

PRELIMINARY PROPOSAL

For Study Code ADS-P-02-16 to the US Army Corps of Engineers (FY07)

Evaluation of California Sea Lion (*Zalophus californianus*) and Other Pinniped Predation in the Bonneville Dam Tailrace

Project Leader:

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Anticipated Duration:

February through June 2007

August 15, 2006

Project Summary

Goals:

The goal of this evaluation is to determine the impact California sea lions (*Zalophus californianus*) and other pinnipeds, have on salmonid (*Onchorhynchus* sp.) and lamprey (*Lampretra tridentata*) populations migrating through the Bonneville Dam tailrace and evaluate effectiveness of deterrent management actions employed. Level of hazing to be conducted is the maximum level established at the project according to policy guidance from Northwest Division and Portland District.

Objectives:

1. Determine seasonal timing and abundance of sea lions present at Bonneville Dam.
2. Estimate pinniped predation on adult salmonids and lamprey in the Bonneville Dam tailrace.
3. Identify individual sea lions at Bonneville Dam, determine whether they return in subsequent years, and their haul out areas.
4. Evaluate impacts that deterrent actions including exclusion gates, acoustics, and harassment on pinnipeds at Bonneville Dam may have on predation rates and abundance of pinnipeds in the tailrace.

Methodology

Surface observations for 2006 will occur seven days a week (two to five days a week before March 5) for most daylight hours at all tailraces where sea lions are observed. All observations will be during daylight hours, since that was when all observed feeding activity occurred in previous years. Observations will occur at each of the three tailrace channels below Bonneville Dam. Information recorded will include date, time of day, numbers of sea lions present, location, observed behavior (feeding, swimming, resting, etc), individual pinnipeds present (if known), and number of salmonids, lamprey, and other fish consumed and lost. In addition, specific locations, such as within 100' of fishway entrances, will be recorded documenting sea lion presence and feeding when gates, acoustics, and hazing deterrents are in place. Acoustics at all main fishway entrances will be turned on and left on from early February through the end of May. If funding permits, active non-lethal hazing may also occur from early February through the end of May during all hours of daylight, 7 days a week, at all three tailraces. Sea lions typically bring an adult salmon to the surface to rip it apart before eating it, making successful predation visible for large prey. However, exactly where the fish was caught before the sea lion brought it to the surface can only be inferred. We can also estimate the percentage of salmonids caught but subsequently lost. Video-camera recordings will be taken to verify some of these observations. When possible, individual sea lions will be identified, documented (specific markings) and compared to individuals seen in previous years. Video-camera recordings will also be taken to back up the observations of individuals.

If possible, an attempt will be made to coordinate contracted USDA/WS agents to conduct hazing of pinnipeds off of haul out sites and near the dam in conjunction with boat hazing conducted by the states and tribes. However, this is dependant upon available funding and manpower for the states boat hazing as well as for the additional effort from the WS dam hazers. The intent would be to conduct a maximum non-lethal hazing effort at the dam to see if fewer salmonids would be taken near the dam by hazing away all pinnipeds in the tailrace. The goal would be to drive as many pinnipeds as possible out of the tailrace area, and therefore reduce the amount of salmon preyed upon. Predation rates and estimates would have to be compared to previous years observations. No observations of predation below Bonneville Dam tailrace will be conducted.

Although difficult, it is possible to identify individual sea lions by markings (scars, colors, patterns, size, and even behaviors) within year at the dam, and possibly between years, if the marks have not grown over.

New marks and healing of older scars may complicate matters. Even branded and tagged sea lions were difficult to identify at times. We did not find any haul out sites for sea lions in 2002 or 2003 from Bonneville Dam down to Ives or Pearce Islands. However, in 2004 several sea lions were seen to haul out on the spillway ogee's before spill began. In 2005, several animals were seen to haul out on several spillway ogees, the rangers' courtesy dock below the new navigation lock, and on the concrete apron to the new corner collector in the powerhouse two tailrace. We will continue to document new haul out sites seen and work with USDA/WS personnel to haze them off when possible. Boat hazers from the states documented sea lions up into Hamilton Creek and in the Ives Island area feeding on salmon. A NMFS technical memo (NMFS, 2001) states that sea lions following fish into fresh water rivers do not always need haul out points during the fish run, and in fact we see them "raft" up at times, resting in the dead water locations such as powerhouse one tailrace. Harassment of these "rafts" will also occur if within distance of our land-based harassment efforts.

Relevance

Marine mammals naturally feed upon salmonids, both in the ocean and in the lower Columbia River. California sea lions have been reported in the tailrace of Bonneville Dam almost every year since at least the 1980's and Lewis and Clark documented hundreds of harbor seals at Celilo Falls in 1805. These pinnipeds are likely taking advantage of the situation imposed by impoundments, which concentrates salmonids as they search for fishway entrances, although we have no data from other sections of the river with which to compare. Salmonids typically take about a day to pass Bonneville Dam once they enter the tailrace area (Bjornn et al., 2000). This concentration and delay of salmonid passage may allow sea lions to inflict higher losses on the salmonid population than would be the case in the free flowing portion of the river below Bonneville Dam. Increasing numbers of California sea lions feeding directly below Bonneville Dam have been estimated to take over 3,500 salmonids of the January 1 to May 31 salmonid run (Stansell, 2004). In 2005, a much smaller spring Chinook run than anticipated presented itself and the sea lions were estimated to have taken 3.4% of that years run. The figure for 2006 was just over 3,000 salmon, which comprised about 2.8 % of the run. Each year the sea lions have been arriving earlier, staying later, eating more fish (until 2005), eating more lamprey, hauling out more, staying for longer periods, and the average number present per day has increased. In 2005 at least eight different sea lions learned to enter the fishways, with one individual being seen at one or both count station windows every day but one from March 11 through March 31. Efforts of active hazing, acoustic deterrents, and Sea Lion Exclusion Devices (SLEDS) in 2006 showed pinniped presence near fishways could be reduced, but overall predation in the tailrace was not affected (in fact, it was actually higher than when no hazing occurred). The SLEDs were 99% effective in keeping sea lions out of the fishways in 2006. Only one animal made it past the SLEDs last spring, and only for a short time. Action is still needed to be taken to prevent sea lions from entering fishways, including bars on the floating orifice gates at Powerhouse Two. Sea lions likely take endangered and threatened stocks of salmonids in proportion to those passing the dam, and this impact could become significant if left unmanaged.

Project Description

Background

Sea lions in the tailrace of Bonneville Dam in the spring have been documented in fishway inspection reports since the early 1980's. However, increasing numbers of sea lions were observed in 2001, and the 2000 NMFS Biological Opinion for the FCRPS RPA 106 directed agencies to evaluate marine mammal predation in the Bonneville Dam tailrace. The Corps Fisheries Field Unit conducted this work in 2002-2004. Additional observations were made in 2005 after sea lions began entering the fishways and hauling out at multiple locations during daylight hours. The additional year of observation was warranted after it became evident that the predicted 250,000 spring Chinook were not going to show up, the final run being about a third of that estimate. In 2006, active and passive hazing techniques were tested with negative results.

Data from 2002 through 2005 (Stansell, 2004; Letter Report, 2005) showed the sea lions arrived earlier and stayed later each year, stayed for longer periods, increased in the average number seen per day, increased the percentage of the salmonid run taken, increased the proportion of lamprey in their diet, increased their catch efficiency (decreased percentage of fish caught then lost), increased their predation activity in the spillway tailrace, and an increase in the level of “boldness” concerning haul out sites and entering of fishways. An estimated 3.4% of the salmonid run from January 1 through May 31 was taken by pinnipeds below Bonneville in 2005 (about 3000 salmonids). Fewer total number of salmonids were estimated to be taken in 2005 compared to 2004 (2,920 and 3,533 respectively), however this was more than for 2002 and 2003, all years having much higher salmonid runs than 2005. In 2006, just over 3,000 salmonids were taken, or 2.8% of the run.

Over 100 individual pinnipeds were identified in 2003 and 2004, averaging 27 present per day in 2006 with a maximum of 46 at the project in one day. Most fish are caught in the powerhouse two tailrace, followed by powerhouse one and the spillway tailrace. The most salmon any one individual sea lion was seen to consume in one day was 10, and 52 total for the season for the same individual. In 2002, we observed 61 (11%) salmonids being caught and brought to the surface by sea lions then subsequently lost, but this steadily decreased each year to 0.8% in 2005. The percentage of returning individuals ranges from between 42% to 81%.

Pacific Lamprey (*Lampretra tridentate*) made up 18% (by number) of the observed diet consumed by pinnipeds in 2005. Roffe and Mate, (1984) discovered that the most abundant food item in seals and sea lions near the Rogue River were Pacific Lamprey. Since lamprey populations in the Columbia River Basin are in decline (Jackson et al., 1996), it could be that marine mammal predation is increasing on salmonids. In 2006, 264 sturgeon were observed taken in the Bonneville Dam tailrace, all but one caught by Steller sea lions. This made up 7% of all fish observed taken in 2006.

Objectives/Methodology

Objective 1: Determine seasonal timing and abundance of pinnipeds present at Bonneville Dam.

Observations at Bonneville Dam tailrace will begin in February and continue until sea lions are no longer consistently present (last week of May to first week of June). Surface observations will occur during daylight hours only (as 2002-2003 observations revealed no predation at night) on at least five days each week. Observations will occur for several hours (between 8 and 15) at each of the three tailrace channels below Bonneville Dam. Information recorded will include date, time of day, numbers of sea lions present, location, observed behavior (feeding, swimming, resting, etc.), individual pinnipeds present (if known), and number of salmonids and lamprey consumed and lost. Video-camera recordings will be taken to verify some of these observations. When possible, individual sea lions will be identified and markings documented. Video-camera recordings may also be taken to back up the observations of individuals.

Objective 2: Estimate pinniped predation on adult salmonids and lamprey in the Bonneville Dam tailrace.

Observations will occur as for Objective 1 and specifically the number and species of prey observed consumed and lost will be noted. Estimates of the amount of salmonids and lamprey consumed by sea lions across the season will be made by taking actual hourly predation observed and expanding for any daylight hour not observed based upon the hourly distribution of catch at the end of the season. Estimates for days missed will be simply extrapolated for by adding the estimates for the two adjacent days and dividing by the number of days not observed. The period of January 1 to May 31 will be used as the run period for salmonids as the arrival and departure dates for the pinnipeds has been expanding, mostly by arriving earlier, and this makes yearly comparisons consistent. This may change to June 15, as that became the official end of the spring Chinook run season in 2005.

Objective 3: Identify individual sea lions at Bonneville Dam, determine whether they return in subsequent years, and their haul out areas.

The Fisheries Field Unit (FFU) determined that sea lions could be identified to individuals in 2002, albeit with some difficulty, by using scar patterns, marks, color, size, and even behavior for the majority of sea lions observed. This, supported by those marked by ODFW at Astoria, will allow us to determine how many different individual sea lions are present in each tailrace, at the project, and across the season. It will also help us determine how many salmonids and lamprey are consumed by specific individuals, and the frequency and duration of occurrence of these individuals both within year and year-to-year. We will work with ODFW to document movements and sightings between Bonneville and Astoria.

Objective 4: Evaluate impacts that deterrent actions including exclusion gates, acoustics, and harassment on pinnipeds at Bonneville Dam may have on predation rates and abundance of pinnipeds.

An evaluation of the average daily numbers of pinnipeds present and predation rates in the Bonneville tailrace with active harassment, acoustics, and exclusion gates will be conducted. This will be with full time hazing and acoustics activity at all tailraces and fishway entrances. This may be conducted in conjunction with hazing from boats by WDFW and ODFW personnel. We will attempt to quantify abundance and predation estimates in the near-dam environment where these measures are assumed to be effective in pushing pinnipeds away, and compare that when these measures are not conducted. Our recommendation is to leave the exclusion gates in at all times (in the spring) at all main entrances and floating orifice gates, and conduct hazing of pinnipeds seven days per week at all tailraces during all hours of daylight from February through the end of May.

Justification of the proposed study area

Bonneville Dam is the first dam on the Columbia River upstream from the mouth of the estuary. Sea lions tend to congregate in large numbers just below the dam to feed on salmonids, lamprey, and shad (*Alosa sapidissima*) in the tailrace of Bonneville Dam in the spring. Steller sea lions have begun to prey upon sturgeon below Bonneville Dam during the winter in increasing numbers. Observations from 2002 through 2006 showed up to 100 different individual sea lions visiting the tailrace of Bonneville, as many as 46 at one time. An evaluation of marine mammal predation below Bonneville Dam was required by the 2000 Federal Columbia River Power System Biological Opinion (section 9.6.1.5.3 Action Item 106) (2000) and completed in 2002-2004. Management techniques to discourage pinnipeds from entering fishways and preying on fish near the entrances need to be evaluated to determine effectiveness and that there is no adverse impact to fish passage.

Statistical justification of the required sample size, number of tests, and replicates

This evaluation is primarily observational. The sea lion exclusion devices/gates will be installed and remain in place during the spring Chinook run. Data from 2006 showed an actual increase in predation during days of hazing and acoustics on, but fewer observations within 100' of entrances was noted. Comparison of average number of pinnipeds seen daily, predation rates, and total predation estimates will be made to previous years to determine the effectiveness of a full time hazing program.

Numbers and species and source of required fish

Not applicable.

Limitations of proposed methodology and expected difficulties

Sea lions can stay submerged for extended periods of time and this may impact our ability to accurately count, and determine individuals. Documenting individuals with digital video will take a great deal of time and patience as they frequently surface for just a few seconds. There is often insufficient time to aim, zoom, focus, and shoot video that captures an individual's distinguishing characteristics. The reflection of the sun can cause glare that can make it hard to see features on a sea lion and cause an auto-focusing lens

to be unable to properly focus, so polarizing filters may be needed. Lighting conditions make coloration appear to change on the same individual. Small prey such as lamprey, jacks, or smolts can be consumed without the sea lion surfacing. If sea lions consume smaller prey while underwater, we may underestimate the total number of those species consumed by sea lions at Bonneville. Individual markings/brands used by ODFW have various degrees of visibility when sea lions are in the water feeding below Bonneville. As always, human error and differing levels of observational skill may play a part in the variability of data collected, but this will likely not be significant.

Expected results and applicability

It is expected that the physical barrier gates will keep all but the smallest or most determined sea lions out of the fishways, but it may increase predation at the fishway entrance if fish hesitate before passing the gates longer than without the gates present. The acoustics may create a safety zone around the entrance gates that will not hinder fish passage but should deter sea lions from hunting within 30-100 feet of the entrances. Harassment of sea lions seen in the tailrace, near the fishways and haul out sights may convince some of the “novice” animals that prey is better hunted for somewhere other than at Bonneville, where they won’t be harassed. Better documentation of sea lion numbers and activities (feeding) below Bonneville Dam will allow for a better assessment of their impact to salmonid populations. Individual sea lions that can be identified as problem animals and repeat offenders is necessary for any potential capture or take of marine mammals by NOAA or the states in the future, if those management strategies become necessary.

Schedule

Observations of sea lions at Bonneville Dam will occur from February through June, depending upon when they arrive and leave. Information will be provided to District personnel weekly for summary update reports. A draft summary report will be written by December 31, 2006 and 2007, and a final report completed by July 31, 2008 covering both years.

Facilities and Equipment

Binoculars, image stabilizing binoculars, night-vision binoculars, spotting scopes, digital video cameras, polarizing filters, tripods, and video tape will be required to document individuals and predation activities. Observations will occur primarily from the powerhouse tailrace decks and along the fisherman’s access shoreline for the spillway for all observers. WS personnel will supply all material for non-lethal hazing, including shotguns, cracker shells, rockets, and rubber bullets. ODFW and WDFW will supply boats for hazing from the tailrace downstream. The states may deploy floating trap barges to begin to see if some animals can be lured into traps for marking, transport, or holding.

Impacts

Active hazing by WS personnel and ODFW/WDFW personnel is not expected to impact fish passage, but the increased level of noise may impact researchers conducting other studies at Bonneville Dam. WS personnel will also likely be hazing avian species in conjunction with this activity and therefore pinnipeds or avian hazing may be compromised for short periods of time. The SLED’s and acoustic deterrents have not shown any sign of impacting salmonid passage or passage of any other fish.

Collaborative Arrangements and/or Sub-Contracts

FFU personnel will work with the USDA/WS agents that will be harassing sea lions hauled out and near the dam to identify specific animals being hazed when possible. This also applies to the project for removal of entrance gate barriers.

FFU will contract about six SCA student interns to assist FFU personnel with observations of pinnipeds from February through the end of May.

FFU will continue to work with NMFS and ODFW crews marking and observing sea lions at Astoria to share re-sight data on brands between Bonneville and Astoria.

List of Key Personnel and Project Duties

Robert Stansell – Team Leader - Oversees studies design, data analysis, and report writing, participates in some observations and documentation of individual sea lions.

Biological Technicians – 2 individuals - Data collection, observations.

Student Conservation Corps personnel – 6 individuals - Data collection, observations.

University of Idaho – Sharing data near entrance gates to compare with radio-tagged fish behavior.

Matt Tennis and Robin Brown, ODFW – Providing data on observations of branded sea lions at Astoria that have been at Bonneville Dam.

USDA/WS Agents – Providing hazing of pinnipeds hauled out on the project and near fishway entrances.

ODFW/WDFW/Tribes – May provide hazing from boats below Bonneville Dam.

Technology Transfer

We plan to transfer information obtained from our analysis in the manners listed below. The information will be used by federal and state agencies, Native American Tribes, and the public to make management decisions to reduce salmonid consumption by sea lions below Bonneville Dam. Technologies that may be evaluated include digital video and digital still images to record and document individual sea lion characteristics.

1. Presentations to the Anadromous Fish Passage Evaluation Program (AFEP) in November 2007 and presentations to fisheries agencies, tribes, and the public as requested by the USACE.
2. Expected draft annual reports for 2007 to AFEP by December 2007 and a final report by July 2008 covering both years.
3. Presentations to the Army Corps of Engineers staff and study review groups.
4. Presentations at professional meetings and publication of information in peer-reviewed journals.

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