

# ***Effect of Disease on Pacific Herring Population Recovery in Prince William Sound***

Project Number: 02462  
Restoration Category: Research and Monitoring  
Proposer: University of California, Davis  
Lead Trustee Agency: ADFG  
Cooperating Agencies: None  
Alaska SeaLife Center: no  
Duration: 4<sup>th</sup> year, 4-year project (1-yr. extension proposed)  
Cost FY02: \$26,800 (UCD) + \$50,600 (ADFG) = \$77,400  
Geographic Area: Prince William Sound  
Injured Resource/Service: Pacific herring, commercial fishing, subsistence

## ***ABSTRACT***

The Pacific herring population of Prince William Sound has not recovered from severe population decline in 1993. The Alaska Department of Fish and Game now predicts that fisheries closed since 1999 will not open for several years. Long-term systematic disease monitoring and research since 1994 has shown a clear relationship between disease prevalence and population change, and this information significantly improves our ability to forecast population change. Because of the importance of Pacific herring in the Prince William Sound ecosystem, and the importance of this project to marine fisheries worldwide, a 4<sup>th</sup> year of disease study is proposed to ensure seamless flow of data from this Restoration project to the Gulf Ecosystem Monitoring program.

## INTRODUCTION

The population of Pacific herring (*Clupea pallasii*) in Prince William Sound (PWS), Alaska has not recovered since the estimated spawning biomass decreased precipitously from over 100,000 tons in 1992 to less than 20,000 tons in 1994 (Figure 1). Study of the population since 1993 revealed that viral hemorrhagic septicemia virus (VHSV), associated ulcers, and the fungus-like organism *Ichthyophonus hoferi* cause the major diseases in Pacific herring, and that VHSV and associated ulcers probably contributed most to population decline in 1993 (Meyers et al. 1994; Marty et al. 1998; Quinn In press). Prince William Sound Pacific herring fisheries were severely curtailed in 1993, and were never opened in 1994 or 1995. The population began to recover in 1996, and a small bait fishery was opened in November of 1996. All fisheries were opened in 1997, but an unexpected increase in prevalence of VHSV in spring samples (15% in 1997 vs. 0% in 1996) was associated with abnormal spawning activity. In 1998, continued high virus prevalence (15%) was associated with increased ulcer prevalence (0% in 1997, 3.2% in 1998; Figure 2).

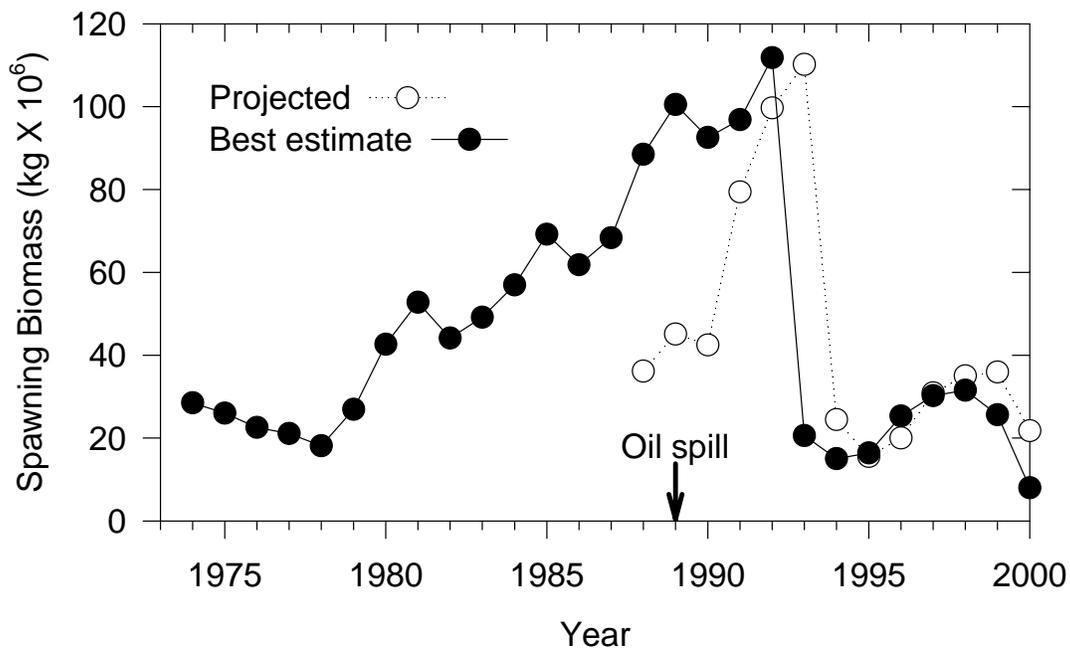


Figure 1. Spring prespawning biomass estimates of mature Pacific herring in Prince William Sound, Alaska. Unexploited spawning biomass is estimated using an age-structured assessment model (ADFG, unpublished data).

After the major crash of 1993, the Pacific herring population continued to decline in 1994 and project 94320-S was initiated under emergency conditions to determine causes of herring morbidity (sickness), with particular emphasis on the role of VHSV. Beginning in 1995, a 4-year multidisciplinary project was initiated to explore the role of VHSV, *Ichthyophonus hoferi*, and other parasites on population change (95320-S, 96162, 97162, and 98162). Study in 1995 and 1996 included examination of fish from a reference site, Sitka Sound, in which the herring fishery was strong and there was no history of a large oil spill. Although 1998 was the final field

season for project 0462, the high ulcer and virus prevalence in 1998 provided strong evidence that the population was at high risk of disease-related decline. Therefore, this project (0462) was proposed and funded for 3 years to continue research on the effect of disease on Pacific herring population recovery.

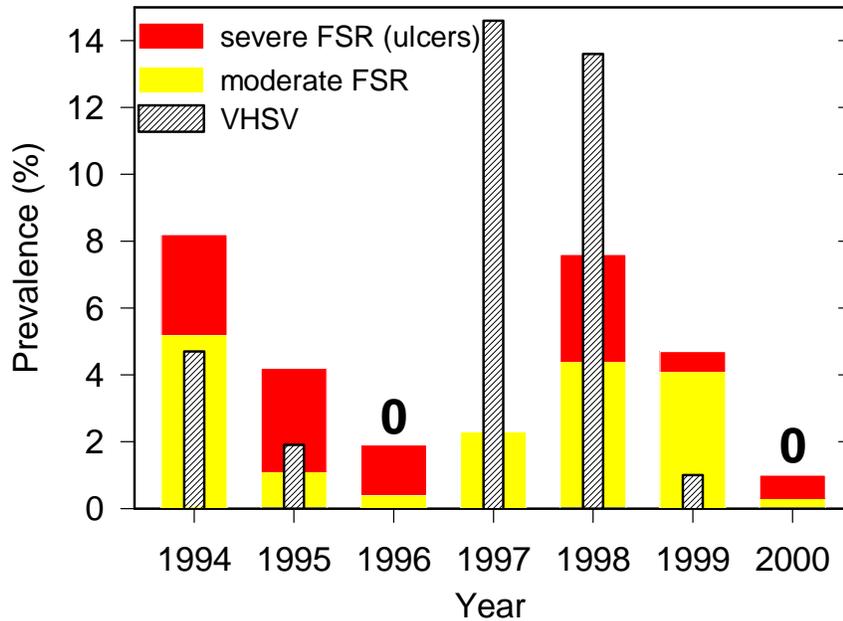


Figure 2. Spring prevalence of focal skin reddening (FSR) and viral hemorrhagic septicemia virus (VHSV) in adult Pacific herring sampled from Prince William Sound, Alaska.

The foresight of funding this study was immediately obvious in its first year, 1999. The Alaska Department of Fish and Game had predicted increasing biomass (Figure 1), and a fishery was scheduled for April 1999. But poor returns closed most of the fisheries, including the most valuable sac roe fisheries. Unlike in 1993—when the population crashed but Pacific herring damage assessment studies were not funded—in 1999 disease study was fully funded and we were able to document a fairly healthy population in 1999 (sample virus prevalence = 1%) and 2000 (sample virus prevalence = 0%). The continuous series of high quality disease information allowed us to determine that most of the population decline occurred in 1998, nearly a year before the decline was detected by biomass estimates. Note that the best biomass estimates are made on prespawning aggregations in early April, but spawning itself can result in high mortality of susceptible fish. Spawning-related mortality in 1998 was not detected until the next prespawning aggregation in 1999.

Results from long-term disease study supported by the Trustee Council have broad significance beyond the herring population of PWS. We are answering basic questions about how disease contributes to mortality of free-ranging, schooling, marine fish. To more fully answer these basic questions, the U.S. National Science Foundation (Biological Oceanography) funded a 3-year project to augment continued disease research in PWS. The NSF project is closely linked to this project (0462). This proposal asks the Trustee Council to continue to fund fish necropsy,

tissue sampling, and virus analysis. NSF has committed to fund analysis of blood and tissues (histopathology) as well as a modeling component through Dr. Terrance Quinn of the University of Alaska, Fairbanks. Both organizations benefit from high quality, multiyear research, but at a fraction of the cost of supporting the entire project. The full NSF component of the project cannot continue unless the Trustee Council continues to fund sample collection. In funding the sampling and virus analysis components of the study, the Trustee Council will have access to the same types of data generated from 1994-2001, with the addition of a modeling component to determine the role of disease in stock assessment.

This project is already the most comprehensive study of disease in a wild fish population, but all 8 years of study have been conducted on a depressed population. We will almost certainly learn more about the interaction of disease and population change when population biomass eventually recovers. The next year is critical period for this project. Extending the project for the final year of restoration funding has two distinct advantages. First, the NSF component of the project is up for competitive renewal (submission deadline 8-15-01, with new project dates 2-1-02 through 1-31-07). A fourth year of funding by the Trustees will provide a strong boost to the NSF renewal proposal (as it did for the original 3-year NSF proposal). And second, because population biomass is at the lowest level ever recorded, continued disease study will help us understand if disease continues to inhibit recovery. Pacific herring are extremely important in the Prince William Sound ecosystem, and this project provides an understanding of disease and population change that is important for understanding marine fisheries worldwide. A 4<sup>th</sup> year of disease study is proposed to ensure seamless flow of data from this Restoration project to the Gulf Ecosystem Monitoring program.

This project has benefited from project \468 “Fundamental Estimations of Acoustic Target Strength” because acoustic estimates of population size are an important component of estimating population biomass. Better estimates of population biomass allow us to more accurately assess the relation of disease and population change.

## ***NEED FOR THE PROJECT***

### ***A. Statement of Problem***

Pacific herring are an injured biological resource in Prince William Sound (PWS) classified as “recovering.” However, estimates of population biomass in 2000 were the lowest on record. The population was low enough in 2000 that ADFG closed all herring fisheries in 2001 without using their age structured assessment model to calculate prespawning biomass. From ADFG’s announcement Wednesday, March 28, 2001, “the PWS herring spawning biomass could be expected to remain below threshold for several more years” (<http://www.cf.adfg.state.ak.us/region2/finfish/herring/pws/pwsupd01.htm>). Lack of recovery of the resource has resulted in lost services, particularly for commercial fisheries. Also, Pacific herring and herring spawn-on-kelp are harvested annually for subsistence purposes and form an important part of the local native culture of Chenega and Tatitlek. Delay in recovery of the herring population results in lost resources for subsistence use. Continued study is needed to examine how disease may be limiting recovery and to document when recovery has occurred.

## ***B. Rationale/Link to Restoration***

This project should be done because it will provide information on what might be limiting population recovery and it will monitor when fish are healthy and recovery has begun. Also, ADFG now uses disease information as part of its mathematical model to estimate population biomass. If disease prevalence again increases, ADFG can use this information to delay opening of any commercial fisheries until the population has truly recovered. Continued sampling of fish twice a year is needed to determine the dynamics of disease in the population.

## ***C. Location***

Study will be done in Prince William Sound, Alaska. Information will benefit fisheries managers as they consider alternatives for managing Pacific herring fisheries. As the resource is enhanced, users throughout PWS could potentially benefit. Because we have identified ulcer prevalence as a key indicator of population health, managers of other Pacific herring fisheries can use this information to monitor the health of their populations.

## ***COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE***

Dr. Marty has a solid record of local contact and dissemination of information, and continued collaboration with local users is proposed for FFY02. For example, Dr. Marty led a herring dissection and necropsy demonstration for the Youth Area Watch in Cordova on April 19, 1999. Contact with fishers, processors, and ADFG managers occurs through participation in conference telephone calls, personal contact while in Anchorage and Cordova, and via e-mail.

To aid in dissemination of information, Dr. Marty is available by phone for interviews and will respond quickly to requests from the Restoration Office for general information and articles for newsletters. Dr. Marty is based in California, but Dr. Kathy Burek of Alaska Veterinary Pathology Services (one of only two board-certified veterinary pathologists residing in Alaska) has been contracted as a necropsy pathologist in 1995, and 1996, and 1999, and she has indicated her interest to serve as the second pathologist in April 2002. Alaska residents will be hired by ADFG for sampling logistics and recording data, and ADFG will charter vessels from local residents for collecting and processing fish.

## ***PROJECT DESIGN***

### ***A. Objectives***

The restoration objective states, "Pacific herring will have recovered when the next highly successful year class is recruited into the fishery and when other indicators of population health are sustained within normal bounds in PWS." The population cannot be classified as healthy until individuals within that population are healthy. Field sampling to determine the ongoing disease status is a high priority of this project. Objectives include:

1. Determine the prevalence of major diseases in Pacific herring.
2. Determine the interaction of gender, age, and season on disease prevalence.
3. Determine if disease prevalence correlates with population trends.

## **B. Methods**

Pacific herring will be randomly sampled from PWS in November (at the end of the feeding season, n = 100) and in April (near the time of spawning, n = 300). Each fish will be examined for abnormalities (e.g., *Ichthyophonus hoferi*), and tissues from each fish will be assayed for VHSV.

This proposal has two specific hypotheses to test:

1. Prevalence of external lesions, VHSV, or *Ichthyophonus hoferi* is different from previous years.
2. Gross lesions, VHSV, or *Ichthyophonus hoferi* are related season, age, or gender.

To test the hypothesis that reproductive stage affects the development of disease, sampling is needed during the spawning season (spring) and during the period of gonadal development and peak condition (fall). Nearly 70% of the PWS Pacific herring biomass schools in the waters on the northern and western edge of Montague Island during November, and the fish remain in this area until after they spawn in April. Most fish will be sampled from this region. During the summer, fish disperse throughout the Sound. The other 30% of the PWS Pacific herring biomass overwinter and spawn in the Northeast region of PWS. Our primary goal is to get a representative sample of disease in PWS herring, and we reserve the option to sample fish in the Northeast region if warranted by changes in biomass trends. During the spawn-on-kelp investigations among fish from Northeast PWS in 1997 and 1998, trends in viral prevalence were similar to fish in the Montague area (Hershberger et al. 1999).

To provide a minimum number of fish from which at least the dominant year class can be analyzed in detail, we propose sampling 300 fish in April. Fish are easier to capture in the spring, and the age distribution in the spring is most consistent with data used in the historical age-structured assessment model. With a sample size of 300, diseases with a prevalence as low as 1% can be detected with 95% confidence, and a 6% difference in sample prevalence (e.g., 10 vs. 16%) can be detected with a statistical power of 0.80 (Becker and Grieb 1987). To test hypotheses of age differences, the dominant year class—often >40% of the sampled population—will be compared with combined groups of smaller year classes. To detect seasonal differences, and minimize costs, 100 fish will be sampled in the fall. A sample size of 100 is sufficient to have 95% confidence that disease with a prevalence of 3% will be detected in at least one fish sampled (Becker and Grieb 1987).

Proposed study is designed to minimize bias associated with gear type, capture, and holding (Holst 1996). All fish will be sampled using commercial purse seines. In the event that large numbers of fish begin to spawn in areas too shallow for commercial seines, fish will be captured

using cast nets. All necropsies will be completed < 5 hours after the seine is pursed around the fish.

To best characterize the condition of herring in Prince William Sound, herring will be subjected to complete necropsy using the following sampling schedule (as field conditions allow) during the final two years of proposed study:

Dates	Reproductive Stage	Number of Fish
<b>FY02:</b> Oct./Nov., 2001 (4 nights)	peak condition/ gonadal development	100
mid-April, 2002 (7 days)	spawning/post-spawning	300
Total Fish, FY02:		400

Fish for necropsy will be anesthetized in tricaine methane sulfonate (Finquel®) and visually screened for external lesions (Marty et al. 1998), which are ranked as none (0), mild (1), moderate (2), or severe (3). Prevalence of *Ichthyophonus* will be estimated by gross examination of internal organs, especially the heart. With funding from NSF, histopathological analysis will be done on 10 organs to determine *Ichthyophonus* prevalence.

Measurements on each fish include body weight, standard length, age (from scales), liver weight, and gonad weight. Otoliths are archived for later use if information on annual growth rates is desired. This study is designed to diagnose gross lesions (e.g., ulcers) and the two major disease agents: VHSV and *Ichthyophonus hoferi*. Results will be compared with previous years of study. Several samples will be collected, but only selected samples will be analyzed:

- a. Virus isolation - To assay fish for virus, anterior kidney, spleen, and any severe skin lesions will be put into individually labeled plastic bags and stored on ice (for each fish, one bag will hold kidney and spleen, and a separate bag will be used for skin lesions). Every 48 to 72 hours, samples will be shipped by air to the ADFG fish pathology laboratory in Juneau (under the direction of Dr. Ted Meyers) for analysis. Isolation using EPC cell lines will be as previously described (Meyers et al. 1994). The application of polymerase chain reaction (PCR) techniques for primary diagnosis of VHSV has been explored (R.M. Kocan and J.R. Winton, personal communication); to date, PCR has not proved more useful than virus isolation.
- b. Bacteriology – during the past 8 years, bacteriology was done on the kidney of each fish with severe gross lesions, but pathogenic bacteria have never cultured. Therefore, tissue around ulcers will be preserved for histopathology or virology, but the kidney will not be cultured for bacteria (superficial bacteria can be diagnosed on histopathology).

Other samples will be collected and analysis will be done using funding from NSF:

- a. Histopathology (fix in 10% neutral buffered formalin) - gill, spleen, liver, gonad, heart, stomach, intestinal tract, exocrine pancreas, trunk kidney, skeletal muscle, skin, brain, and other gross lesions. Also, a touch prep of kidney from each fish is made on a glass slide.

- b. Hematology - blood will be drawn from the caudal vein into a Lithium-heparinized syringe and stored on ice. Packed cell volume (PCV) is determined on site. A blood smear is made on a glass slide, dried, and archived. Plasma is separated by centrifugation (3,000 *g* for 7 min) and frozen within 3 h of collection.
- c. Immunology - a blood smear for leukocyte differential counts will be collected.

In previous study, spring samples from PWS had several other parasites, but these did not seem to be significant on the population level. Gross lesions and other observations will be scored as in previous years. All lesions are described in a “comments” section on a data sheet, but only the most common gross findings are scored for statistical analysis: caudal fin fraying, caudal fin reddening, fin base reddening, focal skin reddening, diffuse skin reddening, iris reddening, branchial copepods, number of 0.5-mm-diameter white foci on gills, number of peritoneal Anisakidae, and gonadal fullness. Parasites requiring histopathology for diagnosis will be scored using NSF funds.

The ADFG fisheries laboratory in Cordova, Alaska, will handle logistics for sampling fish for necropsy, collecting age and length data, preparing formalin and containers for tissue fixation, providing a data recorder for one pathologist on site, and ship all samples. Results from virus isolation will be reported as a VHSV titer.

Quality control and quality assurance is part of all examinations. For necropsy examination, the senior pathologist (Dr. Marty) is on site at all times; when questionable or difficult lesions are encountered, the second pathologist can consult with Dr. Marty. In the event that Dr. Marty is unavailable for necropsy, five other pathologists have experience on the herring necropsy team, and services of these pathologists would be secured.

Statistical analysis in this study will focus on determining changes in disease prevalence over time. The association of selected categorical variables (e.g., VHSV status versus external lesion scores) will be evaluated using chi-square methods for categorical data analysis; comparisons will be considered valid only if individual expected cell frequencies are  $>1$  and no more than 20% of the cells have expected cell frequency  $<5$ . Odds ratios will be calculated only for standard (2x2) two-way contingency tables. Significance of changes in disease prevalence will be tested using chi-square or Fisher's Exact test. For all analyses, comparisons will be considered significant when  $P < 0.05$  and highly significant when  $P < 0.01$ .

### ***C. Cooperating Agencies, Contracts, and Other Agency Assistance***

This proposal includes significant contributions from ADFG as the lead agency. The project is being run through ADFG because Dr. Marty has worked closely with ADFG on several Trustee Council-funded projects during the past decade. ADFG has unique local knowledge on Pacific herring in PWS, including the necessary experience and expertise to secure all necessary charters and ship hazardous materials from Cordova to Davis. Close collaboration with ADFG allows for seamless transfer of disease information to fishery managers, and rapid transfer of disease information to commercial and subsistence fishers. No other agencies are requesting funds for this section of the project, and no other agencies or universities will be contracted for this work.

Dr. Marty has provided information to Dr. Brenda Norcross on ways in which disease information can be used as part of overall Pacific herring studies in PWS during the next century. Results of this effort will not be realized until the Gulf Ecosystem Monitoring plan is initiated.

**SCHEDULE**

**A. Measurable Project Tasks for FY02**

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<i><b>DATES</b></i> <i>(results due on final date)</i>	<i><b>ACTIVITY</b></i>
<i><b>Fall Samples:</b></i>	
Oct. 1 - Nov. 30, 2001:	Collect samples; Person in charge: Gary D. Marty, UC Davis
Nov. 1 - Dec. 31, 2001:	Scale analysis (age); Person in charge: Steve Moffitt, ADFG, Cordova, AK
Nov. 1, 2001 – Feb. 28, 2002:	Virology and bacteriology; Person in charge: Ted Meyers, ADFG, Juneau, AK
March 1- Aug. 1, 2002:	Statistical analysis; Person in charge: Gary D. Marty
January 14-23, 2002 (4 days):	Attend annual restoration workshop (Gary D. Marty)
<i><b>Spring Samples</b></i>	
April 1 - April 30, 2002:	Collect samples; Person in charge: Gary D. Marty
April - July 31, 2002:	Scale analysis (age); Person in charge: Steve Moffitt, ADFG, Cordova, AK
April - Sept. 30, 2002:	Virology and bacteriology; Person in charge: Ted Meyers, ADFG, Juneau, AK
Oct. 2002 - Feb. 1, 2003:	Statistical analysis; Person in charge: Gary D. Marty
Jan. 11, 2003 –April 15, 2003:	Final report writing; Person in charge: Gary D. Marty
open:	Opportunities for public comment

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**B. Project Milestones and Endpoints**

Review of Objectives:

1. Determine the prevalence of major diseases in Pacific herring.
2. Determine the interaction of gender, age, and season on disease prevalence.
3. Determine the effect of disease on population trends.

Objectives will be met when the multi-year study is completed and the final synthesis report is submitted April 15, 2003.

#### ***D. Completion Date***

Basic project objectives will be met at the end of the fourth year of proposed study. Note, however, that each additional year of disease study in Prince William Sound provides more information on the recovery of the Pacific herring population. High prevalence of virus and ulcers among recruiting populations of both the 1994 and 1995 year-classes in 1998 severely limited the capacity of these year classes to contribute to population recovery. Recruitment of the 1996 and 1997 year classes was minimal. Preliminary evidence indicates that the 1998 year-class is no more than average. Even if the 1999 year class is as large as the last major year class (1988), recovery cannot be fully documented until that year class is 5 years old: in 2004 (two years after the current project ends). Therefore, termination of study in 2002 is not likely to be sufficient to document population recovery. Comments from reviewers of my NSF proposal were favorable, but most reviewers agreed that following the population through a full cycle—probably 16 to 20 years—would be needed to understand how disease and population size are linked. Currently proposed study through 2002 will provide us with 9 years of disease information, and this is already the most comprehensive study ever conducted on disease in a wild fish population. However, 9 years of study will provide information on only about ½ of a population cycle. Extending this project another 5-10 years through the Gulf Ecosystem Monitoring and cost sharing with NSF will greatly enhance our understanding of how and when the Pacific herring population recovers. Such an extension is not being proposed now, but the possibility of a long-term extension will be considered, as more details of the Gulf Ecosystem Monitoring plan become known.

#### ***PUBLICATIONS AND REPORTS***

Several publications are anticipated in FY02 that will combine earlier work (\\162) with this project:

- Marty, G. D., C. J. Kennedy, C. R. Davis, and N. H. Willits. In preparation. Effect of age, gender, size, season, and lesions on plasma of free-ranging Pacific herring. I. Total protein, albumin, IgM, cholesterol, and PCV. *Diseases of Aquatic Organisms*
- Marty, G. D., C. J. Kennedy, and N. H. Willits. In preparation. Effect of age, gender, size, season, and lesions on plasma of free-ranging Pacific herring. II. Glucose, bilirubin, ALP, ALT, AST, and CPK. *Diseases of Aquatic Organisms*
- Marty, G. D., C. J. Kennedy, and N. H. Willits. In preparation. Effect of age, gender, size, season, and lesions on plasma of free-ranging Pacific herring. III. Osmolarity, sodium, potassium, chloride, phosphate, calcium, and lactate. *Diseases of Aquatic Organisms*

These manuscripts will be submitted later in FY01 or early in FY02. Funds needed for these publications have already been appropriated through \\162 and NSF.

***PROFESSIONAL CONFERENCES*** – No funds are requested. Funds to attend a professional conference each year are provided by the NSF component of the project.

***NORMAL AGENCY MANAGEMENT*** - Not applicable.

***COORDINATION AND INTEGRATION OF RESTORATION EFFORT***

Continuation of proposed disease research in PWS is critical for obtaining other funding. In late 1998, the National Science Foundation's Division of Biological Oceanography funded an unsolicited proposal to continue complete analysis of the samples collected as part of project \\462. The three-year \$286.4K NSF project has no funds for sample collection, and depends entirely on Trustee Council funds for sample collection. The NSF project includes collaboration with ADFG (through Steve Moffitt) and the University of Alaska, Fairbanks (Dr. Terrance J. Quinn). Using Dr. Quinn's expertise, the NSF project includes a modeling component to mathematically determine the relation of disease and changes in population biomass (Quinn et al In press). Trustee Council-funded studies of herring disease since 1994 were highlighted in the NSF proposal as a significant source of matching funds (about \$2.2 million over the life of the project). NSF normally does not fund unsolicited proposals for more than \$150K per year. Because the Trustee Council funded the first three years of this project (99462 - 01462), NSF saved about \$230K on its project. At the same time, the Trustee Council benefits from \$286.4K worth of analysis funded entirely by NSF. In August 2001, Dr. Marty plans to submit a competitive renewal proposal to NSF to continue funding disease analysis and modeling for another 5 years (2002-2006). The extension to a fourth year of funding included as part of this proposal will provide funds for sample collection during the first year of the 5-year NSF extension. NSF strongly encourages matching funds, and commitment to a fourth year of funding will go far towards convincing NSF to fund additional Pacific herring disease study.

This project is designed to provide the same types of data that were generated during detailed disease study since 1994 (94320S, 95320S, 96162, 97162, 98162, 99462, 00462, and 01462). Each year of research produces some new findings, but with each year the significance of the project becomes greater than its individual parts. The addition of one more year of data to our knowledge about the most important diseases will only add to the significance of this work.

***EXPLANATION OF CHANGES IN CONTINUING PROJECTS*** – This proposal requests extension of this project from 3 years to 4 years. An extra year of study is needed because Pacific herring fisheries were again closed in 2001, and there are no prospects for population recovery in the foreseeable future. Also, an extra year of funding is needed as part of cost sharing to increase the chances that NSF will extend Pacific herring disease research in PWS another 5 years (2002-2006). Methods and budget have no other substantial changes.

***PROPOSED PRINCIPAL INVESTIGATOR***

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## **PRINCIPAL INVESTIGATOR**

**Gary D. Marty, DVM, Ph.D.**, and Diplomate, American College of Veterinary Pathologists, will be responsible for design of pathology studies, on-site necropsy evaluation, and final report writing. Dr. Marty has the required fisheries background (BS and MS in fisheries biology) to integrate the many parts of this study, and he has performed these duties on similar projects since 1994.

## **OTHER KEY PERSONNEL:**

**Steve Moffitt, BS**, is in charge of chartering a commercial seiner for capturing fish and a laboratory vessel for fish necropsy. Mr. Moffitt is also in charge labeling sample vials, mixing 10% neutral buffered formalin, and for shipping hazardous materials (e.g., formalin) to UC Davis.

**Theodore R. Meyers, Ph.D.**, is certified as a Fish Pathologist by the Fish Health Section of the American Fisheries Society. Dr. Meyers has been Principal Pathologist for the AK Dept. of Fish and Game since 1985. Dr. Meyers and the laboratories he supervises have been involved in the detection and diagnosis of VHSV in Alaskan fisheries since 1990, detecting the virus in cod and herring from PWS and in herring from other parts of Alaska. Dr. Meyers will oversee the diagnostic virology and bacteriology parts of this project.

## **LITERATURE CITED and RELEVANT PUBLICATIONS:**

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Davis, C.R., **G.D. Marty**, M.A. Adkison, E.F. Freiberg, and R.P. Hedrick. 1999. Association of plasma IgM with body size, histopathologic changes, and plasma chemistries in adult Pacific herring *Clupea pallasii*. Dis. Aquat. Org. 38:125-133.

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- Meyers, T.R.**, S. Short, K. Lipson, W.N. Batts, J.R. Winton, J. Wilcock, and E. Brown. 1994. Association of viral hemorrhagic septicemia virus with epizootic hemorrhages of the skin in Pacific herring *Clupea harengus pallasii* from Prince William Sound and Kodiak Island, Alaska, USA. *Dis. Aquat. Org.* 19:27-37.
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**2002 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 2001 - September 30, 2002

<b>Budget Category:</b>	Authorized FFY 2001	Proposed FFY 2002						
Personnel	12.9	\$12.9						
Travel	0	\$0.0						
Contractual	58.1	\$50.1						
Commodities	9	\$9.0						
Equipment	0	\$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	80	\$72.0						
General Administration	6	\$5.4						
Project Total	86	\$77.4						
Full-time Equivalentents (FTE)	0.4	0.4						
Dollar amounts are shown in thousands of dollars.								
Other Resources								
<p>Comments:</p> <p>This project proposal includes two components:</p> <ol style="list-style-type: none"> <li>1. University of California, Davis: Fish necropsy               <ol style="list-style-type: none"> <li>a. Funds for writing the final report in FY03 were included in the FY01 budget.</li> </ol> </li> <li>2. Alaska Department of Fish and Game: Logistical and analytical support .</li> </ol>								

**2002**

Project Number: 02462  
 Project Title: **Effect of Disease on Pacific Herring  
 Population Recovery in Prince William Sound**  
 Agency: AK Dept. of Fish & Game

Prepared:  
 GDMarty 4-6-01  
 1 of 8

**2002 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 2001 - September 30, 2002

<b>Personnel Costs:</b>			GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime		
PM	Name	Position Description						
	Vacant	Fishery Biologist II	16D	1.5	5,817			
	Vacant	Fish & Wildlife Technician II	9A	0.5	3,229	2,614		
Subtotal				2.0	9,046	2,614		
Those costs associated with program management should be indicated by placement of an *.							<b>Personnel Total</b>	
<b>Travel Costs:</b>			Ticket Price	Round Trips	Total Days	Daily Per Diem		
PM	Description							
	Description							
Those costs associated with program management should be indicated by placement of an *.							<b>Travel Total</b>	

**2002**

Project Number: 02462  
 Project Title: **Effect of Disease on Pacific Herring  
 Population Recovery in Prince William Sound**  
 Agency: AK Dept. of Fish & Game

**2002 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 2001 - September 30, 2002

<b>Contractual Costs:</b>		
Description		
PWS Fall Sampling	Vessel Charter (lodging boat/sampling platform 5d @ 800/d) Vessel Charter (seiner to locate fish, 5d @ 1100/d) Shipping	
PWS Spring Sampling	Vessel Charter (lodging boat/sampling platform, 7d @ 800/d) Vessel Charter (seiner to locate fish, 7d @ 1100/d) Shipping	
When a non-trustee organization is used, the form 4A is required.		<b>Contractual Total</b>
<b>Commodities Costs:</b>		
Description		
Misc. sampling supplies (tubes, jars, preservative, coolers, totes etc.) (approximately \$500/sample event - 2 events)		
Pathology Laboratory - Virology Supplies (400 samples @ \$20/sample)		
		<b>Commodities Total</b>

**2002**

Project Number: 02462  
 Project Title: **Effect of Disease on Pacific Herring  
 Population Recovery in Prince William Sound**  
 Agency: AK Dept. of Fish & Game

**2002 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 2001 - September 30, 2002

<b>New Equipment Purchases:</b>		Number of Units	Unit Price	
Description				
Those purchases assoc. with replacement equipment should be indicated an "R."			<b>New Equipment Total</b>	
<b>Existing Equipment Usage:</b>		Number of Units		
Description				

**2002**

Project Number: 02462  
 Project Title: Effect of Disease on Pacific Herring Population Recovery in Prince William Sound  
 Agency: AK Dept. of Fish & Game

**2002 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 2001 - September 30, 2002

Personnel	\$18.6	\$12.3					
Travel	\$4.9	\$5.4					
Contractual	\$2.5	\$2.5					
Commodities	\$2.3	\$2.3					
Equipment	\$0.0	\$0.0	LONG RANGE FUNDING REQUIREMENTS				
Subtotal	\$28.3	\$22.5					
Indirect	\$5.3	\$4.3					
Project Total	\$33.6	\$26.8					
Full-time Equivalents (FTE)	0.3	0.2					
Dollar amounts are shown in thousands of dollars.							
Other Resources							

Comments: Indirect Costs include the standard overhead rates and applications for the Institute of Toxicology and Environmental Health (ITEH) at the University of California, Davis (18.9%).

Other funds - A 3-year \$286.4K grant was funded by the National Science Foundation (NSF project # 9871982), 2-1-99 through 1-31-02, with Dr. Gary D. Marty as principal investigator. The NSF grant includes complete blood analysis, histopathology, and population modeling not included in this proposal. This proposal (02462) can stand on its own, but competitive renewal of the NSF grant would be greatly enhanced if the NSF project had access to samples collected as part of this project. The Trustee Council benefits by getting complete analysis of all samples collected, including population modeling, at no additional cost.

Proposal includes funds (here, direct costs) for sample collection (1.0 month time for G. Marty, \$400 of the supply budget), report writing (0.3 month), community involvement (0.2 month time for G. Marty, \$50 for long distance phone calls), and the annual workshop (travel and per diem). The proposal does **not** include funds for NEPA compliance, publications, or professional conferences (the NSF grant provides funds for publication and for Dr. Marty to attend one professional meeting per year).

**FY02**

Project Number: 02462  
 Project Title: Effect of Disease on Pacific Herring Population Recovery in Prince William Sound  
 Name: University of California, Davis  
 Agency: ADFG

Prepared:  
 GDMarty 3-30-00

Personnel Costs:			Months Budgeted	Monthly Costs	Overtime	
Name	Position Description					
Marty, G.	Assistant Researcher V		1.5	7.0	0.0	6/13/2005
Teh, C.	Laboratory Assistant III		0.5	3.5	0.0	

**2002 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 2001 - September 30, 2002

					Subtotal	2.0	10.5	0.0
					<b>Personnel Total</b>			
<b>Travel Costs:</b>					Ticket	Round	Total	Daily
Description					Price	Trips	Days	Per Diem
RT airfare to Cordova for sample collection (1 fall, 3 spring)*					0.7	4	16	0.1
airfare to Anchorage for annual restoration workshop					0.6	1	4	0.1
*There are actually 32 days per diem rather than 16 on these trips, but the field rate is \$45/day which these formulas will not accommodate. Thus the number of days were halved and the rate doubled.								
					<b>Travel Total</b>			

**FY02**

Project Number: 02462  
 Project Title: Effect of Disease on Pacific Herring Population Recovery in Prince William Sound  
 Name: University of California, Davis  
 Agency: ADFG

Prepared:  
 GDMarty 6-26-00

<b>Contractual Costs:</b>		
Description		
150 fish necropsies @ \$16.50/fish (professional services of consulting pathologist)		
6 of 8		6/13/2005

**2002 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 2001 - September 30, 2002

		<b>Contractual Total</b>
<b>Commodities Costs:</b>		
Description		
Materials and supplies (for sampling supplies, report writing, long distance phone, film, computer disks) statistical analysis ITEH supplies		
		<b>Commodities Total</b>

**FY02**

Project Number: 02462  
 Project Title: Effect of Disease on Pacific Herring Population  
 Recovery in Prince William Sound  
 Name: University of California, Davis  
 Agency: ADFG

Prepared:  
 GDMarty 6-26-00

<b>New Equipment Purchases:</b>		Number of Units	Unit Price
Description			
	none		
	7 of 8		6/13/2005

**2002 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 2001 - September 30, 2002

Those purchases associated with replacement equipment should be indicated an "R."		<b>New Equipment Total</b>
<b>Existing Equipment Usage:</b>		Number
Description		of Units
IEC clinical centrifuge equipped with rotors for on-site plasma separation and packed cell vol. determination		1
Revco -80° freezer for archiving plasma		1
YSI Model 55 hand-held dissolved oxygen meter for checking fish holding conditions before necropsy		1
For report writing and correspondence:		
Pentium III 866 DELL-PC desktop computer with 256 Mb RAM, Ethernet card, and internal 56,600 baud modem		1
HP4L LaserJet printer		1
Codonics NP-1600 Color Photographic Network Printer, for publication grade printing of digital images		1

**FY02**

Prepared:  
GDMarty 4-6-01

Project Number: 02462  
 Project Title: Effect of Disease on Pacific Herring Population  
 Recovery in Prince William Sound  
 Name: University of California, Davis  
 Agency: ADFG