

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

Project Number: 01462  
Restoration Category: Research and Monitoring  
Proposer: University of California, Davis  
Lead Trustee Agency: ADFG  
Cooperating Agencies: None  
Alaska SeaLife Center: no  
Duration: 3<sup>rd</sup> year, 4-year project  
Cost FY01: \$25,000 (UCD) + \$52,200 (ADFG) = \$81,700  
Cost FY02: \$37,200 (UCD) + \$53,400 (ADFG) = \$90,600  
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 two most important diseases in these fish are associated with viral hemorrhagic septicemia virus and the fungus-like organism *Ichthyophonus hoferi*. Prevalence of *Ichthyophonus* has been fairly constant since 1994, but virus prevalence has been highly variable. High prevalence of virus and associated ulcers in 1998 was related to decreased biomass and closure of most fisheries in 1999. All Pacific herring fisheries are closed in the year 2000. To determine if disease is limiting recovery, we propose to continue to monitor the two major diseases in Pacific herring in Prince William Sound through April 2002.

## 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) and the fungus-like organism *Ichthyophonus hoferi* cause the two major diseases in Pacific herring, and that VHSV probably contributed most to population decline in 1993 (Meyers et al. 1994; Marty et al. 1998). 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).

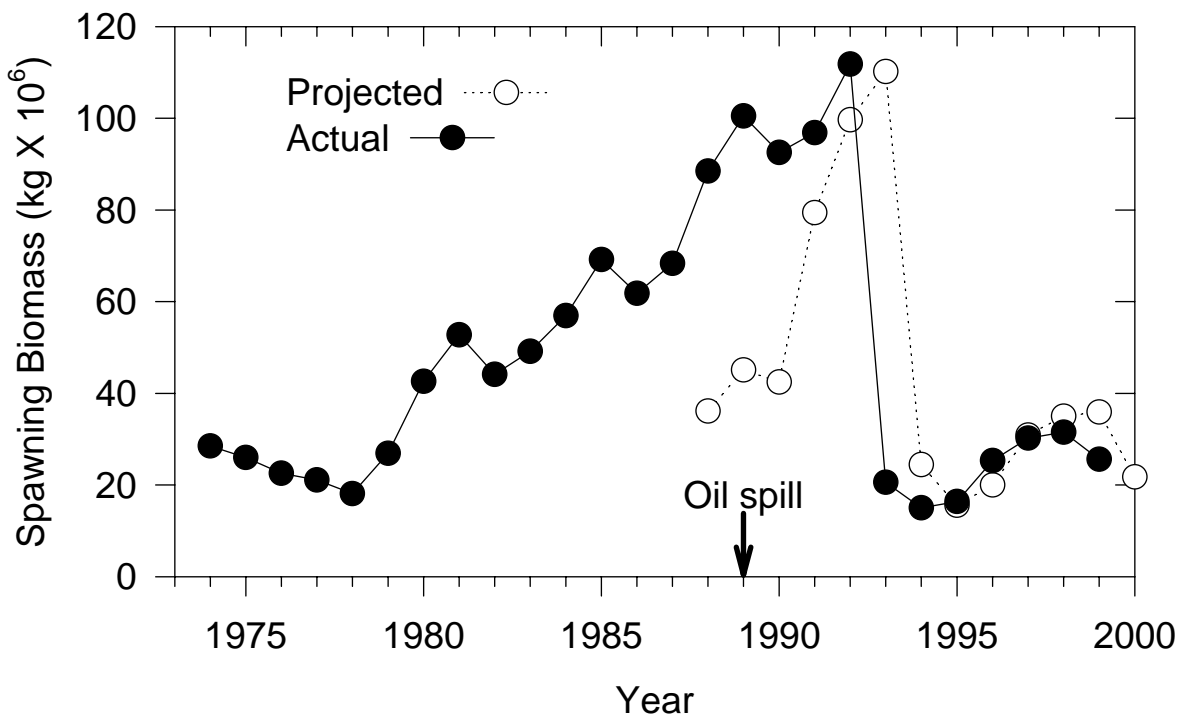


Figure 1. Biomass estimates of mature Pacific herring in Prince William Sound, Alaska. Unexploited spawning biomass is estimated using an age-structured assessment model.

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 01462, 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 (01462) was proposed and funded for 3 years to continue research on the effect of disease on Pacific herring population recovery.

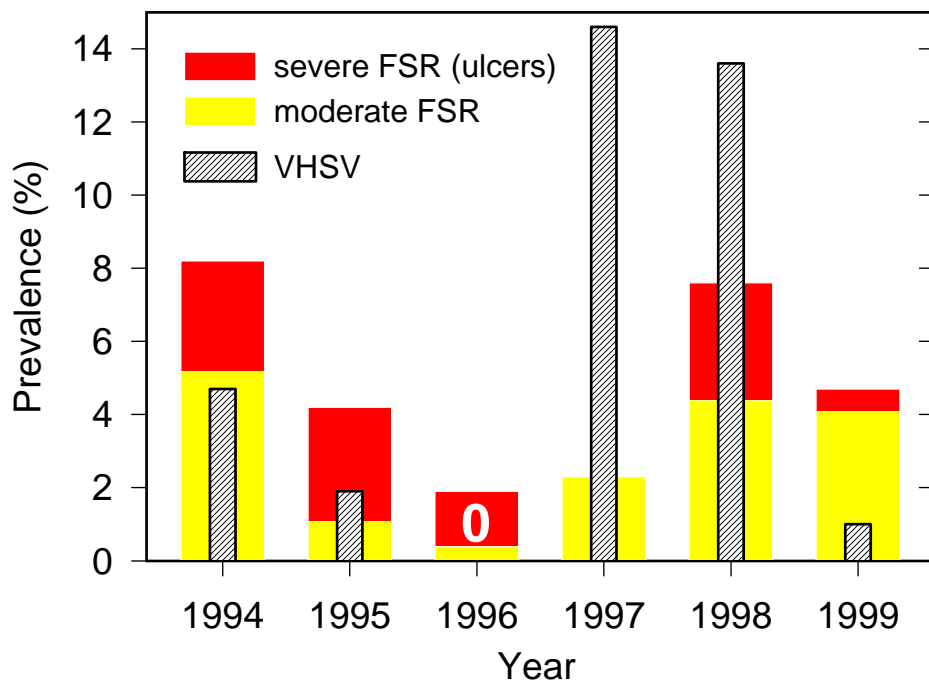


Figure 2. Prevalence of focal skin reddening (FSR; if the fish had ulcers, FSR = severe) and viral hemorrhagic septicemia virus (VHSV) in adult Pacific herring sampled from Prince William Sound, Alaska.

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, 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 (virus prevalence was only 1%). 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 (01462). 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 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 1994-1999, with the addition of a modeling component to determine the role of disease in stock assessment. We propose to continue monitoring the health of the Pacific herring population in PWS through spring of 2002.

Preliminary surveys suggested that the 1994 or 1995 year-classes were the most likely to recruit at numbers large enough for population recovery by 1999 or 2000. Unfortunately, the prevalence of VHSV increased to 15% among all Pacific herring sampled in spring 1997 (Figure 2), and 23% of the fish from 1994 year-class had VHSV (Figure 3). In 1998, the prevalence of VHSV remained high (14%), and 28% of the fish from 1995 year-class had VHSV (Figure 3). The effect of the VHSV outbreak on population biomass in 1997 and 1998 was not as severe as in 1993, but the viral outbreak limited the contribution of the 1994 and 1995 year-classes to population recovery. Fortunately, viral prevalence decreased to only 1% in 1999. This project is not closely linked to any other project, because this is the only funded project that addresses Pacific herring.

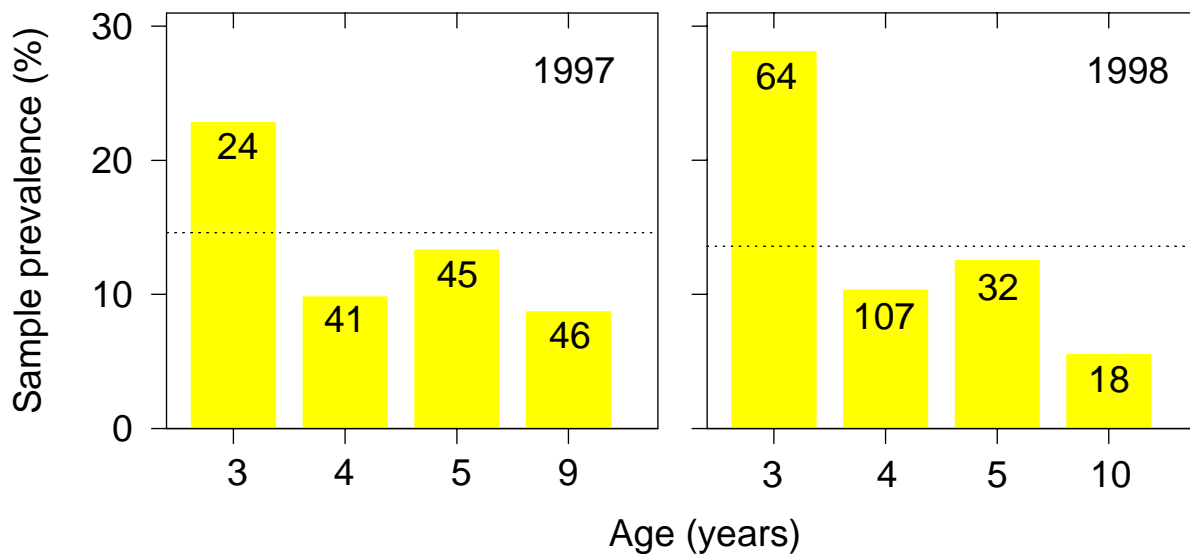


Figure 3. VHSV prevalence in Prince William Sound Pacific herring. Reference line = overall sample VHSV prevalence. Numbers within bars = sample size for each age.

***NEED FOR THE PROJECT***

***A. Statement of Problem***

Pacific herring are an injured biological resource in Prince William Sound (PWS) officially classified as recovering. Viral prevalence dropped to 1% in 1999, but recruitment of the 1996 year class into the fishery in 1999 was less than any other year class in the 30 years that ADFG has estimated herring biomass in Prince William Sound. Preliminary estimates for 2000 provide no evidence that recruitment of the 1997 year-class is any more than average, and recovery of the population will not occur in the foreseeable future. Lack of recovery of the resource has resulted in lost services, particularly for commercial fisheries. Also, several thousand pounds of 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 occurred. 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. During the first 7 years of disease research already funded by the Trustee Council, we established that VHSV and *Ichthyophonus hoferi* were the most significant causes of disease. Prevalence of VHSV can be determined by virus isolation and prevalence of *Ichthyophonus hoferi* can now be estimated fairly closely by gross examination.

### ***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.

## ***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 FFY01. 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 2001. 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 that “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. Continued high prevalence of VHSV in spring 1998 samples was consistent with a population at risk, and this was confirmed by poor returns in 1999. 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>FY01:</b> Oct./Nov., 2000 (4 nights)	peak condition/ gonadal development	100
mid-April, 2001 (7 days)	Spawning/post-spawning	300
	Total Fish, FY01:	400
<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 and the two major diseases: 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, but work is still underway.
- b. Bacteriology - for each fish with severe gross lesions, a sterile loop is stabbed into the anterior kidney and then streaked on Trypticase Soy Agar (TSA) and Marine agar for bacterial isolation. Ulcers will be preserved for histopathology or virology, but they 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 - plasma for IgM determination and 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 this 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 FY01**

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<b><i>DATES</i></b> <b><i>(results due on final date)</i></b>	<b><i>ACTIVITY</i></b>
<b><i>Fall Samples:</i></b>	
Oct. 1 - Nov. 30, 2000:	Collect samples; Person in charge: Gary D. Marty, UC Davis
Nov. 1 - Dec. 31, 2000:	Scale analysis (age); Person in charge: Greg Carpenter, ADFG, Cordova, AK
Nov. 1, 2000 – Feb. 28, 2001:	Virology and bacteriology; Person in charge: Ted Meyers, ADFG, Juneau, AK
March 1- Aug. 1, 2001:	Statistical analysis; Person in charge: Gary D. Marty
January, 2001 (5 days):	Attend Restoration Science Workshop (Gary D. Marty)

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<i><b>DATES</b></i> <i>(results due on final date)</i>	<i><b>ACTIVITY</b></i>
<i><b>Spring Samples</b></i>	
April 1 - April 30, 2001:	Collect samples; Person in charge: Gary D. Marty
April - July 31, 2001:	Scale analysis (age); Person in charge: Greg Carpenter, ADFG, Cordova, AK
April - Sept. 30, 2001:	Virology and bacteriology; Person in charge: Ted Meyers, ADFG, Juneau, AK
Oct. 2001 - Feb. 1, 2001:	Statistical analysis; Person in charge: Gary D. Marty
Jan. 11, 2001 –April 15, 2001:	Annual 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 each year of results is reported in the annual report, but the most complete information will be available 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. The first year of this project (99462) was critical for documenting relatively low disease prevalence in the population in 1999, providing evidence that most of the mortality that resulted in poor returns in 1999 probably happened in 1998 during and after the unusually early sac roe fisheries. High viral prevalence among recruiting populations of both the 1994 and 1995 year-classes in 1998 has severely limited the capacity of these year classes to contribute to population recovery. Preliminary evidence indicates that the 1997 year-class is no more than average. Even if the 1998 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 2003 (a year 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 1/2 of a population cycle. Extending this project another 5 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 FY01 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*
- Marty, G. D., T. F. Quinn, G. Carpenter, T. R. Meyers, and N. H. Willits. In preparation. The role of disease in population abundance of adult Pacific herring. *Science*
- Quinn, T. F., G. D. Marty, J. Wilcock, and M. Willette. In preparation. Disease and assessment of Prince William Sound Pacific herring. Pages *in* Lowell Wakefield Fisheries Symposium: Proceedings of Herring 2000: Expectations for a New Millennium, February 22-26, 2000. Alaska Sea Grant

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 Mark Willette) 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. 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 two years of this project (99462 and 00462), and committed to an additional year of funding, NSF saved about \$207K on its project. At the same time, the Trustee Council benefits from \$286.4K worth of analysis funded entirely by NSF. In February 2001, Dr. Marty plans to submit a proposal to NSF 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 likes matching funds arrangements, 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). 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 two more years 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 1999, 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 a similar project since 1994.

## **OTHER KEY PERSONNEL:**

**Greg Carpenter, BS**, is in charge of chartering a commercial seiner for capturing fish and a laboratory vessel for fish necropsy. Mr. Carpenter 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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**2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 2000 - September 30, 2001

<b>Budget Category:</b>	Authorized FFY 2000	Proposed FFY 2001						
Personnel	12.9	\$12.9						
Travel	0	\$0.0						
Contractual	47.4	\$49.5						
Commodities	9	\$9.0						
Equipment	0	\$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	69.3	\$71.4	Estimated FFY 2002	Estimated FFY 2003				
General Administration	5.3	\$5.4						
Project Total	74.6	\$76.8	\$90.6					
Full-time Equivalents (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 annual report in FY02 are included in the FY01 request. (amount is slightly less than predicted on last year's budget because extra time for final report writing/revision has been moved to FFY 2002)</li> </ol> </li> <li>2. Alaska Department of Fish and Game: Logistical and analytical support . (Contractual amount is slightly higher than last year because of low population size; we need another day of boat charter for finding fish in the fall.)</li> </ol> <p>Extra costs for FFY 2002 are for final report writing in addition to the same sampling plan as FFY 2001.</p>								

**2001**

Project Number: 01462  
 Project Title: **Effect of Disease on Pacific Herring  
 Population Recovery in Prince William Sound**  
 Agency: AK Dept. of Fish & Game

Prepared:  
 GDMarty 3-30-00  
 1 of 8

**2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 2000 - September 30, 2001

<b>Personnel Costs:</b>			GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime		
PM	Name	Position Description						
	G. Carpenter	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							
Those costs associated with program management should be indicated by placement of an *.							<b>Travel Total</b>	

**2001**

Project Number: 01462  
 Project Title: **Effect of Disease on Pacific Herring  
 Population Recovery in Prince William Sound**  
 Agency: AK Dept. of Fish & Game



**2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 2000 - September 30, 2001

<b>Contractual Costs:</b>		
Description		
PWS Fall Sampling	Vessel Charter (hotel boat/sampling platform 5d @ 900/d) Vessel Charter (seiner to locate fish, 5d @ 1100/d) Shipping	
PWS Spring Sampling	Vessel Charter (hotel boat/sampling platform, 7d @ 900/d) Vessel Charter (seiner to locate fish, 7d @ 1100/d) Shipping	
Contract with UC Davis for sample and data analyses and report writing		
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/Bacteriology Supplies (400 samples @ \$20/sample)		
		<b>Commodities Total</b>

**2001**

Project Number: 01462  
 Project Title: **Effect of Disease on Pacific Herring  
 Population Recovery in Prince William Sound**  
 Agency: AK Dept. of Fish & Game

**2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 2000 - September 30, 2001

<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				

**2001**

Project Number: 01462  
 Project Title: Effect of Disease on Pacific Herring Population Recovery in Prince William Sound  
 Agency: AK Dept. of Fish & Game

**2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 2000 - September 30, 2001

Personnel	\$10.4	\$11.3					
Travel	\$5.8	\$4.9					
Contractual	\$2.4	\$2.5					
Commodities	\$2.3	\$2.3					
Equipment	\$0.0	\$0.0	LONG RANGE FUNDING REQUIREMENTS				
Subtotal	\$20.9	\$21.0				Estimated	
Indirect	\$4.0	\$4.0				FY 2002	
Project Total	\$24.9	\$25.0				\$37.2	
Full-time Equivalents (FTE)	0.2	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), 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 (01462) can stand on its own, but completion of the NSF grant is entirely dependent on 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 annual report writing (0.5 month time for G. Marty, \$400 of the supply budget), 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). Increased cost for the final year covers extra time by Dr. Marty (1.0 month) for final report writing.

**FY01**

Prepared:  
GDMarty 3-30-00

Project Number: 01462  
Project Title: Effect of Disease on Pacific Herring Population Recovery in Prince William Sound  
Name: University of California, Davis  
Agency: ADFG

Personnel Costs:			Months Budgeted	Monthly Costs	Overtime	
Name	Position Description					
Marty, G.	Assistant Researcher IV		1.5	6.3	0.0	6/6/2005
Teh, C.	Laboratory Assistant III		0.5	3.5	0.0	

**2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 2000 - September 30, 2001

					Subtotal	2.0	9.8	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)*					0.6	4	16	0.1
airfare to Anchorage for annual restoration workshop					0.5	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>

**FY01**

Project Number: 01462  
 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

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

**2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 2000 - September 30, 2001

		<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>

**FY01**

Project Number: 01462  
 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

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

**2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 2000 - September 30, 2001

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 90 IBM-PC desktop computer with 64Mb RAM, Ethernet card, and internal 14,400 baud modem		1
486-100 IBM-PC color notebook computer with 16MB RAM and internal 14,400 baud modem		1
HP4L LaserJet printer		1
Codonics NP-1600 Color Photographic Network Printer, for publication grade printing of digital images		1

**FY01**

Project Number: 01462  
 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