

New Research Proposal

**EVALUATION OF ADULT SALMON HABITAT USE IN THE COLUMBIA RIVER
ESTUARY AND PLUME**

for

U. S. Army Corps of Engineers - Portland District

Study Code: EST-04-new

C.A. Peery
Idaho Cooperative Fish and Wildlife Research Unit
University of Idaho, Moscow, Idaho 83844-1141
(208) 885-7223

and

Carl Schreck
Oregon Cooperative Fish and Wildlife Research Unit
Oregon State University
Corvallis, Oregon 97331-3803
(541) 737-1961

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Project Summary

A. Goals

This study plan outlines methods to develop detailed information on the distribution and usage of the Columbia River plume and estuary environments by ESA-listed species and runs of adult salmon and steelhead. Information on the temporal and spatial patterns of habitat use in the estuary would be used to determine potential direct and indirect impacts to adult salmon from operation of the Federal Hydropower System and to assist with recovery and restoration efforts. Research activities outlined here would compliment similar projects proposed to evaluate juvenile use of estuarine habitats.

B. Primary Objectives – Year 2005

1. Determine macro-scale temporal and spatial patterns of habitat use of the Columbia River estuarine and plume environments by adult salmon migrants.
2. Conduct monitoring to determine patterns of microhabitat use in the Columbia River estuary by adult salmon migrants.

C. Methods

In 2005, we propose to collect 200 fall Chinook salmon and 200 summer steelhead in the Columbia River estuary, outfit them with acoustic and radio transmitters, and monitor their passage through the Columbia River upstream to Bonneville Dam. Using a combination of acoustic receivers in the estuary, radio receivers in tributary streams and at Bonneville Dam and mobile tracking by boat using both receiver types we will determine macro- and micro-habitat use patterns as adult salmon migrate through the estuary and the lower river. Information on timing, migration rates, and minimum estimates of survival and fishery harvests will also be collected as a component to this study. Data collected during this study will be used to evaluate potential impacts from operation of the Federal Hydrosystem on adult migrants from ESA-listed salmonid populations.

D. Relevance

The study proposed herein addresses gaps in knowledge of habitat use and survival for adult salmon migrating through the Columbia River estuary as identified in RPAs 196 and 197 in the NOAA Fisheries (formerly NMSF) 2000 Biological Opinion for operations of the Columbia River Federal Power System related to recovery of threatened and endangered Columbia and Snake River salmon and steelhead. Specifically, the intention of the RPAs is to collect data for the purpose of potential estuarine habitat recovery and restoration.

Project Description

A. Background

Pacific anadromous salmonids have several distinct life stages, each posing their own characteristic ecological requirements. Unique for anadromous species are the transition phases from fresh- to saltwater existence for ocean going smolts, and the reverse course for returning adult migrants. Recently studies on movement patterns and timing, habitat use, and linkages between estuary survival and year class strength have highlighted the potential importance for estuary survival for juvenile life stages (e.g. Budy et al. 2002). Unfortunately there has been little comparable research completed for adult salmon and their linkages with the estuarine environment is poorly understood.

Adult salmon undergo a physiological transformation to allow them to tolerate freshwater existence. It is unknown when and how quickly this transformation occurs, although it is conceivable that adult salmon may congregate in or near the estuary for periods of several days to weeks prior to ascending the river. There is also evidence that run timing into the Columbia River will vary according to river conditions, primarily temperatures and flows, as determined from trends in count data at Bonneville Dam (e.g. Quinn and Adams 1996, Robards and Quinn 2002). If so, where fish delay (ocean, plume, estuary, or river) is an important consideration. There are also questions regarding the vulnerability of ESA-listed stocks to harvest while resident in the estuary and lower river.

This proposal was developed in response to the original requests for proposals issued by the U.S. Army Corps of Engineers (CORPS) in July 2003, and addresses concerns outlined by the NWPPC in the Columbia River Basin Fish and Wildlife Program, and by NOAA Fisheries in Federal Columbia River Power System Biological Opinion issued in 2000 (which supercedes the 1995 and 1998 Biological Opinions). The proposals have been developed in consultation with personnel from the CORPS. Studies proposed for 2005 would initiate monitoring of adult movements, habitat use, and survival in the Columbia River estuary.

B. Specific Objectives for 2004:

1. Determine macro-scale temporal and spatial patterns of habitat use of the Columbia River estuarine and plume environments by adult salmon migrants.
2. Conduct monitoring to determine patterns of microhabitat use in the Columbia River estuary by adult salmon migrants.

C. Methods

The adult passage research outlined here is a cooperative effort between the University of Idaho and Oregon State University, with cooperation with the Oregon Graduate Institute, Portland, NOAA Fisheries, Lower Columbia River Estuary Partnership, Oregon Department of Fish and Wildlife, and others involved with estuarine studies.

For purposes of this study the area of interest is the Columbia River from the mouth upstream to

Bonneville Dam, river kilometer (rkm) 235 (Figure 1). Although the lower Columbia River upstream to near Bonneville Dam is affected by tide cycles to some extent, the primary area of saltwater influence (i.e. where radio signal detections would be affected) is primarily the lower 20 to 30 km of the study area, approximated to the Astoria bridge. Habitat use, movement patterns, residence times and survival for adult chinook salmon in the Columbia estuary and lower river will be assessed using acoustic and radio telemetry techniques. Fish collected in the estuary will be outfitted with acoustic and radio transmitters and monitored using an array of acoustic and telemetry receivers, as well as by mobile tracking by boat, as they migrate upstream to Bonneville Dam. Protocols for outfitting salmon and steelhead with transmitters, mobile tracking, downloading of data from receivers, recovery of information of recaptured fish, and coding of the data will be similar to those developed and used in prior years for studies for adult salmon passage at upstream locations conducted by University of Idaho personnel, and for smolt studies conducted by personnel from Oregon State University.

We propose that spring chinook salmon collected by contractual fishermen or ODFW researchers in combination with fishery evaluations would be used for this evaluation. Fish would be double tagged with a radio and acoustic transmitters to take advantage of existing monitoring arrays. Radio receivers would be placed at mouths of tributary streams and at Bonneville Dam to monitor potential points of exit from the study area. Acoustic transmitters would be compatible with existing acoustic arrays operated by OSU in the estuary or the new 420 kHz transmitters developed for the CORPS juvenile estuarine evaluations, depending on availability by spring of 2005. Broad-scale information on habitat use, time of residence in different segments of the estuary and survival would be collected using fixed acoustic and radio telemetry equipment. More detailed information on microhabitat use would be determined by mobile tracking individual fish by boat in the study area. Telemetry records would be correlated to environmental information collected during the study period. Currently we are mapping depths, sediment types and bottom features (i.e. presence of large woody debris), using side-scan sonar, for selected areas in the estuary in areas likely to be used by adult salmon. These data, and existing data collected by project cooperators, are being compiled into GIS layers, to create a comprehensive dataset of available habitat information for the Columbia River estuary. Currently we are tracking a small sample of individual adult fall Chinook salmon and concurrently collecting temperature, depth, salinity and velocity preference information that will be used to begin development of a model for adult salmon habitat use in the estuary. Data collected during 2005 would allow parameterizing and validation of the habitat preference model for adult fall Chinook salmon and steelhead.

We also propose to collect blood samples at the time fish are collected in the estuary to determine their physiological status and sexual maturity. A small volume of blood will be collected from a small subsample of fish across the run for staging of reproductive development. This will be accomplished by analysis of sex steroid hormones and vitellogenin. Staging will be accomplished following the methods of Fitzpatrick et al. (1987).

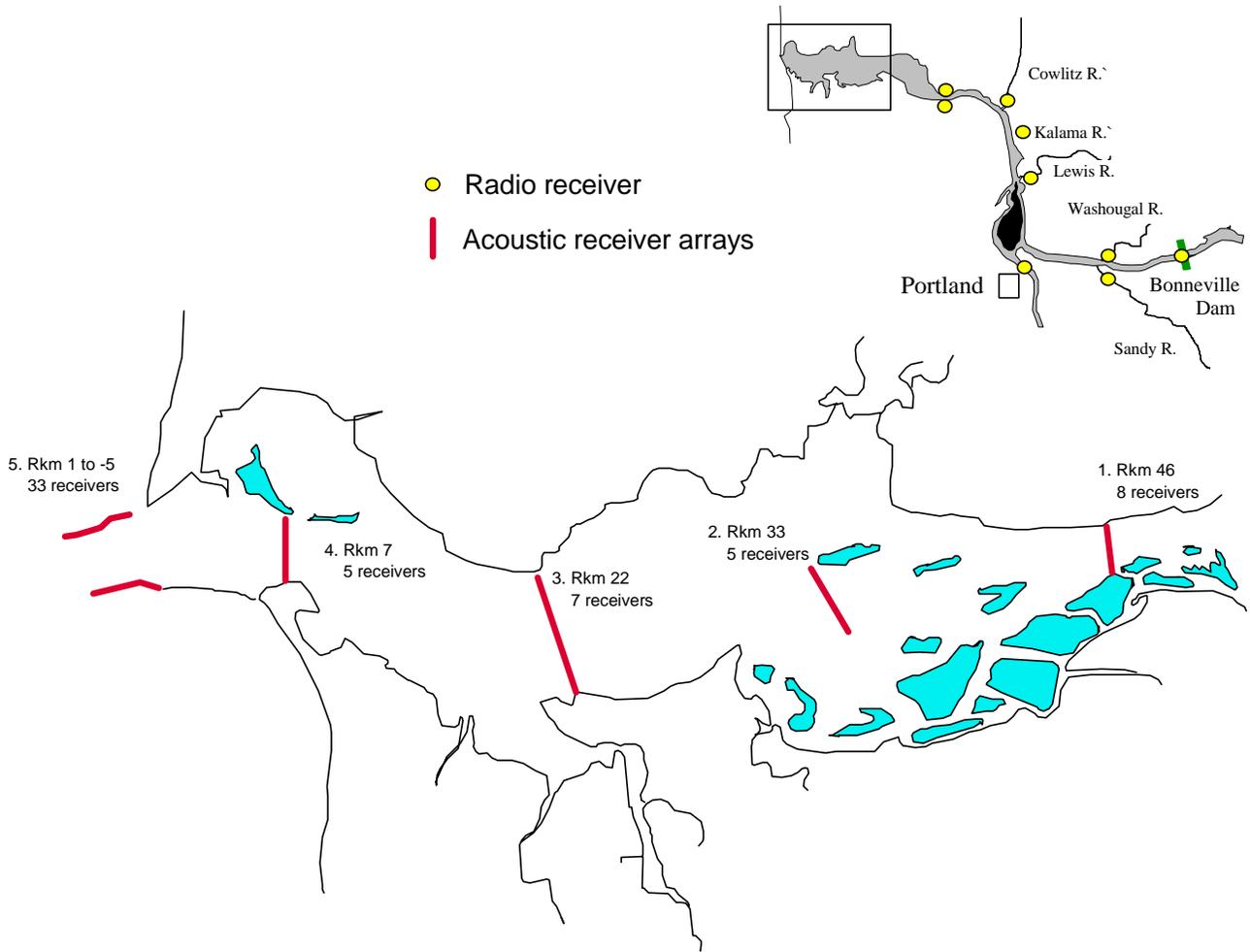


Figure 1. Columbia River estuary study area showing proposed radio receiver sites (top) and locations of acoustic receiver arrays used during 2004 smolt studies.

Studies and work planned for 2005 are listed by objective.

1. Determine macro-scale temporal and spatial patterns of habitat use of the Columbia River estuarine and plume environments by adult salmon migrants.

Large-scale patterns of habitat use in the estuary by adult salmon would be determined using fixed-array hydroacoustic and radiotelemetry receivers. Fish movements in the estuary will be monitored using arrays of acoustic receivers similar as those used in 2004 for juvenile monitoring (see Figure 1). Radio receivers will be located near Longview, WA, near mouths of major tributaries likely to contain spawning populations, and at Bonneville Dam. Actual locations of receivers to be used will be modified according to coverage needed. In this initial year of study we propose to monitor 200 fall Chinook salmon and 200 steelhead. Fall Chinook salmon will be collected using seine or tanglenets operated by commercial fishermen or by researchers in cooperation with fishery evaluations. Once collected, fish will be mildly sedated, their lengths and weights will be measured, and a combination radio-acoustic transmitter will be inserted into the stomach through the mouth. All fish will also receive a PIT tag if one is not

already present. Tagged fish will be transferred to a small tank until sufficiently recovered to volitionally swim away from the boat. We propose to tag during the peak of the fall run (August and September) to collect most representative information during this initial monitoring effort.

Once released, serial detections on acoustic arrays will be used to monitor upstream progression through the estuary while radiotelemetry records will be used to determine fish that turnoff to tributary streams and those that reach and pass Bonneville Dam. Final fates of fish will be used to determine stock of origin for tagged salmon. Information from other sources (i.e. coincidental PIT tag detections) will be used for run reconstruction for fish tagged in the estuary. Data will be collected on water temperatures using recorders placed at various locations in the estuary, flows, tidal and moon cycles, etc., to correlate with movement patterns as determined from telemetry records. Tags returned from fisheries and anglers will be used to estimate harvest rates.

2. Conduct monitoring to determine patterns of microhabitat use in the Columbia River estuary by adult salmon migrants.

Following release, a sub-sample of tagged salmon will be tracked by boat using an acoustic receiver and hydrophone, to determine detailed information on movement patterns, and habitat use. While following individual fish we will periodically (10 minute intervals) record date, time, GPS coordinates, water depth, surface salinity and water temperatures (1 m depth). We will also record general descriptions of habitat type (e.g. deep open channel, embayment, backwater slough, wetland/marsh, etc.) Continuous monitoring of bottom features and substrate type (sonar), water temperatures and salinities (CTD) and water velocities (ADCP) will allow later determinations of conditions individual fish were selecting. Locations will be matched up with previously described GIS coverages to estimate substrate type at fish locations, if available. Additional surveys will be made to collect substrate and habitat information relative to locations used by adult salmon. Habitat preference will be determined overlaying data collected during tracking to GIS datasets compiled during 2003-2004 research activities.

D. Facilities and Equipment.

Radio telemetry receivers for the objectives outlined here will be provided from existing equipment. Acoustic receivers would be from those operated by OSU or the owned by CORPS and tested during 2004 juvenile outmigration. Computers, trucks, boats, temperature recorders, and other such equipment would be provided by researchers as needed on a rental basis.

E. References

Budt, P., G.P. Theide, N. Bouwes, C.E. Petrosky, and H. Schaller. 2002. Evidence linking delayed mortality of Snake River salmon to their earlier hydrosystem experience. *North American Journal of Fisheries Management* 22:35-51.

Fitzpatrick, M.S., J.M. Redding, F.D. Ratti, and C.B. Schreck. 1987. Plasma testosterone concentration predicts the ovulatory response of coho salmon (*Oncorhynchus kisutch*) to gonadotropin-releasing hormone analog. *Canadian Journal Fisheries and Aquatic Sciences* 44:1351-1357.

Quinn, T. P., and D.J. Adams. 1996. Environmental changes affect the migratory timing of American shad and sockeye salmon. *Ecology* 77:1151-1162.

Robards, M.D., and T.P. Quinn. 2002. The migration timing of adult summer-run steelhead in the Columbia River over six decades of environmental change. *Transactions of the American Fisheries Society* 131:523-536.