

FISHERIES FIELD UNIT
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To: David Clugston, USACE
From: Robert Stansell, USACE

Re: Summary of Pinniped Observations at Bonneville Dam in 2005; Letter Report.

The following is a summary of our monitoring of pinniped predation on fish in the Bonneville Dam tailrace for 2005. The purpose of the monitoring was to document predation levels during a low fish-run year and observe preliminary methods of keeping pinnipeds out of fishways.

Background

Pinniped activity at Bonneville Dam became a serious and very visible issue in the spring of 2005 as first one, and then several sea lions began entering the fishways, some all the way up to the count stations. In addition, the forecasted run of over 250,000 spring Chinook did not materialize, ending up about a third of the predicted number. These issues lead the Corps to implement monitoring of pinniped predation at Bonneville Dam as well as conduct some hazing of pinnipeds to chase them out of fishways and construct barriers to prevent them from entering. The Corps Fisheries Field Unit, with the help of staffing through the University of Idaho Fish Cooperation Unit and United States Geological Survey, began this work in mid-March.

Objectives

The objectives were basically the same in 2005 as in previous years except for #4:

1. Determine seasonal timing and abundance of pinnipeds present at Bonneville Dam.
2. Estimate pinniped consumption of adult salmonids at Bonneville Dam.
3. Identify individual California Sea Lions at Bonneville Dam, determine whether they return in subsequent years, and where they haul out at the dam.
4. Conduct non-lethal hazing/harassment of pinnipeds entering fishways to keep them out. Install an acoustic barrier in one fishway and determine if pinnipeds avoid and do not pass this location. Deploy sea lion exclusion devices (SLED) at one or more entrances to the fishways and determine if they succeed in keeping sea lions out of the fishways.

Methods

Methods of surface observations and data collection were the same as those used in 2002-2004 (Stansell, 2004). Limited observations began on March 18, several weeks after the pinnipeds had arrived on project, and full time observations began on April 11. Methods

of calculating estimates of fish taken differed slightly from the previous years in that earlier estimates had been based on an average percentage of hourly take distribution for 2002-2004 combined and (at least in 2004) spillway take estimated at 5% of total project take. Based on observations for this year, current, past (recalculated) and future final estimates will be made using the hourly take distribution of that given year and spillway take estimates made directly from observations made at the spillway. Overall recalculated numbers, percentage take, and trends did not change much from previously reported figures. Take figures for 2005 are likely less than actual, as the pinnipeds were present and taking some fish before our observations began. However, to create an increase in 0.1% of the run would require about 200 additional salmonids to have been taken before our observations began, which is about what was taken in that timeframe for 2004, and during 2005 fewer fish were present during this time.

Hazing and harassment of sea lions that entered fishways began on April 13 and continued through the season. Above water pyrotechnics were used initially, with rubber bullets being added to the efforts later in the season. Additional hazing/harassment was conducted by NMFS, WDFW, ODFW, and Corps personnel on May 5, 6, 17, and 18 in the tailrace of Bonneville Dam, from shoreline and boats, in an effort to see if sea lions could be chased away from fishway entrances and kept out of the tailrace by these means. These means included above water pyrotechnics, rubber bullets, and underwater pyrotechnics. Four SLED's were designed and built rapidly, but as they were installed the week of May 30, the sea lions were mostly gone by then. Three acoustic projectors, loaned to us by NMFS from Ballard Locks, were deployed on April 21 in the junction pool to the Washington shore ladder. These projectors emitted a 205 decibel sound in the 15 kHz range.

Results and Discussion

California sea lions (*Zalophus californianus*) were noted at Bonneville Dam from February 20 through June 3 with a single sighting on January 21 and June 10. This is a little earlier and about a week later than previous years. A sea lion was first seen in a fishway on March 11, and the last on May 20, with one or more sea lions seen one or both fish count station windows in all but one day from March 11 through March 31, when fish counting began and the window crowders were moved, narrowing the opening.

Pinniped Abundance Estimates

As mentioned in the methods, we did not begin to continuously observe pinnipeds until early April, missing at least a months worth of observation. As most pinnipeds arrive multiple times within a year, this is not a big concern, but the actual number is likely higher. Based on the days we did observe in 2005, at least 83 individual California sea lions, 3-4 Steller sea lions (*Eumetopias jubatus*), and 1 harbor seal (*Phoca vitulina*) were observed. This compares to 30 California sea lions in 2002, 110 in 2003, and 102 in 2004. It would be fair to say that numbers this year were similar to the previous two years, considering the late start of our observations.

Almost 60% of the highly identifiable California sea lions seen in 2004 were seen again in 2005. This is the same as we saw returning in 2004 from 2003.

Predation Estimates

Although the estimated number of salmonids taken was less than last year (see Table 1), the percentage of the run taken (January 1 through May 31) was higher at 3.4%. This is primarily due to the fact that much fewer salmonids passed Bonneville Dam than in the previous three years. Again, we did get a late start in monitoring pinniped predation, missing about a month of activity, but in 2004 about 200 salmonids were estimated to be taken during this time period, and fewer fish were present in 2005 to be taken, so we feel this estimate is within 0.1% of the actual take. In the previous two years, pinnipeds were taking relatively large numbers of salmonids before the peak of the salmon passage was occurring at the dam. This would seem to indicate that pinnipeds do not necessarily take more fish when more fish are present and fewer fish when fewer fish are presents in proportion to the run, but rather trying to take fish as they can get them. In other words, the sea lions are consuming fish at a relatively steady rate irregardless of run size. Alternatively, if huge numbers of fish were present below Bonneville, the pinnipeds would likely catch a higher total number of fish, but only to some point of saturation, and the percentage of the run taken would be much less.

It needs to be kept in mind that all these estimates and figures are for observed take in the immediate vicinity below Bonneville Dam, and that predation is occurring all the way down to the mouth of the Columbia River at an as yet unknown level, as anecdotally mentioned by hundreds of sport and commercial fisherman. It is likely that Bonneville Dam presents a “choke point” of some degree for fish passage and that these roughly 100 or so sea lions have learned to capitalize on this situation. However, it is not known whether or not that if these 100 sea lions were excluded from the immediate vicinity below Bonneville Dam they would increase their efforts elsewhere to still get as many fish. It must be remembered that these predominately male California sea lions are fattening up for their trip to southern California breeding grounds, where the successful large breeding males will not feed for a month or two while breeding. They may go after different, easier prey such as lamprey or shad, or target more heavily the sport anglers who have already hooked a salmon. Might they actually take more salmon as they use up energy having to work harder to find and chase their prey? Without further studies to gather this information, we will never know beyond speculation.

More lamprey were taken this year than previous years and about the same number of shad as before (Table1). Since lamprey and shad are smaller prey and can be eaten quickly or swallowed whole, it is likely that these numbers are greatly underestimated. It was interesting to note that for the last two to three weeks in May the sea lions were feeding almost exclusively on lamprey and shad even though over a thousand salmon a day were passing the project and a sturgeon was observed taken for the first time at Bonneville.

Other Behaviors Observed

Although one sea lion was seen in a fishway entrance last year, this year one sea lion was seen up to the fish count station windows at one or both ladders every day but one from March 11 to March 31. By the end of the season, at least eight different sea lions were

seen to have learned to enter the fishways. In addition, last year several animals began to haul out on the spillway ogees at a couple of south end spill bays before spill began, usually at night or early morning. However, this year, not only were they seen to haul out at multiple spill bays at all hours of the day, but they were seen to haul out on the rangers boat dock below the navigation lock and on the concrete apron to the corner collection on Cascades Island.

This progressive boldness of sea lions behavior to begin to “take over” an area is common and may become more of a problem in the future if they are not given negative reinforcement to discourage those behaviors as soon as they begin. It is strongly recommended that sea lions be chased off of haul out sites as soon as they are seen there and prevented from entering fishways by the installation of physical and/or acoustic barriers. Physical barriers, basically aluminum gates with 16” spacings, were in place at the four main entrances to Washington shore ladder in the last week the sea lions were present, but they will need to be installed in early February of next year to see if they keep all sea lions out of the fishways. These can be removed in early June, after the sea lions have left, to allow sturgeon to enter the fishways and feed on shad or pass the dam. It may be necessary to close off the floating orifice gates to the Washington shore collection channel, if the sea lions find and use these as entrance points to the fishway. Plates and guides are set up to make this installation relatively quick, if necessary.

Hazing Activities

After meeting with representatives of NOAA, ODFW, and WDFW, it was determined that the Corps had the permission under the MMPA (1972) to use non-lethal means to harass sea lions that entered the fishways in order to chase them out. Approved techniques to employ were: above water pyrotechnics; high pressure water spray; underwater acoustics; underwater seal control devices (seal bombs); rubber bullets; rubber tipped arrows; and wrist rockets. Seal control devices were ruled out for use in the enclosed fishways, however we did implement most of the other techniques. Initially, above water pyrotechnics alone were used and did successfully chase the sea lions out of the fishways, but they or other animals would still enter the fishways later, and at least once, several pyrotechnics were used for about 40 minutes before the animal left the fishway. We then supplemented this activity with rubber bullets from shotguns (USDA/WS personnel). These had about the same effect, initially chasing most animals away, but one or two of the larger animals barely seemed to notice. High pressure water spray was attempted but the distance from the deck to the water was too far to have any effect on the animals.

Three underwater projectors were borrowed from NOAA at Ballard Locks and installed in the junction pool at the base of the Washington shore ladder, where most of the sea lion activity was observed. These devices emitted a 205 decibel, 15 kHz frequency sound underwater that did not affect salmonids or other fish passing the ladders. This basically produced an acoustic fence where the closer a sea lion got to the noise source, the louder and more uncomfortable it became for them. No sea lions were ever seen past the area where these projectors were installed, however, they were not actually tested by turning them off to see if sea lions would go up the ladder when the sound was off. Installation

of the projectors, on April 21, somewhat coincided with the arrival of greater numbers of Chinook at the dam, and it may have been that the sea lions were able to catch enough prey outside the ladders without having to negotiate a fishway. Many sea lions were seen to enter lower portions of the fishways during this time.

In conjunction with measures to keep sea lions out of the fishways, NOAA, ODFW, WDFW, and the Corps also conducted some harassment activities in the tailraces of Bonneville Dam on May 5, 6, 17, and 18. These efforts are covered in more detail in Norberg, 2005 (in prep.). Harassment measures included above water pyrotechnics, underwater seal control devices, rubber bullets, and boats (at least on May 5 and 6). The process was to initially deploy the underwater seal control devices along the face of the powerhouses, away from fishway entrances, to begin scaring the sea lions downstream. Then, the boats were used to keep the sea lions out of the tailrace area, supplemented with above water pyrotechnics along the dam or shoreline for animals that got past the boats. In general, this was successful in moving the sea lions out of the tailrace, and only a few animals returned and refused to be scared out of the area. However, as soon as the boats left or harassment from the shorelines stopped (after about 4 hours), the sea lions gradually re-entered the tailrace areas. Numbers of sea lions and predation in the tailrace areas was drastically reduced when active hazing occurred, but it was not noted how much predation may have occurred farther downstream by these animals during this time. Also, it is not known the long term effects of such a program, and if the animals may become conditioned to the harassment over time, making it less and less effective.

It was interesting that on each of the days of hazing, the number of Chinook passing the dam increased a few hours after hazing began. In fact, May 5 was the peak of the Chinook run, with over 16,000 passing that day, mostly after hazing. However, fish counts fluctuate greatly, and a controlled test would have to be set up to see if this was just a coincidence, or if there was a direct correlation. And if there was a correlation, was the effect to allow salmon to enter fishways without predators nearby, or was the effect to chase the salmon into the fishways by using underwater explosives in the tailrace?

Table 1. Summary of data for 2005 compared to the previous three years of observation. (Data are for January 1 through May 31. 2005 data collection began in mid-March)

| | <u>2002</u> | <u>2003</u> | <u>2004</u> | <u>2005</u> |
|--|-------------|-------------|-------------|-------------|
| Total Salmonid Run | 284,733 | 217,185 | 186,804 | 82,006 |
| Total Estimated Salmon Take | 1,010 | 2,329 | 3,533 | 2,920+ |
| Percentage of Salmonid Run Taken | 0.4% | 1.1% | 1.9% | 3.4%+ |
| Rate of Salmonids Taken per Hour | 0.13 | 0.33 | 0.53 | 0.42 |
| Estimated Number of Pinnipeds at Bonn. | 31 | 111 | 105 | 87+ |
| Mean Daily Number of Pinnipeds Present | 4.4 | 13.3 | 13.7 | 21.4 |
| Max. Daily Number of Pinnipeds Present | 14 | 32 | 37 | 43 |
| Number of Days Pinnipeds Present | 58 | 71 | 97 | 101+ |
| Mean Number of Days Individuals Present | 4.7 | 6.4 | 7.5 | 8.4 |
| Max. Number of Days a Pinn. was Present | 14 | 25 | 31 | 39 |
| Percentage of Salmonids Caught – Escaped | 11.9% | 9.5% | 1.8% | 0.8% |
| Percentage of Lamprey in Diet | 5.4% | 11.3% | 12.2% | 25.1% |
| Percentage of Shad in Diet | 0.0% | 3.5% | 2.0% | 2.8% |
| Additional Prey Observed Taken (all years combined): Smolts – 18, Northern Pikeminnow – 3, Small mouth bass – 2, Sturgeon – 1, Sucker – 1 | | | | |
| Catch Rate per Hour/per Location | | | | |
| Powerhouse 2 | 0.23 | 0.56 | 0.91 | 0.57 |
| Powerhouse 1 | 0.13 | 0.39 | 0.60 | 0.42 |
| Spillway | 0.02 | 0.05 | 0.08 | 0.27 |
| Total Project | 0.13 | 0.33 | 0.53 | 0.42 |
| Percentage of Individual Pinnipeds Returning From Each Year | | | | |
| 2002 | | 81% | 75% | 56% |
| 2003 | | | 59% | 42% |
| 2004 | | | | 61% |

2005

- Sea Lions arrive in late February
- 2005 Spring Chinook run late, much smaller than predicted (1/3rd)
- Sea Lion seen in one or both fish ladder/count windows 3/11-3/31
- More than one sea lion noted in base of fish ladders
- Haul outs on multiple spillways, boat dock, CC concrete apron, during daylight hours
- Met w/NOAA and States, advised to begin harassment efforts to keep out of fishways
- Hazing in fishways:
 - Above water pyrotechnics – limited short term effectiveness
 - High pressure water/hose - impractical
 - Rubber bullets – limited short term effectiveness
 - Acoustic fence (15 kHz, 205 dB projectors) – potentially very effective
 - SLED's (sea lion exclusion devices – barrier grates) – installed too late to test
- Hazing in tailrace, shoreline, boats:
 - Underwater seal “bombs” – effective at pushing sea lions out, fish and fishway concerns
 - Above water pyrotechnics – limited short term effectiveness
 - Rubber bullets – limited short term effectiveness
 - Animals returned within hours after hazing stopped
 - Fish counts consistently spiked up after hazing events, unknown cause

Concerns/Trends

- Arriving earlier and staying later each year
- Individuals staying for longer periods, spending more time at Bonneville
- Increasing numbers initially to around 100 each year last few years
- Increasing average and maximum seen per day at Bonneville each year
- Until 2005, increasing number of salmon taken
- Increasing percent of run taken each year
- Increasing proportion of lamprey in diet each year
- Increasing frequency of seeing sturgeon taken in lower Columbia River
- Increasing catch efficiency - Decreasing percentage of salmon caught then lost each year
- Increasing predation in spillway tailrace even during spill
- Increasing level of “boldness” concerning haul out sites and entering fishways