



# Oregon

Kate Brown, Governor

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October 30, 2015

William W. Stelle, Jr.  
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Dear Mr. Stelle,

This letter summarizes activities conducted under the Marine Mammal Protection Act Section 120 lethal removal authority granted to the States of Oregon, Washington, and Idaho by NOAA Fisheries on March 15, 2012 to reduce California sea lion (CSL) predation on threatened and endangered Columbia River salmonids. The following information comprises our annual report to NOAA Fisheries documenting compliance with the Terms and Conditions of the 2012 Letter of Authorization (LOA) for activities conducted during the 2015 field season.

#### Terms and Conditions Nos. 1 and 2

The States captured and intentionally removed 32 predatory CSL from April 7 to May 20, 2015. Appendix 1 of the 2012 LOA provided a list of CSL that had previously met the criteria for permanent removal. Working with the U. S. Army Corps of Engineers (USACE) observation program, the States requested the addition of a total of 68 new CSL that had met the criteria for removal during the 2015 field season (letters from Brown to Stelle dated 4/17/2015, 5/8/2015, and 5/22/2015).

#### Terms and Conditions No. 3

By intentionally removing 32 predatory CSL, the States did not exceed the limit of taking no more the one percent of the current PBR (92 animals) in 2015.

#### Terms and Conditions No. 4

As required, the States consulted with our Institutional Animal Care and Use Committee (IACUC) prior to conducting work during the 2015 field season. Certain committee members

monitored our activities throughout the season and some individual members of the committee participated in the capture, transfer, medical screening, and post-mortem examinations of sea lions taken under the LOA. We will again consult with the IACUC early in 2016 to discuss activities planned for the next field season.

#### Terms and Conditions No 5.

As stated above, the States captured 32 CSL in 2015 that had met the criteria for permanent removal. Two of these animals were sent to pre-approved permanent holding facilities while the remaining CSL were chemically euthanized in accordance with protocols approved by the IACUC.

#### Terms and Conditions Nos. 6 and 7.

Firearms were not used to remove predatory CSL. Retrieval of carcasses from the water was not required.

#### Terms and Conditions No. 8

The States (Washington Fish and Wildlife Enforcement and Oregon State Police Fish and Wildlife Division) coordinated safety and security during removal activities among all agencies involved with the process in cooperation with the Columbia Basin Law Enforcement Council. This action included the establishment of an Incident Command Center (ICC) that coordinated security and safety with USACE, US Coast Guard, Columbia River Intertribal Fish Commission (CRITFC), and local law enforcement in Oregon and Washington during capture, removal and transportation operations.

#### Terms and Conditions No. 9

The States worked directly with USACE, Portland District and the Bonneville Lock and Dam Project Manager prior to and during capture and removal operations. The assistance provided by Bonneville Project staff was critical to our work and was very much appreciated. The ICC also worked directly with the Bonneville Project on safety, security and access issues during our removal operations.

#### Terms and Conditions No. 10

The carcasses, tissues, and parts of the CSL that were euthanized were disposed of according to applicable local, state and federal laws. An effort was made to collect and retain multiple biological samples from euthanized animals for scientific and educational purposes.

#### Terms and Conditions No. 11

The States notified the Regional Administrator, NOAA Fisheries West Coast Region, of all sea lion removal operations within the required three day period.

#### Terms and Conditions No. 12

In addition to conducting California sea lion capture, marking and removal operations, the States assisted with the USACE pinniped predation observation program, and the Columbia River Intertribal Fish Commission non-lethal boat-based pinniped hazing program. This work included efforts to document pinniped presence, abundance, foraging behaviors, salmonid consumption, identify individual animals, employ non-lethal hazing tools, and remove predatory California sea

lions. These efforts were directed at evaluating the impact of predation on salmonid passage at Bonneville Dam, determining the effectiveness of non-lethal hazing, identifying predatory sea lions, and ultimately evaluating the results achieved by removing predatory sea lions from the Bonneville Dam area. Detailed descriptions of the work completed in 2015 can be found in the respective annual field reports by USACE and the States/CRITFC (see attached for the latter).

#### Terms and Conditions No. 13

This document (along with those referenced above under Terms and Conditions No. 12) represents the annual report to NOAA Fisheries that is required here. The States, in consultation with all other cooperating agencies, are currently planning for work to be conducted in 2016. We expect USACE to again lead the predation observation program at Bonneville Dam and to contract with USDA Wildlife Services to provide land-based non-lethal hazing operations. The States, along with CRITFC staff will assist USACE with predation observations and non-lethal hazing (boat-based).

We expect to prepare traps for operation at Bonneville Dam in March 2016 as CSL begin to arrive with the spring Chinook run later that month. As in previous years, our priority will be to fill requests from facilities authorized by NOAA Fisheries to receive and permanently house any of the captured CSL identified for removal. If no facilities are available, CSL listed for removal will be chemically euthanized and biological samples will be taken. Use of firearms as a removal tool will continue to be an option and may be used according to the conditions of the LOA in situations where trapping is ineffective.

We also intend to mark any unknown California sea lions that may be captured on the traps and release them in the same area. We may deploy telemetry instruments to some of these animals to further document their movements and foraging patterns in the Bonneville Dam area (e.g. night activities, proportion of time spent in and out of the observation areas). We will continue to opportunistically collect fecal samples from all haul-out sites in the area to identify the variety of prey taken pinnipeds while in this area, including genetic identification of salmonid stocks consumed.

#### Terms and Conditions No 14.

The States will consult with the USACE predation observation program to identify any new CSL that have met the criteria for removal. Periodically during the field season we will request in writing that NOAA Fisheries add these newly qualifying CSL to the approved removal list.

#### Terms and Conditions Nos. 15 and 16

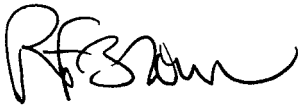
We understand that the current LOA (valid through June 30, 2016) may be modified, suspended, or revoked by NOAA Fisheries at any time given 72 hours notice to the States. We will continue to consult with NOAA Fisheries and other partner agencies regarding the efficacy of this program as we proceed.

The States remain committed to pursuing all reasonable approaches to reduce pinniped predation on threatened and endangered Columbia River salmonids. As you know, existing non-lethal tools have proven highly ineffective and very few new options have been identified. While we would prefer to find and implement successful non-lethal methods of reducing predation,

permanent removal of some number of repeat offending predatory sea lions may continue to be necessary for the foreseeable future.

We thank you for your assistance and support of our work to reduce sea lion predation on threatened and endangered salmonids below Bonneville Dam and look forward to working with you on this project in the years to come. Please let us know if we can provide further information related to our annual reporting obligations.

Sincerely,

A handwritten signature in black ink, appearing to read 'RFBrown', with a stylized, cursive script.

Robin F. Brown  
Marine Mammal Program Leader

Attached: FIELD REPORT: 2015 PINNIPED RESEARCH AND MANAGEMENT  
ACTIVITIES AT BONNEVILLE DAM

FIELD REPORT:  
2015 PINNIPED RESEARCH AND MANAGEMENT ACTIVITIES AT BONNEVILLE DAM

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October 30, 2015

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## TABLE OF CONTENTS

TABLE OF CONTENTS.....	i
LIST OF TABLES .....	ii
LIST OF FIGURES .....	iii
INTRODUCTION .....	1
METHODS .....	2
<i>Boat-based deterrent activities</i> .....	2
<i>Trapping</i> .....	2
<i>Instrumentation</i> .....	3
<i>Diet analysis</i> .....	3
<i>Pinniped surveys</i> .....	3
<i>Effect of removals</i> .....	4
RESULTS AND DISCUSSION .....	4
<i>Boat-based deterrent activities</i> .....	4
<i>Trapping</i> .....	4
<i>Instrumentation</i> .....	5
<i>Diet analysis</i> .....	5
<i>Pinniped surveys</i> .....	6
<i>Effect of removals</i> .....	6
ACKNOWLEDGEMENTS .....	7
REFERENCES .....	8

## LIST OF TABLES

Table 1. Summary of boat-based hazing activities at Bonneville Dam, 2015.....	9
Table 2. Summary of Steller sea lion captures at Bonneville Dam, 2015, by date and brand. Letter codes in cells of table are as follows are A = accidental mortality and C = captured and released.....	10
Table 3. Summary of California sea lion captures at Bonneville Dam, 2015, by date and brand. Letter codes in cells of table are as follows: A = accidental mortality, B = branded, C = captured and released, E = euthanized, I = instrumented (attached or removed), and Z = transferred to zoo/aquarium. ....	11
Table 4. Summary of California sea lion removal activity since initiation of MMPA Section 120 removal program. Removals are categorized by location (Bonneville Dam or Astoria), season (spring or fall), and outcome (captivity, chemical euthanasia, accidental mortality). Accidental mortalities are further categorized by whether animals were on the list for removal or had qualified to be on the list. ....	16
Table 5. Summary of California sea lion accelerometer tagging at Bonneville Dam, 2015. Hz fields denote sampling rates for acceleration (acc; 8 Hz = 8 samples per second, 16 Hz = 16 samples per second) and depth (2 Hz = 2 samples per second, 4 Hz = 4 samples per second). ....	17
Table 6. Summary of prey remains recovered from gastrointestinal tracts of 31 California sea lions and one Steller sea lion from Bonneville Dam, 2015. ....	18
Table 7. Tag histories from 11 PIT tags recovered from the stomachs of three California sea lions from Bonneville Dam (rkm 234), 2015.....	19
Table 8. Predicted numbers of salmonids that would have been required by California sea lions had they not been removed from the lower Columbia River, 2008-2015. ....	20

LIST OF FIGURES

Figure 1. Accelerometer and depth data from a single salmon predation event by California sea lion C040 between 1107 and 1114 on 2015-04-09. Lines represent sensor data: surge (front-back acceleration) is at top in red; sway (left-right acceleration) is second from top in blue; heave (up-down acceleration) is second from bottom in green; and depth is at bottom in purple. Acceleration (surge, sway, and heave) is measured in meters per second per second but are offset above for display purposes; depth is measured in meters. .... 21

Figure 2. Accelerometer and depth data from California sea lion C040 between 0500 and 2000 on 2015-04-09. Lines represent sensor data: surge (front-back acceleration) is at top in red; sway (left-right acceleration) is second from top in blue; heave (up-down acceleration) is second from bottom in green; and depth is at bottom in purple. Acceleration (surge, sway, and heave) is measured in meters per second per second but are offset above for display purposes; depth is measured in meters. .... 22



## INTRODUCTION

Bonneville Dam, located approximately 146 miles upriver from the Pacific Ocean, is the lowermost hydroelectric project on the Columbia River. During the 1980s and 1990s, one to two California sea lions (*Zalophus californianus*) were reported annually at the dam during fishway inspections (Stansell 2004). In 2001, however, there were reports of up to six California sea lions observed at one time, and in 2002 the U.S. Army Corps of Engineers (USACE) estimated that 30 California sea lions were foraging at the dam for salmonids (*Onchorynchus* spp.), many runs of which are listed under the Endangered Species Act (ESA). Since then the minimum number of California sea lions has fluctuated between approximately 40-100 individuals per year with associated predation of between approximately 1000 and 5500 salmonids per year (Stansell et al. 2014).

Steller sea lion (*Eumetopias jubatus*) abundance at the dam has also increased over the last decade, going from zero before 2003 to a high of 89 individuals in 2011 (Stansell et al. 2014). While Steller sea lions initially foraged primarily on white sturgeon (*Acipenser transmontanus*), in recent years they have switched to consuming more salmonids than sturgeon. In 2014 the number of sturgeon and salmonids consumed by Steller sea lions was estimated to be approximately 150 and 1900, respectively (Stansell et al. 2014).

In response to increasing pinniped predation at the dam, state, federal, and tribal partners have attempted to deter pinnipeds using a variety of non-lethal deterrents. Starting in 2005, these methods have included aerial and underwater pyrotechnics, acoustic harassment devices, vessel chase, rubber projectiles, and capture-relocation. In 2010 alone, for example, boat-based hazing crews used approximately 5,000 rounds of cracker shells, 750 seal bombs, and 100 rounds of rubber buckshot in attempts to deter sea lions from the Bonneville Dam tailraces (Brown et al. 2010). While hypothetically effective at deterring predation by naive animals arriving at the dam for the first time, they have been shown to be ineffective at deterring predation by habituated individuals.

Increasing predation by California sea lions on ESA-listed salmonids, coupled with unsuccessful non-lethal deterrence efforts, led the States of Washington, Oregon, and Idaho in November 2006 to apply under Section 120 of the Marine Mammal Protection Act (MMPA) for the authority to permanently remove California sea lions that were observed preying on salmonids near Bonneville Dam. In March 2008, NOAA Fisheries (NMFS) partially approved the States' application and issued a Letter of Authorization (LOA) for the lethal removal of certain California sea lions under specific conditions (NMFS 2008). This authority was repeatedly challenged in federal court, which resulted in intermittent removal activity. Litigation ended in September 2013 when the US Court of Appeals for the Ninth Circuit ruled in NMFS's favor, allowing for the removal activity to continue until at least June 30, 2016, when the current authority expires.

This report summarizes pinniped research and management activities at Bonneville Dam in 2015. This work was led by the Oregon Department of Fish and Wildlife (ODFW) and Washington Department of Fish and Wildlife (WDFW), in association with the Columbia River

Inter-Tribal Fish Commission (CRITFC). This work has been conducted in close coordination and cooperation with USACE and NMFS, as well as numerous other agencies.

## METHODS

### *Boat-based deterrent activities*

Boat-based hazers from CRITFC used a combination of deterrents (seal bombs, cracker shells, and vessel chase) in an attempt to deter pinnipeds from consuming threatened and endangered Columbia River salmon and steelhead as well as white sturgeon. Hazers primarily patrolled the tailrace Boat Restricted Zone (BRZ) at the dam in pursuit of foraging sea lions. The following was recorded for each discrete hazing event: species and number of pinnipeds encountered; starting location, time and direction of travel of pinniped(s); type and number of deterrent devices used; and ending location, time and direction of travel of pinniped(s). Predation observations and identifying marks of pinnipeds were also noted.

For personnel safety, and as recommended by the Fish Passage, Operations, and Management working group, boat access within the BRZ was limited to approximately 30 m from all Bonneville project structures and 50 m from main fishway entrances. No seal bombs were used within 100 m of fishways, floating orifices, the Powerhouse-2 corner collector flume or the smolt monitoring facility outfall. In addition, no seal bombs were used once salmon passage exceeded 1,000 fish per day. Hazing activities were coordinated daily with the USACE Control Room and Fisheries Field Unit (FFU) personnel, as well as with USDA Wildlife Services staff, who were conducting additional sea lion hazing activities from project ground facilities. VHF-radio contact was maintained with Control Room staff while boat-hazing crews were active in the BRZ.

### *Trapping*

Sea lions were captured by ODFW and WDFW using haul-out traps placed in dam tailraces. Sea lions use these traps as haulout sites, entering and exiting traps via a vertically-sliding door which was pad-locked open prior to a scheduled capture attempt. Tailrace traps were monitored by state, federal, and/or private security staff. A telephone contact list was provided to all staff involved with monitoring the traps to notify trained staff should any trap be tampered with or close unexpectedly. Additional sea lion traps were also operated year-round in Astoria and intermittently in the Bonneville Pool.

Tailrace trap doors were closed using a remote-controlled magnetic release mechanism. Once sea lions were captured they were herded into holding cages on a barge built specifically to handle and process sea lions. If an animal was an approved candidate for permanent removal it was transferred to an on-site holding facility for further evaluation. If a NMFS-approved zoo or aquarium facility was available to receive candidate sea lions for permanent holding, then captured animals would be given a health screening by field staff and veterinarians, including members of the States' Institutional Animal Care and Use Committee. If an animal passed the health screening it would be transferred to an approved temporary housing facility prior to shipment to a zoo or aquarium. If an animal failed the health exam, or if there were no approved

facilities prepared to accept an animal, then it was chemically euthanized. Euthanized animals were necropsied and samples (e.g., skull, GI tract, urine) were collected and stored for later analysis.

### *Instrumentation*

A subset of California sea lions that were trapped were tagged with an accelerometer and VHF transmitter as part of a pilot study to further refine our understanding of sea lion foraging behavior. Accelerometer tags (Wildlife Computers, model TRD10-X-340A) were epoxied to the rear of the head and VHF transmitters were epoxied mid-dorsum along the neck. Acceleration was recorded in 3 axes corresponding to the anterior–posterior (surge), lateral (sway), and dorso–ventral axes (heave), which denotes the dynamic component in each respective axis. Acceleration was measured at either 8 Hz or 16 Hz in units of meters per second per second. Accelerometers also measured depth which was measured in meters at either 2 Hz or 4 Hz. Tagged sea lions were video-taped by ODFW and CRITFC in order to document behaviors that could then be compared to the archival accelerometer data. Tags were recovered by recapturing tagged animals on subsequent trapping occasions. Tags were redeployed as possible on new animals captured during subsequent occasions.

### *Diet analysis*

Gastro-intestinal (GI) tracts of euthanized animals were collected for food habits information. Processing of GI tracts followed standard procedures. Each section (stomach, small and large intestines) was separated and processed individually. Remains were run through a series of nested sieves (2mm, 1mm and .05mm) and all parts were collected for identification. Samples were dried and remains were identified using a dissecting microscope and identified to lowest possible taxonomic level by comparing all identifiable prey remains (e.g., bones, otoliths, cartilaginous parts, lenses, teeth and cephalopod beaks) to a comparative reference collection of fish from the northeastern Pacific Ocean and Oregon estuaries. Prey were enumerated by pairing of skeletal structures (otoliths, tail structures, mouthparts, etc.) to achieve the greatest number of prey in the sample. Enumeration takes into account both left and right sides of paired structures and also size of recovered prey remains.

### *Pinniped surveys*

River surveys were conducted weekly between March and May by CRITFC in order to document and enumerate sea lion abundance and predation activity in the river below Bonneville Dam. Surveys either extended from the Bonneville Dam tailrace to the East Mooring Basin, in Astoria, Oregon or from the Bonneville Dam tailrace to the mouth of the Cowlitz River (RM 68) near Longview, Washington. Most surveys were conducted by two independent boats in order to estimate sea lion detectability. Each boat was crewed by a captain and at least one observer. Sea lion species, predation events and GPS location data were recorded for all sightings. In addition, counts of sea lions hauled out at the East Mooring Basin and at Phoca Rock were conducted throughout the season.

### *Effect of removals*

The effect of the California sea lion removal program from 2008-2015 was estimated by predicting the number of salmon that would have been required by the sea lions had they not been removed. Predictions are based on the bioenergetics model described in Brown et al. (2010, 2011). In previous years cumulative totals were estimated by simply summing the endpoints from annual confidence interval estimates which resulted in conservative confidence intervals (i.e., confidence intervals that were too wide). For this year's analysis we applied the bioenergetics model to just two groups: the population of same-year removal animals and the theoretical population of animals that would have returned in the subsequent five years had they not been euthanized. This was considered a more accurate approach since modeling prey requirements on a per year and per cohort basis could result in extreme percentile confidence limits due to small sample sizes.

## RESULTS AND DISCUSSION

### *Boat-based deterrent activities*

The boat-based hazing crew from CRITFC hazed sea lions for a total of 31 days from March to May, 2015 (Table 1). Hazing resulted in 474 and 231 takes of California sea lions and Steller sea lions, respectively. A total of 1254 cracker shells and 735 seal bombs were used during deterrent activities.

As in previous years, the purpose of non-lethal, boat-based deterrent activities was two-fold. First, it attempts to disrupt sea lion foraging behavior and reduce sea lion abundance immediately below Bonneville Dam, thereby increasing salmonid survival. Second, hazing may discourage naïve animals from becoming habituated to foraging below the dam, thus limiting the number of animals that may become eligible for permanent removal. Boat-based and/or structure based hazing also fulfills the LOA requirement that predatory California sea lions be exposed to hazing prior to subjecting them to permanent removal efforts.

Results from this year were similar to that seen in past years. There was no apparent reduction in overall sea lion abundance or predation near the dam in response to hazing. This is similar to other studies that have demonstrated that pinnipeds habituate quickly to acoustic and other deterrents that may be initially effective (see reviews by Fraker and Mate 1999 and Scordino 2010).

### *Trapping*

Trapping in the Bonneville tailrace occurred during April and May, resulting in "takes" of approximately 95 Steller sea lions (Table 2) and 334 California sea lions (Table 3). As in recent years, no new Steller sea lions were branded in 2015 due to limited resources. In contrast, a total of 131 new California sea lions were branded at the dam. A total of 34 California sea lions were removed during 2015 (Table 4): 30 were euthanized; 2 were transferred to a zoo; and 2 died

accidentally after a trap malfunction. A single Steller sea lion also died as the result of an accident although it was not related to an active trapping event.

### *Instrumentation*

A total of seven California sea lions were successfully tagged with accelerometers (Table 5). Deployments ranged from 6 to 35 days and resulted in over 130 million accelerometer records. In addition, foraging and other behaviors were successfully video-recorded by both ODFW and CRITFC. Data and video processing and analysis is currently in progress but an example of an accelerometer-depth profile from a single video-taped predation event is shown in Figure 1 and an example from part of a single day is shown in Figure 2.

In order to interpret these figures, the accelerometer data can be thought of as a seismograph where the up and down traces indicate rapid head movements or "earthquakes". In Figure 1, the first spike at approximately 11:07:50 am indicates the presumed time the salmon was caught. The animal then surfaced (at which time video-taping began) and the rapid head movements from approximately 11:08:35 am to the time at which it dives again are from prey handling at the surface and "shake and break" movements wherein the sea lion breaks chunks of the fish off for eating. This continues until the salmon was eventually stolen by a Steller sea lion at around 11:11 am. Figure 2 shows the accelerometer and dive data for this same animal for nearly the entire day. While there appear to be many potential predation events in this time series, not all "earthquakes" indicate actual events since the dive data suggest it was only actively hunting from approximately 8 am to 2 pm. We are currently developing algorithms to separate out true predation events from other behaviors in order to accurately estimate predation rates from this data.

### *Diet analysis*

No sea lion scat were collected during the 2015 season but the GI tracts of 32 California sea lions (30 euthanized, 2 accidental mortalities) and one Steller sea lion (accidental mortality) were removed during necropsies and frozen for later analysis. All but one of the GI tracts contained prey remains (Table 6). Of the 32 GI tracts with remains, 31 (97%) contained adult (or likely adult) salmonids, one (3%) contained juvenile salmonids, six (19%) contained Pacific lamprey, and three (9%) contained American shad remains; no other prey were recovered. A total of 11 PIT tags were recovered from three animals (Table 7). The maximum number of individual adult salmonid remains found in a single sea lion was ten.

It should be noted that numbers of prey estimated from GI tract analysis are minimums since they require the presence of unique, paired structures such as otoliths for which there are only two per individual. Size of structures is also accounted for when enumerating prey. For example, if a stomach contains two left and one right otolith of the same size, we can only say there are at least two individuals represented when in fact it could be three. Another complication of prey analysis is that prey are digested and passed through the GI tract at variable rates (Harvey 1989). The otoliths in our example could therefore have been from fish consumed on different days.

### *Pinniped surveys*

Preliminary results indicate very large concentrations of sea lions in the lower river during the spring. One river survey, for example, conducted on March 11 observed 69 Steller sea lions, 444 California sea lions, and 1 unknown sea lion in the river between Bonneville Dam and Astoria. In addition, record high numbers of California sea lions were hauled out at the East Mooring Basin during late March and early April, with an all-time high of 2340 animals counted on March 20. The maximum number of Steller sea lions hauled out at Phoca Rock at one time was 37 animals observed on both March 10<sup>th</sup> and 17<sup>th</sup>.

Analysis of survey data is pending, but the peak observations of sea lions in the lower river in March increased over the 2013 and 2014 results and coincident with eulachon (*Thaleichthys pacificus*) run timing. Recently listed as 'threatened' under the Endangered Species Act, these fish were once an important prey item for pinnipeds in the lower river each spring when large numbers of eulachon migrated into the lower river to spawn in its tributaries. The decline of the eulachon runs in the early 1990s may have been one contributing factor to the start of sea lion predation on salmonids at Bonneville Dam in the early 2000s.

### *Effect of removals*

The median daily salmonid biomass requirement for a California sea lion based on the bioenergetics model was 14.2 kg (95% confidence interval was 7.8 to 27.1 kg/day), which translated into a median of 3 Chinook/day (95% confidence interval was 2 to 6 Chinook/day). The median seasonal salmonid requirement for each sea lion was 57 salmonids (95% confidence interval was 6 to 216 salmonids/season). The predicted number of salmonids that would have been required from 2008 to 2015 by the 107 California sea lions that have been removed ranged from 15,255 to 20,484 fish (Table 8). In addition, removal of habituated animals is believed to reduce opportunities for new, naive animals to be recruited into the Bonneville Dam "population", since at least some naive animals are thought to follow habituated animals upriver from the Columbia River mouth haul-outs.

It is important to note that bioenergetic models produce estimates of food requirements, not food consumption. Nevertheless, the results from this model were consistent with data from captive California sea lions (Kastelein et al. 2000) that showed adult (age 10) males consumed approximately 10.9 kg/day on a diet of mackerel, herring, sprat, and squid. They were also consistent with direct observations by the USACE which documented individual sea lions consuming up to 198 salmonids per season (Stansell et al. 2014). Results from bioenergetic calculations may also be applied in other parts of the river, albeit perhaps with some modifications to reflect local conditions. Refinements to the current model may need to be made in the future in order to account for possible changes in sea lion behavior over time such as lower residency and return rates.

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Table 1. Summary of boat-based hazing activities at Bonneville Dam, 2015.

Week of	Days	Take*		Munitions	
		CSL	SSL	Cracker shells	Seal bombs
3/1/2015	1	7	12	38	21
3/8/2015	3	41	28	109	88
3/15/2015	2	9	39	67	49
3/22/2015	3	13	26	103	63
3/29/2015	3	57	41	207	145
4/5/2015	4	27	26	99	91
4/12/2015	3	24	27	63	31
4/19/2015	4	87	13	130	72
4/26/2015	3	57	14	70	62
5/3/2015	3	77	1	177	35
5/10/2015	2	75	4	191	78
Total	31	474	231	1254	735

\* Take refers to numbers of animal-harassment events (note: one animal may be harassed multiple times); CSL=California sea lion, SSL=Steller sea lion.

Table 2. Summary of Steller sea lion captures at Bonneville Dam, 2015, by date and brand. Letter codes in cells of table are as follows are A = accidental mortality and C = captured and released.

ID	2015-04-01	2015-04-07	2015-04-08	2015-04-14	2015-04-15	2015-04-21	2015-04-22	2015-04-28	2015-04-29	2015-05-05	2015-05-13	2015-05-14	2015-05-19	2015-05-20	Total
NA*	0	3	1	3	7	7	4	17	17	1-A**	7	5	6	6	84
O001					C										1
O20		C		C											2
O28		C			C										2
O31			C												1
O38				C			C								2
628R				C		C		C							3
Total	0	5	2	6	9	8	5	18	17	1	7	5	6	6	95

\*Approximate number of unbranded animals

\*\*Animal entangled in external lines; not related to active trapping event

Table 3. Summary of California sea lion captures at Bonneville Dam, 2015, by date and brand. Letter codes in cells of table are as follows: A = accidental mortality, B = branded, C = captured and released, E = euthanized, I = instrumented (attached or removed), and Z = transferred to zoo/aquarium.

ID	2015-04-01	2015-04-07	2015-04-08	2015-04-14	2015-04-15	2015-04-21	2015-04-22	2015-04-28	2015-04-29	2015-05-05	2015-05-13	2015-05-14	2015-05-19	2015-05-20	Total
NA*						3			1-A						4
8193				C			C								2
U33					C										1
U65														C	1
U146								C			C	C	C	C	5
U248									C						1
U250													C	C	2
U334								C	C			C		C	4
U596											C		C	C	3
U621		C	C		C		C	C							5
U646						C	C	C	C						4
U655											C	C	C		3
U673						C	C	C	C						4
U733							C								1
U744											C		C		2
U900								C	C						2
C03														C	1
C026 (E)			E												1
C036 (E)		E													1
C037 (E)		I	C		I			E							4
C039 (E)			E												1
C040 (E)		I	C	I	C	E									5
C041 (E)		E													1
C045 (E)													E		1
C046 (E)		E													1
C047 (E)			E												1
C050 (E)								E							1
C051				C		C	C								3
C052 (E)						E									1
C055 (E)						E									1
C056 (E)				E											1
C057		B													1
C058 (E)		B			C		C		I			IE			5
C059		B	C												2

Table 3. cont.

ID	2015-04-01	2015-04-07	2015-04-08	2015-04-14	2015-04-15	2015-04-21	2015-04-22	2015-04-28	2015-04-29	2015-05-05	2015-05-13	2015-05-14	2015-05-19	2015-05-20	Total
C060		B													1
C061 (E)		B I	I C			E									5
C062		B				C									2
C063 (Z)		B C		I	C			I C			Z				7
C064			B												1
C065			B												1
C066 (E)			B C C	E											4
C067 (E)			B C I										IE		4
C068 (E)			B C C	C I						IE					6
C069			B	C											2
C070				B											1
C071				B C	C C										4
C072				B											1
C073				B C	C										3
C074				B											1
C075				B		C									2
C076					B C										2
C077					B C C										3
C078					B										1
C079 (E)					B C								E		3
C080					B C C										3
C081					B C C										3
C082 (E)					B C	C C		E							5
C083					B C										2
C084					B C C										3
C085 (E)					B			C			E				3
C086						B C									2
C087						B									1
C088						B C	C				C				4
C089						B C									2
C090 (E)						B C							E		3
C091 (E)						B C	C			E					3
C092 (E)						B C	C					E			4
C093						B		C C							3
C094						B		C							2
C095						B				C					2
C096							B								1
C097							B						C		2

Table 3. cont.

ID	2015-04-01	2015-04-07	2015-04-08	2015-04-14	2015-04-15	2015-04-21	2015-04-22	2015-04-28	2015-04-29	2015-05-05	2015-05-13	2015-05-14	2015-05-19	2015-05-20	Total
C098						B		C							2
C099						B									1
1-00						B									1
1-01 (E)						B		C			C		E		4
1-02						B									1
1-03						B							C		2
1-04						B		C						C	3
1-05						B		C	C						3
1-06						B						C		C	3
1-07						B									1
1-08						B									1
1-09						B			C						2
1-10 (E)						B		C	C		E				4
1-11 (E)						B						E			2
1-12						B									1
1-13								B							1
1-14								B	A						2
1-15 (E)								B	C		E				3
1-16 (E)								B					E		2
1-17								B							1
1-18								B				C	C	C	4
1-19								B	C						2
1-20								B							1
1-21 (E)								B	C				E		3
1-22								B							1
1-23								B							1
1-24								B					C		2
1-25								B	C						2
1-26								B	C						2
1-27								B							1
1-28								B			C				2
1-29 (Z)								B	C		Z				3
1-30									B						1
1-31									B						1
1-32									B						1
1-33									B						1
1-34									B						1
1-35									B						1

Table 3. cont.

ID	2015-04-01	2015-04-07	2015-04-08	2015-04-14	2015-04-15	2015-04-21	2015-04-22	2015-04-28	2015-04-29	2015-05-05	2015-05-13	2015-05-14	2015-05-19	2015-05-20	Total
1-36												B			1
1-37												B			1
1-38												B	C		2
1-39												B			1
1-40												B	C	C	3
1-41												B	C		2
1-42												B	C		2
1-43												B	C	C	3
1-44												B	C	C	3
1-45												B	C	C	3
1-46												B			1
1-47												B			1
1-48												B			1
1-49												B			1
1-50												B	C		2
1-51												B	C	C	3
1-52												B			1
1-53												B			1
1-54												B			1
1-55												B		C	2
1-56													B	C	2
1-57													B		1
1-58													B	C	2
1-59													B	C	2
1-60													B	C	2
1-61													B	C	2
1-62													B	C	2
1-63													B	C	2
1-64													B		1
1-65													B	C	2
1-66													B	C	2
1-67													B		1
1-68													B		1
1-69													B	C	2
1-70													B	C	2
1-71													B	C	2
1-72													B		1
1-73													B	C	2

Table 3. cont.

ID	2015-04-01	2015-04-07	2015-04-08	2015-04-14	2015-04-15	2015-04-21	2015-04-22	2015-04-28	2015-04-29	2015-05-05	2015-05-13	2015-05-14	2015-05-19	2015-05-20	Total
1-74													B		1
1-75													B	C	2
1-76													B	C	2
1-77													B		1
1-78													B	C	2
1-79													B	C	2
1-80													B	C	2
1-81													B	C	2
1-82													B		1
1-83														B	1
1-84														B	1
1-85														B	1
1-86														B	1
1-87														B	1
Total	0	13	15	15	22	29	41	38	26	0	14	29	49	43	334
Removals	0	3	3	1	0	4	1	2	0	0	7	3	5	3	32
New brands	0	7	6	6	10	10	17	17	6	0	0	20	27	5	131

\*Approximate number of unbranded animals

Table 4. Summary of California sea lion removal activity since initiation of MMPA Section 120 removal program. Removals are categorized by location (Bonneville Dam or Astoria), season (spring or fall), and outcome (captivity, chemical euthanasia, accidental mortality). Accidental mortalities are further categorized by whether animals were on the list for removal or had qualified to be on the list.

Year	Bonneville Dam				Astoria		Total	
	Captivity	Accident – on list	Accident – qualified	Accident – not qualified	Euthanized	Euthanized (spring)		Euthanized (fall)
2008	6	2	1	2				11
2009	4				10		1	15
2010					12		2	14
2011						1		1
2012	1				11		1	13
2013	2				2			4
2014					15			15
2015	2			2	30			34
Total	15	2	1	4	80	1	4	107



Table 5. Summary of California sea lion accelerometer tagging at Bonneville Dam, 2015. Hz fields denote sampling rates for acceleration (acc; 8 Hz = 8 samples per second, 16 Hz = 16 samples per second) and depth (2 Hz = 2 samples per second, 4 Hz = 4 samples per second).

CSL brand	Accelerometer tag ID	Hz -acc	Hz -depth	Patch color	VHF tag ID	Date released	Date recovered	Deployment duration (d)	Estimated records
C040	663	8	2	Black	164.433	2015-04-07	2015-04-14	7	4,838,400
C037	634	8	2	Red	164.374	2015-04-07	2015-04-15	8	5,529,600
C061	664	8	2	Blue	164.444	2015-04-08	2015-04-14	6	4,147,200
C063	663	16	4	Black	164.433	2015-04-15	2015-04-28	13	17,971,200
C067	664	16	4	Blue	164.444	2015-04-15	2015-05-20	35	48,384,000
C068	634	16	4	Red	164.374	2015-04-22	2015-05-13	21	29,030,400
C058	663	16	4	Black	164.433	2015-04-29	2015-05-14	15	20,736,000
Total								105	130,636,800

Table 6. Summary of prey remains recovered from gastrointestinal tracts of 31 California sea lions and one Steller sea lion from Bonneville Dam, 2015.

Removal date	ID	Salmonid			Pacific Lamprey	Shad	PIT tags
		Adult	Probable adult	Juvenile			
2015-04-07	C036	4					
	C041	5					
2015-04-08	C046		1				
	C026	1					
	C039	2					
2015-04-14	C047	1					
	C056	4	1				
	C040	1					
2015-04-21	C052	1					
	C055	3					
	C066		1				
2015-04-22	C061	2					
2015-04-28	C037	10					
	C050	3					
2015-04-29	CSL*	1		5			2
	1-14*			(empty)			
2015-05-05	SSL*	3					
2015-05-13	C068	2					
	C082	1					
	C091	1					
2015-05-14	1-10	2			1		3
	1-15	1					
	C058	4				1	
2015-05-19	C085	1	1		1		6
	1-11	4					
	C045	4					
2015-05-20	C092	1					
	1-01	1					
	1-16	1			1		
2015-05-20	1-21				10	1	
	C067	3					
	C079	2			1	2	
	C090	4			2		
	Total	73	4	5	16	4	11

\* Accidental mortalities; all other animals euthanized.

Table 7. Tag histories from 11 PIT tags recovered from the stomachs of three California sea lions from Bonneville Dam (rkm 234), 2015.

CSL	Trap date	PIT tag	Run	Release site	Release date	Release rKm	Distance to Bonneville Dam
CSL	04-29	3D9.1C2DF453CF	Hat. spring Chinook	IMQP – Imeques Acclimation Pond	04-09	588	354
		3DD.00774AA353	Hat. spring Chinook	CURP – Curl Lake Rearing Pond	04-06	688	454
1-10	05-13	3DD.00774242B7*	Hat. summer steelhead	TUCR – Tucannon River	04-13	622	388
		3DD.00773BCDBF	Hat. summer steelhead	SAWT – Sawtooth Hatchery	04-14	1442	1208
		3DD.00773C42F0	Hat. summer steelhead	SAWT – Sawtooth Hatchery	04-14	1442	1208
C085	05-14	3DD.0077544864	Hat. summer steelhead	LGR – Lower Granite Dam	05-02	695	461
		3DD.00775F44E7	Hat. summer steelhead	LOLOC – Lolo Creek	04-20	833	599
		3DD.007753C0F5	Hat. summer steelhead	WINT – Winthrop National Fish Hatchery	04-15	924	690
		3DD.0077707C4F	Hat. spring Chinook	RAPH – Rapid River Hatchery	04-08**	978	744
		3DD.0077766B9F	Hat. spring Chinook	RAPH – Rapid River Hatchery	03-27**	978	744
		3DD.00776AB9E3	Hat. spring Chinook	RAPH – Rapid River Hatchery	04-08**	978	744

\* Detected at BON PH2 Corner Collector on 2015-05-11 2000.

\*\*Release dates adjusted to reflect actual departure from release site.

Table 8. Predicted numbers of salmonids that would have been required by California sea lions had they not been removed from the lower Columbia River, 2008-2015.

Population	2008	2009	2010	2011	2012	2013	2014	2015	Total	Total salmonids "saved"
Spring removals (calendar year removals)	11	14 (15)	12 (14)	1	12 (13)	4	15	34	103	3,018 - 4,515*
Hypothetical return group size		11	26	40	41	54	47	47	266	12,237 - 15,969**
Total										15,255 - 20,484***

\*Estimate based on total spring removals, including accidental mortalities.

\*\*Estimate based on the sum of the 5-year, lag-1 running sum of calendar year removals. The total for each year represents the theoretical population of sea lions that would have returned from the previous five years had they not been euthanized.

\*\*\*Estimate is the sum of confidence limit endpoints from the two analysis groups.

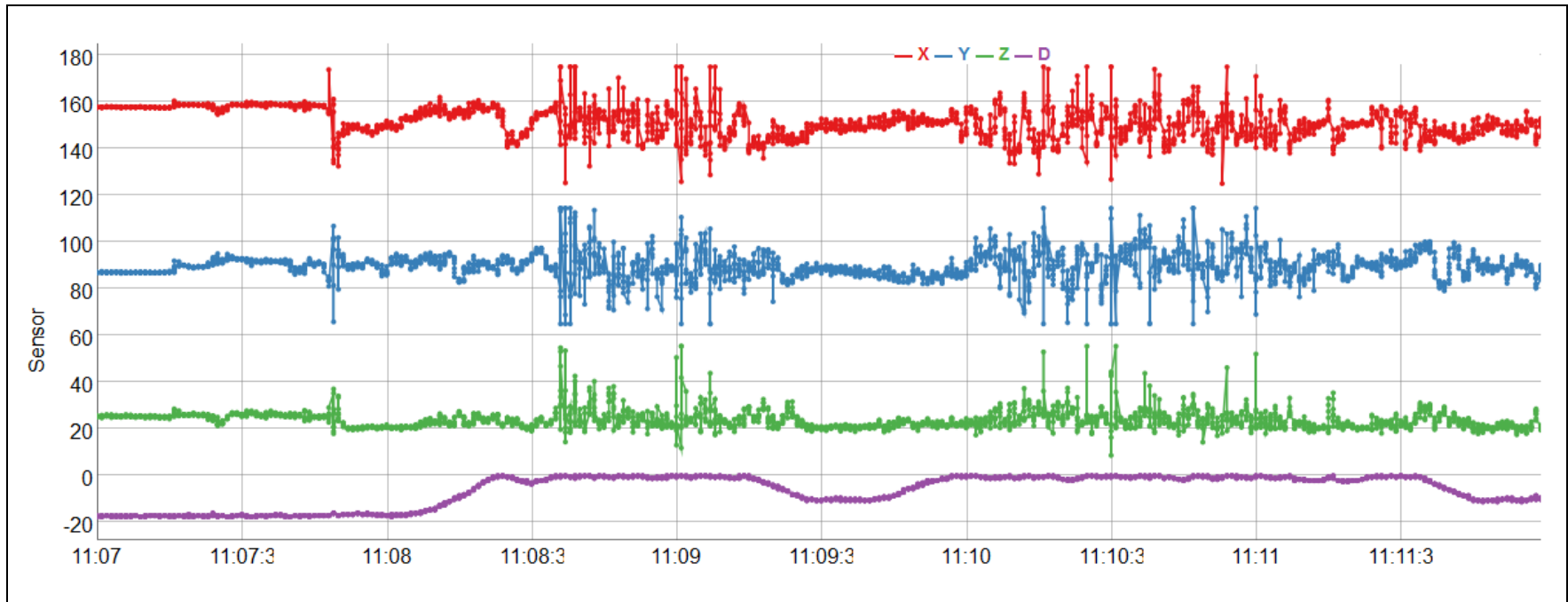


Figure 1. Accelerometer and depth data from a single salmon predation event by California sea lion C040 between 1107 and 1114 on 2015-04-09. Lines represent sensor data: surge (front-back acceleration) is at top in red; sway (left-right acceleration) is second from top in blue; heave (up-down acceleration) is second from bottom in green; and depth is at bottom in purple. Acceleration (surge, sway, and heave) is measured in meters per second per second but are offset above for display purposes; depth is measured in meters.

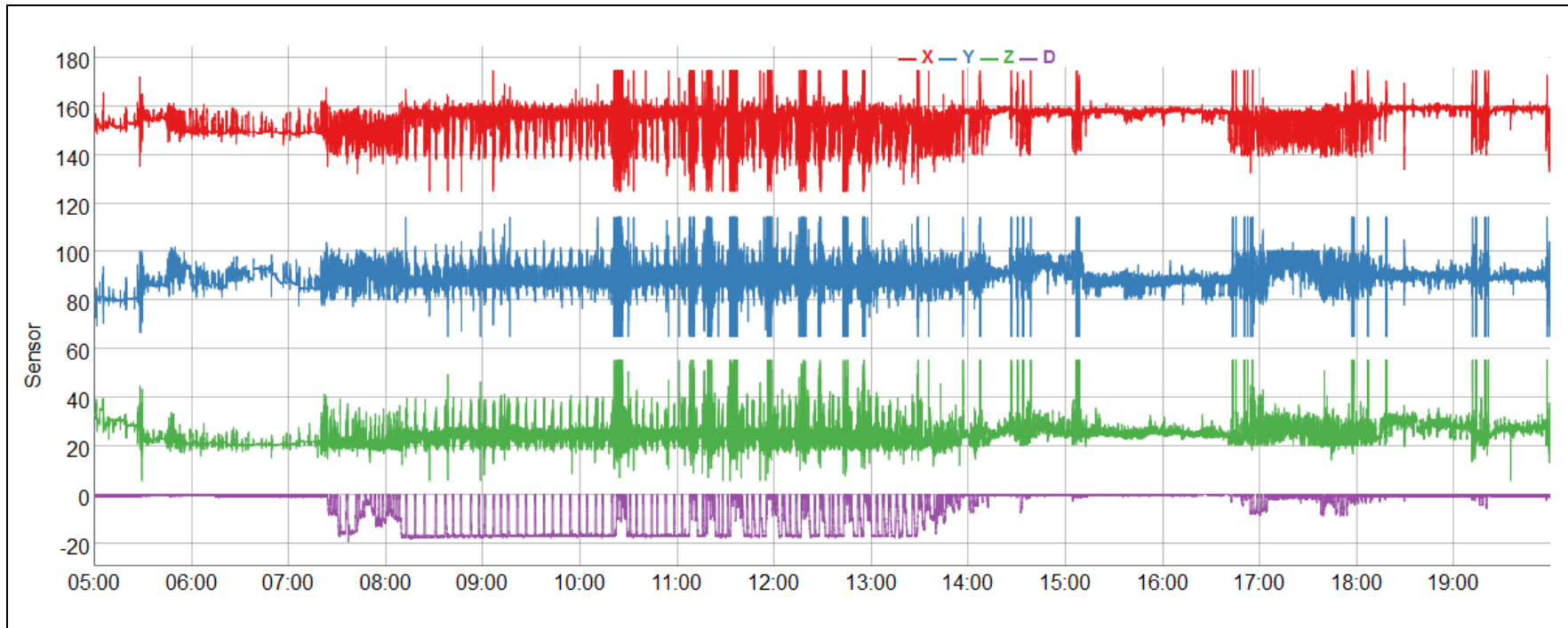


Figure 2. Accelerometer and depth data from California sea lion C040 between 0500 and 2000 on 2015-04-09. Lines represent sensor data: surge (front-back acceleration) is at top in red; sway (left-right acceleration) is second from top in blue; heave (up-down acceleration) is second from bottom in green; and depth is at bottom in purple. Acceleration (surge, sway, and heave) is measured in meters per second per second but are offset above for display purposes; depth is measured in meters.