I. Basic Information

A. Title: Population Level Response to Habitat Restoration

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C. Study Code: EST-02-P-04

D. Anticipated Duration: 2007-2009

E. Date of Submission: August 15, 2006

II. Project Summary

The lower Columbia River main stem and estuary are used extensively by coastal cutthroat trout. This species may be the most appropriate indicator species to assess Pacific salmonid response to habitat restoration in this area of the basin. It is the goal of this project to develop and implement a long-term approach to assess coastal cutthroat trout population response to restoration activities in the lower Columbia River basin. Achieving the objectives of this study will address some confounding factors (movement among tributaries and survival estimates between seasons/life stages) for estimating coastal cutthroat trout population abundance and result in abundance estimates for populations in the lower Columbia River. The project will focus on neighboring tributaries in four areas of the lower Columbia River: the lower estuary/mouth (Chinook River, Wallacut River), the middle estuary/Cathlamet Bay (Gnat Creek, Big Creek, Bear Creek), the upper estuary/lower main stem (Germany Creek, Abernathy Creek, Mill Creek), and the main stem/Scappoose Bay (North Scappoose Creek, South Scappoose Creek, Milton Creek). The

approach will utilize PIT tag technology to assess juvenile and adult coastal cutthroat trout movement among tributaries and straying rates of returning migratory adults and to implement a mark/recapture sampling methodology for abundance estimation. In addition, PIT tag technology will be used to differentiate between migratory and resident life history components in support of investigations to identify other methods toward this objective. Between season and between life stage survival estimates will also be determined. All data collected will be incorporated into an abundance estimation model to determine annual abundance estimates for all eleven tributaries. The resulting abundance estimation model will provide a data analysis tool necessary to evaluate biological response to habitat restoration projects in the lower Columbia River main stem and estuary. Ultimately, this project relates to FY07 Objective 3 for Study EST-02-P-04, continue implementing field evaluations of cumulative effects of restoration projects using standard methods, sensors and remotely operated technologies to measure the effects on listed salmon through ecosystem response.

This proposed study, in both approach and resulting information, is consistent with Reasonable and Prudent Alternatives (RPAs) listed in the NMFS 2000 FCRPS Biological Opinion (NMFS 2000):

- Action 9: Provides for research, monitoring and evaluation to provide data for resolving a wide range of uncertainties, including determining population status, establishing causal relationships between habitat attributes and population response, and assessing the effectiveness of management actions.
- Action 161: Provides for monitoring from a biological perspective to determine how well a management action is implemented.
- Action 193: Provides for state-of-the-art, novel fish detection and tagging techniques to determine growth and survival characteristics based on population and location.
- Action 196: Provides for collecting information on all salmonid life histories to develop an understanding of salmonid estuary use and any influences of the hydrosystem on flows, turbidity, and nutrient delivery that might, in turn, affect salmonid ecology in the estuary.

The NMFS 2004 FCRPS Biological Opinion (NMFS 2004) references the 2000 FCRPS Biological Opinion and the 2004 Final Updated Proposed Action (UPA) for the FCRPS Biological Opinion Remand (USACE et al. 2004) to outline RPAs. The referenced actions above remain relevant under the auspices of the NMFS 2004 FCRPS Biological Opinion. In addition, the UPA identifies specific actions to be implemented pursuant to the Action Agencies' obligations under the Endangered Species Act, the Northwest Power Act and the Clean Water Act that are consistent with the objectives proposed in this project:

- Determine the relationships between habitat conditions and the life history diversity, abundance and performance of juvenile salmon and the potential salmonid responses to past and future habitat change.
- Advance the development and/or adoption of standardized, compatible protocols for sampling designs and data collection for evaluating the effectiveness of management actions.
- Develop reach specific research and monitoring to assess the effectiveness of specific actions.

III. Project Description

A. Background

Although the USFWS withdrew the proposed ruling to list southwestern Washington/lower Columbia River coastal cutthroat trout DPS under ESA in 2002, both the states of Oregon and Washington have indicated that the status of these populations are depressed or unknown (Blakley et al. 2000, ODFW *in prep*). The state of Oregon goes so far as to indicate lower Columbia River populations are "potentially at risk" (K. Goodson, ODFW, *pers. comm.*). Coastal cutthroat trout have been impacted by anthropogenic practices such as logging (Holtby 1987, Johnson et al. 1999), over-harvest (Giger 1972, Ricker 1982, Gresswell and Harding 1997), and artificial propagation (Campton 1985, Flagg et al. 1995). In the Columbia River basin, hydropower is understandably linked to the declines of upper Columbia River stocks through passage impacts (Deriso et al. 1996, Deriso 2001). However, in the lower Columbia River, regulated flow has resulted in a shift in the amplitude and timing of high flow events (PNRC 1978). This shift in hydrological character influences physical, chemical and biological habitat parameters of the lower Columbia River mainstem and estuary.

Recent investigations by the US Fish and Wildlife Service – Columbia River Fisheries Program Office (USFWS-CRFPO) support previous findings, indicating that the lower Columbia River mainstem and estuary are extensively used by multiple life stages of coastal cutthroat trout throughout the year (USFWS 2003, 2004, 2005, *in prep*). Because coastal cutthroat trout make extensive use of the mainstem and estuary (as both juveniles and adults), these fish are believed to be more susceptible to changes in productivity than any other Pacific salmonid (Giger 1972, Pearcy 1997). Many habitat restoration projects have taken place in recent years to address habitat changes in this portion of the Columbia River basin (see Section D). Subbasin plans in the lower Columbia River indicate that depressed coastal cutthroat trout populations will benefit from improvements in stream habitat conditions for anadromous species. Determination of a biological response in Pacific salmonids to habitat restoration projects would further support continued habitat restoration in the lower Columbia River mainstem and estuary. It would be expected that coastal cutthroat trout will not only benefit from habitat improvements in the estuary and Columbia River mainstem, but may be the most appropriate indicator species to assess Pacific salmonid response to these restoration activities. Columbia River salmon and steelhead may use the lower mainstem and estuary up to several months. These species will then migrate to the ocean for up to five years in the case of Chinook salmon. This duration allows these species to be affected by changing "ocean conditions" and confound the population level response to habitat restoration. Coastal cutthroat trout, on the other hand, migrate no further than nearshore ocean environments for only a few months, reducing or eliminating the effect of "ocean conditions" on the response of this species to habitat restoration projects in the lower Columbia River (Pearcy 1997).

Currently, there is little quantitative information on the abundance of lower Columbia River coastal cutthroat trout populations. To properly assess the response of coastal cutthroat trout populations to habitat restoration projects, current population abundances throughout the lower Columbia River are needed and future evaluation of these populations is required. However, determination of coastal cutthroat trout population abundance is confounded not only by sympatric life history components (i.e., anadromous and resident) but by a lack of

understanding of multiple other factors affecting the dynamics of these populations including fluvial dispersal, anadromous straying, and survival.

Recent investigations by the USFWS-CRFPO have demonstrated movement by adult coastal cutthroat trout among multiple tributaries of the lower Columbia River (USFWS 2005, *in prep)*. Juvenile coastal cutthroat trout have also been documented leaving tributaries outside of the typical smolt outmigration window, possibly making migratory moves to the Columbia River mainstem or other tributaries. These recent investigations have also found evidence of straying of hatchery fish stocked by WDFW Cowlitz Fish Hatchery. Dispersal and straying rates should be described and incorporated in model development to estimate coastal cutthroat trout population abundance in lower Columbia River tributaries.

There are no reliable estimates of between season or between life stage survival for lower Columbia River coastal cutthroat trout populations (Quinn 2005). Estimates of survival using mark-recapture approaches that in turn will be used for modeling survival will provide estimates of capture probability that can be used to determine abundance of all life history components of a coastal cutthroat trout population.

Estimating the abundance of coastal cutthroat trout populations and the relative health of sympatric life history components within a population is confounded by an efficient ability to differentiate among life history forms. Proportions of sympatric migratory and resident components within a population can currently be determined using PIT tag technology (USFWS 2003, 2004, 2005, *in prep*). However, this approach relies on analysis of movement data 2-3 years after initial tagging of individuals. Possible alternative approaches that may provide more timely information toward individual life history strategy include stable isotope analysis and growth rate analysis. Stable isotopes within individuals may reflect differences in diet composition and physiological condition between anadromous and resident life history forms. Determination of life history strategy within sympatric populations has been conducted with multiple life stages of steelhead/rainbow trout, brown trout and brook trout (Doucett et al. 1999a, McCarthy and Waldron 2000, Zimmerman and Reeves 2002, Morinville and Rasmussen 2003, Charles et al. 2004). Likewise, growth rate differences between coastal cutthroat trout exhibiting different life history strategies may be another indicator that can be used. Morinville and Rasmussen (2003) found that migratory brook trout have a significantly lower growth rate than residents in the first two years of life. By age 2, residents are 1.3 times larger in size than migrants. In contrast, steelhead and anadromous arctic charr exhibit higher growth rates prior to smolting than their resident counterparts (Rikardsen and Elliot 2000, Thrower et al. 2004). Preliminary data indicates there may be differences in growth rates between migratory and resident coastal cutthroat trout in the lower Columbia River (USFWS *in prep*). However, more thorough experimentation to determine the extent and applicability of those differences is needed. Given past findings with other species, the use of stable isotope analysis and growth rate analysis, individually or in concert, provides a promising opportunity to differentiate between alternate life history strategies of lower Columbia River coastal cutthroat trout.

The proposed project will be conducted in close cooperation with several agencies and organizations including Sea Resources, the Columbia River Estuary Study Taskforce (CREST), Oregon Department of Fish and Wildlife Corvallis Research Lab (ODFW-Corvallis), North Coast Watershed District (ODFW-Tillamook), and North Willamette

Watershed District (ODFW-Clackamas), the Washington Department of Fish and Wildlife (WDFW), and US Fish and Wildlife Service – Abernathy Fish Technology Center (USFWS-AFTC). This project will provide information toward and receive information from projects being conducted by these entities. In addition, the proposed project will relate to multiple other efforts being conducted in the lower Columbia River mainstem and estuary at various ecosystem levels by evaluating a response in coastal cutthroat trout populations.

As part of an ongoing monitoring study, screw traps that are located in the Chinook River are operated year round by Sea Resources and CREST. The routine capture of migrant coastal cutthroat trout will provide opportunities to tag and recapture both adults and juveniles.

ODFW-Corvallis in cooperation with CREST and ODFW-Tillamook are conducting a project in Big Creek evaluating migratory behavior of coho salmon and coastal cutthroat trout. The proposed project complements this ongoing work through efforts that will be implemented in two neighboring tributaries (Gnat Creek and Bear Creek). Resources will be pooled to gain a more comprehensive understanding of coastal cutthroat trout movement among tributaries.

ODFW-Clackamas coordinates smolt and adult trapping in the Scappoose Bay watershed. These efforts will provide an opportunity to tag and recapture coastal cutthroat trout with respect to the goals and objectives of the proposed project.

WDFW operates smolt and adult traps on Mill, Abernathy, and Germany creeks. USFWS-AFTC assists WDFW with operation of the smolt trap on Abernathy Creek. These efforts have provided the opportunity to tag and recapture coastal cutthroat trout in the past and will continue to do so through the course of the proposed project.

USFWS-AFTC is conducting a continuing study to investigate the reproductive success of steelhead in Abernathy Creek, Washington (BPA Project 2003-06-300). This project relies on the use of the long range PIT tag technology. The proposed work will take advantage of the technology operation and maintenance already in place.

The proposed project relates to the Plan for Research, Monitoring, and Evaluation of Salmon in the Columbia River Estuary (Johnson et al. 2004) and to a number of proposed and ongoing efforts in the lower Columbia River mainstem and estuary to provide added biological relevance to habitat restoration efforts. Many of these projects are referred to in Johnson et al. (2004) and include:

- Columbia River Estuary Habitat Mapping – Bonneville Power Administration (BPA) Project 2002-012-00
- Ambient Water Quality Monitoring – Oregon Department of Environmental Quality
- Long Term Watery Quality Monitoring – US Geological Survey
- Estuarine Detection of PIT-Tagged Juvenile Salmonids Using a Pair-Trawl – US Army Corps of Engineers (USACE) Project BPS-00-11
- Estuarine Habitat and Juvenile Salmon: Current and Historic Linkages in the Lower Columbia River and Estuary – USACE Project EST-02-02
- Blind Slough Restoration Project – BPA Project 2003-015-00

- Effectiveness Monitoring of the Chinook River Estuary Restoration Project – BPA Project 2003-006-00
- Optimization of FCRPS impacts on Juvenile Salmonids: Restoration of Lower-Estuary and Plume Habitats – BPA Project 2003-045-00
- Preserve and Restore Columbia River Estuary Islands to Enhance Juvenile Salmonid and Columbia Deer Habitat – BPA Project 2003-008-00
- Implement the Habitat Restoration Program for the Lower Columbia River and Estuary – BPA Project 2003-011-00
- Evaluation of Cumulative Ecosystem Response to Restoration – USACE Project EST-04-NEW

The proposed work builds on an existing infrastructure and utilizes a collaborative network of partners to provide answers to current information needs in order to develop a population abundance estimate model for coastal cutthroat trout in the lower Columbia River basin. The resulting information will provide a baseline for immediate feedback and a framework for future evaluation of biological response to habitat restoration projects in the lower Columbia River mainstem and estuary.

B. Objectives

The goal of this project is to develop and implement a long-term approach to assess coastal cutthroat trout population response to restoration activities in the lower Columbia River basin. The objectives toward this end:

1) Estimate rate of juvenile and adult fluvial coastal cutthroat trout movements among neighboring tributaries in four areas of the lower Columbia River;

2) Estimate rate of straying by returning anadromous wild coastal cutthroat trout among neighboring tributaries in four areas of the lower Columbia River;

3) Estimate between season and between life stage survival for coastal cutthroat trout;

4) Investigate alternative approaches to differentiate between alternate life history strategies in juvenile and adult coastal cutthroat trout;

5) Implement robust sampling design to estimate population abundance of lower Columbia River coastal cutthroat trout;

6) Develop and utilize a population abundance model for lower Columbia River coastal cutthroat trout to evaluate population response to habitat restoration.

Four areas of the lower Columbia River mainstem and estuary comprise the study area: 1) the lower estuary/mouth (Chinook River, Wallacut River), 2) the middle estuary/Cathlamet Bay (Gnat Creek, Big Creek, Bear Creek), 3) the upper estuary/lower mainstem (Germany Creek, Abernathy Creek, Mill Creek), and 4) the mainstem/Scappoose Bay (North Scappoose Creek, South Scappoose Creek, Milton Creek). Selection criteria for study sites is based on past and ongoing work that has identified sufficient numbers of coastal cutthroat trout within streams necessary to meet the stated objectives. The sites are spatially balanced from Scappoose Bay

to the mouth of the Columbia River because past work has indicated that there may be differences in the life history expression of coastal cutthroat trout populations in different portions of the lower Columbia River. The stratification of these tributary groups through the lower Columbia River mainstem and estuary will provide the opportunity for within group and among group comparison of coastal cutthroat trout behavior and population parameters. In addition, over time, the continued evaluation of population dynamics in these subbasins will provide an analysis of response to habitat restoration projects relative to proximity in geographic location of a group of tributaries. The lower estuary site is located adjacent to restoration work occurring in the lower Chinook River and Baker Bay (see BPA Project 2003-006-00), the middle estuary site is located adjacent to restoration that has occurred in Blind Slough (BPA Project 2003-015-00), the upper estuary site is located adjacent to restoration work that has occurred on Crims Island (BPA Project 2003-011-00), and the mainstem site is located adjacent to work that has occurred in the Scappoose Bay watershed (www.lcrep.org). Further habitat restoration projects for all of these areas are planned in future years (see BPA Project 2003-011-00). The resulting information will provide a baseline for immediate feedback and a framework for future evaluation of biological response to habitat restoration projects in the lower Columbia River mainstem and estuary.

C. Methodology

Objective 1. Estimate rate of juvenile and adult fluvial coastal cutthroat trout movements among neighboring tributaries in four areas of the lower Columbia River.

and

Objective 2. Estimate rate of straying by returning anadromous wild coastal cutthroat trout among neighboring tributaries in four areas of the lower Columbia River.

Rates of fluvial coastal cutthroat trout movement among neighboring tributaries and rate of straying by returning anadromous coastal cutthroat trout will be estimated in four areas of the lower Columbia River: the lower estuary/mouth, the middle estuary, the upper estuary/lower mainstem, and the mainstem/Scappoose Bay. Successful achievement of these objectives depends on the use of long range PIT tag technology (Zydlewski et al. 2001) coupled with recaptures from annual fall electrofishing and spring smolt trapping.

One stream within each of the four groups of tributaries will have at least one PIT tag antennae array on it to monitor the movement of PIT tagged fish: lower estuary/mouth – Chinook River, middle estuary – Big Creek, upper estuary/lower mainstem – Abernathy Creek, mainstem/Scappoose Bay – North Scappoose Creek. Antennas will be constructed as open coil inductor loops with PVC-coated multi-strand wire strung through PVC pipe. Each antenna will be connected to a Destron-Fearing reader that emits a 134.2 kHz electromagnetic energizing signal through the antenna. Readers and computers will be powered by AC power supply where available. When AC power is not available, multiple 12-V deep cycle marine batteries (60 ampere hours each) will be used and replaced with fresh batteries on a weekly basis. If feasible, a solar trickle charger will be used to extend battery life. A field PC will receive serial data output from the reader at each site; detected tag identification numbers, date and time of detection will be recorded. The readers, batteries and/or power supplies, and PCs will be housed within a weather-proof box located outside of the immediate flood zone of the streams.

Juveniles and adults will be captured in identified tributaries during annual fall electrofishing and spring smolt trapping (coordinated with ODFW, WDFW, Sea Resources, CREST, and USFWS-AFTC). In each of the tributaries, up to 1000 coastal cutthroat trout will be tagged annually with individually coded PIT tags (23 mm long, 3.84 mm diameter, 0.6 g) and released back into the general area of capture. Recaptured fish will be determined by scanning all captured coastal cutthroat trout for PIT tags. At this time, length, weight, scale samples and tissue samples will be collected from all fish. Animal care protocols will follow those outlined in Kelsch and Shields (1996). Scales will be analyzed to determine age following DeVries and Frie (1996). This approach has been implemented reliably on juvenile coastal cutthroat trout in the lower Columbia River (USFWS *in prep*). Tissue samples will consist of fin clips and/or muscle plugs and be used for stable isotope analysis. Monitoring of fish movements will begin immediately after initial release.

Movements will be monitored through the year using this technology to determine the proportion of adults and juveniles emigrating from the stream and the number of fluvial coastal cutthroat trout immigrating from neighboring tributaries as well as the rate of straying by anadromous individuals. The proportion of coastal cutthroat trout emigrating from streams containing a PIT tag antennae array will be estimated directly from monitoring data generated by the antennae. The rate of emigration will be documented as a percentage of tagged fish that emigrated from the stream relative to the total number of tagged fish. An estimate of fish emigrating from streams without PIT tag antennae arrays will be determined using subsequent electrofishing recaptures, capture efficiencies, and survival rates generated from this project. Spring smolt trap data will be used in addition if that information is available for the stream (i.e., Mill Creek, Germany Creek). The number of coastal cutthroat trout immigrating from neighboring tributaries and the rate of straying by anadromous individuals will be determined directly from monitoring data generated by PIT tag antennae arrays in streams containing such. The rate of immigration or straying will be documented as a percentage of tagged fish that immigrated or strayed from neighboring streams relative to the total number of tagged fish in the stream of origin. An estimate of the number of coastal cutthroat trout immigrating from neighboring tributaries for streams not containing PIT tag antennae arrays will be determined using subsequent electrofishing recaptures, capture efficiencies, and survival rates generated from this project.

Objective 3. Estimate between season and between life stage survival for coastal cutthroat trout.

Between season and between life stage survival (*S*) for coastal cutthroat trout will be determined through mark-recapture approaches employed on one stream per group of tributaries multiple times of the year through the duration of the project. Marking approaches will include PIT tagging during fall electrofishing and spring smolt trapping. Recapture approaches will include fall electrofishing, spring smolt trapping, winter adult trapping, and interrogation at stationary PIT tag antennae arrays. Apparent survival will be estimated using Jolly-Seber type models available in Program MARK (Cormack 1964, Jolly 1965, Pradel 1996, White and Burnham 1999). Data analysis will also generate capture-recapture probabilities that will be necessary for developing the population abundance model.

Objective 4. Investigate alternative approaches to differentiate between alternate life history strategies in juvenile and adult coastal cutthroat trout.

Alternative approaches to differentiate between alternate life history strategies in juvenile and adult coastal cutthroat trout include the use of stable isotope analysis and growth rate analysis. All coastal cutthroat trout collected will be measured, weighed and sampled nonlethally for fin and/or muscle tissue.

Lengths and weights will provide growth rate measures between initial capture and recapture for various age classes and life history strategies. The null hypothesis for this objective is that no differences in growth rate are detectable among age classes and life history strategies. Age will be determined from scale analysis. Life history strategy (resident, fluvial, anadromous) will be determined from location, mode and timing of recapture (i.e., an anadromous coastal cutthroat trout would be recaptured from the stream it originated in a smolt trap during the spring outmigration). An ANOVA on growth rates among the designated groups will determine if significant differences are present. The anticipated end-product of this task is an index to determine the proportion of anadromous and resident coastal cutthroat trout in a juvenile population prior to smolting.

Stable isotope analysis will be conducted on all tissue samples to determine ^{13}C /^{12}C ratios ($\delta^{13}C$ (‰)) and ^{15}N /^{14}N ratios ($\delta^{15}N$ (‰)). These stable isotopes are being identified for analysis because they have been proven to be diagnostic between anadromous and resident forms of other salmonid species (Doucett et al. 1999a, McCarthy and Waldron 2000, Zimmerman and Reeves 2002, Morinville and Rasmussen 2003, Charles et al. 2004). If they do not prove to be diagnostic in coastal cutthroat trout, the analysis of other isotopic ratios (e.g., ^{35}Sr /^{34}Sr) will be considered. However, it should be noted that evaluation of other stable isotopes may require additional tissue and, therefore, may not be conducive to nonlethal sampling (Doucett et al. 1999b). All samples will be processed by a commercial laboratory (i.e., Colorado Plateau Stable Isotope Laboratory, Northern Arizona University) using an automated continuous flow isotope ratio mass spectrometer. Samples will be processed by a commercial laboratory to expedite analysis. All data will be analyzed using ANOVA to determine if significant differences occur in the relative ratios of stable carbon and nitrogen isotopes with respect to age and life history strategy. The anticipated end-product of this task is an index relating stable isotope ratios in juvenile and adult coastal cutthroat trout to life history strategy.

Objective 5. Implement robust sampling design to estimate population abundance of lower Columbia River coastal cutthroat trout.

A robust sampling design will be used to capitalize on the strengths of closed and open population models used to estimate demographic parameters (Pollock 1982, Pollock et al. 1990). This approach depends on multiple sampling occasions occurring within a short time frame (e.g., weeks) to estimate population size using closed population models. This level of sampling conducted in at least two consecutive years allows for continued estimates of survival rates (Objective 3). A mark-recapture sampling approach will be implemented within this sampling design as a means of most accurately determining point estimates of population abundance (Peterson and Cederholm 1984, Thurow and Schill 1996, Rosenberger and Dunham 2005).

Objective 6. Develop and utilize a population abundance model for lower Columbia River coastal cutthroat trout to evaluate population response to habitat restoration.

Program MARK (White and Burnham 1999) will be used to develop a population abundance model incorporating data from the robust sampling design, life history identification, survival, immigration and emigration, and probability of capture to determine an abundance estimate for coastal cutthroat trout in the study area of the lower Columbia River. The resulting model will be available for widespread use to assess habitat restoration activities of the lower Columbia River mainstem and estuary in the future as well as to assist in the management of coastal cutthroat trout.

D. Facilities and Equipment

USFWS personnel will be stationed at the Columbia River Fisheries Program Office, Vancouver, Washington. Suitable office space, laboratories, and storage along with the necessary equipment to implement the project are maintained on site. A fleet of vehicles and maintenance infrastructure is readily available.

It will be necessary to purchase equipment for one PIT tag antennae array to be constructed on North Scappoose Creek. PIT tag antennae arrays for the other three identified tributaries will be operational prior to implementation of this project. An additional backpack electrofisher (Smith Root, Inc.) will be purchased to facilitate the simultaneous operation of two field crews. Two GPS receivers (Trimble) will be purchased to identify standardized sampling reaches and to provide accurate location information to GIS databases.

E. Impacts

The activities proposed herein are not expected to impact other research or projects. Direct impacts to listed species is not expected to exceed take already identified in existing permits. Throughout the entire project area, we are authorized to capture, handle, and release take up to a total of 1000 juvenile steelhead (Lower Columbia River Steelhead ESU); 900 juvenile, 55 listed hatchery adipose clipped adult and 30 naturally produced adult coho salmon (Lower Columbia River Coho Salmon ESU); 35 listed hatchery adipose clipped adult and 60 naturally produced adult Chinook salmon (Lower Columbia River Chinook Salmon ESU); and 60 adult listed hatchery adipose clipped coho salmon (Lower Columbia River Coho Salmon ESU).

F. Collaborative Arrangements and/or Sub-Contracts

Collaborative arrangements with CREST, ODFW, WDFW, and USFWS-Abernathy Fish Technology Center are described in detail in the background relative to the relationship of the proposed research to other ongoing or proposed research. No sub-contracts will be issued in 2007. Sub-contracting for stable isotope lab analysis will occur in outyears.

IV. Key Personnel

J. Michael Hudson, Principal Investigator (0.75 FTE)
Supervisory Fishery Biologist, Native Trout Project
US Fish and Wildlife Service – Columbia River Fisheries Program Office, Vancouver, WA
Duties include the coordination, design and implementation of the proposed work, analysis and dissemination of all data.

Timothy Whitesel, Co-Principal Investigator (0.05 FTE)
Team Leader, Conservation, Assessment, and Natural Production Team
US Fish and Wildlife Service – Columbia River Fisheries Program Office, Vancouver, WA
Duties include assistance with project coordination and design and technical assistance.

Howard A. Schaller, Co-Principal Investigator (0.05 FTE)
Project Leader, Columbia River Fisheries Program Office
US Fish and Wildlife Service – Columbia River Fisheries Program Office, Vancouver, WA
Duties include assistance with project coordination and design and technical assistance.

V. Technology Transfer

All data collected through this project relative to PIT tag technology will be uploaded to PTAGIS database.Annual and final reports will be provided to contracting agency to meet obligations of contract. Information will be disseminated to scientific community through agency final report, peer reviewed literature, and/or presentation at professional meetings. Updates and final results will be available to scientific community, general public and contracting agency through US Fish and Wildlife Service - Columbia River Fisheries Program Office web site.

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