State of Washington DEPARTMENT OF FISH AND WILDLIFE

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November 1, 2021

Barry Thom
Regional Administrator, West Coast Region
National Marine Fisheries Service
1201 Northeast Lloyd Boulevard, Suite 1100
Portland, OR 97232

Dear Mr. Thom:

The following information comprises a final report to the National Marine Fisheries Service (NMFS) from the Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, and Idaho Department of Fish and Game (States), documenting compliance with the terms and conditions of our authorization for the lethal removal of predatory California sea lions (CSLs) in the vicinity of Bonneville Dam from 2017-2021 under §120 of the Marine Mammal Protection Act. This authorization was initially granted by NMFS on June 28, 2016, and extended until June 30, 2021.

Due to the COVID-19 pandemic, anticipated management work in spring 2020 was not conducted due to governor's orders and transmission risk for staff in handling animals. This decision was made unanimously by managing partners for both Bonneville Dam and Willamette Falls. On August 19, 2020, NMFS granted the above-listed States and several Columbia River Tribes co-manager status on a new and expanded authorization to lethally remove predatory California and Steller sea lions in the Columbia River, between river mile 112 (I-205 bridge) and river mile 292 (McNary Dam), or in any tributary to the Columbia River that includes spawning habitat of threatened or endangered salmon or steelhead. All lethal removals of sea lions in the Columbia River that took place after August 14, 2020, were conducted under this new authorization, except for those CSLs already on the list of animals approved for removal under the §120 authorization. Thus, the contents of this report primarily describe the management activities conducted between June 28, 2016, and August 13, 2020, and also include information for four CSLs lethally removed at Bonneville Dam in spring 2021.

Adherence to relevant Terms and Conditions are listed below.

Terms and Conditions

No. 1
During the period that management activities were conducted under this NMFS authorization (June 28, 2016 to August 13, 2020, plus four removals between August 13, 2020, and June 30, 2021), the States lethally removed 76 individually identifiable predatory CSLs that were having a significant negative impact on Endangered Species Act (ESA)-listed salmonids at Bonneville Dam.

No. 2
The States provided NMFS a letter dated January 6, 2017 that outlined additional safeguards we implemented to individually identify CSLs for removal.

No. 3
Based on the observations conducted by the US Army Corps of Engineers (USACE), 82 individually identifiable predatory CSLs that met the criteria for removal were requested to be added to the Bonneville Dam Removal Authorization List during the period covered by this report. As of the end of the period when removals were conducted under this authorization, 393 CSLs had been included on this list, of which 242 were removed. Of these 242, 15 were transferred to eligible facilities, 7 died as the result of accidental mortalities, and 220 were intentionally lethally removed.

No. 4
The States did not exceed the limit of taking more than one percent of the current potential biological removal (PBR) in any given year (maximum of 29 actual removals in 2018 out of up to 92 potential allowable removals). Over the period when lethal removals of CSLs were conducted under this authorization, 76 actual removals were conducted compared with an allowable 460 (1% of PBR over four years, 2017-2021).

No. 5
The States consulted with our Institutional Animal Care and Use Committee (IACUC) prior to each field season to review protocols for capture, holding, and euthanasia of individually identifiable predatory CSLs.

No. 6.
No pre-approved permanent holding facilities requested CSLs during the period covered by this authorization. Therefore all 76 captured animals meeting the criteria for removal were euthanized according to IACUC-approved methods.

Nos. 7 and 8.
Firearms were not used to remove any predatory CSLs; therefore, retrieval of carcasses from the water was not required.

No. 9
The States coordinated safety and security protocols with the Columbia Basin Law Enforcement Council and the USACE.

No. 10
The States notified the USACE, Portland District, and the Project Manager at Bonneville Locks and Dam, prior to the beginning of lethal removal operations.

No. 11
The transfer and disposal of carcasses, tissues, and other parts were done in accordance with applicable law. In addition, the States made tissues available to authorized recipients for scientific research or for educational purposes.

No. 12
The States notified the Regional Administrator, NMFS West Coast Region, of all sea lion removal operations within the required three-day period, as well as of the cancellation of fieldwork for the spring 2020 management field season.

No. 13
The States, in cooperation with the USACE and the Columbia River Inter-Tribal Fish Commission (CRITFC), presented results from on-going monitoring of predation, the use of non-lethal deterrence, and the effectiveness of removals to reduce adult salmonid mortality in a February 8, 2017 report titled "Effectiveness review of Marine Mammal Protection Act §120 implementation under 2012 Letter of Authorization to Washington, Oregon, and Idaho" (https://archive.fisheries.noaa.gov/wcr/publications/protected_species/marine_mammals/pinnipeds/sea_lion_removals/2017/appendix_c_effectiveness_review_of_mmpa_section_120_implementation_under_2012_letter_of_authorization_to_wa__or__id_2017.pdf)

No. 14
This letter describing our compliance with the terms and conditions of the current authorization and the following field report represents our annual monitoring report and final report to NMFS for this authorization. As of August 14, 2020, managing parties are under an MMPA §120(f) permit to conduct similar management activities at Bonneville Dam and an extended geographic area under a new set of requirements. The newest authorization also includes Steller sea lions within the geographic area of management (SEE: “NMFS MMPA Section 120 Permit Authorizing the Intentional taking on the Waters of the Columbia River and its Tributaries of California Sea Lion and Steller Sea Lions”, 14 August 2020). Four CSLs lethally removed in spring 2021 were included on the list of animals approved for removal under the §120 authorization, so are included in this report; however, information for the other CSLs removed in spring 2021 is included in the annual report for the new §120(f) authorization.

No 15.
Under this authorization, the States consulted with the USACE predation observation program to identify any new CSLs that have met the criteria for removal. During the period that management was conducted under this authorization, 82 new animals were added to the Bonneville Dam Removal Authorization List. Under the new 2020 permit, individual identification of sea lions is not required. Four CSLs lethally removed in spring 2021 were included on the list of animals approved for removal under the §120 authorization, so are

included in this report; however, information for the other CSLs removed in spring 2021 is included in the annual report for the new §120(f) authorization.

No. 16
We understand that the authorization may be modified, suspended, or revoked by NMFS at any time given 72 hours' notice to the States.

No. 17
We understand that this authorization is valid until June 30, 2021, at which time it may be extended by NMFS for an additional period to be determined by NMFS.

Managing parties remain committed to pursuing all reasonable approaches to reduce pinniped predation on threatened and endangered Columbia River salmonids. As you know, however, existing non-lethal tools have proven largely ineffective, and no effective new options have been identified. While we would prefer to find and implement successful non-lethal methods for reducing predation, permanent removal of some number of predatory sea lions may continue to be necessary for the foreseeable future.

We thank you for your assistance and support of our work to monitor and reduce sea lion predation on threatened and endangered salmonids below Bonneville Dam and elsewhere in the lower Columbia River basin. Please let us know if we can provide further information related to our annual reporting obligations.

Sincerely,

Casey Clark

Casey Clark
Lead Marine Mammal Researcher
Washington Department of Fish & Wildlife

FINAL FIELD REPORT:
2017-2021 PINNIPED RESEARCH AND MANAGEMENT ACTIVITIES AT BONNEVILLE DAM

Casey Clark[1], Mike Brown[2], Doug Hatch[3], and Joe Dupont[4]

November 1, 2021

[1] Washington Department of Fish and Wildlife
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INTRODUCTION

Bonneville Dam, located approximately 235 km (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 (CSLs; *Zalophus californianus*) were reported annually at the dam during fishway inspections (Stansell 2004). In 2001, however, there were reports of up to six CSLs observed at one time, and in 2002 the U.S. Army Corps of Engineers (USACE) estimated 30 CSLs were foraging on salmonids (*Onchorynchus* spp.) at the dam. Many of these salmonid runs are listed under the Endangered Species Act (ESA). Since that time, the minimum number of CSLs seen at Bonneville Dam during a given year has fluctuated between approximately 40-200 individuals, with associated predation of between approximately 1,000 and 8,000 salmonids per year (Tidwell et al. 2019).

Steller sea lion (SSL; *Eumetopias jubatus*) abundance and residency at the dam has also increased over the last decade, increasing from zero animals before 2003 to a maximum of 89 individuals in 2011 (Tidwell et al. 2019). This species is now present at Bonneville Dam for most of the year, unlike CSLs which are present primarily in the spring. While SSLs initially foraged primarily on white sturgeon (*Acipenser transmontanus*), in recent years they have consumed more salmonids than sturgeon and have increasingly impacted fall and winter salmonid runs. Most notably, in 2017, SSLs consumed more salmonids than CSLs did in 2006 when the initial §120 authority was requested (Tidwell et al. 2019).

In response to increasing pinniped predation at the dam, state, federal, and tribal agencies have attempted to deter pinnipeds using a variety of non-lethal methods. Starting in 2005, these methods have included aerial and underwater pyrotechnics, acoustic harassment devices, vessel chase, rubber projectiles, and capture-relocation. While hypothetically effective at deterring predation by naïve animals, they have generally been found to be ineffective at deterring predation by habituated individuals (Scordino 2010).

Increasing predation by CSLs 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 §120 of the Marine Mammal Protection Act (MMPA) for the authority to permanently remove CSLs that were observed preying on salmonids near Bonneville Dam. In March 2008, National Marine Fisheries Service (NMFS) partially approved the States' application and issued a Letter of Authorization (LOA) for the lethal removal of certain CSLs 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 was to expire on June 30, 2016, but on June 28, 2016, it was renewed until June 30, 2021. On April 17, 2019, the removal criteria in Term & Condition 1 of this authorization were amended, but the duration of the authorization was not changed (NMFS 2016, NMFS 2019). On August 14, 2020, managing parties were granted a new authorization to conduct similar management activities at Bonneville Dam and an extended geographic area under a new set of requirements. The newest authorization also includes Steller sea lions within the geographic area of management (SEE: “NMFS MMPA Section 120 Permit Authorizing the

Intentional taking on the Waters of the Columbia River and its Tributaries of California Sea Lion and Steller Sea Lions", 14 August 2020).

This report summarizes pinniped research and management activities at Bonneville Dam during the period when these activities were conducted under this initial §120 authorization (June 28, 2017 to August 13, 2020), as well as the lethal removal of four CSLs in spring 2021 that were on the list of animals authorized for removal under the §120 authorization. This work was led by the Oregon Department of Fish and Wildlife (ODFW) and the Washington Department of Fish and Wildlife (WDFW), in cooperation with the Columbia River Inter-Tribal Fish Commission (CRITFC) and Idaho Department of Fish and Game (IDFG). This work has been conducted in close coordination and cooperation with USACE and NMFS, as well as numerous other agencies.

METHODS

Activities conducted under and in association with this authorization included pinniped surveys between Bonneville Dam and the mouth of the Columbia River, boat-based non-lethal deterrence of sea lions by CRITFC staff, trapping and lethal removal of predatory CSLs, diet analysis from contents of stomachs and intestines recovered from euthanized CSLs, and estimation of the effect of removals on salmonid runs (i.e., the number of salmon "saved" as a result of lethal removal of predatory CSLs). The methods used for these activities are detailed below.

Pinniped surveys

River surveys were conducted by CRITFC to document and enumerate sea lion abundance and predation activity in the river below Bonneville Dam. Surveys extended either 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 near Longview, Washington. Most surveys were conducted by two independent boats to estimate sea lion detectability. Each boat was crewed by a captain and at least one observer. Sea lion species, observed 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.

Boat-based deterrent activities

Boat-based hazers from CRITFC used a combination of deterrents (e.g., seal bombs, cracker shells, and vessel chase) to 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 Bonneville Dam to look for foraging sea lions. For each discrete hazing event, the following information was recorded: 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 staff 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, use of seal bombs was halted 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 staff from ODFW and WDFW using haul-out traps placed in dam tailraces. Sea lions use these traps as haul-out sites, entering and exiting traps by way of a vertically-sliding door, which was pad-locked open when trapping was not actively underway (e.g., weekends and months when fieldwork did not occur). Tailrace traps were monitored by state, federal, and private security staff. 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. In spring 2019, real-time trap monitoring was introduced using in-trap cellular cameras. This allowed co-managers to determine whether animals were on the traps, which was particularly important in the event of an unplanned trap closure.

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 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 various samples (e.g., teeth, tissue, blood, whiskers) were collected and stored for later analysis.

Diet Analysis

Stomachs and large intestines from euthanized CSLs were collected and scanned for PIT tags to gather dietary information. Processing of gastrointestinal (GI) tracts followed established procedures (e.g., see Lance et al. 2001). Undigested remains were washed through a series of nested sieves (2 mm, 1 mm, and 0.05 mm) and all parts were collected for later identification. Samples were identified to the lowest possible taxonomic level using a dissecting microscope by comparing all identifiable prey remains (e.g., bones, otoliths, cartilaginous parts, eye lenses, teeth, and cephalopod beaks) against a reference collection of fish and invertebrates from the northeastern Pacific Ocean and Oregon estuaries. Prey were enumerated by examining all structures (otoliths, tail structures, cephalopod beaks, etc.) to determine the minimum number of individual prey items in the sample. This enumeration process accounts for paired structures (i.e.,

left vs. right side structures) and differences in size of recovered prey remains that may indicate they originated from different individual prey items.

Effect of removals

The effect of removals was characterized by estimating how many salmonids would have been required over the expected post-removal lifetimes of individual sea lions had they not been removed. This was accomplished using an agent-based modeling (ABM) approach (see Sibley et al. 2013, Macal 2016, and An et al. 2021 for background and examples). Results are based on summaries of 100 model runs. Note that this work is ongoing and subject to revision as new data becomes available and as new modeling approaches are evaluated. Details of the model are provided in the Appendices; model code (R) is available upon request.

RESULTS AND DISCUSSION

Pinniped surveys

Boat-based surveys were conducted during 10 weeks in 2017, and 11 weeks in 2018 and 2019. In 2020, survey effort was limited to 4 weeks of single-boat surveys due to the COVID-19 pandemic. Surveys were typically conducted between March and May, but sometimes occurred as early as February. Sea lion abundance between Bonneville Dam and Astoria, Oregon, increased precipitously through 2015, declined substantially in 2017 and 2018, and returned to relatively high numbers in 2019 and 2020 (Table 1). In 2020, sea lion abundance was similar to the counts in 2019 with an average of 558.5 sea lions (range: 489–646) per week for Zones 2–4; however, these estimates are not fully comparable due to the omission of Zone 1 counts and an abbreviated season due to COVID-19 restrictions (February 24 – March 16). Estimates for some weeks, and for the entire 2020 season (noted with an * in Table 1), were generated from single-boat surveys, which underreport sea lion numbers relative to tandem boat surveys. On average the second boat increased reported counts by 39.4%.

Boat-based deterrent activities

The boat-based hazing crew from CRITFC hazed sea lions for an average of 31 days (range: 29-34, total: 94) from March to May, 2017-2019 (Table 2). This work involved an average of 209 individual hazing events (range: 200–222), and resulted in an average of 173 (range: 103-311) and 512 (range: 456-592) "takes" of CSLs and SSLs, respectively (where "take" refers to a discrete hazing event). Takes of CSLs declined across the period of this authorization, whereas takes of SSLs increased during this period, reflecting the increasing use of the area below Bonneville Dam by SSLs through time. An average of 1,811 (range: 1,487-2,204) cracker shells and 903 (range: 824-1046) seal bombs were used during deterrent activities. In 2020, seven days of hazing activities were conducted before they were suspended due to COVID-19 restrictions. This week of hazing involved 16 hazing events, resulting in 14 takes of CSLs and 30 takes of SSLs, bringing the total takes from boat-based deterrent activities conducted under this authorization to 535 for CSLs and 1,566 for SSLs resulting from 642 individual hazing events.

CRITFC employees deployed 169 cracker shells and 117 seal bombs, thus a total of 5,602 cracker shells and 2,708 seal bombs were deployed under this authorization.

The purpose of non-lethal, boat-based deterrent activities was three-fold. First, it attempted 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 have become eligible for permanent removal. Lastly, boat-based hazing, in conjunction with USACE-provided dam-based hazing, helps satisfy the §120 requirements for hazing prior to any removal efforts. However, based on our anecdotal observations, there was no obvious reduction in overall sea lion abundance or predation in response to hazing. This is similar to other studies, which 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 activities were conducted during the months of April and May in 2017-2019. Successful trapping occurred on an average of 15 (range: 12-18, total: 46) nights during the management period (Table 3). Average capture rates per night of trapping were 7 (range 3-10) CSLs and 4 (range: 2-6) SSLs per night. New brands were applied to an average of 10 (range: 3-18, total: 29) CSLs and 5 (range: 1-12, total: 16) SSLs per season. In 2017 and 2018, many uniquely marked CSLs were captured (some multiple times) and subsequently released because they did not fit the criteria for removal. In 2019, the eligibility criteria were modified (specifically, the “and” provision in Term and Condition 1 was changed to “or”) to make the process more efficient. In this year, 23 uniquely marked individuals were captured and 19 met the criteria for removal. California sea lion trapping activities were not conducted in 2020 due to the COVID-19 pandemic. Sea lion trapping after August 14, 2020, was conducted under the new §120(f) authorization; however, CSLs previously added to the list of animals authorized for removal under the §120 authorization are reported here. In April and May 2021, four CSLs on this list were removed under the §120 authority. All other CSLs lethally removed in spring 2021 are included in the reporting for the §120(f) authorization.

The average weight of euthanized CSLs (n = 76) was approximately 235 kg (517 lbs), with a range of 141-428 kg (311-944 lbs). The average length of euthanized CSLs was approximately 220 cm (7.2 ft), with a range of 196-246 cm (6.4-8.1 ft). Age data based on sectioned teeth have been obtained for 191 animals lethally removed since 2009. The average age of euthanized animals over the whole project was 7.7 years, with a range of 2-13 years. Tooth age data is available for 66 animals lethally removed between 2017 and 2021 under the authorization discussed in this report. The average age of euthanized animals during this period was 7.7 years, with a range of 3-11 years.

Diet analysis

During the period when lethal removals were conducted under this authorization, a total of 72 GI tracts containing recoverable, undigested remains were collected from CSLs: 24 in 2017, 29 in

2018, and 19 in 2019. Of these GI tracts, 94% (n = 68) contained remains of adult salmonids, and 38% (n = 27) contained remains of juvenile salmonids (Table 4). Over the course of the management work detailed in this report, remains of at least 174 adult salmonids were recovered from the GI tracts of CSLs, with 90% (n = 156) of those being adult Chinook salmon. In 2018 and 2019, remains from at least 572 juvenile salmonids were recovered from the GI tracts of CSLs at Bonneville Dam.

A total of 37 PIT tags were recovered from CSL GI tracts, providing some information about the origins of salmonids consumed by predatory CSLs in the Columbia River (Tables 4 and 5). The origins of these fish included wild spring Chinook, hatchery fall Chinook, wild summer steelhead, and hatchery summer steelhead. Most PIT tags originated from juvenile fish, though some were consumed when the fish was an adult.

Other, less-commonly recovered prey items included Pacific lamprey (*Entosphenus tridentatus*), Cyprinidae (pikeminnow/peamouth), American shad (*Alosa sapidissima*), eulachon (*Thaleichthys pacificus*), Pacific herring (*Clupea pallasii*), sculpin (Cottidae), and one small unidentified lamprey species (Petromyzontidae).

Effect of Removals

Results from agent-based modelling of the 76 CSLs removed under MMPA §120 authority for Bonneville Dam indicate that the median post-removal lifetime requirement for these individuals was approximately 14,000 salmonids (Figure 1); the 95% confidence interval was approximately 3,000 to 34,000 salmonids. Median daily biomass requirement (all prey) was estimated to be 11.4 kg, which as a percent of body mass was estimated to be 4.2%. Median annual and lifetime residency was estimated to be 21 days and 85 days, respectively.

CONCLUSIONS

The lethal removals of CSLs at Bonneville Dam conducted under this authorization resulted in real conservation benefits for ESA-list fish stocks in the Columbia River, with an estimated ~14,000 (95% CI: 3,000 - 34,000) salmonids “saved” as a result of these removals. Overall numbers of CSLs at Bonneville Dam declined over the period when lethal removals were conducted under this authorization (Tidwell et al. 2019) and the efficiency of trapping efforts increased, particularly with the amendment of the authorization in 2019. Though work under this authorization concluded early due to the COVID-19 pandemic and the change to a new, expanded authorization, the management efforts described here were successful and have helped to move in the direction of achieving management goals for Threatened and Endangered fish stocks in the Columbia River. Continued adaptability and innovation by co-managers will no doubt drive further improvements to the efficiency and effectiveness of management efforts at Bonneville Dam.

The substantial increase in numbers of SSLs at Bonneville Dam presented a management challenge that could not be addressed under the authorization discussed in this report. The

expanded authorization under which the States have been operating since August 14, 2020, has allowed managers the flexibility needed to address the problem of predatory sea lions at Bonneville Dam. Continued development and testing of non-lethal deterrents will be important as the number of habituated sea lions at the dam decreases and the opportunities to meet management goals by deterring naïve increase. The expanded management also allows for lethal removals of sea lions in tributaries of the Columbia River that include spawning habitat of threatened or endangered salmon or steelhead. To be successful in this task, we will need to apply lessons learned while working under the authorization discussed in this report, as well as new management tools and techniques.

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We also wish to acknowledge and congratulate three colleagues who retired in 2020 that have worked on salmon and sea lion issues in the Columbia River Basin for decades and for whom we owe a great debt of gratitude: Tom Murtagh (ODFW), Steve Jeffries (WDFW), and Bob DeLong (NMFS). And more sadly, we note the passing of two long-time colleagues in 2020 who were also instrumental in salmon conservation and sea lion work in the Columbia River Basin: Bobby Begay (CRITFC) and Dan Heiner (PSMFC). For all five of these colleagues, we can truly say that if we are successful in our work then it will be by building on the strong foundation that they have laid.

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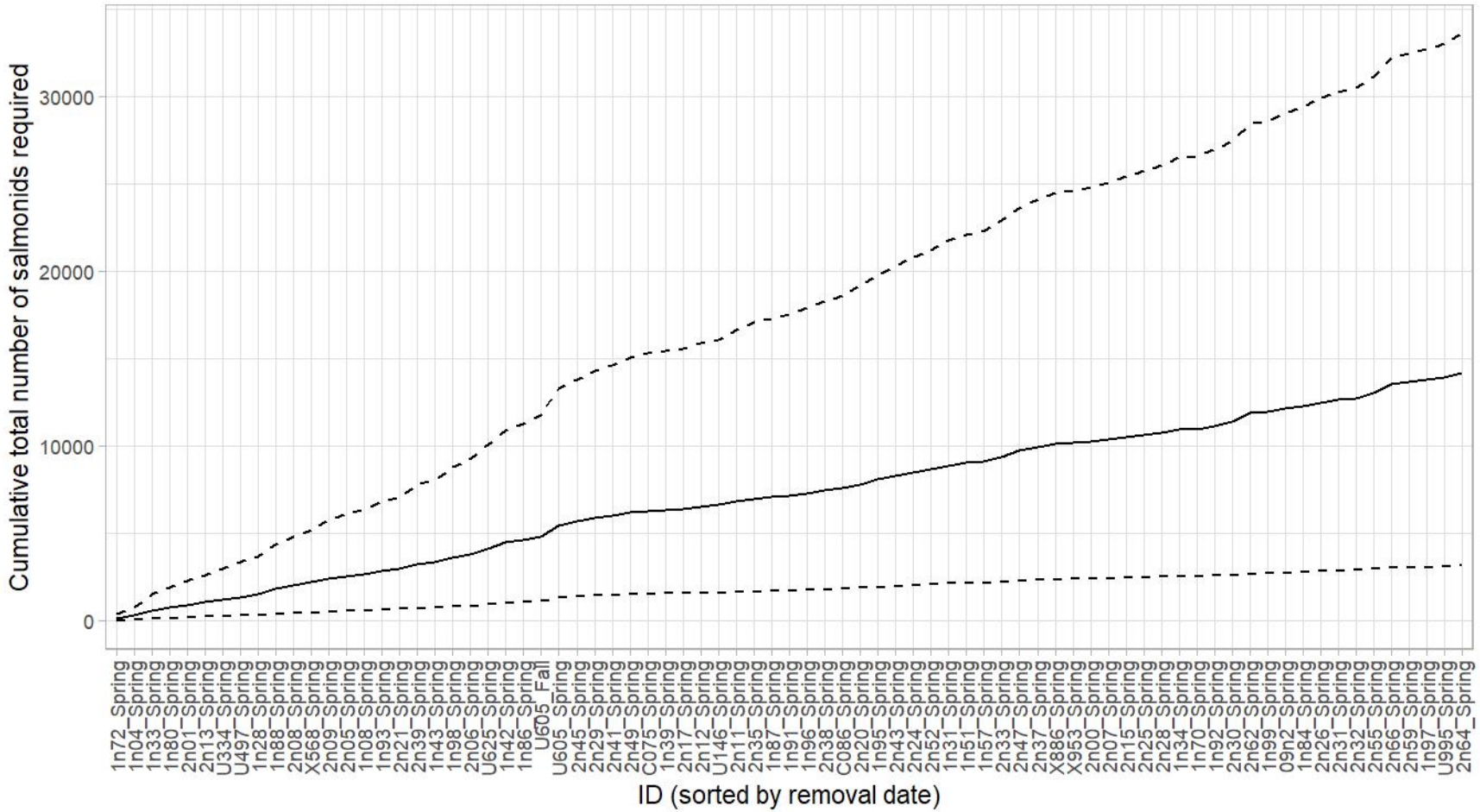


Figure 1. Estimated post-removal lifetime salmonid requirements for 76 California sea lions removed under MMPA Section 120 authority. Solid line equals median estimated requirements; dashed lines equal 2.5th and 97.5th percentiles. See Appendices 1 and 2 for model details.

TABLES

Table 1. Weekly tandem boat sea lion counts by zone from 2017-2020. * Indicates single boat surveys versus tandem.

Statistical Week	9	10	11	12	13	14	15	16	17	18	19	20
2017 Date	28-Feb	7-Mar	14-Mar	22-Mar	28-Mar	4-Apr	11-Apr	18-Apr	25-Apr	2-May	9-May	16-May
Zone 1	2	2	3	5	3	1	6	-	12*	9*	9*	-
Zone 2	14	14	5	1	5	4	5	-	2*	3*	2*	-
Zone 3	15	15	6	2	2	2	1	-	-	-	-	-
Zone 4	3	3	4	1	1	2	3	-	-	-	-	-
2018 Date	-	6-Mar	14-Mar	20-Mar	27-Mar	3-Apr	10-Apr	17-Apr	24-Apr	1-May	8-May	15-May
Zone 1	-	5	2	4	3	5	9	10	9	12	4*	8*
Zone 2	-	5	28	13	4	3	12	6	10	8	1*	5*
Zone 3	-	3	2	3	7	3	1	5	8	15	7*	0*
Zone 4	-	3	2	1	3	13	2	4	5	5	-	-
2019 Date	-	5-Mar	12-Mar	19-Mar	26-Mar	2-Apr	9-Apr	16-Apr	23-Apr	30-Apr	7-May	15-May
Zone 1	-	1	5	0	2	14	6	11	20	19	5*	5*
Zone 2	-	84	34	31	71	13	4	6	6	3	0*	0*
Zone 3	-	411	263	356	144	72	14	9	7	5	1*	12*
Zone 4	-	33	20	6	22	15	17	12	3	4	1*	NA
2020 Date	24-Feb	2-Mar	9-Mar	16-Mar	-	-	-	-	-	-	-	-
Zone 1	-	-	-	-	-	-	-	-	-	-	-	-
Zone 2	149*	531*	12*	276*	-	-	-	-	-	-	-	-
Zone 3	344*	76*	280*	133*	-	-	-	-	-	-	-	-
Zone 4	18*	39*	296*	80*	-	-	-	-	-	-	-	-

Table 2. Summary of boat-based hazing activities at Bonneville Dam, 2017-2020.

			Take*		Munitions	
Year	Days	Hazing Events	CSL	SSL	Cracker Shells	Seal Bombs
2017	29	222	311	592	1,487	824
2018	31	204	105	488	2,204	838
2019	34	200	103	378	1,742	1,046
2020	7	16	14	30	169	117
Total	101	642	533	1,566	5,602	2,825

* Take refers to numbers of animal-harassment events (one animal may be harassed);
CSL=California sea lion, SSL=Steller sea lion.
**Sea lion hazing activities were suspended in 2020 due to Covid-19 shutdowns and mitigation.

Table 3. Summary of sea lion captures at Bonneville Dam, 2017-2019. Captures were not conducted under this authorization in 2020 due to the COVID-19 pandemic. In spring 2021, capture activities were conducted under the new §120(f) authorization and are reported as such; however, four California sea lions captured that season had been previously authorized for lethal removal under the §120 authorization, thus are included in other sections of this report.

Year	Total sea lions caught	Steller sea lions		California sea lions		
		Total	Released (branded*)	Total	Released (branded**)	Euthanized
2017	255	91	91 (12)	164	140 (18)	24
2018	225	75	75 (3)	150	122 (8)	28
2019	54	19	19 (1)	35	16 (3)	19
Total	534	185	185 (16)	349	278 (29)	71
Average	178	61.7	61.7 (5.3)	116.3	92.7 (9.7)	23.7

*New Steller sea lion brands: O-40 to O-55.

**New California sea lion brands: 2-38 to 2-66.

Table 4. Summary of prey remains recovered from gastrointestinal tracts of 72 California sea lions removed at Bonneville Dam, 2017-2019. Information for the four CSLs removed in 2021 under the §120 authorization discussed in this report are still pending and will be reported in the 2021 Section §120(f) annual report.

		Salmonid										
Date	CSL ID	Adult*	Juvenile	PIT tag	Pacific lamprey	Lamprey Spp.	Cyprinid	Shad	Eulachon	Cottidae	Herring	Cephalopod
2017-04-19	1-72	1	1				1					
2017-04-25	1-80	3										
	U334											
	2-01	1										
	1-33	2	1									
	2-13	6			3							1
	1-04	1						1				1
2017-04-27	U497	2										
2017-05-02	2-08	1	2	1								
	1-88	8										
	X568	1										
	1-28	4										
2017-05-03	2-09	3										
2017-05-04	2-05	2		1								
2017-05-09	1-08	5										
	2-21	2			1							
	2-39	3			7							
	1-93	1										
2017-05-10	1-98	1										1
	1-43	1	1									
2017-05-11	U625	3	2									
2017-05-16	1-42	2	1									
2017-05-17	2-06	4			1							
	1-86	2	1									1
2018-02-15	U605**	1	2									
2018-04-10	2-45	1			2				1		1	
2018-04-11	2-29	1	80	2				1				
	2-41	1										
	2-49	1						1				
	C075	1	5	1			1					
2018-04-17	1-39	1										
	2-17	1	7			1						
2018-04-18	2-12		101	7			1			1		
	U146	3	11	1								

2018-04-19	2-11		28	1			1	1				
	2-35	2	33	1			1					
2018-04-24	1-87	2					1					
	1-91	3						1				
	1-96	1	9		1							
	2-38	1	1									
	C086	4		3								
2018-04-25	2-20	1	18				1					
2018-05-01	1-95	1										
	2-43	1	1									
2018-05-03	2-24	7			1							
	2-52	1	1		1							
2018-05-08	1-31	7										
	1-51	3										
	1-57	6			2							
	2-33	3			2							
	2-47	11										
2018-05-09	2-37											
2018-05-15	X886	1										
2019-04-30	X953	5										
2019-05-01	2-00	1	148	6				1				
	2-07	4										
	2-15	1			1							
	2-25	3			1							
	2-28	1										
2019-05-02	1-34	3	72	6	1							
	1-70	2										
	1-92	2	29	5								
	2-30	5			1							
2019-05-07	2-62	1	1									
2019-05-08	1-99	1										
2019-05-14	1-84	5	1			1		1				
	2-26	3										
	09-2	3	1									
2019-05-15	2-31	5			2							
	2-32	2						2				
	2-55	1	14	2				1				
	2-66	1										
Total		174	572	37	27	2	7	10	1	1	1	4

*All identified as Chinook salmon except nine that were unidentified to species.
**Captured at Willamette Falls; all other removals from Bonneville Dam.

Table 5. Tag histories from 40 PIT tags recovered from gastrointestinal tracts of California sea lions removed at Bonneville Dam, 2016-2019.

CSL	Removal date	PIT tag	Run*	Release site	Release type	Release sub-basin	Release date	Release distance (km)
1-85	2016-04-09	3DD.007788DD51	hChS	PELTON	Acclimation Pond	Lower Deschutes	2016-04-04	255
U638	2016-04-20	3DD.00777441BB	hStS	NEWSOC	River	South Fork Clearwater	2016-04-05	716
1-38	2016-05-18	3DD.0077482EE4	wChS	JDAR2	River Segment	Upper John Day	2014-10-22	482
2-08	2017-05-02	3DD.0077ADFE1C	hChF	PLAP	Acclimation Pond	Hells Canyon	2017-04-07	676
2-05	2017-05-04	3DD.003BF766FD	hStS	DAYP	Acclimation Pond	Walla Walla	2017-04-10	381
2-29	2018-04-11	3DD.0077A191D9	hChS	WSPH	Hatchery	Lower Deschutes	2018-03-29	245
		3D9.1C2DEE9B3F	hChF	SPRC	Hatchery	Middle Columbia	2018-04-09	34
C075	2018-04-11	3DD.0077A22457	hChS	WSPH	Hatchery	Lower Deschutes	2018-03-29	245
2-12	2018-04-18	3DD.0077A9701E	hChS	KLIH	Hatchery	Klickitat	2018-03-26	121
		3DD.003C02799F	hStS	DWORMS	Hatchery	Clearwater	2018-04-02	581
		3DD.003C028F06	hStS	DWORMS	Hatchery	Clearwater	2018-04-02	581
		3DD.007797EA5D	hChF	LYFE	Hatchery	Lower Snake	2018-04-02	372
		3DD.0077A46A89	hChS	LWSH	Hatchery	Middle Columbia	2018-04-10	55
		3DD.003C006076	hChS	PELTON	Acclimation Pond	Lower Deschutes	2018-04-11	255
		3DD.003C0452FE	hStS	RINH	Hatchery	Upper Columbia	2018-04-15	328
U146	2018-04-18	3DD.003BFE998E	hChS	PELTON	Acclimation Pond	Lower Deschutes	2018-04-09	255
2-11	2018-04-19	3DD.007781F6CF	hChF	LYFE	Hatchery	Lower Snake	2018-04-02	372
2-35	2018-04-19	3DD.0077BE3C99	hStS	SNAKE4	River	Hells Canyon	2018-03-27	676
C086	2018-04-24	3DD.007790208E	hChF	LYFE	Hatchery	Lower Snake	2018-04-02	372
		3DD.0077A54AAD	hStS	SAWT	Hatchery	Upper Salmon	2018-04-02	1208
		3DD.003C045C03	hStS	RINH	Hatchery	Upper Columbia	2018-04-15	328
2-00	2019-05-01	3DD.0077C9BF64	hChS	RAPH	Hatchery	Little Salmon	2019-03-11	744
		3DD.0077CC9158	hStS	SAWT	Hatchery	Upper Salmon	2019-04-01	1208
		3DD.0077D8E975	hStS	PAHSIW	Trap or Weir	Pahsimeroi	2019-04-02	1082
		3DD.0077B548A3	hStS	SAWT	Hatchery	Upper Salmon	2019-04-02	1208

		3DD.003C095CE0	hChS	PELTON	Acclimation Pond	Lower Deschutes	2019-04-09	255
		3DD.0077BEAB62	hChS	MVFLAP	Acclimation Pond	Middle Columbia-Hood	2019-04-22	63
1-34	2019-05-02	3DD.0077ADB72D	wStS	SFSRKT	Trap or Weir	South Fork Salmon	2018-10-30	869
		3DD.0077DA7D94	hStS	MEAD2C	River	South Fork Clearwater	2019-03-20	699
		3DD.0077D17B78	hStS	NEWSOC	River	South Fork Clearwater	2019-03-27	716
		3DD.0077B0C498	hChS	CLWHNF	Hatchery	Lower N Fork Clearwater	2019-03-28	577
		3DD.0077C08332	hStS	LGRRRR	Intra-Dam	Lower Snake-Tucannon	2019-04-18	461
		3DD.0077ADC4D3	hStS	KLICKR	River	Klickitat	2019-04-23	84
1-92	2019-05-02	3DD.0077C98F2A	hChS	RAPH	Hatchery	Little Salmon	2019-03-11	744
		3DD.0077C0DF1E	hStS	WALH	Hatchery	Wallowa	2019-03-26	754
		3DD.003BF2FD91	hChS	WSPH	Hatchery	Lower Deschutes	2019-04-05	245
		3DD.003D3DAE88	hChS	PELTON	Acclimation Pond	Lower Deschutes	2019-04-11	255
		3DD.0077CA9B97	wStS	ASOTIC	River	Lower Snake-Asotin	2019-04-19	525
2-55	2019-05-15	3DD.003BE69D71	wChS	NASONC	River	Wenatchee	2018-09-18	698
		3DD.0077B4877F	hStS	COTP	Acclimation Pond	Lower Grande Ronde	2019-04-21	605

*h = hatchery, w = wild, ChS = spring Chinook salmon, ChF=fall Chinook salmon, StS = summer steelhead

Table 6. Individually identifiable predatory California sea lions lethally removed at Bonneville Dam under MMPA Section 120 authority, 2017-2021.

Removal Date	Brand	Appendix Serial Number	Date Added to Removal Appendix	Date Branded	Age	Weight (lbs)	Length (cm)
2017-04-09	1-72	272	2016-04-22	2015-05-19	8	600	227
2017-04-25	1-04	237	2015-05-26	2015-04-22	9	492	230
2017-04-25	1-33	313	2017-04-24	2015-04-29	5	450	217
2017-04-25	1-80	292	2016-05-16	2015-05-19	9	430	225
2017-04-25	2-01	312	2017-03-24	2016-05-03	9	380	202
2017-04-25	2-13	306	2016-05-23	2016-05-10	9	420	220
2017-04-25	U334	289	2016-05-11	2013-03-24	8	403	214
2017-04-27	U497	315	2017-04-24	2014-03-31	7	649	231
2017-05-02	1-28	299	2016-05-23	2015-04-28	8	472	220
2017-05-02	1-88	301	2016-05-23	2016-05-03	6	520	223
2017-05-02	2-08	304	2016-05-23	2016-05-10	7	350	203
2017-05-02	X568	319	2017-05-02	2016-08-15	9	518	N/A
2017-05-03	2-09	317	2017-05-02	2016-05-10	8	530	217
2017-05-04	2-05	296	2016-05-16	2016-05-04	8	415	217
2017-05-09	1-08	220	2015-05-11	2015-04-22	7	520	230
2017-05-09	1-93	293	2016-05-16	2016-05-03	7	411	211
2017-05-09	2-21	309	2016-05-23	2016-05-12	9	324	196
2017-05-09	2-39	318	2017-05-02	2017-04-20	7	576	222
2017-05-10	1-43	250	2016-03-29	2015-05-14	7	496	223
2017-05-10	1-98	316	2017-05-02	2016-05-03	6	472	209
2017-05-11	2-06	322	2017-05-08	2016-05-05	8	486	205
2017-05-11	U625	297	2016-05-16	2014-08-25	9	584	224
2017-05-16	1-42	314	2017-04-24	2015-05-14	6	943	240
2017-05-17	1-86	324	2017-05-15	2015-05-20	9	843	246

2018-02-14	U605*	267	2016-04-15	2014-08-019	N/A	585	232
2018-04-10	2-45	328	2017-05-15	2017-05-03	N/A	550	230
2018-04-11	2-29	331	2017-05-22	2016-05-17	N/A	485	230
2018-04-11	2-41	326	2017-05-15	2017-04-26	10	422	219
2018-04-11	2-49	341	2018-03-23	2017-05-10	N/A	420	227
2018-04-11	C075	198	2015-05-11	2015-04-14	9	475	220
2018-04-17	1-39	245	2015-05-26	2015-05-14	10	440	215
2018-04-17	2-17	338	2018-03-23	2016-05-11	9	493	226
2018-04-18	2-12	323	2017-05-08	2016-05-10	5	380	214
2018-04-18	U146	342	2018-03-23	2010-09-29	9	612	242
2018-04-19	2-11	305	2016-05-23	2016-05-10	4	347	206
2018-04-19	2-35	339	2018-03-23	2016-05-19	7	391	214
2018-04-24	1-87	288	2016-05-11	2015-05-20	6	376	217
2018-04-24	1-91	337	2018-03-23	2016-05-03	7	310	202
2018-04-24	1-96	320	2017-05-08	2016-05-03	8	401	215
2018-04-24	2-38	325	2017-05-15	2017-04-19	9	500	215
2018-04-24	C086	321	2017-05-15	2018-04-24	10	547	228
2018-04-25	2-20	329	2017-05-22	2016-05-12	8	573	232
2018-05-01	1-95	302	2016-05-23	2016-05-03	7	501	212
2018-05-01	2-43	334	2017-05-22	2017-05-02	9	737	238
2018-05-03	2-24	330	2017-05-22	2016-05-17	8	551	207
2018-05-03	2-52	336	2017-05-22	2017-05-11	11	584	223
2018-05-08	1-31	291	2016-05-16	2015-04-29	8	782	229
2018-05-08	1-51	349	2018-05-07	2015-05-14	7	455	206
2018-05-08	1-57	285	2016-05-11	2015-05-19	7	508	219
2018-05-08	2-33	347	2018-05-07	2016-05-18	7	607	217
2018-05-08	2-47	348	2018-05-07	2017-05-09	7	636	224
2018-05-09	2-37	344	2018-05-04	2016-05-23	P	454	203

2018-05-15	X886	350	2018-05-14	2017-04-18	P	427	204
2019-04-30	X953	381	2019-04-29	2017-05-31	9	630	228
2019-05-01	2-00	303	2016-05-23	2016-05-03	8	487	226
2019-05-01	2-07	369	2019-04-17	2016-05-10	9	563	230
2019-05-01	2-15	370	2019-04-17	2016-05-10	5	392	205
2019-05-01	2-25	371	2019-04-17	2016-05-17	8	528	224
2019-05-01	2-28	373	2019-04-17	2016-05-17	10	516	224
2019-05-02	1-34	383	2019-04-30	2015-04-29	8	551	207
2019-05-02	1-70	351	2018-05-14	2015-05-19	10	498	230
2019-05-02	1-92	366	2019-04-17	2016-05-03	5	386	205
2019-05-02	2-30	374	2019-04-17	2016-05-18	5	421	203
2019-05-07	2-62	388	2019-05-06	2018-05-22	5	564	233
2019-05-08	1-99	367	2019-04-17	2016-05-03	8	474	220
2019-05-14	09-2	387	2019-05-06	2017-09-22	10	635	228
2019-05-14	1-84	365	2019-04-17	2015-05-20	8	551	222
2019-05-14	2-26	346	2018-05-07	2016-05-17	8	820	230
2019-05-15	2-31	332	2017-05-22	2016-05-18	9	697	232
2019-05-15	2-32	385	2019-04-30	2016-05-18	9	580	222
2019-05-15	2-55	389	2019-05-13	2017-05-18	6	495	201
2019-05-15	2-66	391	2019-05-15	2019-05-08	3	570	228
2021-04-06	2-59	393	2019-05-20	2018-05-09	P	589	223
2021-04-20	1-97	294	2016-05-16	2016-05-03	P	423	218
2021-04-29	U995	386	2019-04-30	2015-08-26	P	569	224
2021-05-06	2-64	390	2019-05-15	2019-05-07	P	612	223
Average					7.7	517.3	220.1

P=Analysis pending, N/A=Data not collected

*Captured at Willamette Falls; all other removals from Bonneville Dam.

APPENDICES

Appendix 1. ODD (Overview, Design concepts, Details) protocol for agent-based model of sea lion prey requirements.

This draft model description follows the ODD protocol for describing individual- and agent-based models (Grimm et al. 2006), as updated by Grimm et al. (2020). Additional detail will be added in future reports.

1. Overview: Purpose and pattern

The primary purpose of the sea lion management ABM is to predict the number of prey (particularly salmonids) required over the post-removal lifetime of California sea lions and Steller sea lions that were captured in the Columbia River Basin under Section 120/120(f) of the Marina Mammal Protection Act from 2008-present.

We define two patterns as the criteria for model usefulness: estimates of per capita biomass consumption consistent and per capita biomass consumption as a percent of body mass that are consistent with the published literature.

2. Overview: Entities, state variables, and scales

Entities in the model are individual sea lions.

Sea lions each have a unique ID and have state variables for age in years, whether or not they survived an annual time step, growth in body mass per annual time step, whether or not they returned (site fidelity) to an upriver site per annual time step, and the residency duration per annual time step. Within an annual time step, state variables include biomass requirements for up to three prey items. Species (CSL, SSL), sex (male), location (Bonneville Dam, Willamette Falls), season (fall = July-December; spring = January-June), and diet composition are not considered state variable since they do not change during time steps.

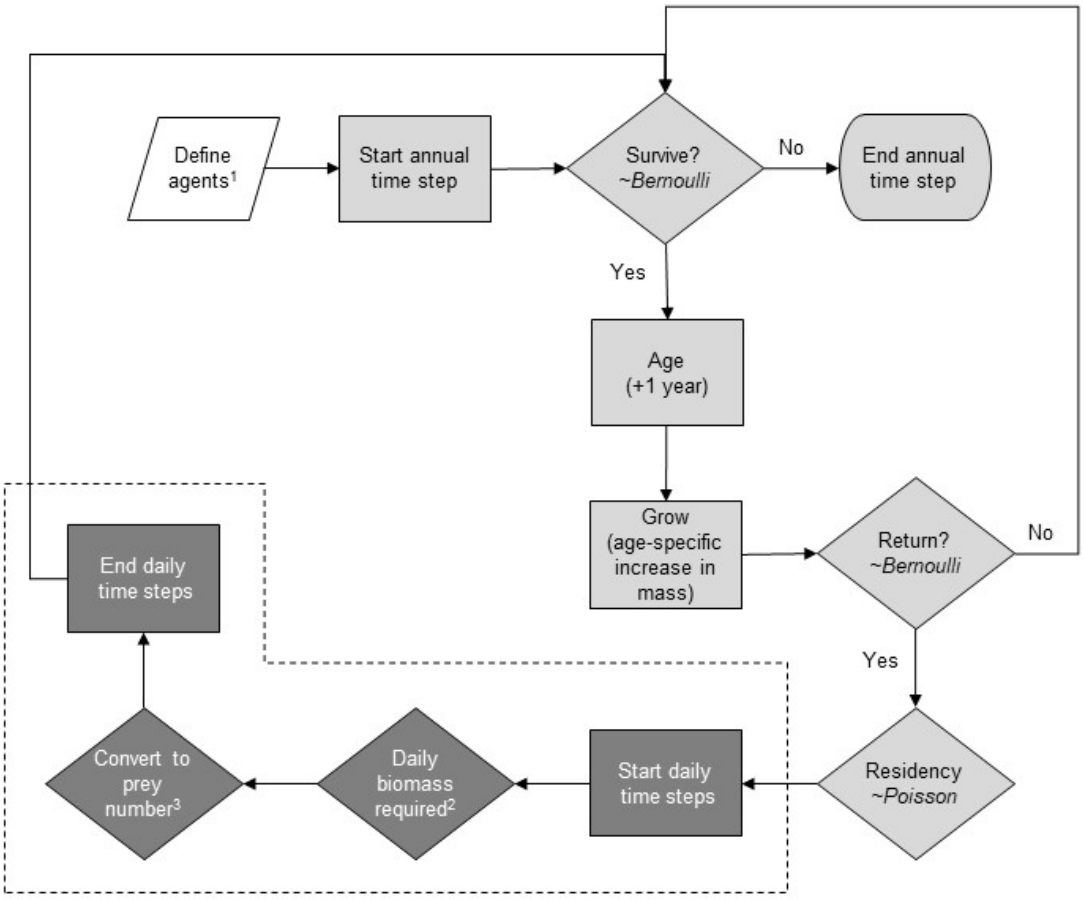
The model is non-spatial so the environment is not represented and sea lions only have one location (Bonneville Dam or Willamette Falls). The model runs at two different time scales: annual for survival, growth, fidelity, and residency; daily for biomass consumption requirements.

3. Overview: Process overview and scheduling

Processes: The model was developed to cover the life-cycle of nuisance sea lions as it pertains to their time at terminal upriver feeding sites in the Columbia River Basin. It is structured in a combination of several deterministic and stochastic processes (see flowchart below).

Schedule: The simulation starts one year post-removal for each sea lion (within year biomass requirements will be added to future model). Each animal's probability of surviving to the first year post-removal is governed by a species, sex (male), and age-specific survival probability as defined in a Bernoulli trial where the probability of survival is based on the published literature. If an animal

survives then its age is incremented and body mass increases by an age-specific factor based on the published literature (stochasticity in growth may be added at a later date). Next, the probability of returning to an upriver site for a given location and season is determined independently for each sea lion based on a Bernoulli trial where the site fidelity (return probability) is based on empirical data from marked animals from Bonneville Dam and Willamette Falls. Next, residency duration is estimated independently for each sea lion based on a single sample from a Poisson distribution where the parameter is based on empirical data from marked animals from Bonneville Dam and Willamette Falls. A within-year daily loop then starts based on the residency realization where for each day, location- and season- specific biomass requirements are estimated based on a bioenergetics model for up to three diets. Currently the biomass requirement is converted to number of fish at the end of the simulation based on mean prey weights but future updates to the model will likely convert biomass to fish numbers at the daily level. At the end of the residency period the sea lion migrates and repeats the annual loop beginning with the survival step.



[1] See Appendix 3
[2] Based on bioenergetic model adapted from Winship et al. 2002
[3] Currently based on location-specific mean prey weights (i.e., non-stochastic); future models will draw from size distributions.

Flowchart of sea lion management ABM.

4. Design: Design concepts

The 11 design concepts (basic principles, emergence, adaptation, objectives, learning, prediction, sensing, interaction, stochasticity, collectives, and observation,) will be included at a later date

5. Details: Initialization

Each individual's state variable (age, mass, fidelity, residency) is initialized by based on either individual-specific empirical data or estimated from such data. Estimated or actual state data is indicated in Appendix 3 by variable suffixes ending in "_est" whose values are "1" for estimated and "0" for actual. Additional initialization details will be included at a later date.

6. Details: Input data

Three input files (besides agent data in Appendix 3) are imported into the model: survival data, growth data, and diet composition data. These are defined in separate model scripts and are based on either the published literature or empirical data.

7. Details: Sub-models

Sub-model details will be provided at a later date.

Appendix 2. Agent input file for sea lion management ABM.

	ID	Location	Capture_date	Sge	Age_est	Mass_lbs	Mass_est	Season	Fidelity	Fidelity_est	Residency	Residency_est
1	1n72	Bonneville Dam	20170419	8	0	600	0	Spring	1.00	0	21.00	0
2	1n04	Bonneville Dam	20170425	9	0	492	0	Spring	1.00	0	31.82	1
3	1n33	Bonneville Dam	20170425	5	0	450	0	Spring	1.00	0	31.82	1
4	1n80	Bonneville Dam	20170425	9	0	430	0	Spring	1.00	0	31.82	1
5	2n01	Bonneville Dam	20170425	9	0	380	0	Spring	1.00	0	31.82	1
6	2n13	Bonneville Dam	20170425	9	0	420	0	Spring	1.00	0	31.82	1
7	U334	Bonneville Dam	20170425	8	0	403	0	Spring	1.00	0	25.67	0
8	U497	Bonneville Dam	20170427	7	0	649	0	Spring	1.00	0	15.33	0
9	1n28	Bonneville Dam	20170502	8	0	472	0	Spring	1.00	0	26.00	0
10	1n88	Bonneville Dam	20170502	6	0	520	0	Spring	1.00	0	31.82	1
11	2n08	Bonneville Dam	20170502	7	0	350	0	Spring	1.00	0	31.82	1
12	X568	Bonneville Dam	20170502	9	0	518	0	Spring	0.98	1	31.82	1
13	2n09	Bonneville Dam	20170503	8	0	530	0	Spring	1.00	0	31.82	1
14	2n05	Bonneville Dam	20170504	8	0	415	0	Spring	1.00	0	31.82	1
15	1n08	Bonneville Dam	20170509	7	0	520	0	Spring	1.00	0	9.50	0
16	1n93	Bonneville Dam	20170509	7	0	411	0	Spring	1.00	0	31.82	1
17	2n21	Bonneville Dam	20170509	9	0	324	0	Spring	1.00	0	31.82	1
18	2n39	Bonneville Dam	20170509	7	0	576	0	Spring	0.98	1	31.82	1
19	1n43	Bonneville Dam	20170510	7	0	496	0	Spring	1.00	0	12.50	0
20	1n98	Bonneville Dam	20170510	6	0	472	0	Spring	1.00	0	31.82	1
21	2n06	Bonneville Dam	20170511	8	0	486	0	Spring	1.00	0	31.82	1
22	U625	Bonneville Dam	20170511	9	0	584	0	Spring	1.00	0	61.00	0
23	1n42	Bonneville Dam	20170516	6	0	943	0	Spring	1.00	0	31.82	1
24	1n86	Bonneville Dam	20170517	9	0	843	0	Spring	0.50	0	31.82	1
25	U605	Willamette Falls	20180214	8	1	585	0	Fall	0.50	0	52.70	1
	U605	Willamette Falls	20180214	8	1	585	0	Spring	1.00	0	77.33	0
26	2n45	Bonneville Dam	20180410	8	1	550	0	Spring	1.00	0	31.82	1
27	2n29	Bonneville Dam	20180411	8	1	485	0	Spring	1.00	0	31.82	1

28	2n41	Bonneville Dam	20180411	10	0	422	0	Spring	1.00	0	31.82	1
29	2n49	Bonneville Dam	20180411	8	1	420	0	Spring	1.00	0	31.82	1
30	C075	Bonneville Dam	20180411	9	0	475	0	Spring	1.00	0	20.50	0
31	1n39	Bonneville Dam	20180417	10	0	440	0	Spring	1.00	0	9.00	0
32	2n17	Bonneville Dam	20180417	9	0	493	0	Spring	1.00	0	11.50	0
33	2n12	Bonneville Dam	20180418	5	0	380	0	Spring	1.00	0	16.00	0
34	U146	Bonneville Dam	20180418	9	0	612	0	Spring	1.00	0	14.25	0
35	2n11	Bonneville Dam	20180419	4	0	347	0	Spring	0.50	0	31.82	1
36	2n35	Bonneville Dam	20180419	7	0	391	0	Spring	1.00	0	31.82	1
37	1n87	Bonneville Dam	20180424	6	0	376	0	Spring	1.00	0	10.00	0
38	1n91	Bonneville Dam	20180424	7	0	310	0	Spring	1.00	0	19.00	0
39	1n96	Bonneville Dam	20180424	8	0	401	0	Spring	1.00	0	28.00	0
40	2n38	Bonneville Dam	20180424	9	0	500	0	Spring	1.00	0	31.82	1
41	C086	Bonneville Dam	20180424	10	0	547	0	Spring	1.00	0	27.50	0
42	2n20	Bonneville Dam	20180425	8	0	573	0	Spring	1.00	0	31.82	1
43	1n95	Bonneville Dam	20180501	7	0	501	0	Spring	1.00	0	31.82	1
44	2n43	Bonneville Dam	20180501	9	0	737	0	Spring	1.00	0	31.82	1
45	2n24	Bonneville Dam	20180503	8	0	551	0	Spring	1.00	0	31.82	1
46	2n52	Bonneville Dam	20180503	11	0	584	0	Spring	1.00	0	31.82	1
47	1n31	Bonneville Dam	20180508	8	0	782	0	Spring	1.00	0	29.00	0
48	1n51	Bonneville Dam	20180508	7	0	455	0	Spring	1.00	0	20.00	0
49	1n57	Bonneville Dam	20180508	7	0	508	0	Spring	1.00	0	9.50	0
50	2n33	Bonneville Dam	20180508	7	0	607	0	Spring	1.00	0	31.82	1
51	2n47	Bonneville Dam	20180508	7	0	636	0	Spring	1.00	0	31.82	1
52	2n37	Bonneville Dam	20180509	8	1	454	0	Spring	1.00	0	31.82	1
53	X886	Bonneville Dam	20180515	8	1	427	0	Spring	0.98	1	31.82	1
54	X953	Bonneville Dam	20190430	9	0	630	0	Spring	1.00	0	8.00	0
55	2n00	Bonneville Dam	20190501	8	0	487	0	Spring	0.67	0	16.50	0
56	2n07	Bonneville Dam	20190501	9	0	563	0	Spring	1.00	0	17.00	0
57	2n15	Bonneville Dam	20190501	5	0	392	0	Spring	1.00	0	16.00	0
58	2n25	Bonneville Dam	20190501	8	0	528	0	Spring	1.00	0	19.00	0

59	2n28	Bonneville Dam	20190501	10	0	516	0	Spring	1.00	0	24.00	0
60	1n34	Bonneville Dam	20190502	8	0	551	0	Spring	1.00	0	27.67	0
61	1n70	Bonneville Dam	20190502	10	0	498	0	Spring	0.75	0	3.50	0
62	1n92	Bonneville Dam	20190502	5	0	386	0	Spring	1.00	0	16.50	0
63	2n30	Bonneville Dam	20190502	5	0	421	0	Spring	1.00	0	22.00	0
64	2n62	Bonneville Dam	20190507	5	0	564	0	Spring	1.00	0	31.82	1
65	1n99	Bonneville Dam	20190508	8	0	474	0	Spring	1.00	0	15.00	0
66	09n2	Bonneville Dam	20190514	10	0	635	0	Spring	0.98	1	31.82	1
67	1n84	Bonneville Dam	20190514	8	0	551	0	Spring	1.00	0	21.00	0
68	2n26	Bonneville Dam	20190514	8	0	820	0	Spring	1.00	0	25.50	0
69	2n31	Bonneville Dam	20190515	9	0	697	0	Spring	1.00	0	20.00	0
70	2n32	Bonneville Dam	20190515	9	0	580	0	Spring	1.00	0	15.67	0
71	2n55	Bonneville Dam	20190515	6	0	495	0	Spring	1.00	0	31.82	1
72	2n66	Bonneville Dam	20190515	3	0	570	0	Spring	0.98	1	31.82	1
73	2n59	Bonneville Dam	20210406	8	1	589	0	Spring	1.00	0	13.50	0
74	1n97	Bonneville Dam	20210420	8	1	423	0	Spring	1.00	0	22.33	0
75	U995	Bonneville Dam	20210429	8	1	569	0	Spring	0.75	0	25.33	0
76	2n64	Bonneville Dam	20210506	8	1	612	0	Spring	0.98	1	31.82	1