A. **Title:** Application for Permit for Scientific Purposes under the Endangered Species Act of 1973.

B. **Species:** ESUs: wild Hood Canal Summer Run Chum Salmon (*Oncorhynchus keta*), hatchery North Fork Stillaguamish River Summer run Chinook (Oncorhynchus tshawytscha), hatchery White River Summer run Chinook (Oncorhynchus tshawytscha), hatchery Kendall Creek Spring run Chinook (Oncorhynchus tshawytscha) and wild Puget Sound Chinook Salmon (*Oncorhynchus tshawytscha)*.

C. **Date of Permit Application**: 8-11-04

D. **Applicant:**

Dr. Daniel P. Cheney, Executive Director
Pacific Shellfish Institute
120 State Avenue NE #142
Olympia, WA 98501
Tel: 360-754-2741
Fax: 360-754-2246
E-mail: Cheney@pacshell.org

Principle Contact:

Andrew D. Suhrbier, Marine Biologist
Pacific Shellfish Institute
120 State Avenue NE #142
Olympia, WA 98501
Tel: 360-754-2741
Fax: 360-754-2246
E-mail: Suhrbier@pacshell.org

E. **Information on Personnel, Cooperators, and Sponsors.**

Field Personnel:

Hector Beltran, Marine Biologist
Pacific Shellfish Institute
120 State Avenue NE #142
Olympia, WA 98501
Tel: 360-754-2741
Fax: 360-754-2246
E-mail: Beltran@pacshell.org

Aimee Christy, Marine Biologist
Pacific Shellfish Institute
120 State Avenue NE #142
Olympia, WA 98501
Tel: 360-754-2741
Fax: 360-754-2246
E-mail: Aimee@pacshell.org

Funding Opportunity Title:
National Marine Aquaculture Initiative:

Funding Source:
National Sea Grant College Program, National Oceanic and Atmospheric Administration, Department of Commerce**.**

Contact Information:
Dr. James P. McVey
Program Director for Aquaculture
U.S. Department of Commerce, NOAA
National Sea Grant College Program
1315 East-West Highway, Rm 11838
Silver Spring, MD 20191-3282
Phone: (301) 713-2451 ext. 160
Email: Jim.Mcvey@noaa.gov

Contractor:
The use of a contractor is not required for the proposed study.

Remains and Transport of Listed Species:
Marine species will be collected via pop-up nets at all field sites. All specimens will be returned to the capture site after their on site evaluation. Considerable effort will be provided to assure the survival of all captured species. The use of pop-up nets allows for the least amount of harm to be inflicted on all species collected. Species caught in the pop-up nets will not be held in the net for more than 20 hours. While enclosed, sufficient ambient seawater will be able to pass through the netting. When samples are taken out of the net, they will be placed gently into large bins filled with ambient seawater. If the sample is dense, listed species will be separated out and placed in separate buckets holding ambient seawater. Listed species will be identified, counted, measured and immediately released into their native environment. "Soft" mesh aquarium nets will be used to pick up each individual to reduce bodily stress and/or harm. Please reference section G for more information on sampling procedures and techniques.

F. **Project Description, Purpose, and Significance.**

Background and Justification

The purpose of this research is to study environmental affects of alternative shellfish production methods. Including the sampling of ESA listed species will provide a clearer picture of usage by and the habitat of marine organisms within culture sites.

(Please reference the attached NMAI project proposal for more detail.)

The past two decades have seen a rapid expansion of alternative and innovative methods for the cultivation of oysters and hard-shell clams; however, there is little information on the affects of these practices on the surrounding environment. The project proposed by the Pacific Shellfish Institute (PSI) and its collaborators is to conduct an environmental and technical assessment of alternative methods to cultivate bivalve shellfish, and develop specific guidance for modifications and improvements in those methods. The key research questions are: 1) what are the beneficial and detrimental impacts of shellfish aquaculture gear on submerged aquatic vegetation (SAV), and specifically eelgrass; 2) how do benthic infauna and epifauna species, juvenile salmonids, shrimp and crab utilize aquaculture sites; 3) what are the sediment and water column interactions associated with shellfish aquaculture culture methods; 4) what are the carrying capacity limitations of certain areas and culture methods; and 5) what culture practices can be used to enhance positive affects and minimize negative affects on the surrounding environment? This project addresses a suite of economically important alternative shellfish production practices which have had limited research study on either coast of the U.S., but have been subject to increasingly critical environmental and regulatory oversight. These include cage and bag-on-bottom, bag-on-rack or bottom suspended oyster and clam culture, and net-protected or enhanced clam culture methods. All proposed research is to be conducted in collaboration with representatives of the shellfish industry on the East and West coasts. It meets the goals and objectives of the NMAI and the North American West Coast Shellfish Industry 2010 Goals Research and Initiative Priorities; and the research priorities of the Northeast Regional Aquaculture Center and the East Coast Shellfish Growers Association. This project will provide the shellfish industry with the information and tools to move forward proactively in achieving the regulatory compliance needed to assure it can continue to operate sustainably and viably far into the future. The research findings will be relevant in addressing local problems and issues; and the study results will be pertinent anywhere in the U.S.

Extensive estuarine areas on the U.S. West Coast are currently used for commercial cultivation of oysters (*Crassostrea gigas* and others) and Manila clams (*Tapes philippinarum*) On the East Coast, both Eastern oysters (*Crassostrea virginica*) and hard clams or quahogs (*Mercenaria mercenaria*) are actively cultured. Oysters are cultivated using a variety of methods including ground or bottom culture as well as suspended culture techniques. Manila clams and quahogs are cultured on the bottom in open, netted or bag-culture systems. Cultivation of these species accounts for a large fraction of the domestic shellfish production with oysters making up the majority of the crop on the West Coast and hard clams on the East Coast. The role played by the shellfish industry in rural coastal communities is important to local, state and federal economies. Technological advances in the shellfish aquaculture sector have allowed production to double in the past 15 years despite a 29 percent loss of growing areas due to non-point pollution. Today the West Coast industry claims the title of largest regional producer of farmed shellfish in the nation, and production on the East Coast is advancing rapidly.

The proliferation and expansion of new production technologies are driven in part by market changes, mainly the increased demand for fresh oysters, clams and specialty products, and a need to increase production efficiencies, such as the application of protective barrier nets for crop management. At the same time, these new culture practices are coming under greater environmental and public scrutiny as natural resource agencies and government officials direct more attention towards protecting estuarine ecosystems for their biological productivity, complex habitats, and diverse assemblages of aquatic

species. There are an abundance of federal and state laws and policies that relate to SAV and associated resources and habitats. Unfortunately, the "best available science" with which resource agencies choose to address the regulatory challenges such as the Endangered Species Act (ESA) is very weak or simply doesn't exist, leading these agencies to be very cautious about any perceived impacts to habitats and/or organisms that have been studied in more detail. This cautious approach has already begun to influence existing aquaculture practices in California and Oregon, because growers have been forced to abandon culture areas or switch to off-bottom culture, particularly in areas where eelgrass is present (Chew 2001). East Coast shellfish growers have also been restricted from working in and adjacent to eelgrass habitat due to the potential impacts that the gear may have on the beds (Cori Rose, US Army Corps of Engineers, personal communication). Recent listings of additional salmon stocks under ESA on the West Coast promise that similar actions will be considered there in the very near future, again with little scientific understanding of the consequences.

Domestic shellfish growers, if they are to survive economically, need to respond to the expanding sphere of environmental and technical issues affecting their operations with the most accurate and relevant data available. These producers have received relatively little financial assistance from the federal government in comparison with funding made available to other agricultural producers or regulatory and resource agencies, yet they can be called upon to make substantial changes in their existing operations. At the same time they are being asked to raise their products in an increasingly competitive global economy. As the U.S. strives to become a more important player in the growing world aquaculture industry, it must build the environmental management and farm practice skills of the shellfish farming community. The assistance requested in this proposal is essential. Solving critical issues addressed in this project requires a level of scientific skills and facilities that are beyond the scope of support possible from the domestic shellfish industry. The need for this project is indicated in the collaboration by shellfish industry members and their willingness to commit their own staff time to the project.

Wild populations of Hood Canal Summer Run Chum Salmon (Oncorhynchus keta) juveniles and Puget Sound Chinook salmon (Oncorhynchus tshawytscha) juveniles will benefit from this research as best management practices (BMP) for shellfish farmers are established to protect them. These BMP's will focus on ways to reduce accidental "take" and to increase beneficial habitats of these species.

Objectives

This project addresses a suite of economically important alternative shellfish production practices which are not covered by the above research projects, but have been subject to increasingly critical environmental and regulatory oversight. These include bag-on-bottom, and bag-on-rack or bottom suspended oyster and clam culture, net-protected or enhanced clam culture methods, and effects of these practices on SAV. Not included in this study are experimental observations of ground (clusters and dispersed singles) and long-line (clusters) cultured oysters, mussel and geoduck clam culture. These culture practices are being adequately addressed by the projects discussed above.

The specific goals and objectives of this project are as follows:

1. Characterize and quantify the affects of alternative shellfish gear on eelgrass.
2. Assess and compare benthic infauna and epifauna species, juvenile salmonids, shrimp and crab diversity, density, and biomass within and adjacent to shellfish culture and control sites.
3. Determine sediment and water column interactions associated with culture method and compare with control conditions.
4. Model carrying capacity, phytoplankton concentrations, and sedimentation for different submerged and floating aquaculture methods and planting densities.

5. Develop recommendations and guidelines for modifications to growing methods to reduce adverse and maximize positive environmental effects and improve production efficiency and yield in an ecologically-sound and economically-viable manner.

Coordination with Other Programs

There is extensive literature on the general impacts of different shellfish culture methods; however, until recently, and with respect to many methods currently employed in coastal U.S. estuaries there has been little objective and quantitative evaluation of their effects on the environment or surrounding shellfish crops. However, research has been recently completed or is underway, which will provide data suitable for comparison with this proposed project. Starting in 1999 and continuing through the present, research funded by the Western Region Aquaculture Center (WRAC) has begun to assess the interactions of traditional oyster farming practices with water column and sediment chemistry, and marine plant, invertebrate and finfish communities. Entitled "The Ecological Role and Potential Impacts of Molluscan Shellfish Culture in the Estuarine Environment," the first of two WRAC studies focuses on intertidal "bottom cultured" and "long-lined" oyster farming. A second WRAC study, begun in early 2003 looks at interactions of traditionally cultured oysters and cultured geoducks with submerged aquatic vegetation (SAV) with emphasis on filter feeding affects and nutrient coupling between shellfish and eelgrass. PSI is a participating institution in the first study, with the Universities of Washington and Oregon, and the Washington Department of Fish and Wildlife. Taylor Shellfish Farms and PSI also recently completed Phase II of a USDA funded Small Business Innovation Research (SBIR) study entitled, "Development of Farming Practices for the Commercial Cultivation of Geoduck." That project contained a environmental component to assess effects of geoduck clam growout facilities and harvest operations. Currently, PSI is completing a comprehensive Sea Grant funded assessment of water column and benthic interactions, and carrying capacity analyses of large-scale suspended mussel farms in Puget Sound. PSI is also engaged in several SK and Sea Grant funded projects addressing shellfish diseases, and environmental factors influencing shellfish health, survival and growth. In addition, this proposed research will utilize in Task 2a data gathered by University of Rhode Island researchers described in Kilpatrick (2002) which showed that alternative aquaculture gear provided ecosystem services such as essential habitat (foraging area, protection) for a suit of marine organisms.

Dr. Luckenbach has received funding and has initiated a far-field sampling and modeling study of Cherrystone Inlet, Virginia. The model output will be intended to provide an understanding of the relationship between current clam production levels and primary production within Cherrystone Inlet. The utility of this model will be in identifying larger-scale and system-wide elements which may be linked to the farm-scale effects being evaluated and modeled in our project.

While we are not targeting USFWS listed Bull Trout (*Salvelinus confluentus*) they could possibly utilize the areas sampled and thus be caught. We are in the process of acquiring a Federal Fish and Wildlife License/Permit through the USFWS offices in Lacey, WA and Portland, OR. Our primary contact for this process is Jeffery Chan, 360-753-9542, at the Lacey office. We anticipate this permit to be granted in advance of the NMFS permit.

Justification of using ESA listed species

To properly estimate impacts and usage of marine fish species on alternative shellfish gear, there may be a take of target ESA listed species. Listed species require extra attention when determining BMP's of aquaculture operation. To target salmonids, it is proposed that information be gathered on fish usage of aquaculture gear during times of juvenile salmon out-migration. While it is not known if ESA or USFWS listed species will be present during collection times it is necessary to notify NMFS of the possibility of take. Environmental fluctuations require the sampling method (pop-up nets) to be flexible enough so the

least amount of harm will be inflicted on all species collected. Sample collection and soak (amount of hours gear is fishing) times will also be flexible in order to reduce take and harm of protected species. The use of underwater video in assessing fish usage will further reduce the take of listed species. Data collected during this process will benefit not only aquaculturists but also the scientific and regulatory community as well. PSI is open to data and specimen sharing if authorized by the permitting agency.

Alternative methods to determine fish usage have been analyzed. Underwater video will be taken at the experimental sites to give a visual qualitative assessment of fish usage. It has been determined that to provide a closer, quantitative assessment the use of pop-up nets is required. Different types of netting have been considered. Shellfish beds often present a significant fish and large invertebrate sampling problem because it is difficult to fish with traditional net sampling gear such as beach seines and trawls over such rough and sharp terrain. In addition, because Chinook and chum salmon, and bull trout are listed under ESA or USFWS as threatened, we are reluctant to use destructive fish sampling gear at our Washington sites. Therefore, we will apply various non-destructive fish sampling techniques including pop-up nets and underwater video.

G. Project Methodology.

Timing

Proposed duration of sampling for listed species: October 1, 2004 thru October 1, 2006.

Procedures and Techniques

Listed fish will be captured (using pop-up nets) counted, visually checked for tags, measured and released.

Floorless $25m^2$ pop-up nets will be used as our primary gear for the 2004-06 seasons. Underwater video will be used as our secondary means of assessing fish usage providing qualitative data. Design specifics for pop-up nets can be found in a technical report by Wilding (2001). Pop-up nets are a simple and cost effective way to collect a snapshot of fish usage over different substrates. These nets have a history of providing high recovery rates and clean samples (Rozas, 1997). A lower incident of take mortality will likely occur from the using of pop-up nets over fyke nets. The use of pop-up nets will likely reduce stress by lowering the density of captured species in the confined area. Four nets will be deployed monthly at each of the study sites in Washington from March to October. If this permit or any other pending permit is not accepted prior to October 2004, then sampling will start in March 2005. A total of 64 sample collections will be conducted at each site. Fish and crab will be sampled at low tide when the nets are partially uncovered. As the tide is receding fish and crab will be collected and placed in large bins containing seawater collected at the sample site. Water will be of ambient subsurface temperatures. All fish and crab captured will be identified to species, visually checked for tags, measured, and returned live to the water immediately after collection.

Underwater video will be taken after fish species have been funneled through a modified fyke net. This net will consist of only the wings and first 1 m hoop of the full design. The use of this design eliminates the mortalities that would likely occur with the use of a standard fyke net. A total of 32 video surveys will be conducted at each site. Funnel nets will be used only when sufficient water 1m depth is covering the site.

Tagging or drugging of fish will not be required for this project. As stated above, fish will not be held for an extended period of time, they will be released live back into their natural environment immediately after identification and measurement. It is estimated that holding times will range from a minimum of 5 minutes to a maximum of 45 minutes. If multiple nets are fished at one site, all fish will be collected and placed in large saltwater bins prior to any processing. Then, ESA and USFWS listed species will be processed first, to further reduce holding time. If more than 30 of a particular ESA listed species are collected by one net, only the first 30 will be measured and checked for tags visually, the rest will only be counted prior to release. Samples will not be collected from any of the listed species.

There is a potential for injury or mortality of the species involved which is minimized by the above techniques. Reducing holding time and handling will greatly reduce these adverse effects. Out of water time will be kept at a minimum level as only one specimen will be measured out of water at a time. Listed species will also be transferred to a smaller holding bucket, containing cool saltwater from the sample site, while waiting to be measured and released. This will reduce stress put upon the listed species by decreasing density and the cohabitation with predatory fish and crab. Care will be employed by gently handling all species ensuring a successful return to their natural environment.

H. Description and Estimates of Take.

ESU's to be taken

Hood Canal Summer Run Chum Salmon (*Oncorhynchus keta*) juveniles and Puget Sound Chinook Salmon (*Oncorhynchus tshawytscha)* juveniles.

Sample schedule

Estimated take of listed species is detailed in the attached "Take Table". Sampling will be conducted monthly to at the Washington study sites during March to October. During each sampling event, 4 pop-up nets will be deployed at each study site to gather data at control and shellfish production sites. A total of 32 samples will be collected each year at each site. Video surveys will be conducted during the same time frame pop-up nets are utilized. A total of 16 video surveys will be conducted each year at each site. Specific site location is included in the Take Table.

Little is known on the recent status of the species listed at the sample locations. A literature search revealed that publish data was limited to non site-specific information. Personnel at the Washington Department of Fish and Wildlife (WDFW) confirmed this notion: that little or no research has been done in assessing listed species populations at our specific sample locations.

Jim Ames, WDFW Chum specialist, provided useful information on Hood Canal chum, bull trout, and Puget Sound Chinook. It was his assessment that there is no known Summer Run of chum using Thorndyke Creek which leads out into our study site in Thorndyke bay. He noted that our proposed study may capture juvenile chum utilizing the nearshore environment, but did not know when, where, how long, or how many. He concluded that the study may gather a lot of juvenile salmonids or that it may not catch any at all. He commented that adult Fall Chum may use Thorndyke creek as spawning grounds in November but adult catch should be avoided as proposed sampling does not occur from November to February.

Bruce Sanford, Chinook specialist from WDFW, provided detailed information on the Puget Sound and Hood canal Chinook populations. Native Chinook populations are not known to spawn in Eld Inlet,

Thorndyke or Samish bays or their rivers or streams. Native and non-native Chinook have been known to utilize Eld Inlet for foraging but not for spawning.

There are native Hood Canal Chinook populations according to Appendix A of the Puget Sound Chinook Harvest Resource Management Plan (2004). Known runs located in the mid-canal region include: Hamma Hamma, Duckabush and Dosewallips rivers. These rivers have been influenced by hatchery production of salmon, particularly non-native stocks. There is a hatchery produced Hamma Hamma fall run Chinook that utilizes native stocks but is not listed. This places the mid-canal region as Category 2. According to the management plan: "Category 2 are those that once possessed sustainable indigenous chinook populations but they have either been lost or no longer sustainable." While the proposed Thorndyke bay sample area does not provide and entrance for a known Chinook stream, salmon may be present in the near shore as they out-migrate or when they come back as adults.

There are non-native Chinook populations in the Samish river watershed presently according to the management plan. These populations are maintained by the Samish Hatchery which has been releasing juvenile Chinook for many years. The management plan places the Samish watershed in category 3 which: "…are those that historically never possessed sustainable populations of chinook." Hatcheries on the Nooksack, White River, and Stillaquamish produce spring run Chinook derived from threatened native stocks. While these rivers are a considerable distance away from the Samish study site they may be present in the near shore as they out-migrate or when they come back as adults.

Estimated Mortalities

The estimated annual take for each species and location is detailed in the Take Table. While considerable effort will be put forth by the study team to reduce the number of indirect mortalities incurred by this study (see the procedures and techniques section above), it is possible that mortalities will occur due to the delicate nature of the listed species. Capturing these species will undoubtedly incur stress to the animals as it will limit their movement and bring them in close proximity to potential predators as the tide goes out. Handling is also considered deleterious as it further stresses the animals by touching and placing them out of water for a brief period of time. Intentional mortalities are not part of the proposed study.

Estimates of take, noted on the Take Table, were derived from anecdotal experience in the use of pop-up nets. It was difficult to estimate the take number of all of the listed species as little relevant data has been collected and published on the population dynamics of each species.

I. Transportation and Holding.

Transportation of Listed Species

Transportation of listed species will not be conducted during this study.

Holding of Listed Species

Holding of listed species will not be conducted during this study.

Emergency Contingencies

Emergency contingencies will not be set up for this program since listed species will not be transported or held in holding facilities.

J. Cooperative Breeding Program

If employees of the PSI are asked to participate in a cooperative breeding program by contributing or maintaining data, they will be encouraged to participate.

K. Previous or Concurrent Activities Involving Listed Species

Neither PSI nor its employees have been previous permit holders.

L. Certification

"I hereby certify that the foregoing information is complete, true and correct to the best of my knowledge and belief. I understand this information is submitted for the purpose of obtaining a permit under the Endangered Species Act of 1973 (ESA) and regulations promulgated thereunder, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001. or to penalties under the ESA"

_____

Signature/Date/Position/Title

M. Length of Time and Cost to Prepare Application:

Time 42hrs

Additional Cost

References

Hosak, Geoff. 2003 Effects of *Zostera marina* and *Crassostrea gigas* culture on the intertidal communities of Willapa Bay, Washington, University of Washington Masters Thesis

Hosak, Geoff. 2004. Personal Communication

Lawrence P. Rozas, Thomas J. Minello. 1997. Estimating Densities of Small Fishes and Decapod Crustaceans in Shallow Estuarine Habitats: A Review of Sampling Design With Focus on Gear Selection. *Estuaries* 20:1:199-213

Puget Sound Indian Tribes and the Washington State Department of Fish and Wildlife. 2004. Appendix A of the Puget Sound Chinook Harvest Resource Management Plan.

Rose, Cori. 2003. Personal Communication

Thomas A. Wilding, Robin N. Gibson and Martin D.J. Sayer. 2001. Procedural Guideline No. 4-2 Recording benthic and demersal fish in dense vegetative cover, *Marine Monitoring Handbook June 2001*, Joint Nature Conservation Committee. p. 347-353

Anticipated Annual Take Table

ESU/Species	Life Stage	Sex	Origin	Take Activity	# of Fish Requested	Requested Unintentional Mortality	Research Location	Research Period
Puget Sound Chinook, (Oncorhynchus tshawytscha)	Juvenile	Unknown	Wild	Capture, handle, release	400	1/25	Hood Canal: Thorndyke Bay: Lat 47.808 Long -122.73	March-October
Puget Sound Chinook, (*Oncorhynchus tshawytscha*)	Juvenile	Unknown	Wild	Capture, handle, release	400	1/25	Puget Sound: Eld Inlet: Lat 47.128 Long -122.96	March-October
Puget Sound Chinook, (*Oncorhynchus tshawytscha*)	Juvenile	Unknown	Wild	Capture, handle, release	400	1/25	Samish Bay: Lat 48.5959 Long -122.46	March-October
Stillaguamish River Summer run Chinook, (Oncorhynchus tshawytscha)	Juvenile	Unknown	Hatchery	Capture, handle, release	400	1/25	Samish Bay: Lat 48.5959 Long -122.46	March-October
White River Summer run Chinook, (Oncorhynchus tshawytscha)	Juvenile	Unknown	Hatchery	Capture, handle, release	400	1/25	Samish Bay: Lat 48.5959 Long -122.46	March-October
Kendall Creek Spring run Chinook, (Oncorhynchus tshawytscha)	Juvenile	Unknown	Hatchery	Capture, handle, release	400	1/25	Samish Bay: Lat 48.5959 Long -122.46	March-October
Hood Canal summer run Chum, (*Oncorhynchus keta*)	Juvenile	Unknown	Wild	Capture, handle, release	400	1/25	Hood Canal: Thorndyke Bay: Lat 47.808 Long -122.73	March-October
Hood Canal summer run Chum, (*Oncorhynchus keta*)	Juvenile	Unknown	Wild	Capture, handle, release	200	1/25	Samish Bay: Lat 48.5959 Long -122.46	March-October
Bull Trout, (*Salvelinus confluentus*)	Adult	Unknown	Wild	Capture, handle, release	25	1/50	Hood Canal: Thorndyke Bay: Lat 47.808 Long -122.73	March-October
Bull Trout, (*Salvelinus confluentus*)	Adult	Unknown	Wild	Capture, handle, release	50	1/50	Samish Bay: Lat 48.5959 Long -122.46	March-October
Bull Trout, (*Salvelinus confluentus*)	Adult	Unknown	Wild	Capture, handle, release	25	1/50	Puget Sound: Eld Inlet: Lat 47.128 Long -122.96	March-October