State of Washington DEPARTMENT OF FISH AND WILDLIFE
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Jennifer Quan 12/1/2025
Regional Administrator, West Coast Region
National Marine Fisheries Service
501 West Ocean Boulevard, Suite 4200
Long Beach, CA 90802

RE: MMPA §120(f) Sea Lion Management Annual Report for the period of July 1, 2024, through June 30, 2025

Dear Ms. Quan:

The following information comprises the 2025 annual report to the National Marine Fisheries Service from the eligible management entities regarding Marine Mammal Protection Act (MMPA) §120(f) management and monitoring activities of sea lions in the Columbia River Basin. This report documents compliance with the Terms and Conditions of our August 14, 2020, permit for lethal removal of predatory California sea lions (CSLs) and Steller sea lions (SSLs) in the mainstem of the Columbia River between river mile 112 and river mile 292, or in any tributary (below river mile 292) to the Columbia River that includes spawning habitat of threatened or endangered salmon or steelhead. The current permit was granted to the States of Oregon, Washington, and Idaho, the Nez Perce Tribe, the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes of the Warm Springs Reservation of Oregon, the Confederated Tribes and Bands of the Yakama Nation, the Confederated Tribes of the Grand Ronde Community, and the Confederated Tribes of the Siletz Indians of Oregon (with Eligible Entities having the option to delegate authority to the Columbia River Inter-Tribal Fish Commission) on August 14, 2020 and expired on August 14,2025[1].

We thank you for your assistance and support of our work to monitor and reduce sea lion predation on threatened and endangered fish in the Columbia River Basin.

Sincerely,

Casey Clark

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

[1]On August 22, 2025, NMFS issued the Eligible Entities a renewed MMPA Section 120(f) permit valid through August 22, 2030.

This section outlines the Terms and Conditions from the 2020 Authorization and how the Eligible Entities complied with these Terms and Conditions for the period from July 1, 2024, through June 30, 2025. For information regarding how the Eligible Entities complied with these Terms and Conditions during previous reporting periods for this permit, refer to the annual reports for those years (Clark et al. 2021a, Edwards et al. 2022, Clark et al. 2023, Clark et al. 2024).

The following are the Terms and Conditions from the 2020 Authorization:

1) Authorization

This permit authorizes the Eligible Entities, as defined below, consistent with the terms and conditions set forth herein, to lethally remove sea lions that are located in the mainstem of the Columbia River between river mile 112 and river mile 292, or in any tributary (below river mile 292) to the Columbia River that includes spawning habitat of threatened or endangered salmon or steelhead.

2) Permit Duration

This permit is valid beginning August 14, 2020, and expired on August 14, 2025. On August 22, 2025, NMFS issued the Eligible Entities a renewed MMPA §120(f) permit valid through August 22, 2030.

3) Eligible Entities

a) For removal of sea lions located in the mainstem Columbia River, from river mile 112 to river mile 292, and its tributaries in the state of Washington and in the state of Oregon above Bonneville Dam, the Eligible Entities are: the state of Washington; the state of Oregon; the State of Idaho; the Nez Perce Tribe; the Confederated Tribes of the Umatilla Indian Reservation; the Confederated Tribes of the Warm Springs Reservation of Oregon; and the Confederated Tribes and Bands of the Yakama Nation.

b) For removal of sea lions located in the Willamette River and other tributaries of the Columbia River within the state of Oregon below Bonneville Dam, the Eligible Entity is a Committee composed of Oregon Department of Fish and Wildlife, the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes of the Warm Springs Reservation of Oregon, the Confederated Tribes of the Grand Ronde Community, and the Confederated Tribes of the Siletz Indians of Oregon.

4) Delegation of Authority

The Eligible Entities described in paragraph 3(a) above may delegate their removal authority to the Columbia River Inter-Tribal Fish Commission. In order to delegate their authority, the Eligible Entities must submit a request to NMFS in writing, and NMFS will respond in writing either approving or denying the request.

5) Limit on Removals

a) The Eligible Entities shall not remove (i.e., place in permanent captivity or kill) more than **540 California sea lions** and not more than **176 Steller sea lions** over the 5-year period of this permit.

b) The number of sea lions removed under this permit, combined with the number of sea lions removed under any other permits issued by NMFS under MMPA §120(f), may not exceed 10 percent of the potential biological removal (PBR) levels for either the CSL or SSL stocks. If at any time NMFS determines that removals under this permit may result in cumulative removals in excess of 10 percent of PBR, NMFS shall reduce the allowable number of removals under this permit to ensure that cumulative removals under MMPA §120(f) do not exceed 10 percent of PBR levels. If NMFS determines that reducing the number of removals identified in paragraph 5(a) above is required, NMFS shall provide the Eligible Entities with 72 hours' notice of the new removal limits.

6) Manner of Removals

a) The Eligible Entities may capture and remove sea lions by trapping or by live capture of free ranging sea lions using established wildlife darting techniques.

b) The Eligible Entities may capture and remove sea lions at any time of year.

c) Under this permit, lethal removal of sea lions is not contingent on nonlethal measures.

d) The use of firearms by the Eligible Entities to kill sea lions is prohibited.

e) The Eligible Entities shall appoint an Institutional Animal Care and Use Committee (IACUC) composed of veterinarians, marine mammal biologists, and a non-affiliated member who shall represent the community, to advise the Eligible Entities on protocols for capture, darting, anesthetizing, holding, transferring, and euthanasia of sea lions.

f) Prior to implementation, the IACUC shall develop, and NMFS shall approve, the methods for chemical euthanasia of sea lions.

g) Prior to implementation, the IACUC shall develop, and NMFS shall approve, the specific methods and protocols for darting and removal of free-ranging sea lions subject to this authorization.

h) Annually, the IACUC shall reevaluate the methods and protocols and determine any needed modifications.

i) Annually, NMFS will review the IACUC methods and protocols for darting and removal of free-ranging sea lions administered by the Eligible Entities and affirm that lethal removals are consistent with the definition of humane within the meaning of section 3(4) of the MMPA.

j) The Eligible Entities will notify and coordinate with local law enforcement/governments and tribes prior to sea lion removal activities as part of a communications strategy to maximize coordination and public awareness.

k) Any intentional taking must be implemented by qualified individuals. Qualified individuals include the Eligible Entities and their employees and other qualified individuals under contract to such entities.

7) Disposition

Sea lions removed under this permit shall be relocated or disposed of as follows:

a) Should NMFS notify the Eligible Entities that a pre-approved permanent holding facility (research, zoo, or aquarium) is willing to accept an animal(s); the Eligible Entities shall maintain the animal in a temporary holding facility approved by the IACUC for up to 48 hours. If the pre-approved research, zoo, or aquarium facility (or their designee) does not collect or make arrangements to collect an animal within 48 hours of its capture, the Eligible Entities may euthanize it.

b) Like other marine mammals, sea lions are susceptible to a variety of environmental contaminants that bioaccumulate upward through marine food webs to high-level predators. These substances include organochlorines (e.g., polychlorinated biphenyls, dioxins, dichloro-diphenyl-trichloroethane and its derivatives, various other pesticides and herbicides), polybrominated diphenyl ethers, heavy metals (e.g., mercury, copper, selenium, zinc), and may have harmful zoonotic organisms, all of which may have negative health consequences if not handled with appropriate protective gear. Thus, to reduce these risks, we recommend that the Eligible Entities use protective gear to reduce the risk of contamination when handling dead marine mammals. The Eligible Entities shall ensure that the disposal of carcasses, tissues, organs, or parts is in accordance with applicable laws.

c) If a tribe that is party to this permit has interest in a sea lion carcass for educational and cultural uses[1], the Eligible Entities may make sea lion carcasses killed pursuant to this permit available to the requesting tribe(s) for educational and cultural uses. *See* 50 CFR 216.22.

8) Monitoring and Reporting.

a) The Eligible Entities may collect biological samples of sea lions killed pursuant to this permit for scientific research or for educational purposes.

b) The Eligible Entities shall report all removals of sea lions (i.e., placed in permanent captivity or killed) to the Regional Administrator, NMFS, West Coast Region, within 3 days following removal.

c) The Eligible Entities shall provide reports to the Regional Administrator, NMFS, West Coast Region, consistent with the marine mammal regulations at 50 CFR 216.22(b) and 50 CFR 216.22(c) regarding all sea lion carcasses provided to tribes for educational and cultural uses.

[1] As proposed in the June 13, 2019, application.

d) **Annually, on or before December 1st,** the Eligible Entities shall submit a monitoring report to the Regional Administrator, NMFS, West Coast Region, that includes:

i. The number of sea lions observed in the action area.

ii. The specific locations (e.g., latitude-longitude or river mile) where the Eligible Entities captured individual sea lions.

iii. The number of sea lions killed or transferred by species.

iv. The method of removal.

v. The number of prey observed[2] taken by sea lions throughout the action area.

vi. The impacts of sea lion predation (e.g., percent predation) on affected at-risk fish stocks in the Columbia River Basin.

vii. The preemptive measures, e.g., non-lethal deterrence, taken to reduce sea lion predation on at-risk fish stocks.

viii. The Eligible Entity's compliance with the terms and conditions of this authorization, and plans for future actions in compliance with this authorization.

e) The Eligible Entities shall evaluate the impacts of sea lion predation on at-risk fish species, and the effectiveness (benefits) of permanent removal of predatory sea lions as a method to reduce mortality on at-risk fish species.

i. The Eligible Entities shall evaluate key population parameters for at-risk fish species by means of a population viability analysis or equivalent method to estimate the effectiveness of permanent removal of predatory sea lions as a method to reduce or eliminate mortality on at-risk fish species and estimate extinction risks to at-risk fish species.

ii. **By December 1, 2023,** the Eligible Entities shall submit a 3-year comprehensive report to NMFS on the above-mentioned requirements so NMFS and the Task Force can evaluate the effectiveness of the authorized lethal removal or alternative actions implemented, as required pursuant to section 120(c)(5) of the MMPA.

9) NMFS may modify, suspend, or revoke this authorization at any time with 72 hours' notice to the Eligible Entities

The Eligible Entities' compliance with the Terms and Conditions is listed below:

1. Authorization

All animals were removed within the designated boundaries of the management area as described above. Specifically, removals conducted between July 1, 2024, and June 30,

[2] When predation impacts cannot be observed, an eligible entity shall use a bioenergetics model or equivalent method.

2025, occurred at Bonneville Dam and in the Willamette River. In total, 26 CSLs and 19 SSLs were removed during this period (Table 2).

2. Permit Duration

This annual report covers management activities between July 1, 2024, and June 30, 2025. The permit under which this work was conducted was granted on August 14, 2020, and expired on August 14, 2025.

3. Eligible Entities

All removal efforts were conducted by the Eligible Entities.

a) Staff from the States of Washington, Oregon, Idaho, and the Columbia River Inter-Tribal Fish Commission participated in lethal removal of 25 adult male CSLs and 15 adult male SSLs at Bonneville Dam. One adult male CSL was transferred to the Oregon Coast Aquarium to be held in permanent captivity.

b) Staff from the State of Oregon participated in the lethal removal of 4 adult male SSLs in the Willamette River. No other removals occurred during this reporting period in other tributaries of the Columbia River within the state of Oregon below Bonneville Dam.

4. Delegation of Authority

The Confederated Tribes of the Umatilla Reservation, the Confederated Tribes and Bands of the Yakama Nation, and the Nez Perce Tribe delegated management authority to the Columbia River Inter-Tribal Fish Commission during this reporting period.

5. Limit on Removals

a) The eligible entities did not remove, via permanent placement in captivity or lethal removal, more than 540 CSLs or more than 176 SSLs over the 5-year period of this permit. As of this reporting period (ending June 30, 2025), a cumulative total of 116 CSLs and 114 SSLs have been removed under this authorization.
b) NMFS made no determination that removals under this permit exceeded 10 percent of PBR.

6. Manner of Removals

a) All removals during this reporting period were conducted using live trapping and capture methods (see Methods section).

b) Removals are now permitted at any time of year.

c) Under this permit, lethal removal is not contingent on nonlethal measures.

d) The use of firearms by the Eligible Entities is expressly prohibited and they were not utilized.

e) The Eligible Entities appointed an Institutional Animal Care and Use Committee (IACUC) composed of veterinarians, marine mammal biologists, and a member not affiliated with any of the Eligible Entities who serves to represent the community. Approval by this committee is required for all protocols for capture, darting, anesthetizing, holding, transferring and euthanasia of sea lions used by the Eligible Entities.

f) The IACUC was formed prior to any removal operations and conducted a review and approval of proposed methodologies on September 11, 2025. These protocols were further approved by NMFS before use. The currently approved Animal Care and Use Protocols are included in Appendix 1.

g) The Eligible Entities developed darting protocols, which were considered and approved by the IACUC as part of the protocol review and update on August 20, 2021. To date, no management activities have been conducted using these methods.

h) The IACUC will reevaluate the methods and protocols by December 1, 2026, to determine any needed modifications.

i) NMFS reviewed and approved the IACUC Animal Care and Use Protocols finalized on September 11, 2025, prior to their enactment for management. These methodologies will again be presented to NMFS for annual approval prior to December 1, 2026.

j) The Eligible Entities coordinated with local law enforcement and tribes prior to sea lion removal activities as part of regular communication that maximized coordination and awareness for all parties.

k) All intentional taking was conducted by employees of Eligible Entities.

7) <u>Disposition</u>

a) In 2025, the Oregon Coast Aquarium made a request to NMFS for permanent placement of a California sea lion. As a result, on May 7, 2025, one adult male California sea lion was captured and transferred to the Oregon Coast Aquarium for permanent care. The remainder of the sea lions captured during this reporting period were humanely euthanized.

b) Staff were given safety trainings on handling of wildlife, including possible exposure to zoonoses and transmission of reverse zoonoses. Any staff participating in management or handling of animals utilized the appropriate Personal Protective Equipment, including safety glasses, respirators, nitrile gloves, work gloves, cut-proof gloves, aprons and waterproof sleeves, waterproof boots.

c) Tribes that are party to this permit requested parts from sea lion carcasses killed pursuant to this permit for educational and cultural purposes. On May 7, 2025, the Eligible Entities provided parts from sea lions EB099 and EB100 to The Confederated Tribes of the Warm Springs Reservation of Oregon, while parts of ZB082 were provided to the Nez Perce Tribe.

8. Monitoring and Reporting

a) The Eligible Entities conducted full necropsies of removed animals and collected biological samples (Appendix 2) for scientific research purposes including food habits, immunology, toxicology, pathogens, biometrics, and general health.

b) The Eligible Entities reported all removals to the Regional Administrator of NMFS within 72 hours of removals. These reports were subsequently forwarded to the Task Force members *via* NMFS.

c) Sea lion carcasses provided to tribes for educational and cultural purposes under Term 7c) were reported to the NMFS West Coast Regional Administrator.

d) This document fulfills the reporting requirements for the management period beginning July 1, 2024, until June 30, 2025.

i. The number of sea lions observed in the action area are detailed in the Results and Discussion sections of the annual report.

ii. The specific locations where the Eligible Entities captured individual sea lions is detailed in Table 1 of the annual report.

iii. The number of sea lions killed or transferred by species is detailed in Table 1 of the annual report.

iv. The method of removal for all sea lions killed during this reporting period was by chemical euthanasia via overdose of anesthetic. Method details are provided in the attached IACUC documents (Appendix 1).

v. The number of prey observed taken by sea lions throughout the action area are detailed in the Results and Discussion section and Table 2 of the annual report.

vi. Estimates of predation impacts of removed animals are presented in the Results and Discussion sections of the annual report, and in Appendix 3.

vii. Nonlethal deterrence measures taken to reduce sea lion predation on at-risk fish stocks are detailed in the Methods sections of the annual report.

viii. This letter describing our compliance with the terms and conditions of the 2020 Authorization for monitoring and management activities conducted in 2024 – 2025 represents our annual monitoring report to NMFS. The Eligible Entities are currently planning to conduct similar work in 2025 – 2026 under a new MMPA §120(f) permit approved by NMFS on August 22, 2025.

e) The Eligible Entities continue to evaluate the impacts of sea lion predation on at-risk fish species, and the effectiveness (benefits) of permanent removal of predatory sea lions as a method to reduce mortality on at-risk species. Monitoring and predation reports to date have been summarized in previous Willamette Falls and Bonneville Dam sea lion management reports (e.g., Clark et al. 2021b, Wright et al. 2024). This same information for the current MMPA §120(f) permit is included in this report.

i. In the 3-year comprehensive report submitted to NMFS on December 1, 2023 (Clark et al. 2023) the Eligible Entities presented an evaluation of key population parameters for at-risk fish species by means of a population

viability analysis to estimate the effectiveness of permanent removal of predatory sea lions as a method to reduce or eliminate mortality on at-risk fish species and estimate extinction risks to at-risk fish species.

ii. On December 1, 2023 the Eligible Entities submitted a 3-year comprehensive report to NMFS detailing how the on the above mentioned-requirements were met, in fulfillment of the request to submit such a report on or before December 1, 2023.

9) The Eligible Entities understand that NMFS may modify, suspend, or revoke this authorization at any time with 72 hours' notice to the Eligible Entities.

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ANNUAL REPORT:
2025 COLUMBIA RIVER BASIN RESEARCH AND MANAGEMENT ACTIVITIES

Casey Clark[1], John Edwards[1], Mike Brown[2], Shay Valentine[2], Bryan Wright[2], Susan Riemer[2], Doug Hatch[3], John Whiteaker[3], and Sarah Maher[4]

December 1, 2025

Submitted on behalf of all MMPA §120(f) Eligible Entities, including:

The State of Oregon
The State of Washington
The State of Idaho
The Nez Perce Tribe
The Confederated Tribes of the Umatilla Indian Reservation
The Confederated Tribes of the Warm Springs Reservation of Oregon
The Confederated Tribes and Bands of the Yakama Nation
The Confederated Tribes of the Grand Ronde Community
The Confederated Tribes of the Siletz Indians of Oregon
The Columbia River Inter-Tribal Fish Commission

[1] Washington Department of Fish and Wildlife
[2] Oregon Department of Fish and Wildlife
[3] Columbia River Inter-Tribal Fish Commission
[4] Idaho Department of Fish and Game

INTRODUCTION

Bonneville Dam is the lowermost hydroelectric project on the Columbia River, approximately 235 km (146 miles) upriver from the Pacific Ocean. Sea lion presence at this location has historically been minimal, with only one or two California sea lions (*Zalophus californianus*; CSLs) reported annually at the dam during fishway inspections in the 1980s and 1990s (Stansell 2004). The abundance of sea lions at the dam began to increase in the early 2000s, with reports of six CSLs observed at one time in 2001 and 30 CSLs estimated to be foraging on salmonids (*Onchorynchus* spp.) at the dam in 2002 by the U.S. Army Corps of Engineers (USACE). Sea lion presence increased steadily from the early 2000s, with the minimum annual count of CSLs at Bonneville Dam fluctuating between ~30 – 200 individuals and associated predation estimates of 1,000 – 8,000 salmonids per year (Braun et al. 2024). The increase in both sea lion abundance at Bonneville Dam and observations of predation on salmonids raised concerns about impacts to salmon runs, many of which are listed under the Endangered Species Act (ESA).

State, federal, and tribal agencies attempted to deter pinnipeds using a variety of non-lethal methods. Starting in 2005, non-lethal deterrents 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, Tidwell 2021) and proved ineffective at deterring predation by sea lions at Bonneville Dam.

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 across the first five years of implementation.

A new threat to Columbia River salmonids arose at Bonneville Dam during the initial period of CSL removal efforts. The abundance of Steller sea lions (*Eumetopias jubatus*; SSLs) at Bonneville Dam steadily increased following initial sightings in 2003 to a peak count of 89 individuals in 2011 (Braun et al. 2024). 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 nearly as many salmonids as CSLs did in 2006 when authority to lethally remove CSLs at Bonneville Dam was initially requested (Braun et al. 2024). In addition, this species is now present at Bonneville Dam for most of the year, in contrast to CSLs which are present primarily in the spring.

In 2018, the U.S. Congress passed the Endangered Salmon Predation Prevention Act, which amended MMPA §120(f) to address increasing impacts of predation on listed salmonids in the Columbia River basin by California and Steller sea lions. On August 14, 2020, NMFS issued the

Eligible Entities a permit pursuant to §120(f) of the MMPA to conduct pinniped management activities in an extended geographic area (the mainstem of the Columbia River between river mile 112 and river mile 292, or in any tributary (below river mile 292) to the Columbia River that includes spawning habitat of threatened or endangered salmon or steelhead). The August 14, 2020, permit expired on August 14, 2025.

This report summarizes pinniped research and management activities between July 1, 2024, and June 30, 2025, in the management area encompassed in this MMPA §120(f) permit. 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. During the reporting period, management was only conducted at Bonneville Dam and the Willamette River.

METHODS

Activities conducted under and in association with this authorization included pinniped surveys between Bonneville Dam and the mouth of the Columbia River, pinniped surveys and estimates of fish predation by pinnipeds in the area of Willamette Falls, trapping and lethal removal of predatory CSLs and SSLs, diet analysis from contents of stomachs and intestines recovered from euthanized CSLs and SSLs, 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 and SSLs). The methods used for these activities are detailed below.

Non-lethal hazing of sea lions at Bonneville Dam continued to be conducted by USDA staff in 2024 and 2025. These activities will be included in the forthcoming USACE report of activities at Bonneville Dam. Additionally, hazing activities conducted near Bonneville Dam by the Eligible Entities in 2025 are outlined below. No non-lethal deterrence measures were conducted at Willamette Falls due to limited animal presence during the reporting period.

Estimation of sea lion abundance in the action area

Sea lion abundance in the action area is monitored using a variety of approaches. At Bonneville Dam, the USACE has taken the lead role in reporting sea lion abundance in the tailraces since 2002 (see Braun et al. 2024 for methods). These data were used in this report by the Eligible Entities to calculate "sea lion days" for both species of sea lions during the fall (August – December) and spring (January – May) management periods, as well as annually (all months). For this metric, a single day with twenty sea lions observed at Bonneville Dam was counted as twenty sea lion days and twenty days with a single sea lion observed were also counted as twenty sea lion days. The USACE counts (both direct observations and interpolated estimates between observations) were summed to provide total sea lion days within a period of interest. Additionally, the direct observation data were used to calculate the mean (±1 standard deviation) and peak sea lion counts for each species in fall, spring, and annually.

In the mainstem Columbia River, CRITFC conducts periodic river surveys to document and enumerate sea lion abundance and predation activity in the river below Bonneville Dam. Surveys extended from the Bonneville Dam tailrace to the I-205 river crossing in Portland, Oregon. A single 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 Phoca Rock were conducted throughout the season.

Lastly, in the lower Willamette River and at Willamette Falls, ODFW staff conduct a variety of observations to monitor abundance including land-based observations, automated camera counts, and boat-based river surveys. See Wright et al. (2025) for methods, but briefly, counts at Willamette Falls were conducted hourly during weekday, daytime observation shifts whereas camera counts were based on hourly images of the trap decks taken 24 hours a day, 7 days a week. Periodic boat-based surveys of the Willamette River were typically conducted in a single 24-ft closed cabin boat travelling downstream at approximately 5 knots with a minimum of two staff per survey. Surveys began in Oregon City below Willamette Falls and proceeded downriver, typically to the confluence with the Columbia River (42 km; 26 mi). Staff recorded the number, behavior, and location of each species of pinniped observed, which were also photographed when possible.

Deterrent activities

Subjecting sea lions to hazing prior to removal is no longer a requirement of the authorizing, therefore boat-based hazing is only deployed to enhance trap use by sea lions. Boat-based hazers used a combination of deterrents (e.g., seal bombs, cracker shells, and vessel chase) to deter sea lions from freely residing in the entirety of the Bonneville Dam tailrace and encourage residence around the sea lion haul out traps. 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, 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, seal bombs use 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.

Motion-activated sprinkler systems were deployed as a means of non-lethally deterring sea lions from haulout spaces. These sprinklers are used to move sea lions from preferred terrestrial haulout habitat to floating traps, to potentially move animals to haulouts downriver away from

the dam, and by pushing the animals to spend more time in the water may have the potential to dissuade residency in the area by making it more energetically costly. Sprinklers were deployed on Tower Island, adjacent to the trap array at Bonneville Dam, and at Phoca Rock, a haulout 12 miles downstream of the dam. Deterrent sprinklers were used in both Fall 2024 and Spring 2025 seasons, and deployment occurred after animals had been consistently using a haulout location.

Trapping

Sea lions at both Bonneville Dam and Willamette Falls are trapped using haul-out traps placed in areas that the sea lions prefer to haul out. Sea lions use these traps as haul-out sites, entering and exiting traps by way of a vertically sliding door, which was padlocked 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 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 Eligible Entities' 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 (Appendix 2).

Estimation of predation rates and diet analysis

As with abundance monitoring, estimation of predation rates varies by location. At Bonneville Dam, the USACE has taken the lead role in estimating sea lion predation in the tailraces since 2002 (see Braun et al. 2024 for methods). In addition, the total number of salmonids needed to be consumed to meet the energetic demands of sea lions present at Bonneville Dam by year, and season, were estimated by multiplying the calculated sea lion days for CSLs and SSLs by the daily consumption estimates from the agent-based model (Appendix 3). At Willamette Falls, ODFW has estimated sea lion predation since 2014; see Wright et al. (2025) for methods.

Diet analysis is based on the identification of undigested prey remains from the stomachs and large intestines of euthanized CSLs and SSLs following the procedures in Lance et al. (2001). Briefly, 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 Appendix 3 for details). Estimates of annual salmon consumption and "savings" were also calculated based on the daily energetic requirements for SSLs and CSLs generated by the ABM and sea lion days as described above. Salmon saved were calculated by comparing estimates of the number of salmon required to meet the energetic demands of sea lions to pre-management baselines for each season and species. In Spring, these baselines were defined as the estimated salmonid requirements of CSLs from 2005 – 2007 (3,821 salmonids/year), the three years prior to the beginning of management under the initial MMPA §120 authorization, and for SSLs from 2017 – 2020 (4,353 salmonids/year), the three years prior to spring management of SSLs which began under the current MMPA §120(f) authorization in Spring 2021. In fall, CSL predation is negligible and was not considered. Fall SSL salmon requirements from 2019 (9,611 salmonids/year) were used as a baseline because of the shorter time series of fall monitoring data and the steeply increasing trend from 2017 to 2019.

RESULTS AND DISCUSSION

Estimation of sea lion abundance in the action area

Bonneville Dam

Results of USACE sea lion monitoring efforts at Bonneville Dam will be included in their annual report in early 2026; however, the Corps has shared preliminary data with the Eligible Entities to be reported here. The information included here can be used to infer timing and trends in sea lion abundance in the vicinity of Bonneville Dam, but these numbers should not be treated as final until they are published in the next USACE annual report[3].

Sea lion monitoring efforts at Bonneville Dam are conducted during the period of sea lion presence at the dam, typically extending from August until May. This timeframe is officially broken into two monitoring periods, with fall monitoring extending from August to December,

[3] When completed, the 2024-2025 USACE annual report will be available here: http://pweb.crohms.org/tmt/documents/FPOM/2010/Task%20Groups/Task%20Group%20Pinnipeds/

and the spring period from January to May. The Fall 2024 monitoring efforts began on July 22, 2024, and concluded on December 31, 2024, consisting of 111 separate counts. Only SSLs were present at Bonneville Dam during the fall, and animals were observed during the entire reporting period. Peak SSL abundance during Fall 2024 was 11 animals, a count that occurred twice, first on August 23, 2024, and again on December 31, 2024. Average SSL abundance during the entire Fall 2024 monitoring period was 3 ± 2 individuals.

Both CSLs and SSLs were present at Bonneville Dam during the Spring 2025 monitoring period, which began on January 1, 2025, and extended until June 2, 2025, consisting of a total of 111 separate counts. Whereas SSLs were present at the dam for much of Spring 2024 (January 1 – May 16), CSLs were only consistently present beginning on April 4 and were last seen on May 29. A single CSL was observed on January 6, 2025, and one or two CSLs were present on March 23 and March 24, 2025. Peak SSL abundance in Spring 2025 was 48 animals seen on April 24 and April 25, 2025. Average Spring 2025 SSL abundance was 6 ± 12 individuals. Peak CSL abundance during this same period was 50 individuals, which were recorded on April 7, 2025. The average CSL abundance in Spring 2024 was 4 ± 7 animals; however, if only the period when CSLs were consistently observed is considered, the average was 10 ± 9 individuals.

The metric of “sea lion days” closely tracks the mean number of sea lions present at the dam since 2017 in spring, fall, and annually (Figure 1). During the period from 2017 – Spring 2025, SSLs greatly outnumbered CSLs based on the sea lion days metric, which is driven by a combination of a greater abundance and a longer duration of presence by SSLs than CSLs at Bonneville Dam. Finally, the presence of, and therefore likely impact on salmonids by, SSLs is substantially greater during the fall than the spring.

The patterns observed in sea lion occupancy and abundance since the initiation of the current permit in August 2020, which reduced the requirements for a sea lion to be eligible for removal and allowing removals of SSLs, indicate the removals are successfully reducing habitat use by sea lions at Bonneville Dam. This is particularly true for SSLs and for the fall management season. In Fall 2020, when the first six SSLs were removed under the new permit, we estimated 4,484.5 Steller sea lion days, an average of 29 ± 14 SSLs, and a peak of 68 SSLs at the dam, and in Fall 2024 we estimated 418.0 Steller sea lion days, an average of 3 ± 2 SSLs, and a peak of 11 SSLs. This represents an 91% decrease in sea lion days, an 90% decrease in mean counts, and a 84% decrease in peak counts for SSLs at Bonneville Dam in fall over the course of this permit. The patterns of SSL presence and abundance in the spring have followed a similar, if less pronounced, trajectory decreasing from an estimated 1,646.0 Steller sea lion days, an average count of 11 ± 17 SSLs, and a peak count of 62 SSLs in Spring 2021 to an estimated 984.5 Steller sea lion days, an average count of 6 ± 12 SSLs, and a peak count of 48 SSLs in Spring 2025. This represents a decline of 40%, 45%, and 23% for these three metrics, respectively.

California sea lion presence at Bonneville Dam in the fall is minimal and patterns of presence and abundance are not interpreted here. In spring, however, the metrics of sea lion day, mean abundance, and peak abundance all reflect a small upward trend that peaked in 2023 and remained relatively stable in 2024 and 2025 (Figure 1). Large and protracted eulachon runs in the Columbia River in Spring 2023 were likely responsible for the increase in observations of CSLs at that time, but relaxation of competition with SSLs for haulout space and foraging

opportunities due to removals of SSLs may also have caused CSLs to visit the dam in greater numbers.

Mainstem Columbia River

A single river survey between the Bonneville Dam tailrace and the I-205 crossing in Portland, Oregon was conducted on April 10, 2025. A total of 348 sea lions (106 CSL and 242 SSL) were counted with the highest concentration occurring on Tower Island, where 55 CSL and 157 SSL were tallied.

Willamette River

Pinniped counts based on automated cameras and incidental observations by staff began in July 2024, before sea lions migrated into the study area, and continued through June 2025, when sea lions had migrated out of the study area. Counts based on formal observations at Willamette Falls began the second week of January 2025 and continued through mid-June 2025. Boat-based river surveys began in September 2024 and continued through May 2025.

California sea lions—The first documented California sea lion sighting in the study area was on January 24, 2025, but that animal was only observed for one day (Figure 2). The spring cohort did not begin arriving until March, when numbers increased from one individual to a peak of four in late April and early May. However, since these animals were unmarked, the actual number present during the study likely exceeded the daily maximum observed. Nevertheless, this year marked the lowest one-day maximum count for California sea lions since the current monitoring program began. The last California sea lion was observed on June 13, approximately two weeks later than most years. The relative abundance and timing of California sea lions observed during the boat surveys were similar to that observed at the Falls (Figure 3).

Steller sea lions—The first documented Steller sea lion sighting was on January 13, 2025, although they were likely present before the formal observation period began (Figure 2). At least three individuals were seen intermittently at the Falls through mid-March, followed by a gap until mid-April, when a single animal was observed through May 9. However, since these animals were unmarked, the actual number present during the study likely exceeded the daily maximum observed. This year tied the second-lowest maximum daily count for Steller sea lions since the current monitoring program began. Boat surveys in the lower river, however, documented many more Steller sea lions for a longer period of time than at the Falls, with as many as 14 seen in early February (Figure 3).

Boat-based deterrent activities

Boat based sea lion hazing was conducted on April 3, 2025, to encourage congregating sea lion to use the traps. Twenty-one CSL and 21 SSL were hazed in five events using 73 cracker shells and 17 seal bombs.

Trapping

All animals captured during this reporting period (July 1, 2024, until June 30, 2025) were captured using the trap array within the Boat Restricted Zone in the tailrace below Bonneville Dam, Columbia River Mile 146 (45.6392°, −121.9521°), the Boat Restricted Zone in the forebay above Bonneville Dam, Columbia River Mile 147 (45.6379°, −121.9456°), or the trap array near West Linn, Oregon, on Willamette River mile 22 (45.39075°, −122.62879°).

In total, 25 adult male CSL and 19 adult male SSL were humanely euthanized between July 1, 2024, and June 30, 2025 and one additional male CSL was transferred to the Oregon Coast Aquarium in Newport, Oregon (Table 1). At Bonneville Dam two weeks of trapping occurred in Fall 2024; October 15 and December 3, while 9 weeks of trapping took place in Spring 2025; from January 15 through June 4 (Table 1). Two weeks of trapping occurred on the Willamette River in Fall 2024; November 5 and December 10, while 1 week of trapping on the Willamette River occurred in Spring 2025 on April 23. (Table 2).

The average weight of CSLs removed between July 1, 2024, and June 30, 2025, (n = 26) was approximately 222 kg (489 lbs), with a range 115 – 432 kg (253 – 935 lbs). The average length of removed CSLs (n = 25, as the animal transferred to the Oregon Coast Aquarium was not measured) was approximately 212 cm (7.0 ft), with a range of 172 – 291 cm (5.6 – 9.5 ft). For SSLs humanely euthanized between July 1, 2024, and June 30, 2025, (n = 19), the average weight was approximately 498 kg (1097 lbs) with a range of 191 – 836 kg (421 – 1843 lbs) The average length of euthanized SSLs was approximately 266 cm (8.7 ft), with a range of 203 – 294 cm (6.7 – 9.6 ft). Age data based on sectioned teeth are not yet available for the reporting period.

Estimates of predation rates and diet analysis

Bonneville Dam

Predation—As with the sea lion abundance data, the USACE shared preliminary results of their predation monitoring efforts with the Eligible Entities to be included in this report. Statistically expanded estimates for unsampled times and locations will be included in the final USACE report. Predation monitoring is typically divided into a Fall 2024 and a Spring 2025 period, though these efforts are more discrete than the abundance estimation periods, as predation monitoring occurs once a trigger of 20 animals present is met. For the first time since fall predation monitoring was instituted in 2017, there was no predation monitoring in Fall 2024 because the trigger of 20 animals was never met. The peak number of sea lions in Fall 2024 was 11 individuals.

Predation monitoring in Spring 2025 began on April 6 and continued until May 17, when abundance of sea lions at the dam declined. Spring predation sampling occurred at the spillway and Powerhouse 2 tailraces. Both SSLs and CSLs were present at Bonneville Dam during this period and observers collected 205 hours of predation monitoring data consisting of 493 predation events (Table 2). Observed prey consumed by both SSLs and CSLs consisted almost entirely of Chinook salmon (*Oncorhynchus tshawytscha*). Other observations of predation

consisting in order of abundance were white sturgeon, steelhead, and lamprey, as well as seven predation events on other species and 27 events where the prey item could not be identified.

Estimated salmonid consumption below Bonneville Dam has declined since the initiation of management efforts in 2008 for CSL and 2020 for SSL (Figures 4 and 5). Whereas consumption of salmonids in the Bonneville Dam tailrace has declined markedly in the four years of management implementation during the fall season, there the estimate of salmonids consumed by both species of sea lions in spring has remained relatively steady for the last several years at just below 4,000 salmonids required to meet the energetic needs of sea lions present at the dam in spring (Figures 4 and 5).

Diet—GI tract summary

Ninety- two gastro-intestinal (GI) tracts were collected from humanely euthanized CSLs and SSLs between April 1, 2024, and June 30, 2025. Spring 2024 GI removals (both species) were not reported in the 2024 Section 120(f) report due to a processing delay. All stomachs were processed by ODFW for all seasons along with the large intestines collected in 2024 for both sea lion species. The 2025 spring Bonneville large intestine samples were processed by WDFW with the exception of 5 samples (ZB075, ZB088, ZB100, EB089 and EB94) which will be reported later, stomach contents from these animals are included here.

In 2024, staff began sampling gastric (stomach) juices from removed animals for genetic identification of prey to fulfill a request from Yakama Nation Fisheries (Ralph Lampman). This is a novel procedure for sea lions and is aimed at identifying presence/absence of sea lion prey species, with particular interest in lamprey. Staff collected 10 ml of fluid from each stomach (2024 and 2025) at the time of necropsy or before processing the stomachs. Samples were preserved in ethanol and frozen for later analysis. WDFW also collected genetic samples from emulsified large intestine contents to quantify prey DNA from animals removed in 2024 and 2025 using DNA metabarcoding. Results from these analyses are expected in late 2026.

Remains from GI Tracts

In spring 2024 (the previous reporting period) forty-four sea lions (17 SSL and 27 CSL) were lethally removed from Bonneville Dam and 3 additional CSL were removed from Willamette Falls. Six Steller sea lions were lethally removed in Fall 2024 (4 at Bonneville Dam and 2 at Willamette Falls). During spring 2025 thirty-seven sea lions (11 SSL and 26 CSL) were removed from Bonneville Dam and 2 SSL from Willamette Falls. One CSL was transferred to The Oregon Coast Aquarium in spring 2025.

Remains from animals collected at Bonneville dam during spring 2024 included 72 adult Chinook salmon (*Oncorhynchus tshawytscha*), 231 juvenile Chinook, 6 adult salmonids and 12 juvenile salmonids (*Oncorhynchus spp*), 1 Pacific lamprey (*Entosphenus tridentatus*), 8 white sturgeon (*Acipenser transmontanus*), and 289 peamouth chub (*Mylocheilus caurinus*). A single walleye (*Sander vitreus*) was recovered from a SSL stomach collected at Bonneville Dam this was the first identified walleye recovered in GI tracts to date (Table 3). The 3 CSLs removed from Willamette Falls in spring 2024 included 3 adult Steelhead (*Oncorhynchus mykiss*), 12

Pacific lamprey and 2 adult Chinook salmon (Table 4). Three CSL GI tracts collected at Bonneville Dam contained no identifiable prey remains.

For the 34 sea lions collected during spring 2025 at Bonneville Dam, remains included 57 adult Chinook salmon, 7 adult and 30 juvenile salmonids, 5 white sturgeon, 10 Pacific lamprey, 6 river lamprey (*Lampetra ayresii*) and 16 peamouth chub. The 2 SSL removed from Willamette Falls had remains from 4 adult Chinook salmon, 3 white sturgeon, and 41 Pacific lamprey (Table 3). Two CSL GI tracts collected at Bonneville Dam contained no identifiable prey remains.

Six SSL were removed in fall 2024 (4 Bonneville Dam and 2 Willamette Falls). Bonneville prey remains included 9 Chinook salmon adults, 1 chum salmon adult (*Oncorhynchus keta)*, 2 Pacific lamprey, 12 white sturgeon, 30 sculpin (Cottidae) and 1 common carp (*Cyprinis carpio*) (Table 3). The 2 SSL removed from Willamette Falls had remains from 1 adult salmonid, 2 white sturgeon and 2 common carp (Table 4). Identifiable hard parts were recovered from all GI tracts collected during fall 2024 and 2025 at both locations.

PIT Tag Recovery

Eight PIT tags were recovered in spring 2024. Seven were read and represented 6 hatchery spring Chinook from 4 different hatcheries. A Floy tag was also recovered in spring. This fish was a hatchery summer steelhead adult. The fish was tagged at the Lyle Falls fish trap and released. It was determined by tagging staff that the fish was likely a fallback and after tagging returned downstream and was then consumed below Bonneville Dam. Four PIT tags were recovered from the spring Bonneville prey remains. These represented 3 hatchery summer steelhead juveniles and one hatchery spring Chinook from 3 different hatcheries (Table 5).

Willamette Falls

California sea lions—The estimated number of salmonids consumed by California sea lions over the six-site, 1,828-hour sampling frame was 627 fish (95% confidence interval: 528–727) (Table 1). Partitioning salmonids to run based on Monte Carlo modeling, we estimated that California sea lions consumed 72 winter steelhead (1.5% of potential passage), 86 summer steelhead (≤1.7% of potential passage), 78 unmarked spring Chinook salmon (1.4% of potential passage), and 391 marked spring Chinook salmon (1.5% of potential passage).

Steller sea lions—The estimated number of salmonids consumed by Steller sea lions over the six-site, 1,828-hour sampling frame was 45 fish (95% confidence interval: 3–106) (Table 1). Partitioning salmonids to run based on Monte Carlo modeling, we estimated that Steller sea lions consumed 1 winter steelhead (<0.1% of potential passage), 3 summer steelhead (≤0.1% of potential passage), 9 unmarked spring Chinook salmon (0.2% of potential passage), and 31 marked spring Chinook salmon (0.1% of potential passage).

Effect of Removals

A total of 230 individual sea lions and 238 "agents" (8 sea lions occurred in two seasons) were included in the ABM (Table A3.1, Appendix 3). Of these, 193 agents from previous reporting periods (August 14, 2020 – June 30, 2024) and 45 from the current reporting period (July 1, 2024 – June 30, 2025). The predicted post-removal salmonid requirement for these 238 agents was 49,230 salmonids (95% CI = 32,068-69,728) (Figure A3.5, Appendix 3). While it is important to note that bioenergetic models produce estimates of food requirements and not food consumption, these results were consistent with data from captive animals. In addition, the removal of habituated sea lions likely reduces the recruitment of new, naive animals into upriver nuisance populations, further benefiting fish in future years.

It is important to note that bioenergetic models produce estimates of food requirements and not food consumption, therefore are likely to generate conservative estimates of salmonid consumption by sea lions and salmon saved by management actions. The results of the ABM are further conservative in that they do not account for sea lion predation happening away from Bonneville Dam, nor do they incorporate behavioral or social factors such as the presence of habituated animals at the dam leading to recruitment of new, naïve sea lions into upriver nuisance populations (e.g., Schakner et al. 2016). The salmonid requirement and savings estimates produced by multiplying sea lion days by the estimated daily salmonid requirements generated by the ABM do not incorporate predation happening away from Bonneville Dam, but they do include the expected social and behavioral benefits of sea lion removals including decreased recruitment. This appears to be reflected in the difference between the estimates of salmon saved as a result of management actions since the beginning of the current MMPA §120(f) authorization, which were approximately 41,887 fish using the ABM approach to project savings from removals into the future, but were estimated to be 52,044 in realized savings Fall 2020 – Spring 2025 using the sea lion days approach.

Finally, there are differences in the trends in salmonid predation observed in spring and fall. Salmonid predation in fall is almost entirely due to the presence of SSLs, with few or no CSLs present. This predation had been steeply increasing from 2017 to 2019, prior to the beginning of fall management. Since fall management began, the estimated salmonid requirements (a very conservative proxy for salmonid consumption) for sea lions present in fall have steeply declined from 9,611 fish in 2019 to 752 fish in 2024 (Figure 5). In contrast, the combined estimates of salmonid requirements by SSLs and CSLs in spring have remained relatively constant during this period, fluctuating around 4,000 fish required by sea lions at Bonneville Dam in the spring each year (Figure 5). Though the estimated requirements of SSLs present in the spring have declined since the beginning of management under the MMPA §120(f) authorization in fall 2020, the requirements by CSLs have increased from historical lows in 2019 and 2020, resulting in relatively stable total salmonid requirements in the spring. This may suggest an increase in recruitment of CSLs during this period and may also support the hypothesis that the larger SSLs competitively displace the CSLs when present in large numbers. Regardless of the cause, sea lion predation on salmonids has remained relatively steady for several years, if slowly declining.

TASK FORCE RECOMMENDATIONS

In addition to the Terms and Conditions outlined previously, in the 2020 Authorization NMFS determined that a subset of Task Force recommendations warranted consideration by the Eligible Entities as they will help achieve the goal of reducing/eliminating sea lion predation on at-risk fish species in the Columbia River Basin. NMFS requested that the Eligible Entities, to the maximum extent practicable, implement the following recommendations to minimize sea lion predation on at-risk fish species in the Columbia River Basin and-or to help evaluate the effectiveness of the authorized lethal removals or alternative actions:

1. Consistent with the intent of the Endangered Salmon Predation Prevention Act, NMFS requests that the Eligible Entities develop a long-term management strategy to prevent the future recruitment of sea lions into the 120(f) geographic area.

2. As recommended by the Task Force, NMFS requests that the Eligible Entities continue to pursue non-lethal methods to reduce sea lion predation on at-risk fish stocks.

3. As recommended by the Task Force, NMFS requests that the Eligible Entities conduct necropsies on euthanized sea lions to monitor sea lion age, disease, diet, and health trends in sea lion populations.

4. As recommended by the Task Force, NMFS requests that the Eligible Entities explore opportunities to displace and-or minimize the use of manmade haul outs by sea lions in the Columbia River.

5. As recommended by the Task Force, NMFS requests that the Eligible Entities look at the rate of sea lion recruits after habituated animals are removed to understand the effectiveness of the lethal removal program.

6. As recommended by the Task Force, NMFS requests that the Eligible Entities, in coordination with the Alaska Fisheries Science Center, monitor Steller sea lion rookeries in northern California (Saint George Reef and Sugarloaf Island), Oregon (Three Arch Rocks, Orford Reef and Rogue Reef), and Washington (Carroll Island and Sea Lion Rock) to assess the population status of Steller sea lions at these rookeries.

7. As recommended by the Task Force, NMFS requests that the Eligible Entities consider creating a way to collect public input and observations on the problem interactions in areas identified as Categories 2 and Category 3.

8. As recommended by the Task Force, NMFS requests that the Eligible Entities consider setting up a program, in coordination with NMFS, which would support or help secure the funds needed for monitoring to evaluate success of the lethal removal program.

9. As recommended by the Task Force, NMFS requests that the Eligible Entities conduct a management strategy evaluation on the performance of the bioenergetics model used to estimate the expected benefits of the MMPA section 120 program.

The Eligible Entities provided a report on December 1, 2023, to NMFS on the implementation status of each of these recommendations (see Clark et al. 2023 for details).

TABLES AND FIGURES

Table 1**.** Description and relevant data for sea lions removed between July 1, 2024, and June 30, 2025, under MMPA §120(f) authority. Bonneville Dam Coordinates = 45.6392º, −121.9521º Bonneville Dam Forebay Coordinates = 45.6379°, −121.9456°, Willamette River Coordinates = 45.39075°, −122.62879°.

Removal Date	Location	Species	Animal ID	Weight (lbs)	Length (cm)
2024 Fall Management Season					
10/15/2024	Bonneville Dam	SSL	EB086	1082	272
10/15/2024	Bonneville Dam	SSL	EB087	1043	287
11/5/2024	Willamette River	SSL	EW002	1346	292
12/4/2024	Bonneville Dam	SSL	EB088	1470	289
12/4/2024	Bonneville Dam	SSL	EB089	1573	291
12/10/2024	Willamette River	SSL	EW003	1196	276
2025 Spring Management Season					
4/15/2025	Bonneville Dam	SSL	EB90	1168	273
4/15/2025	Bonneville Dam	SSL	EB91	1079	270
4/15/2025	Bonneville Dam	SSL	EB92	623	241
4/16/2025	Bonneville Dam	CSL	ZB075	380	195
4/16/2025	Bonneville Dam	CSL	ZB076	617	232
4/17/2025	Bonneville Dam	CSL	ZB077	670	230
4/17/2025	Bonneville Dam	CSL	ZB078	535	214
4/17/2025	Bonneville Dam	CSL	ZB079	405	204
4/22/2025	Bonneville Dam	SSL	EB93	819	255
4/22/2025	Bonneville Dam	SSL	EB94	1843	294
4/23/2025	Willamette River	SSL	EW004	1210	277
4/23/2025	Willamette River	SSL	EW005	1420	281
4/30/2025	Bonneville Dam	SSL	EB95	1259	269
5/1/2025	Bonneville Dam	CSL	ZB080	499	230
5/7/2025	Bonneville Dam	SSL	EB096	1080	263

Removal Date	Location	Species	Animal ID	Weight (lbs)	Length (cm)
5/7/2025	Bonneville Dam	SSL	EB097	661	229
5/7/2025	Bonneville Dam	SSL	EB098	421	206
5/7/2025	Bonneville Dam	SSL	EB099	925	255
5/7/2025	Bonneville Dam	SSL	EB100	630	230
5/7/2025	Bonneville Dam	CSL	ZB081	821	232
5/7/2025	Bonneville Dam	CSL	ZB082	377	202
5/7/2025	Bonneville Dam	CSL	ZB083	253	*
5/7/2025	Bonneville Dam	CSL	ZB084	497	220
5/7/2025	Bonneville Dam	CSL	ZB085	431	204
5/7/2025	Bonneville Dam	CSL	ZB086	632	214
5/7/2025	Bonneville Dam	CSL	ZB087	790	235
5/7/2025	Bonneville Dam	CSL	ZB088	383	196
5/7/2025	Bonneville Dam	CSL	ZB089	547	220
5/7/2025	Bonneville Dam	CSL	ZB090	335	172
5/12/2025	Bonneville Dam forebay	CSL	ZB097	415	193
5/12/2025	Bonneville Dam forebay	CSL	ZB098	288	189
5/13/2025	Bonneville Dam	CSL	ZB091	935	244
5/13/2025	Bonneville Dam	CSL	ZB092	562	214
5/13/2025	Bonneville Dam	CSL	ZB093	482	197
5/13/2025	Bonneville Dam	CSL	ZB094	328	181
5/13/2025	Bonneville Dam	CSL	ZB095	262	191
5/13/2025	Bonneville Dam	CSL	ZB096	522	210
5/15/2025	Bonneville Dam forebay	CSL	ZB099	291	191
6/4/2025	Bonneville Dam forebay	CSL	ZB100	461	291

*Length was not taken for CSL ZB083 because it was not euthanized and was transferred to the Oregon Coast Aquarium for permanent captivity.

Table 2. Raw data from USACE sea lion predation monitoring during Fall 2024 and Spring 2025 (statistically expanded estimates for unsampled times and locations will be included in the final report). Only Steller sea lions were present at Bonneville Dam in fall, whereas both California and Steller sea lions were present in spring. Number of observed predation events for each sea lion species are presented, broken down by prey species where possible. Statistically expanded estimates for unsampled times and locations will be included in the final USACE report.

Fish predation by pinnipeds at Bonneville Dam between 6 April 2025 and 17 May 2025			
Fish Species	**Observed Number of Fish Killed**	**Adjusted Number of Fish Killed (95% CI)**	**Percent Run Consumed During Observation Period**
Spring Chinook Salmon	442	3,943 (3,435 – 4,467)	4.0%
Steelhead	4	28 (0 – 55)	5.5%
White Sturgeon	11	102 (31 – 163)	N/A
Lamprey	2	N/A	N/A
Other	7	N/A	N/A
Unknown	27	N/A	N/A

Season	**Dates Observed**	**Location Observed**	**Total Daylight Hours Available**	**Daylight Hours Observed**	**Sample Rate (%)**
Fall 2024	N/A	N/A	N/A	N/A	N/A
Spring 2025	24 March - 13 May	SPW*, PH1, PH2	1773	205	11.6

*SPW observations began on 10 April 2025

Table 3. Frequency of occurrence (FO) and minimum number of individual (MNI) prey recovered from stomach and large intestines collected from 32 euthanized Steller sea lion (SSL) and 47 California sea lion (CSL) captured at Bonneville Dam between April 1, 2024, and June 30, 2025.

	Bonneville 2024 (45 GI total)						**Bonneville 2025 (34 GI total)**			
Prey Species	CSL 2024 n=24 Spring		SSL 2024 n=17 Spring		SSL 2024 n=4 Fall		CSL 2025 n=23 Spring		SSL 2025 n=11 Spring	
Identified by recovered hard parts	**FO**	**MNI**	**FO**	**MNI**	**FO**	**MNI**	**FO**	**MNI**	**FO**	**MNI**
American Shad	8.3%	2	0.0%	0	50.0%	5	17.4%	8	0.0%	0
Cephalopod	0.0%	0	0.0%	0	0.0%	0	4.4%	1	0.0%	0
Chinook Salmon Adult	75.0%	51	52.9%	21	50.0%	9	65.2%	35	45.5%	22
Chinook Salmon Juvenile	33.3%	231	0.0%	0	0.0%	0	0.0%	0	0.0%	0
Chum Salmon Adult	0.0%	0	0.0%	0	25.0%	1	0.0%	0	0.0%	0
Common Carp	0.0%	0	0.0%	0	25.0%	1	0.0%	0	0.0%	0
Cyprinid spp.	0.0%	0	11.8%	2	0.0%	0	0.0%	0	18.2%	4
Eulachon	0.0%	0	0.0%	0	0.0%	0	4.4%	1	0.0%	0
Hatchery Spring Chinook Juvenile*	8.3%	2	0.0%	0	0.0%	0	0.0%	0	9.0%	1
Hatchery Summer Steelhead Juvenile*	4.2%	1	0.0%	0	0.0%	0	4.4%	1	9.0%	2
Juvenile Salmonid spp.	12.5%	9	17.6%	3	25.0%	1	34.8%	28	9.0%	2
Largescale Sucker	0.0%	0	11.8%	2	0.0%	0	0.0%	0	0.0%	0
Pacific Lamprey	4.2%	1	0.0%	0	25.0%	2	26.1%	9	9.0%	1
Peamouth Chub	20.8%	142	29.4%	147	0.0%	0	0.0%	0	27.3%	16
Perch spp.	0.0%	0	0.0%	0	0.0%	0	4.4%	1	9.0%	2
River Lamprey	0.0%	0	0.0%	0	0.0%	0	0.0%	0	9.0%	6
Adult Salmonid spp.	25.0%	6	0.0%	0	50.0%	6	13.0%	3	36.4%	4
Sculpin spp.	0.0%	0	11.8%	2	25.0%	30	0.0%	0	0.0%	0
Smallmouth Bass	0.0%	0	5.9%	1	0.0%	0	0.0%	0	0.0%	0
Squid	0.0%	0	0.0%	0	0.0%	0	4.4%	1	0.0%	0
Steelhead Salmon juvenile	4.2%	3	0.0%	0	0.0%	0	0.0%	0	0.0%	0
Sturgeon	4.2%	1	41.2%	7	100.0%	12	0.0%	0	27.3%	5

Unidentified cartilaginous fish	0.0%	0	0.0%	0	0.0%	0	4.4%	1	0.0%	0
Unidentified fish	0.0%	0	11.8%	2	50.0%	6	4.4%	1	0.0%	0
Walleye	0.0%	0	5.9%	1	0.0%	0	0.0%	0	0.0%	0
Yellow Perch	0.0%	0	11.8%	3	0.0%	0	0.0%	0	0.0%	0

* Identified to species by PIT tag.

Table 4. Frequency of occurrence (FO) and minimum number of individual (MNI) prey recovered from stomach and large intestines collected from 4 euthanized Steller sea lion (SSL) and 3 California sea lion (CSL) captured at Willamette Falls between April 1, 2024, and June 30, 2025.

Willamette Fall and Spring 2024 and 2025						
Prey Species	CSL 2024 n=3 Spring Removal		SSL 2024 n=2 Fall Removal		SSL 2025 n=2 Spring Removal	
Identified by recovered hard parts	**FO**	**MNI**	**FO**	**MNI**	**FO**	**MNI**
Chinook Salmon Adult	33.3%	2	0	0	100.0%	4
Common carp	0.0%	0	50.0%	2	0.0%	0
Northern Pikeminnow	0.0%	0	0.0%	0	50.0%	1
Lamprey spp.	33.3%	1	0.0%	0	0.0%	0
Pacific lamprey	33.3%	12	0.0%	0	100.0%	41
Salmonid	0.0%	0	50.0%	1	0.0%	0
Sculpin spp.	0.0%	0	0.0%	0	50.0%	1
Steelhead Salmon Adult	66.7%	3	0.0%	0	0.0%	0
Sturgeon	0.0%	0	100.0%	2	100.0%	3
Unidentified fish	33.3%	1	50.0%	1	50.0%	1

Table 5. PIT tags recovered from stomach and large intestines collected from 32 euthanized Steller sea lion (SSL) and 47 California sea lion (CSL) captured at Bonneville Dam between April 1, 2024, and June 30, 2025.

PIT tags Recovered from Bonneville Dam Removal Animals Spring 2024 and 2025					
Predator	**Removal Date**	**Tag Type**	**Prey Species**	**Age Class**	**Release Site**
CSL	5/8/2024	Floy	Hatchery Summer Steelhead	Adult Fallback	Lyle Falls fish trap
CSL	5/2/2024	PIT	Hatchery Spring Chinook	Juvenile	Clearwater Hatchery
CSL	4/23/2024	PIT	Hatchery Spring Chinook	Juvenile	Round Butte Hatchery
CSL	4/24/2024	PIT	Hatchery Spring Chinook	Juvenile	Klickitat hatchery
CSL	4/24/2024	PIT	Hatchery Spring Chinook	Juvenile	Round Butte Hatchery
CSL	4/24/2024	PIT	Hatchery Spring Chinook	Juvenile	Little White Salmon Nat Fish hatchery
CSL	4/23/2024	PIT	Hatchery Spring Chinook	Juvenile	Little White Salmon Nat Fish hatchery
CSL	4/23/2024	PIT	No Read	NA	NA
SSL	5/7/2025	PIT	Hatchery Summer Steelhead	Juvenile	Dworshak NFH
SSL	5/7/2025	PIT	Hatchery Summer Steelhead	Juvenile	Magic Valley Hatchery
SSL	4/15/2025	PIT	Hatchery Spring Chinook	Juvenile	Klickitat Hatchery
CSL	5/12/2025	PIT	Hatchery Summer Steelhead	Juvenile	Magic Valley Hatchery

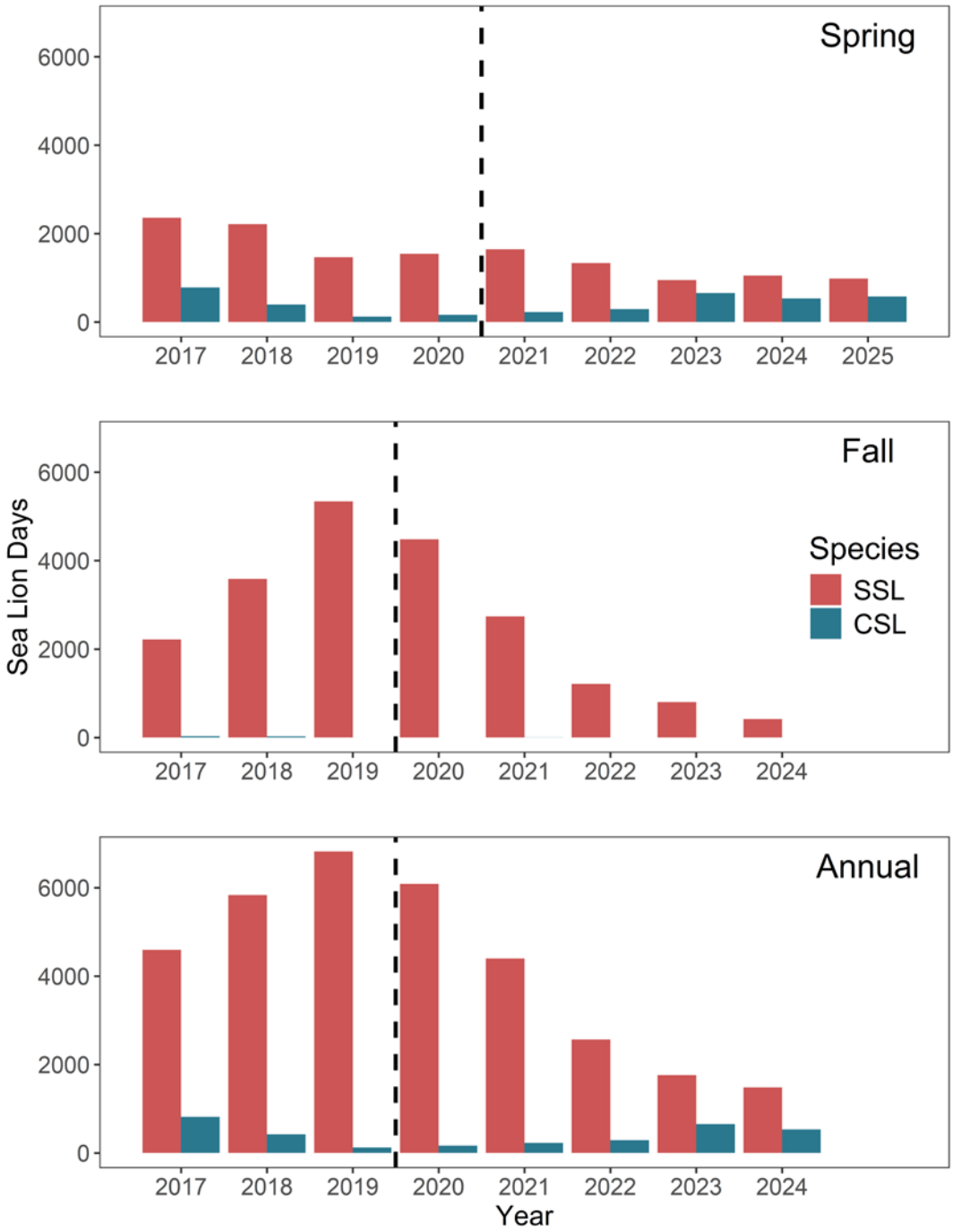


Figure 1. Yearly estimates of the number of sea lion days spent at Bonneville Dam by California (CSL, blue) and Steller (SSL, red) sea lions from 2017 (when USACE implemented consistent Fall monitoring) through Spring 2025. Top: estimated sea lion days for the Spring monitoring period (January – May); Middle: estimated sea lion days for the Fall monitoring period (August – December); Bottom: year-round estimates of sea lion days. Vertical dashed line represents the beginning of the current removal permit in August 2020. Fall 2025 data are not included in this reporting period, so are omitted in the middle and bottom panels.

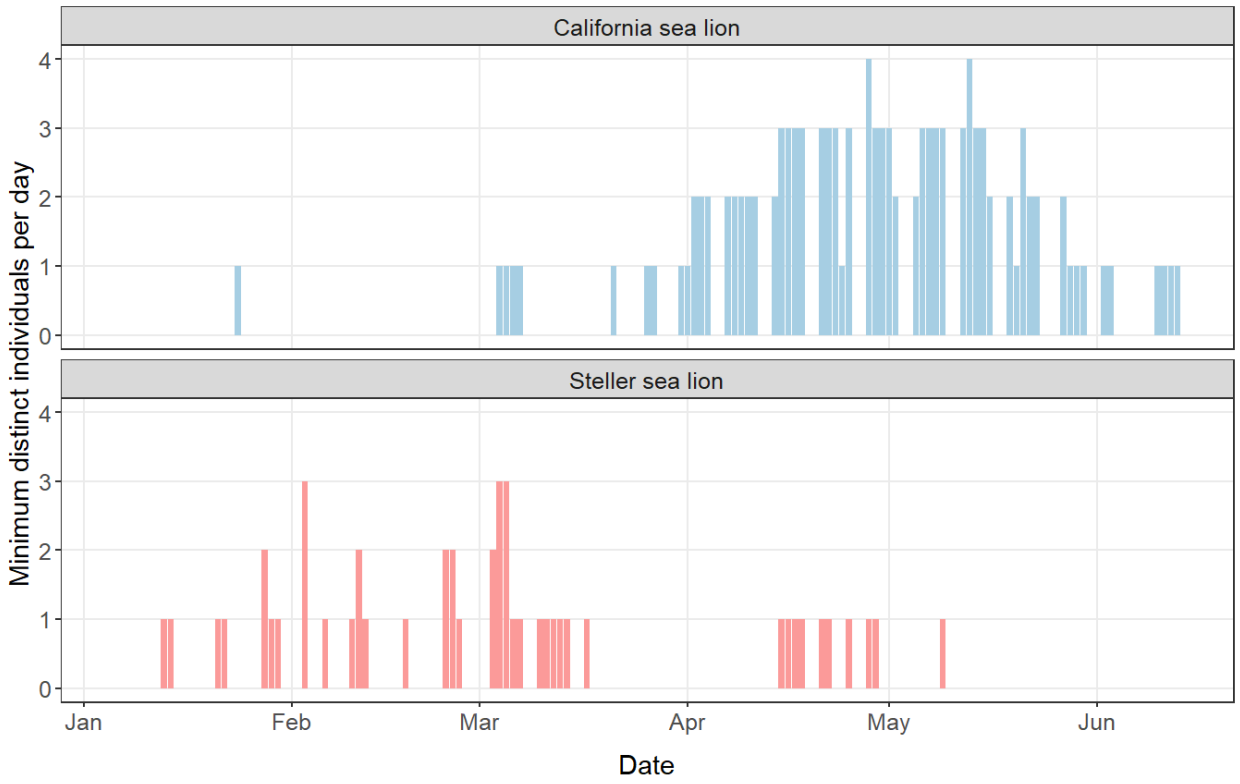
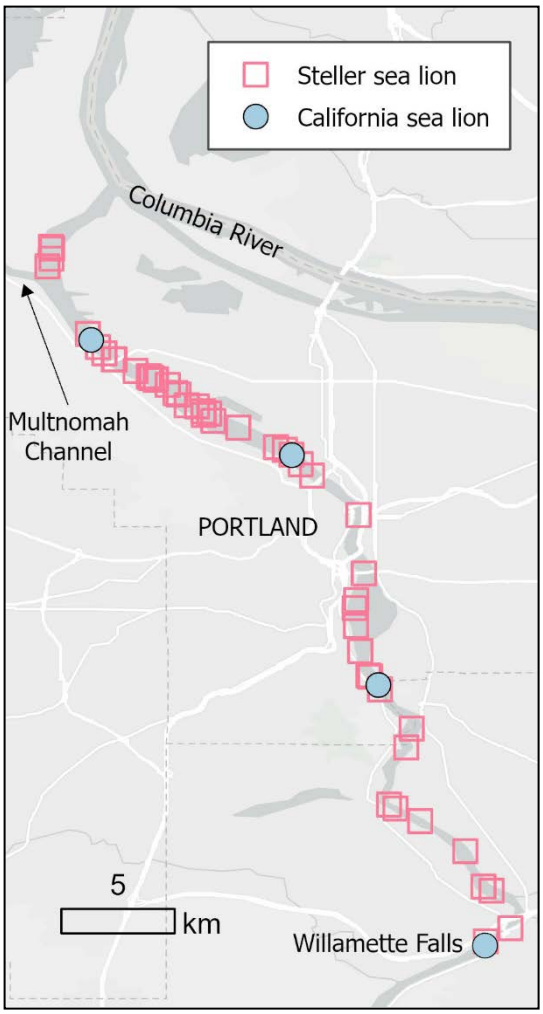


Figure 2. Weekday counts of sea lions at Willamette Falls, January 6 – June 13, 2025. Counts include animals observed from the falls downstream to approximately the I-205 bridge.



Date	Survey end	CSL	SSL
2024-09-13	Multnomah Ch.		
10-04	Multnomah Ch.		
10-18	Columbia R.		3
10-25	Multnomah Ch.		1
11-15	Columbia R.	1	1
11-27	Columbia R.		
12-13	Columbia R.		2
12-27	Columbia R.		3
2025-01-13	Columbia R.		5
02-03	Columbia R.		14
02-12	Columbia R.		10
03-03	Columbia R.		9
03-21	Columbia R.	1	1
04-04	Columbia R.	2	1
04-25	Columbia R.	2	7
05-08	Columbia R.	4	5
05-22	Columbia R.	1	1

Figure 3. Individual locations (map at left) and total counts (table at right) for California sea lions (CSL) and Steller sea lions (SSL) observed during vessel-based surveys of the Willamette River, beginning at Willamette Falls in Oregon City and proceeding downriver to the end location noted in the table.

Figure 4. Estimated salmon required by California (blue, CSL) and Steller (red, SSL) sea lions at Bonneville Dam. Spring estimates (January – May) from 2002 – 2025 are shown in the bottom panel. Top panel shows fall estimates (August – December) for years with complete fall monitoring data (2017 – 2024). Estimates derived by multiplying sea lion days for each species by daily consumption estimates from the agent-based model (Appendix 3).

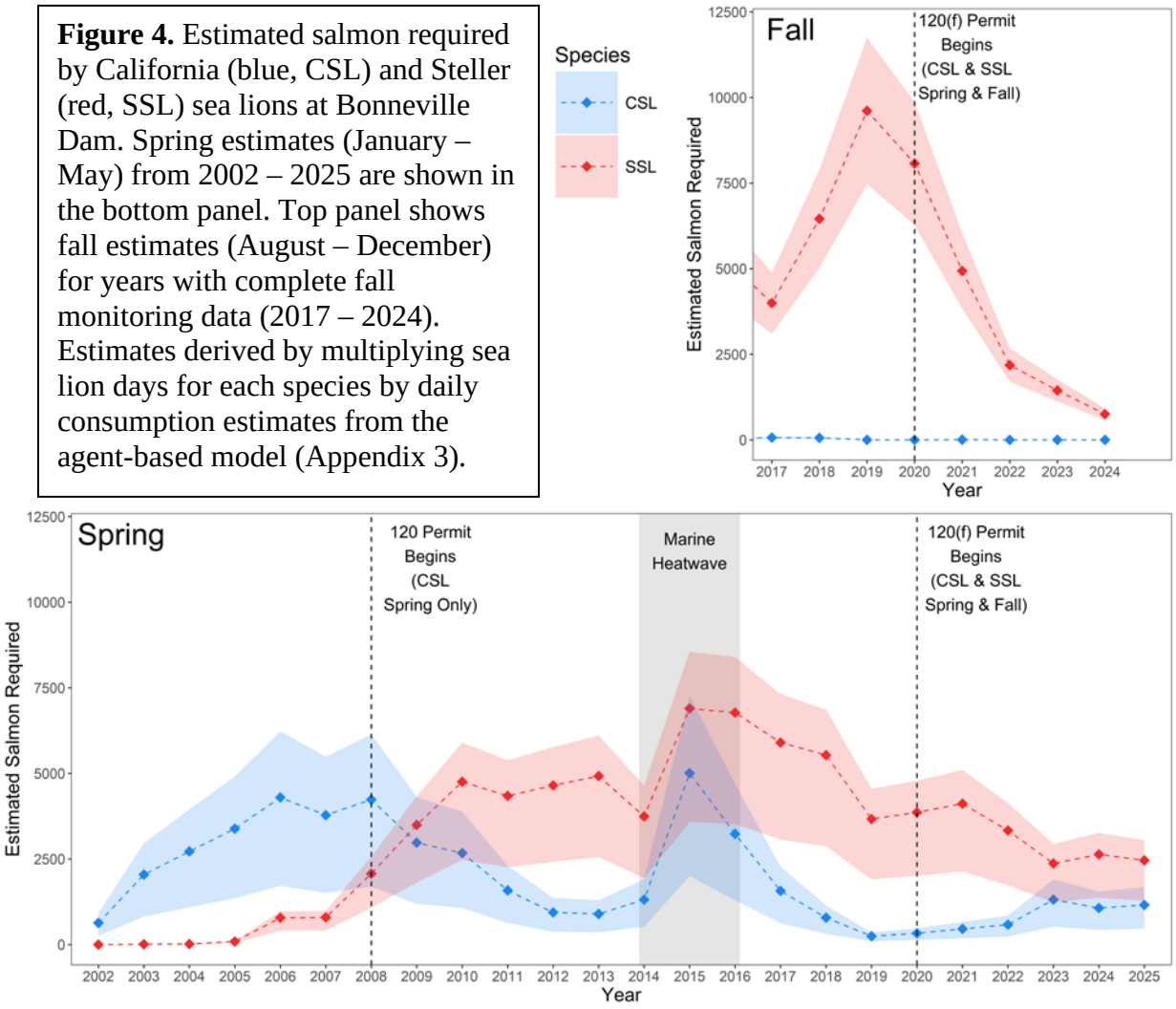
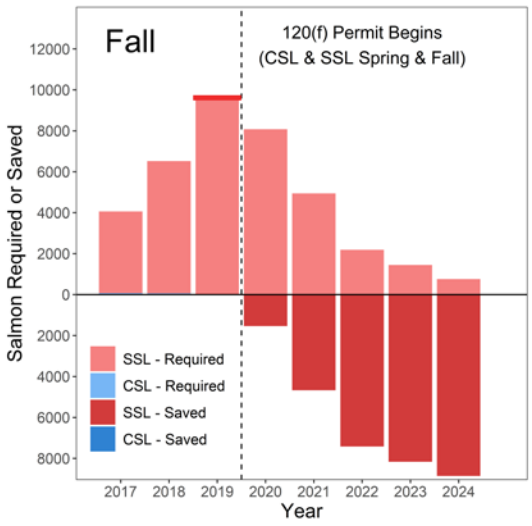
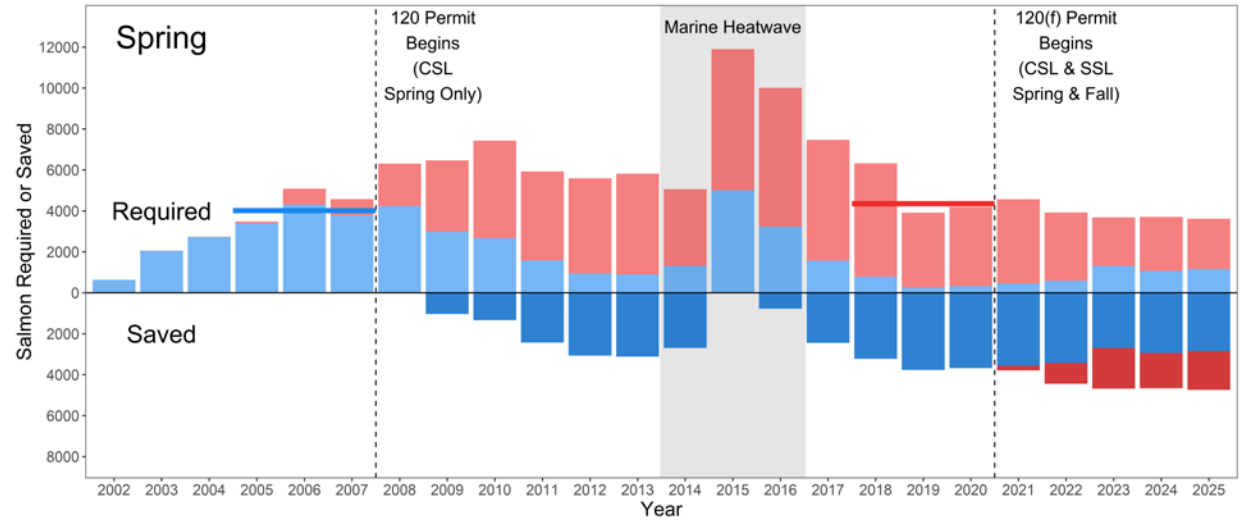


Figure 5. Estimated salmonids required (values above zero line) by California (blue, CSL) and Steller (red, SSL) sea lions at Bonneville Dam, as well as "saved" by management actions (values below zero line). Top: Fall estimates (August – December) 2017 – 2024. Bottom: Spring estimates (January – May) 2002 – 2025. Salmon required derived by multiplying sea lion days for each species by daily salmonid requirement estimates from the agent-based model (Appendix 3). Savings calculated by subtracting salmon required from a pre-management baseline for each species. CSL spring baseline = 2004 – 2007 (thick blue line). SSL spring baseline = 2018 – 2020. Due to rapidly increasing SSL predation 2017 – 2019, only 2019 used as fall baseline. CSL presence was negligible in fall, so not used to calculate savings.





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APPENDICES

Appendix 1. IACUC

Assurance of Animal Care and Use Form

IACUC Use Only

IACUC Number:

ODFW/WDFW/CRITFC/IDFG 2022-1

(Circle One)

Date Received: 09 11 2025

Initial Review Date: 09 11 2025

Second review:

Third review:

IACUC Training Complete: ☒

IACUC Recommendations: Approved: ☒ Not Approved: ☐

Withhold Approval Pending Modification: ☐

Type of Submission: New ☐ Modification ☐ Renewal ☒

IACUC Chair Signature: Doug Mat **Date:** 9/11/2025

Columbia River Predatory California and Steller Sea Lion Lethal Removal Section 120(f) Authorization Animal Care and Use Form

A. Administrative Data

Project Title: Columbia River Predatory California and Steller Sea Lion Lethal Removal

Institutions: State of Washington, State of Oregon, State of Idaho, Columbia River Intertribal Fish Commission (representing: Nez Perce Tribe, Confederated Tribes and Bands of the Yakama Nation, Confederated Tribes of the Umatilla), Confederated Tribes of the Grand Ronde Community; Confederated Tribes of the Siletz Indians of Oregon, and the Confederated Tribes of the Warm Springs Reservation of Oregon

Principal Investigators: Sarah Maher (IDFG), Casey Clark (WDFW), Michael Brown (ODFW), Douglas Hatch (CRITFC -- Chair), Robin Brown (Community Member At-Large), Colin Gillin (ODFW – Veterinarian)

Mailing Address:

Telephone: **Fax:** **Email:**

Initial Submission ☐ **Renewal** ☒ **or Modification** ☐

Project Title: Columbia River Predatory California and Steller Sea Lion Removal

Anticipated Start Date: September 12, 2025 **Anticipated End Date:** Ongoing

Duration of Approved Protocol: September 12, 2025 through August 14, 2026

Study Site(s) Location (or Where Animals Will Be Housed): Bonneville Lock and Dam, Willamette Falls (Willamette River), Columbia River main stem River Miles 112-292, Columbia River Tributaries

Other approved IACUC Animal Care and Use Assurance relating to this project:

Permits: Identify all relevant permits (Federal, State and other) necessary to conduct this project. Provide permit type(s), permit number(s), and expiration date(s). Please indicate if a permit application is pending a decision.

Permit Type	Permit Number	Expiration Date
NMFS Permit & Letter of Authorization		August 22, 2030
Oregon Fish & Wildlife Statutes	OARs	
Washington F&W Statutes	RCWs	

*The NMFS policy intends to comply with the **Animal Welfare Act** (AWA) - Title 7 of U.S. Code §2131 et. seq. and implementing regulations and adhere to the principles of the **U.S. Government Principles** for the Utilization and Care of Vertebrate Animals Used in Testing, Research, and Training (USGP) and follow the guidelines in the National Research Council **Guide for the Care and Use of Laboratory Animals.***

B. Justifications

This is a request to renew Approved Protocols contained in the Assurance of Animal Care and Use (AAC&U) Form with IACUC Number ODFW, WDFW, CRITFC & IDFG 2021-1 entitled "Columbia River Predatory California and Steller sea lion Removal" dated 31 August 2021.

In accordance with USGP #2, "Procedures involving animals should be designed and performed with due consideration of their relevance to human or animal health, the advancement of knowledge, or the good of society."

1. Research Goals:

a. What are the scientific issues addressed by the research? Specifically, how will this research improve human or animal health or advance knowledge?

Predatory California and Steller sea lions foraging for salmonids, sturgeon, lamprey and other species in the Columbia River below Bonneville Dam are having a significant negative impact on the recovery of populations of threatened and endangered (T&E) fish populations. This action, as permitted by 2020 Amendments to the Marine Mammal Protection Act, will reduce predator-associated mortality of fish stocks from depleted or ESA-listed populations. In particular, salmonids attempting to pass fishways to reach upriver spawning areas are subjected to bottleneck effects as they stage below upriver obstacles or attempt to pass through fish ladders. The objective of this work is to remove a number of upriver, habituated individual California and Steller sea lions from a large, robust, and healthy populations to protect T&E salmonids, lamprey and sturgeon, many from very small and highly at-risk populations. This management tool was provided to the states by the U.S. Congress in Section 120 of the MMPA, as originally amended in 1994. This current management authorization was granted the states by the Dept of Commerce, NOAA-NMFS under a Permit and Letter of Authorization (LOA) dated August 14, 2020, providing authorization for a duration of five years until August 22, 2030.

b. What are the specific goals of the animal studies described in this protocol?

The goal of this work is to reduce pinniped predation on T&E salmonids, and populations of lamprey, sturgeon and other at-risk stocks in the lower Columbia River (River Mile 112 to River Mile 292) and its tributaries to aid in the recovery of these fish populations. This will be accomplished by lethally removing California and Steller sea lions in these areas. After pinnipeds are captured and euthanized, numerous biological samples (e.g., GI

tracts, blood, tissues, organs, teeth) will be collected for a variety of scientific study purposes including food habits analyses, histology, and studies of pathogens and disease as per Task Force recommendation (See Letter of Authorization, 22 Aug 2025).

2. Explain why animal studies are preferred to non-animal alternatives in achieving these research goals.

The permanent removal of these predatory sea lions is required to achieve the objective of protecting fish stocks in the Columbia River and its tributaries. Multiple years of capture and transport, capture and holding, and all other non-lethal tools currently available have been shown to be statistically and biologically ineffective in reducing pinniped predation in these areas.

In accordance with the Animal Welfare Act – "…the principal investigator has provided written assurance that the activities do not unnecessarily duplicate previous experiments."

3. Does this research duplicate previous experiments? ☐ YES ☒ NO

If YES, please explain why this duplication is necessary. N/A

4. Do the animal procedures planned for this research involve only simple field observation with no impact on either the animals or their environment? (e.g. aerial surveys, brand or tag resighting, focal "animal" follow, vessel surveys)

☐ YES ☒ NO

If YES, it is not necessary to complete the informational sections of this protocol form. Instead, answer the following:

Use Appendix A to describe the study activities. Include all precautions to ensure no adverse impact on the study animals and their environment.
Include copies of any required permits.
Sign this form under Section H

If NO, the remainder of this form must be completed. Complete Appendix A for observational studies and then proceed to the next section.

In accordance with the USGP #3, "The animal selected for a procedure should be of an appropriate species and quality and the minimum number required to obtain valid results."

5. List the research species (and stock) and describe why is the most appropriate species to use in these studies:

California sea lions (*Zalophus californianus*), U.S. Stock; Steller sea lions (*Eumetopias jubatus*). The relatively small number of adult and sub-adult male sea lions present within the management zone of the Columbia River are responsible for significant mortalities of adult salmonids, sturgeon and lamprey below Bonneville Dam, Willamette Falls and other sites along the lower Columbia River and its tributaries (Tidwell et al. 2019, Rub et al. 2019, Falcy 2017). Removal of predatory sea lions in this area will permit more salmonids to reach upriver spawning areas contributing to the recovery of these T&E fish populations, prevent predation on other fish stocks, and reduce the numbers of animals annually recruiting to bottleneck sites where fish are especially vulnerable.

6. How many animals do you plan to use for the protocol? Please provide a justification for the numbers of animals used (e.g., statistical power, survey, etc).

The NMFS Bonneville Pinniped-Fishery Interaction Task Force set the maximum lethal removal number for this project to be 540 California sea lions and 176 Steller sea lions over the 5-year period of the permit. These management actions will not exceed 10% of the potential biological removal (PBR) levels for either species.

Complete the following table below to define the numbers(s) of animal(s) to be used in each category and type procedure(s). Use the following animal welfare categories:

Category (adapted from AWAR):

B: Applies only to animals held captive in non-research status (display, rehabilitation, brood stock, holding).
C: Applies to little or momentary pain or discomfort
D: Applies to potential discomfort or pain which is relieved by the appropriate anesthetic or analgesic
E: Applies to discomfort or pain which is not relieved thus requires written justification and full IACUC (must consider the 3 R's)

Species (Common Name)	Age/Sex	Category C (List Procedure)	Category D (List Procedure)	Category E (List Procedure)	Total # of animals needed for duration of project
California sea lion (*Zalophus californianus*)	Adult males, subadult males	A maximum of 424 during the study period, minor pain or discomfort during trapping and transport to work facility. or trapping and release at site of capture	A maximum of 424 individuals during the study period, chemically anesthetized and euthanized	N/A	540 maximum
Steller sea lion (*Eumetopias jubatus*)	Adult males, subadult males	A maximum of 62 during the study period, minor pain or discomfort during trapping and transport to work facility, or trapping and release at site of capture.	A maximum of 62 individuals during the study period, chemically anesthetized and euthanized.	N/A	176 maximum

In accordance with the AWA: "The principal investigator has considered alternative to procedures that may cause more than momentary or slight pain or distress to the animals, and has provided a written narrative description of the methods and sources (e.g. the Animal Welfare Information Center) used to determine that alternative were not available…."

7. If you have placed any animal numbers in categories D and E, you must complete the following (use Appendix B if additional space is necessary)

a. Explain why the pain or discomfort cannot be relieved and what procedure will be used to minimize discomfort.

SECTION I: CAPTURE VIA TRAPS AND SUBSEQUENT EUTHANASIA

Capture and handling of pinnipeds by use of floating traps, transfer cages, and squeeze cages result in no pain and very little physical discomfort to pinnipeds included in this work. California and Steller sea lions that are to be euthanized are given appropriate primary (e.g. Telazol) and/or secondary (e.g., Telazol, Midazolam, Xylazine, or Medetomidine) doses of anesthetic (e.g., Telazol, Xylazine) via direct injection to be administered to the animal in the squeeze cage or transfer cage. Animals are to be in late Stage 3 anesthesia as defined by the AVMA (i.e., surgical or deep anesthesia characterized by loss of blink reflexes, shallow breathing) prior to euthanasia and

verification of death. A secondary means of euthanasia may be required if death cannot be verified, and is given via approved chemical or physical means (e.g., sodium pentobarbital (Euthasol), potassium chloride or overdose of an anesthetic, or captive bolt). The licensed veterinarian on site shall use discretion to choose the AVMA-approved euthanasia method most appropriate to the circumstances (with the exception of gunshot, which is prohibited for this work). Monitoring devices and physical exam findings should be used to confirm cessation of respiratory and cardiac function, thus verifying death.

Method	**Tools**
Secondary euthanasia method*	Pentobarbital IV IC/ IV potassium chloride Captive Bolt Exsanguination
Monitoring devices	Doppler unit EKG

*All of these secondary methods of euthanasia should only be performed when the animal is completely unconscious and unresponsive.

SECTION II: IMMOBILIZATION AND REMOVAL VIA DARTING

Darting will be used when appropriate as a method for immobilizing and capturing pinnipeds under the Marine Mammal Protection Act Section 120(f) authorization, and subsequent NMFS authorization (22 Aug 2025). The following methodologies for darting, immobilization, handling, and subsequent humane euthanasia are designed with an emphasis on maximizing human and animal safety. Protocols will reflect best scientific methodologies for darting, handling, and immobilizing pinnipeds, as well as safety considerations for other wildlife, people, or pets that may encounter the carcass of a darted animal or a partially injected dart. Darting is to be method of lethal removal secondary to trapping efforts and would be used in situations where trapping is not a practical or effective means of capture, and darting is deemed appropriate by all Eligible Entities (See Section 120(f) Letter of Authorization, 22 Aug 2025).

Darting of animals under MMPA Section 120(f) authority is to be utilized specifically for permanent removal efforts related to sea lion management in relation to conservation of fisheries species in the Columbia River Basin management area. Darting methods in this protocol do not include animals handled under state MMPA Section 109(h) authorization. Darts with tracking capabilities (e.g., acoustic, VHF) may be used, within consideration for the ultimate outcome of darting, including best effort to retrieval of the dart and/or the darted animal

The specific methods proposed for darting activities are as follows:

Pre-Darting Monitoring and Assessment

1. Animals residing in removal areas may be evaluated remotely or in person to determine patterns of behavior to increase the probability of success. This could

include situational assessment, remote monitoring by camera, UAV, or in-person resights to confirm predictability of behavior and hauling out at the site of management.

Dart Application

1. During darting, at least two boats and five staff will be present. One person not operating each vessel will be designated to visually track the animal. If beneficial, one or more additional staff members may be present on shore to monitor the animal from land.
2. Each darting attempt will include at least one veterinarian on staff, and a designated veterinarian or another qualified, experienced darter may conduct the darting attempt. All staff handling drugs, darts, or applying remote delivery of anesthetics will be trained, certified, and approved under their agency capture and immobilization training and policy. Primary preference is to first dart the animal while it is hauled out. Animals will be darted using an appropriate dart delivery system depending on individual scenarios.
3. Animals will be darted with an appropriate dose using a combination of Midazolam-Butorphanol-Medetomidine (Frankfurter et al. 2016, Haulena 2007).

Post-Darting Monitoring

4. After an animal is darted, it will be observed for anesthetic effect leading to induction, and tracked at an appropriate distance for safe and rapid retrieval to secure and transport the animal for subsequent euthanasia.

Handling and Euthanasia

5. Nets, donut poles (a pole with a round section of PVC attached), noose poles, Shepherd's hooks or other similar tools may be used to secure the animal or retain the animal in the direct management area.
6. Once the animal displays signs of full induction on land or water (i.e., non-responsiveness to direct stimuli, bubble blowing, and/or aimless swimming or treading water), it will be approached and secured in a manner that allows for controlled administration of euthanasia as per existing IACUC protocols for sea lion management.
7. After the animal has been secured, it may be euthanized in the field by the attending veterinarian[7], or transported to a secure facility for euthanasia, necropsy, and disposal.

Documentation and Reporting

[7] Mortality can be confirmed via several methods including the following: (1) lack of vital signs (heartbeat, respiration measured manually); (2) lack of retinal responsiveness; (3) lack of intraocular Doppler signal; (4) lack of cardiac activity via EKG monitor, or other (5) AVMA-approved methodologies.

8. Documentation will be collected of all darting attempts, including (but not limited to): managing parties initiating the darting activity; veterinary staffing; gun and dart type; drug combinations; animal reaction to anesthesia and ultimate results; means of physical immobilization, handling, and euthanasia; and a recap of efforts with notes for improvement or debriefing before future attempts. A report regarding the removal effort will be filed to NMFS within 72 hours as per MMPA Section 120(f) requirement.

b. What informational methods and resources did you use to determine that (no-animal or non-painful) alternative were not appropriate for this research?

i. **Include the databases that were searched (include keywords used).**
ii. **Include literature citations**
iii. **Include meetings with knowledgeable individuals (name, date)**
iv. **Include other methods/resources**

Beginning in the early 2000s, the number of California, and subsequently Steller sea lions observed foraging for salmonids below Bonneville Dam has increased annually (along with the number of salmonids, lamprey and sturgeon killed by these predators). Beginning in 2005, through 2008, the States of Oregon and Washington used all available non-lethal tools, at increasing levels of intensity, in efforts to non-lethally deter California sea lions from foraging at this location. Over that period and to this date, non-lethal hazing has proven to be ineffective at deterring CSL and reducing their predation rates on salmonids at this site (Brown et al. 2008, Annual Report on Field Activities at Bonneville Dam, Willamette Falls Task Force Meeting 2018). Known individual California sea lions observed killing salmonids below Bonneville Dam exposed to significant hazing efforts continue to kill salmonids and return to this area to forage year after year, despite ongoing hazing efforts by USACE. As a result of the failure of effective non-lethal tools to reduce predation, and at the recommendation of the NMFS Pinniped-Fishery Interaction Task Force, NMFS has issued a Permit & Letter of Authorization to the states and tribes for lethal removal of California and Steller sea lions between River Mile 112 and 292 in the Columbia River and Columbia River Tributaries, under certain outlined criteria and methodologies.

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C. Experimental Procedures

1. General Procedures. ***(Detail research procedures in Appendix A)***

In accordance with the AWA, "Procedures that may cause more than momentary or slight pain or distress to the animals will a) be performed with appropriate sedatives, analgesics, or anesthetics unless withholding such agents is justified for scientific reasons in writing by the principal investigator and will continue for only the necessary period of time; b) involve in their planning, consultation with the attending veterinarian…, c) not include the use of paralytics without anesthesia…"

Capture, Samples and methods of collection

Sample Type	Collection method	Sample size	Number of animals
None	Trap, barge, and euthanize	Up to 424 CSL, 62 SSL during study period	Up to 424 CSL, 62 SSL during study period
Entire carcass	Trap, barge, and euthanize identified and authorized animal	Up to 424 CSL, 62 SSL	Up to 424 CSL, 62 SSL
Blood from deceased animals	Syringe	As needed	Up to 424 CSL, 62 SSL
Tissues, organs, skeletal remains	Necropsy and pathological/ histological preparation	Samples of tissues from major organs and tissue types; Multiple samples from up to 540 CSL, 176 SSL	Up to 424 CSL, 62 SSL
Hide, organs, muscle, skeletal remains	As needed for subsistence use by qualifying recipient tribe	As needed	Up to 424 CSL, 62 SSL

2. Animal Restraint

Physical (*Describe method, duration, equipment used)*

CAPTURE VIA FLOATING TRAPS

For full darting methodologies, please see section above

Sea lions are captured on a floating trap used by animals for a resting area. Traps are locked open (unarmed) when staff are not present or weather conditions (excessive heat, cold or precipitation) prohibit a safe working environment to prevent accidental or unintended trapping which could result in injuries or mortality to animals. Trap doors are closed by a magnetized remote release system (TrapSmart™, SkyHawk™, or similar mechanized system) by team members within line of sight of traps and animals. Tarps are lowered around the seven-foot chain-link walls of the trap to calm animals and reduce visual stimuli. Animals may be moved between traps via an enclosed chain-link tunnel system and either retained or released. Animals that are to be transported and removed are herded or allowed to move freely from the trap into a transfer cage that is tall enough for the animals to walk into a handling barge. In rare cases sea lions that are not possible to move either due to size (i.e. over 1500lbs) or behavior may be chemically immobilized in the trap, removed mechanically by crane or wench, and placed in a transfer cage and moved by vehicle to the designated work area for processing. Animals are transported via barge and transfer cage, then subsequently into a transfer cage on the back of a vehicle to the work area for processing. Chemical immobilization will take place by direct injection – whichever method can be most safely administered- to deploy a dose of immobilizing drugs (i.e. Telazol-see chemical restraint table). At the work site, live sea lions are restrained in a squeeze cage at the work area where injectable or gas anesthesia or sedation and euthanasia are administered (see chemical restraint table). A variety of biological samples are collected from each euthanized animal prior to disposal or transfer of the carcass to tribal co-managers.

b. Chemical

Anesthetics and Analgesics:

If anesthetics or analgesics are to be used, please provide the following information: procedure, anesthetic, recommended starting dose and method of administration

Procedure	Anesthetic*	Recommended Starting Dose (to effect) & Method of Administration	Intervention
Anesthesia	Telazol, or generic	IM injection 1-4 mg/kg	N/A
Anesthesia	Telazol Ketamine Xylazine, or generic	1-4 mg/kg IM 0.5-1.0 mg/kg IM 0.5-1.0 mg/kg IM	N/A
Anesthesia	Telazol Xylazine, or generic	1-4 mg/kg IM 1-2 mg/kg IM	N/A
Anesthesia	Isoflurane gas	Cone / mask induction and maintenance at 3-5% saturation.	N/A
Anesthesia	Medetomidine Ketamine, or Xylazine	140 μg/kg IM 0.5-1.0 mg/kg IM 0.5-1.0 mg/kg IM	N/A
Anesthesia	Midazolam-Butorphanol-Medetomidine combination	0.2-0.26 mg/kg Midazolam 0.2-0.4 mg/kg Butorphanol 10-13 μg/kg Medetomidine IM	N/A
Sedation	Diazepam	0.1-0.2 mg/kg IM	N/A
Sedation	Midazolam	0.15-0.2 mg/ kg IM	N/A

*Those drugs that pose the lowest risk to human safety will be considered first for this work, at the discretion of the veterinarian on site.

3. **Marking and Instrumentation** ***(Describe mark or tag type, or instrument type to be used. Provide mass of attachment device, range of body mass of study animal, device mass a proportion of body mass and the recommended device mass as a percent of body mass)***

Tag or Instrument	Size (dimensions & mass)	% of body mass	Attachment Method
Duflex flipper tag	2.25x7/8” 5g	(<<1.00%)	Punch
Branded Digits	5” lettering	N/A	Hot Iron Brand

In accordance with AWA: “Activities that involve surgery include appropriate provision for pre-operative and post-operative care of the animal in accordance with established veterinary medical and nursing practices. All survival surgery will be performed using aseptic procedures, including surgical gloves, masks, sterile instruments, and aseptic techniques.”

4. Surgical Procedures – Is surgery to be performed? ☐ YES ☒ NO

a. If YES, list surgery location/room:
b. If YES,

i. is it a terminal procedure? ☐ **YES** ☐ **NO**

ii. is it a survival procedure? ☐ **YES** ☐ **NO**

c. If YES, then describe the surgical procedure to be performed in Appendix A. Be sure to include the protocol to be followed to ensure asepsis.
d. If aseptic procedures are not to be performed, use this space below to justify why not and describe the procedure of choice.
e. Describe the post-operative care (both immediate and long-term).

5. Injury to animals – Accidental injuries which might occur to animals during handling (Describe the most likely injuries which might occur to research animals, how frequent injuries are expected and planned procedures to treat injuries.)

Possible injuries to SSL and CSL that will be euthanized, held, or released include minor scrapes, abrasions, and bites during the trapping and marking operations (Appendix A). This type of superficial injury may occur in up to 10% of animals handled during any trapping and/or marking operation. Traps are locked (disarmed) open when not in use to prevent accidental or unintended trapping which could result in injury or mortality. When traps are open, at least three staff will be available and in the area in case emergency response is needed. Animals being held or transported are monitored for physiological distress and continually cooled with pumped water to prevent overheating in warm conditions.

6. Euthanasia – All methods of euthanasia must follow the American Veterinary Medical Association Guidelines for the Euthanasia of Animals: 2013 Edition. (2013, 102 pp). Any deviations must be scenically justified. Even if you do not intend to euthanize animals as part of the project, a method of euthanasia must be listed in case of emergency. (Describe agent, dose and route of administration).

-Will the animals be terminated if severely injured during handling?

☒ YES ☐ NO

-Will animals be terminated as part of handling protocol

☒ YES ☐ NO

If YES, provide the method of euthanasia and disposal of animal upon completion.
If NO, provide method of euthanasia in case of emergency.

Method	Recommended Starting Dose (to effect) and Method of Administration	Disposal
Pentobarbital sodium	IV 60-120 mg /kg or 1ml/4.5 kg (10-20 lbs) BW to effect	Incineration or burial*
Potassium Chloride	IV, IC 75 -150 mg/kg [34.1 to 68.2 mg/lb] BW	Rendering facility, incineration or burial*
Overdose of anesthetic	Recommended starting dosages on previous page, Table of Anesthetics	Rendering facility, incineration or burial*
Captive Bolt	Administered to cranium	Rendering facility, Incineration or burial*

**Disposal method selected based on method of euthanasia, agreement with facility and/or federal guidelines. Tribal co-managers may request use of the carcass or parts of the carcass for traditional use purposes. This will occur on a case-by-case basis, and a database will be maintained regarding the disposition of samples used for research and traditional use.*

Please consult NMFS Research Protocol Guidelines (TBD) for acceptable practices. (AVMA Guidelines, AAZV Guidelines, etc.)

In accordance with the AWA, "Personnel conducting procedures on the species being maintained or studied will be appropriately qualified and trained in those procedures."

7. Training

Please describe below the training and qualifications of yourself and other individuals who are included in this protocol. In particular, please be very specific about the hands-on training of those individuals performing procedures which may produce animal discomfort (i.e., restraint, injections, blood collection, surgery, tagging, biopsy, tooth extraction, urine, fecal, gastric, milk, semen, sample collection, euthanasia, etc.). Use Appendix B to further describe training and experience.

The state program leaders and veterinary staff directing this work have at more than 20 years combined experience in capturing, handling and marking pinnipeds from California to Alaska (Appendix B). This experience includes a wide variety of methods and equipment for accomplishing this work. All euthanasia procedures will be conducted and overseen by licensed agency veterinarians. Program leaders have extensive experience performing necropsies and collecting biological samples of all types. All ODFW and WDFW project support staff have multiple years of direct experience in pinniped capture, handling, marking, necropsies, and biological sample collection. Several support staff and veterinarians have worked on this project since its inception providing extensive

experience related to procedures and methodologies described herein. All support staff were trained directly by the state program leaders and several have had additional experience with similar programs conducted in other areas.

Each year, staff involved in handling or managing animals in the field are required to complete an in-person (or virtual) training by their Program Leaders that includes considerations for animal handling safety, euthanasia, and psychological effects staff may experience in relation to euthanasia of wildlife. They also are required to read a material packet regarding the ethical use and treatment of animals and wildlife in research.

D. Husbandry Practices (In Laboratory and Field)

Temporary holding (period greater than 1 hour and less than 24 hours)
Long term holding (periods greater than 24 hours)
(Describe holding facilities or equipment, i.e. pens, cages, nets ,shade, water, etc.)

1. Will the research require holding the animals in captivity? ☒ YES ☐ NO

2. If YES, describe the husbandry practices that will be used.

Sea lions to be lethally removed or permanently placed under human care in a NMFS-approved facility may be held in transfer cages or a specially built trailer for up to 48 hours. In the case of permanent placement, the purpose for holding is to perform a veterinary health assessment and transfer the animal alive to an approved placeholder facility for quarantine. In the case of lethal removal, animals may be held overnight prior to euthanasia. In both cases, animals are held in a secure area and monitored with access permitted only to authorized staff. The holding area is temperature-controlled and with light adjusted as appropriate. Requests for animals for permanent holding are facilitated by federal partners, the interim holding facility (local aquarium or zoo), and the approved permanent holding facility (aquarium or zoo).

3. If YES, describe procedures for disposition of dead animals, including whether or not a necropsy will be performed.

Necropsies and biological sample collection are performed on all sea lions that are euthanized. Multiple biological samples are archived, cataloged and can be made available to external collaborators or researchers for study and analyses as appropriate, via proper permitting and sample use agreements completed by the requesting party. Carcasses (minus biological samples, GI tracts, and skulls) will be transported to a rendering plant for disposal, transferred to tribal co-managers, incinerated or buried via landfill.

4. Will the animals be removed from the facility? ☒ YES ☐ NO

a. If YES, for how long?

For the life of the animal.

b. If YES, to where?

Occasionally live California or Steller sea lions may be made available to permanent holding facilities in the U.S. at the request of the facility and with the approval of NMFS.

c. If YES, will they be returned to the facility? ☐ YES ☒ NO

d. If NO, why not?

California and Steller sea lions approved for removal will either be euthanized at the project work facility or will be transferred to a permanent holding facility and will not be returned to the project or released into the wild.

E. Environmental Safety

1. Are infectious agents to be used and is there potential for exposure?

☐ YES ☒ NO

If YES, the agent(s) is…
If YES, is the agent infectious to humans?

2. Are chemical hazards to be used?

☐ YES ☒ NO

If YES, the chemical hazard is…

3. Are radioisotopes to be used? ☐ YES ☒ NO

If YES, the radioisotope is…

Are there other biohazards of concern like exposure to zoonotic agents?

☒ YES ☐ NO

IF YES, the biohazard(s) is…

A range of diseases that naturally occur in the CSL population, including bacterial and viral agents. Some of these are potentially zoonotic:

Leptospira spp., found primarily in urine samples
Brucella pinniipedialis, B. ceti, Brucellosis
Bisgaardia hudsonensis, seal finger
Mycoplasma phocacerebrale, M. phocarhinis, M. phocidae, mycoplasmosis
Calicivirus, San Miguel sea lion virus, seal finger
Parapoxvirus, seal finger
Mycobacteriia marinum, M. pinnipedii, Mycobacteriosis
Erysipelothrix insidiosa, Erysipeloid
Coxiella burnetti
Toxoplasma gondii, Toxoplasmosis
Ajellomyces dermatiditis, Blastomycosis
Lacazia lobio, Blastomycosis
Influenza A

Note – If any of the above questions are answered YES, all procedures must comply with NMFS Environmental Safety requirements (TBD).

F. Use of Controlled and/or Prescription Substances (*Source, arrangements for use, ordering, record keeping, storage and precautions taken to avoid unauthorized access)*

Drugs for animal sedation and euthanasia are administered by licensed state veterinarians for this project. They acquire the drugs and maintain a record of purchase, storage, use and disposal of all drugs used.

G. Occupational Health and Safety

Awareness of potential stress disorders in project staff resulting from participation in lethal sea lion removal work under MMPA Section 120 authorizations.

Employees involved with the repeated euthanasia of apparently healthy, live animals can suffer from work-related stress. Studies of these phenomena have shown the negative effects on employee mental health can include compassion fatigue, burnout, traumatic or chronic stress, subconscious fears or anxieties, the general hardening of emotions, depression, and the development of unhealthy coping mechanisms (e.g. substance abuse) (See Literature Cited 1-9, Below).

We aim to be aware of potential issues that may arise related to the experiences of our employees.

Prior to the initiation of work each season, our project leaders and veterinary staff will discuss with all management staff the importance of demonstrating respect and ethical treatment of the animals that we capture, handle and ultimately may euthanize as part of project operations. These cautions and sensitivities will be repeated through the season as appropriate and needed.

An annual in-person or virtual training for all project personnel that discusses animal welfare and the concept of euthanasia. The training describes the effects of handling and anesthesia on wildlife and prioritizing the animal's state of wellbeing in all stages of capture, handling, and euthanasia. Another section of this training discusses PITS (perpetuation-induced traumatic stress), compassion fatigue or burnout, and state and agency employee assistance resource programs available to staff.

Conversations will be conducted before, during and after the season to address the need for all staff to be aware of any possible negative feelings or responses that might result from this work, particularly as a result of the acts of euthanizing and processing (performing necropsy and disposing of) the animals.

Additionally, we will encourage staff to feel comfortable discussing concerns with supervisors. Staff, supervisors or crew leads are not to diagnose themselves or others, but are encouraged to seek professional medical or counseling assistance if they feel they (or staff working on the project) are affected by PITS (perpetuation-induced traumatic stress), compassion fatigue or burnout related to project activities.

State agency Human Resources and Safety Programs for information on exposure of staff to PTSD is also available as a resource to staff.

Concerns or other discussions by staff related to work performance and production, and employee attitude toward the work and sense of overall wellbeing should be directed to managers or crew leads. Staff will be provided appropriate options for addressing any concerns or health needs as a result of field operations, including reminders of how to access specific health resources including the Oregon and Washington Employee Assistance Programs (EAPs).

Resources:
Oregon
https://www.oregon.gov/dcbs/RightStart/Pages/EAP.aspx
https://inside.dfw.state.or.us/safety/wellness.asp

Washington
https://des.wa.gov/services/hr-finance/washington-state-employee-assistance-program-eap
http://inside.dfw.wa.gov/employees/wellness/stress.html

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G. Training on Animal Care and Use

Have you and all of the personnel listed in the table below as investigators completed Training Module 1 of the AFSC/NWFSC Animal Care and Use Training Program?

☒ YES ☐ NO

If **NO**, you must complete this Training Module before the IACUC will consider this Animal Care and Use Assurance Form.

Animal Welfare Act IACUC Training Module 1

List all the names and telephone numbers of personnel associated with this project and identified in this protocol who will work with animals or animal tissue. Check the appropriate box to indicate whether or not each individual has completed the NMFS Animal Care and Use Training Program.

IACUC Training	Name	Affiliation	Phone	Email
☒Y ☐N	Casey Clark	WDFW	206-503-4244	casey.clark@dfw.wa.gov
☒Y ☐N	JP Viviano	WDFW	360-624-5714	johnpaul.viviano@dfw.wa.gov
☒Y ☐N	Lindsey Bull	WDFW	253-682-7318	lindsey.bull@dfw.wa.gov
☒Y ☐N	Michael Brown	ODFW	971-707-1764	michael.l.brown@odfw.oregon.gov
☒Y ☐N	John Edwards	WDFW	360-280-2155	john.edwards@dfw.wa.gov
☒Y ☐N	Bryan Wright	ODFW	541-757-5225	bryan.e.wright@odfw.oregon.gov
☒Y ☐N	Shay Valentine	ODFW	971-278-5067	shay.w.valentine@odfw.oregon.gov
☒Y ☐N	Eric Nass	ODFW	971-469-4287	eric.r.nass@odfw.oregon.gov
☒Y ☐N	Amber Kruis	ODFW	971-501-0349	amber.k.kruis@odfw.oregon.gov
☒Y ☐N	Zane Kroneberger	ODFW	971-323-3511	zane.p.kroneberger@odfw.oregon.gov
☒Y ☐N	Colin Gillin	ODFW (Vet)	541-231-9271	colin.m.gillin@odfw.oregon.gov
☒Y ☐N	Julia Burco	ODFW (Vet)	541-207-7305	julia.d.burco@odfw.oregon.gov
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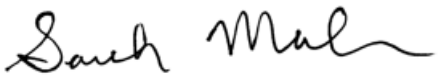
I. Assurance

I attest to the accuracy and completeness of the information provided. As a permitted managing party, I promise to ensure this work with animals is conducted in accordance with the outlined protocols as approved by the Columbia River California sea lion lethal removal IACUC under the NMFS Animal Care and Use Policy. I will not make any substantive changes in the above protocol without first obtaining the approval of the NMFS IACUC, and I will not use any procedures not included in this form.

Principal Investigators/Applicants:



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Appendix A

Experimental Procedures Description(s)

Describe the animal procedures that are to be performed and the necessity in fulfilling the goals and objectives of the project. Be sure to be specific about any procedures which may impact the health and comfort of the study animals (e.g., frequency of performance of any procedures, methods of restraint, blood sample volumes, etc.). Please provide a justification for the animal numbers used.

Additional procedures continued from above:

Blocking panels between traps are used to prevent animals from hauling out in-between traps where they potentially could become injured or entangled. Each panel is made of 3/8" thick x 48" wide commercial grade rubber belting material. Belting is 54" high and hangs from top of trap corner posts with ½" Blue Steel line with no gap at the bottom decking. Note: bottom of the panel can be secured to the corner posts with short lines if needed.

Appendix B

Training and Experience description(s)

The program leaders directing this work (ODFW Brown, Gillin, WDFW Clark, CRITFC Hatch, IDFG Maher, External R. Brown) have at least a combined 20 years of experience in capturing, handling and marking pinnipeds from California to Alaska. This experience includes a wide variety of methods and equipment for accomplishing this work. All euthanasia procedures will be conducted and overseen by licensed agency veterinarians. Program leaders have extensive experience performing necropsies and collecting biological samples of all types. All ODFW and WDFW project support staff have multiple years of direct experience in pinniped capture, handling, marking, necropsies, and biological sample collection. Several support staff and veterinarians have worked on this project since its inception providing extensive experience related to procedures and methodologies described herein. All support staff were trained directly by the program leaders and several have had additional experience with similar programs conducted in other areas.

Appendix 2. Tissue samples collected from euthanized animals.

SEA LION SAMPLING/RESEARCH LIST – 2024-2025			
PRIMARY SAMPLING - ALL ANIMALS			
Recipient	**Tissue**	**Purpose**	**Collection Method, Quantity, and Preservation**
OSU	Blood serum	Immune Assays	Collect up to 6 mL of blood into Red Top glass vials. Spin down and aliquot serum into 3 cryovials
UCLA	Blood serum	Leptospirosis Study	Collect up to 6 mL of blood into Red Top glass vials. Spin down and aliquot serum into 4 cryovials
WDFW/ODFW/EPMOHC	Blood serum	Disease surveillance, HPAI	Collect up to 6 mL of blood into one Red Top glass vial. Spin down and aliquot serum into 1 cryovial
ODFW	Whole Blood	Archive	Collect up to 6 mL of blood into one Purple Top vial. Transfer 1-2 mL into cryovial, discard excess
OSU	Whole Blood	Total and methylmercury	2 Royal Blue Top 6 mL vials (only 3-4 mL each) invert 5 times. Transfer to OSU for processing
OSU	Blubber	PBDE Analysis; PCBs, DDTs, Organochlorines	Collect 1 baseball-sized blubber sample and put into 250 mL amber glass jars. Do not use foil. Collect blubber in the same place where the blubber depth is measured
OSU	Fur	Heavy metals	Collect 1-inch^2 fur from the same location for each animal using stainless steel scissors or sheers. Put into envelope
ODFW	Gastro-Intestinal Tract	Food Habits	Collect stomach and large intestine. Use Ziptie to seal each. Put all bags into one contractor bag with ID label

UCLA	Kidney	Leptospirosis Study	Collect 1 cm thick wedge (1/4 circle) that includes renal pelvis. Place into Whirlpack. Freeze at -20 or -80
ODFW	Lip	Contaminants	Collect section of lip with at least 2 whiskers wrap in Teflon and place in Whirlpack/ bank
OSU	Liver	Toxicology	1-2cm cube or biopsy and place in 30ml plastic vial. Freeze at -20 or -80
WDFW/ODFW/EPMOHC	Lung	Disease surveillance, HPAI	Collect one 5 cm^2 section of lung tissue. Place into Whirlpack. Freeze at -20 or -80
ODFW	Lymph Node	Urogenital Cancer/OHV	Collect one sublumbar lymph node. Remove 1 cm^2 tissue sample and store in formalin
ODFW	Muscle	Archive	Use a scalpel to collect 1 muscle sample (5-10 g) into a 50 mL Falcon tube
ODFW/WDFW/ EPMOHC	Nasal Swab	Disease surveillance, HPAI	Swab nostrils well with 2 swabs, store in preservation medium
ODFW	Penis	Urogenital Cancer/OHV	1 x 2-3cm section of junction of lesion/ normal tissue; if no visible lesion still take section- formalin; 1 cm^2 section frozen; pictures for archiving
ODFW/WDFW	Skin	Genetics	Take two small pieces of skin and place in a labeled cryovials filled with 95% EtOH
Yakama	Stomach Fluid	Food Habits	Collect 10 mL of stomach fluid via needle through stomach wall. Place in 50 mL Falcon Tube filled with 20 mL 95% EtOH. Freeze at -20 or -80
WDFW	Teeth	Aging	Collect flensed snout posterior to upper canine teeth. Freeze for later post-canine and canine extraction
UCLA	Urine	Leptospirosis study	Fill 4 2ml cryovials. Freeze at -20 or -80

OSU/ODFW	Whiskers	Stable isotopes, total mercury, archive	Collect 6 whiskers, approximately the same length (~10 cm), and put into 2 labeled envelopes
SUBSAMPLING - AS POSSIBLE			
Recipient	**Tissue**	**Purpose**	**Collection Method, Quantity, and Preservation**
WDFW/ODFW	Skull	Morphometrics	Collect entire skull, flense as much tissue away as possible. Freeze for later cleaning and measurement

OSU=Oregon State University; UCLA=University of California, Los Angeles; EPMOHC=Eastern Pacific Marine One Health Coalition; WDFW=Washington Department of Fish and Wildlife; ODFW=Oregon Department of Fish and Wildlife; Yakama=Yakama Nation Fisheries

Appendix 3. Agent-based model for predicting post-removal prey requirements of sea lions removed under §120(f) of the Marine Mammal Protection Act.

1. Introduction

Under section 120 of the Marine Mammal Protection Act (MMPA), NOAA Fisheries has authorized the permanent removal of sea lions in the Columbia River basin to reduce predation on salmon and steelhead listed under the Endangered Species Act as well as other species of conservation concern (NMFS 2022). As part of the terms and conditions of that authorization, permit holders are required to report annually on the expected benefits of the takings such as the actual or predicted predation impacts on prey species of concern.

Direct observation of prey consumption by marine mammals is usually not possible except for unique situations such as surface feeding on large or difficult to consume prey (adult salmonids, sturgeon, and lamprey) from elevated observation substrates such as at Bonneville Dam and Willamette Falls (e.g., Braun et al. 2025, Wright et al. 2025). Even in these exceptional situations, however, estimates are typically conservative (i.e., underestimates) since they include only an unknown fraction of an individual animal's daily foraging activity in both space and time. Furthermore, it is usually not possible to attribute predation events to individual sea lions due to unknown inclusion and detection probabilities which are typically less than one. Lastly, consumption estimates based on direct observation only address past events and not predation that is hypothetically prevented in the future due to the removal program.

One method that overcomes some of these limitations is bioenergetics modeling. In this approach, the daily energy requirement of an animal is estimated and then translated into prey-specific biomass requirements which in turn can be translated into individual prey numbers. Furthermore, the bioenergetics model can be nested in a series of models that describe other processes affecting total post-removal biomass requirements such as survival, growth, site fidelity, residency, and diet composition. Since such a complex series of models quickly becomes intractable using standard analytical approaches, one possible approach to analyzing such a system is to use agent- or individual-based models (ABMs/IBMs) (An et al. 2021, Grimm et al. 2020, Macal 2016, Sibley et al. 2013).

The objective of this exercise was to develop a sea lion management ABM to predict the cumulative, post-removal prey requirements of sea lions removed under MMPA §120(f)[8]. Note that this model is still under development and will be updated as new data become available.

2. Methods

This draft model description follows the Overview, Design concepts, and Details (ODD) protocol for describing individual- and agent-based models (Grimm et al. 2006), as updated by Grimm et al. (2020). Additional details will be added to future reports. The model was developed and implemented in R 4.4.3 (R Core Team 2025).

[8] For permit period 8/14/2020-8/14/2025.

2.1. Overview: Purpose and pattern

The primary purpose of the sea lion management ABM is to predict the cumulative number of prey (particularly salmonids) required over the projected post-removal lifetime of California sea lions and/or Steller sea lions authorized for removal under MMPA §120(f) (Table A3.1).

We define three patterns as the criteria for model usefulness: 1) estimates of per capita biomass consumption that are consistent with the published literature; 2) estimates of per capita biomass consumption as a percentage of body mass that are consistent with the published literature; and 3) estimates of numbers of prey consumed that are consistent with observation data.

2.2. Overview: Entities, state variables, and scales

Entities in the model are individual sea lions that were removed under MMPA §120(f).

Each sea lion has a unique ID and the following variables: age in years; whether they survived the annual time step; growth in body mass per annual time step; whether they returned to an upriver site per seasonal time step (site fidelity); and the residency duration in days per seasonal time step. Within a seasonal time-step, additional variables included biomass requirements for up to three prey items including salmonids, sturgeon, lamprey, and "other". Species (CSL, SSL), sex (male), location (Bonneville Dam, Willamette Falls), season (fall = July-December; spring = January-June), and diet composition were fixed and did not vary by annual, seasonal, or daily time steps.

The model is currently non-spatial, so the environment is not represented, and sea lions only have one location per season (Bonneville Dam or Willamette Falls). The model runs at three different time scales: annual (survival, growth), seasonal (fidelity, residency, diet), and daily (bioenergetics).

2.3. 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 (Figure A3.1).

Schedule: The simulation starts after the removal for each sea lion and varies depending on whether the animal was removed in the fall or spring.

For fall-season removals, a daily loop starts based on residency duration, which 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. To account for the within-season removal process, the residency is multiplied by a draw from a Uniform(0,1) distribution. For each day in the residency loop, location and season specific biomass requirements are estimated based on a bioenergetics model for up to three prey types. 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 may convert biomass to fish numbers at the daily level (e.g., using a multinomial distribution to select prey types).

After the fall residency loop ends, the probability of returning in the spring to an upriver location is determined independently for each sea lion based on a Bernoulli trial, where site fidelity (return probability) is based on empirical data from marked animals from Bonneville Dam and Willamette Falls (stochasticity in return location may be added at a later date). If an animal returns, residency duration is estimated as above but without any reduction due to the removal process; for spring-season removals the residency is multiplied by a draw from a Uniform(0,1) distribution.

At the end of the spring residency loop, each animal's probability of surviving to the next fall is determined by a species-, sex- (male), and age-specific survival probability as defined by a Bernoulli trial where the probability of success (survival) is based on the published literature. If an animal survives, then its age is increased by one year and the body mass increases by an age-specific factor based on the published literature (stochasticity in growth may be added at a later date).

2.4. Design: Design concepts

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

2.5. Details: Initialization

Individual state variables (age, mass, fidelity, residency) were initialized based on either individual-specific empirical data or population averages estimated from such data (Table A3.2). See below for additional details on estimated initialization parameters.

2.6. Details: Input data

Three input files (besides agent data) are imported into the model: survival data, growth data, and diet composition data. These are defined in separate model scripts and are based on published literature, observed data, and/or expert opinion.

2.7. Details: Sub-models

There are six sub-models in the ABM; two of these operate at the annual time scale (survival, growth), three at the seasonal time scale (fidelity, residency, diet), and one at the daily time scale (bioenergetics). Each agent (sea lion) only occurs at one location based on where it was removed (Bonneville Dam or Willamette Falls) but may occur in more than one season (fall, spring) at that location if it’s resight history included more than one season (which would only apply to identifiable animals). Future versions of the ABM may allow for multiple locations per year (but not within season) and inclusion of individually un-identifiable sea lions.

2.7.1. Survival sub-model (annual)

The probability of an animal surviving each annual time step was based on a species-, sex-, and age-specific survival rate (Table A3.3, Figure A3.2). Individuals at each time step live or die based on the outcome of a Bernoulli trial where the probability of success (survival) equals the species-, sex-, and age-specific survival rate. If the animal survives, then it advances to the growth sub-model after which its age is increased by one year regardless of whether it was removed in the spring (before its birthday) or the fall (after its birthday); future versions of the model may explicitly account for the timing of the birthday with respect to removal season.

For animals removed in the spring, the probability of surviving from spring of year i to spring of year $i + 1$ closely matches the assumptions of the survival estimates since parturition is during the summer (assumed July 1 for modeling purposes). For fall removals of animals, the meaning of annual survival becomes more ambiguous and may be refined in subsequent models. If the animal dies, then that run in the overall simulation is complete for that animal. Model runs that result in no biomass requirements due to mortality and/or not returning to the upriver sites are temporarily retained, however, to accurately estimate summary statistics. The model is run for 18 years to ensure mortality for every individual.

2.7.2. Growth sub-model (annual)

The amount of food an animal requires per day is a function of many factors but the most important is an animal's metabolic rate, which in turn is a function of its body mass as stated in Kleiber's equation (adults; from Winship et al. 2002):

$$\text{Basal metabolism (BM in kJ d}^{-1}) = 292.88 \times M^{0.75}$$

where M is body mass (kg). The growth sub-model may undergo further development but is currently based on relative rates of change from the mass-at-age models of Winship et al. (2006) (Figure A3.3). Asymptotes of 1000 lbs (454 kgs) and 2000 lbs (907 kgs) were used to cap growth for CSLs and SSLs, respectively. In the ABM, the growth process is currently deterministic but future versions of the model may add stochasticity.

2.7.3. Site fidelity sub-model (seasonal)

The site fidelity sub-model estimates the probability of an animal returning to an upriver location in a given season, given that it's known to be alive. For example, CSL "2n11" was branded at Bonneville Dam in 2016 but not detected there again until 2018; his estimated fidelity rate or probability of returning was therefore one year (2018) out of two (2017, 2018) or 0.5. If that same animal had also been seen on the coast in 2020 his estimated fidelity would have been one year (2018) out of four (2017-2020) or 0.25. Removal animals that were unmarked or marked but only seen one year (e.g., removed same year as marking) were given the average fidelity rate for that species-, location-, and season combination (Table A3.4). The probability of an animal returning is based on the outcome of a Bernoulli trial where the probability of success (returning) equals the fidelity parameter for that animal.

It is important to note that the estimated fidelity rates are likely biased low due to imperfect detectability of marked animals since 1) in any given year a marked animal may occur but not be detected and 2) prior to marking they are undetectable even though they may have occurred there for multiple years. In addition, as with other datasets, there is a time lag between data collection and data entry so new resights are continually being added and therefore fidelity estimates will likely be revised in future model runs. In addition, future versions of the ABM may include a step where the probability of returning is drawn from a multinomial distribution with three outcomes possible outcomes: not return, return to Bonneville Dam, return to Willamette Falls.

2.7.4. Residency sub-model (seasonal)

The residency sub-model estimates the number of days an animal stays at a given location in a given season, given that it has returned. Residency rates were calculated based on the elapsed days between the first and last date a marked animal was observed but only after first removing seasons in which they were marked and/or removed in order to avoid negatively biasing rates by including artificially left- or right-censored seasons. Removal animals with unknown residency histories were assigned the average residency rate for that species-, location-, and season combination (Table A3.4, Figure A3.4).

As with the site fidelity sub-model, imperfect detectability of marked animals likely led to conservative estimates of residency (i.e., too low). On the other hand, residency may have been overestimated in some cases if animals made temporary within-season trips to and from an upriver site rather than staying there the entire time between first and last detection. This latter behavior was observed in the early years of research at Bonneville Dam, but it is unknown to what extent it currently occurs. In addition, apparent residency rates for CSLs at both Bonneville Dam and Willamette Falls have declined over time. Future versions of this ABM could incorporate the apparent decline in residency rather than including the mean value, although the point of this exercise is to predict what might have happened had there been no intervention and in that case the residency rates would most likely have remained high or have even increased.

2.7.5. Diet sub-model (seasonal)

The current version of the diet sub-model consists of three prey (Table A3.5). The percent biomass contribution of each prey type is based on a synthesis of results from scat and gastro-intestinal tract analyses as well as direct observations of surface feeding events at and below Bonneville Dam and Willamette Falls. Currently the diet composition is fixed but future versions of the ABM may include stochasticity by drawing from a multinomial distribution of prey types. Energetic densities (kJ g-1) of prey are treated as fixed except for the "other" category which draws from a uniform distribution.

Total biomass requirements are converted to numbers of fish based on average prey weights. Currently only salmonid numbers are calculated but future versions of the model may include sturgeon, lamprey, and possibly other species. Prey size currently enters the modeling process after the ABM run is complete and total prey-specific biomass estimates have been calculated. Future versions of the ABM may treat prey size as a separate sub-model and also include

stochasticity by randomly drawing prey sizes from a distribution of values rather than treating it as fixed.

2.7.6. Bioenergetics sub-model (daily)

The final component of the ABM is the bioenergetics sub-model which was modified from Winship et al. (2002). This sub-model estimates the daily biomass requirement for prey category *i* and predator *j* based on the following formula

$$BR_{ij}[kg\ d^{-1}] = \frac{GER[kJ\ d^{-1}] \times prey_i}{ED_i[kJ\ g^{-1}]} \div 1000$$

where GER is the gross energy requirement

$$\frac{P + (A_j \times BM_j)}{E_{HIF} \times E_{f+u}}$$

and A is the energetic cost of activity

$$A_j = water_j * \ A_{water} + \left(1 - water_j\right) * A_{land}$$

Additional parameter definitions and values are described in Table A3.6. (Note that the update to the denominator of GER found in Winship and Trites (2003) was not used since it is not applicable to high energetic densities such as that found in Pacific lamprey.)

In contrast to many other bioenergetic models (e.g., Winship et al. 2002), for this particular application the model was greatly simplified since it is only for one sex (males), one age-class (non-pups), and for relatively short periods of time which meant that production (growth in body mass) could be omitted. Future versions may include production, however, since Steller sea lions have longer annual residency times at Bonneville Dam than California sea lions for which the model was originally intended. On the other hand, biomass requirements for growth in adults have shown to be small relative to requirements such as basal metabolism, activity, and waste (e.g., see Figure 1 in Winship et al. 2002), so omitting it from the model is not likely to negatively bias the results.

2.8. Sensitivity analysis

Sensitivity analysis will be implemented at a later date.

2.9 Output

Results are based on 200 repetitions of the ABM, which is a third fewer than in previous years to avoid exceeding available RAM when processing this year's larger dataset. The method of summary varies depending on whether statistics are at the individual level or the population level. At the population level, estimates are based on percentiles from the 200 repetitions, where

point estimates are equal to 50th percentile (median) and interval estimates (95% CIs) are based on the 2.5th and 97.5th percentiles.

For individual-level attributes, results are summarized using a four-step approach. First, annual summaries per location-species-season-agent-run-year are stored (e.g., residency) or calculated (e.g., mean daily biomass requirement), conditional on survival and fidelity where applicable. Removal years are excluded prior to this step since they would negatively bias the results. Second, mean values per location-species-season-agent-run are calculated across years such that the total number of records equals the product of the number of repetitions (200) and agents (230 in 2025). Third, mean values per location-species-season-agent are calculated across runs such that the total number records equal the number of agents. And finally, the mean and range per location-species-season are calculated across agents such that the total number of records equals the number of agents in each location-species-season combination.

3. Results

The predicted post-removal salmonid requirements for the 230 sea lions removed under MMPA §120(f) was 49,230 salmonids (95% CI = 32,068-69,728) (Figure A3.5). Individual-level summary statistics are summarized in Table A3.7.

4. Discussion

Section 2.1 defined three patterns as the criteria for model usefulness: 1) estimates of per capita biomass consumption that are consistent with the published literature; 2) estimates of per capita biomass consumption as a percentage of body mass that are consistent with the published literature; and 3) estimates of prey numbers consumed that are consistent with observation data. Regarding the first two criteria, while it's important to note that bioenergetic models produce estimates of food requirements and not food consumption, the ABM results (Table A3.7) were nonetheless consistent with published data on food consumption by captive animals.

For example, Kastelein et al. (2000) reported that one captive 16-year-old male California sea lion consumed an average 9.5 kg day^{-1} and up to a maximum of 35.5 kg day^{-1}. This is comparable to mean ABM estimates of 12.3 and 14.8 kg day^{-1} at Bonneville Dam and Willamette Falls, respectively. Similarly, Kastelein et al. (1990) reported that one captive 16-year-old male Steller sea lion consumed an average of approximately 20 kg day^{-1} and up to a maximum of 26 kg day^{-1}. This is also comparable to mean ABM estimates for Steller sea lions across locations and seasons, which ranged from 24.4-35.4 kg day^{-1}. Likewise, when expressed as a percentage of body weight, estimates of daily food consumption by captive male California sea lions and Steller sea lions (i.e., 3-9%; Winship et al. 2006) were similar to ABM estimates (3.2-5.0%). Regarding the third criteria, while direct comparisons between the ABM results and surface-based predation estimates are challenging for a variety of reasons (e.g., differing predator population sizes, limited fall observation effort), results from the ABM are nonetheless a similar order of magnitude as observation-based estimates.

In conclusion, agent-based modeling has proven to be a useful and effective framework for the ongoing analysis of the benefits of sea lion management in the Columbia River Basin. Future

work on the model may include a restructuring of how daily prey requirements are calculated as well as incorporating additional stochasticity into one or more of the sub-models (e.g., diet).

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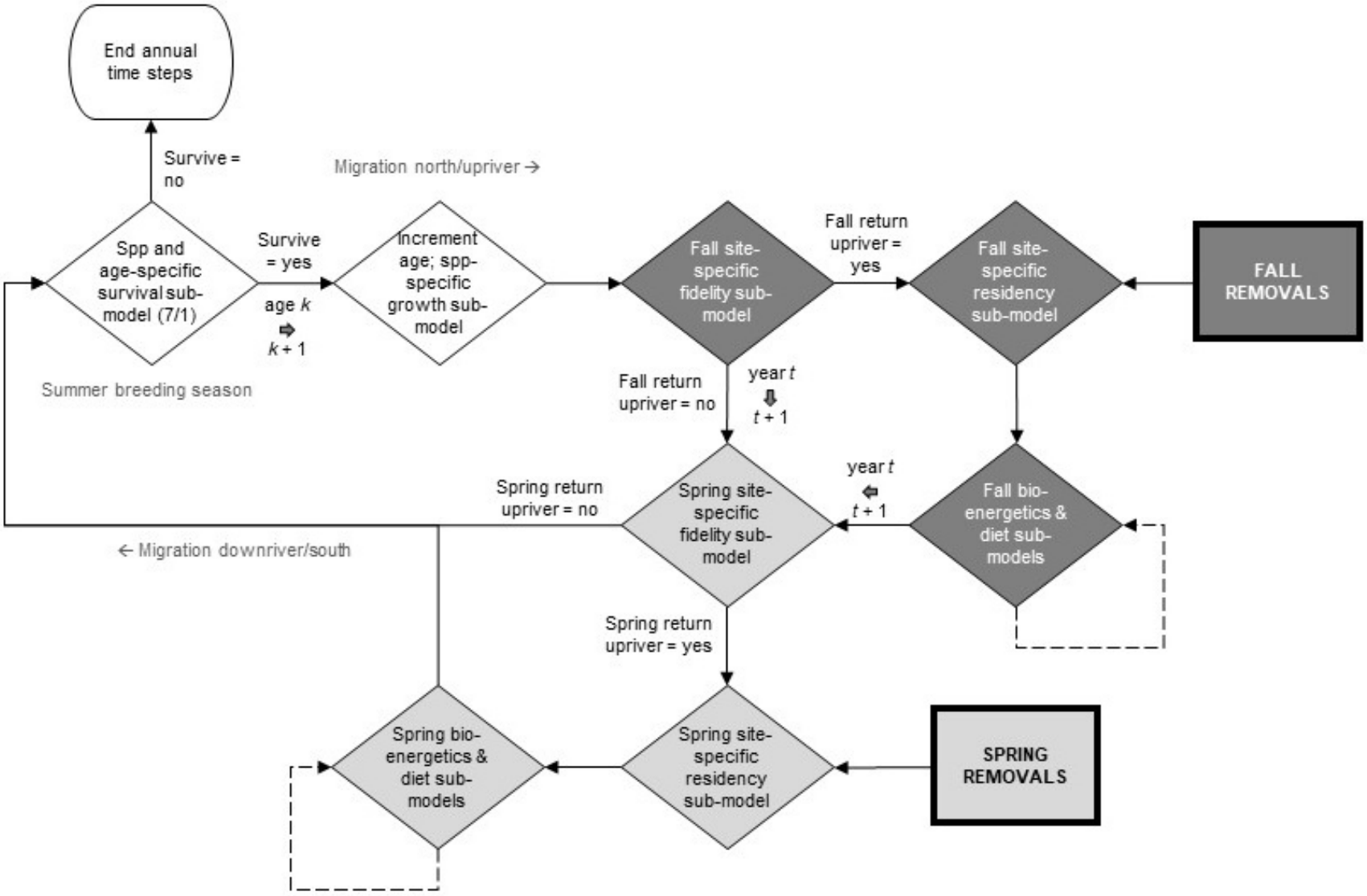

Figure A3.1. Flowchart of sea lion management agent-based model.

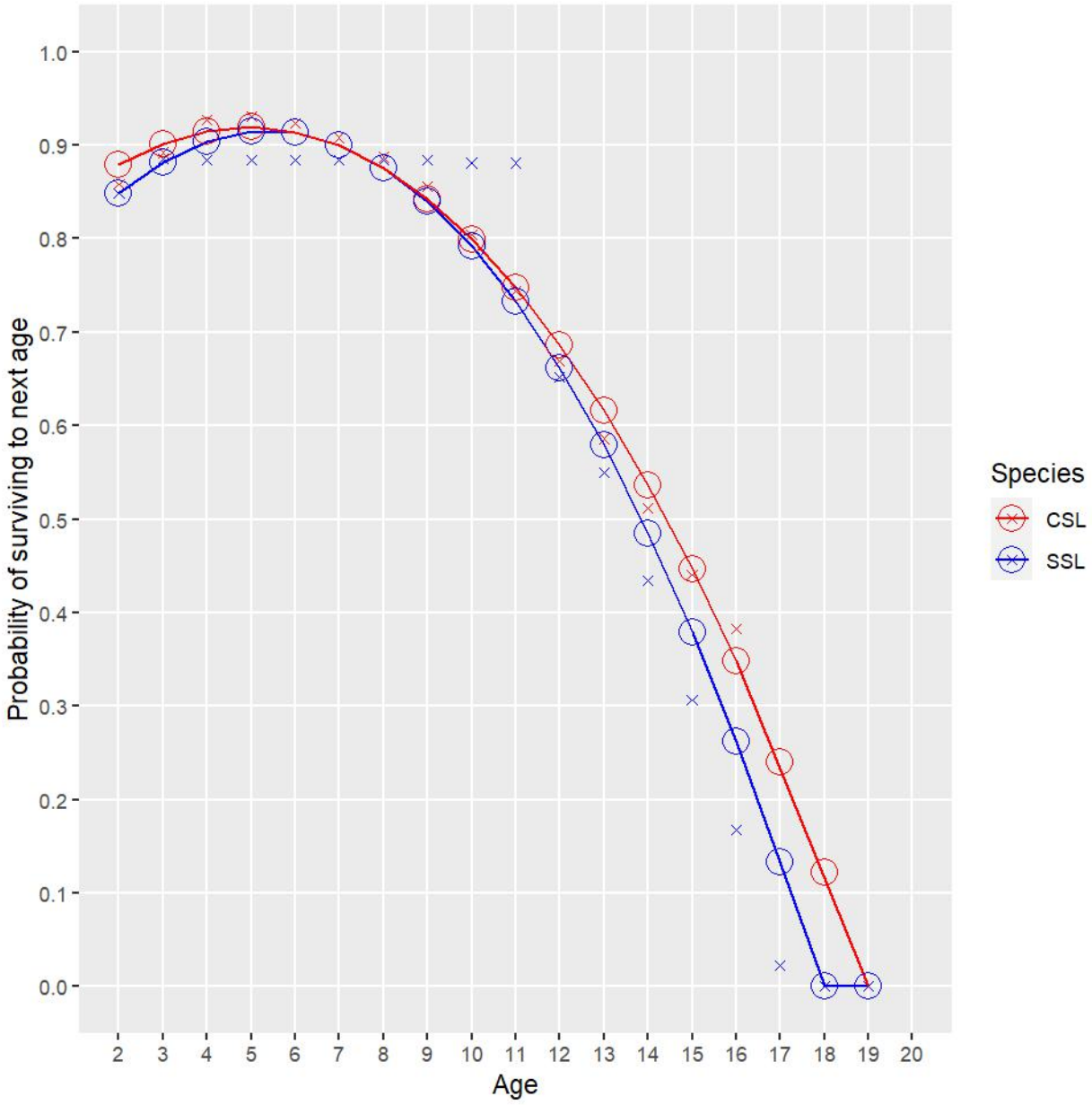

Figure A3.2. Survival sub-model. California sea lion (CSL) data from DeLong et al. (2017); Steller sea lion (SSL) data from Wright et al. (2017; ages 0-11) and Maniscalco et al. (2015; ages >11); lines indicate second order polynomial fits to data. See Table A3.3 for additional details.

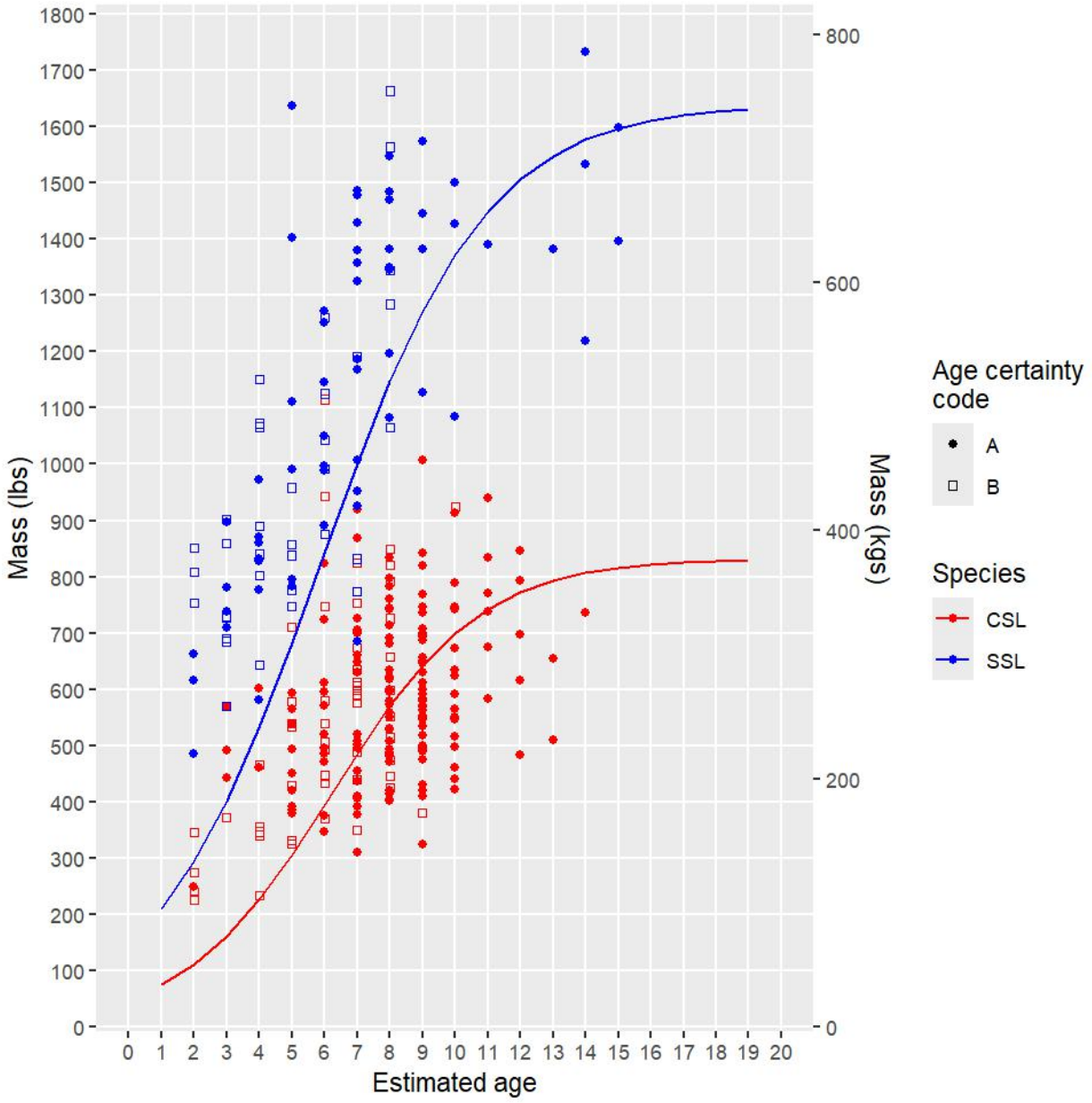

Figure A3.3. Growth sub-model. Lines represent mass-at-age growth curves for male California sea lions (CSL) and Steller sea lions (SSL) (Winship et al. 2006); points represent empirical age and weight data from sea lions removed at Bonneville Dam and Willamette Falls. Age certainty code is a reliability index provided by Matson's Laboratory, where “A” is the highest reliability rating.

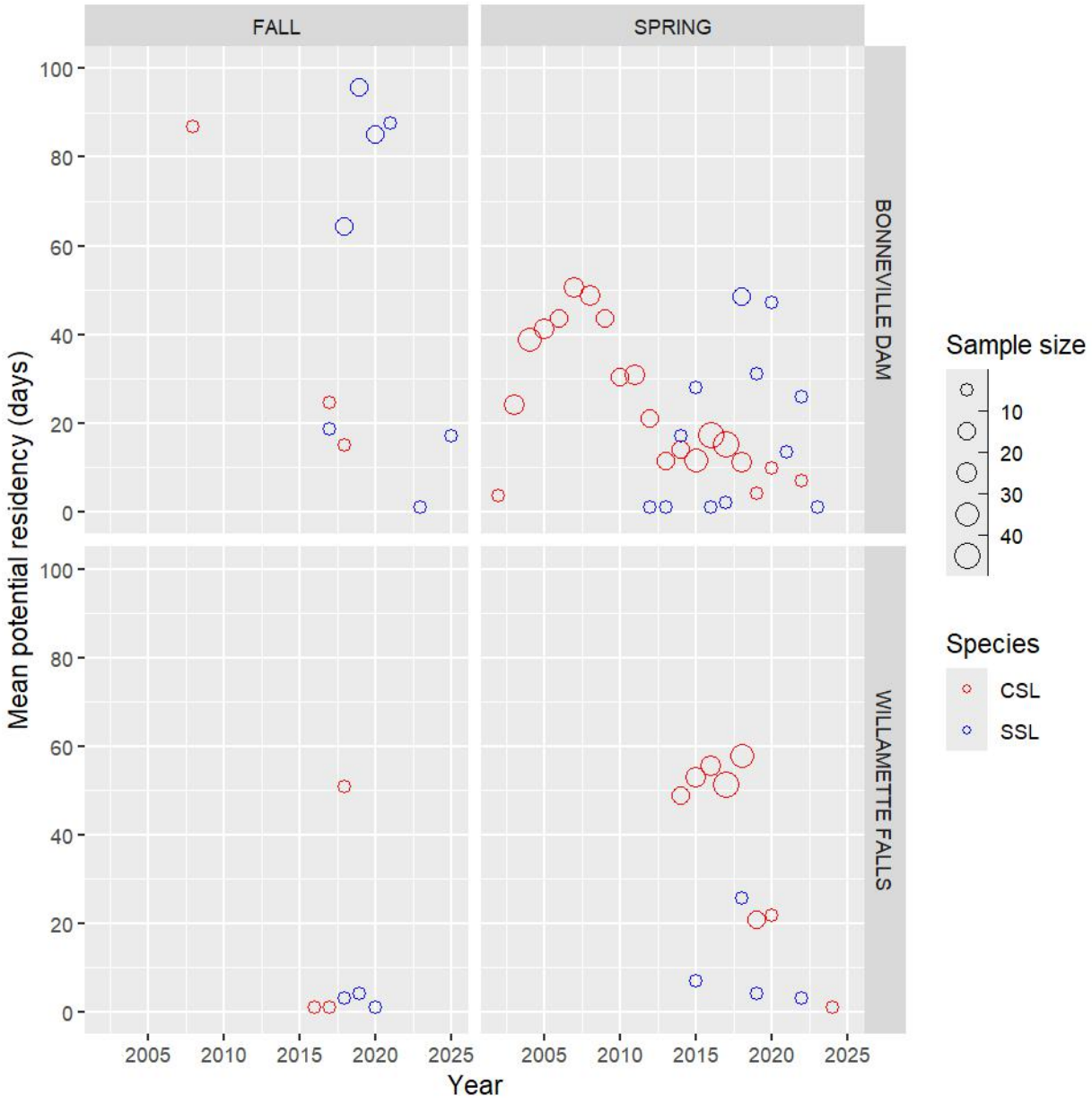

Figure A3.4. Residency sub-model. Annual average potential residency by year, season, location and species (based on all identifiable upriver animals, not just removals).

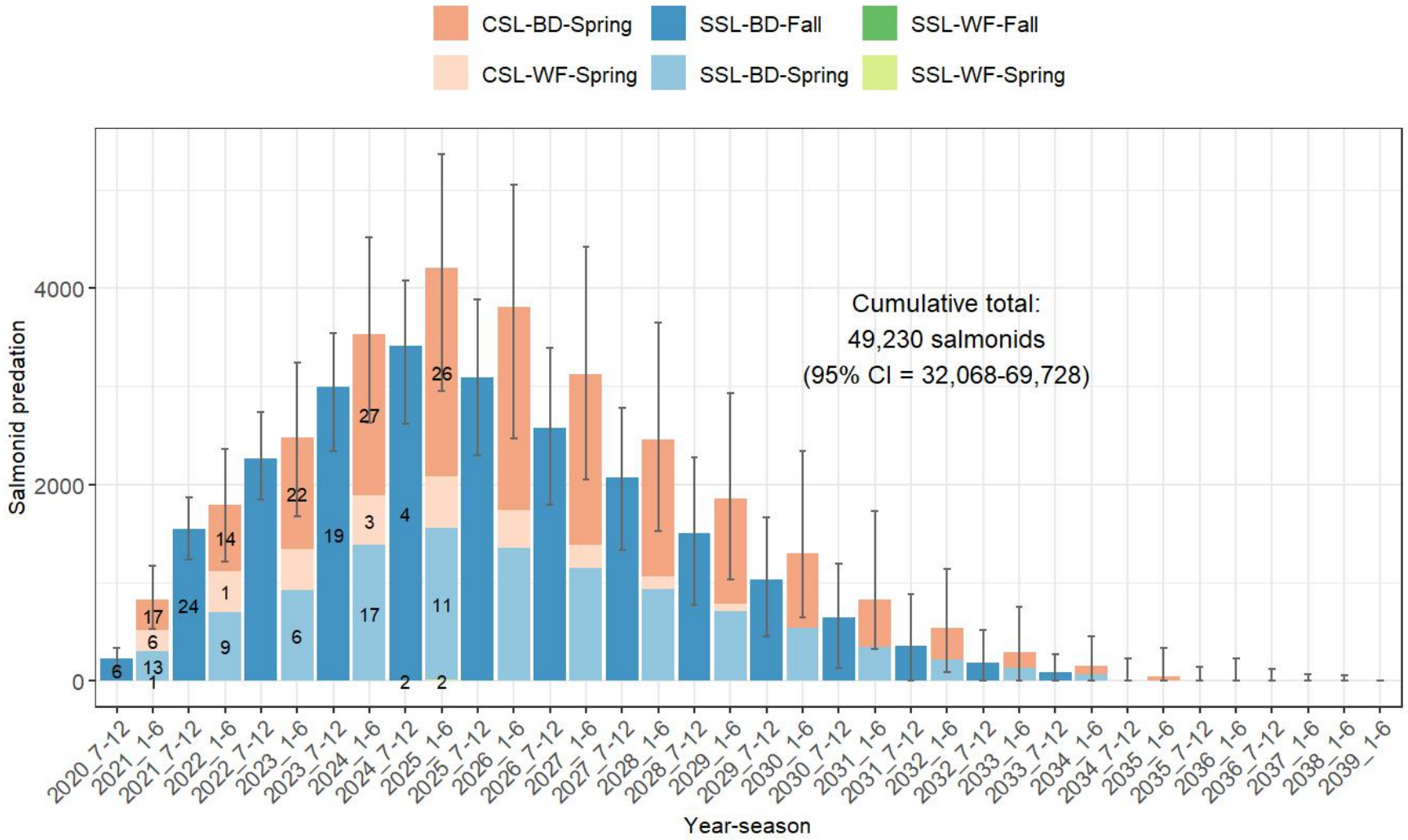

Figure A3.5. Predicted post-removal salmonid requirements for 116 California sea lions (CSLs) and 114 Steller sea lions (SSLs) removed at Bonneville Dam (BD) and Willamette Falls (WF) from fall 2020 to spring 2025 under MMPA §120(f). Predictions based on 2.5th, 50th, and 97.5th percentiles from 200 ABM simulations; numbers overlaid on bars indicate number of animals removed for the species-location-season combination indicated in the legend. Note: estimated salmonid requirements for Steller sea lions at Willamette Falls are too low to be visible in graph.

Table A3.1. California sea lions (CSLs) and Steller sea lions (SSLs) removed at Bonneville Dam (BD) and Willamette Falls (WF) from fall 2020 to spring 2025 under MMPA §120(f). Animals removed under separate but overlapping MMPA §120 authorities were not included.

Location	Species	Season	2020	2021	2022	2023	2024	2025	Total removals
BD	CSL	Spring	NA	17	14	22	27	26	106
	SSL	Spring	NA	13	9	6	17	11	56
		Fall	6	24	0	19	4	NA	53
WF	CSL	Spring	NA	6	1	0	3	0	10
	SSL	Spring	NA	1	0	0	0	2	3
		Fall	0	0	0	0	2	NA	2
Total			6	61	24	47	53	39	230

Table A3.2. Dataset used to initiate the ABM, sorted by date of capture. The variable 'Type' indicates whether individual-level (I) or population-level (P) data were used to parameterize the preceding variable to its left. Note that O37 was a suspected hybrid SSL-CSL but was modeled as a SSL.

Agent	Individual	Spp	ID	Location	Season	Date	Age	1	Mass_kgs	1	Fidelity_p	1	Residency_d	1
1	1	Ej	EB001	Bonneville Dam	Fall	20201014	6	P	403	I	0.84	P	55	P
2	2	Ej	EB002	Bonneville Dam	Fall	20201015	3	I	322	I	0.84	P	55	P
3	3	Ej	O53	Bonneville Dam	Fall	20201022	5	I	339	I	1.00	I	123	I
4		Ej	O53	Bonneville Dam	Spring	20201022	5	I	339	I	1.00	I	25	P
5	4	Ej	EB003	Bonneville Dam	Fall	20201103	4	I	352	I	0.84	P	55	P
6	5	Ej	O44	Bonneville Dam	Fall	20201104	7	I	431	I	1.00	I	48	I
7		Ej	O44	Bonneville Dam	Spring	20201104	7	I	431	I	0.67	I	1	I
8	6	Ej	EB004	Bonneville Dam	Fall	20201105	3	I	409	I	0.84	P	55	P
9	7	Ej	EW001	Willamette Falls	Spring	20210302	6	P	483	P	0.10	P	16	P
10	8	Ej	EB005	Bonneville Dam	Spring	20210406	4	I	364	I	0.38	P	25	P
11	9	Zc	ZW001	Willamette Falls	Spring	20210413	8	P	250	P	0.87	P	39	P
12	10	Zc	ZW002	Willamette Falls	Spring	20210413	8	P	250	P	0.87	P	39	P
13	11	Zc	ZW003	Willamette Falls	Spring	20210413	8	P	250	P	0.87	P	39	P
14	12	Ej	EB006	Bonneville Dam	Spring	20210414	6	I	567	I	0.38	P	25	P
15	13	Zc	ZB001	Bonneville Dam	Spring	20210414	5	I	242	I	0.72	P	22	P
16	14	Ej	EB007	Bonneville Dam	Spring	20210415	3	I	390	I	0.38	P	25	P
17	15	Ej	EB008	Bonneville Dam	Spring	20210415	2	I	367	I	0.38	P	25	P
18	16	Zc	ZB002	Bonneville Dam	Spring	20210415	9	I	338	I	0.72	P	22	P
19	17	Zc	ZW004	Willamette Falls	Spring	20210415	8	P	250	P	0.87	P	39	P
20	18	Ej	O41	Bonneville Dam	Fall	20210420	5	I	636	I	1.00	I	1	I
21		Ej	O41	Bonneville Dam	Spring	20210420	5	I	636	I	0.75	I	22	I
22	19	Zc	ZW005	Willamette Falls	Spring	20210420	8	P	250	P	0.87	P	39	P
23	20	Zc	ZW006	Willamette Falls	Spring	20210420	8	P	250	P	0.87	P	39	P
24	21	Ej	EB009	Bonneville Dam	Spring	20210421	6	I	397	I	0.38	P	25	P
25	22	Ej	EB010	Bonneville Dam	Spring	20210422	6	I	452	I	0.38	P	25	P
26	23	Ej	EB011	Bonneville Dam	Spring	20210428	2	I	342	I	0.38	P	25	P
27	24	Ej	EB012	Bonneville Dam	Spring	20210428	4	I	381	I	0.38	P	25	P
28	25	Zc	ZB003	Bonneville Dam	Spring	20210428	10	I	250	I	0.72	P	22	P
29	26	Ej	EB013	Bonneville Dam	Spring	20210429	3	I	313	I	0.38	P	25	P
30	27	Zc	06n3	Bonneville Dam	Spring	20210429	8	I	282	I	1.00	I	1	I
31	28	Zc	ZB004	Bonneville Dam	Spring	20210429	6	I	506	I	0.72	P	22	P

Table A3.2 continued

Agent	Individual	Spp	ID	Location	Season	Date	Age	1	Mass_kgs	1	Fidelity_p	1	Residency_d	1
32	29	Zc	X693	Bonneville Dam	Spring	20210504	10	I	209	I	0.72	P	22	P
33	30	Zc	ZB005	Bonneville Dam	Spring	20210504	8	I	288	I	0.72	P	22	P
34	31	Zc	ZB006	Bonneville Dam	Spring	20210504	9	I	272	I	0.72	P	22	P
35	32	Zc	ZB007	Bonneville Dam	Spring	20210504	6	I	264	I	0.72	P	22	P
36	33	Zc	ZB008	Bonneville Dam	Spring	20210504	5	I	245	I	0.72	P	22	P
37	34	Ej	EB014	Bonneville Dam	Spring	20210505	3	I	335	I	0.38	P	25	P
38	35	Zc	ZB009	Bonneville Dam	Spring	20210505	6	I	339	I	0.72	P	22	P
39	36	Zc	ZB010	Bonneville Dam	Spring	20210505	6	I	259	I	0.72	P	22	P
40	37	Zc	ZB011	Bonneville Dam	Spring	20210505	5	I	262	I	0.72	P	22	P
41	38	Ej	EB015	Bonneville Dam	Spring	20210506	5	I	355	I	0.38	P	25	P
42	39	Zc	ZB012	Bonneville Dam	Spring	20210506	3	I	223	I	0.72	P	22	P
43	40	Zc	ZB013	Bonneville Dam	Spring	20210511	5	I	244	I	0.72	P	22	P
44	41	Zc	ZB014	Bonneville Dam	Spring	20210511	6	I	224	I	0.72	P	22	P
45	42	Zc	ZB015	Bonneville Dam	Spring	20210511	8	P	552	I	0.72	P	22	P
46	43	Ej	EB016	Bonneville Dam	Spring	20210512	6	P	721	I	0.38	P	25	P
47	44	Ej	EB017	Bonneville Dam	Fall	20210914	5	I	352	I	0.84	P	55	P
48	45	Ej	EB018	Bonneville Dam	Fall	20210915	5	I	435	I	0.84	P	55	P
49	46	Ej	EB019	Bonneville Dam	Fall	20210915	3	I	259	I	0.84	P	55	P
50	47	Ej	EB020	Bonneville Dam	Fall	20210916	5	I	361	I	0.84	P	55	P
51	48	Ej	O49	Bonneville Dam	Fall	20210921	5	I	504	I	1.00	I	133	I
52		Ej	O49	Bonneville Dam	Spring	20210921	5	I	504	I	1.00	I	2	I
53	49	Ej	EB021	Bonneville Dam	Fall	20210922	10	I	492	I	0.84	P	55	P
54	50	Ej	EB022	Bonneville Dam	Fall	20210923	15	I	634	I	0.84	P	55	P
55	51	Ej	EB023	Bonneville Dam	Fall	20210928	4	I	390	I	0.84	P	55	P
56	52	Ej	EB024	Bonneville Dam	Fall	20210929	8	I	709	I	0.84	P	55	P
57	53	Ej	EB025	Bonneville Dam	Fall	20210930	4	I	292	I	0.84	P	55	P
58	54	Ej	EB026	Bonneville Dam	Fall	20211006	8	I	673	I	0.84	P	55	P
59	55	Ej	EB027	Bonneville Dam	Fall	20211006	7	I	626	I	0.84	P	55	P
60	56	Ej	O48	Bonneville Dam	Fall	20211007	8	I	610	I	1.00	I	84	I
61		Ej	O48	Bonneville Dam	Spring	20211007	8	I	610	I	1.00	I	89	I
62	57	Ej	O42	Bonneville Dam	Fall	20211014	7	I	541	I	1.00	I	76	I
63		Ej	O42	Bonneville Dam	Spring	20211014	7	I	541	I	1.00	I	33	I
64	58	Ej	EB028	Bonneville Dam	Fall	20211102	7	I	457	I	0.84	P	55	P
65	59	Ej	EB029	Bonneville Dam	Fall	20211103	6	I	450	I	0.84	P	55	P

Table A3.2 continued

Agent	Individual	Spp	ID	Location	Season	Date	Age	1	Mass_kgs	1	Fidelity_p	1	Residency_d	1
66	60	Ej	O47	Bonneville Dam	Fall	20211103	7	I	670	I	1.00	I	83	I
67		Ej	O47	Bonneville Dam	Spring	20211103	7	I	670	I	1.00	I	14	I
68	61	Ej	EB030	Bonneville Dam	Fall	20211109	4	I	377	I	0.84	P	55	P
69	62	Ej	EB031	Bonneville Dam	Fall	20211109	7	I	529	I	0.84	P	55	P
70	63	Ej	EB032	Bonneville Dam	Fall	20211110	5	I	449	I	0.84	P	55	P
71	64	Ej	EB033	Bonneville Dam	Fall	20211116	6	I	572	I	0.84	P	55	P
72	65	Ej	EB034	Bonneville Dam	Fall	20211116	6	P	784	I	0.84	P	55	P
73	66	Ej	EB035	Bonneville Dam	Fall	20211117	15	I	724	I	0.84	P	55	P
74	67	Ej	EB036	Bonneville Dam	Fall	20211117	14	I	695	I	0.84	P	55	P
75	68	Ej	EB037	Bonneville Dam	Spring	20220419	7	I	538	I	0.38	P	25	P
76	69	Ej	EB038	Bonneville Dam	Spring	20220420	9	I	655	I	0.38	P	25	P
77	70	Ej	EB039	Bonneville Dam	Spring	20220420	8	I	754	I	0.38	P	25	P
78	71	Zc	ZB016	Bonneville Dam	Spring	20220420	5	I	195	I	0.72	P	22	P
79	72	Ej	O37	Bonneville Dam	Spring	20220422	6	P	873	I	0.56	I	36	I
80	73	Zc	X842	Bonneville Dam	Spring	20220426	6	I	230	I	0.72	P	22	P
81	74	Zc	ZB017	Bonneville Dam	Spring	20220426	8	I	329	I	0.72	P	22	P
82	75	Zc	ZV018	Bonneville Dam	Spring	20220426	7	I	317	I	0.72	P	22	P
83	76	Ej	EB040	Bonneville Dam	Spring	20220427	4	I	441	I	0.38	P	25	P
84	77	Ej	EB041	Bonneville Dam	Spring	20220428	5	I	743	I	0.38	P	25	P
85	78	Zc	ZB019	Bonneville Dam	Spring	20220428	8	I	362	I	0.72	P	22	P
86	79	Ej	EB042	Bonneville Dam	Spring	20220503	4	I	375	I	0.38	P	25	P
87	80	Zc	C096	Bonneville Dam	Spring	20220503	8	I	378	I	0.57	I	13	I
88	81	Zc	ZB020	Bonneville Dam	Spring	20220503	5	I	224	I	0.72	P	22	P
89	82	Zc	ZB021	Bonneville Dam	Spring	20220503	3	I	201	I	0.72	P	22	P
90	83	Zc	ZB022	Bonneville Dam	Spring	20220503	4	I	211	I	0.72	P	22	P
91	84	Zc	2n61	Bonneville Dam	Spring	20220504	9	I	316	I	0.50	I	1	I
92	85	Zc	ZB023	Bonneville Dam	Spring	20220505	9	I	371	I	0.72	P	22	P
93	86	Ej	EB043	Bonneville Dam	Spring	20220510	4	I	395	I	0.38	P	25	P
94	87	Ej	EB044	Bonneville Dam	Spring	20220510	3	I	330	I	0.38	P	25	P
95	88	Zc	ZB024	Bonneville Dam	Spring	20220510	8	P	298	I	0.72	P	22	P
96	89	Zc	ZB025	Bonneville Dam	Spring	20220511	5	I	269	I	0.72	P	22	P
97	90	Zc	ZB026	Bonneville Dam	Spring	20220511	7	I	272	I	0.72	P	22	P
98	91	Zc	ZW007	Willamette Falls	Spring	20220516	8	P	311	I	0.87	P	39	P
99	92	Zc	ZB027	Bonneville Dam	Spring	20230420	7	I	329	I	0.72	P	22	P

Table A3.2 continued

Agent	Individual	Spp	ID	Location	Season	Date	Age	1	Mass_kgs	1	Fidelity_p	1	Residency_d	1
100	93	Zc	ZB028	Bonneville Dam	Spring	20230420	6	I	277	I	0.72	P	22	P
101	94	Ej	EB045	Bonneville Dam	Spring	20230502	2	I	279	I	0.38	P	25	P
102	95	Ej	EB046	Bonneville Dam	Spring	20230502	2	I	301	I	0.38	P	25	P
103	96	Zc	ZB029	Bonneville Dam	Spring	20230502	7	I	286	I	0.72	P	22	P
104	97	Zc	ZB030	Bonneville Dam	Spring	20230502	7	I	171	I	0.72	P	22	P
105	98	Ej	EB047	Bonneville Dam	Spring	20230503	5	I	389	I	0.38	P	25	P
106	99	Zc	ZB031	Bonneville Dam	Spring	20230503	6	I	245	I	0.72	P	22	P
107	100	Zc	ZB032	Bonneville Dam	Spring	20230503	6	I	373	I	0.72	P	22	P
108	101	Zc	ZB033	Bonneville Dam	Spring	20230504	8	I	224	I	0.72	P	22	P
109	102	Zc	ZB034	Bonneville Dam	Spring	20230504	4	I	106	I	0.72	P	22	P
110	103	Zc	ZB035	Bonneville Dam	Spring	20230504	9	I	293	I	0.72	P	22	P
111	104	Zc	ZB036	Bonneville Dam	Spring	20230504	7	I	199	I	0.72	P	22	P
112	105	Ej	EB048	Bonneville Dam	Spring	20230509	7	I	311	I	0.38	P	25	P
113	106	Zc	ZB037	Bonneville Dam	Spring	20230509	7	I	342	I	0.72	P	22	P
114	107	Ej	EB049	Bonneville Dam	Spring	20230510	3	I	354	I	0.38	P	25	P
115	108	Zc	ZB038	Bonneville Dam	Spring	20230510	9	I	348	I	0.72	P	22	P
116	109	Zc	ZB039	Bonneville Dam	Spring	20230510	6	I	270	I	0.72	P	22	P
117	110	Zc	ZB040	Bonneville Dam	Spring	20230510	9	I	286	I	0.72	P	22	P
118	111	Ej	EB050	Bonneville Dam	Spring	20230511	2	I	220	I	0.38	P	25	P
119	112	Zc	ZB041	Bonneville Dam	Spring	20230511	2	I	113	I	0.72	P	22	P
120	113	Zc	ZB042	Bonneville Dam	Spring	20230511	9	I	312	I	0.72	P	22	P
121	114	Zc	ZB043	Bonneville Dam	Spring	20230511	8	I	263	I	0.72	P	22	P
122	115	Zc	ZB044	Bonneville Dam	Spring	20230516	3	I	169	I	0.72	P	22	P
123	116	Zc	ZB045	Bonneville Dam	Spring	20230516	5	I	148	I	0.72	P	22	P
124	117	Zc	ZB046	Bonneville Dam	Spring	20230516	13	I	297	I	0.72	P	22	P
125	118	Zc	ZB047	Bonneville Dam	Spring	20230516	2	I	124	I	0.72	P	22	P
126	119	Zc	ZB048	Bonneville Dam	Spring	20230516	8	I	202	I	0.72	P	22	P
127	120	Ej	EB051	Bonneville Dam	Fall	20230912	7	I	420	I	0.84	P	55	P
128	121	Ej	EB052	Bonneville Dam	Fall	20230912	7	I	616	I	0.84	P	55	P
129	122	Ej	EB053	Bonneville Dam	Fall	20230913	14	I	786	I	0.84	P	55	P
130	123	Ej	EB054	Bonneville Dam	Fall	20231011	13	I	627	I	0.84	P	55	P
131	124	Ej	EB055	Bonneville Dam	Fall	20231011	7	I	377	I	0.84	P	55	P
132	125	Ej	EB056	Bonneville Dam	Fall	20231012	6	I	519	I	0.84	P	55	P
133	126	Ej	EB057	Bonneville Dam	Fall	20231012	5	I	380	I	0.84	P	55	P

Table A3.2 continued

Agent	Individual	Spp	ID	Location	Season	Date	Age	1	Mass_kgs	1	Fidelity_p	1	Residency_d	1
134	127	Ej	EB058	Bonneville Dam	Fall	20231012	7	I	351	I	0.84	P	55	P
135	128	Ej	EB059	Bonneville Dam	Fall	20231018	8	I	626	I	0.84	P	55	P
136	129	Ej	EB060	Bonneville Dam	Fall	20231024	10	I	647	I	0.84	P	55	P
137	130	Ej	EB061	Bonneville Dam	Fall	20231026	11	I	630	I	0.84	P	55	P
138	131	Ej	EB062	Bonneville Dam	Fall	20231031	8	I	582	I	0.84	P	55	P
139	132	Ej	EB063	Bonneville Dam	Fall	20231101	9	I	511	I	0.84	P	55	P
140	133	Ej	O50	Bonneville Dam	Fall	20231101	8	I	702	I	0.83	I	115	I
141		Ej	O50	Bonneville Dam	Spring	20231101	8	I	702	I	1.00	I	81	I
142	134	Ej	EB064	Bonneville Dam	Fall	20231114	9	I	626	I	0.84	P	55	P
143	135	Ej	EB065	Bonneville Dam	Fall	20231114	8	I	483	I	0.84	P	55	P
144	136	Ej	EB066	Bonneville Dam	Fall	20231130	4	I	264	I	0.84	P	55	P
145	137	Ej	EB067	Bonneville Dam	Fall	20231130	3	I	331	I	0.84	P	55	P
146	138	Ej	EB068	Bonneville Dam	Fall	20231130	2	I	386	I	0.84	P	55	P
147	139	Ej	EB069	Bonneville Dam	Spring	20240402	14	I	552	I	0.38	P	25	P
148	140	Ej	EB070	Bonneville Dam	Spring	20240402	6	I	448	I	0.38	P	25	P
149	141	Zc	ZB049	Bonneville Dam	Spring	20240404	11	I	306	I	0.72	P	22	P
150	142	Zc	ZB050	Bonneville Dam	Spring	20240404	9	I	298	I	0.72	P	22	P
151	143	Ej	EB071	Bonneville Dam	Spring	20240409	6	I	577	I	0.38	P	25	P
152	144	Ej	EB072	Bonneville Dam	Spring	20240409	3	I	406	I	0.38	P	25	P
153	145	Ej	EB073	Bonneville Dam	Spring	20240409	10	I	680	I	0.38	P	25	P
154	146	Ej	EB074	Bonneville Dam	Spring	20240410	7	I	601	I	0.38	P	25	P
155	147	Ej	EB075	Bonneville Dam	Spring	20240410	4	I	404	I	0.38	P	25	P
156	148	Ej	EB076	Bonneville Dam	Spring	20240410	4	I	484	I	0.38	P	25	P
157	149	Ej	EB077	Bonneville Dam	Spring	20240411	6	I	510	I	0.38	P	25	P
158	150	Ej	EB078	Bonneville Dam	Spring	20240411	3	I	311	I	0.38	P	25	P
159	151	Zc	ZB051	Bonneville Dam	Spring	20240411	6	I	236	I	0.72	P	22	P
160	152	Ej	EB079	Bonneville Dam	Spring	20240416	4	I	522	I	0.38	P	25	P
161	153	Ej	EB080	Bonneville Dam	Spring	20240416	7	I	648	I	0.38	P	25	P
162	154	Zc	ZB052	Bonneville Dam	Spring	20240416	4	I	209	I	0.72	P	22	P
163	155	Ej	EB081	Bonneville Dam	Spring	20240417	6	I	476	I	0.38	P	25	P
164	156	Ej	EB082	Bonneville Dam	Spring	20240417	7	I	674	I	0.38	P	25	P
165	157	Zc	ZB053	Bonneville Dam	Spring	20240423	9	I	186	I	0.72	P	22	P
166	158	Zc	ZB054	Bonneville Dam	Spring	20240423	9	I	243	I	0.72	P	22	P
167	159	Zc	ZB055	Bonneville Dam	Spring	20240423	6	I	203	I	0.72	P	22	P

Table A3.2 continued

Agent	Individual	Spp	ID	Location	Season	Date	Age	1	Mass_kgs	1	Fidelity_p	1	Residency_d	1
168	160	Zc	ZB056	Bonneville Dam	Spring	20240423	7	I	184	I	0.72	P	22	P
169	161	Zc	ZB057	Bonneville Dam	Spring	20240423	4	I	155	I	0.72	P	22	P
170	162	Zc	ZB058	Bonneville Dam	Spring	20240423	2	I	109	I	0.72	P	22	P
171	163	Zc	ZB059	Bonneville Dam	Spring	20240423	8	I	271	I	0.72	P	22	P
172	164	Zc	ZB060	Bonneville Dam	Spring	20240424	2	I	103	I	0.72	P	22	P
173	165	Zc	ZB061	Bonneville Dam	Spring	20240424	6	I	157	I	0.72	P	22	P
174	166	Zc	ZB062	Bonneville Dam	Spring	20240424	5	I	151	I	0.72	P	22	P
175	167	Zc	ZB063	Bonneville Dam	Spring	20240424	2	I	157	I	0.72	P	22	P
176	168	Zc	ZB064	Bonneville Dam	Spring	20240424	8	P	84	I	0.72	P	22	P
177	169	Zc	ZB065	Bonneville Dam	Spring	20240424	8	P	187	I	0.72	P	22	P
178	170	Ej	EB083	Bonneville Dam	Spring	20240425	4	I	486	I	0.38	P	25	P
179	171	Zc	2n65	Bonneville Dam	Spring	20240425	11	I	378	I	0.60	I	12	I
180	172	Zc	ZB066	Bonneville Dam	Spring	20240425	10	I	256	I	0.72	P	22	P
181	173	Zc	ZB067	Bonneville Dam	Spring	20240425	5	I	323	I	0.72	P	22	P
182	174	Zc	ZB068	Bonneville Dam	Spring	20240502	8	I	280	I	0.72	P	22	P
183	175	Ej	EB084	Bonneville Dam	Spring	20240507	8	I	612	I	0.38	P	25	P
184	176	Ej	EB085	Bonneville Dam	Spring	20240507	6	I	404	I	0.38	P	25	P
185	177	Zc	ZB069	Bonneville Dam	Spring	20240507	9	I	251	I	0.72	P	22	P
186	178	Zc	ZB070	Bonneville Dam	Spring	20240507	4	I	161	I	0.72	P	22	P
187	179	Zc	ZB071	Bonneville Dam	Spring	20240507	10	I	337	I	0.72	P	22	P
188	180	Zc	ZB072	Bonneville Dam	Spring	20240508	10	I	338	I	0.72	P	22	P
189	181	Zc	ZB073	Bonneville Dam	Spring	20240508	8	I	270	I	0.72	P	22	P
190	182	Zc	ZB074	Bonneville Dam	Spring	20240508	8	I	313	I	0.72	P	22	P
191	183	Zc	ZW008	Willamette Falls	Spring	20240508	10	I	414	I	0.87	P	39	P
192	184	Zc	ZW009	Willamette Falls	Spring	20240508	11	I	350	I	0.87	P	39	P
193	185	Zc	ZW010	Willamette Falls	Spring	20240514	10	I	420	I	0.87	P	39	P
194	186	Ej	EB086	Bonneville Dam	Fall	20241015	8	I	491	I	0.84	P	55	P
195	187	Ej	EB087	Bonneville Dam	Fall	20241015	6	I	473	I	0.84	P	55	P
196	188	Ej	EW002	Willamette Falls	Fall	20241105	8	I	611	I	0.25	P	3	P
197	189	Ej	EB088	Bonneville Dam	Fall	20241204	8	I	667	I	0.84	P	55	P
198	190	Ej	EB089	Bonneville Dam	Fall	20241204	9	I	714	I	0.84	P	55	P
199	191	Ej	EW003	Willamette Falls	Fall	20241210	8	I	542	I	0.25	P	3	P
200	192	Ej	EB90	Bonneville Dam	Spring	20250415	6	P	530	I	0.38	P	25	P
201	193	Ej	EB91	Bonneville Dam	Spring	20250415	6	P	489	I	0.38	P	25	P

Table A3.2 continued

Agent	Individual	Spp	ID	Location	Season	Date	Age	1	Mass_kgs	1	Fidelity_p	1	Residency_d	1
202	194	Ej	EB92	Bonneville Dam	Spring	20250415	6	P	283	I	0.38	P	25	P
203	195	Zc	ZB075	Bonneville Dam	Spring	20250416	8	P	172	I	0.72	P	22	P
204	196	Zc	ZB076	Bonneville Dam	Spring	20250416	8	P	280	I	0.72	P	22	P
205	197	Zc	ZB077	Bonneville Dam	Spring	20250417	8	P	304	I	0.72	P	22	P
206	198	Zc	ZB078	Bonneville Dam	Spring	20250417	8	P	243	I	0.72	P	22	P
207	199	Zc	ZB079	Bonneville Dam	Spring	20250417	8	P	184	I	0.72	P	22	P
208	200	Ej	EB93	Bonneville Dam	Spring	20250422	6	P	371	I	0.38	P	25	P
209	201	Ej	EB94	Bonneville Dam	Spring	20250422	6	P	836	I	0.38	P	25	P
210	202	Ej	EW004	Willamette Falls	Spring	20250423	6	P	549	I	0.10	P	16	P
211	203	Ej	EW005	Willamette Falls	Spring	20250423	6	P	644	I	0.10	P	16	P
212	204	Ej	EB95	Bonneville Dam	Spring	20250430	6	P	571	I	0.38	P	25	P
213	205	Zc	ZB080	Bonneville Dam	Spring	20250501	8	P	226	I	0.72	P	22	P
214	206	Ej	EB096	Bonneville Dam	Spring	20250507	6	P	490	I	0.38	P	25	P
215	207	Ej	EB097	Bonneville Dam	Spring	20250507	6	P	300	I	0.38	P	25	P
216	208	Ej	EB098	Bonneville Dam	Spring	20250507	6	P	191	I	0.38	P	25	P
217	209	Ej	EB099	Bonneville Dam	Spring	20250507	6	P	420	I	0.38	P	25	P
218	210	Ej	EB100	Bonneville Dam	Spring	20250507	6	P	286	I	0.38	P	25	P
219	211	Zc	ZB081	Bonneville Dam	Spring	20250507	8	P	372	I	0.72	P	22	P
220	212	Zc	ZB082	Bonneville Dam	Spring	20250507	8	P	171	I	0.72	P	22	P
221	213	Zc	ZB083	Bonneville Dam	Spring	20250507	8	P	115	I	0.72	P	22	P
222	214	Zc	ZB084	Bonneville Dam	Spring	20250507	8	P	225	I	0.72	P	22	P
223	215	Zc	ZB085	Bonneville Dam	Spring	20250507	8	P	195	I	0.72	P	22	P
224	216	Zc	ZB086	Bonneville Dam	Spring	20250507	8	P	287	I	0.72	P	22	P
225	217	Zc	ZB087	Bonneville Dam	Spring	20250507	8	P	358	I	0.72	P	22	P
226	218	Zc	ZB088	Bonneville Dam	Spring	20250507	8	P	174	I	0.72	P	22	P
227	219	Zc	ZB089	Bonneville Dam	Spring	20250507	8	P	248	I	0.72	P	22	P
228	220	Zc	ZB090	Bonneville Dam	Spring	20250507	8	P	152	I	0.72	P	22	P
229	221	Zc	ZB097	Bonneville Dam	Spring	20250512	8	P	188	I	0.72	P	22	P
230	222	Zc	ZB098	Bonneville Dam	Spring	20250512	8	P	131	I	0.72	P	22	P
231	223	Zc	ZB091	Bonneville Dam	Spring	20250513	8	P	424	I	0.72	P	22	P
232	224	Zc	ZB092	Bonneville Dam	Spring	20250513	8	P	255	I	0.72	P	22	P
233	225	Zc	ZB093	Bonneville Dam	Spring	20250513	8	P	219	I	0.72	P	22	P
234	226	Zc	ZB094	Bonneville Dam	Spring	20250513	8	P	149	I	0.72	P	22	P
235	227	Zc	ZB095	Bonneville Dam	Spring	20250513	8	P	119	I	0.72	P	22	P

Table A3.2 continued

Agent	Individual	Spp	ID	Location	Season	Date	Age	1	Mass_kgs	1	Fidelity_p	1	Residency_d	1
236	228	Zc	ZB096	Bonneville Dam	Spring	20250513	8	P	237	I	0.72	P	22	P
237	229	Zc	ZB099	Bonneville Dam	Spring	20250515	8	P	132	I	0.72	P	22	P
238	230	Zc	ZB100	Bonneville Dam	Spring	20250604	8	P	209	I	0.72	P	22	P

Table A3.3. Survival sub-model parameters. Estimate is value from the published literature and indicates probability of surviving to next age (e.g., probability of male CSL surviving from age 2 to age 3 is 0.858). Final indicates predicted value from second order polynomial fit to published estimates (see footnotes).

	Male California sea lion survival probabilities			Male Steller sea lion survival probabilities		
Age	Estimate	Source	Final	Estimate	Source	Final
2[a]	0.858	Table 3, DeLong et al. 2017	0.879	0.848	Averaged 2002-2009 cohorts, Table S2, Wright et al. 2017	0.849
3	0.892	Ibid	0.901	0.885	Ibid	0.882
4	0.927	Ibid	0.915	0.884	Ibid	0.904
5	0.931	Ibid	0.919	0.884	Ibid	0.914
6	0.923	Ibid	0.914	0.884	Ibid	0.913
7	0.908	Ibid	0.899	0.884	Ibid	0.900
8	0.887	Ibid	0.876	0.884	Ibid	0.875
9	0.856	Ibid	0.842	0.884	Ibid	0.839
10	0.804	Ibid	0.800	0.881	Ibid	0.792
11	0.744	Ibid	0.748	0.881	Ibid	0.732
12	0.669	Ibid	0.686	0.652	Table S1/Appendix 1b, Maniscalco et al. 2015	0.661
13	0.586	Ibid	0.616	0.550	Ibid	0.579
14	0.512	Ibid	0.536	0.434	Ibid	0.485
15	0.440	Ibid	0.446	0.306	Ibid	0.379
16	0.383	Ibid	0.348	0.168	Ibid	0.262
17	0.354[b]	Ibid	0.240	0.023	Ibid	0.133
18	0.350[b]	Ibid	0.122	0.001	Ibid	0.001
19	0.366[c]	Ibid	0.000	0.001[c]	Ibid	0.000

[a] No CSLs <2 years of age have been observed in removal population

[b] Set to NA (prior to smoothing) due to small sample size and high uncertainty in estimates

[c] Set to zero since no male CSL in the study was sighted >19 years of age; survival of male SSL >19 was also effectively zero.

Table A3.4. Fidelity and residency sub-model parameters based on mark-resight data of all upriver animals (not just removals). Note that some individuals may occur in multiple locations and/or seasons.

			Fidelity*		Residency (days)**	
Location	Species	Season	Mean	n	Mean	n
BD	CSL	Spring	0.72	363	21.6	252
	SSL	Spring	0.38	49	24.6	31
		Fall	0.84	21	54.3	25
WF	CSL	Spring	0.87	57	38.7	72
	SSL	Spring	0.10	6	16.1	6
		Fall	0.25	2	2.8	2

* Base dataset consisted of 16,317 resights of 570 individual sea lions. Excluding cases where an animal was only seen upriver one season and then never again (anywhere) resulted in a final dataset of 15,136 resights of 443 individuals.

**Base dataset consisted of 16,317 resights of 570 individual sea lions. Excluding season of initial marking and/or removal resulted in 12,735 resights of 369 individuals. Further excluding cases where <20% of the residency was actually resighted resulted in a final dataset of 11,801 resights of 342 individuals.

Table A3.5. Diet sub-model parameters based on synthesis of scat, gastro-intestinal tract, expert opinion, and surface feeding data from Bonneville Dam (BD) and Willamette Falls (WF).

			Diet component #1				Diet component #2			Diet component #3		
Location	Spp	Season	Prey	%	ED (kJ/g)*	Weight (kg)**	Prey	%	ED (kJ/g)*	Prey	%	ED (kJ/g)*
BD	CSL	Spring	Spring Chinook salmon	90	7.2	5.7	Pacific lamprey	5	25.65	Other	5	*U*(3, 7.2)
	SSL	Spring	Spring Chinook salmon	70	7.2	5.7	White sturgeon	20	4.4	Other	10	*U*(3, 7.2)
		Fall	Salmonid	40	5.9	5.4	White sturgeon	40	4.4	Other	20	*U*(3, 7.2)
WF	CSL	Spring	Salmonid	85	5.9	5.4	Pacific lamprey	10	25.65	Other	5	*U*(3, 7.2)
	SSL	Spring	Salmonid	15	5.9	5.4	White sturgeon	70	4.4	Other	15	*U*(3, 7.2)
		Fall	Salmonid	15	5.9	5.4	White sturgeon	70	4.4	Other	15	*U*(3, 7.2)

*Energetic density (ED) sources: salmonids (O'Neil et al 2014), sturgeon (pers. com. P. Stevens, ODFW), lamprey (Clemens et al. 2019), other (Winship and Trites 2003).

**Mean weight sources: salmonids (predation-weighted mean of salmon and steelhead at Willamette Falls, Jepson et al. 2015); spring Chinook salmon (CRTIFC, 2004-2007).

Table A3.6. Bioenergetics sub-model parameters as modified from Winship et al. (2002).

Symbol	Description	Value	Units	Source
P	Production (energy invested in growth)	0	kJ d^{-1}	See methods
A_{water}	Water metabolic rate multiplier	~triangle(2.5, 4.0, 5.5)	Unitless	Winship et al. (2002)
A_{land}	Land metabolic rate multiplier	~triangle(1.0, 1.2, 1.4)	Unitless	Winship et al. (2002)
$water_{j = CSL}$	Percent of time spent in the water	~triangle(0.08, 0.78, 1)	%	Unpublished data, ODFW & WDFW
$water_{j = SSL}$	Percent of time spent in the water	~triangle(0, 0.68, 1)	%	Unpublished data, ODFW & WDFW
BM_j	Basal metabolism	$292.88 \times M_j^{0.75}$	kJ d^{-1}	Winship et al. (2002); adults
M_j	Body mass	f_i(mass, age)	kgs	Growth sub-model
E_{f+u}	Fecal and urinary digestive efficiency	~U(0.81, 0.89)	%	Winship et al. (2002)
E_{HIF}	Energy utilization efficiency	~U(0.85, 0.90))	%	Winship et al. (2002); maintenance
$prey_i$	% of total diet biomass comprised of prey i	0-100	%	Diet sub-model
ED_i	Energetic density of prey i	3-25.65	kJ g^{-1}	Diet sub-model

Table A3.7. Individual-level results summary for sea lion management ABM.

Location	Species	Season	Agents	Mean of agent means (range in agent means)					
				Recurrence, yrs	Residency, days	Daily biomass requirement, kgs	Daily biomass requirement, % body mass	Daily salmonid biomass requirement, kgs	Daily salmonid requirement, # fish
BD	CSL	Spring	106	2.7 (0.8-4.5)	21.1 (1.5-22.2)	12.3 (5.2-18.1)	3.8 (3.3-5.0)	11.2 (4.7-16.5)	2 (0.8-2.9)
	SSL	Spring	63	2.0 (0.3-5.0)	26.0 (1.5-88.5)	24.4 (12.3-29.6)	3.5 (3.2-4.4)	14.5 (7.3-17.6)	2.5 (1.3-3.1)
		Fall	54	3.2 (0.5-5.1)	59.0 (1.6-132.6)	29.2 (21.6-36.1)	4.3 (4.0-4.4)	9.9 (7.3-12.2)	1.8 (1.4-2.3)
WF	CSL	Spring	10	2.6 (1.5-3.1)	38.8 (37.6-38.9)	14.8 (13.4-17.9)	4.3 (4.0-4.4)	13.5 (12.2-16.3)	2.5 (2.3-3.0)
	SSL	Spring	3	0.4 (0.3-0.4)	15.7 (15.0-16.1)	35.4 (32.5-37.4)	4.5 (4.5-4.6)	4.2 (3.8-4.4)	0.8 (0.7-0.8)
		Fall	2	0.8 (0.7-0.8)	2.9 (2.9-2.9)	31.8 (29.9-33.7)	4.5 (4.5-4.6)	3.7 (3.5-4.0)	0.7 (0.7-0.7)