# Pinniped Removals at Bonneville Dam

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2022-01-12

| Year | Bonneville Dam | | | | | Willamette Falls | Astoria | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | Placed in captivity | Accidental mortality | | | Euthanized | Euthanized (spring) | Euthanized (spring) | Euthanized (fall) | |
| | | On list | Qualified | Not yet qualified | | | | | |
| **2008** | 6 | 2 | 1 | 2 | | | | | 11 |
| **2009** | 4 | | | | 10 | | | 1 | 15 |
| **2010** | | | | | 12 | | | 2 | 14 |
| **2011** | | | | | | | 1 | | 1 |
| **2012** | 1 | | | | 11 | | | 1 | 13 |
| **2013** | 2 | | | | 2 | | | | 4 |
| **2014** | | | | | 15 | | | | 15 |
| **2015** | 2 | | | 2 | 30 | | | | 34 |
| **2016** | | | | | 59 | | | | 59 |
| **2017** | | | | | 24 | | | | 24 |
| **2018** | | | | | 28 | 1 | | | 29 |
| **2019** | | | | | 19 | 3 | | | 22 |
| **2020** | NO SEA LION REMOVALS DUE TO COVID-19 | | | | | | | | |
| **2021** | | | | | 4 | | | | 4 |
| **Total** | 15 | 2 | 1 | 4 | 214 | 1 | 1 | 4 | 245 |

# MMPA §120 Permit Removal Criteria

- Each CA sea lion must be individually identifiable – this requires trapping, marking, and releasing the animal, *AND*
- individual sea lions must be observed at Bonneville Dam for 5 days, *AND**
- individual sea lions must be observed eating salmonids at Bonneville Dam, *AND*
- individual sea lions must be subjected to nonlethal deterrence while at Bonneville Dam.

*Criteria changed in 2019 to 5 days of observation OR observed eating salmonids

# Removal Summary 2008-2021

- 392 individually identifiable California sea lions were designated as having a significant negative impact on Endangered Species Act (ESA)-listed salmonids at Bonneville Dam, and listed for removal

- 240 listed CSLs were removed in the period from 2008-2021

- NOAA Fisheries authorized the eligible entities' MMPA §120f permit in August 2020. Lethal removals after August 14, 2020, were conducted under this new authorization, except for those CSLs already on the list of animals approved for removal under the §120 authorization. During 2021 4 CSLs were removed under §120 authority, and 17 were removed under §120f authority.

# Removal Summary 2008-2021

- Removals limited to a maximum of 1% of potential biological removal (PBR) annually
- PBR for population of California sea lions set at 8,511 from 2008-2011, and 9,200 from 2012-2021
- Highest yearly removal level was 59 animals in 2016, 0.64% of PBR
- All removed animals were male

# Age of lethally removed animals

- Age data based on sectioned teeth have been obtained for 197 CSLs lethally removed since 2009
- Average age of euthanized animals over the course of §120 authorization was 7.7 years, with a range of 2-15 years
- No shift in age composition over time

# Size of lethally removed animals

- The average weight of euthanized CSLs (n = 116) was approximately 266 kg (587 lbs.), with a range of 140-659 kg (310-1454 lbs).

- The average length of euthanized CSLs (n = 78) was approximately 220 cm (7.2 ft), with a range of 196-246 cm (6.4-8.1 ft).

# Diet analysis

Summary of prey remains recovered from gastrointestinal tracts of 72 California sea lions removed at Bonneville Dam, 2017-2019.

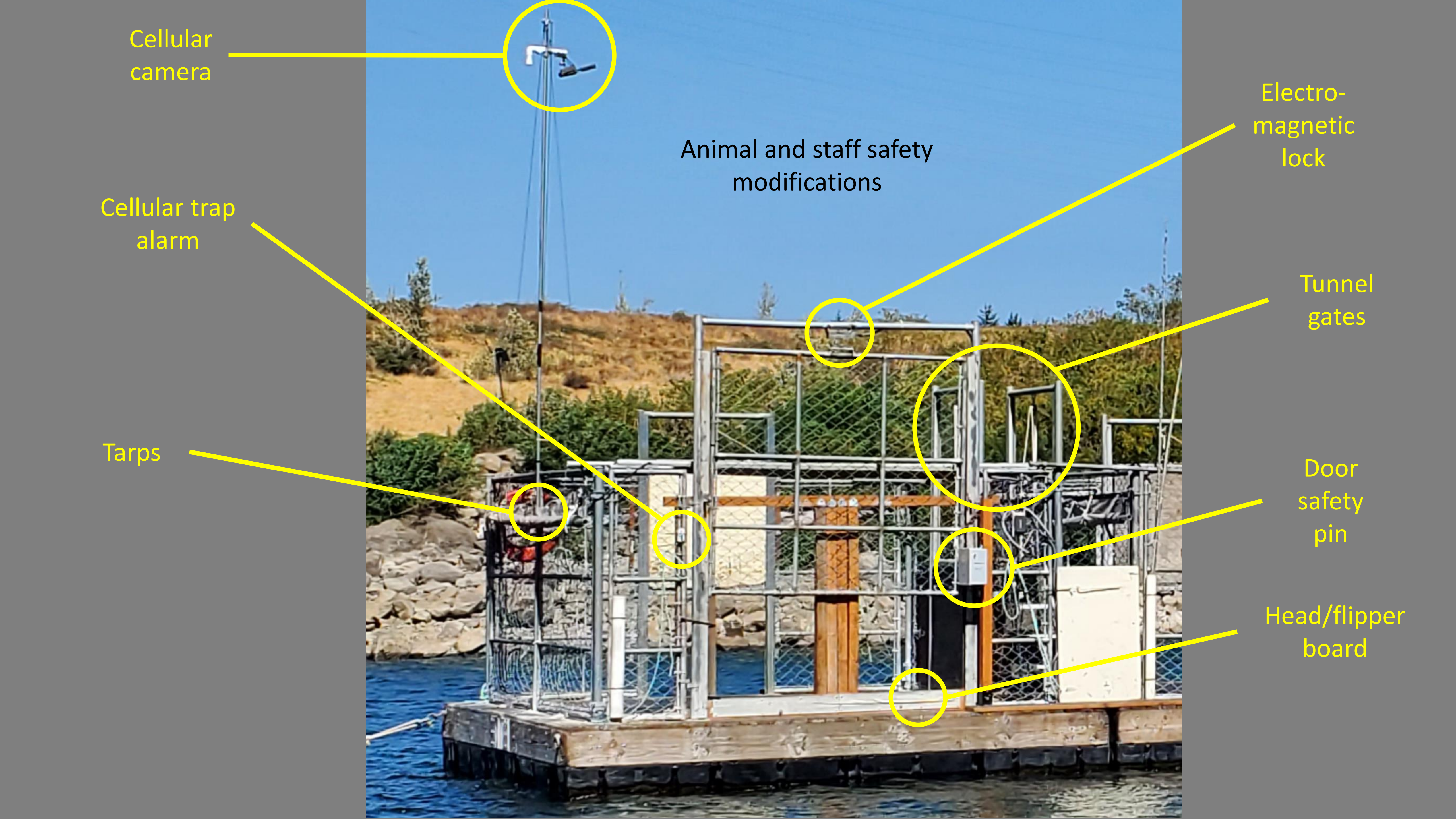
| | Salmonid | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Adult* | Juvenile | PIT tag | Pacific lamprey | Lamprey Spp. | Cyprinid | Shad | Eulachon | Cottidae | Herring | Cephalopod |
| Total | 174 | 572 | 37 | 27 | 2 | 7 | 10 | 1 | 1 | 1 | 4 |

*All identified as Chinook salmon except nine that were unidentified to species.

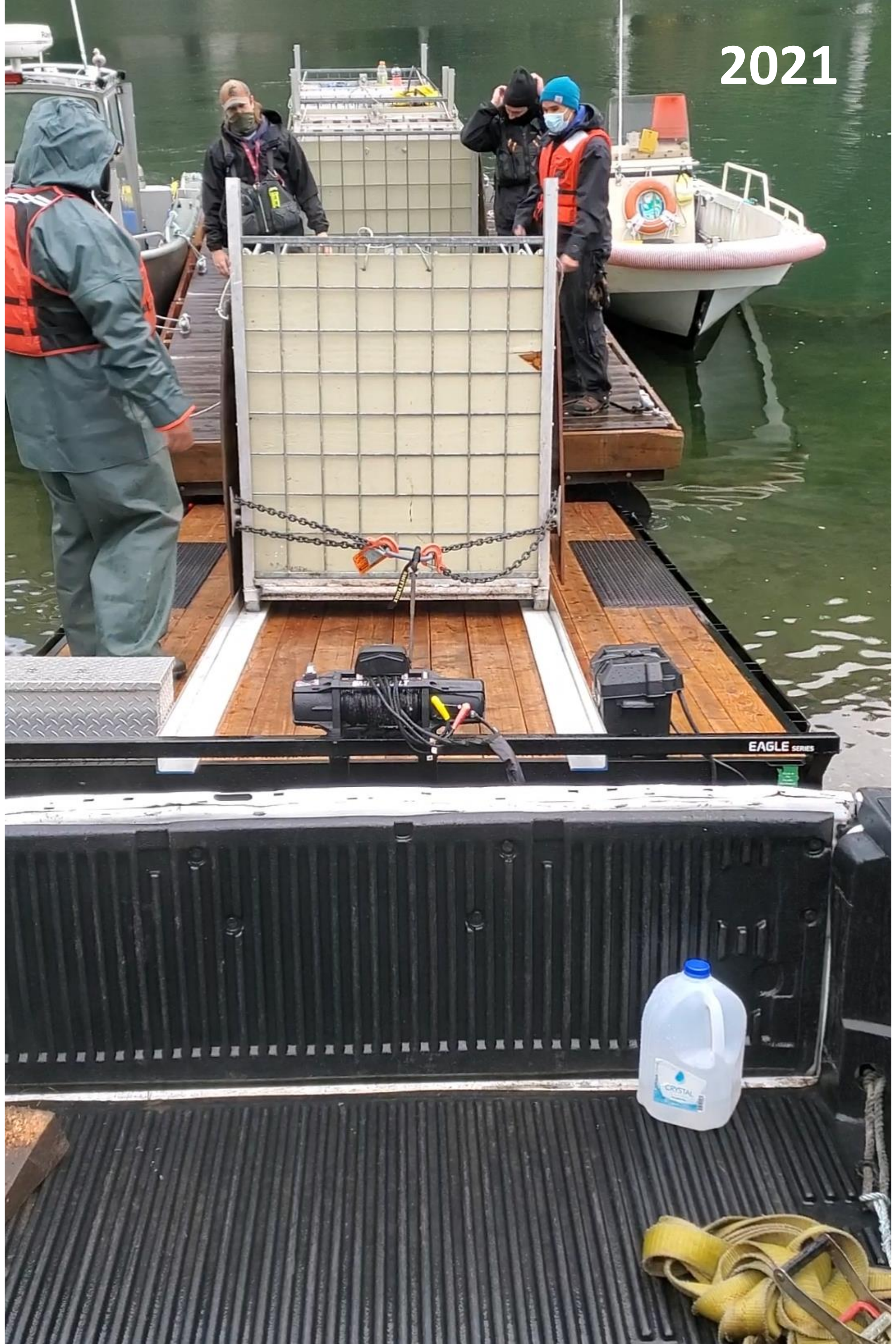
- Of these GI tracts, 94% (*n* = 68) contained remains of adult salmonids, and 38% (*n* = 27) contained remains of juvenile salmonids
- 174 adult salmonids were recovered from the GI tracts of CSLs, with 90% (n = 156) of those being adult Chinook salmon


2007


2021


Animal and staff safety modifications
Cellular camera
Cellular trap alarm
Tarps
Electro-magnetic lock
Tunnel gates
Door safety pin
Head/flipper board


2007
Link-Belt


2021
EAGLE

# Benefits analysis

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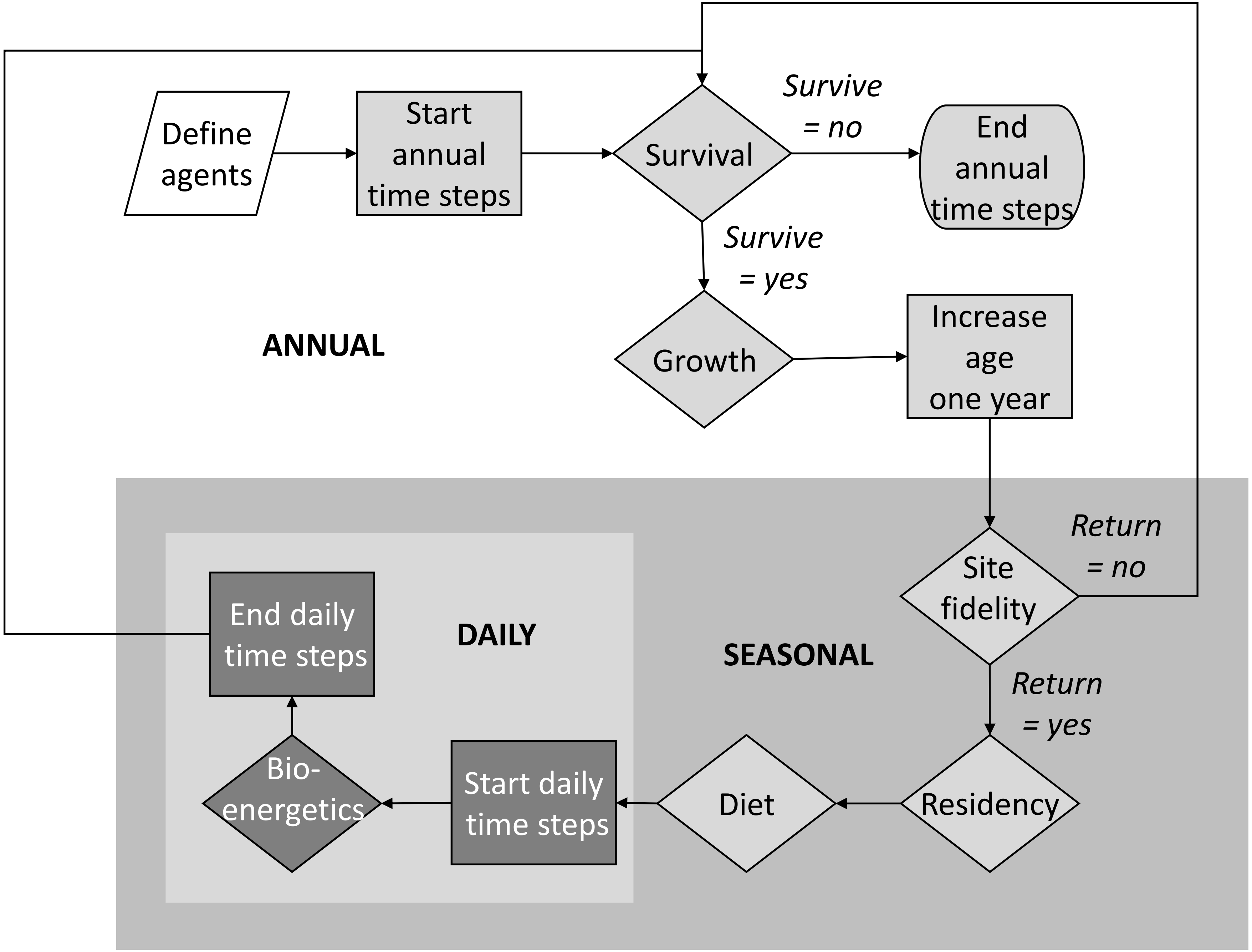
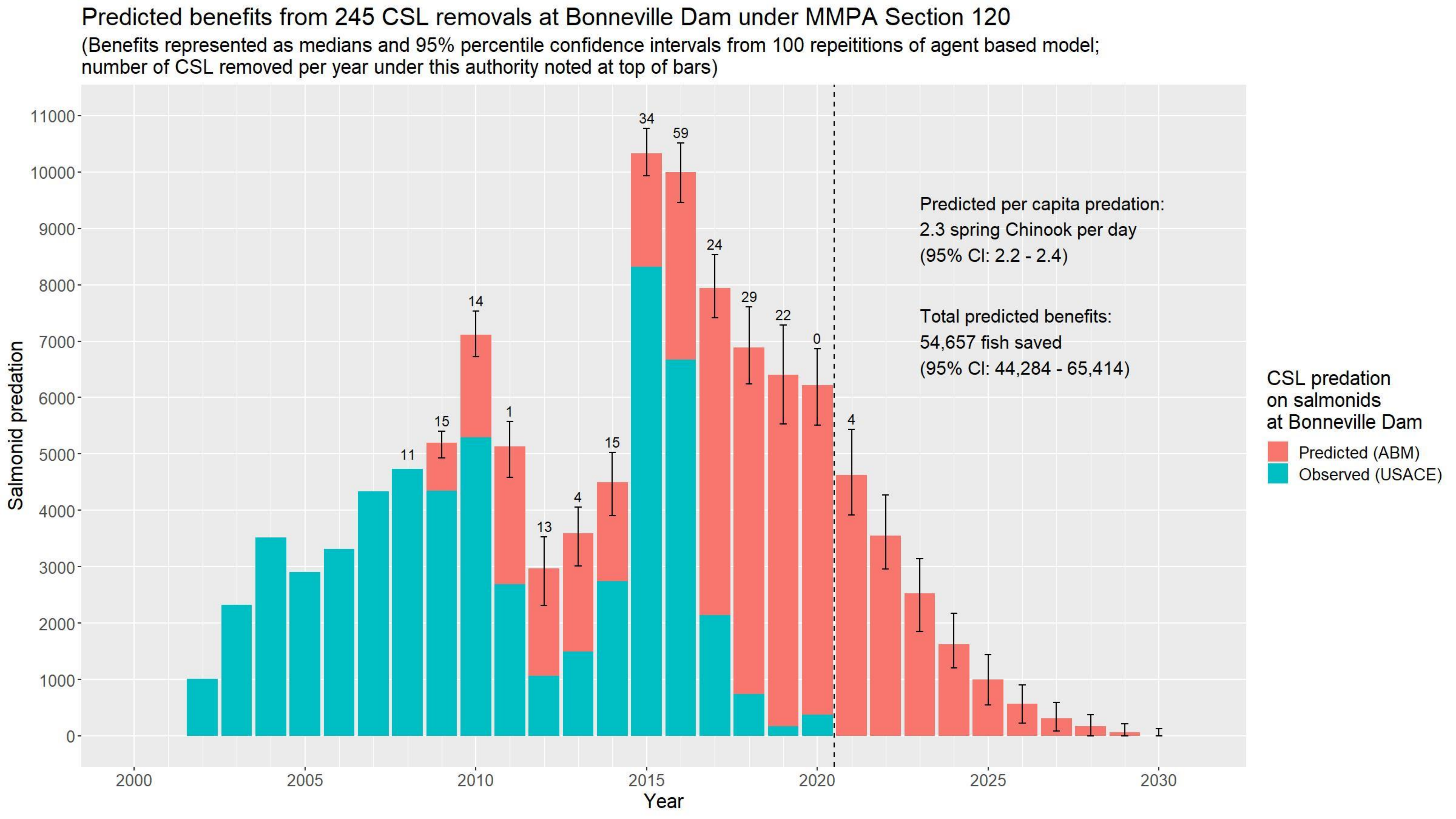
# Benefits analysis

- How many (future) fish were saved by sea lion removals?
- Depends on sea lion:
  - age
  - weight
  - annual site fidelity (recurrence)
  - daily site fidelity (residency)
  - prey
    > composition
    > energetic density
    > weight

# Methods

- Agent (Individual) Based Model
- See Appendix 3 of MMPA §120(f) Sea Lion Management Annual Report (12/1/2021) for details
- Ongoing development

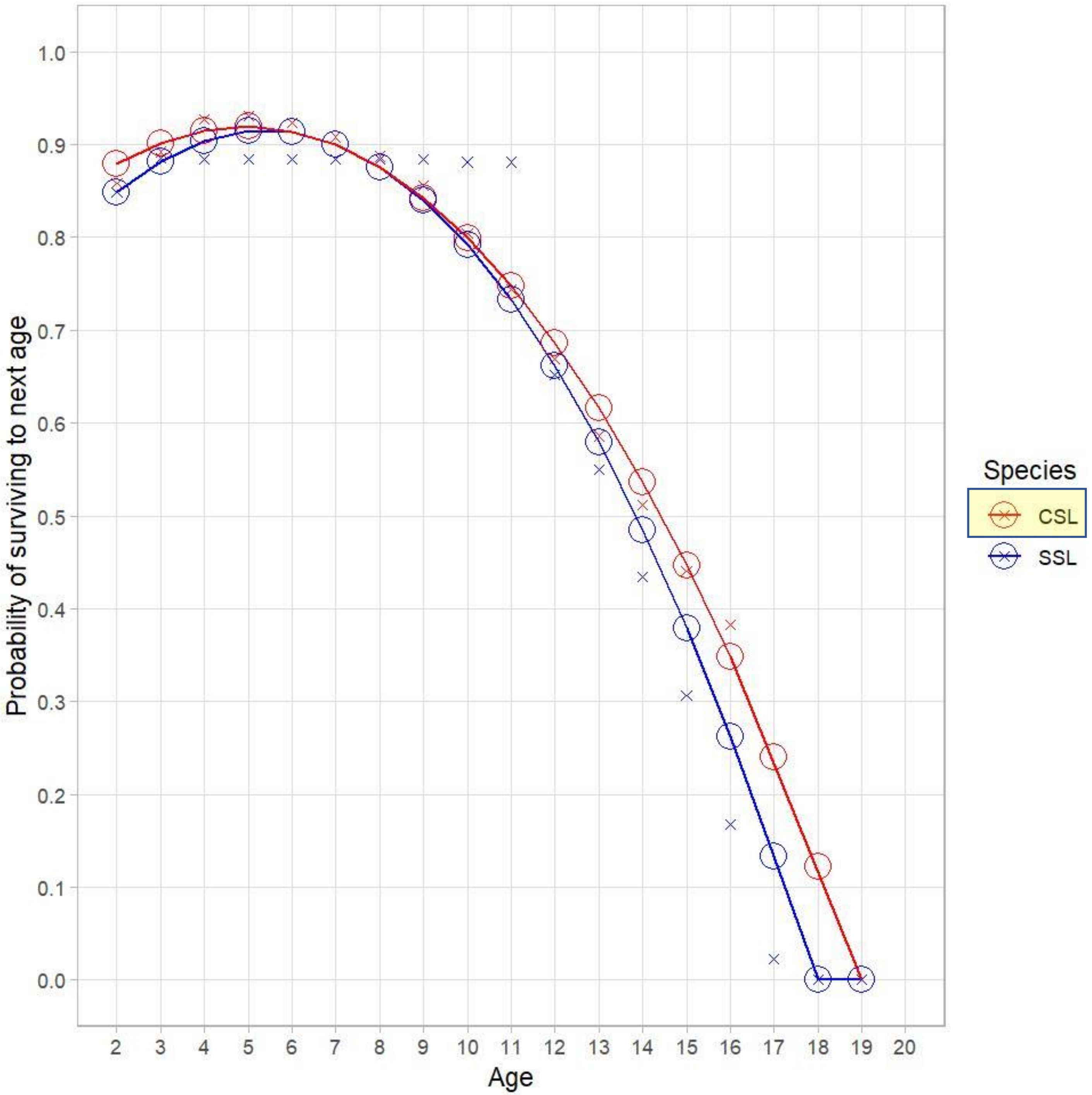

Define agents
Start annual time steps
Survival
Survive = no
End annual time steps
Survive = yes
Growth
Increase age one year
ANNUAL
Site fidelity
Return = no
Return = yes
SEASONAL
Residency
Diet
DAILY
Start daily time steps
Bio-energetics
End daily time steps



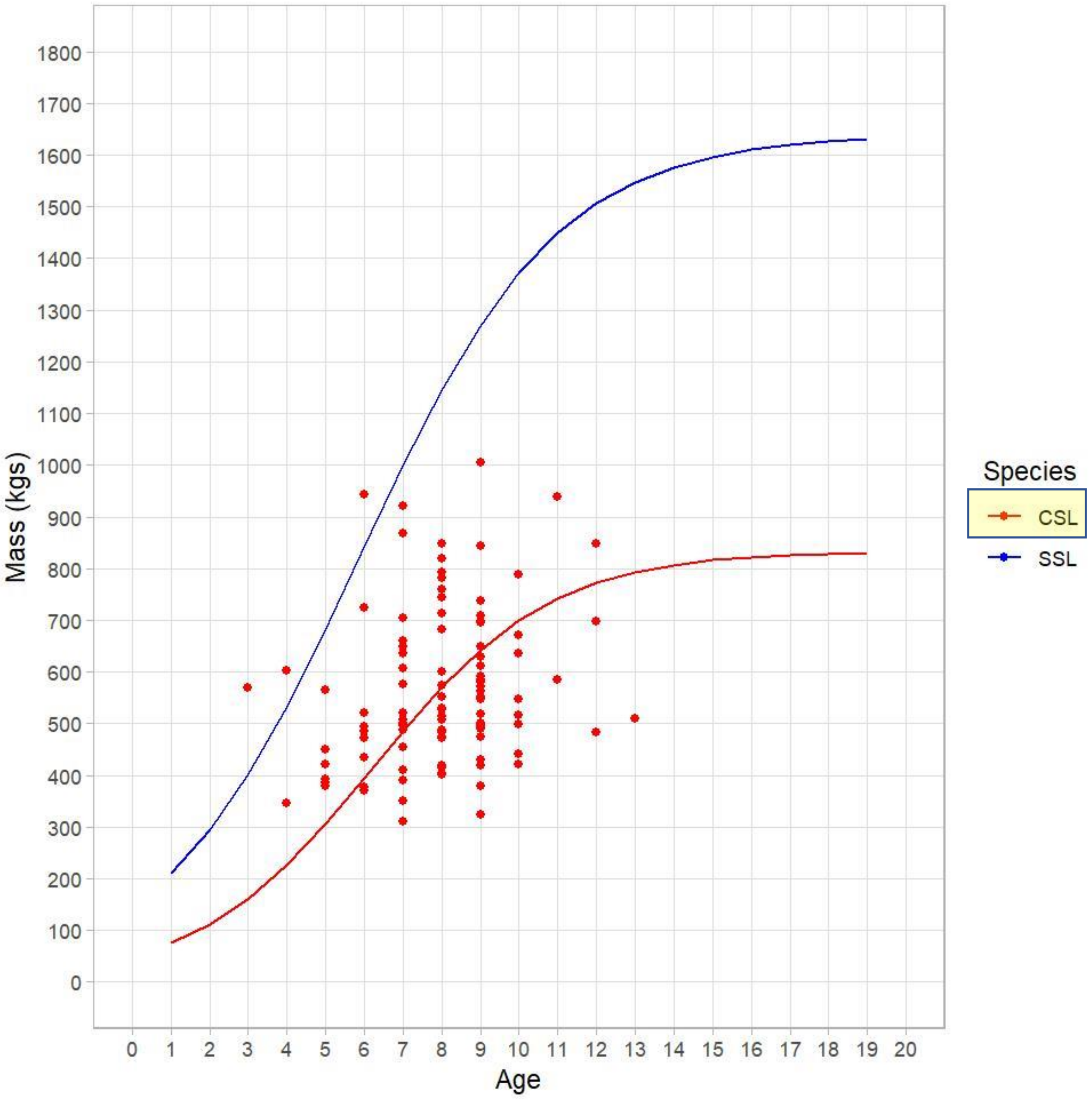
Predicted benefits from 245 CSL removals at Bonneville Dam under MMPA Section 120
(Benefits represented as medians and 95% percentile confidence intervals from 100 repetitions of agent based model; number of CSL removed per year under this authority noted at top of bars)
Salmonid predation
Year
Predicted per capita predation:
2.3 spring Chinook per day
(95% CI: 2.2 - 2.4)
Total predicted benefits:
54,657 fish saved
(95% CI: 44,284 - 65,414)
CSL predation on salmonids at Bonneville Dam
Predicted (ABM)
Observed (USACE)

# Questions?

# Survival sub-model



# Growth sub-model

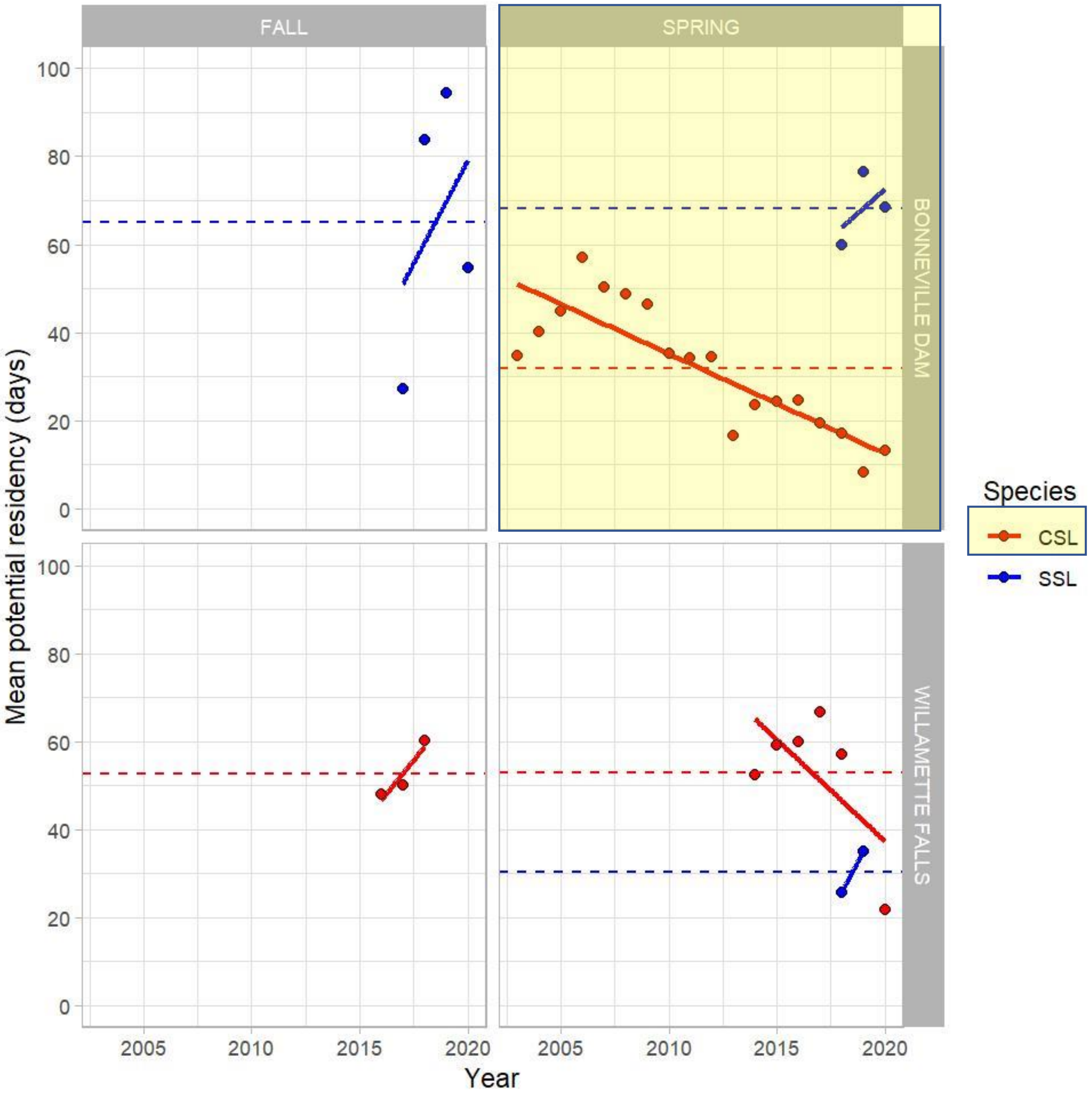


# Fidelity and residency sub-models

**Table 2.** Average fidelity and residency sub-model parameters based on mark resight data of upriver animals.

| | | | Fidelity | | | Residency (d) | | |
|---|---|---|---|---|---|---|---|---|
| Location | Species | Season | Mean | *n* (unique) animals | | Mean | *n* years | *n* (non-unique) animals |
| Bonn. Dam | CSL | Spring | 0.98 | 190 | | 32 | 18 | 435 |
| Bonn. Dam | SSL | Spring | 0.79 | 7 | | 68 | 3 | 44 |
| Bonn. Dam | SSL | Fall | 0.95 | 7 | | 65 | 4 | 49 |
| Will. Falls | CSL | Spring | 1 | 21 | | 53 | 6 | 131 |
| Will. Falls | CSL | Fall | 0.48 | 9 | | 53 | 3 | 21 |
| Will. Falls | SSL | Spring | 0.79* | 0 | | 30 | 2 | 8 |

# Residency sub-model



# Diet sub-model

**Table 3.** Diet sub-model parameters.

| | | | Diet component #1 | | | | Diet component #2 | | | Diet component #3 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Species | Season | Prey | % | ED* (kJ/g) | Weight** (kg) | Prey | % | ED* (kJ/g) | Prey | % | ED* (kJ/g) |
| Bonn. Dam | CSL | Spring | Spr. Chi. salmon | 90 | 7.2 | 5.7 | NA | 0 | NA | Other | 10 | ~*U*(3, 7.2) |
| Bonn. Dam | SSL | Spring | Spr. Chi. salmon | 45 | 7.2 | 5.7 | W. sturgeon | 45 | 4.4 | Other | 10 | ~*U*(3, 7.2) |
| Bonn. Dam | SSL | Fall | Salmonid | 30 | 5.9 | 5.4 | W. sturgeon | 60 | 4.4 | Other | 10 | ~*U*(3, 7.2) |
| Will. Falls | CSL | Spring | Salmonid | 90 | 5.9 | 5.4 | P. lamprey | 5 | 25.65 | Other | 5 | ~*U*(3, 7.2) |
| Will. Falls | CSL | Fall | Salmonid | 70 | 5.9 | 5.4 | NA | 0 | NA | Other | 30 | ~*U*(3, 7.2) |
| Will. Falls | SSL | Spring | Salmonid | 30 | 5.9 | 5.4 | W. sturgeon | 60 | 4.4 | Other | 10 | ~*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).

# Bioenergetics sub-model

$$BR_{ij}[kg\ d^{-1}] = \frac{GER[kJ\ d^{-1}] \times prey_i}{ED_i[kJ\ g^{-1}]} \div 1000, \qquad GER = \frac{P + (A_j \times BM_j)}{E_{HIF} \times E_{f+u}}, \qquad A_j = water_j * A_{water} + (1 - water_j) * A_{land}$$

**Table 4.** Bioenergetics sub-model parameters.

| 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 |