



Oregon

Kate Brown, Governor

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October 14, 2016

Barry Thom
Regional Administrator
West Coast Region
NOAA Fisheries
7600 Sand Point Way NE, Bldg 1
Seattle, WA 98115

Dear Mr. Thom,

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 2016 field season.

Terms and Conditions Nos. 1 and 2

The States captured and intentionally removed 59 predatory CSL from April 6 to May 18, 2016. 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 62 new CSL that had met the criteria for removal during the 2016 field season.

Terms and Conditions No. 3

By intentionally removing 59 predatory CSL, the States did not exceed the limit of taking no more the one percent of the current PBR (92 animals) in 2016.

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 2016 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 2017 to discuss activities planned for the next field season.

Terms and Conditions No. 5.

As stated above, the States captured 59 CSL in 2016 that had met the criteria for permanent removal. Since no pre-approved permanent holding facilities were available to accept the animals they 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 2016 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 2017 under a new LOA issued by NOAA Fisheries in June of 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 2017 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 No. 15

We understand that the authorization may be modified, suspended, or revoked by NOAA Fisheries at any time given 72 hour notice to the States.

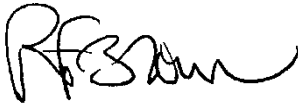
Terms and Conditions No. 16

The 2012 LOA expired on June 30, 2016 but was renewed on June 28 of this year for the period July 1, 2016 through June 30, 2021. Per Terms and Conditions No. 2 of the 2016 LOA we shall provide NMFS with a report no later than March 1, 2017 that explains what additional safeguards the states have considered to the means by which individually identifiable California sea lions are identified.

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 'RF Brown', written in a cursive style.

Robin F. Brown
Marine Mammal Program Leader

Attached: FIELD REPORT: 2016 PINNIPED RESEARCH AND MANAGEMENT
ACTIVITIES AT BONNEVILLE DAM

FIELD REPORT:
2016 PINNIPED RESEARCH AND MANAGEMENT ACTIVITIES AT BONNEVILLE DAM

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October 14, 2016

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TABLE OF CONTENTS

TABLE OF CONTENTS.....	1
LIST OF TABLES	2
INTRODUCTION	3
METHODS	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>	5
<i>Effect of removals</i>	5
RESULTS AND DISCUSSION	6
<i>Boat-based deterrent activities</i>	6
<i>Trapping and associated activities</i>	6
<i>Pinniped surveys</i>	7
<i>Effect of removals</i>	7
ACKNOWLEDGEMENTS	8
REFERENCES	9

LIST OF TABLES

Table 1. Summary of boat-based hazing activities at Bonneville Dam, 2016.	10
Table 2. Summary of sea lion captures at Bonneville Dam, 2016.....	11
Table 3. Summary of California sea lion accelerometer-tagging at Bonneville Dam, 2016.	12
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.	13

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 40-200 individuals per year with associated predation of between approximately 1000 and 11,000 salmonids per year (USACE 2016).

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 (USACE 2016). 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 2015 the number of sturgeon and salmonids consumed by Steller sea lions was estimated to be approximately a few dozen and 2,500, respectively (USACE 2016).

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 under the State's 2012 LOA. That LOA expired on June 30, 2016 but was renewed until June 30, 2021.

This report summarizes pinniped research and management activities at Bonneville Dam in spring 2016. 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. In addition, wireless trap monitoring sensors were installed on all trap doors to automatically notify all project staff by text in the event of an unplanned trap closure. 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 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, samples of body tissues, organs, fluids) 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. Tags (Loggerhead Instruments, "Open Tag") were epoxied to the rear of the head. 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. 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 will follow standard procedures. Each section will be separated and processed individually. Remains will be run through a series of nested sieves (2mm, 1mm and .05mm) and all parts will be collected for identification. Samples will be dried and remains will be 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 will be 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 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 2008-2016 was estimated by predicting the number of salmon that would have been required by the sea lions had they not

been removed. Predictions were based on the bioenergetic model of Winship et al. (2002) and Winship and Trites (2003). Modified parameter inputs included: normally distributed CSL weights (mean = 318 kg, SD = 45 kg); an average salmonid weight of 5.7 kg; salmonids as primary prey, uniformly distributed from 90% to 100% of diet; and primary and secondary prey energetic density uniformly distributed 5-9 kJ/g wet mass and 3-11 kJ/g wet mass, respectively. We ran the model 10,000 times to obtain the mean and simple 95% percentile confidence interval estimates for salmonids required per day in terms of kg, fish, and percent of body weight. We then multiplied the estimate and confidence interval for fish/d by the total number of California sea lions removed (including accidental mortalities) for the year they were removed plus up to five subsequent years. Note that the approach just described is a modification to that used in previous annual reports; CSL weight distribution, residency times, and fish weights have either been updated or simplified with respect to their inclusion in the model.

RESULTS AND DISCUSSION

Boat-based deterrent activities

The boat-based hazing crew from CRITFC hazed sea lions for a total of 28 days from March to May, 2016 (Table 1). Hazing resulted in 358 and 452 takes of California sea lions and Steller sea lions, respectively. A total of 1006 cracker shells and 715 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 and associated activities

Trapping in the Bonneville tailrace occurred on 18 nights (i.e., early morning, pre-dawn hours) from April 6 to May 24. On average, approximately 11 Steller sea lions and 23 California sea lions were captured per trap night (Table 2). A total of 50 California sea lion received new brands ("1-88" to "1-99", "2-00" to "2-37") and 9 received telemetry instruments (Table 3). On average, approximately 3 California sea lions were euthanized per trap night, totaling 59 over the entire trapping period (Table 4).

Gastro-intestinal tracts of the euthanized California sea lions were removed during necropsies and frozen for future analysis. Additional samples were collected for disease monitoring and ageing.

Pinniped surveys

A preliminary review of survey count data showed an apparent drop in the number of sea lions observed in the lower Columbia River compared to previous years. On March 8, the week of peak abundance in 2016, we observed 145 California sea lions, 42 Steller sea lions and 3 unknown sea lions in the river between Bonneville Dam and Astoria. This was approximately a 37% decrease compared to last year's count. However, the likely explanation for the drop in the in-river counts was the large number of sea lions hauled out near the Cowlitz River at the Rainier, Oregon docks. On March 8 there were 812 and 42 California and Steller sea lions hauled out at that location, respectively. In previous years large numbers of sea lions were observed rafting within or near the mouth of the Cowlitz River and would have been included in the river surveys. Further downriver, record high numbers of California sea lions were once again hauled out at the East Mooring Basin during March, with an all-time high of 3834 animals counted on March 11.

Analysis of survey data is pending, but if the Rainer Dock counts are included in the 2016 estimate, the peak observations of sea lions in the lower river in March continued a trend of increasing over previous years and are coincident with eulachon (*Thaleichthys pacificus*) run timing. Recently listed as 'threatened' under the Endangered Species Act, eulachon 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 mean daily salmonid biomass requirement for a California sea lion based on the bioenergetics model was 13.4 kg (95% percentile confidence interval was 7.9 to 21.3 kg/day), which translated into a mean of 2.4 Chinook/day (95% percentile confidence interval was 1.4 to 3.7 Chinook/day) and a percent-of-body-mass of 4.2%/day (95% percentile confidence interval was 2.6% to 6.5%). While it is important to note that bioenergetic models produce estimates of food requirements, not food consumption, these results were nonetheless consistent with data from captive California sea lions that showed adult males consumed an average of 10.9 kg/day (and up to a maximum of 35.5 kg/d) on a diet of mackerel, herring, sprat, and squid (Kastelein et al. 2000).

The predicted number of salmonids that hypothetically would have been required for the 166 California sea lions that were removed from 2008-2016 was 24,466 fish (95% percentile confidence interval was 14,329 to 38,795 fish). In addition to preventing the loss of future fish, removal of habituated sea lions 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 haul-outs near the mouth of the river.

ACKNOWLEDGEMENTS

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- NMFS: Robert DeLong, Robert Anderson, Scott Rumsey, and Garth Griffin.
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- PSMFC: Matt Tennis, Dan Heiner, Dave Colpo, and Carol Barstow.
- USACE: Jerry Carol, Ben Hausmann, Mike Roth, Brian Smith, the Bonneville Rigging Crew, Patricia Madson, Karrie Gibbons, and Bjorn van der Leeuw.
- USDA Wildlife Services staff.
- WDFW: Mike Brown, Josh Oliver, Chris Golden, Shay Valentine, Sandra Jonker, and Guy Norman.
- Safety and Security: Chris Allori, Oregon State Police; Murray Schlinker and Jeff Wickersham, Washington Department of Fish and Wildlife; and Jennifer Baker and Greg Webb, USACE.

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REFERENCES

- Brown, R., S. Jeffries, D. Hatch, B. Wright, and S. Jonker. 2010. Field Report: 2010 Pinniped management activities at and below Bonneville Dam. Oregon Department of Fish and Wildlife, 7118 NE Vandenberg Ave. Corvallis, OR 97330.
- Brown, R., S. Jeffries, D. Hatch, B. Wright, and S. Jonker. 2011. Field Report: 2011 Pinniped research and management activities at and below Bonneville Dam. Oregon Department of Fish and Wildlife, 7118 NE Vandenberg Ave. Corvallis, OR 97330.
- Fraker, M. A. and B. R. Mate. 1999. Seals, sea lions, and salmon in the Pacific Northwest. Pages 156-178 in J. R. Twiss Jr. and R. R. Reeves (eds.). Conservation and management of marine mammals. Smithsonian Institution Press, Washington, D.C., USA.
- Harvey, J. T. 1989. Assessment of errors associated with harbour seal (*Phoca vitulina*) faecal sampling. J. Zool. (Lond.), 219: 101-111.
- Kastelein, R. A., N. M. Schooneman, N. Vaughan, and P. R. Wiepkema. 2000. Food consumption and growth of California sea lions (*Zalophus californianus californianus*). Zoo Biology 19:143-159.
- NMFS (National Marine Fisheries Service). 2008. Letter of Authorization to Oregon.
- Scordino, J. 2010. West Coast Pinniped Program Investigations on California Sea Lion and Pacific Harbor Seal Impacts on Salmonids and Other Fishery Resources. Pacific States Marine Fisheries Commission, 205 SE Spokane Street, Suite 100, Portland OR 97202.
- Stansell, R. 2004. Evaluation of pinniped predation on adult salmonids and other fish in the Bonneville Dam tailrace, 2002-2004. U.S. Army Corps of Engineers, Bonneville Lock and Dam, Cascade Locks, OR 97014.
- U.S. Army Corps of Engineers (USACE). 2016. 2015 field report: evaluation of pinniped predation on adult salmonids and other fish in the Bonneville Dam tailrace, 2015. http://www.westcoast.fisheries.noaa.gov/publications/protected_species/marine_mammals/pinnipeds/sea_lion_removals/2015_coe_field_rpt.pdf (last accessed: 2016-09-20).
- Winship, A. J. and A. W. Trites. 2003. Prey consumption of Steller sea lions (*Eumetopias jubatus*) off Alaska: how much prey do they require? Fisheries Bulletin 101:147-167.
- Winship, A. J., A. W. Trites, and D. A. S. Rosen. 2002. A bioenergetic model for estimating the food requirements of Steller sea lions in *Eumetopias jubatus* in Alaska, USA. Marine Ecology Progress Series 229:291-312.

Table 1. Summary of boat-based hazing activities at Bonneville Dam, 2016.

Week of	Days	Take*		Munitions	
		CSL	SSL	Cracker shells	Seal bombs
3/6/2016	3	6	37	72	61
3/13/2016	3	7	46	98	70
3/20/2016	3	4	52	79	72
3/27/2016	3	24	108	166	162
3/3/2016	3	25	89	121	115
4/10/2016	3	58	29	101	67
4/17/2016	3	91	36	149	87
4/24/2016	2	30	19	69	42
4/1/2016	1	29	8	28	8
5/8/2016	3	66	25	92	16
5/15/2016	1	18	3	31	15
Total	28	358	452	1006	715

* Take refers to numbers of animal-harassment events (note: one animal may be harassed multiple times).

Table 2. Summary of sea lion captures at Bonneville Dam, 2016.

Date	Steller sea lions	California sea lions				Total
	Released	Released	Branded	Instrumented	Euthanized	
2016-04-06	12	18			4	22
2016-04-07	8	21			6	27
2016-04-12	14	27		1	4	32
2016-04-13	12	13		3	2	18
2016-04-19	11	18			7	25
2016-04-20	12	29			6	35
2016-04-26	18	20		1	4	25
2016-04-27	12	20		1	5	26
2016-05-03	9	12	14	1	2	29
2016-05-04	12	16	4	1	4	25
2016-05-05	14	19	1		3	23
2016-05-10	15	19	9			28
2016-05-11	12	10	4	1	4	19
2016-05-12	14	10	4		3	17
2016-05-17	17	12	6		3	21
2016-05-18	6	16	5		2	23
2016-05-19	3	11	1			12
2016-05-24			2			2
Total	201	291	50	9	59	409

Table 3. Summary of California sea lion accelerometer-tagging at Bonneville Dam, 2016.

Brand	Tag ID	Color	VHF	Secondary tag	Date released	Date recovered
1-85	6	ORANGE	149.655		2016-04-12	2016-04-18
1-56	3	YELLOW	149.303		2016-04-13	2016-04-27
1-81	2	GREEN	149.235		2016-04-13	2016-05-09*
C051	1	BLUE	149.195		2016-04-13	2016-05-03
U334	5	PINK	149.596	PTT	2016-04-26	2016-05-10
1-83	6b	ORANGE	149.655	PTT	2016-04-27	-
1-38	3b	YELLOW	149.303		2016-05-03	2016-05-18
2-01	1b	YELLOW	149.195	Patch	2016-05-04	-
V60	5b	ORANGE	149.596		2016-05-11	2016-05-17

*Approximate date; found on Martin Island near Kalama.

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
2016					59			59
Total	15	2	1	4	139	1	4	166