Washington State Commission on Pesticide Registration
REQUEST FOR FUNDING

PROJECT # _____

Project Title: Screening of Alternative Methods to Manage Burrowing Shrimp Infestations on Bivalve Shellfish Grounds

1) Applicant (user group) Name and Address:
Tim Morris**,** Willapa/Grays Harbor Oyster Growers Association, P.O. Box 3, Ocean Park, WA 98640

3) Project Contact Name and Phone:
Kim Patten, Washington State University – Long Beach Research and Extension Unit, 2907 Pioneer Road, Long Beach, WA 98631; phone/fax: 360-642-2031; e-mail: pattenk@wsu.edu

2) Details of Project:

Crop/Site Oyster Chemical Several
Pest Management Issue Burrowing Shrimp
Pest - Burrowing Shrimp

4) Research Lead: Name, Institution
Kim Patten, WSU Long Beach

5) Project Category: Check all that describe the focus of your project.

Old Mandate 80% *(see pg.1 of Guidelines for definition)*

__X_ Efficacy Trial
___ Phytotoxicity Study
___ Residue Study

New Mandate 20% *(see pg.1 of Guidelines for definition)*

___X_ Integrated Pest Management
____ Pesticide Resistance Study
____ Other _____

___ GLP
__X_ non-GLP

6) Project Duration Start Date : 04/01/05 End Date : 03/31/06

7) Total Project Cost $53,074 **WSCPR Request** $ 24,107
Matching $ 28,967

8) Project Summary:

Willapa Bay and Grays Harbor Estuary shellfish beds are plagued by two species of burrowing shrimp. These shrimp cause major economic losses to shellfish growers by inhibiting oyster growth or killing the crop. Shrimp activity also acts to destroy bottom habitat that virtually all the bottom dwelling species rely upon. The pesticide carbaryl (Sevin©) is the primary product used to control and reduce burrowing shrimp populations in oyster beds. The oyster industry will no longer have carbaryl in 2012. Without research on alternative controls, this thirty million dollar industry will cease to exist. We will conduct research on alternative chemical and mechanical controls to replace carbaryl. We will also develop better monitoring techniques.

9) Signatures *I certify to the best of my knowledge that the information in this application is true and correct.*

Printed Name of applicant: Tim Morris
Title of Applicant: President, Grays Harbor Oyster Growers Association

Signature of Applicant

Date Signed: Feb 9, 2005

Problem Description

There are 45,000 acres of tidelands in Willapa Bay and 34,460 in Grays Harbor. Of these, approximately 9,000 acres (20%) in Willapa Bay and 900 acres (3%) in Grays Harbor are farmed for oysters. Total oyster production in these bays ranges from 5 to 6 million pounds annually of shellfish meats (about 45 million pounds live weight) with a farm-gate value of $32 million (PCSGA, 2001). Since the 1940's, Willapa Bay and Grays Harbor have experienced expansive growth in populations of burrowing ghost shrimp (*Neotrypaea californiensis*) and mud shrimp (*Upogebia pugettensis*). It is estimated that from 5,000 to 20,000 acres are dominated by high densities of burrowing shrimp. Aside from the detrimental impacts to oyster crops (losses of from 30 to 40% are documented on oyster farm lands containing high densities of burrowing shrimp), areas dominated by burrowing shrimp exhibit reduced species diversity and altered composition of the benthic invertebrate community. While oyster growers have investigated various alternative mechanical and chemical control measures over the past 40 years, none yet has proven to be as economical, reliable, effective, or more species-specific than carbaryl.

Carbaryl, although effective, has come under considerable scrutiny from a short-term environmental perspective, and is scheduled for a phase-out in the next in 2012. The timeline to find alternative managements for burrowing shrimp in oyster production is very short and needs to be in place within five years. This research project will be critical for providing those management solutions. Our goal is to develop those management alternatives within that short timeframe.

Ranking and Prioritization

Criterion:

1) This project may directly result in the registration of a pesticide or use of compound exempt from registration.
2) This project enhances an IPM program, by providing alternative control strategies.

This project fits within two priority categories: Category B - Protection of the environment: wildlife (fish and aquatic invertebrates) and natural resources (Willapa Bay), and Category C - Importance to local or regional economy: 1 - existence of an emergency situation with no effective alternative control, 3 - development of an integrated pest management tactic, and 4 - registration of additional pest control tactics (data needed for condition of NPDES permit renewal).

Project Description

Chemical control – screening new chemistries: The following pesticides are being considered for new or follow-up efficacy trials in 2005: elemental sulfur, azadirachtin (Neemix), cinnamaldehyde (Cinnacure), clove/cinnamon/mint oil mix (Valoram II), mustard oil (allylisothio-cyanate), and oleoresin of capsicum hot pepper (capsaicin). Several more traditional insecticides (buprofezin (Applaud), flonicamid (Turbine 50 WG), bifenthrin (Brigade) may also be evaluated. For all products being tested, registrants have been contacted and queried about their willingness to pursue registration if their insecticide has good efficacy; their responses are pending. Additional inputs will be obtained from EPA OPP regarding the potential for any of these products to receive a

registration close to the 2012 timeline. At this time we have no assurances that any of these products will be fully supported by the registrant.

Trials will first be conducted in small aquariums to make sure the product has activity on shrimp. After preliminary trials, products will be evaluated in small replicated plots on the tideflats in May and June. If results are favorable, products will be evaluated in larger plots that feature topical application (10 m x 10 m) and/or subsurface application (1.5 m x 3.6 m) in July and August. Efficacy will be based on burrow density at 7 and 50 days after treatment. If none of the contacted registrants responds favorably, additional attempts to find new chemistries will be made utilizing new insecticides from the IR4 new products/transitions list and the EPA Biopesticide Active Ingredient list. Research on any given chemistry is also contingent on obtaining an experimental use permit.

Chemical control – improved efficacy of carbaryl: Our previous studies have indicated that carbaryl efficacy for burrowing shrimp is dependent on sediment type, vegetative cover and dry time. These data, however, were not complete enough to fully assess all the variables that affect the insecticide's efficacy. For 2005, we will compare dry time and percentage eelgrass cover in a series of stand-alone experiments across several different sediment types. The general protocol for these experiments will feature applications of carbaryl (Sevin 80S) at 0 and 4 lbs ai/ac. Plot size will be 3 m x 4 m, with four replicates per treatment and a 3 m buffer between each plot. Spray volume will be 20 gpa. Efficacy will be based on burrow density at 7 and 50 days after treatment. For the dry time experiment, applications will be made in July at two low inter- and two high inter-tidal sites. Dry times will be 0.5, 1, and 2 hr. For the eelgrass cover experiment, applications will be made in August at two sites with *Zostera japonica* and two sites with *Zostera marina*. Treatment conditions will be no cover, half cover, and full cover of eelgrass. Research using lignosulphonate as a surfactant/ binding agent with carbaryl will continue. Four rates of lignosulphonate (5, 25, 50 and 100 gallons per acre) will be used with carbaryl at 0 and 2 lbs ai/ac in replicated field trials.

Mechanical control – field treatments: We have evaluated compaction methodology for the past two years. The results indicate that this approach, even with multiple crushing events, will not work. In 2005, we will obtain our final follow-up data on our large-scale crushing plots. We will also initiate research that evaluates high pressure water jets when the tide is in. A tool bar with 10 -12" shanks with high pressure injection ports will be towed from a boat or barge through high density shrimp sites. Water will be injected at pressures of 300 to 400 psi, using a high pressure pump. Refinement will be made in the tool bar to improve efficacy (adjustment for depth and number of shanks). Treatment areas will be 2 m x 15 m plots replicated four times. Shrimp density (before and after treatment) and cost and ease of treatment of application will be evaluated.

Mechanical and chemical control – in-situ subsurface video evaluations: Efforts to understand burrowing shrimp biology and control have been hampered by the shrimps' subsurface locations and our inability to monitor and see what happens with a given control method. We have recently developed and tested underwater-subsurface video methodology that can provide detailed records on what happens during a chemical or

mechanical control episode. Replicated (three) viewing containers will be buried four feet deep in sediment with a high shrimp population (16" equilateral triangle containers with one side made of Plexiglas). Once shrimp have made burrows up against the buried viewing pane of the Plexiglas window, cameras will be put inside the containers to record shrimp response to control efforts. This will include Sevin treatment under different application conditions, mechanical control and baiting attempts. The goal will be to understand shrimp behavior and movement in response to different treatments and how to improve efficacy.

Monitoring methods: One of the more significant concerns with an IPM plan for burrowing shrimp is the inability to make an inference on spring burrow counts and the level of crop loss that will occur two to three years in the future. In 2004 we evaluated how burrow counts change as a function of temperature and time at different burrow densities. In 2005, we will expand this study to more sites. Four monitoring sites with 20 1 m x 1 m permanent markers will be established. Burrow density will be counted every 45 days. Sediment temperature (10 cm and 30 cm below the surface) will be measured using Hobo temperature recorders. This monitoring project will be conducted in concert with the burrowing shrimp monitoring study team. Members are Dennis Tufts, Pacific Shellfish Institute; Brett Dumbauld, USDA, and Steve Booth, IPM Consultant for the oyster industry.

Time Frame: Field trials will occur during the summer of 2005. Data collection will continue until December 2005. The project will be completed by early spring 2006.

Project Budget

Expenditure	WSCPR (Request)	Matching (CASH or IN-KIND)*			TOTAL COST
		Source:	**Source:**	**Source:**	
		Amount (CASH)	**Amount (IN-KIND)**	**Amount (IN-KIND TIME)**	
Salaries	13,035[1]	13,035[1]			26,070
Benefits - salaried	4,432[1]	4,432[1]			8,864
Temporary workers	3,789[2]	0		5,000[3]	8,789
Benefits – hourly (11%)	417				417
Travel	1,033[4]				1,033
Equipment	0	1,000[5]	4,000[6]		5,000
Misc. supplies	1,401[7]				1,401
Grower in-kind			1,500[8]		1,500.
Total	24,107	18,467	5,500	5,000	53,074

* A project titled "Integrated Development of Alternative Management Tactics against Burrowing Shrimp on Commercial Oyster Grounds" has been submitted for $100,000 to the 2005 WSU-UI Aquaculture Research Program. This project has not been funded yet and is therefore not used for match. In addition, WSU does not allow for the use of federal funds as match. Nevertheless these two projects are closely related. ~$40,000 is budgeted for UI to evaluate the physics, mechanics, and impacts of substrate liquefaction on burrowing shrimp, ~$16,000 to Pacific Shellfish Institute to determine

the impact of alternative burrowing shrimp management tactics on the benthic infauna, ~$21,000 to Jim Durfey, WSU Pullman, to address alternative mechanical methods, and ~ $23,000 to WSU Long Beach. WSU Long Beach monies will be used to develop and test equipment for the subsurface delivery of pesticides to burrowing shrimp. They will also be used to supplement two aspects of the WSCPR project: (1) to evaluate the potential of alternative pesticides to manage burrowing shrimp using both topical and sub-surface applications and (2) to study how eelgrass and dry time affect the efficacy of alternative pesticides against burrowing shrimp. If funded, these monies will be used for maintaining the Research Tech. 1 from ~January 2006 to June 2006.

[1] Research technician I, salary and benefits; (40% of 1 FTE is requested from WSCPR and 40% of 1 FTE is cash match under account 10U-3077-0586).
[2] Timeslip labor- 512 hours @ $7.40/hr =$3789.
[3] In-kind labor from $5000 from Shawn Stern of M.J. Murdock Charitable Trust Partners in Science Grant, 10A-4167-1205.
[4] Travel at $0.405/mile; 3 trips Long Beach – Olympia to attend burrowing shrimp - oyster grower meetings (210 miles RT) =$255, 18 trips from Long Beach to Bay Center to visit research plots (60 miles RT) =$437, 42 trips Long Beach to Nahcotta to visit research plots (20 miles RT) = $340. Total travel=$1,033.
[5] Equipment purchase for $1000 (underwater camera, Plexiglas panels, macro-infauna screens) using Murdock Charitable Trust Grant 10A-4167-1205.
[6] Purchase of research boat ($4000) to access remote oyster beds under account 10U-3077-0586.
[7] Supplies (stakes, chemicals, plywood, videos, weights, markers ($1,176), and usage of WDFW Nahcotta Shellfish Lab (3 months @ $75/month).
[8] In-kind use of Rolligon from Taylor United @ $1250 and in-kind use of oyster beds from Taylor United, Bay Center Mariculture and Northern Oyster Company @ $250.

Has this budget been reviewed for accuracy? Yes **By Whom?** Terry L. Porter, Principal Assistant to the SW District Director WSU-Extension

Projected Expenditures (by quarter)

Time Period	Jan-Mar 2005	Apr-Jun 2005	Jul-Sept 2005	Oct-Dec 2005	Jan-Mar 2006	Apr-Jun 2006
WSCPR Funds		3,000	12,034	9,073	0	0
Total Funds	8,733[1]	11,734	23,534	9,073	0	0

[1]February and March salary for Research Tech I currently working on this project.

Has this project been funded previously by WSCPR? Yes
If so, for how long and with what progress: This project was funded by the WSCPR in 2003 and 2004. We field-screened numerous products for efficacy, evaluated the factors affecting insecticide efficacy, evaluated mechanical control and began work to develop a field assay to assess damage potential as a function of burrow density. Excellent progress has been made, but we are still years away from having technology to replace carbaryl before 2012.