Project Title: Testing Satellite Pop-up Tags as a Tool for Identifying Critical Habitat

Project Number:	01478
Restoration Category:	Research
Principal Investigator:	Dr. Jennifer L. Nielsen Alaska Biological Science Center USGS-Biological Resources Division 1011 E. Tudor Rd. Anchorage, Alaska 99503
Lead Trustee Agency:	DOI--USGS
Cooperating Agencies:	na
Alaska Sea Life Center:	Yes
Project Duration:	2nd year of 1-year project
Cost FY 00:	originally projected at $77K; instead will be $70.1K
Cost FY01:	$6.9K
Geographic Area:	Prince William Sound, Gulf of Alaska
Injured Resource/Service:	Near shore and pelagic species

ABSTRACT

The definition of "critical habitat" in the marine environment is essential to the development of reserves or protected areas in relationship to a sustainable commercial or sport fishery. This proposal will assess and test the appropriate application and effectiveness of a new technology, satellite pop-up tags, that could assist in the assessment of critical marine habitat in the Gulf of Alaska. We will adapt and develop satellite tag technology and software for geolocation tracking of marine fishes using light and depth data from satellite pop-up tags and sea floor bathometry. Tag application and light-geolocation relationships will be tested on live halibut (*Hippoglossus stenolepis*) brought into husbandry at the Alaska Sea Life Center and kept under an accelerated solar-shift regime mimicking extreme crepuscular and solar light conditions throughout the year in the Gulf of Alaska. These data will be compared to light and depth reading taken from tags placed *in situ* on live fish deployed from boats and released into their natural habitat and to an array of tags attached to a stationary buoy in the Gulf of Alaska. We will determine the effectiveness of light sensors for geolocation, the duration of light measurements, and the data sequence design needed for the most efficient and informative transfer of data via satellite pop-up tags from the Gulf of Alaska.

These developments will assist in multiple applications of this new technology in fisheries-independent, habitats assessments for near shore and pelagic marine environments in the Gulf of Alaska. Development of the appropriate technology and an analytical design specific to the Gulf of Alaska will facilitate current and future investigations into the temporal and spatial distribution of key fish species that fall under the jurisdiction of the Trustee Council, such as, king salmon (*Oncorhynchus tshawytscha*), coastal cutthroat trout (*O. clarki clarki*), Pacific halibut, and ling cod (*Ophiodon elongatus*) in the Gulf of Alaska.

July 2000 update: This project was intended for completion in one year, FY00. Delays in conveyance of funds to the Principle Investigator until late June, in obtaining a fishing boat until August, in the manufacturer's production of the satellite tags until August, and in hiring a Fisheries Project Leader until August have pushed the project at least 1.5 months behind its original schedule. A revised schedule is provided on page 10. Because of the 1.5-month delay, we estimate returning $6.9K to the Trustee Council in lapsed funds at the end of FY00. We are requesting $6.9K from FY01 funds to complete the project as proposed.

INTRODUCTION

The definition of "critical habitat" in the marine environment for anadromous and pelagic fishes is essential to the development of reserves or protected areas (Anonymous, NOAA, 1999). In Alaska, the relationship of aquatic protected areas to subsistence, commercial, or sport fisheries is a critical factor in considerations of design and implementation of reserves. Resource protection and strategic use are not incompatible concepts when a sound foundation of scientific knowledge on the distribution and abundance of key species is incorporated into reserve planning and resource use, and if local community-based natural resource management is included in the analyses of such data (Getz et al. 1999). This proposal tests the application and sets the foundation for deployment of a new technology, satellite pop-up tags, in investigations into the temporal and spatial distribution of key anadromous and marine fish species in the Gulf of Alaska. Many aquatic species that fall under the jurisdiction of the Trustee Council in their efforts to restore the resources and services injured by the spill may benefit from the development and local adaptation of this technology. Fisheries-independent data on real-time position and monitoring of critical habitat use by Gulf of Alaska fish species will allow the organisms to speak directly to the managers of the resource without relying solely on information dependent on harvest recapture that most tagging technologies currently demand.

For many commercially important anadromous and marine fish species ocean-use and critical habitat remain uninvestigated with little or no scientific evidence to support distribution on temporal or spatial scales. The use of radio telemetry and satellite-linked tracking for studying fishes has experienced a recent exponential growth in the development of technologies and applications (Lucas et al. 1993; Eiler 1995; Sibert 2000). For example, the recent study of the effects of commercial halibut fishing on the Glacier Bay marine ecosystem by P.N. Hooge and S. J. Taggart of the USGS/BRD have shown limited but seasonally predictable movements of halibut within Glacier Bay (P. Hooge, USGS/BRD, personal communications). In addition to critical habitat designation, physiological telemetry can now be used to monitor energy expenditure, life history migrations, stage of life cycle, and environmental conditions critical to improving and validating habitat-use models for pelagic fishes (B. Block, Stanford University, personal communications).

Archival satellite technologies offer the fisheries research community a new technology that is required to resolve movement patterns, spatial and temporal habitat use, and stock structure of many migratory marine species found in the Gulf of Alaska. The critical advantage to this new technology is that it allows documentation of habitat use that is independent of any fisheries harvest. Conventional identification tags have been used since the early 1900s, but individuals must be recaptured before information is obtained. Hydroacoustic tags can provide multi-day records of location, depth, temperature and swimming speed in marine fishes, but their temporal and spatial scale is limited by the range of signal recovery and transmission duration in salt water. In 1996 the first generation of archive satellite "pop-up" tags were developed and deployed on pelagic fish.

The range of signal available at depth, sea water conductivity, required recapture of tagged fish, and/or the temporal scale of signal recoveries limit sonic and radio telemetry tags for fish found in the ocean. New technology involving microwave archive tags and satellite-linked telemetry with temperature, light, and pressure sensors can be used to identify critical habitat in near-shore and pelagic fishes that are unavailable with more conventional technologies. There are several versions of satellite pop-up tags currently developed for fish. One (PTT100) can store location data based on solar angle and a set number of average or instantaneous temperature points (up to 60). This tag is commercially available from Microwave Telemetry, Inc. A second, the pop-up archival transmitting (PAT) tag, collects and stores data on depth, temperature, and light levels at user set intervals and transmits these data at a preselected time via Argos satellites. The PAT tags are available from Wildlife Computers. In studies of pelagic movements of Atlantic blue fin tuna, pop-up tags developed by both manufacturers gave very similar results following applications by two independent research groups. Recovery rates for PTT pop-up tags deployed by one European research group were low in 1999. It is unclear, however, if these poor recoveries are due to differences in survivorship of the fish, differences in attachment technique, or failure of the tags.

A more technical tag is in development which measures and records light intensity, hourly temperatures, and/or pressure for up to one year and downloads these data remotely to a satellite link from any location. These tags have limited commercial availability at this time, have been field tested on a limited number of deep-sea pelagic fishes (tuna and marlin), but can be made available in limited quantities for this study (P. Howey, Microwave Telemetry, Inc., personal communications). Size restrictions are a problem with the first series of satellite pop-up tags. These tags require large animals (around 70 lbs) for successful attachment. Smaller, more hydrodynamic tags are currently in development by several vendors and may be available for research in the near future.

Data archived by satellite tags include records of ambient and internal body temperature, pressure, and light. It is possible to estimate latitude (geoposition) for tag location at any given time from light intensity, temperature, and accurate temporal measurements of dawn and dusk (Hill 1994). The longitude determination is equally accurate throughout the year and at all locations except those where no dawn and dusk events are recorded. Latitude determinations are most accurate at the solstices and useless at the equinoxes. This is clearly a problem in Alaska waters where long crepuscular periods (winter) are followed by intense solar periods (summer). The accuracy of light-level measurements, duration of crepuscular events, atmospheric aberrations, and individual fish behavior can all impact the accuracy of geoposition estimates. A current error rate of 50-60 miles is not uncommon in the analyses of these data from temperate waters. We should expect a much wider error rate in Alaskan waters unless data collection and processing are adapted to local light conditions. Wildlife Computers is working on new analytical algorithms using time-series analyses of light sensor data for increased accuracy of geoposition estimates from pop-up tags. This approach seems very promising for areas, such as Alaska, where crepuscular light conditions alternate with long solar exposures.

Light sequence data from pop-up tags are downloaded to satellite relays in predetermined data sequences. These sequences can be set as individual records of light/temperature/pressure at set intervals, means of individual sequence data, or as data series sets (such as sets based on time series analyses). Data sequence, architecture, and analyses can be developed for local conditions at different times of the year increasing the effectiveness of geoposition estimates. *In situ* temperature records can be integrated with sea surface temperature (SST) to add rigor to geoposition estimates taken from tags recording near the surface. However, any correlation between SST and actual temperatures at various depths in the Gulf of Alaska remains unclear. A combination of temperature and pressure data can be used to evaluate fish behavior (time at surface, length of dive, time at depth, etc.), but a clear association between ocean bathometry and currents for the Gulf of Alaska and temperature/pressure at depths needs to be evaluated.

Satellite tags are attached externally to fish released back into their natural habitat. Tags release at a preprogrammed time, float to the surface, and transmit their data continuously to available satellites. The data are then available via satellite links to the individual researcher. These data can be made available in real time to any user group after developed algorithms translate the satellite transmissions into temperature, pressure, and light data. Successful integration of satellite tag data into the EVOS Trustee Council's Gulf Ecosystem Monitoring (GEM) program will allow the development of a unique and continuous information base on natural use of critical marine habitat by migratory fishes due to the fact that tags can be programmed to detach at predetermined intervals and transmit location and other pertinent data over both short and long time intervals. This flexibility in data recovery from natural distributions of organisms will allow research scientists and managers to develop and test hypotheses concerning critical habitat use over temporal and spatial scales unavailable with any other tool.

One additional advantage to satellite tagging technology is the ease of application and data transfer to multiple user groups beyond the research scientist, making these data a potentially important link between fisheries, conservation, and management groups. This proposal suggests that data collected from archive tags deployed in the Gulf of Alaska be made available to local communities and interest groups in real-time through internet web links with a USGS/BRD web site dedicated to this study.

This proposal is intended to test the accuracy and efficiency of archive satellite tags for estimates of geoposition in the Gulf of Alaska. If successful these data can provide an effective database for analyses of critical habitat use in Alaska waters. This technology is clearly universal in its application and testing. A recent 5-day symposium was held in Hawaii on "Tagging and Tracking Marine Fish with Electronic Devices." This symposium had registered participants from 13 countries (Australia, Canada, France, Germany, Iceland, Iran, Italy, Japan, Mexico, New Zealand, Norway, Sweden, United Kingdom, and United States). There were 21 satellite-tracking presentations at the symposium covering case studies on four species of tuna, swordfish, marlin, Atlantic salmon, brown trout, Arctic char, and five species of sharks. Also included were six talks on new hardware and software application developments in satellite tagging technology. The PI for this project is currently editing the proceedings of this symposium. Clearly there are numerous data sets in development that will facilitate the application of satellite tags in Alaska waters. One research project scheduled for funding by EVOS (Alaska Shark Assessment Project #00396) has agreed to cooperate on the analyses of light and temperature data from pop-up tags deployed on sharks (Lee Hulbert, pers. comm.)

There are several developmental issues based on conditions endemic to Alaska that have not yet been addressed to date in the use of satellite tags. Primary is the issue of geolocation estimated from ambient light levels. Studies of satellite tags in the lower 48 states and Europe primarily rely on records of sunrise and sunset recorded by changes in light intensity on the tag data to establish approximate longitude and latitude locations for individual tags (fish). With the long duration of crepuscular light sequences in Alaska waters new light interpretative algorithms need to be developed for the Gulf of Alaska to provide an efficient tool for geolocation using satellite tags. This is critical to studies where we end up tracking animals over time in very shallow or very deep waters where variation in depth and temperature data will not provide collaborative evidence of fish locations. For best results these algorithms need to be developed and tested in conjunction with laboratory experiments of light conditions and sensor data and compared to data collected from an array of tags submerged at different depths on a stationary mooring line in the Gulf of Alaska.

Additional research needs to be undertaken on cost-effective tagging regimes for this area. These analyses would investigate species-specific tagging protocols, size and anchor location of tags as they affect survival rates (for both fish and tags), effects of coastal geology on tag recovery, release mechanisms appropriate for depth and scale of movement by different species, and the effects of fish mortality and tag mortality on the interpretation of results. We also need to develop some platform for data exchange, crossover studies, and data archive capacity for ecosystem scale marine habitat analyses in the Gulf of Alaska. The latter objectives will require integration of satellite tag data with other significant geological, oceanographic, and climatic databases for this area.

The approach of this study is directed at multiple species, not individuals of any one species. Halibut were selected as the test organism at the Sea Life Center because of their general size in the Gulf of Alaska, their ease of capture and adaptation to captivity that will allow experiments of light intensity, tag sensitivity, and handling (tagging) stress under different natural and artificial conditions available at the Center. This proposal requests funding to initiate satellite telemetry studies incorporating three elements: 1) initiate and monitor satellite telemetry data from tags on captive fish under artificial light regimes that mimic crepuscular conditions in the Gulf of Alaska, on a few tagged fish released into their natural environment, and on a tag array placed *in situ* on a stationary buoy in the Gulf of Alaska; 2) develop data architecture (i.e. duration and sequence of data points) and analytical approaches (sequence mean or time series analysis) for estimates of geoposition from satellite pop-up tags in the Gulf of Alaska; 3) initial studies in captivity of tagging effects, efficiency, and physiological response in individual fish at Alaska Sea Life Center.

NEED FOR THE PROJECT

A. Statement of Problem

The development of marine reserves or protected areas in geographic localities with subsistence, commercial, and sport fisheries depend on sound scientific knowledge of "critical habitat" and ecosystem use at several temporal and spatial scales. Our knowledge of marine habitat use over time for different life stages and fish species in the Gulf of Alaska are currently limited to information from harvest statistics and antidotal information from resource users and managers (Int. Pac. Halibut Comm. 1987; Pelletier and Parma 1994), with the notable exception of recent work done on halibut in Glacier Bay (Chilton et al in press; Hooge and Taggart unpublished data). Knowledge of the distribution of individual fish over time within the Gulf of Alaska ecosystem is needed to make sound management decisions at the inception of reserves or protected areas. Without sound scientific support, initial development of marine reserves can create significant conflict among diverse user groups. Including local community based information in the deployment and recovery of these scientific data will be an effective tool in resource management. Documentation of individual fish behavior in economically and ecologically important species within the reserve will aid in the development of a common-ground database on fish distributions over time and space during the development of reserve boundaries and temporal management units within the reserve where frequent conflict-of-interest problems are expected to arise.

The marine environment imposes severe constraints on the type of electronic tags that can be used to monitor the behavior of fish in their natural environment. Seawater is highly conductive and radio waves do not propagate well in this medium. Recently marine biologists have developed new technologies in an effort to address this problem. Pop-up devices are externally attached to fish and are programmed to detach from the animal at a specific date, surface to the ocean, and transmit data to available satellites. The newest pop-up tags incorporate archive technology and transmit a full suite of data arrays to the satellite. To date this technology has been applied to large pelagic fish spending at least part of their time in temperate waters. The developmental approach used in the acquisition and analyses of pop-up tag data need to be adapted to local climatic and solar conditions if this technology is to be effectively implemented in the Gulf of Alaska.

There are numerous data sets in development that will facilitate the application of satellite tags in Alaska waters. But there are several developmental issues based on conditions endemic to Alaska that have not yet been addressed. Primary is the issue of geolocation by light levels. Studies of satellite tags in the lower 48 states and Europe primarily rely on records of sunrise and sunset recorded by changes in light intensity on the tag data to establish approximate longitude and latitude locations for individual tags (fish). With the long duration of crepuscular light sequences in Alaska waters new light interpretative algorithms need to be developed for the Gulf of Alaska to provide an efficient tool for geolocation using satellite tags. This is critical to studies where we end up tracking animals over time in very shallow or very deep waters where variation in depth and temperature data will not provide collaborative evidence of fish locations.

Additional research needs to be undertaken on cost-effective tagging regimes for this area. This study would facilitate investigations of species-specific tagging protocols, size and anchor location of tags as they affect survival rates (for both fish and tags), effects of coastal geology on tag recovery, release mechanisms appropriate for depth and scale of movement by different species, and the effects of fish mortality and tag mortality on the interpretation of results. We also need to develop some platform for data exchange, crossover studies, and data archive capacity for ecosystem scale marine habitat analyses in the Gulf of Alaska. I anticipate that this latter objective will require integration of satellite tag data with other significant geological, oceanographic, and climatic databases for this area.

The approach of this study has always been one directed at multiple species found in their natural marine habitats. Halibut were selected as the test organism simply because of their ease of capture and adaptation to captivity that would allow experiments of light intensity, tag sensitivity, and handling (tagging) stress under different natural and artificial conditions we can manipulate at the Sea Life Center. Potential future applications directed at discovery and monitoring of ocean habitat use by critical Trustee fish species are broad. A clear understanding of marine salmonid life history and ocean forage migrations will only be possible with the development of this technology. Understanding temporal and spatial use of marine habitats by species, such as sharks, lingcod, rockfish, halibut, trout, and salmon will contribute significant information to fisheries resource management decisions in the Gulf of Alaska.

B. Rationale/Link to Restoration

Information collected during this study will contribute to our ability to use new technology to assess recovery and impediments to recovery (critical habitat) for economically and ecologically important fish species found in Prince William Sound and the Gulf of Alaska. The proposed work represents a sound initial scientific approach to increase our technological capacity to investigate the factors that affect population dynamics on multiple temporal and spatial scales and if successful, this technology will help in the definition of critical habitat for proposed marine reserves in the Gulf of Alaska. Without an understanding of the general underlying patterns of habitat use that dictate population change and species interaction within marine units or areas, we can not prescribe or limit specific activities within the reserve based on species distribution. Analysis of critical habitat use for different life history stages of key species will allow integration of sustainable use or limited harvest in the conservation and management of these species within the marine reserve. The development of satellite tag technology offers a promising window on this type of information.

Archival satellite technologies offer the fisheries research community a new technology that is required to resolve movement patterns, spatial and temporal habitat use, and stock structure of many migratory marine species found in the Gulf of Alaska. The critical advantage to this new technology is that it allows documentation of habitat use that is independent of any fisheries harvest. Conventional identification tags have been used since the early 1900s, but individuals must be recaptured before information is obtained. Hydroacoustic tags can provide multi-day records of location, depth, temperature and swimming speed in marine fishes, but their temporal and spatial scale is limited by the range of signal recovery and transmission duration. In 1996 the first generation of archive satellite “pop-up” tags were developed and deployed on pelagic fish. The data archived by satellite tags include records of ambient and internal body temperature, pressure, and light. It is possible to estimate latitude and longitude for tag location at any given time from changes in light intensity. Only after crepuscular 24hr light sequence data are developed for local conditions and integrated with the satellite data will the true potential of these tags be available to species in the Gulf of Alaska.

Satellite tags are attached externally to fish, release at a preprogrammed time, float to the surface, and then transmit their data continuously to ARGOS satellites. The data are then available via satellite links to the individual researcher. These data can be made available in real time to any user group after developed algorithms translate the satellite transmissions into temperature, pressure, and light data. Successful integration of satellite tag data into GEM’s goals will allow the development of a unique and continuous information base on natural use of critical marine habitat by migratory fishes due to the fact that tags can be programmed to detach at predetermined intervals and transmit location and other pertinent data over both short and long time intervals. This flexibility in data recovery from natural distributions of organisms allows research scientists to develop and test hypotheses concerning critical habitat use over temporal and spatial scales unavailable with any other tool.

One additional advantage to satellite tagging technology is the ease of application and data transfer to multiple user groups beyond the research scientist, making these data a potentially important link between fisheries, conservation, and management groups. This proposal suggests that data collected from archive tags deployed in the Gulf of Alaska be made available to local communities and interest groups in real-time through internet web links with a USGS/BRD web site dedicated to this study.

C. Location

Data to be compiled will come from tags deployed in the Gulf of Alaska and tags in controlled light condition at the Sea Life Center. Initial physiological data concerning tagging effects and efficiencies of light intensity data will be assessed using a limited number of fish (6) in captivity at the Alaska Sea Life Center in Seward, AK. Tagging of four wild fish with satellite pop-up tags will take place in collaboration with the local sport and commercial fishing community. Tag array disposition on a stationary buoy in the Gulf of Alaska will be done in collaboration with the National Weather Service, National Marine Fisheries, and the US Coast

Guard. Satellite data recovery, data architecture, data array analysis, and the development of a web-site for real-time data access to tag data will be done by the staff of the USGS/BRD Alaska Biological Science Center, in conjunction with tag vendors.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

All efforts will be made throughout the project to incorporate participation in and provide local involvement in the implementation and development of this project in relation to target populations and tagging localities. Project staff will be available to present information to local communities, internet access to real-time data from satellite tags will be made available at the local level as it becomes available to the PI. All articles, video, or photographs of the tagging study will be made available to the Trustee Council. The nature of the tagging study and the charismatic character of the fish subjects make this a potentially high profile public relations project for the recovery and Trustee Council.

PROJECT DESIGN

A. Objectives

1. Develop critical criteria for satellite telemetry data dedicated to geolocation of organisms in marine habitats within the Gulf of Alaska:

   a. Monitor satellite telemetry data derived from artificial light conditions simulating long crepuscular and intense solar periods on fish maintained in short-term captivity studies at the Alaska Sea Life Center

   b. Deploy pop-up tag array from a stationary buoy in the Gulf of Alaska and develop data sets on light, temperature, and pressure from direct *in situ* studies of tag efficiency and data architecture.

   c. Monitor and plot individual movement and geolocation estimates based on data derived from four tagged fish releases in the Gulf of Alaska

   d. Integrate all available light data bases taken from pop-up tags in the Gulf of Alaska, including NMFS's data on tagged sharks into analyses of geolocation on fish in the Gulf of Alaska

2. Study captivity effects, metabolic compensation, and fish physiology based on tagging efficiency (attachment methods, tag stability, fish response) for Pacific halibut brought into captivity at the Sea life Center

3. Summarize data available for different tag configuration and data architecture accessible via satellite links. Test efficiency of geolocation estimates based on tag studies and publish results in peer-reviewed scientific journals

4. Create a public access internet site for the display and development of study results with

real-time deposition of tag recovery data throughout the duration of the project.

B. Methods

A total of 14 pop-up tags will be deployed under various conditions to gather and analyze data on estimates of geolocation in the Gulf of Alaska. Six fish will be collected in FY00 from the halibut sport fishery and transported live to the Alaska Sea Life Center for analyses of tag attachment, tagging efficiencies under different light conditions, and photo sensor precision. Fish in captivity will be fitted with pop-up tags (3.5 g). Each tag is housed in a composite, positively buoyant, low-drag housing that is towed by the fish via a short "leader" attached to a tagging dart. The PI will monitor tag attachment effects with at least two veterinary scientists with a background in fish, and a representative from the satellite tag vendor. Tests will include attachment location effects, physiological stress during and after tagging, and stability of implantation over time.

Several features of the satellite tags will be tested from an array of tags deployed from a stationary buoy located in the Gulf of Alaska. This tag array will be used to test efficiency of light sensors at latitudes within the Gulf of Alaska, temperature cycles at depth, stability of pressure sensors at depth, and effective deployment of timed-release mechanisms in pop-up tags. The data downloaded from this artificial *in situ* array of tags will be compared to results we obtained from our artificial light experiments for halibut held in captivity under controlled conditions. The relative efficiencies of different data arrays, download capacity, and photo sensors for estimates of geoposition in conditions common to the Gulf of Alaska will be analyzed in these comparisons artificial and natural light conditions.

Estimates of actual fish location will be obtained from data collected from four live fish released with pop-up tags into the Gulf of Alaska and from coordination and data sharing with other research groups working with pop-up tags in the same area (i.e. NMFS's shark project). These data will then be compared and analyzed for rigor of geoposition estimates based of our findings from captivity light studies and the stationary tag array.

Conversion of satellite data to position and movement cycles for individual fish will be made using adaptations of existing conversion algorithms available from the vendor and our initial field trials of tags in the Gulf of Alaska. New approaches to estimating geoposition from light data using time series analyses will be tested in this study (R. Hill, Wildlife Computers, pers. comm.) Data for location and position for individual tags collected in the wild will be plotted by species on digitized maps of the Gulf of Alaska (two dimensional) incorporating any bathymetric data (three dimensional) available for this area using standard telemetry and GIS mapping methods (Swilhard and Slade 1985; Baltz 1990; Cressie 1991; Thompson et al. 1992).

The development of the internet link to tagging studies and results will run parallel to the ongoing field studies and tagging data development. The initial web site will be posted on the USGS/BRD Alaska Biological Science Center's home page.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

This proposal relies on data collected by a number of research collaborators as yet unnamed (i.e. commercial or sport boat captains, fishing volunteers, and community internet links). Known collaborators include: Dan Mulcahy, DVM, USGS/BRD fish and wildlife veterinarian; Riley Wilson, DVM Anchorage Zoo; Roger Hill, Wildlife Computers; Dr. Paul Howey, Microwave Telemetry, Inc.; Philip Hooge and Spencer Taggart, USGS/BRD Glacier

Bay; Dr. Barbara Block, Hopkins Marine Station, Stanford University; Dr. Heidi Dewar, the Pfleger Institute of Environmental Research; Dr. Steve McCormick, fish physiologist, NMFS, Conte Anadromous Fish Laboratory; and the staff of the Alaska Sea Life Center. Lee Hulbert of the National Marine Fisheries has volunteered collaboration on the analysis of light data collected from their shark pop-up tag study. All technical and clerical staff will be current employees of USDGS/BRD Alaska Biological Science Center or qualified individuals contracted directly for this project.

SCHEDULE

A. Measurable Project Tasks for FY 00 - 01

Aug. 1 – Sept. 15:	Purchase satellite-linked tags, establish download links, develop field collection protocols, and prepare live tanks (3) for halibut at Alaska Sea Life Center. Consult with resource managers and local users on best populations to target for captivity and tagging studies. Letters with study plan have been sent to ADFG and IPHC.
Aug. 16 – Sept 15:	Collect six Pacific halibut and transport to Alaska Sea Life Center. Time depends on availability of vessel (boat still in negotiation and under permit constraints from ADFG and IPHC).
Aug. 15 – Nov. 15:	Captivity test on light data arrays using UV tank covers. Do analyses of halibut physiology, tagging effects and efficiency, and survival trials in captivity at Sea Life Center.
Dec. 2000:	Field trials of environmental sensors in satellite tags in Gulf of Alaska. Deploy pop-up tag array on stationary buoy. Service date for UAF buoy is 12/00. We intend to leave in place 1 yr. to capture spring and fall crepuscular light cycles
Nov.– Mar. 01:	Release 4 halibut in Gulf of Alaska. Surviving fish from Sea Life Center will be used for live releases. Deploy tags to pop-up in 2-3 months.
Apr. - May 01:	Collect and analyze first data sets (two tags from Sea Life Center and returns from live releases). Develop Web Page for study results and plot initial data. Consult on tagging applications and data interpretation. Develop oceanic temperature and bathymetry database for Gulf of Alaska.
Feb. – Apr. 01:	Analyze final data from tagging recoveries in captivity and in the wild.
Postponed:	Prepare data presentation and attend restoration meeting
July – Aug. 01:	Compile data and write annual report. Integrate analyses from parallel studies of pop-up tags in Gulf of Alaska.
Sept. 2001:	Submit final report to EVOS on study results.

B. Project Milestones and Endpoints

EVOS costs for this project will be billed in FY00 and FY01.

Due to late implementation of study plan and funding, USGS/BRD data analyses will continue into FY2001.

Project will be completed upon submission of the final report prior to Sept. 30, 2001.

C. Completion Date

All project objectives will be met during FY2000-2001.

PUBLICATIONS AND REPORTS

A final report of activities will be submitted to the Restoration Office on or before 30 September 2001.

Manuscript containing final results and recommendations will be submitted to a peer-reviewed scientific journal for publication in FY01-FY02.

Website development and maintenance of our tagging database will be available FY01. At the end of the project we will transfer the internet site to a webmaster designated by the Trustee Council.

PROFESSIONAL CONFERENCES

International Marine Biotechnology Conference (IMBC) 2000
American Society of Ichthyologists and Herpetologists FY01
American Fisheries Society FY02

NORMAL AGENCY MANAGEMENT

The work proposed here is not part of normal agency management and is related specifically to research addressing oil spill restoration concerns. No similar work has been conducted, is currently being conducted, or is planned using agency funds.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This research provides fundamental information needed for the implementation and development a new technology dedicated to the identification of critical marine reserve areas in Prince William Sound and the Gulf of Alaska. The definition of critical marine habitat for economically and ecologically important fish species will serve as a cornerstone for future Trustee sponsored conservation and use management proposals under the GEM program. The major objectives of this work require interaction with several other investigators and integration of all available data that are relevant to the question of critical marine habitat in the Gulf of Alaska.

PROPOSED PRINCIPAL INVESTIGATOR

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PERSONNEL QUALIFICATIONS

Jennifer Nielsen is Fisheries Supervisor and Research Biologist (GS14) with the Alaska Biological Science Center, USGS Biological Resources Division. She has conducted salmonid and fisheries research throughout the western Pacific for the past 20 years. Dr. Nielsen is a Associate Professor at the University of Alaska, Fairbanks in the School of Fisheries and Ocean Sciences. From 1995 - 1999 she was a visiting scientist at Hopkins Marine Station, Stanford University, where the first experiments on satellite pop-up tags were conducted on blue fin tuna. From 1995 - 1999, she was an Adjunct Professor in Ichthyology and Fisheries at the University of California, Berkeley and Moss Landing Marine Laboratory, and served on the Scientific Review Board for the Monterey Bay Aquarium. Dr. Nielsen has published over 30 peer-reviewed journal publications and book chapters, numerous technical reports, and gives frequent national and international presentations at scientific meetings addressing research issues in fish conservation, behavior, evolution, and genetics. Her work on salmonid fishes is recognized internationally for its contribution and focus in fisheries conservation and management.

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LITERATURE CITED

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2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1999 - September 30, 2000

Budget Category:	Actual FY 2000	Proposed FY 2000						
Personnel	$15.5	$6.0						
Travel	$1.0	$0.0						
Contractual	$5.5	$0.0						
Commodities	$0.9	$0.0						
Equipment	$51.4	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$74.3	$6.0			Estimated FY2002	Estimated FY 2003		
General Administration	$2.7	$0.9						
Project Total	$77.0	$6.9			$0.0	$0.0		
Full-time Equivalents (FTE)	0.8	0.3						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

USGS/BRD will contribute travel from Anchorage to the SeaLife Center, salaries for the PI and a project veterinarian

NOTE: We were unable to complete this project during FY00 as scheduled due to overseen delays. Our currently revised schedule for the work during FY00 projects $6K in unspent FY00 salary costs plus $0.9 GA which will be returned to the Council in lapsed funds at the end of FY00. A total of $6K in salary costs plus $0.9 GA are being requested for FY01 to complete

FY01

Prepared: 7/20/00

Project Number: 01478
Project Title:Testing satellite tags as a tool for idenifying critical habitat
Agency: DOI-BRD

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1999 - September 30, 2000

Personnel Costs*:			GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	
Name	Position Description						
J. Nielsen*	Fisheries Supervisor		GS14/01	1.0	7.2		
TBA	Fisheries Project Leader		GS9/01	1.5	4.0		
D. Mulcahy*	Fish/Wild. Veterinarian		GS13/05	0.3	6.8		
D.Douglas*	Fish/Wild Scientists		GS12/05	0.3	6.0		
TBA**	Aquaculture Technician	(ASLC)	ASC grade	168 hrs.	$20/hr		
TBA**	ASC Veterinarian	(ASLC)	ASC grade	7 hrs.	$40/hr		
*all personnel costs will be covered by USGS/BRD							
** presonnel costs covered by Sea Life Center							
		Subtotal		3.1	24.0	0.0	
						Personnel Total	

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	
Description					
				Travel Total	

FY01

Prepared: 7/20/00

Project Number: 01478
Project Title: Testing satellite tags as a tool for identifying critical habitat
Agency: DOI-BRD

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1999 - September 30, 2000

Contractual Costs:	
Description	
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	
Commodities Costs:	
Description	
Commodities Total	

FY01

Prepared: 7/20/00

Project Number: 01478
Project Title: Testing satellite tags as a tool for idenifying critical habitat
Agency: DOI-BRD

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1999 - September 30, 2000

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

Existing Equipment Usage: Description	Number of Units	