					
Personnel		$57.7						
Travel		$5.2						
Contractual		$33.3						
Commodities		$5.5						
Equipment		$0.0						
Subtotal	$0.0	$101.7	Estimated					
Indirect		$23.0	FY 2003					
Project Total	$0.0	$124.7						
Full-time Equivalents (FTE)		1.5						
			Dollar amounts are shown in thousands of dollars.					
Other Resources								

Comments:

Indirect rate is 40% of salary (personnel) costs

$0 for NEPA compliance (Not Applicable)
$2 for annual restoration workshop attendance
$3.8 for report writing (1 month for S.Batten)
$0 for publications (peer reviewed publications will be submitted, however, the results from FY02 will not be published within FY02 on current publishing timescales)
$3.2 for professional conferences (PICES XI)
$0 for community involvement.

No other funds are anticipated, although efforts will be made to obtain funding for further sampling or processing of collected samples.

FY02

Prepared: April 6th 2001

Project Number: 06024-BAA
Project Title: A CPR-Based Plankton Survey Using Ships of Opportunity
Name: Sir Alister Hardy Foundation for Ocean Science

FORM 4A
Non-Trustee
SUMMARY

FY 02 *EXXON VALDEZ* TRU : COUNCIL PROJECT BUDGET

October 1, 200. September 30, 2002

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 2002
	S. Batten	Principal investigator/lead researcher	3.5	3.8	0.0	13.3
	P. Pritchard	Operations Manager	1.0	4.1	0.0	4.1
	R. Barnard	Technician	1.0	2.8	0.0	2.8
	L. Gregory	Technician	1.0	2.8	0.0	2.8
	Various	Taxonomists (team of ~12 people)	11.5	2.9	0.0	33.4
	D. Stevens	Data Manager	0.5	2.5	0.0	1.3
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	18.5	18.9	0.0	
					Personnel Total	$57.7

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FY 2002
	S. Batten and D. Welch to attend annual restoration workshop	0.8	2	4	0.1	2.0
	S. Batten to attend PICES XI meeting	1.2	1	10	0.2	3.2
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$5.2

FY02

Project Number:
Project Title: A CPR-Based Plankton Survey Using Ships of Opportunity
Name: Sir Alister Hardy Foundation for Ocean Science

FORM 4B
Personnel & Travel
DETAIL

Prepared: April 6th 2001

FY 02 *EXXON VALDEZ* TRU : COUNCIL PROJECT BUDGET

October 1, 200 . eptember 30, 2002

Contractual Costs:	Proposed FY 2002
Description	
Replacement/testing of Davit - A davit already has been purchased for ARCO vessel but may need transferring to another vessel and safety testing	12.0
Leasing of Continuous Plankton Recorders ($0.9 per tow)	5.4
Transport of CPRs for servicing between tows, and servicing costs	12.0
Computing services (these are provided by the Plymouth Marine laboratory at an agreed rate PA. Pro rata costs indicated)	3.9
Contractual Total	$33.3

Commodities Costs:	Proposed FY 2002
Description	
Filtering mesh ($0.2 per unit)	5.5
Commodities Total	$5.5

FY02

Prepared: April 6th 2001

Project Number:
Project Title: A CPR-Based Plankton Survey Using Ships of Opportunity
Name: Sir Alister Hardy Foundation for Ocean Science

FORM 4B
Contractual & Commodities DETAIL

FY 02 *EXXON VALDEZ* TRU[illegible]E COUNCIL PROJECT BUDGET
October 1, 2001 - September 30, 2002

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2002
none needed			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
existing CPRs will be used. Rental costs charged above cover replacement and repair	
external bodies	2
internal mechanisms	11

FY02

Project Number: 0262 4-BAA
Project Title: A CPR-Based Plankton Survey Using Ships of Opportunity
Name: Sir Alister Hardy Foundation for Ocean Science

FORM 4B
Equipment
DETAIL

Prepared: April 6th 2001

A Symbiotic Acoustic Signal Processor (SASP) to Increase Stock Assessment Effort; Submitted under the BAA

RECEIVED
APR 12 2001
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Project Number:	02627-BAA
Restoration Category:	Monitoring
Proposer:	BioSonics, Inc.
Lead Trustee Agency:	
Cooperating Agencies:	
Alaska SeaLife Center:	No
Duration:	1st year of 1-year study
Cost FY 02:	$159,800
Geographic Area:	Prince William Sound/Gulf of Alaska
Injured Resource/Service:	Pacific herring, Pink salmon, Sockeye salmon, Commercial fishing

ABSTRACT

We are proposing a Symbiotic Acoustic Signal Processor (SASP) system, consisting of a high resolution digital sonar receiver that attaches to an existing shipboard echo sounder and routes the output over an Ethernet connection to displays, storage, and processing systems. This system provides the capability to store geo-referenced raw digital acoustic data in an established scientific format to PC hard disk. The data collected and analyzed using this system can determine abundance and distribution of stocks within the sampled areas. The design philosophy provides a low cost system that is extremely simple for a skipper to operate, does not require dry-dock installation or towing of an underwater transducer sled, and does not affect the operation of the currently installed echo sounder.

INTRODUCTION

Scientists operating aboard research or charter vessels have conducted stock assessment tasks using a variety of methods. Scientific hydroacoustic techniques have been used to determine the abundance and distribution of many stocks with good success. In many cases, a large research vessel with an installed scientific quality hydroacoustic system is required to complete these assessment tasks. We propose to develop a cost-effective tool using these same scientific hydroacoustic techniques installed on commercial vessels to improve monitoring of commercially fished stocks injured by the oil spill.

NEED FOR THE PROJECT

A. Statement of Problem

The depressed condition of many commercially fished stocks places additional requirements on managers and scientists to accurately assess abundance. Patchiness of stocks often increases as abundance decreases, presenting additional challenges in stock assessment. Additionally, as abundance decreases the distribution of effected stocks will likely change and mobility may increase. Current levels of assessment effort may not be able to detect these changes and may not provide adequate levels of precision and accuracy to define stock levels and properly manage fisheries. Employing the necessary number of properly equipped and manned research vessels may not be economically possible. One alternative is to utilize information from echo sounders installed on other commercial vessels. However, the existing echo sounders on most commercial vessels are not calibrated or designed to collect scientific quality acoustic data. Installing scientific-quality hydroacoustic systems on commercial vessels can provide an unobtrusive, non-lethal, and legally defendable sampling tool for estimating the abundance and distribution of fish stocks.

B. Rational/Link to Restoration

This proposal addresses the need for monitoring of commercial fish stocks to determine their ongoing recovery. We propose to instrument commercial vessels with a system that would allow collection of geo-referenced scientific quality acoustic data in an industry standard format. Commonly called a "Ships of Opportunity" echo sounder, the proposed design addresses many of the unique requirements of such a system. This system will be constructed from existing proven building blocks. The first system component involves a high-resolution high dynamic range acoustic receiver that provides a scientific quality digital output for displays, storage, and signal processing. This receiver is based on the BioSonics DT/DE scientific echo sounder, and the low cost and flexibility of the proposed device will allow installation on most or all boats in a fishing fleet.

A working commercial fishing vessel interfaces with a "ships of opportunity" assessment program in unique ways. Most skippers cannot afford the time or cost of placing the vessel in drydock for transducer installation, nor is it convenient or practical to tow an underwater transducer sled or have a side-mounted transducer. They often rely on the ship's echo sounder to obtain information on fish location, and would not want to observe the interference and acoustic cross-talk from another echo sounder. They also would not have time or inclination to learn a complicated scientific system. The proposed system avoids these problems. The system

attaches to the ship's existing echo sounder and utilizes the signal generated by its transmitter and transducer while not affecting their function. With a few simple keystrokes, the proposed system will collect scientific quality data to a computer hard drive. The industry standard data format and geo-referenced data will provide a significant increase in the assessment effort for a variety of fish stocks. When this system has proven its capabilities in the fishing industry, management agencies may consider mandating its use on all vessels fishing on specified stocks.

Several byproducts of this system are expected. The color echogram displayed by the system is of higher quality and resolution than video screen displays. The skipper will have more information on which to base decisions on when to set gear to increase profitability and reduce bycatch. A future step in development of this system is the creation, testing, and ground-truthing of software for measuring parameters from patches and aggregations of fish for determination of species. Prototype "speciation" software has been written based on techniques found in the peer-reviewed literature, but has not been applied to a commercial fishing endeavor in a systematic way.

Because this project has the potential for implementation of long-term monitoring of commercial fish stocks for the GEM (Gulf Ecosystem Monitoring), funding for development and testing of the system during the GEM transition year is critical.

C. Location

Engineering work will be completed in our facility in Seattle. Field testing of units is anticipated to occur both in the Gulf of Alaska and off the East Coast of Canada. Successful completion of the project will produce benefits for most areas that have commercial fisheries. Although part of this project is research, the primary component involves increasing monitoring capabilities of commercial stocks.

BioSonics, Inc. is an 8500ft^2 laboratory, manufacturing, and office complex located at 4027 Leary Way NW, Seattle, WA 98107, Phone (206) 782-2211, Fax (206) 782-2244. The company employs a technical staff of 11 engineers and scientists with a total staff of 18. The following BioSonics facilities and equipment will be available for this project:

- transducer manufacturing facility;
- echosounder manufacturing and assembly facility;
- calibration tank and instruments for lab testing of equipment and transducer calibrations;
- 20' twin outboard cabin cruiser used for testing echosounders and transducers in nearby marine and freshwater environments

Our manufacturing facility allows us to design, fabricate, and test all prototype equipment. Our location in the Pacific Northwest allows us easy access to various freshwater and marine sites for in situ testing.

COMMUNITY INVOLVEMENT AND TRADITIONAL KNOWLEDGE

Commercial fishermen will be involved during the testing and implementation phases of this proposal. By involving fishermen in the stock assessment process, a relationship will be strengthened between resources managers and harvesters. Additionally, a high-resolution echo

sounder will provide a more accurate picture to the fishing skipper, resulting in fewer false sets, higher recognition of target species, and a reduction in bycatch. These items provide benefit both to the community and to the environment.

PROJECT DESIGN

This proposal is submitted under the Ecosystem synthesis/GEM Transition component. It provides needed capabilities to increase long term monitoring of fish stocks harvested commercially or used by marine mammals.

A. Objectives

Objectives addressed in this proposal are defined as:

1. Design, manufacture, and testing of prototype smart interface (see items 4-7 in the technical overview section below). Included would be the high impedance connection, the mix frequency synthesizing, and the creation of a trigger pulse from the host transmit pulse.

2. Adapt the hardware and software currently implemented in the DT4000 scientific echo sounder to utilize the smart interface and incorporate the timing data from the interface (see item 8 in the technical overview section below).

3. Design, manufacture, and test an embedded PC with Ethernet output capability (items 10, 11 in the technical overview section below)

4. Modify existing software to provide display functions (items 13, 14 in the technical overview section below) on a PC.

5. Integration of components and field testing of system

The above objectives will be addressed to complete the design, manufacture, and testing of the data collection component. A future objective is based on the successful completion of the above steps:

6. Analyze collected data using existing prototype speciation software. Evaluate existing speciation algorithms. Propose, implement, and test a variety of new algorithms (FFT, fractal dimension are examples).

   The above objective advances the knowledge base of speciation algorithms.

B. Methods

Technical Overview of Symbiotic Acoustic Signal Processor (SASP) System

The SASP is envisioned as a symbiotic sonar receiver that attaches to echo sounders installed on fishing vessels. A block diagram of the SASP is provided in Figure 1.

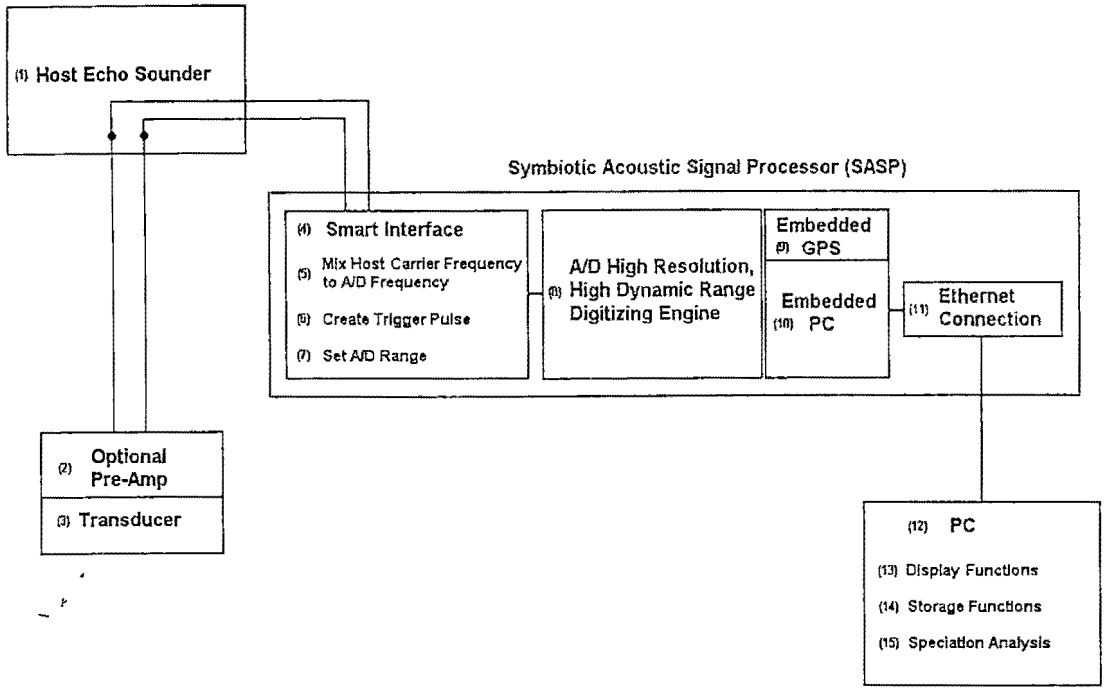

Figure 1. Block Diagram of SASP

SASP components are itemized in Figure 1. Items 1-3 indicate the host echo sounder and transducer installed on a fishing vessel. The SASP system interfaces to the ship's existing echo sounder through the Smart Interface (4). This interface extracts the acoustic signal from the host echo sounder through a high impedance connection so that the host signal is not loaded down. The host signal is mixed with a synthesized frequency (5) to heterodyne it down to the correct frequency for quadrature sampling. The interface also gates out the high voltage transmit pulse of the host but creates a timing pulse from it for internal use (6). The period between timing pulses is converted into an A/D sampling range (7), allowing the SASP to track pulse repetition rate changes of the host echo sounder. The SASP will utilize the high dynamic range analog-to-digital conversion designed for the BioSonics DT6000 scientific echo sounder (8). This component samples at a 41.667 kHz rate and has a dynamic range without TVG of 120 dB. Please see Appendix A for a reprint of the Sea Technology publication, June, 1999, for reference (note: Appendix A in hard copy only, the publication is not available in electronic format). Time Varied Gain (TVG) and absorption compensation are applied digitally. The digital data stream is sent to the embedded PC (10), where it is geo-referenced with data from the GPS (9). Item (9) may also be an external or shipboard GPS outputting the NMEA0183 protocol. The data are sent to an industry standard Ethernet port (11) for use on a shipboard LAN.

Our design concept of SASP includes a PC connected to the Ethernet output. Software in the PC would allow high-resolution display (13) of color echograms and digital oscilloscopes, and storage of acoustic data in compressed files (14). Figure 2 is an echogram demonstrating the resolution provided by the DT series of acoustic instruments.

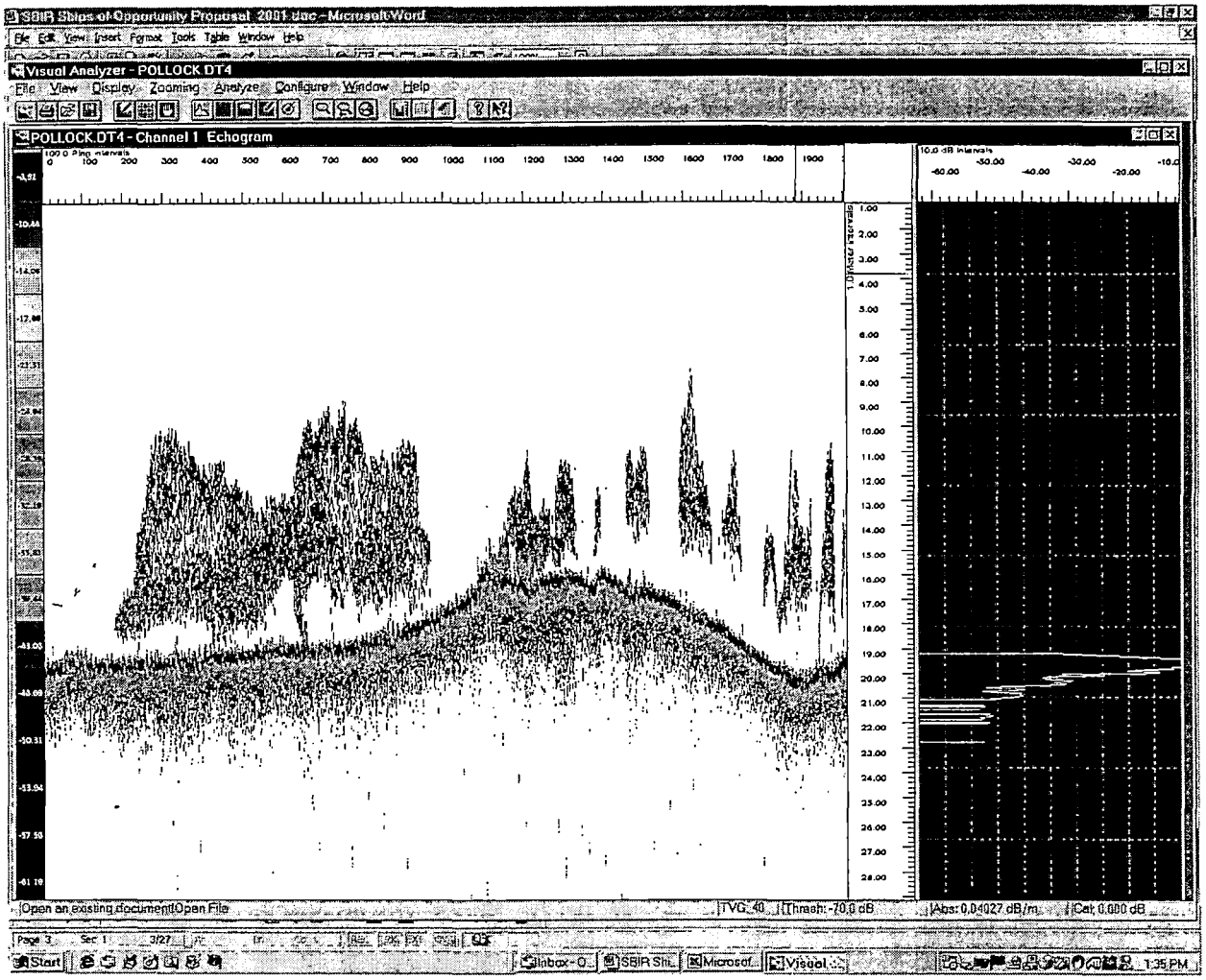

Figure 2. Echogram from a DT Series Scientific Echo Sounder

Items 8, 9, 13, and 14, exist in the BioSonics DT6000 scientific echo sounder, and would require minimal modifications to be adapted to SASP.

Speciation Software. A future component (15) of SASP is software that provides a species-unique indicator from fish aggregations detected by the acoustic system. These techniques are based on the work of Rose and Leggett, 1987. Prototype software using these and other techniques has been developed by C-CORE, a research arm of Memorial University in Newfoundland, and utilizes the output of the DT series echo sounder.

Calibration. A standard calibration sphere would be suspended under the transducer and the scaling of the SASP receiver would be determined to achieve calibration. This procedure would be completed after installation of the SASP system on a ship of opportunity.

Ability to Reduce By-Catch. The SASP system provides the fishing vessel skipper two additional views of a fish aggregation before the net is set. The display function of the SASP provides a color echogram with much higher dynamic range and increased detail when compared to most shipboard echo sounders (Figure 2). The clarity of the images will provide additional insights to the skipper on what species or species mix is present in the fish school. Second, the speciation algorithms will provide a more objective means of making fishing decisions.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

This proposal utilizes cooperation with several agencies, specifically NOAA/NMFS, and DFO, Canada. We also have included several contractors we plan to use to successfully complete the project.

Consultants and Subcontractors.

Robert Keiser of the Department of Fisheries and Oceans in Canada, will be a consultant on this project. He collected acoustic and netting data on hake and pollock schools that we plan to further analyze using species classification algorithms. He will be consulting on the design of the system and evaluate the hardware.

John Guzzman of C-Core will be a consultant on this project. BioSonics and C-Core entered into an agreement to work together on development of a selective harvesting echo sounder for the commercial fishing industry. C-Core's expertise lies in the development of species classification software.

Dr. John Hedgepeth will consult on this project. Currently he is the project lead for new product development of an autonomous deep water system for bottom typing. He will be consulting on the design of system.

BioSonics Cost Sharing.

We propose a ten- percent cost-sharing component for this proposal. BioSonics will provide additional engineering and development labor hours over and above those budgeted for this project. In addition, BioSonics will provide engineering/technical support to install the units into the chosen ships, and provide training for operation of the unit and data collection objectives to the skipper and/or other designated people. Documentation for tasks completed during these additional hours will be provided.

SCHEDULE

A. Measurable Project Tasks for FY 02 (October 1, 2001 – September 30, 2002)

October 1-30:	Complete Designs of hardware interface, embedded PC, Ethernet components
November 1-15:	Complete Design of Software Interface

November 15 – February 15:	Construct 2 prototype SASP systems
February 15 – May 30:	Complete bench testing, interfacing with analog sounders
June 1-August 30:	Complete first field tests on ships of opportunity, develop protocols for system installation, calibration, training, data collection, and data analysis.
September 1 – 30:	Compile data and results, write report and prepare manuscript to be published.

B. Project Milestones and Endpoints

Objectives addressed in this proposal can be divided into 6 relatively broad categories, most of which are parallel efforts. The fifth component is one of integrating the four tasks into a single system with seamlessly operating parts. Although we plan to include the investigation of the speciation tool in a future proposal, we have included it in this proposal to show how it integrates into and complements the current proposal.

Objective 1: Smart Interface

Many skippers have gained considerable expertise operating their ship's echo sounder, and know how to adjust the gain and other settings to create the most informative image. Typically, these adjustments include receiver gain, depth range (or pulse repetition rate), signal threshold, and color assignments. They may also adjust transmit characteristics (power, pulse width). These captains would be hesitant to purchase and install a device that connects to their ship's echo sounder unless they were assured that the device did not affect the echo sounder performance or limit how they used the instrument.

The smart interface component is designed to access the acoustic signal without changing its level. The skipper using the proposed system would be discouraged from adjusting transmit parameters. However, the smart interface and digitizing hardware will be able to adjust to changes in receive characteristics, since the receiver section of the ship's echo sounder is not used.

All of the design, manufacture, and testing of the smart interface component will be completed at the BioSonics engineering and manufacturing facility in Seattle. Hardware design engineers for this task include Stan Tomich and Bill Acker, and Shui Yang. Software engineers include Dale and Lyle Harkness. James Dawson, Colleen Sullivan, and Jon Walsh will conduct scientific analyses. Melanie Milnes will complete publication and Graphics.

Objective 1 Component 1 – Signal Extraction and Conditioning

Before design work commences, we will contact manufacturers or retailers of the commonly used brands of echo sounders to determine the exact transducer and signal impedance, signal levels at the transducer terminals, and presence or absence of pre-amplifiers. In addition to designing circuitry to extract the acoustic signal, we will design appropriate connectors or connections to allow attachment to the ship's echo sounder.

Initially, we will test the ability of the signal extraction on BioSonics analog scientific echo sounders and Ross Laboratories bathymetric echo sounders. The second tier of evaluations will

include echo sounders on selected fishing boats. The evaluation of the Component 1 circuit will test the ability to extract a signal without loading the host echo sounder.

We have contacted vessel skippers in the Cordova, Alaska area about cooperative work, and plan as part of testing to establish additional collaborations in Washington and Alaska fishing fleets.

Objective 1 Component 2 – Mixer Frequency Synthesizer

Component #2 develops a frequency mixer circuit. The Analog to Digital (A/D) Converter of SASP will be designed to digitize a single selected frequency. Part of the design research is to select an optimal frequency to digitize. At this point, we anticipate using a 10.4 kHz frequency as the input to the A/D process. Since a variety of frequencies may be encountered in host echo sounders, a mixing frequency will be synthesized in the smart interface. The mixing frequency will be selected during connection to the host. When mixed with the signal extracted from the host echo sounder, the beat frequency of 10.4 kHz will be created. This circuit will be similar to those used in the older analog BioSonics Model 101 and 102 scientific echo sounders.

This component will first be bench tested, then evaluated with a BioSonics analog echo sounder. Successful evaluation involves production of a signal from a host echo sounder with correct frequency and levels for the SASP digitizer.

Objective 1 Component 3 – T/R and Timing Circuits

A skipper may change the depth range over which his echo sounder is operating. This change usually sets the pulse repetition rate to a time value appropriate for sound to make the round trip back to the transducer. Since this capability is important to the skipper, SASP will be able to monitor the pulse repetition rate of the host and adjust it's own sampling range accordingly. To accomplish this, a T/R and Timing circuit will be designed. This third component is a circuit that will generate a timing or synchronizing pulse aligned in time with the high voltage transmit pulse of the host. The SASP will measure the time period between these pulses and set it's A/D range accordingly. For example, if the skipper selected a pulse repetition rate on the host echo sounder of 2 transmissions per second, the ½ second between pulses would roughly correspond to a sampling range of about 375 m. The smart interface would determine the timing between transmit pulses and forward that information to the A/D component.

An additional function of the T/R and Timing Circuit involves measuring the pulse length transmitted by the host echo sounder. The length of the transmitted pulse will be used to set the bandwidth of the receiver, as implemented in digital programmable filters.

Evaluation of Component 3 circuits will include an accurate measure of pulse length and timing between host transmission pulses, and verification of SASP receiver circuit protection from the host transmit pulse.

Objective 2: Analog to Digital Converter

Objective 2 will be completed at BioSonics' facility in Seattle. The A/D Converter proposed for this system is based on the digitizing engine of the DT series of scientific echo sounders

developed by BioSonics. The digital sampling rate is 41.667 kHz, and the A/D converter has 22 bits. 20 bits are used, resulting in an instantaneous dynamic range of 120 dB. Quadrature sampling produces a digital representation of the signal intensity. A user-selected threshold is applied to the signal, which is stored to hard disk file, displayed on the PC screen as a high resolution echogram or digital oscilloscope, and transmitted through the Ethernet connection to signal processing algorithms.

Objective 2 involves modifying the existing digital engine to allow slaving to the synchronizing pulses discussed above. We will redesign the architecture, which currently does not allow external triggering. Programmable band-pass filters will be modified to receive pulse length information and adapt accordingly. Current wide dynamic range and high-resolution characteristics of the DT6000 echo sounder will be retained, along with real-time data compression.

Evaluation of the success of Objective 2 will involve collecting acoustic data in the field using an analog echo sounder with the SASP receive module attached. We will use the BioSonics Model 221 281 Echo Signal Processor and associated software to analyze the analog signal from the echo sounder, and the DT6000 analysis software to analyze the signal from the SASP system. Both analysis systems are calibrated to allow comparison of digitizing accuracy. Both engineering and scientific members of the team will complete this work.

Objective 3: Embedded PC and Ethernet

Objective 3 will also be completed at the BioSonics facility in Seattle. The current data flow is through a PCMCIA interface for small portable computers. The PCMCIA standard, although specified by the PC industry, has considerable variability in its implementation. As a result, incompatibilities between the digitizing circuitry and personal computers exist. The embedded PC will reformat the data string into Ethernet packets. The Ethernet protocol is standardized and will provide connectivity to any PC or to shipboard networks. The embedded PC will also capture the positional data from the GPS and encode it into the acoustic data stream, along with time and date.

The completion of Objective 3 will be evaluated by bench-testing at the BioSonics facility. We will test the Objective 3 capabilities by connecting the SASP receiver to our Windows-based Local Area Network (LAN) currently installed in our BioSonics facility in Seattle. Test software exists to receive the digital signal over the network and display it as color echogram.

Objective 4: Display and Storage of Acoustic Data

BioSonics software engineers will complete Objective 4 at our Seattle facility. A foundational design concept of the proposed system is to extract data and publish a high resolution representation on the Ethernet (Objective 3). Any number of devices can listen on the Ethernet and utilize the acoustic data. Objective 4 involves providing software packages that will control the proposed acoustic system and allow data to be saved to file, displayed on screen, or sent to species identification software. The first package will turn on the system receiver and display data on the PC screen as either a high-resolution echogram and/or a digital oscilloscope. The operator will select the data collection and display thresholds. An additional program or capability will write acoustic data to data files.

We propose to use the data format currently implemented in our DT/DE series of scientific echo sounders. This format will allow use of existing analysis software to evaluate the performance and capabilities of the SASP system itself. Furthermore, the use of the existing format will allow assessment of acoustic test data with existing BioSonics software and with software developed by other scientists and commercial vendors (US Army Corps of Engineers, Sonar Data).

Objective 5: Integration of Components and System Installation

We envision both system integration and field testing to occur under this current proposal. The three Objective 1 components will be completed, then mated to the A/D component. The embedded PC and Ethernet connectivity will also be completed and tested. A new simplified user interface will be created to provide simplified operation of the system, high-resolution displays of the acoustic signal, and storage of the raw data. At this time, BioSonics will provide engineering/technical support to install the units into the chosen ships, and provide training for operation of the unit and data collection objectives to the skipper and/or other designated people.

Objective 6: Speciation Software (future component)

The assignment of species based on characteristics of the acoustic signal is a relatively new branch of scientific acoustics. The potential of this capability is only now beginning to be realized by members of the scientific community. Holliday presented work in the early 1970's measuring the frequency spectrum of reflections from aggregations and schools of commercially important marine fish exposed to an explosive charge. Similar work was completed by Scrimger et al the following year. New research in this area was presented at the ICES/FAO International Symposium on Fisheries Acoustics in Seattle, Washington, June 22-26, 1987. Nero and Magnuson used a patch recognition algorithm to discriminate a variety of "Patch types", and concluded that "measurements of echo statistics and ...patch recognition techniques produce biologically meaningful parameters.

At the same symposium, Rose and Leggett presented research describing identification of species from the acoustic characteristics of fish schools. They digitized the envelope-detected output of a BioSonics Model 105 scientific echo sounder at a 16.5 kHz sampling rate. They collected acoustic data and captured fish from cod, capelin, and mackerel schools. Based on waveform measurements, Dr. Rose was able to correctly identify cod, capelin, and mackerel schools 98% of the time. These species aggregate very differently, and the study results might be considered a "simple" case as a result. These techniques have not been tried in species that school in a more similar manner, such as herring and candlefish, or hake and pollock.

In a future effort, we will address the potential of determining species from the acoustic signature in several ways. BioSonics and C-CORE of Memorial University have a collaborative agreement in place to further investigate and advance the capabilities of speciation from the acoustic signature. C-CORE has written prototype software incorporating the algorithms investigated by Rose and Leggett. The software has been coded to read the file format produced by the DT6000 scientific sounder. The 41.66 kHz digital sampling rate of the DT system can be analyzed with a much finer scale than the 16.5 kHz rate used in Rose and Leggett's work.

Although the speciation component is to be addressed in a future effort, it is linked to the current proposal in the following ways. First, we will collect a variety of test data sets, and second, we will evaluate a broader range of algorithms to extract species-unique characteristics.

Collection of acoustic field data has and will continue to occur off both the East and West Coasts of North America. BioSonics has manufactured and provided scientific echo sounder systems for use on cruises by Dr. Robert Kieser, Department of Fish and Oceans, Nanaimo, British Columbia, and by Dr. George Rose, Memorial University, St. Johns, Newfoundland. The objective is to collect high-resolution acoustic data in the course of their research for the purposes of evaluating the acoustic signature for species identification. Additional data sets will be collected for the same purpose. We have included one trip to Alaska to collect additional data. These data sets will be analyzed at C-CORE, a research arm of Memorial University and at BioSonics.

In addition to the algorithms already used by Rose and Nero, we will evaluate a variety of additional algorithms that are currently used for classifying the seabed. These include measures of fractal dimension (Lubniewski and Stepnowski, 1997), and Fast Fourier Transform of the within-school signal to characterize the spectral patterns. This work will be accomplished at BioSonics using MatLab analysis functions. We plan on one trip to Newfoundland to meet with colleagues at Memorial University.

C. Completion Date

System development and field-testing will be completed by September 30, 2002. A report will be completed and submitted by April 15, 2003.

PUBLICATIONS AND REPORTS

Because this is the first year of a one-year project, no manuscripts will be submitted to peer-reviewed journals during FY 02. Once the Trustee Council has reviewed the final report, a manuscript will be prepared for publication during FY 03.

PROFESSIONAL CONFERENCES

No travel funds for conference attendance is requested during FY 02.

NORMAL AGENCY MANAGEMENT

Not applicable

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

BioSonics has not coordinated with any Trustees on Trustee Council funded projects. However, we have coordinated with the following trustees on other projects: Alaska Department of Fish and Game, Department of Interior, Fish and Wildlife Service and U.S. Geological Survey and the National Oceanic and Atmospheric Administration. This coordination has taken the form of equipment vendor, providing training and customer support and consulting services. In January 2001 we submitted a scaled-down version of this proposal to obtain funds through the Department of Commerce, Small Business Innovation Research (NOAA/SBIR) for Phase I

funding for proof of concept under solicitation subtopic "Development of gear technology to improve stock assessments". A decision about funding for that project will not be released until July 2001.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

Not Applicable

PROPOSED PRINCIPAL INVESTIGATOR

Name: James Dawson
Affiliation: BioSonics, Inc.
Mailing Address: 4027 Leary Way NW, Seattle, WA 98107
Phone Number: (206) 782-2211
Fax Number: (206) 782-2244
E-mail address: jdawson@biosonicsinc.com

PRINCIPAL INVESTIGATOR

RESUMÉ

JAMES J. DAWSON
Senior Scientist

Education:

M.S. in Fisheries, 1972, University of Washington, Seattle, Washington
B.S. in Fisheries Biology, 1969, University of Washington

Positions Held:

BIOSONICS, INC., Seattle, Washington. March 1981 to present
Senior Scientist

FISHERIES RESEARCH INSTITUTE, University of Washington, Seattle, Washington, January, 1973 to March, 1981.
Staff Fisheries Biologist

COLLEGE OF FISHERIES, UNIVERSITY OF WASHINGTON, Seattle, Washington, December, 1969, to January, 1973.
Research Assistant

Selected Projects:

Alaska Statewide Riverine Sonar Development Project, May, 1998 to present
Fixed-Location Project, Grand Coulee Dam, Summer, 1996 to present.
Acoustic surveys, Hiram M. Chittenden Locks, May-June, 1997 and May-June, 1998
Acoustic Surveys and Fixed-location Projects, Vischer Ferry and Crescent Dam Reservoirs, New York Power Authority, June, October, 1996,1997
Fixed Location Projects, The Dalles, John Day, Bonneville Dams, Summer, 1996,1997
Fixed Location Projects, Ice Harbor Dam, Summer, 1995

Marine Surveys in the Bering Sea with NMFS, 1991

Selected Publications:

J.J. Dawson, 1972. "Determination of seasonal distribution of juvenile sockeye salmon in Lake Washington by means of acoustics." MS thesis, University of Washington, 112 pp.

R.E. Thorne, and J.J. Dawson. 1974. "An acoustic estimate of the escapement of sockeye salmon (Oncorhynchus nerka) into Lake Washington in 1971." J. Fish. Res. Board Can. 31:222-225.

R.E. Thorne, J.J. Dawson, J.J. Traynor, and R.L. Burgner. 1975. "Population studies of juvenile sockeye salmon in Lake Washington with the use of acoustic assessment techniques." pp 328-345 in Robin L. Welcomme, ed. EIFAC Technical Paper No. 23, Suppl. 1, Symposium on the Methodology for the Survey, Monitoring and Appraisal of Fisheries Resources in Lakes and Large Rivers.

J.J. Dawson, and R.E. Thorne. 1980. "Lake Washington sockeye salmon presmolt studies, 1980." Final Report to Washington State Department of Fisheries. University of Washington, College of Fisheries, Fisheries Research Institute. 17 pp.

J.J. Dawson and W.A. Karp. "*In situ* measures of target-strength variability of individual fish." Rapp. P.-v. Reun. Cons. int. Explor. Mer, 189: 264-273. 1990

OTHER KEY PERSONNEL

Mr. James Dawson will serve as principal investigator. Dr. John Hedgepeth and Mr. Jon Walsh and Ms. Colleen Sullivan will support him in the research aspect of the project. Mr. Stan Tomich, Electrical Engineer at BioSonics, will conduct the engineering aspect of the development effort. Mr. William Acker, Mr. Lyle Harkness, Mr. Dale Harkness and Mr. Yong Jun Yang will support him in the development aspects of the project. Both Mr. Dawson and Dr. Hedgepeth have extensive experience in hydroacoustics and especially in the detection, monitoring and tracking of targets in dense aggregations, which is directly related to the proposed work. Supporting BioSonics scientists and engineers have vast experience in the application of hydroacoustics and also in the design of sonar hardware and software which are related to this project. Abbreviated resumes' for these individuals follow.

WILLIAM ACKER is Chairman of the Board at BioSonics. He received his MS in Electrical Engineering from the University of Washington in 1963. He founded BioSonics in 1978. From 1963 until 1995 he was on the faculty at UW Electrical Engineering and the Applied Physics Laboratory. His area of special expertise is design and production of very low side-lobed transducers.

JAMES DAWSON is a Senior Scientist involved in product development at BioSonics. He received his MS from the College of Fisheries at the University of Washington in 1972. From 1973 to 1981 he was a fisheries biologist with the UW. Fisheries Research Institute where he conducted hydroacoustic enumeration surveys in both marine and inland waters. His area of special expertise is application development for new products. Since joining BioSonics in 1981 as a Project Leader, he has directed numerous fisheries surveys all over the world.

DALE HARKNESS is a Software Engineer involved in the design and development of real-time acoustic data acquisition and analysis systems. He received his AA in Computer Science from Western Iowa Technical College. His responsibilities include architectural design of new software systems and maintaining existing software products.

LYLE HARKNESS joined BioSonics in 1996 as a Software Engineer. He received his AA in Digital Electronics from North Seattle College. Since joining BioSonics he has worked on new product development of the motorized fish tracking system and assisted in development of digital data acquisition systems for hydroacoustic equipment.

JOHN HEDGEPETH is a Senior Scientist who has been involved in many diverse fisheries studies all over the world since he joined BioSonics in 1989. In 1999, Dr. Hedgepeth relocated to California, and continues to work with BioSonics as a consultant. From 1980 to 1983, he was employed at the Inter-American Tropical Tuna Commission in La Jolla, CA. From 1983 to 1985 he worked at the National Marine Fisheries Service. He received his MS in Fisheries from Humboldt State University in 1983 and his Ph.D. in Fisheries from the University of Washington in 1994. Currently he is project lead for new product development of an autonomous deep water system for bottom typing. His publications include the chapter, "The Application of Some Acoustic Methods for Stock Assessment for Small Scale Fisheries", in Gallucci et al.'s 1996 book " Stock Assessment", and recent publications in ICES Journal of Marine Science and Transactions of the American Fisheries Society. He currently has no other commitments during the contract period.

MELÁNIE MILNES joined BioSonics in 1992 as an Administrative Assistant. She received her AA in Computer Information Systems. Her responsibilities include technical writing and preparation of scientific reports and documents. Her area of special expertise is developing databases for analysis of acoustic data.

COLLEEN SULLIVAN is a Senior Scientist with an extensive background in the design and implementation of acoustic studies. She received her BS degree in Fisheries from the University of Washington in 1981. She has been the project lead on numerous research projects on the Snake and Columbia Rivers in Washington. Her area of special expertise is data analysis. Since joining BioSonics in 1981 she has lead numerous fixed location fisheries surveys mainly in the Pacific Northwest.

STAN TOMICH is an Electrical Engineer who recently joined BioSonics. He received his BS in Electrical Engineering at Arizona State University. As a consulting project engineer for HiLine Engineering and Science Applications International Corporation (SAIC) he was involved in all aspects of design, implementation, and deployment of instrumentation ranging from handheld microprocessors to computer controlled electro-mechanical systems. While a Senior Engineer for Seafloor Surveys International (SSI) his specialty was the precision tracking of underwater towed survey equipment as related to real-time data acquisition for acoustic survey data processing. As a consultant for Ross Laboratories he developed a new acoustic sounder that became the platform for their newest suite of products. At Battelle PNNL for over thirteen years, he was project lead, responsible for the design, implementation and assembly of microprocessor based data acquisition systems. Other commitments during the contract period include research and development for the new generation of products under development at BioSonics.

JON WALSH is a Fishery Biologist who joined BioSonics, Inc. in May of 2000. He received his BS in Aquatic Biology from University of California – Santa Barbara in June of 1995. In his short time with BioSonics, he has been involved in numerous deployments of hydroacoustic gear and data acquisition at both fixed sites and surveying vessels. He has also supported the data analysis of many BioSonics projects.

YONG JUN YANG is an Electrical Engineer who joined BioSonics in 1989. He received degrees from Shandong Engineering University, the Oceanography Institute of Academia Sinica and Qingdao Ocean University in China. From 1984 to 1990 he was an Electronics Field Engineer for Sea-Bird Electronics. From 1984 to 1990 he was an Electrical Engineer at the Institute of Oceanography, in Qingdao China.

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Lubniewski, Z. A. Stepnowski. Sea Bottom Typing Using Fractal Dimensions. In: Proceedings of the International Symposium on Hydroacoustic and Ultrasonics. Gdansk-Jurata, Poland 12-16 May 1997.

Nero, R.W., and J.J. Magnuson. Characterization of Patches Along Transects Using High-Resolution 70-kHz Integrated Acoustic Data. Can. J. Fish. Aquat. Sci. Vol. 46. 1989.

Rose, G.A., and W.C. Leggett. Hydroacoustic Classification of Cod, Capelin, and Mackerel Schools by Target Strength and School Structure. International Symposium on Fisheries Acoustics, June 22-26, 1987, Seattle, WA, USA, 32 pp.

Scrimger, J.A, R. G. Turner, and G.J.H. Heyd. Backscattering of Underwater Sound in Saanich Inlet, British Columbia, Including Observations of Scattering from a Fish School. JASA, Vol. 51, No. 3, Part 2. 1972.

Sea Technology, June 1999. Digital Transducers: A New Sonar Technology. Vol. 40, No. 6: 31-35.

Appendix A. Reprint of Sea Technology publication "Digital Transducers: A New Sonar Technology.

Digital Transducers: A New Sonar Technology

Flexible Scientific Measurement Tool for Fisheries & Macrophyte Assessment, Seabed Classification, Bathymetry & Physical Oceanography Studies

By Professor William C. Acker
Chief Executive Officer
Dr. Janusz Burczynski
International Sales, R&D Projects
James Dawson
Chief Scientist
Dr. John Hedgepeth
Senior Scientist
and
[illegible] Wiggins
[illegible]ef Engineer
[illegible]Sonics Inc.
Seattle, Washington

Recent developments in digital technology have fostered a tidal wave of advances in sonar technology. Digital transducer echosounder systems offer substantial improvements over traditional analog equipment by collecting higher resolution data that can be easily processed, stored and analyzed without using the additional interface equipment which produces unwanted noise in analog systems. This powerful compact format allows many new uses and improved applications for underwater measurements.

A new digital transducer (DT) architecture for sonar/ echosounders, designed and produced by BioSonics, allows the acoustic signal received by the transducer to be digitized virtually on the face of the ceramic element. is digitally filtered, quaduature npled, and sent up the cable to the surface unit at transmission rates up to 10 MHz. The surface unit houses a PC, which displays, stores, and processes the data. The digital data transmission removes the problems of noise pickup, signal loss, and signal distortion associated with receiving low-level analog signals through long transmission lines. Due to superior noise rejection, lack of signal loss in the transmission cable, and advanced high-resolution and high-speed analog-to-digital conversion, the usable instantaneous dynamic range of the DT system is greater than 122 dB. This is enough to allow detection of plankton and bottom return simultaneously in the linear region of the system.

BioSonics DT digital transducer echosounder system.

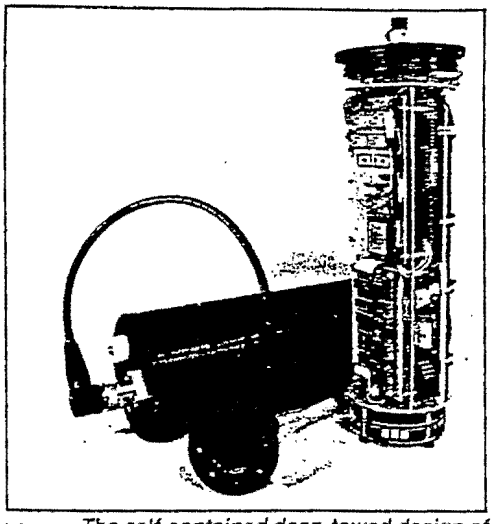
One of the primary goals of BioSonics' design was to maximize the probability of collecting high-quality data. This was achieved by creating a sonar/echosounder with performance characteristics that shift almost all the decision processes from the data collection phase to the data analysis phase. For example, the wide dynamic range removes decisions about gain and power. Each digital transducer contains stored system data such as frequency, calibration characteristic, beamwidth, transducer configuration (split-, dual-, or single-beam) and other information specific to that transducer. The data are sent to the surface unit to automatically adjust system parameters. This allows transducers of different frequencies, sensitivities, beamwidths, and configurations to be used with the same cable and surface unit. In addition, multiple transducers can be chained together to create arrays of independent echosounders.

Additional advantages of the digital sonar/echosounder include high accuracy and resolution due to the high rate of digitization and quantification. The BioSonics DT System returns digital samples of greater than 0.013 percent accuracy every 18 millimeters. Chirp technology provides 10 dB noise reduction over standard monotone signals and, because of the wide dynamic

range, TVG (time varied gain) is not required during data collection, and is applied during analysis in a purely mathematical form.

The basic BioSonics DT Echosounder System includes a digital transducer, cable, and surface unit housed in a weatherproof case. Operating frequencies range from 38 kHz to 1 MHz. It is GPS-compatible with location information included in the data stream. No external recording devices are required. Raw acoustic data are recorded on the surface-unit laptop-computer hard drive, along with real time processed data. This architecture is designed to be useful for many different applications. The small size, portability and operational characteristics have made this system a popular research tool.

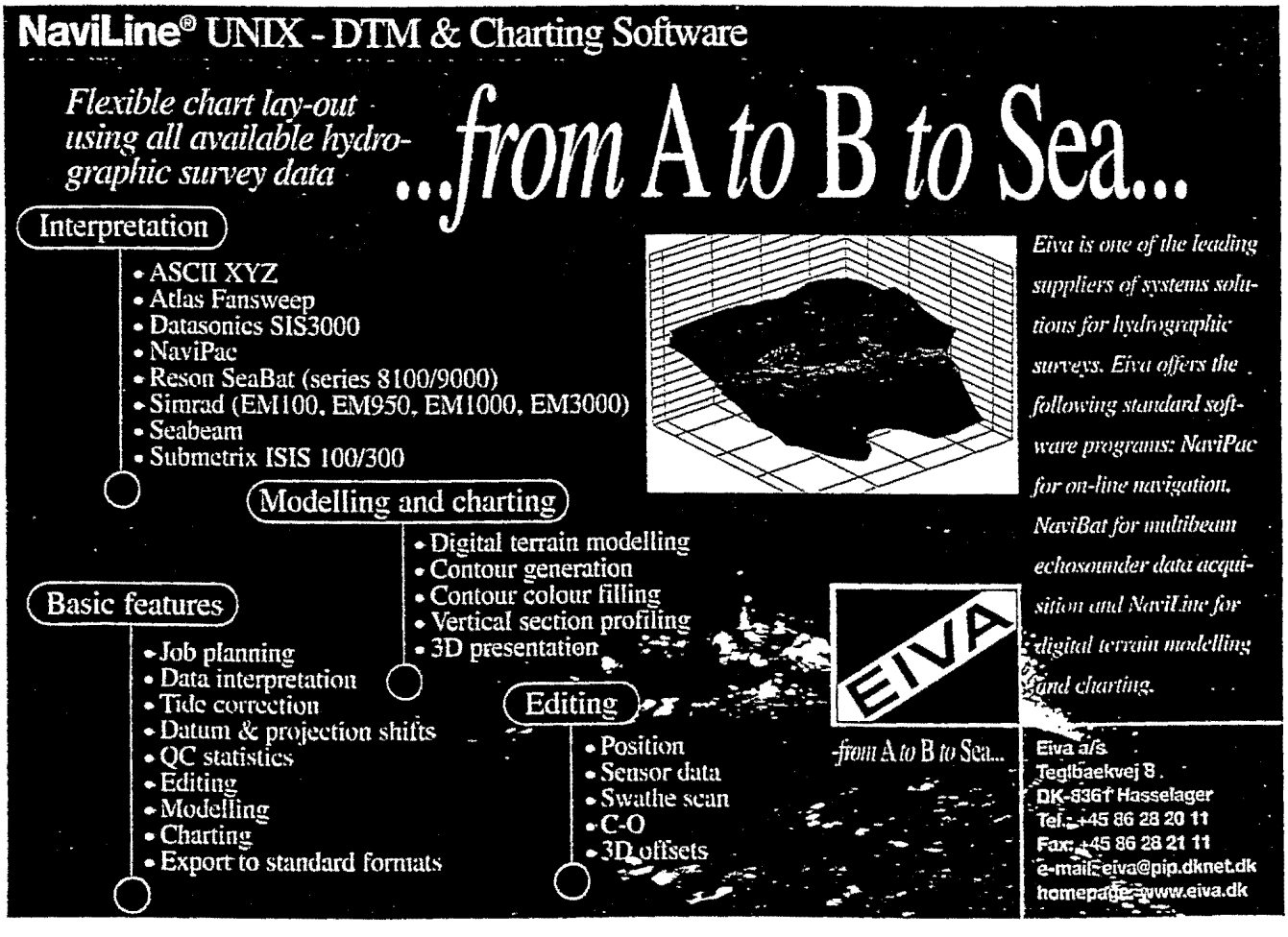
The primary acquisition job of the BioSonics DT System is to make it easier to gather, display, and store high quality, high resolution acoustic data. These data can be processed in real time or in postprocessing with analysis software written for a specific application. A large variety of analysis software has been written by BioSonics and by many DT users. These applications include fish and plankton biomass analysis at ranges from 1 meter to 500 meters, fish and plankton target strength studies, species identification studies, and fish behavior studies using a variety of real-time and postprocessing target-tracking techniques. In addition, applications have been developed for the assessment of aquatic macrophyte ranging from marine eel-grass to nuisance fresh water plants, bathymetry and physical oceanography studies, and seabed classification.



The self-contained deep-towed design of the BioSonics DT scientific echosounder.

Seabed Classification

There is a growing demand in the market for simple, reliable acoustic instruments, and methods for seabed classification (e.g. mud, sand, and rock) and the monitoring of sediments. BioSonics' "VBT SeaBed Classifier" software is currently being used for bottom classification studies in the Mississippi River and the Fraser River (Canada). The U.S. National Marine Fisheries Service is conducting seabed studies off the Alaska coastline using an autonomous deep-towed system newly developed by BioSonics. This self-contained DT System contains a board level computer, equipped with a rechargeable battery, connected to the digital transducer in a stainless steel cylinder, and capable of operating at 1,000-meter depth. This system can be towed near-bottom to assess bottom types. Alternatively, it can be raised and lowered in the water column to assess plankton. After the system is returned to the surface, data is removed and the battery is recharged through an external



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connection. The rugged system does not need to be opened during field erations.

Four methods of seabed classification are implemented in the VBT SeaBed Classifier software: (1) cumulative curves of bottom echo envelope, (2) first/second bottom echo, (3) first bottom echo division, and (4) fractal dimension. Different types of bottom (e.g. mud, sand, gravel, and rock) produce different signatures, and the type of bottom is classified accordingly. In the first method the system recognizes different shapes of the averaged cumulative energy curve of the echo envelope. In the second method, the roughness signature (energy of the second part of first bottom echo) and the hardness signature (energy of the second bottom echo) are determined. In the third method the bottom echo is split into two parts, corresponding to coherent and non-coherent components of an echo, and hardness and roughness signatures are determined. In the fourth method the fractal dimension, which is a measure of irregularity of an echo envelope, is determined. VBT SeaBed Classifier output reports can be imported to GIS and other specialized software packages for further applications.

Macrophyte Assessment

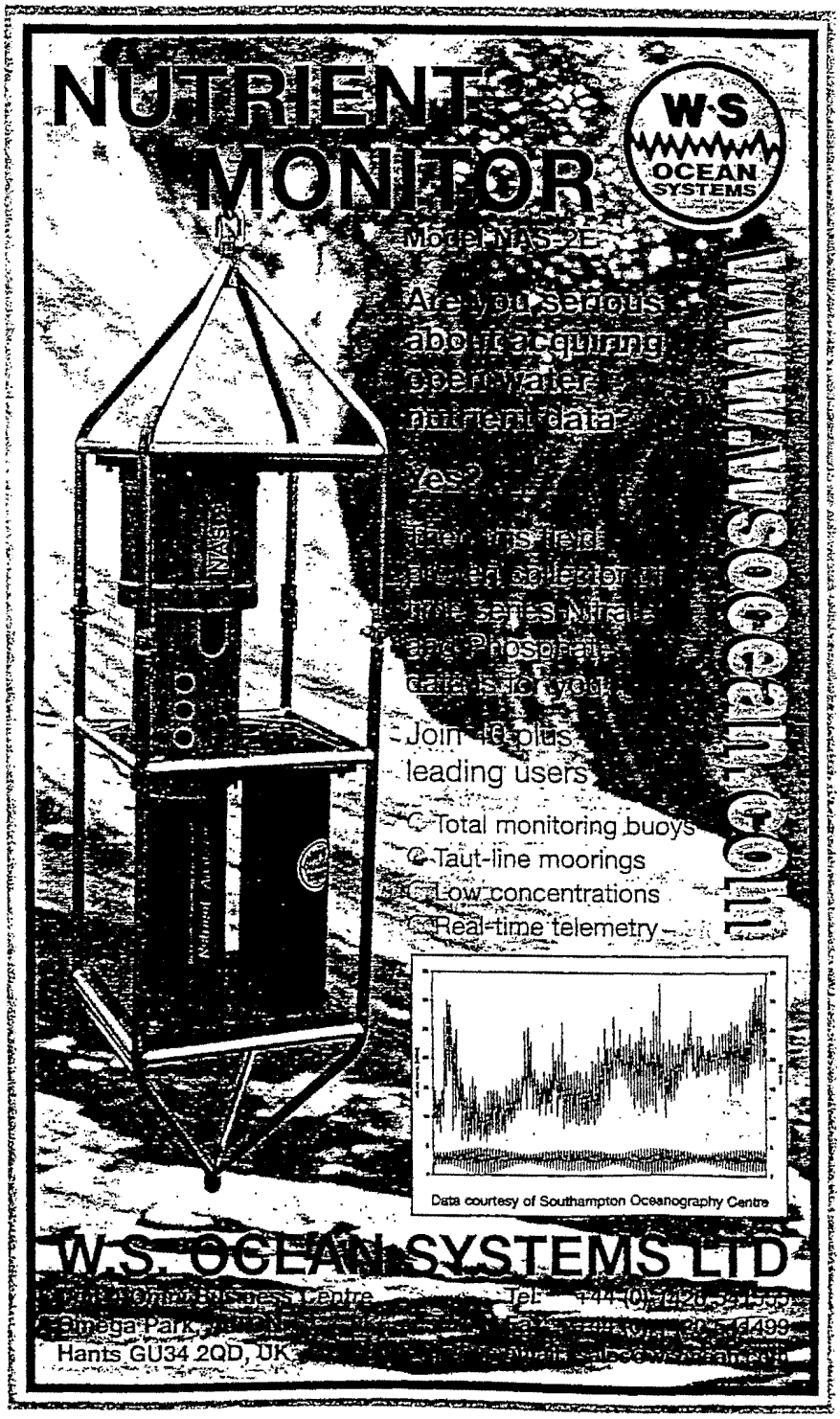
Managing aquatic vegetation in commercial waterways is an on-going task of the U.S. Army Corps of Engineers in many areas of the United States. This requires clearly identifying the type, density, and spatial distribution of submersed vegetation in order to develop efficient strategies for controlling nuisance aquatic plants. Operational means for obtaining these data include physical techniques such as diver sampling and remote optical techniques like aerial photography. Physical techniques provide highly detailed data but are labor intensive and provide limited spatial information. Remote optical techniques can provide wide-area distribution maps but are limited by water clarity. To overcome these problems, the U.S. Army Waterways Experiment Station (WES) has developed an aquatic-plant debris and analysis system based on the BioSonics DT4000 single-beam sonar operated at 420 kHz. WES has developed a software package for the DT called "Submersed Aquatic Vegetation Early Warning System" (SAVEWS). Bruce Sabol at WES has been operating this system successfully for an extended period in Vicksburg, Mississippi.

Fisheries Assessment Studies

The BioSonics DT6000 Split-beam Echosounder system provides a flexible scientific measurement tool for many fisheries applications. The DT has been used in the North Pacific to assess plankton stocks as part of a bowhead-whale study and in the North Atlantic to assess the cod population to depths of 500 meters.

At the Hiram M. Chittenden Locks in Seattle, Washington, the BioSonics DT System was deployed when significant mortality on smolts was suspected as they passed through filling culverts into the lock chamber. A series of mobile survey transects in the forebay of the impoundment dam were repeatedly sampled with down- and side-looking transducers. The objective was to determine the horizontal and vertical distribution of salmonid smolts migrating out to sea through the structure.

Survey data were processed using



echo integration, and fish densities were imported into a GIS package and overlaid on area maps. The resulting fish-distribution patterns will be used to design and locate fish guidance and bypass devices. Alternative passage routes are being investigated.

The BioSonics DT System was also used to count sockeye salmon migrating upstream in Alaskan rivers. The system was installed in two rivers during the 1998 field season, with transducers mounted on dual-axis rotators and aimed horizontally across the river. The split-beam technique implemented in the digital transducer provides estimates of fish velocity, direction of travel, and target strength. Counts of upstream- and downstream-moving fish were estimated by range. The vertical distribution of fish measured by this system showed that most fish were traveling near the bottom.

Fish counts based on echo-tracking were highly correlated ($R^2 = 0.86$) with tower count data through densities of 1,000 fish per hour per meter of range. Overall fish-passage rates based on echo integration correlated well ($R^2 = 0.94$) with tower counts up to 40,000 fish per hour. The DT technology writes raw digital data and processed data to an industry standard SQL-compliant database. Linking of raw and processed data with the data stream from a variety of sensors (pitch and roll, CTD, and flow) allows correlation of acoustic measures with environmental parameters and provides a high level of defensibility for all scientific measurements of fish and plankton abundance, distribution, and passage rates.

Fish Behavior via Split-Beam DT

Studies of fish behavior around hydroelectric dams require accurate estimates of individual fish location. In 1994, BioSonics began development of a split-beam system to provide spatial coordinates of fish targets. Split-beam methodology has been used for evaluating the effectiveness of fish bypass facilities at hydroelectric dams on the Snake and Columbia Rivers, operated by the Portland and Walla Walla Districts Corps of Engineers.

Biosonics applied the principle of tracking radar, (i.e. aligning the antenna beam with a target), a split-beam transducer, and computer-controlled high-speed dual-axis rotators to track individual fish as they approached the dams. Deviation of the target from the beam axis produces a correction to point the axis toward the target. This "tracking transducer" was used in successive studies beginning with Ice Harbor Dam on the Snake River in 1995, the Dalles Dam in 1996, John Day Dam in 1997, both on the Columbia River, and in the Fraser River (Canada) in 1998.

Recently, DT Tracking Transducer Systems were used to triangulate the position of small acoustic transmitters implanted in fish near hydroelectric dams. The tracking equipment consisted of two DT6000 201 kHz 6° (half power full beam) tracking transducers systems placed several meters apart. A 125 dB *re* micropascal 200 kHz tag emitting a 1 millisecond long pulse every 100 millisecond was used. Once one system acquired an acoustic tag, the second system scanned along the primary bearing until it located and centered on the tag. The tag positions were then estimated by interpolated triangulation. Rotator control computers received data from the DT6000s, then synchronized movement and

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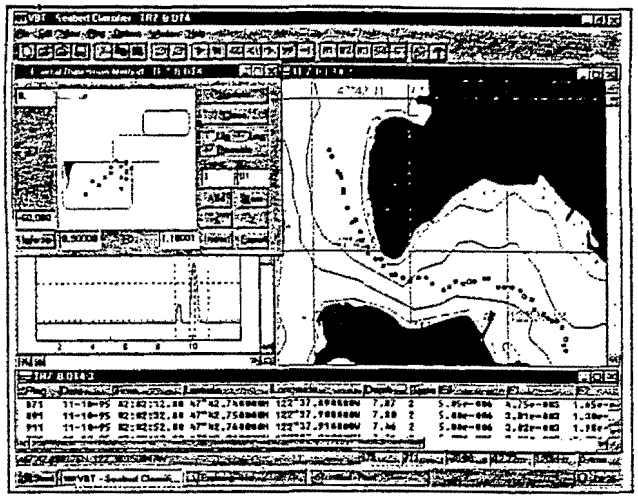

VBT seaBed classifier software using the fractal dimension method to identify a soft bottom with results displayed in GIS format.

recorded information about the tag position. For simplification of acoustic-tag telemetry, a single tracking transducer system can triangulate position by using surface reflection to establish range instead of a secondary system.

Many exciting possibilities exist for future development and applications. The digital input/output on Ethernet and storage to industry-standard database format makes the digital-transducer architecture eminently suitable as tonomous acoustic engine for ori equipment manufacturers of underwater devices. BioSonics is currently involved in developments addressing species identification for commercial fishing, optimization of aquaculture production of salmon, and products for the hydrographic industry. */st/*

Professor William C. Acker founded BioSonics in 1978 to develop scientific hydroacoustic instruments for fisheries research. He is a Professor Emeritus of electrical engineering at the University of Washington and formerly a senior researcher at the University of Washington Applied Physics Laboratory.

Dr. Janusz Burczynski manages international sales and special research/development projects, including the recent development of the "VBT SeaBed Classifier" application software. He holds a master's degree in electrical engineering and doctorate in fisheries science.

James Dawson has been with BioSonics since 1981. He is currently in charge of the Alaska Riverine development project. Dawson holds a master's degree in fisheries from the University of Washington.

Dr. John Hedgepeth is a prime contributor in the development of many BioSonics' products, most recently, the Tracking Radar-Type Acoustic Transducer System and commercial aquaculture products. He holds a doctorate in fisheries from the University of Washington.

Dan Wiggins, with over ten years of hardware and software design experience, has managed the development of the high-resolution digital sonar system. He also participates in international conferences on developing standards for storage and management of acoustic data.

FY 02 *EXXON VALDEZ* TRUS COUNCIL PROJECT BUDGET
October 1, 2001 - September 30, 2002

Budget Category:	Authorized FY 2001	Proposed FY 2002
Personnel		$65.7
Travel		$4.8
Contractual		$30.1
Commodities		$0.3
Equipment		$30.0
Subtotal	$0.0	$130.9
Indirect		$28.9
Project Total	$0.0	$159.8
Full-time Equivalents (FTE)		1.0
Other Resources		$16.0

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2003					

Dollar amounts are shown in thousands of dollars.

Comments:
Indirect costs - rate of 0.44 includes office lease costs (including electricity, water, heat and maintenance, office supplies and equipment, phones, fax, copy machine); accounting functions including payroll and personnel functions, contract accounting and reporting and administrative support; clerical support; facilities use including in-house computers, calibration, electronic assembly, and testing equipment.

Report writing - Personnel costs apportionment includes 1.2 months for report writing (approximately $7000USD).

Annual restoration Workshop attendance - 0.25 months ($1450USD) plus travel costs ($800USD) for annual restoration workshop attendance.

Community involvement - apportionment includes vessel time in Alaska 0.5 months (aproximately $2200USD) plus travel costs (approximately $2000USD).

Other resources - BioSonics has committed to cost-sharing of 10% on this project.

FY02

Prepared: 4/11/01

Project Number: 02627-BAA
Project Title: A Symbiotic Acoustic Signal Processor (SASP) to Increase Stock Assessment Effort; Submitted under the BAA
Name: BioSonics, Inc.

FORM 4A
Non-Trustee
SUMMARY

FY 02 *EXXON VALDEZ* TRUS :OUNCIL PROJECT BUDGET

October 1, 2001 - September 30, 2002

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 2002
	J. Dawson	Principal Investigator	4.6	5.8		26.7
	W. Acker	Electrical Engineer	0.5	5.8		2.9
	S. Tomich	Electrical Engineer	1.9	5.8		11.0
	D. Harkness	Software Engineer	1.9	5.1		9.7
	L. Harkness	Software Engineer	0.7	5.1		3.6
	Y. Yang	Electrical Engineer	0.5	5.1		2.6
	J. Walsh	Fisheries Biologist	1.2	4.4		5.3
	C. Sullivan	Fisheries Biologist	0.7	4.4		3.1
	M. Milnes	Graphics/Word Processing	0.2	3.8		0.8
						0.0
						0.0
						0.0
		Subtotal	12.2	45.3	0.0	
					Personnel Total	$65.7

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FY 2002
	J. Dawson St. John's Newfoundland CANADA, system testing	1.0	1	5	0.2	2.0
	J. Walsh, Anchorage AK field sampling	0.6	1	14	0.1	2.0
	J. Dawson, Anchorage AK workshop attendance	0.6	1	2	0.1	0.8
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$4.8

FY02

Prepared: 4/11/01

Project Number:
Project Title: A Symbiotic Acoustic Signal Processor (SASP) to Increase Stock Assessment Effort; Submitted under the BAA
Name: BioSonics, Inc.

FORM 4B
Personnel
& Travel
DETAIL

FY 02 *EXXON VALDEZ* TRUS' :OUNCIL PROJECT BUDGET

October 1, 2001 - September 30, 2002

Contractual Costs:	Proposed
Description	FY 2002
R/V Kittywake 3-day vessel lease for system testing	2.6
John Hedgepeth - consultant for acoustic system design and testing	9.0
Robert Keiser - consultant for acoustic system design and testing	8.0
John Guzzwell - consultant for system design and speciation software	8.0
Calibration barge 2 day lease - system testing	2.5
Contractual Total	$30.1

Commodities Costs:	Proposed
Description	FY 2002
Computer acrhiving supplies - estimated	0.3
Commodities Total	$0.3

FY02

Prepared: 4/11/01

Project Number:
Project Title: A Symbiotic Acoustic Signal Processor (SASP) to Increase Stock Assessment Effort; Submitted under the BAA
Name: BioSonics, Inc.

FORM 4B
Contractual & Commodities DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2002
Laptop Computer - cost estimate using Dell on-line quote service	2	4.8	9.6
MatLab Software - cost quote obtained from vendor	2	5.8	11.6
Electronic parts - cost estimated from DT system parts list	2	0.8	1.6
Embedded GPS - cost estimate from vendor	2	1.4	2.8
Embedded PC and Ethernet - cost estimate from vendor	2	2.2	4.4
			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**	$30.0

Existing Equipment Usage: Description	Number of Units	

FY02

Project Number:
Project Title: A Symbiotic Acoustic Signal Processor (SASP) to Increase Stock Assessment Effort; Submitted under the BAA
Name: BioSonics, Inc.

FORM 4B
Equipment
DETAIL

Prepared: 4/11/01