ASSESSMENT OF SPOT SHRIMP ABUNDANCE IN PRINCE WILLIAM SOUND A DECADE AFTER THE *EXXON VALDEZ* OIL SPILL

Project Number:	99401
Restoration Category:	General Restoration
Proposer:	NOAA
Lead Trustee Agency:	NOAA
Cooperating Agencies:	Valdez Native Tribe/Charlie Hughey Prince William Sound Economic Development Council
Alaska Sea Life Center:	no
Duration:	4 year project
Cost FY 99:	$38,300
Cost FY 00:	$89,800
Cost FY 01:	$95,000
Cost FY 02:	$33,000
Geographic Area:	Prince William Sound
Injured Resource/Service:	Spot Shrimp/Subsistence

ABSTRACT

The project proposed here will estimate the abundance of spot shrimp and determine the structure of the spot shrimp population in western Prince William Sound (PWS). The project will augment current Alaska Department of Fish and Game (ADF&G) surveys to determine whether the spot shrimp population is recovering from depletion. To maintain consistency with the timing of the ADF&G surveys the first full sampling cruise will take place in October 1999. In year one we will survey western PWS for study sites. In years two and three we will estimate spot shrimp relative abundance, population structure and reproductive potential at the study sites. An added objective in year three will be an estimate of recruitment potential achieved by expanding the depth range of the sampling into shallow water to assess the relative abundance of juveniles. In year four we will close out, produce manuscripts, and provide input into the development of a shrimp management plan with ADF&G.

A. INTRODUCTION

Most crustacean stocks in Alaska are in need of rebuilding. Evidence that the rapid expansion of crab and shrimp fisheries in Alaska from 1960 to 1980 resulted in the serial depletion of these stocks is compelling (Orensanz et al. 1998). The effects on recruitment of climatic change, including climate-mediated increases in predation or disease, as opposed to overfishing, probably played an important role in the decline of many crustacean stocks in Alaska (Orensanz et al. 1998). The case for overfishing as the main cause for population decline is perhaps strongest for spot shrimp, *Pandalus platyceros* Brandt, in Prince William Sound (Trowbridge 1994, Orensanz et al. 1998).

The commercial spot shrimp fishery in Prince William Sound (PWS) began in the 1950's and remained small until the late 1970's. After 1975 the fishery expanded rapidly. The harvest increased from 7 tonnes in 1978 to more than 131 tonnes in 1986 as the number of vessels participating in the fishery increased ninefold to 80 vessels (Trowbridge 1994). Area closures after the *Exxon Valdez* oil spill resulted in a precipitous decline in the harvest in 1989. Low stock abundance necessitated closure of the fishery in 1990 by emergency order (Orensanz et al. 1998). A reduced fishery involving 15 vessels took place in the fall of 1991, but the season was closed early when a reduced guideline harvest level was reached. Catch per unit effort (CPUE) averaged 0.4 kg of whole shrimp per pot during the 1991 season. The fishery was closed in 1992 and remains closed (Trowbridge 1994, Orensanz et al. 1998). The decision point for reopening the fishery has been set tentatively at a survey CPUE of 0.6 kg (Trowbridge 1994).

Annual surveys of the abundance of spot shrimp in PWS begun in 1989 by the Alaska Department of Fish and Game (ADF&G) continue to the present. The surveys sample spot shrimp at six to eight sites in the seven major statistical reporting areas that divide the Traditional Harvest Area in western PWS (Trowbridge 1992, 1994). From 1989 to 1993 the survey CPUE has declined from 0.6 kg to 0.2 kg. During the same period the percentage of large shrimp (females) increased from 4 to 20% indicating a somewhat reduced recruitment in the near term after 1993 (Trowbridge 1994). The study proposed here would augment the ADF&G sampling program by adding population information from other areas in PWS, would enhance our understanding of spot shrimp population dynamics by providing information on juvenile distribution, abundance, and size structure, and ultimately aid ADF&G in developing a management plan for spot shrimp when the population recovers. In FY'99 NMFS personnel will consult with Valdez Native Tribe shrimpers and ADF&G to identify potential sampling sites. A preliminary, exploratory cruise in spring/summer 1999 will be conducted to evaluate these sites for the study of spot shrimp population size and structure. The first major cruise of the study will take place in October 1999 to be consistent with the seasonal timing of past ADF&G surveys. The second full year of the study (FY'01) will, in addition to estimating spot shrimp relative abundance, population structure and reproductive potential, determine recruitment potential of the spot shrimp population by expanding the depth range of the sampling into shallow water to assess the relative abundance of juveniles in the population.

NEED FOR PROJECT

A. Statement of Problem

Evidence for depletion of the spot shrimp resource in PWS after 1989 is convincing (Trowbridge 1994). The role that the *Exxon Valdez* oil spill (EVOS) may have played in the reduction of spot shrimp abundance in western Prince William Sound is unclear. Trowbridge (1992) found reduced CPUE in weight and number of spot shrimp in oiled vs unoiled areas in 1989 and 1990 in PWS. The differences in CPUE (number and weight of shrimp) did not persist into 1991. Mean size of shrimp was reduced in the oiled area in all three years. However, Trowbridge (1992) could not find conclusive evidence "that spot shrimp within PWS were themselves affected by the EVOS" owing, in large part to limitations in time and funding for spot shrimp damage assessment. Spot shrimp were not considered a high priority species by the EVOS damage assessment process. Lack of pre-spill abundance information coupled with confounding reductions in spot shrimp abundance prior to the spill rendered the species less favorable for a definitive damage assessment study. Trowbridge (1992) ultimately concluded that the observed abundance and structure of the spot shrimp stock in PWS in the first few years after the *Exxon Valdez* oil spill could mostly be explained by fishing pressure. Nevertheless, he hypothesized that highly sensitive shrimp larvae which were probably in the water column and near the surface during the oil spill were adversely affected by oil toxicity. No damage assessment study focused on larvae was initiated after the spill. The impact on the shrimp population after 1989 of exposure to oil of the 1989 year class in the larval stage is unknown.

Of additional concern is the increased pressure on the spot shrimp resource by sport and subsistence shrimpers as a result of greater access to western PWS following the soon to be completed access road connecting Portage and Whittier. Increased cruise ship traffic in and independent tourist visitations to western PWS in recent years may be having adverse impacts on spot shrimp habitat within PWS.

B. Rational/Link to Restoration

This project falls under the category of monitoring. We will seek to assess the extent to which spot shrimp abundance has recovered since the population decline which began just prior to 1989. Although the major cause of the decline was probably overfishing rather than the EVOS, there is great interest by subsistence users of shrimp as well as sport shrimpers and individuals who fished for shrimp commercially in PWS prior to 1992 in the present status of the spot shrimp population in PWS. The ADF&G currently surveys spot shrimp abundance at selected locations in PWS annually. The intent under this proposal is first to broaden the geographical coverage and increase the amount of replication within existing major statistical reporting areas of the asssessment of spot shrimp abundance in western PWS. Second by focusing on the reproductive potential of females and recruitment potential as indicated by the abundance of juveniles in the population we can determine whether the population is recovering. The results

of this work should greatly enhance the information base underpinning ADF&G management decisions.

C. Location

The proposed project will focus on various sites in the Traditional Harvest Area for spot shrimp in western Prince William Sound. The project will include sites currently surveyed by ADF&G as well as additional sites in statistical reporting areas currently surveyed and in adjacent reporting areas. Elements of the communities of Whittier, Valdez and Cordova that are now or have in the past been associated with the sport, subsistence or commercial harvest of spot shrimp may be affected by the results of the project.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

Charles Hughey of Valdez Native Tribe will act as community facilitator for the project and will act as facilitator with villages in Prince William Sound. Shrimpers in the Valdez Native Tribe will participate in the project, providing vessels, crew, shrimp pots, buoys, line, etc.

PROJECT DESIGN

Two important considerations enter into the project design. First, the project will overlap as much as possible the existing survey sites of ADF&G as well as add sites, and, to the extent possible, the project will duplicate the methods that ADF&G uses in their surveys. This will accomplish two ends: 1) It will allow us to compare with greater confidence our data with that previously collected by ADF&G on spot shrimp abundance in western PWS in order to determine, more convincingly, whether spot shrimp population recovery is taking place in PWS, and 2) It will be more likely to provide data of the greatest use to ADF&G for future management of the spot shrimp resource in PWS.

The second consideration is that to maximize community involvement and to make the best use of traditional ecological knowledge, shrimpers associated with the Valdez Native Tribe will participate in the project. The shrimpers will, to the extent that they desire, have input into the selection of additional sampling sites and will participate in the sampling. Because the shrimp pots and other fishing equipment used by these shrimpers may differ in configuration from that used by ADF&G, the extent to which the project can overlap the ADF&G sites and sampling dates may permit the calculation of correction factors for comparison of the project's data with that of ADF&G.

A. Objectives

1. Estimate abundance (CPUE) of spot shrimp by weight and number of individuals (years two and three).

2. Determine the sex and size composition of spot shrimp at the study sites (years two and three).

3. Estimate spot shrimp fecundity and relative number of egg-bearing females at the study sites (years two and three).

4. Estimate juvenile abundance and compare between sites (year three).

5. Compare abundance, sex and size composition, fecundity and proportion of ovigerous females between sites and years (year three).

6. Compare abundance data and data on population structure obtained under the present project with historical data collected by ADF&G to determine if the population is recovering and to assess the potential for full recovery of the spot shrimp population in PWS (year four).

7. Work with ADF&G, using data collected from this study, to develop a spot shrimp management plan for PWS.

B. **Methods**

The methods that will be used in the proposed study are modified after Trowbridge (1992, 1994). Shrimp pots will be fished at six sites in northern and western PWS previously surveyed by ADF&G (Figure 1). The sampling sites will be located in Unakwik Inlet, at Golden in Port Wells, in lower Culross Passage, in Herring Bay, at northeast Chenega Island and at northern Green Island. Six additional sites, yet to be determined, will be added to the existing ADF&G sites.

At least two strings of shrimp pots will be set at each site. Each string will consist of 11 pots spaced 18.3 m (60 ft) apart along a groundline and buoyed at both ends. Rectangular pots measuring 41 cm x 41 cm x 91 cm (16 in x16 in x 36 in) will be used. Pots will be covered with black woven plastic fabric (engineers cloth) except in the two opposing tunnel ends which will have a 6.4 cm (2.5 in) tunnel opening set 18 cm (7 in) into each end of the pot. The tunnels will be enclosed by 1.3 cm (0.5 in) stretched mesh web. A single 2.4 L perforated plastic jar containing chopped herring will be placed in each pot at the time of deployment. The pots will be fished in the depth range 37-146 m (20-80 fm) for a minimum of 18 h at each site. In year two additional pot sets will be made in the depth range 0-37 m (0-20 fm) to assess the abundance of juvenile spot shrimp.

Upon retrieval of the pot strings all pandalid shrimp in each pot will be speciated. Spot shrimp will be counted and weighed to the nearest gram on an electronic balance. If time permits, other species of pandalid shrimp (eg. *P. eous* and *P. hypsinotus*) will be counted and weighed. All non-shrimp bycatch will be speciated and counted. All spot shrimp will be sexed and the

length of the carapace measured. Additional observations of ovigerous spot shrimp will include egg condition (eyed vs uneyed) and egg color. The egg clutches of a total of 30 ovigerous females will be sampled at each site for estimates of fecundity and the number of dead eggs in the clutch. For nonovigerous females, the presence or absence of breeding dress [characterized by "...the presence of long, simple, and plumose setae on the protopodites of pleopods" (Butler 1980)] will be recorded. Breeding dress indicates a mature female.

A preliminary sampling cruise will be conducted in spring/summer 1999 to explore for sites to be added to those currently sampled by ADF&G. Field cruises in the two main years of sampling will be conducted in October (the time of year when ADF&G normally samples) for the purposes of comparing the catch data collected by this project with that previously collected by ADF&G.

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

This project will be a partnership between the National Marine Fisheries Service, the Valdez Native Tribe with Charlie Hughey as facilitator and Prince William Sound Economic Development Council.

SCHEDULE

A. Measurable Project Tasks for FY99 (October 1, 1998-September 30, 1999)

January 1 - March 30	Consult with Valdez Native Tribe shrimpers and ADF&G.
April 1-30	Arrange logistics (vessels, equipment, contracts, etc.) for preliminary sampling cruise in spring/summer 1999.
May1 - August 30	Conduct preliminary, exploratory cruise to assess new sampling sites.
September 1 - 30	Arrange logistics (vessels, equipment, contracts, etc.) for sampling cruise in October 1999.

B. Project Milestones and Endpoints

October 15, 1999	Complete sampling for spot shrimp in first full sampling year.
March 31, 2000	Complete estimates of abundance, sex and size composition, and relative number of egg-bearing females and fecundityof spot shrimp
at	the study sites in year one.
April 15, 2000	Submit annual report (FY00 findings)
October 15, 2000	Complete sampling for spot shrimp in second full sampling year.
February 20, 2001	Complete estimates of abundance, sex and size composition,

	and relative number of egg-bearing females of spot shrimp at the study sites in year two.
April 15, 2001	Submit annual report (FY01 findings)
June 15, 2001	Complete estimates of spot shrimp fecundity and juvenile abundance at the study sites in year two.
October 31, 2001	Complete comparison of spot shrimp abundance, sex and size composition, fecundity and proportion of ovigerous females between sites and years.
January 15, 2002	Complete comparison of the abundance data and the data on population structure obtained under the project with historical data collected by ADF&G.
April 15, 2002	Submit final report and recommendations to ADF&G for development of a PWS shrimp management plan.

C. Completion Date

September 30, 2002

PUBLICATIONS AND REPORTS

No publications or reports will be submitted in FY99. Annual reports will be submitted on 15 April in FY00 and FY01. A final report will be submitted on 15 April in FY02. It is anticipated that at least two publications will derive from this project.

PROFESSIONAL CONFERENCES

No travel funds are requested for attendance at conferences in FY99. The principal investigators from NMFS will be attending the 10th Anniversary Exxon Valdez Symposium in March 1999 under separate funding.

NORMAL AGENCY MANAGEMENT

The National Marine Fisheries Service (NMFS) does not manage shrimp resources in Alaska and has never been required by statute or regulation to survey spot shrimp populations in PWS. No project similar to the one proposed here has been conducted by NMFS in the past without funds from the Trustee Council. Spot shrimp are managed by ADF&G which conducts annual surveys in PWS to assess the status of the resource.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The Valdez Native Tribe Facilitator Charles Hughey and Prince William Sound Economic Development Council will work with NMFS scientists to successfully complete this spot shrimp project. The ADF&G will be asked to review the proposal and subsequent reports to

improve their quality and to increase their relevance to management goals.

The Prince William Sound Economic Development Council has coordinated other projects for EVOS in the past. Recent projects nearing completion are the Chenega Bay Beach Clean-up and the five Oil Waste Management buildings in Valdez, Whittier, Cordova, Chenega Bay and Tatitlek.

PROPOSED PRINCIPAL INVESTIGATORS

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PRINCIPAL INVESTIGATORS

Charles G. Hughey is a commercial fisherman, EVOS community facilitator for Valdez, and serves on the Alaska Fish and Game Advisory Committee.

Sue Cogswell is executive director of Prince William Sound Economic Development Council and has experience in project management.

Charles E. O'Clair will be responsible for sampling, data analysis and interpretation and report writing. For qualifications see curriculum vitae below.

Mandy Lindeberg will participate in consultation with Valdez Native Tribe shrimpers and ADF&G and will be responsible for summarizing the results of those consultations. Ms. Lindeberg will also be responsible for arranging logistics (vessels, equipment, contracts, etc.), will participate in sampling, data processing, and will assist in report writing. For qualifications see curriculum vitae below.

OTHER KEY PERSONNEL

None

LITERATURE CITED

Orensanz, J. M., J. Armstrong, D. Armstrong and R. Hilborn. 1998. Crustacean resources are vulnerable to serial depletion - the multifaceted decline of crab and shrimp fisheries in the Greater Gulf of Alaska. Reviews in Fish Biology and Fisheries 8: 117-176.

Trowbridge, C. 1992. Injury to Prince William Sound spot shrimp. Final report for Exxon Valdez Oil Spill State/Federal Natural Resource Damage Assessment Subtidal Study Number 5. 141 p.

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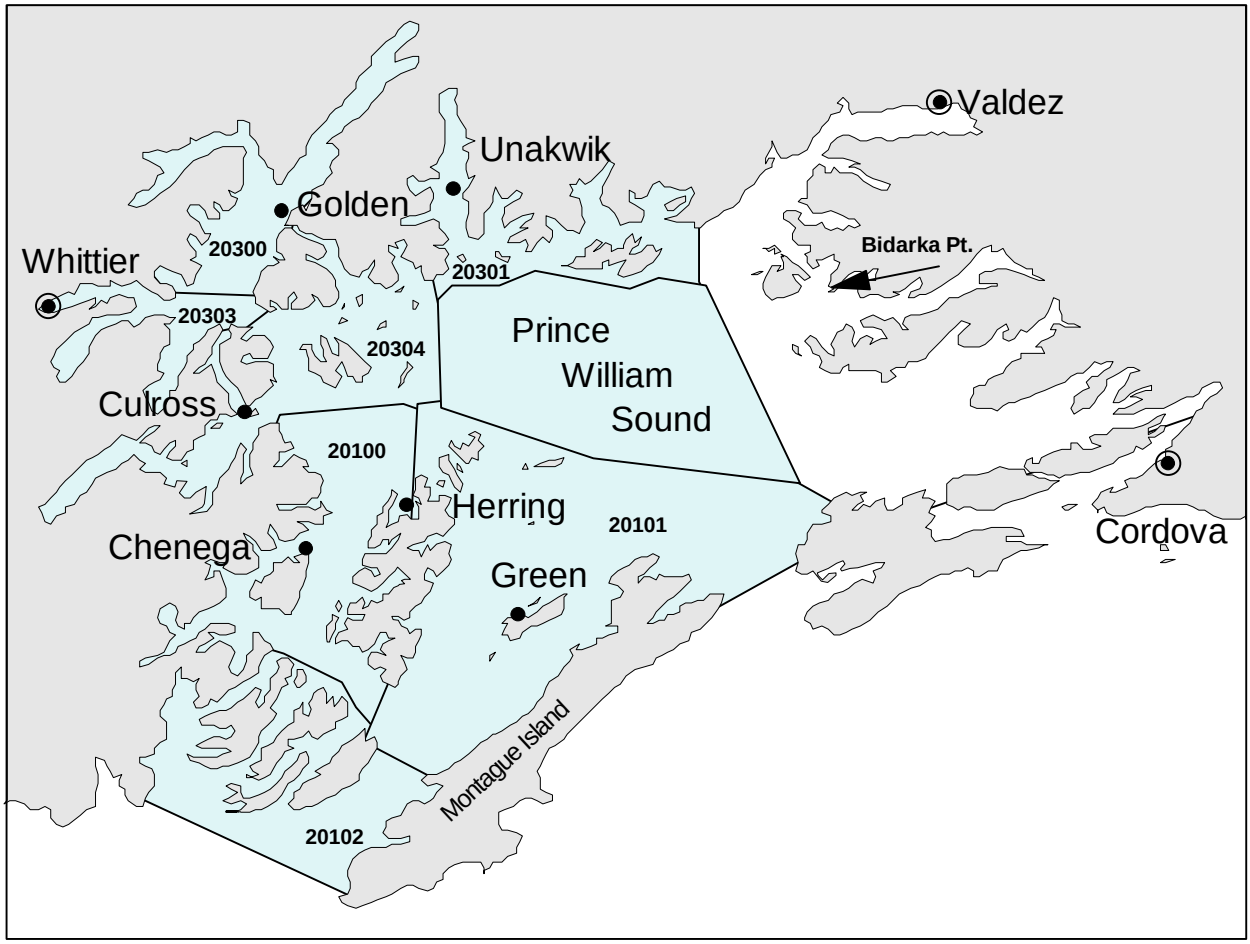

Figure 1. Proposed sampling area (shaded) and core sampling sites (closed circles) for spot shrimp abundance and population structure in western Prince William Sound. Alaska Department of Fish and Game major statistical areas for reporting commercial shellfish catch are outlined within the shaded area. (Major statistical areas are numbered). The Traditional Harvest Area is that area west of a line drawn between Bidarka Pt. and Montague Pt. (Modified after Trowbridge 1992)