New Research Proposal

EVALUATION OF AN INSTREAM PIT DETECTION SYSTEM TO MONITOR ADULT SALMON AND STEELEHAD HOMING AND STRAYING BEHAVIOR

For:

U.S. Army Corps of Engineers - Portland District

Study Code: ADS-00-4

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A. Goals

This proposal outlines means to develop new methodology to estimate homing, straying and tributary turnoff for Endangered Species Act (ESA) listed adult salmon and steelhead migrating through the Columbia River system. We propose to evaluate the use of instream PIT-tag detectors that are compatible with equipment in place to monitor adult fish passing dams via fishways. Data from instream PIT sites would be used to estimate survival and straying rates for adult salmon and steelhead migrants in the Columbia River.

B. Project Objectives

1. Identify potential locations for instream PIT tag interrogation site(s) within the lower Columbia River.

2. Construct and install instream PIT tag detector(s).

3. Evaluate effectiveness of using instream PIT technology to record fish movements in tributary streams of the lower Columbia River.

C. Methods

In 2005, we propose to evaluate the use of instream PIT-tag detectors to monitor for fish straying temporarily or permanently into tributaries of the lower Columbia River. Research activities outlined in this proposal would be a cooperative effort between the University of Idaho and U.S. Fish and Wildlife Service. Initial activities would involve locating likely locations in the Deschutes River to establish interrogation sites that would provide representative data collection, constructing a working prototype and evaluate the effectiveness of site to detect adult salmon movements. Testing would involve outfitting radio-tagged salmon (from separate study) with PIT tags to determine detection efficiencies for fish known to have passed sample site(s) based on telemetry records and spawning ground surveys. Studies would be conducted using adult Chinook salmon and steelhead collected at Bonneville Dam as part of proposed studies to evaluate passage in the lower Columbia River.

D. Relevance

The study proposed herein addresses activities related to recovery and management of threatened and endangered salmon and steelhead migrating through the Columbia and Snake rivers, as identified in RPSs 48, 50, 107, 118, 167, and 191 in the NOAA Fisheries (previously NMFS) 2000 Biological opinion for operations of he Columbia River Federal Power System. Research activities described here would also be applicable for monitoring movements of native trout, such as listed bull trout, populations in the lower Columbia and Snake rivers.

Project Description

A. Background

Some level of straying behavior is natural in Pacific salmon populations and an important colonization and dispersion mechanism. However, in the current system, salmon staying rates may be affected by operations and management practices. For example, alterations on the lower Columbia River temperature regime may increase straying to cool water refuges during summer. Hatchery rearing, supplementation and juvenile release strategies, and transportations programs may affect homing abilities for returning adults. Clarification of straying rates is important for adjusting PIT-based escapement estimates and for evaluating 2000 Biological Opinion survival goals. Upriver (Snake, upper Columbia Rivers) stocks that stray to non-natal tributaries are considered escapement losses from natal streams and will artificially inflate escapement estimates in non-natal populations. Accurate documentation of straying, wandering and homing rates for specific stocks is necessary to reliably evaluate escapement and recovery goals for ESA listed populations. Additional concerns regarding straying include documenting harvest of listed stocks that temporarily stray into non-natal tributaries and possible swamping of small wild populations by straying hatchery stocks (e.g., Snake River hatchery steelhead that stray into the John Day River). Out-of-basin spawning by hatchery fish can directly harm local wild populations (e.g., Waples 1991; Chilcote 2003).

Currently radio telemetry is used to evaluate the degree of temporary and permanent straying of known-source salmon and steelhead. From those studies we have found evidence that some groups, such as Snake River steelhead and summer and fall Chinook salmon, will stray temporarily into lower river tributaries when Columbia River water temperatures are warm. Some of these fish will remain in the tributaries or be caught in tributary fisheries. We have also found evidence that transport history (barging) may affect straying rates for returning adult salmon. This type of information has important implications for determining escapement rates, setting harvest levels, improving and evaluating recovery strategies.

PIT tags are widely used within the Columbia River basin to assess survival and movements of anadromous salmonids. Most efforts have focused on using PIT-tag monitoring to evaluate juvenile survival indices. With advent of PIT interrogation stations in adult fishways at dams, smolt-to-adult survival values are now also possible. As the number and effectiveness of these adult PIT-tag detection systems has increases, we and other researchers have explored their utility to monitor adult salmon passage and survival indices. Although effort are underway to increased the effectiveness of fishway PIT sites to detect fish passing dams, currently, there is no accurate way to measure tributary turnoff and straying by adult salmon using only PIT tags. Fish recaptured in tributary hatcheries, at weirs, or recovered in spawning ground surveys could be systematically scanned for PIT tags, but we believe this would provide only limited data regarding straying and survival rates. Most known-source radio-tagged fish that were recorded straying in 2000-2004 did not enter hatcheries, and none were identified as strays solely by PIT tags. Evaluating straying, and other passage and survival metrics, using PIT systems instead of radiotelemetry will require development of methods to reliably monitor tributary turnoff and to differentiate between temporary and permanent straying fates.

This proposal outlines means to develop new methodology to estimate straying and escapement for adult salmon and steelhead migrating through the Columbia River system. We propose to

evaluate the use of instream PIT tag detectors that are compatible with equipment in place in dam fishways to aid in estimating straying, wandering, and escapement, for adult summer and fall Chinook salmon and steelhead returning to the Deschutes River. Studies have been underway recently developing methods to use PIT tag techniques to monitor movement patterns of coastal cutthroat and other trout populations in streams. PIT tag interrogation sites have been established in the Chinook River, Abernathy Creek, and Gee Creek. These detections sites are constructed using loops of PVC pipe that can be combined to monitor the entire width and depth of the sample streams. We believe similar installations can be developed to monitor escapement to the Deschutes River. Tasks for this study include identifying one or more locations where instream interrogation sites may be used to provide representative data, to construct and install a prototype PIT tag detector across the width of the river based on the 23 mm ISO (134 kHz) PIT technology, and evaluate the effectiveness of the prototype to detect adult salmon movements. PIT interrogation sites will be evaluated using known movements for radio-tagged salmon migrating through the lower Columbia River in associated with Adult Fish Passage Project conducted by University of Idaho researchers to evaluate new PIT-interigaton stations at Bonneville Dam in 2005. Information from instream monitors at specific index streams would be used in combination with existing detections in fishways at Bonneville, McNary dams to estimate straying, wandering and escapement levels in the lower Columbia River.

This proposal was developed in response to the original request for proposals issued by the U.S. Army Corps of Engineers (CORPS) in July 2004, and addresses concerns outlined by the NWPPC in the Columbia River Fish and Wildlife Program, and NOAA Fisheries in Federal Columbia River System Biological Opinion issued in 2000 (which supercedes the 1995 and 1998 Biological Opinions). The proposal has been developed in consultation with personnel from CORPS. Tasks proposed for 2005 would initiate evaluation of a new methodology to monitor movements and escapement of adult anadromous salmonids in the lower Columbia River.

B. Project Objectives

1. Identify potential locations for instream PIT tag interrogation site(s) within the lower Columbia River.

2. Construct and install instream PIT tag detector(s).

3. Evaluate effectiveness of using instream PIT technology to record fish movements in tributary streams of the lower Columbia River.

C. Methods

Research activities outlined in this proposal would be a cooperative effort between the University of Idaho and U.S. Fish and Wildlife Service. The study area of interest is the tributary streams in the lower Columbia River, primarily in the Bonneville reservoir where extensive straying and wandering behavior by adult salmon and steelhead has been documented. Initially we intend to focus on the Deschutes, Wind, Little White Salmon, and Whit Salmon rivers which are known straying sites in the lower Columbia River. Testing would involve outfitting radio-tagged salmon with PIT tags, or using known-source fish collected at Bonneville Dam. Fish would be radio-tagged

for a proposed evaluation of new PIT tag detectors scheduled to be installed at Bonneville Dam for 2005.

Studies and work planned for 2005 are listed by objective.

1. Identify potential locations for instream PIT tag interrogation site(s) within the lower Columbia River.

The initial step for this study will be to identify likely locations to install interrogation sites within the lower Columbia River tributaries. Deschutes River will of primary interest because of the number of fish documented to have strayed and wander into this tributary. Prime criteria for sites is to find locations that would be logistically feasible to use. Factors such as access, power, support structures, size and amount of flow, physical dimensions will all be considered. We hope to find areas in the mainstem and near the mouth of the river upstream from navigable waters but downstream from primary spawning areas. We have been in consultation with local State and Tribal biologists to determine best locations for PIT detection sites within the Deschutes River. Secondary monitoring sites could be installed at upstream locations such as Sherars Falls on the Deschutes River.

2. Construct and install instream PIT tag detector(s).

Instream PIT tag interrogation sites used for coastal cutthroat evaluations were constructed by USFWS researchers using open coil inductor loops composed of multi-strand wire strung through 4 in. diameter PVC pipe. Multiple loops are strung together to cover the entire width of stream. The largest single loop tested to date was 20 x 6 ft. A multiplex transceiver, portable computer, and power supply (AC-to-DC converter) contained in weatherproof housing completes the sites. With new multiplexers recently developed, multiple coils can be monitored at a single location to produce redundancy and indicate directionality of movement. Ideally we will select areas with a bridge, culverts, etc, that will provide a stable mounting structure and defined channel shape. Once a suitable site has been identified, we propose to construct and install detection loops across the width of the tributary river. Ideally monitoring sites will be so constructed so that the in-river equipment (loops) can be easily installed early in the spring and removed late in the fall during periods of relatively low water. We also intend that loops can be mounted so that they can use either in an upright or prone position (Figure 1).

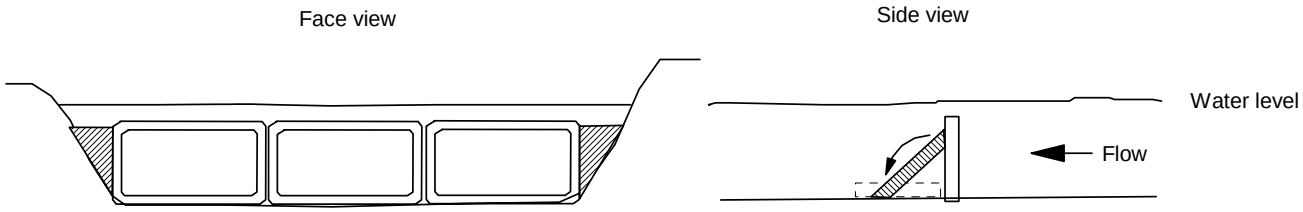

Figure 1. Illustration of potential instream PIT tag monitoring site using three detector loops to span width of river (left). Loops can be deployed in vertical or horizontal position (right),

3. Evaluate effectiveness of instream PIT detectors to record fish movements in tributary streams of the lower Columbia River.

Once detector loops have been constructed and installed we will conduct extensive testing to evaluate detection sensitivity, range, and accuracy under various operational conditions using test PIT tags including the standard 12 mm, extended read range-12 mm, 20 mm, and 23 mm tags. We will also investigate detection efficiencies with antenna loops at various positions and angles to flow.

We (University of Idaho) have proposed to collect and outfit about 100 to 200 adult Chinook salmon and 100 steelhead during 2005 to evaluate new PIT tag detectors scheduled to be installed into the Washington-shore fishway at Bonneville Dam. Many of those fish will have been previously PIT tagged as juvenile using the standard 134 kHz (12 mm) tags. Fish we collect without PIT tags will receive a PIT tag. A telemetry radio receiver will be placed with antennas positioned up and downstream from the stream monitoring site. Detections of fish known to have passed monitor site, based on telemetry records, will be compared to those recorded at the PIT interrogation site. We will also conduct extensive testing using underwater drones passed through detectors at various speeds and depths. Detection efficiencies for fish and drones will be compared to determine what combination of loop orientation produces the best detection efficiencies. Results from these tests will be used to develop regression or logistic equations whereby PIT tag detections can be converted to numbers of actual fish passed.

D. Facilities and Equipment.

Telemetry receivers and antennas needed would be from existing equipment. Trucks, computers and other equipment will be provided by researchers on rental basis.