Pre-Proposal

Evaluation of Pinniped Exclusion Devises and Deterrents on Passage of Adult Anadromous Salmonids at Bonneville Dam - 2007

Study Code: ADS-02-16

by

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Project Summary

A. Goals

Evaluate potential effects of adding barred gates, harassment measures, and acoustic deterrents intended to discourage pinnipeds on adult salmon and steelhead passage at Bonneville Dam. We will also assist U.S. Army Corps of Engineers (USACE) biologist with sea lion evaluations as needed.

B. Objectives

1. Evaluate effects on adult salmon entrance use and passage with pinniped exclusion gates in place and while testing other deterrents using radio telemetry.

2. Provide assistance to USACE biologists with pinniped evaluations and operation of acoustic deterrents.

C. Methods

We propose to evaluate potential effects of modified entrance gates on adult salmon passage at Bonneville Dam using radiotelemetry. This technique is intended to measure different aspects of salmon and steelhead passage behavior and performance with the sea lion exclusion devises (SLEDs) gates in place during April-June, during which acoustic deterrents and harassment measures would be evaluated using blocked treatments. Effects of SLEDs will be determined by comparing information collected by monitoring 300 to 400 radio-tagged Chinook salmon to similar information collected during previous years. An alternative method for this evaluation would use a paired-block treatment test that would allow direct comparison of effects of SLED gates. In previous years, we have assisted USACE biologists observe sea lion predation behavior and with testing of acoustic deterrent devices. For 2007, we propose to continue with those activities.

D. Relevance

Because of the endangered status of many Columbia River salmonid populations, there is concern that the concentration of fish at dams may inflate losses from pinniped predation. As sea lions have habituated to Bonneville Dam, they have increasingly foraged near fishways. In 2005, sea lions began foraging in the fishways as high as the count windows. In addition to potential increased mortality, the presence of piscivores in the fishways may deter salmon and steelhead from entering the fishways. Therefore, there is an immediate need to develop means to exclude pinnipeds from fishways at Bonneville Dam but still allow free movement by salmon and lamprey. The proposed study relates to actions discussed in the 2005-2007 Implementation Plan for the FCRPS Endangered Species Act Updated Proposed Action. Specifically, under Section V. B. Predator Control RM&E Actions, it states, “The Corps will conduct evaluations of the effectiveness of harassment effort, acoustic deterrent systems, and sea lion excluder devices to determine their effectiveness.” And that “Effects on migrating salmonids and lamprey will also be needed to ensure that the excluders are not negatively affecting passage.”

Project Description

A. Background

Sea lions and other pinniped species were historically present in the lower Columbia River, especially during peak salmon migration periods when salmon were readily consumed by adult pinnipeds. With the addition of Bonneville Dam, however, there is concern that the concentration of all salmon migrants at a few migration routes (fish ladders) may make these fish, many from ESA-listed populations, more vulnerable to predation from pinnipeds. In recent years, sea lions and harbor seals have become common in the vicinity of the tailrace area of Bonneville Dam. By conducting systematic surveys, USACE biologists have been able to document salmon predation by pinnipeds in the immediate vicinity of Bonneville Dam tailrace, and that pinniped predators have been consuming an increasing proportion of the salmon run over time (Stansell 2004). As sea lions have become familiar with (habituated to) Bonneville Dam, a few individuals have even ventured into salmon fishways, placing them in the direct route of fish passing the dams. Many fish species are well known for their predator-avoidance behavior (Brown 2003). Salmonids, in particular, have been known to be sensitive to changes in water chemistry when predators are present. In addition to direct predation pressure, pinnipeds can have indirect impacts on salmon behaviors, including fish passage delay or avoidance of fishway entrances when sea lions are near.

During 2005, active hazing and acoustic deterrent methods were tested as means to persuade pinnipeds to leave the fishways, but there was an immediate need to develop an effective and permanent method to exclude pinnipeds from entering fishways at Bonneville Dam. One method is to add barred gates to fishway entrances that would block pinniped access. An initial design installed during 2005 at the four main entrances at Powerhouse II (two each on the north and south ends) used circular vertical bars with 16 inch gaps. A blocked paired-treatment test was initiated in June of 2005 to investigate the effects of the gates on adult salmon passage. Four-day blocks, consisting of 2 d each with and without the gates in place, were used during which radio-tagged Chinook salmon were monitored as they passed the dam. However, significant cracks in the gates were found after 4 blocks were completed and the test was discontinued. It is thought that turbulence from water passing around the round bars, and the resulting strain and vibrations, caused the cracks to form. For 2006, USACE engineers developed a new design for the SLED to eliminate structural problems that occurred during 2005. The newly designed gates were installed early spring 2006 at all the main fishway entrances at Bonneville Dam although open floating orifice gates and sluice gates were not covered. We also added new acoustic deterrents at key locations in the tailrace of the dam in and near fishway entrances. Acoustic deterrents and harassment was again used to discourage sea lions from the vicinity of fishway entrances. In 2006, the adult spring Chinook salmon run arrived later than average at Bonneville Dam. Preliminary analysis of data from 2006 indicated fish were not significantly delayed passing the project once they began passing the dam in reasonable numbers. We are currently conducting final analyses to evaluate the effects of the different sea lion deterrent methods on salmon migrant performance during 2006.

It is critical that any modifications to the fishways or management actions to deter sea lions do not interfere with use of the fishways by adult migrating salmonids. This proposal is intended

to evaluate potential effects of modified fishway entrances and other deterrent measures to discourage pinnipeds on adult salmonid migrants.

B. Objectives

1. Evaluate effects on adult salmon entrance use and passage with pinniped exclusion gates in place and while testing other deterrents using radio telemetry.

2. Provide assistance to USACE biologists with pinniped evaluations and operation of acoustic deterrents.

C. Methods

SLED gates will be in place from late February until early June when sea lions are present. From mid March to end of May, acoustic deterrents and harassment measures will be evaluated using blocked treatments. Effects of SLEDs would be determined by comparing information collected by monitoring 300 to 400 radio-tagged Chinook salmon to similar information collected during previous years. Reactions of fish to the deterrent treatments would be evaluated using the methods described below. Preliminary analyses if data will be made weekly in-season to determine if SLEDs are affecting salmon passage.

Fish counts and PIT-tag detections of adult Chinook salmon and steelhead.

Adult salmon and steelhead outfitted with PIT tags as juveniles and migrating upstream during 2007 will be detected on readers located in the fishways at Bonneville Dam. Using PIT detections, it would be possible to relate relative ladder usage to entrance and deterrent treatment condition. SLEDs will be in place continuously and deterrents are proposed to be used in daily blocks during the period sea lions are present. If deterrent activities inhibit fish from using fishway entrances, this may be evident in the relative proportion of detections that occur at the different fishway detectors between blocks. We will compare relative passage within the season between days with and without deterrents active. There are two drawbacks to relying exclusively on PIT-tagged fish. First, no information would be available on the experience of fish downstream from the PIT-tag detection points, which encompasses most of the variation in passage behavior we have observed during telemetry evaluations. This lack of detailed behavioral information near entrances also results in the possibility of fish being assigned to the wrong treatment group (e.g., if a fish enters the fishway but is not detected by the PIT-tag system until the next day). The evaluation methods will be facilitated if dam operations (i.e. powerhouse priority and spill) remain constant as much as possible to avoid confounding results. Relative proportions would be compared to previous years using Chi-square analysis. It is expected that gates will be installed sometime during the early spring 2007. Second, we know from pervious research that route selection can be highly ESU-specific (Keefer et al. 2006). That is, fish from the Snake River Basin tend to use the south shore ladders more so than fish from the Yakima River or Mid-Columbia River. If the relative proportion of PIT-tagged fish from these different ESUs changes between years, any comparisons of ladder use between years could be

biased. We will check for route preference among stocks, but fortunately, this effect appears to be minimal at Bonneville Dam.

Similar to analyses using PIT detections, visual counts of adult Chinook salmon will be inspected for indications of effects of harassment techniques. Visual counts from the Washington-shore fishway and proportional use of the Washington and Bradford ladders will be compared between days with and without harassment measures using Chi-square analysis. We will also compare daily ladder visual count ratios to counts from previous years for periods with similar flow and spill levels to look for potential effects of SLEDs on passage behavior.

Based on PIT-tag detections from past years, there should be sufficient numbers of PIT-tagged Chinook salmon passing Bonneville Dam (>10 per day per ladder) to allow an evaluation from about mid-April. There is no evaluation planned for the period after the sea lions leave at this time. Currently, we can not calculate the detectable effect size because this value is dependent on variability of relative ladder use within and among blocks. However, we expect that only a relatively large impact to passage (>20% difference in ladder preference between treatments) will be detectable given the constraints of the PIT systems.

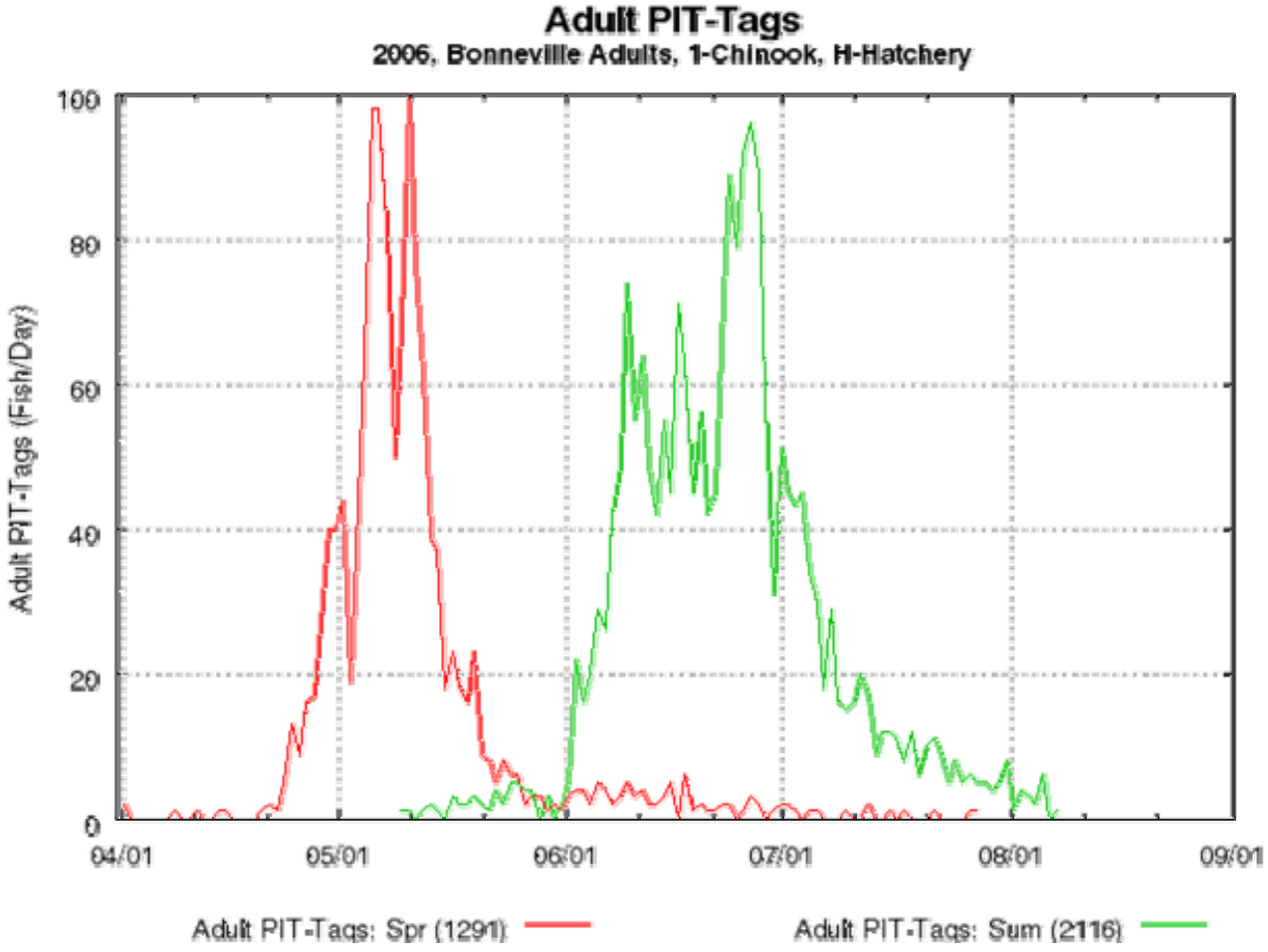

Figure 1. Counts of PIT-tagged adult spring and summer Chinook salmon detected in fishways at Bonneville Dam during spring and summer of 2006.

Behavior of radio-tagged adult Chinook salmon.

Method 2 calls for comparing radio-tagged adult Chinook salmon as they approach, enter, and ascend fishways at the dam with SLEDs in place and with and without deterrents methods active. Fish would be collected at the Adult Fish Facility trap, Washington-shore, gastrically outfitted with transmitters, released downstream from the project, and monitored using a series of receivers and antennas located in and near fishways, as in previous years. Passage indices to be measured include proportions of fish that approach an entrance, proportions of fish that approach an entrance that subsequently enter at that location, the ratio of total approaches per entrance, time to make first entrance, and fishway preference during times with and without modified gates installed. These metrics will be compared using ANOVA and time-to-event analyses. Time-event analyses will be particularly useful for radiotelemetry evaluations because the models can incorporate any changes in treatment during individual passage events described above, control for missing data (e.g. individuals which are detected, but do not pass), and statistically control for environmental variability on hourly time scales. SLEDs will be in place continuously during the spring migration and it has been proposed that acoustic and harassment deterrents will be alternately active and idle on a daily pattern. We propose to release 5 fish per day during the spring migration period, or approximately 240 to 360 fish to be tagged. Effects of SLEDs will be assessed by comparing data from springs of 2003 and 2004 to those collected during 2006 and 2007 during periods without deterrents using passage metrics described above.

Evaluating fish behavior with radiotelemetry would overcome the two problems associated with only using PIT-tag data. Much more detailed information would be gathered regarding fish behavior prior to entering the fishway. Ladder avoidance (due to presence of pinnipeds or to the ladder modification) would likely only be evident prior to ladder ascension. We can also tag spring Chinook throughout the run, rather than relying on previously PIT-tagged fish. This should result in tagged fish that are more representative of the run as a whole.

We propose to use 300 to 400 radio-tagged Chinook salmon for this evaluation. Fish would be collected and tagged with radio transmitters at the AFF, transported downstream, and monitored as they approach and pass the dam. Telemetry coverage for this objective will be similar as used in 2006, receives with aerial antennas will be used in the tailrace of the dam, receivers with underwater antennas will be used to monitor all fishway entrances, and exits, and transition pool areas in fishways. A minimum number of receivers will also be operating at The Dalles Dam (tailrace, main fishway entrances and exits) to verify fish that have passed Bonneville Dam and for other potential monitoring tasks.

University of Idaho personnel have assisted observe pinniped presence and behavior at and near Bonneville Dam and with installation and operation of acoustic deterrent systems. Durign 2007 we propose to continue assisting with these activities.

D. Facilities and Equipment

We will use existing equipemnt (either University/Agency-owned or already-funded by USACE) for most aspects of this work. Other necessary equipment (vehicles, computers, tools, etc.) will be provided by University of Idaho on a rental basis as needed. Crane support will be

needed to install equipment. UI can provide crane, certified crane operator, and rigger if required.

E. Impacts of study on USACE projects and other activities

Assistance from project personnel will be required as follows:

1. Logistical support to install and remove entrance gate modifications at night or early mornings on pre-set schedule. (UI can provide if not available from USACE).
2. Access to Bonneville fishways will be needed to install and maintain telemetry and deterrent equipment during April and May.
3. Installation and removal of gates will be coordinated so as to minimize disruptions to normal fishway operations and ongoing lamprey research proposed for 2007.

Biological Effects:

Radio-tagged fish would be delayed in their dam passage by approximately 1 d. No other biological effects are expected from the proposed studies. We anticipate less than 0.09% mortality of study animals from collection and radio tagging activities.

Key Personnel

Project planning, administration, reporting:
C. Peery, U of I
David Clugston, Robert Stansell, COE
B. Burke, NOAA Fisheries

Equipment specifications and purchase:
K. Tolotti, U of I

Fish tagging and release:
S. Lee, U of I

Data processing, analysis and writeup:
C. Peery, M. Jepson, D. Joostn, UI
B. Burke, NOAA Fisheries
B. Stansell, COE

Technology Transfer

Information and analyses from this study will be provided to managers via email reports and verbal presentations and as a written summary.

References

Brown, G.E. 2003. Learning about danger: chemical alarm cues and local risk assessment in prey fishes. Fish and Fisheries 4:227-234.

Keefer, M. L., C. C. Caudill, C. A. Peery, T. C. Bjornn. 2006. Route selection in a large river during the homing migration of Chinook salmon (*Oncorhychus tshawytscha*). Can. J. Fish. Aquat. Sci. 63:1752-1762.

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