

Project Sponsors ISRP Response Report

Date: April 20, 2009

Project Number	2008-004-00
Proposer	Columbia River Inter-Tribal Fish Commission
Project Title & Brief Description	Sea lion hazing, abundance estimation, and local movements study at Bonneville Dam.
Contact Name	Doug Hatch
Contact email	hatd@critfc.org

Please see instructions for naming convention below before posting to Pisces.

ISRP Review History:

Original Narrative submission date: 11/4/08

Date ISRP Review comments were received: Needs Date here *[Insert date and paste link to comments]*

ISRP Review results: *[Check appropriate box]*

- Meets scientific criteria.
- Meets scientific criteria (qualified).
- Response requested - meets scientific criteria (qualified).
- Response requested – does not meet scientific criteria.

Response to ISRP Summary: *[Please check appropriate box and respond below in: Response to ISRP Comments]*

- The narrative will be revised and resubmitted by **(insert target date)**.
- A response to ISRP comments are provided in this document below.
[Your response should include 1) areas of agreement with ISRP comments, i.e. additional information, and/or any changes in the project scope of work and, 2) areas of disagreement, i.e. state why you believe there is sufficient data or sound science to proceed, and/or provide additional information which supports your perspective].

Response to ISRP Comments:

The intent and focus of this project is to address marine mammal predation on Columbia River salmonids. This is a new and growing impact to salmonids, particularly in the last several years. To date, most of the attention has focused on the area just below Bonneville Dam, where salmon are concentrated before they enter the fish ladders and where visual estimates of predation rates are easier to develop. However, there are anecdotal reports of extensive sea lion predation in areas below the dam that are not visible from the dam. This unaccounted for predation may be greater than the observed predation. This CRITFC project has two objectives:

1. Conduct boat-based non lethal sea lion hazing annually generally between March 1 and May 31.
2. Prototype methods to estimate sea lion predation on salmon and sturgeon in the area below Bonneville Dam that is not routinely monitored. This objective has two sub-objectives:
 - A. Track movements of individual sea lions at various spatial scales in the Columbia River using acoustic telemetry to determine their movements and potential areas of predation;
 - B. Evaluate video methods to enumerate sea lions and estimate predation in areas that are not presently routinely monitored.

The Action Agencies are required to conduct certain activities to address marine mammal predation under the FCRPS Biological Opinion (Reasonable and Prudent Actions RPAs 49 and 69):

RPA	Action Description
49	<p>Marine Mammal Control Measures</p> <p>The Corps will install and improve as needed sea lion excluder gates at all main adult fish ladder entrances at Bonneville dam annually. In addition, the Corps will continue to support land and water based harassment efforts by NOAA Fisheries, Oregon Department of Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), and the Tribes to keep sea lions away from the area immediately downstream of Bonneville Dam.</p>
69	<p>Monitoring Related to Marine Mammal Predation</p> <p>The Action Agencies will:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Estimate overall sea lion abundance immediately below Bonneville Dam. (Initiate in FY 2007-2009 Projects) <input type="checkbox"/> Monitor the spatial and temporal distribution of sea lion predation attempts and estimate predation rates. (Initiate in FY 2007-2009 Projects) <input type="checkbox"/> Monitor the effectiveness of deterrent actions (e.g., exclusion gates, acoustics, harassment and other measures) and their timing of application on spring runs of anadromous fish passing Bonneville Dam. (Initiate in FY 2007-2009 Projects)

The activities carried out under this project help fulfill these RPAs by:

- 1) RPA 49: CRITFC is conducting water-based harassment efforts to keep sea lions away from the area below Bonneville Dam.
- 2) RPA 69.1: CRITFC is estimating the abundance of sea lions below Bonneville Dam by tracking individual sea lions numbers and presence while monitoring predation.
- 3) RPA 69.2: CRITFC is monitoring the temporal and spatial distribution of sea lion predation attempts by tracking location and time of predation attempts by individual animals. In addition, the video and acoustic technologies will also track temporal and

spatial distribution of predation attempts. CRITFC is able to estimate predation rates based on the frequency of predation by individual animals.

- 4) RPA 69.3: While conducting hazing activities, CRITFC is monitoring the effectiveness of the deterrent actions used by recording location and direction of each individual sea lion encountered, the number of deterrent devices used, and the direction and location of the end of the encounter.

We appreciate the comments provided by the ISRP and below we have extracted them (in italics) regarding the three objectives of this project. Following the ISRP comments we have responded with clarifications and additional project details.

ISRP Comment #1: CRITFC Objective 1, Non-lethal hazing. *As the proposal states, non-lethal hazing has not been documented to reduce California sea lion predation on salmon and steelhead. This proposal did not convince ISRP reviewers that a continuation of hazing would be of any benefit in reducing or solving the problem. The only justification for using this approach is that problem animals cannot be removed or terminated unless previously subjected to non-lethal hazing (NOAA 2008a).*

The Action Agencies are required to conduct “harassment efforts” (which includes non-lethal hazing) under the FCRPS BiOp. Non-lethal hazing is also one of the first steps that is required by the NOAA Environmental Assessment (NOAA 2008) that supports the Section 120 Marine Mammal Protection Act (MMPA) permit authorizing the states to lethally remove specific individual California sea lions (*Zalophus californianus*). Moreover, it is the only management tool that can be used to control predation by Steller sea lions (*Eumetopias jubatus*) as a result of their threatened status under the Endangered Species Act (ESA).

The ultimate management solution to controlling nuisance California sea lions at Bonneville Dam is removal of individual problem animals or a means of excluding them from the area. Non-lethal hazing is a required action prior to removing nuisance animals—it has to be documented that an individual animal has been hazed before it can be lethally removed. Moreover, the Action Agencies are responsible for evaluating the effectiveness of deterrent actions in reducing immediate predation. This activity helps identify those animals that pose special problems and that are candidates for future removal.

The ISRP raises some interesting questions regarding the effectiveness and value of non-lethal hazing. However, these questions are not pertinent since the regulatory agency (NOAA) has determined that non-lethal hazing is a necessary action. It is analogous to putting marks on a sample of fish prior to estimating population abundance using mark/recapture techniques. One may only be interested in fish abundance, but one still must mark a portion of the population to make the abundance estimate.

While conducting hazing activities a variety of observational data will be collected and reported annually in collaboration with ODFW and WDFW. The information collected on encounters with sea lions below Bonneville Dam includes location, date/time, species and if possible, individual identifications of all sea lions observed. Information on spatial and temporal distribution of sea lion predation attempts will be collected and observations on effectiveness of deterrent actions including: hazing method utilized, effects on identifiable individuals, proximity of effort to individual(s), and immediate response to hazing will be attempted. Data collected from the acoustic telemetry objective may assist us in evaluating the effectiveness of hazing. If

hazing crews can identify that an individual sea lion is acoustically tagged (generally observable), the time and location of the hazing event can be noted and matched up with telemetry data. These data may provide insight into sea lion movements before, during, and after hazing events.

ISRP Comment #2: CRITFC Objective 2b, Video monitoring. *Video monitoring is proposed, “for estimating sea lion predation outside of the Corps observation area”... and “one video system would be deployed to observe river surface activities in known areas of the river.” This is far too vague for a study design and needs a much more detailed explanation. A second video system is proposed to be deployed in the areas on/near the dam as shown in Fig. 1. Video monitoring in this area could be more efficient than by human observers, but the case is not made why this is needed. The proposal states that the main need is to survey the area outside the current observation area. Until a better survey design and rationale for such a video monitoring system is developed Objective 2 is not supported. The proposal would be improved by more detail on the technical aspects of the video system, as it is not clear how effective the system would be for observing and enumerating sea lions. The system is not ready for deployment and requires considerable research and ground-truthing before it can be applied, especially in a large river like the Columbia.*

Based on the initial ISRP response above, the exploratory nature of this study over the next year was not made clear enough in our narrative. The next year’s activities are aimed at evaluating whether the video system is sufficient to estimate predation in currently unmonitored areas. This will be done by deploying one system in one unmonitored area to see whether sea lion activity and predation events can be detected. A similar video system will be deployed at Bonneville Dam to compare video estimates with the present land-based visual estimates. This is necessary to calibrate any new system with the existing estimates.

As stated in the narrative this is a proof-of-concept objective where we have identified the need for quantitative estimates of sea lion predation. Currently, the Corps of Engineers calculates sea lion predation in the area very near Bonneville Dam using visual, land-based observations. The number of salmonids being consumed by sea lions in this visually-limited area is significant, particularly given the very small area where this predation is occurring (within ¼ mile of Bonneville Dam).

Summary of yearly minimum pinniped take observation data at Bonneville Dam.							
	2002	2003	2004	2005	2006	2007	2008
Observed minimum salmonids predation (fish take) by pinnipeds. 2006-08 are adjusted salmonids catch	1,010	2,329	3,533	2,920	3,401	4,355	4,927
Total salmonids passage	284,733	217,185	186,804	82,006	105,063	88,474	147,543
Pinniped predation of salmonids as a percentage of salmonid run size(%)	0.4	1.1	1.9	3.1	3.1	4.7	3.2
Source: R. Stansell, U.S. Army Corps of Engineers.							

There is a very real need to improve estimates of total sea lion predation throughout the lower Columbia River to further quantify the impacts of this growing problem on ESA listed salmonid stocks. Developing a portable video system that could record surface activities, day or night, at a variety of locations would be a very time and cost effective tool for estimating sea lion predation throughout the lower Columbia River. Estimating predation rates is essential in making informed marine mammal predation management decisions.

The envisioned system consists of four video cameras, a multiplexing recording system and an infrared illumination system. Additionally, a digital video play back system will be used at our lab to review records and observe predation events. The camera array includes 3 fixed focus cameras that, in concert, image a field of view spanning 300m and 150°. A programmable dome camera follows a course that surveys the field being imaged by the fixed focal length cameras at a “zoomed” focal length allowing detailed observation within the observation area. The dome camera surveys the entire observation area approximately every 10s. Images from all four cameras will be multiplexed and recorded together. This will allow a technician to review a single monitor containing images from the camera array. The infrared illumination system allows for nighttime imaging of the area. The operational concept is to image a particular reach of the Columbia River and determine the overall area being imaged. Images will be digitally recorded from the camera array. After a specified period of time (hours to days), the recordings will be reviewed at our lab.

A technician will observe images from the fixed focal length cameras looking for disturbances on the surface of the water. Once a disturbance is observed the technician will turn their attention to the image from the dome camera which will be paused when it reaches the disturbance area. The image from the dome camera should be of high enough quality to determine sea lion and fish species if the disturbance is a sea lion attack. Counts of sea lion attacks will be tallied for the period of the records. After several areas have been recorded, predation rate estimates will then be calculated by expanding these attack tallies using:

$$\bar{y} = \frac{\sum_{i=1}^n y_i}{n}$$

where:

y_i = total sea lion attacks in each of i observation areas, and
 n = total number of observation areas in each river reach.

The variance associated with this estimate is calculated as:

$$V(\bar{y}) = \frac{s^2}{n} \left(\frac{N-n}{N} \right)$$

where:

$$s^2 = \frac{\sum_{i=1}^n (y_i - \bar{y})^2}{n}$$

$$\begin{array}{c} i=1 \\ \text{-----} \\ n-1 \end{array}$$

N = total number of possible observation units in each river reach,
n = number of observation areas recorded.

During the initial years of the study system, testing will be conducted to determine the optimum size of the observation area. Recording locations will be selected and tested. Criteria for recording locations may include: sea lion activity, light direction and other imaging qualities, access, and security. Camera settings will be tested. Ground-truthing of the system will be accomplished by selecting an observation area within the area that the Corps conducts predation counts. We will compare video system derived predation rates with Corps observer rates using a t-test.

ISRP Comment #3: CRITFC Objective 2a, Acoustic telemetry. *This proposed acoustic telemetry study might provide useful data on the feeding behavior of individual sea lions (including distributional shifts with changes in dam operation changes, diurnal patterns, preferred areas, etc.) that may have some direct benefits for reducing this problem. However, the study design is way too general (i.e. only large circles on a large scale map are provided to show hydrophone arrays) to be of much use, methods are lacking (i.e., “This project will use similar methods to Wright et al. (2007)”, and description of the data to be collected is far from complete “... record data on sea lion movements and foraging behaviors, download data from hydrophones.” The coarse movements of tagged sea lions might yield some research results on home ranges of the animals. The lower river below Bonneville Dam and estuary is an open ecosystem so the boundaries for this study are arbitrary until these data are available. The home range data might also be used in conjunction with physiological data in an attempt to estimate food requirements in relation to salmon consumption (i.e., how many salmon are needed to support a sea lion).*

The intent of this objective is to collect and analyze data on California sea lion movements at a fine and course scale. This information will be useful for designing a specific video sampling and predation estimation system, should the technology prove viable. The fine scale movements will be monitored from Bonneville Dam to approximately 6 miles downstream. In our original proposal we provided a map with possible hydrophone locations and potential ranges. These estimates take into account the desire to listen for transmitters in as much of the 6 mile area as possible but are also subject to logistical constraints, thus the general circles on the large-scale maps. Constraints include impacts to hydrophone performance in areas with water conditions such as high turbulence and entrained bubbles as well as constraints due to commercial and pleasure boat navigation. Actual deployment locations will be impacted by these factors and range tests will be conducted to determine actual listening areas. A map with specific deployment locations and fields of coverage will be prepared when the testing phase is complete. Course scale movements will be monitored at hydrophone array locations deployed by another project (BPA project 2007-401-00). In general these arrays are located at RM 85, RM 35, and RM 2. Detections at these arrays will provide insight into sea lion movements from the estuary and/or ocean. Travel times will be calculated and time spent occupying these areas of the river will be determined. This information is important in estimating actual abundance of sea lions below BON, spatial/temporal distribution and predation rates.

Analysis of the fine scale movement data could yield insight into affinity of individuals to particular feeding locations, number and duration of feeding events in a given day, nocturnal movements and feeding, and assist in determining the amount of activity that may be occurring outside the COE visual observation area. Wright et al. (2007) used similar hydro-acoustic telemetry techniques to infer foraging behavior of harbor seals in the Alsea River, Oregon. By plotting tag detection locations as a function of time in the Alsea River (Wright et al. 2007) determined that seal predation on salmonids was substantial, occurred in the river, mostly at night by a relatively small proportion of the local seal population.

All of this information will assist in enumerating the impact sea lions are having on ESA listed salmonids. In addition, acoustically tagged individuals could be used to evaluate the efficiency of visual and video enumerations by comparing the observation data to the known presence of tagged individuals. These data may also lend to the evaluation of hazing activities.

Reference:

Wright, B.E., S.D. Riemer, R.F. Brown, A.M. Ougzin, and K.A. Bucklin. 2007. Assessment of harbor seal predation on adult salmonids in a Pacific Northwest estuary. *Ecological Applications*, 17(2).