# The Columbia Basin Collaborative

Revised Recommendations 3-13-25

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# Introduction

The Columbia Basin Collaborative (CBC) charter aims to achieve the quantitative and qualitative goals for salmon and steelhead documented in the Columbia Basin Partnership Task Force (CBPTF) Phase 1 and 2 Reports, as adopted by the Marine Fisheries Advisory Committee (MAFAC). The CBPTF "explored the various limiting factors that impact salmon and steelhead across their life cycles. The results of the analyses show that no single strategy (e.g., reducing predation, increasing habitat, reducing harvest) will achieve the Goals on its own. Instead, improvements in multiple factors will be needed to increase abundance to desired levels for most stocks. Together, these improvements create synergies that compound benefits greater than those achievable through single actions."

The CBPTF also identified that, "reliable and predictable funding is essential. Funding must be targeted to achieve the Partnership's Quantitative and Qualitative Goals. New funding sources should be identified. Funding must come from multiple sources, consider the burden across communities, and account for past, present, and potential impacts."

The CBC agrees with these MAFAC-adopted objectives and hence the recommendations below are aimed to help achieve those CBPTF Goals. No one recommendation can meet these goals alone.

The parties of the CBC have come to consensus that these recommendations are valid for implementer consideration. As stated in the Charter "sovereigns with management decision-making authority will review recommendations and make independent decisions to implement or support actions. The CBC itself is not a management decision-making body, but will strive to support its recommendations through to implementation."

# Assessment & Trends Work Group

## Recommendation: Monitor Progress on the CBPTF Goals

The region should fund basin-wide reporting of salmon abundance, survival, and trends to track progress towards the Columbia Basin Partnership Task Force Goals.

In the Columbia River Basin, stocks are monitored by fish and wildlife managers differently across geographies and jurisdictions. Without a coordinated, basin-wide monitoring effort, it is challenging to understand how progress is being made towards meeting the goals in the Partnership Report. This basin-wide effort should take into consideration gaps in monitoring at the stock level, identify information required to assess effectiveness and progress towards CBP goals, where needed identify appropriate surrogates of survival for stocks with insufficient monitoring information, assemble the existing information under a common interface, and distill the information into a useable public-facing tool that can be accessible to the public. Several regional planning documents[1] have identified monitoring progress towards the CBPTF goals across the basin as a priority, including:

- The Phase 2 Report of the Columbia Basin Partnership Task Force of the Marine Fisheries Advisory Committee outlines a strategy to, "expand monitoring and assessment efforts to assess status and progress toward salmon and steelhead recovery."
- The Northwest Power and Conservation Council Columbia River Basin Fish & Wildlife Program 2020 Addendum states, "the Council expects work implemented under the program will contribute toward achieving these distributed targets along the way to achieving the overarching program goal, and thus the Council will track progress toward these distributed abundance targets as part of program performance."
- The Independent Scientific Advisory Board's 2024 review of the Council's Columbia River Basin Fish & Wildlife Program provided several recommendations for improvement including to, "Establish Strategy Performance Indicators to be tracked for each salmon and steelhead stock for the major subbasins."
- The Columbia Basin Restoration Initiative's recommended approach for ensuring accountability to fisheries recovery goals outlines their aim to, "establish a long-term biological performance monitoring and reporting program to measure progress and support accountability towards the qualitative and quantitative recovery and abundance goals identified in the CBP Phase II Report."

In addition to monitoring abundance and survival, the Phase 2 report calls for monitoring:

1. Toxics (p 121)
2. Specifically which habitat improvements produce results (p 134 and p 289 for estuary specific)
3. Project effectiveness monitoring (p 140, includes #2 habitat)
4. Early detection monitoring of predators and invasives (p 147)
5. Natural/Hatchery composition of spawners (p 150,151)

A basin-wide monitoring effort should consider all of these components.

# Hydropower/Blocked Areas Work Group

## Recommendation: Fully fund the Phase 2 Implementation Plan (P2IP)

Fully fund the Upper Columbia United Tribes (UCUT) and their project partners to implement the Phase 2 Implementation Plan to evaluate the feasibility and strategies for fish passage at five hydroelectric dams on the upper Columbia and Spokane rivers and reintroduce anadromous fish to historically occupied habitats. The Columbia Basin Collaborative acknowledges that the P2IP is critical to realizing the CBPTF Goals.

This includes (1) providing juvenile hatchery fish from appropriate donor stocks from existing and/or local interim fish production facilities; (2) performing juvenile and adult behavior and survival studies; (3) developing, operating, and maintaining a trap-and-haul operation at Chief Joseph Dam; (4) programmatic research, monitoring, and evaluation; (5) depending on outcomes from experimental releases above; design, install, test, operate, and maintain upstream and downstream interim fish passage facilities at up to five hydroelectric dams (Chief Joseph, Grand Coulee, Little Falls, Long Lake, and Nine Mile dams). In addition to fully funding the P2IP, the below policy considerations are necessary to advance Phase 2 in an efficient manner:

a. *Policy Considerations:* Expedite the supply of hatchery fish to support the P2IP through expansion of existing facilities and development of new fish production facilities. This will require adequate funding and efficient regulatory processes.
b. *Policy Considerations*: Provide access to appropriate donor stocks, including Chief Joseph Hatchery, so that both the facilities and fish stocks may be used for fish passage and reintroduction activities.
c. *Policy Considerations*: Authorize and fund the U.S. Army Corps of Engineers and Bureau of Reclamation to research, develop, and maintain fish passage facilities at Chief Joseph and Grand Coulee dams and to utilize funds from both public and private sources for such activities and facilities.
d. *Policy Considerations:* Expedite the development of fish passage facilities essential to the reintroduction effort by means of adequate funding and alleviation of regulatory burdens.

The I/RG alongside tribal, federal, and state partners should be tasked with identifying the most appropriate funding mechanism or mechanisms to support completion of the P2IP.

## Stock Benefits Report Card:

Blocked Areas: Recommendation to fund the Upper Columbia United Tribes Phase 2 Implementation Plan

| | | | Abundance | | | MAFAC Phase II Impact Priority | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sub-Region | Stock | Status | Current | MAFAC Medium goal | Current as % of Medium Goal | Tributary Habitat | Estuary Habitat | Hydro (Mainstem) | Hydro (Latent) | Hydro (Blocked) | Predation | Fishery | Hatchery | Harvest |
| Low-C | L Col R Spring Chinook | Threatened | 2,240 | 21,550 | 10% | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 3 |
| Low-C | L Col R Winter Steelhead | Threatened | 5,989 | 27,900 | 21% | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Low-C | L Col R Fall (tule) Chinook | Threatened | 12,329 | 54,100 | 23% | 1 | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 1 |
| Low-C | L Col R Coho | Threatened | 31,524 | 129,550 | 24% | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| Low-C | L Col R Summer Steelhead | Threatened | 10,594 | 29,800 | 36% | 2 | 4 | 4 | 4 | 2 | 4 | 4 | 4 | 4 |
| Low-C | Col R Chum | Threatened | 11,762 | 33,000 | 36% | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | |
| Low-C | SW WA Winter Steelhead | Threatened | 3,252 | 5,850 | 56% | 2 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Low-C | L Col R Late Fall (bright) Chinook | | 10,800 | 16,700 | 65% | | | | | | | | | |
| Low-C | L Col R Fall (bright) Chinook | Threatened | 11,000 | 11,000 | 100% | 5 | 5 | 5 | 5 | 4 | 5 | 4 | 5 | 4 |
| Mid-C | M Col Sockeye | Not Listed | 1,036 | 45,000 | 2% | 3 | 3 | 3 | 2 | 1 | 3 | 3 | | 3 |
| Mid-C | M Col R Spring Chinook | Not Listed | 11,600 | 40,425 | 29% | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
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| Mid-C | M Col R Summer/Fall Chinook | Not Listed | 11,500 | 13,000 | 88% | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 4 |
| Up-C | U Col R Coho | Not Listed | 392 | 15,000 | 3% | | | | | | | | | |
| Up-C | U Col R Summer Steelhead | Threatened | 1480 | 31,000 | 5% | 1 | 1 | 2 | 1 | 1 | 1 | 3 | 2 | 3 |
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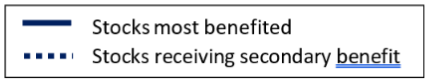
*Draft for Internal Review – 3/30/23*



## Recommendation: Pursue Increasing Salmon Production to Support and Sustain a Stable and Dedicated Source of Fish in the Upper Snake

### Background:

Historically, the Bannock, Paiute, and Shoshone peoples harvested salmon and trout throughout the Columbia River Basin for subsistence. Annual salmon and steelhead runs in what are now Idaho (ID), Nevada (NV), Oregon (OR), and Washington (WA) provided harvest opportunities throughout the year. Access to anadromous fish for subsistence and ceremonial purposes has been eliminated from much of the Upper Snake River Basin following the construction of dams for hydroelectric, flood control, and irrigation purposes within the Columbia and Snake basins. Upper Snake River tribes have an abiding interest in protecting and enhancing the fish and wildlife and cultural resources in ancestral territories and are actively working towards these goals.

Beyond the partnership goals, the Upper Snake River Tribes (USRT) Foundation, USRT member tribes, National Oceanic and Atmospheric Administration (NOAA), US Fish and Wildlife Service (USFWS), along with input from other stakeholders developed the Hells Canyon Complex Fisheries Resource Management Plan (Plan). Finalized in 2018, the Plan lists both short term goals (ex. anadromous fish for ceremonial fisheries) and long-term goals (ex. sustainable, harvestable populations of anadromous fish).

The major problem with the above goals is that hatcheries throughout the Columbia River Basin are struggling to meet production and escapement goals. The ID Governor's Salmon Workgroup recognized this struggle. The Hatchery Policy Recommendations of the ID Salmon Work Group Report (Report) states the importance of making sure the mitigation goals of the Lower Snake River Compensation Plan, Dworshak mitigation, and Idaho Power Company settlement agreements are being met. The Report also states the need for further funding to enhance hatchery production to meet current mitigation, supplementation, and conservation programs. The fact that hatcheries are struggling to meet current needs means the Upper Snake River member tribes are left to rely on "excess fish" even for ceremonial fish releases. The challenge is that there are no "excess fish." The USRT member tribes appreciate the efforts and importance that the states of ID and OR have put into providing fish, from the states harvest share, for ceremonial fisheries. However, this process is not sustainable, and unfortunately does nothing to move towards the goals of the Partnership or the Plan.

### Summary of Action:

This recommendation is to either pursue increasing hatchery production or creating new hatchery facilities with the production being dedicated to the Upper Snake River Basin and the goals outlined in the Partnership. Increased production would allow for a dedicated source of fish for ceremonial/subsistence fisheries and future reintroductions into select tributaries in the Upper Snake River. Some collaborative agreements are already in place to support developing solutions, for example, in the 2022 MOA "ODFW and BPT agreed to meet to review opportunities to increase fish hatchery production of Chinook salmon and steelhead [...]", and to support "efforts to form an advisory and coordination body referred to as a "Hells Canyon Advisory Committee" with representatives from federal and state agencies, Tribes, and hydropower interests."

The Partnership goals call for 9,500-13,500 returning unlisted hatchery-origin Spring/Summer Chinook and Summer Steelhead adults for the Upper Snake. Using current smolt to adult return rates, the proposed new, or expanded, hatchery facility would need to produce four million smolts annually to

achieve these goals. In addition to the partnership goals, the plan lists three goals. A hatchery with dedicated production for the Upper Snake Basin would help accomplish goal one: Re-establish anadromous fisheries on unlisted, hatchery origin spring/summer/fall Chinook salmon and/or steelhead in select tributaries to provide subsistence, cultural, and recreational harvest opportunities.

The broodstock for this facility would most likely come from fish trapped at HCC. Another potential source for initial broodstock could be from the Rapid River Hatchery. Any fish used from these two locations for broodstock would need to be acquired through negotiations with the Nez Perce Tribe (NPT) and the States of ID and OR. The HCC and Rapid River hatchery fish are the best options as these fish are excluded from the Endangered Species Act (ESA). All fish in the new, or expanded, facility would not have ESA listing and all fish placed or reintroduced would follow the ID Governors Blocked Area policy listed in the Partnership.

### Existing or New Program:

New program.

### Benefit Provided by Action:

This action will provide salmon to the Shoshone, Bannock, and Paiute people that call the Upper Sanke River Basin home. This will start a cultural healing that is long overdue. Salmon being returned to tributaries will be a benefit to all species as lost nutrients will begin to be restored.

The Plan does not only call for harvest by the tribes, but also a harvest share for public fishing opportunities in the states of ID and OR. Therefore, increased hatchery production and reintroductions would benefit the states of ID, NV, and OR. Further, increased production and reintroductions would increase the number of anadromous fish further downriver, which would increase potential harvest opportunities and decrease the stress due to harvest on the stocks that are currently harvestable.

### Stocks Benefited by the Action:

Potentially all stocks may see a benefit, as there will be more salmon available for harvest which could potentially reduce the harvest of all stocks.

### Implementing Entities:

- Shoshone Bannock Tribes
- Shoshone Paiute Tribes
- Burns Paiute Tribes
- Fort McDermitt Tribes
- Warm Springs Tribes
- Nez Perce Tribes
- State of Idaho
- State of Oregon
- State of Washington
- Bureau of Reclamation
- USFWS
- NOAA

### Time Needed to Implement:

10-20 years.

### Time Needed to Benefit Fish Populations:

10-20 years.

### Estimated Cost:

Unknown at this time as planning has not occurred as to whether a new facility will be constructed or additions to a current facility may be made**.**

### Uncertainties:

- Who would fund the project?
- Where would the hatchery be located?
- How will fish be distributed?

### Associated Regulatory Processes or Policies:

- Idaho blocked area policy
- Harvest allocations
- United States v. Oregon

### Potential Challenges:

- Idaho blocked area policy
- Harvest allocations
- United States v. Oregon
- Initial brood stock
- 2019 settlement agreement between Idaho, Oregon and IPC

### Adaptive Management:

Adaptative management would be used to determine the best rearing and release strategy to return adults most successfully. As part of the adaptive management plan straying rates and the potential impacts of an additional four million smolts will be monitored and evaluated. The returning adults would be monitored in each tributary to best utilize them to meet short- and long-term goals of the Partnership phase two report. This recommendation is for the construction of a hatchery, the adaptive management will play a more important role in the operation of a hatchery once it is constructed and operational.

## SIWG Narrative Feedback & Stock Benefits Report Card:

**SIWG Feedback:**

- The Upper Snake River has been blocked by federal and private dams for 100 years, and fishing opportunities for Upper Snake River tribes have been lost as a result. The CBPTF goals call for 9,500-13,500 returning unlisted hatchery-origin Spring/Summer Chinook and Summer Steelhead adults for the Upper Snake. This recommended action would either build a new hatchery or expand a current hatchery to produce four million smolts annually to achieve these goals. All fish in this hatchery facility would be non-listed fish and would likely come from Hells Canyon or Rapid River. The benefits of this action include that it would put higher numbers of fish in the river, providing more fish to harvest downriver and reducing fishing pressure on Endangered Species Act (ESA)-listed stocks.
- This action would integrate well with other efforts in the basin. Opening the habitat in the upper basin could help advance salmon and steelhead recovery throughout the Columbia Basin. It would also increase the non-ESA listed fish available for harvest. Increases in salmon abundance would result in harvest to be shared with the Upper Snake River Tribes and the States.
- This action is aligned with achieving the quantitative and qualitative goals within the CBPTF Phase 2 Report.
- This effort aligns well with the ongoing project at Grand Coulee and Chief Joseph Dams. That initiative could be used as a source of information on how that effort impacted factors downstream.
- This recommended action is also consistent with the recent Presidential Memorandum on Restoring Healthy and Abundant Salmon, Steelhead, and Other Native Fish Populations in the Columbia River Basin and actions asked of federal agencies by the Biden administration.
- SIWG members raised a concern related to disease management. The recommended action includes strategies to manage this risk in the long-term plan, which specifies that any stocks used would be examined for disease potential.
- There could be unintended consequences of this action related to predation.
    - Some SIWG members shared that increasing the number of outmigrants could promote greater predation. Increased avian presence and predation has been observed with increased numbers of hatchery fish, particularly if they are all released at the same time.
    - Other SIWG members shared that it is also possible that the recommended action could alleviate predation impacts since an increased number of smolts in the river system could reduce predation pressure on other stocks.
    - Others shared that the scale of this action may not be enough to have a measurable impact, since the four million smolt output called for in the recommended action is very small compared to the total smolt production in the system, so the impact on predator food budget would be minimal.
    - SIWG members suggested potentially having this recommendation reviewed by the Avian Predation subgroup and having a structured risk assessment included as part of implementation for this recommended action.
- SIWG members noted that any new hatchery program in the basin would need to undergo ESA consultation, which would include a NOAA analysis that evaluates these risks and impacts. They

also noted that this action relates to harvest allocations that are determined in the *United States vs. Oregon* process, and appropriate coordination would be needed.

- This action would likely benefit all stocks in the Columbia River, with a significant benefit to the Upper Snake River stocks above the blocked area. SIWG members noted that the main benefits of this recommendation are to fisheries by increasing the number of fish available for harvest. Others noted that increasing the number of fish could also create challenges for other limiting factors and the dynamics of downstream fisheries.
- The goal of this action is to gain regional support acknowledging that that Upper Snake Tribes have lost the cultural benefit of access to fish and that the only way to restore fish in the Upper Snake is to increase production. This is still a long-term goal and the intention of having this as a CBC recommendation is to demonstrate regional support when seeking funding for this effort. There are many uncertainties remaining and additional work that would need to happen to implement the action.

**Stock Benefits Report Card:**

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*Draft for Internal Review – 11/15/23*

Stocks most benefited
Stocks receiving secondary benefit

## Recommendation: Assess run timing and entry timing of natural origin juvenile salmon and steelhead

### Summary of Action:

Assess run timing and entry timing of natural origin juvenile salmon and steelhead from natal tributaries into the Columbia River to provide information that can be used in adaptive management of spill and/or bypass operations to ensure safe passage routes for early migrants. Data could be collected through smolts traps, PIT tag detection (barges or other) or in some cases mainstem bypasses and traps or other methods.

### Existing or New Program:

Varies. Some tributaries and populations are beginning to collect this information, and others are not. In many cases existing monitoring methods (bypass operation, PIT detection, juvenile trapping, etc.) do not begin early enough in the migratory season to understand the scope and magnitude of fish use and migration before April. Beginning in 2018, the juvenile bypass system at one or two lower Snake River dams has begun operating as early as March 1 to assess the extent to which juvenile salmon and steelhead are migrating in the lower Snake River prior to the defined spring spill season. This information is not sufficient to assess individual populations and does not assess when juveniles are entering the Snake River from their natal tributaries. The data gap in the upper Columbia may be greater. To date, other than decades-old fyke net studies at Wells Dam, there has been no early sampling at mainstem mid-Columbia River dams, yet smolt trap data from the Wenatchee and Entiat may indicate a sizable proportion (up to 60%; ISAB 2018-01 of the ESA listed natural origin spring Chinook are entering the Columbia River prior to the start of spill.

This recommendation assumes that adequate numbers of Juveniles are PIT tagged for species or populations.

Citation: Independent Scientific Advisory Board (ISAB). 2018. Review of Spring Chinook Salmon in the Upper Columbia. ISAB 2018-01 February 9, 2018.

### Benefit Provided by Action:

These data would inform whether spill and other means of passing juvenile fish begins early enough to provide the same migratory benefits to both wild and hatchery fish. Natural origin spring chinook appear to migrate earlier out of their natal tributaries than their hatchery counterparts. In the upper Columbia potentially up to 50% of the natural origin spring chinook have migrated into the mainstem reservoirs prior to the start of spring spill (based on smolt trap data in the lower reaches of tributaries). In some cases, spring chinook may enter the Columbia and rear in a reservoir for a time prior to migration, but the behavior, passage timing, and survival of these fish is largely not known. Typical bypass operation and associated monitoring do not begin early enough to understand this component of the natural origin spring chinook migration.

### Stocks Benefited by the Action:

All early migrating salmon and steelhead stocks throughout the Columbia Basin, including Upper Columbia, Mid-Columbia, and Snake River stocks would benefit if mainstem dam operations are not

aligned with actual migration timing. Magnitude of benefit may be population or MPG-specific and will not be understood until data is collected.

### Data Supporting Benefits:

In the Upper Columbia this data gap is supported by information learned from smolts traps in the lower Wenatchee and Entiat Rivers. In the Snake River this data gap is supported, at least in part, by the early bypass operations which have begun at one-to two projects per year. Other populations likely exhibit similar behaviors (Umatilla, Yakima, Klickitat, etc.). In addition, climate change projections (especially increasing winter temperatures) support the idea that many ocean type salmon and steelhead populations might respond to climate change by migrating earlier in the year. Earlier monitoring, both in the lower reaches of tributaries and at key mainstem projects, would ensure that operations designed to protect juvenile migrants retain their effectiveness.

### Implementing Entities:

State and Tribal Agencies (tributaries) and federal and non-federal dam operators (key mainstem Snake and Columbia River dams) and fishery co-managers (tributary traps and detection sites).

### Time Needed to Implement:

Minimal data can be collected immediately. Acting upon the data can also be implemented quickly but may require use of adaptive management or modification of existing agreements or requirements.

### Time Needed to Benefit Fish Populations:

Immediately: if it is determined that spill and other bypass measures should start earlier to ensure that earlier migrating natural origin fish are provided adequate spill and bypass operations.

### Estimated Cost:

Variable based on method of data collection and pre-existing monitoring programs. Where existing sampling infrastructure exists, costs may be minimal to collect the information. Cost of implementing responsive operations would be variable and depend upon the specific project starting spring spill operations at an earlier date.

### Uncertainties:

The behavior of juvenile salmon and steelhead after entering the mainstem Snake and Columbia Rivers (do they continue migrating, rear for extended periods before continuing to migrate, etc.). The ability (and willingness) of dam operators to implement early bypass and data collection. Costs may be incurred to obtain data values of zero; but this should not be a deterrent to learning.

### Associated Regulatory Processes or Policies:

To collect data where fish sampling permits currently exist there may be no new regulatory processes. In areas where new sampling infrastructure are needed, new state and federal permits may be required.

### Potential Challenges:

Data collection and sampling may require improved facilities, earlier staffing and training, and other challenges. Data collected may have implications for system-wide water management, power production, predator management (avian, native, and non-native fish, and pinnipeds), resident

recreational fisheries management, (and navigation?) which will present challenges to adaptive management.

### Adaptive Management:

Data informing when fish are entering the Columbia and Snake rivers could be used to adaptively manage when spill and bypass operations start each season if a relationship between mainstem entry and passage at key mainstem projects could be established.

**Stock Benefits Report Card:**

Hydropower: Recommendation for assessment of run timing and entry timing of natural origin juveniles

| | | | Abundance | | | MAFAC Phase II Impact Priority | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sub-Region | Stock | Status | Current | MAFAC Medium goal | Current as % of Medium Goal | Tributary Habitat | Estuary Habitat | Hydro (Mainstem) | Hydro (Latent) | Hydro (Blocked) | Predation | Fishery | Hatchery | Harvest |
| Low-C | L Col R Spring Chinook | Threatened | 2,240 | 21,550 | 10% | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 3 |
| Low-C | L Col R Winter Steelhead | Threatened | 5,989 | 27,900 | 21% | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Low-C | L Col R Fall (tule) Chinook | Threatened | 12,329 | 54,100 | 23% | 1 | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 1 |
| Low-C | L Col R Coho | Threatened | 31,524 | 129,550 | 24% | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| Low-C | L Col R Summer Steelhead | Threatened | 10,594 | 29,800 | 36% | 2 | 4 | 4 | 4 | 2 | 4 | 4 | 4 | 4 |
| Low-C | Col R Chum | Threatened | 11,762 | 33,000 | 36% | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | |
| Low-C | SW WA Winter Steelhead | Threatened | 3,252 | 5,850 | 56% | 2 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Low-C | L Col R Late Fall (bright) Chinook | | 10,800 | 16,700 | 65% | | | | | | | | | |
| Low-C | L Col R Fall (bright) Chinook | Threatened | 11,000 | 11,000 | 100% | 5 | 5 | 5 | 5 | 4 | 5 | 4 | 5 | 4 |
| Mid-C | M Col Sockeye | Not Listed | 1,036 | 45,000 | 2% | 3 | 3 | 3 | 2 | 1 | 3 | 3 | | 3 |
| Mid-C | M Col R Spring Chinook | Not Listed | 11,600 | 40,425 | 29% | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Mid-C | M Col R Summer Steelhead | Threatened | 18,155 | 43,850 | 41% | 2 | 4 | 4 | 4 | 4 | 2 | 4 | 4 | 4 |
| Mid-C | M Col R Coho | Not Listed | 6,324 | 11,600 | 55% | | 5 | 4 | 5 | 5 | 5 | 4 | | 4 |
| Mid-C | M Col R Summer/Fall Chinook | Not Listed | 11,500 | 13,000 | 88% | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 4 |
| Up-C | U Col R Coho | Not Listed | 392 | 15,000 | 3% | | | | | | | | | |
| Up-C | U Col R Summer Steelhead | Threatened | 1480 | 31,000 | 5% | 1 | 1 | 2 | 1 | 1 | 1 | 3 | 2 | 3 |
| Up-C | U Col R Sockeye | Not Listed | 40,850 | 580,000 | 7% | 1 | 3 | 1 | 1 | 1 | 2 | 3 | 3 | 3 |
| Up-C | U Col R Spring Chinook | Endangered | 1430 | 19,840 | 7% | 1 | 3 | 1 | 1 | 1 | 2 | 3 | 1 | 3 |
| Up-C | U Col R Summer Chinook | Not Listed | 16920 | 78,350 | 22% | 1 | 2 | 1 | 1 | 1 | 3 | 1 | 2 | 1 |
| Up-C | U Col R Fall Chinook | Not Listed | 92,400 | 62,215 | 149% | 5 | 5 | 4 | 5 | 5 | 5 | 4 | 5 | 4 |
| Snake | Snake R Coho | Not Listed | 100 | 26,600 | 0% | | | | | | | | | |
| Snake | Snake R Sockeye | Endangered | 100 | 15,750 | 1% | 3 | 3 | 1 | 1 | 1 | 2 | 3 | | 3 |
| Snake | Snake R Spring/Summer Chinook | Threatened | 6,988 | 98,750 | 7% | 1 | 3 | 1 | 1 | 2 | 2 | 3 | 3 | 3 |
| Snake | Snake R Summer Steelhead | Threatened | 28,000 | 75,000 | 37% | 2 | 4 | 4 | 2 | 2 | 2 | 4 | 4 | 4 |
| Snake | Snake R Fall Chinook | Threatened | 8,360 | 10,780 | 78% | 5 | 5 | 4 | 4 | 4 | 5 | 4 | | 3 |
| Willam | U Will R Spring Chinook | Threatened | 4,278 | 47,850 | 9% | 1 | 2 | 3 | 3 | 1 | 3 | 3 | 2 | 3 |
| Willam | U Will R Winter Steelhead | Threatened | 2,816 | 27,805 | 10% | 1 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |

*Draft for Internal Review – 3/30/23*

Stocks most benefited
Stocks receiving secondary benefit

## Recommendation: Maintain and Improve Mainstem Reach Survival Estimates and Smolt to Adult Return (SAR) Data

### Summary of Action:

Maintain and improve mainstem reach survival estimates and Smolt to Adult Return (SAR) data by installing PIT tag detection systems at key mainstem hydro-projects so that reach-based juvenile salmon and steelhead survival and SAR estimates can be generated throughout the Columbia and Snake River basins. Maintaining and improving reach-based survival estimates will allow for changes in reach survival to be identified, investigated, and addressed. Improving juvenile detections at key projects (and downstream of Bonneville Dam) will allow for more accurate estimates of SARs from different ESUs/DPSs and populations within the Columbia River Basin. Recommended key projects and structures include: Wanapum Dam juvenile bypass; Wanapum Dam adult fishway; one McNary Dam surface spillbay; Bonneville Dam spillway[1]; and the Columbia River estuary (where these "downstream" detections are needed to make survival estimates to Bonneville Dam and could serve as the basis for generating SAR information for ESUs/DPSs and populations within the Columbia River Basin – including the Willamette River basin).

### Existing or New Program:

Both. Several mainstem Columbia and Snake River dams have juvenile PIT tag detection systems while many others do not. There is generally a lack of juvenile PIT tag detection at the five mid-Columbia Public Utility District owned dams. Detection capabilities at many federally owned dams in the lower Snake and lower Columbia rivers have been substantially reduced by recent (higher spring spill) operations and improvements are needed in order to maintain and enhance detection capabilities. Enhancing PIT tag detection capabilities in the Columbia River estuary will increase the accuracy of reach survival estimate to Bonneville Dam and will allow lower river ESUs/DPSs to be detected (which could support reach survival or SAR estimates for these stocks).

### Benefit Provided by Action:

Both reach survival and SAR estimates include confounding factors which can complicate their interpretation and use as management tools, but each of these metrics are widely used to describe survival and productivity of salmon and steelhead stocks in the Columbia River Basin.

These data would maintain or enhance the means by which regional managers and dam operators identify reaches where juvenile and adult survival rates are changing unexpectedly. Coupled with increased PIT tagging of underrepresented natural origin juveniles (in many basins) we can potentially increase our understanding of stock specific survival through these same reaches. These data would also inform whether reach-based survival studies conducted entirely or predominantly with hatchery fish are a reasonable approximation of natural origin smolt survival. Increasing detections in the spillways at mainstem dams could also provide adult fallback and fallback/reascension estimates at these projects.

Currently, SAR estimates for Upper Columbia stocks are limited to release locations or McNary Dam (juvenile detections). The NPCC F&W Program relies on SAR data as a performance metric for the hydro system and overall stock performance. Improved SAR data for upper Columbia Stocks (via increased PIT tag detection) is needed to assess stock performance, improve assessments of delayed mortality, and help evaluate in-river survival bottlenecks.

### Stocks Benefited by the Action:

All stocks entering the Snake and Columbia rivers upstream of targeted reaches, especially Upper Columbia River (UCR spring Chinook, steelhead and Okanogan River and Lake Wenatchee sockeye) and lower Columbia River stocks to the extent they would be detected at Wanapum Dam or in the Columbia River estuary.

### Data Supporting Benefits:

CSS Annual Report(s); NOAA Annual Report on Survival Estimates for the Passage of Spring-migrating Juvenile Salmonids Through Snake and Columbia River Dams and Reservoirs; NOAA Life Cycle Models.

### Implementing Entities:

Federal and non-federal dam operators (key mainstem detection sites) at mainstem dams; multiple agencies might be capable of contributing to Columbia River estuary PIT tag detectors.

### Time Needed to Implement:

Development of new PIT tag detection systems at key locations (Wanapum juvenile bypass, Wanapum adult fishway, McNary surface spillbay, Bonneville spillway, and Columbia River estuary – needed as a required downstream detection site and a detection site for lower Columbia River ESUs/DPSs) could take several years to develop and implement after funding is approved and systems are designed. Responses to the information provided by these enhancements could occur quickly – as early as the following migration season – using adaptive management; other responsive actions may require modification of existing agreements or requirements.

### Time Needed to Benefit Fish Populations:

Data can be used to adaptively manage responsive actions – potentially in the outmigration season following identification of an issue. Longer time periods will be needed to build data sets (reach survival and SAR estimates) for many UCR, LCR, and Willamette River ESUs/DPSs.

### Estimated Cost:

Unknown, likely many millions of dollars for each key location to develop, design, and implement.

### Uncertainties:

Locating PIT tag detection systems that are effective and durable could be challenging (though the Lower Granite surface weir PIT tag detector and estuary pile dyke detectors demonstrate that success is possible). Bonneville Dam might be especially challenging because detectors will likely need to occur in either the forebay (prior to passage through one of the many spillbays) or in the tailrace (after passage through a spillbay) rather than in each of the spillbays themselves as this would likely be cost prohibitive and detection in a single spillbay would likely be very inefficient.

### Associated Regulatory Processes or Policies:

NOAA 2020 CRS Biological Opinion; FERC licenses and BiOps, and potentially NOAA's Willamette River BiOp.

### Potential Challenges:

Designing the spillway PIT tag detector at the Lower Granite Dam surface spillbay took many years. Future systems should take less effort to design as they can build upon the knowledge gathered from this

earlier effort. Wanapum Dam's juvenile bypass system is unique as is the Bonneville spillway (located in a separate channel). NOAA has been investigating technologies (alternatives to the towed array and detections at bird colonies) to obtain PIT tag detections in the Columbia River estuary – these efforts should be useful to this effort.

### Adaptive Management:

Data informing reach-based juvenile survival estimates can be used to identify survival issues within each reach. This information can alert managers to investigate potential causative factors and use adaptive management (i.e., alternative dam operations or predator management actions) to improve survival. This data could also be used to monitor adult fallback and fallback/reascension at the key mainstem locations. Lastly, SAR data is a basic metric used to assess ESU/DPS level (and potentially population level) survival across the smolt to adult life stages (from all factors); it might also be used to evaluate delayed mortality (comparisons between stocks with different treatments – hydro operations, etc.).

### SIWG Narrative Feedback & Stock Benefits Report Card:

**SIWG Feedback:**

- Fishery managers have faced challenges acquiring funding for full SAR monitoring of wild populations in upper rivers. Most mitigation systems are set up for hatchery fish since tagging technology previously did not support tagging wild fish.
- This recommended action is highly integrated with other efforts and limiting factors in the Columbia River Basin. This is an overarching monitoring effort that would allow fishery managers to improve precision for population estimates for SAR and in-river survival rates. This information would help gauge progress towards the Columbia Basin Task Force (CBPTF) goals on a stock-by-stock basis. This action is primarily about addressing data gaps which will support adaptive management of several limiting factors, including hydropower operations, habitat, and predation.
- Some SIWG members expressed that they would like to see more specificity in the recommendation about where estimates are possible now with reasonable certainty, how much those return estimates could be improved by this action, and how those estimates will lead to improvements in the hydro system or management actions. It is always beneficial to have better data, yet this effort will take significant money and time and it is already possible to estimate SAR in some reaches.
    - The Northwest Fisheries Science Center (NWFSC) has a 20-year database for estimating reach survivals throughout the system. Since 2018 when maximum spill started being implemented, the precision around these estimates has gone down and estimates for the last three years are very low.
- SIWG members also noted that the recommendation is not specific about who should pay for and install the PIT detection technology. The recommendation would be strengthened by clarifying who the recommendation is directed to and who is being asked to support this action.
- This monitoring depends on the ability both to tag fish and to detect them. A lot of juvenile traps have already been placed in the system, and this action would leverage infrastructure investment that has already been put into the system.
- This action would more precisely define where mortality happens and help focus on bottlenecks.
- This action would address several major data gaps, such as, data for survival estimates in the Upper Columbia and the contrast between the Snake and the Upper Columbia reaches. This would significantly benefit the whole basin. It would also improve data sensitivities for each of the basins, including climate change effects.
- The benefits to individual stocks are project specific. For the Lower Granite Dam, the Snake River stocks are most likely to benefit. Improved detection at McNary Dam is very important for the Upper Snake stocks. Improvements at Bonneville Dam and in the estuary would benefit all stocks. More generally, the overall recommendation would benefit all listed stocks.

**Stock Benefits Report Card:**

| | | | Abundance | | | MAFAC Phase II Impact Priority | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sub-Region | Stock | Status | Current | MAFAC Medium goal | Current as % of Medium Goal | Tributary Habitat | Estuary Habitat | Hydro (Mainstem) | Hydro (Latent) | Hydro (Blocked) | Predation | Fishery | Hatchery | Harvest |
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| Low-C | L Col R Winter Steelhead | Threatened | 5,989 | 27,900 | 21% | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Low-C | L Col R Fall (tule) Chinook | Threatened | 12,329 | 54,100 | 23% | 1 | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 1 |
| Low-C | L Col R Coho | Threatened | 31,524 | 129,550 | 24% | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| Low-C | L Col R Summer Steelhead | Threatened | 10,594 | 29,800 | 36% | 2 | 4 | 4 | 4 | 2 | 4 | 4 | 4 | 4 |
| Low-C | Col R Chum | Threatened | 11,762 | 33,000 | 36% | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | |
| Low-C | SW WA Winter Steelhead | Threatened | 3,252 | 5,850 | 56% | 2 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Low-C | L Col R Late Fall (bright) Chinook | | 10,800 | 16,700 | 65% | | | | | | | | | |
| Low-C | L Col R Fall (bright) Chinook | Threatened | 11,000 | 11,000 | 100% | 5 | 5 | 5 | 5 | 4 | 5 | 4 | 5 | 4 |
| Mid-C | M Col Sockeye | Not Listed | 1,036 | 45,000 | 2% | 3 | 3 | 3 | 2 | 1 | 3 | 3 | | 3 |
| Mid-C | M Col R Spring Chinook | Not Listed | 11,600 | 40,425 | 29% | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
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| Mid-C | M Col R Summer/Fall Chinook | Not Listed | 11,500 | 13,000 | 88% | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 4 |
| Up-C | U Col R Coho | Not Listed | 392 | 15,000 | 3% | | | | | | | | | |
| Up-C | U Col R Summer Steelhead | Threatened | 1480 | 31,000 | 5% | 1 | 1 | 2 | 1 | 1 | 1 | 3 | 2 | 3 |
| Up-C | U Col R Sockeye | Not Listed | 40,850 | 580,000 | 7% | 1 | 3 | 1 | 1 | 1 | 2 | 3 | 3 | 3 |
| Up-C | U Col R Spring Chinook | Endangered | 1430 | 19,840 | 7% | 1 | 3 | 1 | 1 | 1 | 2 | 3 | 1 | 3 |
| Up-C | U Col R Summer Chinook | Not Listed | 16920 | 78,350 | 22% | 1 | 2 | 1 | 1 | 1 | 3 | 1 | 2 | 1 |
| Up-C | U Col R Fall Chinook | Not Listed | 92,400 | 62,215 | 149% | 5 | 5 | 4 | 5 | 5 | 5 | 4 | 5 | 4 |
| Snake | Snake R Coho | Not Listed | 100 | 26,600 | 0% | | | | | | | | | |
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| Willam | U Will R Spring Chinook | Threatened | 4,278 | 47,850 | 9% | 1 | 2 | 3 | 3 | 1 | 3 | 3 | 2 | 3 |
| Willam | U Will R Winter Steelhead | Threatened | 2,816 | 27,805 | 10% | 1 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |

*Draft for Internal Review – 11/15/23*

Stocks most benefited
Stocks receiving secondary benefit

Note that the stock benefits are project specific. The Snake River stocks would be most benefited by improvements at Lower Granite Dam and the Upper Columbia River Stocks would be most benefited by improvements at McNary Dam.

# Predation Work Group

## Recommendation: Manage Double-crested Cormorants (DCCO) in the Columbia River Estuary

### Problem Statement

The abundance of double-crested cormorants nesting upriver of East Sand Island in the Columbia River estuary has grown dramatically in recent years, causing concern for the recovery of imperiled salmonid runs. Most of this growth occurred during 2015–2020, coincident with implementation of a federal management plan for the nearby East Sand Island colony (ESI management plan), where 97% of double-crested cormorants within the estuary nested during 2004–2014 (pre-management period). During 2020 and 2021, however, the colony associated with the Astoria-Megler Bridge supported most breeding individuals in the estuary, although substantial numbers also occurred at a variety of other sites, mostly upriver of East Sand Island (Lawonn 2023a, 2023b). Although the intent of the ESI management plan was to reduce double-crested cormorant predation of juvenile salmon and steelhead (salmonids) listed under the federal Endangered Species Act (ESA), increases in predation associated with colonies besides East Sand Island have substantially offset the recent management-caused reduction in predation at the East Sand Island colony (Evans et al. 2022). This result is somewhat paradoxical because the abundance of double-crested cormorants in the Columbia River estuary has declined about 56% since implementation of the ESI management plan. However, per capita predation of salmonids is far higher at the upriver locations where most double-crested cormorants currently nest compared to East Sand Island. This is because salmonids make up a far larger share of the cormorant diet at upriver locations because there are fewer alternative sources of prey nearby compared with the marine zone of the estuary, where East Sand Island is located. As a result, predation by double-crested cormorants may now be equivalent to, or even substantially higher than, the pre-management period (Lawonn 2023a).

### Summary of Action:

A sustained management effort using primarily non-lethal techniques could be implemented to reduce double-crested cormorant abundance on the Astoria-Megler Bridge colony and other colonies that lie upriver of East Sand Island, while minimizing double-crested cormorant dispersal to undesired areas. Five main actions would be necessary for this effort to succeed. First, double-crested cormorants would need to be deterred from nesting on the Astoria-Megler Bridge and other colony sites of management importance. Deterrence methods could include deployment of passive exclusion such as netting, bird wires, or other physical deterrents, although the use of such exclusion techniques would be limited to those that do not adversely affect the structural integrity of the Astoria-Megler Bridge or other structures used by cormorants for nesting. Along with passive exclusion, workers operating from boats or on the colonies themselves would harass, or “haze”, cormorants prior to the breeding season, and continue harassment as needed through the duration of the breeding season. Harassment could involve use of water cannons, handheld lasers, pyrotechnics, predator effigies, or other techniques. Second, social attraction techniques would be used to attract cormorants displaced from the Astoria-Megler Bridge and other colonies back to East Sand Island. This action would be expected to increase the efficacy of deterrence activities and reduce the likelihood of cormorant dispersal to undesired locations. Management of bald eagle and gull disturbances could also be a component of social attraction on East Sand Island. Third, monitoring the status of double-crested cormorants would be necessary to evaluate

double-crested cormorant dispersal within the basin, as well as the effects of management on the regional population. In addition, annually monitoring predation rates at double-crested cormorant colony sites in the estuary would be necessary to ensure that management reduces predation impacts on salmonids. Fourth, adaptive management would likely be necessary to deter nesting at additional estuary colony sites because it is probable at least some individuals would disperse to undesired locations. Finally, to the extent possible, managers would evaluate whether double-crested cormorant management improved outcomes for salmonids. Such evaluation would ideally be based on changes to salmonid survival rates following management but could also be derived from a community-based modelling approach informed by research on food web dynamics in the estuary and plume. New research on food web dynamics would likely be needed for the latter modelling approach. This recommendation will require increases to funding and coordination between managing entities (outlined below).

### Existing or New Program:

This action would be part of a new program.

### Benefit Provided by Action:

If successful, the action would reduce double-crested cormorant predation on most or all ESA-listed salmonids in the basin, since all outmigrants must pass through the estuary to reach the ocean. Although monitoring does not currently occur at all double-crested cormorant colonies in the estuary, available data suggest estuary-wide predation rates on various ESA-listed runs are currently at least as high as associated with East Sand Island during the pre-management period (Evans et al. 2022), when estimates of average annual predation rates at the East Sand Island colony ranged from 1.8% to 27.5% for various ESA-listed runs (Lawes et al. 2021). Lawonn et al. (2023a, 2023b) suggest that current estuary-wide predation rates could be substantially higher than during the pre-management period, perhaps by about a factor of 1.7.

Management would ideally reduce estuary-wide predation to an equivalent of no more than 5,380–5,939 breeding pairs on East Sand Island, the level envisioned by the National Marine Fisheries Service in their 2008 Biological Opinion related to hydrosystem operation. This target reflects a 4.5- to 4.9-fold reduction in double-crested cormorant predation compared to estimated predation impacts in 2021 (Lawonn 2023b).

### Stocks Benefited by the Action:

Recent work suggests average annual double-crested cormorant predation rates associated with the East Sand Island colony prior to implementation of the ESI management plan (2004–2014) were about 7.4%, 7.6%, and 6.6% for Middle Columbia River, Snake River, and Upper Columbia steelhead surviving to Bonneville Dam, respectively (Roby et al. 2021). However, based on analyses in Lawonn (2023a), an estimated 17% of estuary-wide predation occurred at colonies besides East Sand Island during these years. For the purpose of this recommendation, we accounted for predation associated with these other colonies, and estimated that average annual estuary-wide predation rates during 2004–2014 were 8.9%, 9.2%, and 8.0% for Middle Columbia River, Snake River, and Upper Columbia steelhead, respectively. Reducing estuary-wide predation to the equivalent of 5,380–5,939 breeding pairs on East Sand Island would be estimated to reduce annual double-crested cormorant predation rates across the estuary to at

least 3.4%, 3.5%, and 3.0% for Middle Columbia River, Snake River, and Upper Columbia River steelhead, an estimated 62% reduction in predation compared to the pre-management period, and an estimated 78% reduction in predation compared to 2021.

Although not highlighted in the Columbia Basin Partnership Task Force's phase 2 report, available information suggests double-crested cormorant predation rates on juvenile Lower Columbia River Chinook and Lower Columbia River Coho are considerably higher compared to other ESA-listed runs in the basin, with predation rates averaging about 27% and 15% on these runs, respectively, for sampled years associated with the East Sand Island colony (Roby et al. 2021). Both of these ESA-listed runs may be expected to benefit substantially from double-crested cormorant management. Based on predation rates presented in Roby et al. (2021), management may also be likely to benefit Snake River Spring Chinook, Snake River Fall Chinook, Upper Columba River Spring Chinook, Upper Willamette River Spring Chinook, Snake River Sockeye, and Lower Columbia River Steelhead.

### Data Supporting Benefits:

A comprehensive analysis of estimated predation impacts following implementation of the ESI management plan is provided in Lawonn (2023a, 2023b). A recent analysis of predation rates for the double-crested cormorant colony on the Astoria-Megler Bridge is presented in Evans et al. (2022), and a synthesis of double-crested cormorant impacts on salmonids is presented in Roby et al. (2021).

### Implementing Entities:

It is unknown what entities would implement this action. Current and potential colony sites are administered by a variety of local, state, and federal entities, and some potential sites may be owned by private entities. A high degree of coordination across jurisdictions would be necessary for this action to be successful. Fish and wildlife management responsibilities are also shared by multiple agencies. Parties that may be involved include:

- Bonneville Power Administration – Operates and maintains transmission towers, including those located near the confluence of the Sandy River and the mainstem Columbia River, and The Dalles Dam. These are current double-crested cormorant colony sites.
- Columbia River basin tribes and Columbia River Inter-Tribal Fish Commission representatives.
- National Marine Fisheries Service – Federal agency responsible for management of anadromous salmonids under the Endangered Species Act and the Magnuson–Stevens Fishery Conservation and Management Act.
- Oregon Department of Fish and Wildlife – State agency responsible for managing fish and wildlife.
- Oregon Department of Transportation (ODOT) - Maintains the Astoria-Megler Bridge under an agreement with the State of Washington.
- U.S. Army Corps of Engineers (USACE) - Manages East Sand Island (a double-crested cormorant colony site) and implemented the management plan, Double-crested Cormorant Management to Reduce Predation of Juvenile Salmonids in the Columbia River Estuary (USACE 2015).

- U.S. Coast Guard (USCG) – Regulates/advises on activities or modifications that could affect navigation near the Astoria-Megler Bridge and manages aids to navigation (e.g. buoys and channel markers) that are used for nesting by double-crested cormorants.
- U.S. Fish and Wildlife Service – USFWS responsibilities include the conservation and management of double-crested cormorants, which are included on the list of protected migratory birds under the Migratory Bird Treaty Act.
- Washington Department of Transportation – Manages Longview Bridge under an agreement with the Oregon Department of Transportation. The Longview Bridge is a current double-crested cormorant colony site.
- Washington Department of Fish and Wildlife – State agency responsible for managing fish and wildlife.

### Time Needed to Implement:

Given the need for substantial funding and coordination across various governmental and tribal entities and compliance with federal and state environmental laws and regulations, it is likely that recommended actions would not begin until at least 2024 or 2025.

A redistribution of double-crested cormorants from the Astoria-Megler Bridge and other colony sites to East Sand Island will likely take at least four years. Thereafter, a reduced level of management will be necessary in perpetuity to maintain deterrence infrastructure and actively manage individuals attempting to nest at undesired locations. Monitoring will need to occur in perpetuity to guide adaptive management.

### Time Needed to Benefit Fish Populations:

Benefits for salmonid populations could be realized during the first return years associated with reduced double-crested cormorant predation on outmigrating juvenile salmonids.

### Estimated Cost:

The overall cost for this plan is estimated to be at least $9.5 M over four management years, with a recurring cost of up to or greater than $0.4 M annually thereafter. An estimated $2.6 M will be needed prior to and during the first year of implementation: $1 M dedicated for deterring double-crested cormorant use of the Astoria-Megler Bridge, $0.5 M for social attraction on East Sand Island, $0.3 M for a status assessment of the regional double-crested cormorant population (ideally conducted prior to plan implementation), $0.4 M for monitoring within the Columbia River basin, and $0.4 M for deterring use of other colony sites, as needed. Costs may decline in future years as double-crested cormorant fidelity to East Sand Island increases and as the efficacy of deterrence improves at the Astoria-Megler Bridge and other sites where displaced birds may attempt to relocate. Nevertheless, the estimated cost for the second through fourth year of implementation is $2.3 M annually. Because the Columbia River estuary is a highly attractive site for double-crested cormorants, monitoring and management will likely be required in perpetuity to prevent reuse of the bridge or other undesired sites for nesting. Therefore, an estimated $0.4 M will be required annually following the initial four-year management period to continue monitoring and deterrence efforts on the Astoria-Megler Bridge and other colony sites, as needed. If relocation of double-crested cormorants to East Sand Island is not successful, annual costs for

monitoring and deterring cormorant use of undesired sites in the estuary could be substantially greater than $0.4 M annually. Because of substantial uncertainty inherent in the estimates above, they should be considered minimum estimates.

### Uncertainties:

There are three main uncertainties related to management. First, it is unclear the extent to which predation by double-crested cormorants or other predators reduces life-cycle scale abundance of anadromous salmonids in the Columbia River basin (ISAB 2016). Losses to double-crested cormorants during the juvenile life stage might be ameliorated by improved survival later in life, especially if double-crested cormorants preferentially consume the least fit individuals (ISAB 2016).

Second, the role of predators in maintaining the structure of biological communities, even communities altered by humans, is often poorly understood (ISAB 2016). For example, depending on their colony sizes, double-crested cormorants can consume hundreds to even thousands of tons of forage fish in the Columbia River estuary annually, the vast majority of which are non-salmonids (Lawes et al 2021). Reductions in double-crested cormorant abundance could therefore substantially alter the local food web and predator community, which could result in counterintuitive and unintended consequences for juvenile salmonids, as suggested by a wide body of research related to predator-prey dynamics across a variety of taxa (Holt and Lawton 1994, Sih et al. 1998, Yodzis 2001, Bruno and O'Connor 2005, Harvey and Karieva 2005, Weise et al. 2008, Abrams 2009, Ellis-Felege et al. 2012).

Finally, the likelihood that management will substantially reduce estuary-wide double-crested cormorant predation is uncertain, at least at the estimated minimum cost of implementing this recommendation. The Independent Science Advisory Board (2016) suggests predator management is best suited to local scale and temporary conflicts (i.e. hotspots) rather than persistent conflicts that occur across a wide geographical area. This is because of the high cost and biological uncertainty related to predation management conducted at large scales. Nevertheless, this recommendation seeks to manage cormorant predation across a wide area because isolated colony-specific management would likely cause dispersal of displaced cormorants to new areas of the estuary unless prevented, which would move the predation issue rather than resolve it.

There are several examples of uncertainties related to such large-scale management:

1) Double-crested cormorants nested at 20 discrete sites in the Columbia River estuary in 2021. The cost of managing these sites could be substantially higher than estimated if the relatively less expensive passive dissuasion techniques recommended here are unsuccessful.
2) Bald eagle disturbance of the East Sand Island colony has been an important contributing factor to recent breeding failures there and may reduce the likelihood of future nesting at that location. If eagles or other factors prevent renesting at East Sand Island despite social attraction efforts, deterring use of other colony sites will be more difficult and costly because of the lack of a viable alternative breeding site for displaced individuals.
3) The focus on non-lethal management may not be as effective or cost-effective as desired, and lethal take may therefore need to be incorporated at a larger scale than anticipated.

Despite the uncertainties listed in this section, however, available information suggests substantial risk to salmonids from ESA-listed runs as a result of double-crested cormorant predation across the Columbia River estuary (Lawes et al. 2021, Roby et al. 2021, Evans et al 2022, Lawonn 2023a, 2023b). We therefore recommend carefully designed and implemented management with adequate effectiveness monitoring and adaptive management to address this risk. This recommendation is further supported by recent work by the Independent Science Advisory Board (ISAB 2021). They reviewed two studies that considered the effects of avian predation on interior Columbia Basin steelhead and concluded that the most prudent conclusion from a management perspective is that, despite the uncertainties, these predators have some level of effect on adult returns. Finally, the double-crested cormorant colony on the Astoria-Megler Bridge is causing substantial costs related to infrastructure maintenance and even human safety risks, which appear likely to be resolved with management at that site, despite uncertainties related to benefits for salmonids.

### Associated Regulatory Processes or Policies:

Agencies implementing the recommended actions would have to comply with relevant federal and state environmental laws and regulations, such as the National Environmental Policy Act (NEPA), ESA, MBTA, and the Bald and Golden Eagle Protection Act. If double-crested cormorants can be managed using non-lethal techniques, environmental reviews are expected to be less complex than if lethal techniques are used.

### Potential Challenges:

The high abundance of prey (juvenile salmonids, marine forage fish, and other species) in the Columbia River estuary is a major draw for double-crested cormorants and will likely continue to make the estuary an attractive nesting location. There are 11 historical nesting colonies or colony complexes in the estuary, and individuals would likely disperse among these sites if management is not appropriately coordinated. In addition, unused potential nesting habitat is present within the estuary at a variety of locations, suggesting management-related dispersal could be a persistent problem. Finally, potential colony sites are administered by a variety of local, state, federal, and private entities; coordination across jurisdictions would be necessary for this recommendation to be successful. Furthermore, given the multiple jurisdictions and agencies involved, it is currently unclear which parties would be responsible for implementation, monitoring, and adaptive management.

### Adaptive Management:

We envision several reasons for adaptive management:

1) Double-crested cormorant distribution and abundance in the estuary are not responding as anticipated.
2) Estuary-wide predation rates are not responding as anticipated.
3) Ideally changes to measures of survival across the life cycle would be used to assess project success and whether a change in management actions would be necessary. However, given the degree of variability in annual marine survival, human activities, and environmental conditions, these changes would be extremely difficult, perhaps impossible, to assess empirically.

A detailed adaptive management plan that outlines roles and responsibilities of the implementing parties would need to be developed. Examples of adaptive responses include adjusting management effort at the Astoria-Megler Bridge and upriver sites in response to cormorant use, and potential management of colony disturbances at East Sand Island.

### Best Management Practices (BMPs)

The working group recommends development of a formal set of best practices and guiding principles for predator management that can be used to guide future work. The following are examples of potential BMPs:

- Managers should identify clear objectives and develop evaluation criteria for avian management to measure progress toward meeting these objectives.
- Predation should be managed at the appropriate spatial scale.
- Managers should plan, coordinate, and budget for adaptive management.
- Managers should conduct effectiveness monitoring that directly measures results against management objectives.
- Potential non-lethal management options should be evaluated before implementing lethal methods, as appropriate.

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**Stock Benefits Report Card:**

Predation: Recommendation for management of double-crested cormorants in the Columbia River Estuary

| | | | Abundance | | | MAFAC Phase II Impact Priority | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sub-Region | Stock | Status | Current | MAFAC Medium goal | Current as % of Medium Goal | Tributary Habitat | Estuary Habitat | Hydro (Mainstem) | Hydro (Latent) | Hydro (Blocked) | Predation | Fishery | Hatchery | Harvest |
| Low-C | L Col R Spring Chinook | Threatened | 2,240 | 21,550 | 10% | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 3 |
| Low-C | L Col R Winter Steelhead | Threatened | 5,989 | 27,900 | 21% | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Low-C | L Col R Fall (tule) Chinook | Threatened | 12,329 | 54,100 | 23% | 1 | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 1 |
| Low-C | L Col R Coho | Threatened | 31,524 | 129,550 | 24% | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| Low-C | L Col R Summer Steelhead | Threatened | 10,594 | 29,800 | 36% | 2 | 4 | 4 | 4 | 2 | 4 | 4 | 4 | 4 |
| Low-C | Col R Chum | Threatened | 11,762 | 33,000 | 36% | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | |
| Low-C | SW WA Winter Steelhead | Threatened | 3,252 | 5,850 | 56% | 2 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Low-C | L Col R Late Fall (bright) Chinook | | 10,800 | 16,700 | 65% | | | | | | | | | |
| Low-C | L Col R Fall (bright) Chinook | Threatened | 11,000 | 11,000 | 100% | 5 | 5 | 5 | 5 | 4 | 5 | 4 | 5 | 4 |
| Mid-C | M Col Sockeye | Not Listed | 1,036 | 45,000 | 2% | 3 | 3 | 3 | 2 | 1 | 3 | 3 | | 3 |
| Mid-C | M Col R Spring Chinook | Not Listed | 11,600 | 40,425 | 29% | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Mid-C | M Col R Summer Steelhead | Threatened | 18,155 | 43,850 | 41% | 2 | 4 | 4 | 4 | 4 | 2 | 4 | 4 | 4 |
| Mid-C | M Col R Coho | Not Listed | 6,324 | 11,600 | 55% | | 5 | 4 | 5 | 5 | 5 | 4 | | 4 |
| Mid-C | M Col R Summer/Fall Chinook | Not Listed | 11,500 | 13,000 | 88% | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 4 |
| Up-C | U Col R Coho | Not Listed | 392 | 15,000 | 3% | | | | | | | | | |
| Up-C | U Col R Summer Steelhead | Threatened | 1480 | 31,000 | 5% | 1 | 1 | 2 | 1 | 1 | 1 | 3 | 2 | 3 |
| Up-C | U Col R Sockeye | Not Listed | 40,850 | 580,000 | 7% | 1 | 3 | 1 | 1 | 1 | 2 | 3 | 3 | 3 |
| Up-C | U Col R Spring Chinook | Endangered | 1430 | 19,840 | 7% | 1 | 3 | 1 | 1 | 1 | 2 | 3 | 1 | 3 |
| Up-C | U Col R Summer Chinook | Not Listed | 16920 | 78,350 | 22% | 1 | 2 | 1 | 1 | 1 | 3 | 1 | 2 | 1 |
| Up-C | U Col R Fall Chinook | Not Listed | 92,400 | 62,215 | 149% | 5 | 5 | 4 | 5 | 5 | 5 | 4 | 5 | 4 |
| Snake | Snake R Coho | Not Listed | 100 | 26,600 | 0% | | | | | | | | | |
| Snake | Snake R Sockeye | Endangered | 100 | 15,750 | 1% | 3 | 3 | 1 | 1 | 1 | 2 | 3 | | 3 |
| Snake | Snake R Spring/Summer Chinook | Threatened | 6,988 | 98,750 | 7% | 1 | 3 | 1 | 1 | 2 | 2 | 3 | 3 | 3 |
| Snake | Snake R Summer Steelhead | Threatened | 28,000 | 75,000 | 37% | 2 | 4 | 4 | 2 | 2 | 2 | 4 | 4 | 4 |
| Snake | Snake R Fall Chinook | Threatened | 8,360 | 10,780 | 78% | 5 | 5 | 4 | 4 | 4 | 5 | 4 | | 3 |
| Willam | U Will R Spring Chinook | Threatened | 4,278 | 47,850 | 9% | 1 | 2 | 3 | 3 | 1 | 3 | 3 | 2 | 3 |
| Willam | U Will R Winter Steelhead | Threatened | 2,816 | 27,805 | 10% | 1 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |

*Draft for Internal Review – 3/14/23*

Stocks most benefited
Stocks receiving secondary benefit

## Recommendation: Enhance and Modify the Marine Mammal Protection Act Section 120 Pinniped Removal Program

### Problem Statement:

The following recommendation addresses pinniped predation on adult returning salmon and steelhead.

Steller sea lions (SSL) and California sea lions (CSL) residing at Bonneville Dam and Willamette Falls can consume between 2 and 6 adult salmon per day depending on salmon aggregation densities at the ladders, which means approximately 2,000 adult migrating chinook salmon consumed for every 10 sea lions present at each project (assuming 4 salmon per sea lion per day for a 50-day period). This translates to 2% mortality on spring run chinook salmon (assuming a run size of 100,000) for every 10 sea lions present. Mortality estimates vary depending on run size, sea lion abundances, and sea lion residency times. Direct observations at Bonneville Dam have been documented since 2002, accounting for animals in the immediate vicinity of Bonneville Dam. Salmonid mortalities have ranged across the stocks from 2-6% at Bonneville in that period within the area observable at Bonneville dam, but the total impact is greater because predation is not limited to the observed area. Sea lion predation studies documented losses of Spring chinook salmon between 22% and 50% of the run in the Astoria to Bonneville reach.

The Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), Idaho Department of Fish and Game (IDFG), and the Columbia River Inter-Tribal Fish Commission (CRITFC) jointly manage and implement lethal removal of SSLs and CSLs under the Marine Mammal Protection Act Section 120 Pinniped Removal Program. Section 120(f) of the program authorizes removal of sea lions from river mile 112 to river mile 292 of the Columbia River, and its tributaries to the mouth. Sea lion removals under the program have resulted in approximately 30-60% reductions of the animals present. The 120(f) permit is authorized through August 2025 and funded through June 2024. The current program has reduced pinniped predation mortality on salmon and steelhead. Stable long-term funding is essential to maintain the reduction in predation. Additional improvements and innovations may increase the effectiveness of the program.

### Summary of Action:

Recommended enhancements and modifications to the existing Marine Mammal Protection Act Section 120 Pinniped Removal Program would include:

a. Maximize the use of existing authority.
b. Extend authorization and fully fund the *status-quo* 120(f) permit scope with inflationary costs through 2035 to provide stability to the program's effectiveness.
c. Additionally provide one-time funding for new sea lion removal equipment and to replace outdated equipment.
d. Provide additional funding to increase the capacity to remove sea lions and process animals, including a program to maintain an on-call veterinarian roster for euthanasia processing, and a program to train more state and/or tribal biologists and technicians for seasonal work.
e. Additionally extend and fully fund pinniped abundance estimation and kill rate monitoring programs, e.g., USACE Bonneville monitoring.
f. Additionally pursue research and development into lethal tributary removals and the use of lethal darts.

g. Develop a comprehensive monitoring program to gauge effectiveness.

### Existing or New Program:

Existing program.

### Benefit Provided by Action:

A removal of 10 sea lions per year can translate to between 1,200 and 5,100 additional adult salmon passing Bonneville Dam and Willamette Falls (based on a 60 to 90 consumption window and a range of 2 to 6 salmon per day).

### Stocks Benefited by the Action:

Spring chinook and winter steelhead migrating past Willamette Falls and Bonneville Dam will benefit from the removal of CSLs and SSLs.

### Data Supporting Benefits:

COE observed CSL abundance and salmon kills at Bonneville dam. See Van der Leeuw B.K. and K.S. Tidwell. 2022. Evaluation of Pinniped Predation on Adult Salmonids and Other Fish In The Bonneville Dam Tailrace, 2021. U.S. Army Corps of Engineers, Portland District, Fisheries Field Unit. Cascade Locks, OR. 42 pp.

### Implementing Entities:

ODFW, WDFW, IDFG, Tribes.

### Time Needed to Implement:

The *status-quo* 120(f) component is already implemented. Additional research and innovation actions can be implemented before the expiry of the 2025 120(f) permit and continue upon extension.

### Time Needed to Benefit Fish Populations:

The 120(f) status-quo is on-going, and immediately benefits each run of adult chinook and steelhead upon removal of CSLs and SSLs. Additional trapping and darting capacity and innovation will benefit salmon and steelhead runs immediately upon implementation.

### Estimated Cost:

$3.25M total operational budget per year, plus a $800K one-time equipment cost. The status-quo removal budget for the 120(f) program is approximately $2M per year for ODFW, WDFW, IDFG, and CRITFC operational costs. It is recommended that this budget be extended through 2035. Additional annual budgets are:

1. Research and development to increase capacity to remove and process animals - $250K
2. Effectiveness monitoring of pinniped abundance and kill rates (USACE) - $500K
3. Adaptive management research and analysis - $250K
4. Research and development in the use of darts and lethal removal from tributaries - $250K

### Uncertainties:

Biological uncertainties exist regarding sea lion abundance trends and upstream migration rates, as well as the resulting predation mortality rates. Uncertainties also exist in capture and removal effectiveness rates.

### Associated Regulatory Processes or Policies:

Marine Mammal Protection Act section 120(f).

### Potential Challenges:

Trapping and euthanizing animals has many logistical problems and sea lions periodically change their haul out behavior which necessitates changes in trapping methods. Darting and retrieving animals may provide new challenges for managers to consider. Legal authorization only allows remove with trap or dart capture followed by chemical euthanasia.

### Adaptive Management:

Continued monitoring and/or abundance estimation of predator and prey abundances, and of prey kills will provide evidence of the effectiveness of the program.

**Stock Benefits Report Card:**

Predation: Recommendation to enhance and modify the Marine Mammal Protection Act Section 120 Pinniped Removal Program

| | | | Abundance | | | MAFAC Phase II Impact Priority | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sub-Region | Stock | Status | Current | MAFAC Medium goal | Current as % of Medium Goal | Tributary Habitat | Estuary Habitat | Hydro (Mainstem) | Hydro (Latent) | Hydro (Blocked) | Predation | Fishery | Hatchery | Harvest |
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| Low-C | L Col R Coho | Threatened | 31,524 | 129,550 | 24% | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| Low-C | L Col R Summer Steelhead | Threatened | 10,594 | 29,800 | 36% | 2 | 4 | 4 | 4 | 2 | 4 | 4 | 4 | 4 |
| Low-C | Col R Chum | Threatened | 11,762 | 33,000 | 36% | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | |
| Low-C | SW WA Winter Steelhead | Threatened | 3,252 | 5,850 | 56% | 2 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Low-C | L Col R Late Fall (bright) Chinook | | 10,800 | 16,700 | 65% | | | | | | | | | |
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| Up-C | U Col R Summer Steelhead | Threatened | 1480 | 31,000 | 5% | 1 | 1 | 2 | 1 | 1 | 1 | 3 | 2 | 3 |
| Up-C | U Col R Sockeye | Not Listed | 40,850 | 580,000 | 7% | 1 | 3 | 1 | 1 | 1 | 2 | 3 | 3 | 3 |
| Up-C | U Col R Spring Chinook | Endangered | 1430 | 19,840 | 7% | 1 | 3 | 1 | 1 | 1 | 2 | 3 | 1 | 3 |
| Up-C | U Col R Summer Chinook | Not Listed | 16920 | 78,350 | 22% | 1 | 2 | 1 | 1 | 1 | 3 | 1 | 2 | 1 |
| Up-C | U Col R Fall Chinook | Not Listed | 92,400 | 62,215 | 149% | 5 | 5 | 4 | 5 | 5 | 5 | 4 | 5 | 4 |
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| Snake | Snake R Sockeye | Endangered | 100 | 15,750 | 1% | 3 | 3 | 1 | 1 | 1 | 2 | 3 | | 3 |
| Snake | Snake R Spring/Summer Chinook | Threatened | 6,988 | 98,750 | 7% | 1 | 3 | 1 | 1 | 2 | 2 | 3 | 3 | 3 |
| Snake | Snake R Summer Steelhead | Threatened | 28,000 | 75,000 | 37% | 2 | 4 | 4 | 2 | 2 | 2 | 4 | 4 | 4 |
| Snake | Snake R Fall Chinook | Threatened | 8,360 | 10,780 | 78% | 5 | 5 | 4 | 4 | 4 | 5 | 4 | | 3 |
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| Willam | U Will R Winter Steelhead | Threatened | 2,816 | 27,805 | 10% | 1 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |

*Draft for Internal Review – 3/14/23*

Stocks most benefited
Stocks receiving secondary benefit

## Recommendation: Develop and initiate testing of a comprehensive piscine predator monitoring and evaluation program (PPMEP) for the Columbia River Basin

### Problem Statement:

Currently, there is no coordinated, large-scale program to investigate and quantify the overall predatory impact of piscine predators (e.g., Northern Pikeminnow, Smallmouth Bass, Walleye) to juvenile salmonid stocks, in the lower and mid-Columbia River Basin. Without more complete estimates of piscine predation rates to salmonid stocks and data to track potential predator compensatory responses, it is difficult to recommend meaningful predator management actions and virtually impossible to measure the effect of any implemented management actions. Furthermore, sustained piscine predation information is needed to track long-term changes to the ecological system and to better inform management decisions involving natural and anthropogenic processes (e.g., climate change). This action item recommends the Region support the process needed to design an improved PPMEP that can be used to provide actionable information for future piscine predation management. The scope of this action item and associated budget are limited to the PPMEP project design process and does not include any PPMEP implementation. It is intended that this action item be the first in a series of action items eventually culminating in a functional PPMEP used to guide management decisions to improve the status of salmonid stocks.

Numerous studies have already been implemented to estimate piscine predation to juvenile salmonids (e.g., Beamesderfer et al. 1996, Tiffan et al. 2020, Northern Pikeminnow Management Program 2021, WDFW in prep.) and while they have improved our understanding of the predator/prey dynamics in the lower and mid-Columbia River Basin, the findings are difficult to compare to each other as the methods employed were often different. Furthermore, none of the previous studies have received the support needed to be expanded into a lower and mid-Columbia Basin PPMEP. Previous studies have estimated the effects of piscine predation to salmonids but there remain several key data gaps:

- Unbiased estimates of predator abundance
- Identification of salmonid prey including stock and hatchery- versus natural-origin
- Spatial and temporal trends of salmonid predation
- A general lack of understanding about the seasonal and interannual variability in native and non-native predator/prey population dynamics

In order to implement and measure the impact of future piscine predator management actions, a scientifically robust and spatiotemporally broad monitoring program is needed in the lower and mid-Columbia River Basin that would address these data gaps. The PPMEP stemming from this action item would be spatially modular incorporating slight study modifications due to the physical and biological differences in the various sub-areas of the lower and mid-Columbia River Basin. However, the focus would be to collect biological metrics that would be comparable over space and time, relative to the predator and prey species present in each sub-area. This action item is designed to leverage the numerous pre-existing study designs with the technical knowledge of staff at various agencies, tribes, and NGO's to design an improved PPMEP with monitoring and analytical tools to address the listed data gaps. This action item establishes the framework for that design process (action item 'a' in Section 3) and recommends pilot projects needed to inform the design of a lower and mid-Columbia River Basin PPMEP (action sub-items '1 – 4' in Section 3).

The product from this action item would be a study design to provide a lower and mid-Columbia River Basin data stream that address critical questions regarding the effects of piscine predation on the viability (e.g., life stage specific survival rates) of salmonid stocks. The design process for this action item is structured to incorporate the collaborative approach of the CBC by including technical expertise from an array of state, federal, tribal, NGO, and academic entities. This approach will culminate in a study design for monitoring and evaluation of piscine predation that will be relevant to the unique conditions of the lower and mid-Columbia River Basin.

### Summary of Action:

The following components action items are required to inform the design of a lower and mid-Columbia River Basin PPMEP:

1. Design a modular PPMEP study to generate unbiased estimates of predator abundance and the consumption rates of juvenile salmonids. These metrics can be used to inform adaptive management of the lower and mid-Columbia River Basin (**PPMEP Study Design**). The design of this study will be coordinated closely with managers to ensure that the data being collected will be directly applicable to management decisions and actions for both new and existing programs.
    1.1. Assess the effectiveness and bias of sampling gear types for selected piscine predators (**Gear Effectiveness**).
    1.2. Develop GIS layers classifying river habitat (e.g., bank, near shore, off-shore) at the required spatial scales to inform predator abundance models (**GIS Habitat**).
    1.3. Evaluate methods to improve prey information from predator digestive tract contents beyond species (e.g., stock, origin, ESU or population) (**Diet Analyses**).
    1.4. Assess information about new or expanding non-native piscine predator species Adaptively manage the PPMEP study design to incorporate information to achieve unbiased predator abundance estimates (**Additional Non-native Predators**)
    1.5. Work with relevant agencies to include monitoring and enforcement of regulations.
    1.6. Consider expanding the PPMEP study design to other areas of the basin.

### Existing or New Program:

The **PPMEP Study Design** action item will incorporate technical staff identified by the Columbia Basin Collaborative Piscine Predation Work Group who will utilize pre-existing studies to design a PPMEP for the lower and mid-Columbia River Basin, including field and analytical components (e.g., Beamesderfer et al. 1996, Friesen and Ward 1999, Counihan 2011, Tiffan et al. 2020, Murdoch pers. comm.). The four action sub-items (**Gear Effectiveness, GIS Habitat, Diet Analyses, Additional Non-native Predators**) could be integrated into existing programs or study designs (e.g., Northern Pikeminnow Management Program, WDFW GRTS study). There are a number of state, federal, regional, tribal, and academic groups that are currently conducting work related to these action items. These existing efforts could collaborate and partner with the proposed action sub-items for effective and efficient PPMEP implementation, in a future action item.

### Benefit Provided by Action:

**PPMEP Study Design:**

Designing a scientifically robust, lower and mid-Columbia River Basin PPMEP is the missing tool to effectively assess the benefit of future management actions and prioritize impacts among all sources of piscine predation mortality. Developing a modular study design to generate unbiased piscine predator abundance estimates and analytical tools to compare estimates across space and time will reduce the inherent uncertainty in the responses of predator populations to management actions and climate change. Without a PPMEP, there will be significant data gaps and uncertainty related to any future management action, further complicating the utility of actionable information to resource managers. The occurrence of piscine predation on juvenile salmonids is certain, but inaccurate estimates of predation lead to questions about the efficacy or necessity of piscine predation control measures among resource managers and stakeholders. Long-term monitoring studies conducted under the recommended adaptive management framework should provide actionable management information while maintaining the flexibility to incorporate additional monitoring approaches to account for the expected (but unknown) dynamics of the Columbia River Basin.

**Gear Effectiveness, GIS Habitat, Diet Analyses, Additional Non-native Predators:**

The four additional action sub-items could be addressed concurrently with and to help inform the PPMEP design process. These action sub items are Gear Effectiveness, GIS Habitat, Diet Analyses, and Additional Non-native Predators. Addressing each of these four areas would provide critical information needed to ensure the PPMEP is utilizing effective and efficient sampling gear, has appropriate habitat data to inform statistical models, provides taxonomically resolved predator diet composition data, and can integrate sampling for additional non-native piscine predators.

### Stocks Benefited by the Action:

Presumably, the survival of individuals from all stocks is negatively impacted by piscine predation (i.e., another data gap). However, because information about piscine predator impacts to out-migrating juvenile salmonids are data limited, the size at migration may serve as a relative measure. Hence, subyearling Chinook may benefit the greatest and steelhead the least, while Spring Chinook, Coho and Sockeye are intermediate.

### Data Supporting Benefits:

Studies assessing piscine predator/prey dynamics have been conducted in the Columbia River Basin for over 40 years. Below is a list of relevant studies that will be used to help inform a lower and mid-Columbia River Basin PPMEP though this list is not exhaustive:

Beamesderfer, R.C., Ward, D.L. and Nigro, A.A., 1996. Evaluation of the biological basis for a predator control program on northern squawfish (Ptychocheilus oregonensis) in the Columbia and Snake rivers. Canadian Journal of Fisheries and aquatic sciences, 53(12), pp.2898-2908.

Counihan, T.D., Hardiman, J.M., Burgess, D.S. and Simmons, K.E., Assessing Native and Introduced Fish Predation on Migrating Juvenile Salmon in Priest Rapids and Wanapum Reservoirs, Columbia River, Washington, 2009–11.

Friesen, T.A. and Ward, D.L., 1999. Management of northern pikeminnow and implications for juvenile salmonid survival in the lower Columbia and Snake rivers. North American Journal of Fisheries Management, 19(2), pp.406-420.

McLellan, H. J., S. Wolvert, A. O. Silver, K. T. Thurman, C.D. Lee, and T. Parsons. 2019. Lake Roosevelt Northern Pike Suppression and Monitoring, 2018 Annual Report. Bonneville Power Administration Project # 1994-043-00 and 2017-004-00.

NPMP 2022

Poe, T.P. and Rieman, B.E. eds., 1988. Predation by resident fish on juvenile salmonids in John Day reservoir, 1983-1986. US Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife.

Tiffan, K.F., Erhardt, J.M., Hemingway, R.J., Bickford, B.K. and Rhodes, T.N., 2020. Impact of smallmouth bass predation on subyearling fall Chinook salmon over a broad river continuum. Environmental biology of fishes, 103, pp.1231-1246.

Waltz, G. T., K. J. Rybacki, C. M. Barr, A. L. Carpenter, K. R. Anderson, E. B. Lamb, and P. E. Chambliss. 2022. Report C–System-wide predator control program: fisheries and biological evaluation. Oregon Department of Fish and Wildlife, Project Number 1990-077-00. 2021 Annual Report to the Bonneville Power Administration, Portland, Oregon.

Willis, C.F., Ward, D.L. and Nigro, A.A., 1993. Development of a Systemwide Program: Stepwise Implementation of a Predation Index, Predator Control Fisheries, and Evaluation Plan in the Columbia River Basin. 1992 Annual Report. BPA Project, (90-077).

### Implementing Entities:

Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), the Yakima Nation (YN), and the Confederated Tribes of the Colville Reservation (CTCR). Other fisheries resource agencies may also choose to participate.

### Time Needed to Implement:

PPMEP design efforts could be initiated within a couple of months after funding. CBC Piscine Predation Work Group members have the professional contacts needed to staff a PPMEP design panel as well as the technical capacity to lead the design of a lower and mid-Columbia River Basin PPMEP (resumes available on request). Action sub-items 1.1 – 1.4, could be integrated with ongoing projects affiliated with ODFW (NPMP), WDFW, YN, and CTCR. While much work is conducted during the juvenile salmonid outmigration (April – July), other components could be implemented at any time of the year (e.g., Gear Effectiveness).

PPMEP could be designed in 1-2 years. Some of the action sub-items would be conducted concurrently with the PPMEP design process because the PPMEP design process can be initiated while the sub-action items are being completed. These sub-action items would also take 1-2 years to complete.

### Time Needed to Benefit Fish Populations:

Unlike other sources of predation (avian and pinniped), piscine predation has not been adequately quantified. Relative to other sources of predation, the magnitude of predation by species is unknown. This critical data gap precludes prioritization of management actions due to uncertainty in the effectiveness of any action.

### Estimated Cost:

Existing programs could serve as a cost share (e.g., WDFW ~ $282k; NPMP ~$4.2M), but funding to design a PPMEP, including all sub-action items, is likely to require an additional $500,000-$1,100,000 which does not include implementing PPMEP in the lower and mid-Columbia River Basin.

### Uncertainties:

Many of the uncertainties as related to the PPMEP can be addressed through adaptive management of the monitoring program that results from the design process. Given the lack of previous work in the Columbia River Basin for many of the components, the precision of estimates is unknown at this time. As the PPMEP is fully implemented and our understanding of the predator-prey interactions increases, the type and effectiveness of management actions is also uncertain. Compensatory response to Northern Pikeminnow (NPM) reductions may have been occurring over the last 30 years. The responses of Northern Pikeminnow or other piscine predators to further management actions will require better information than we have gathered to date.

### Associated Regulatory Processes or Policies:

Permits to collect NPM, Smallmouth Bass, Walleye, and potentially incidental take of other species (e.g., salmonids) including ESA coverage for all salmonid populations.

### Potential Challenges:

Engagement with the recreational angler and guide community will be important and challenging. Providing unbiased scientific information as related to the predator risk will be critical for resource managers to take any recommended control measures.

Effective PPMEP study design will need to be scalable, potentially incorporating pilot studies in sub-areas of the lower and mid-Columbia River Basin, as well as modular such that the core study design is relevant across this large spatial scale. There will likely be many challenges to develop a relevant and effective PPMEP study design for all sub-areas of the lower and mid-Columbia River Basin. Some of these challenges are expected from previous research while there are potentially numerous others that will be identified through the design process. However, the modular and scalable nature of the PPMEP will be a strength as it progresses from the design to testing and eventually implementation phases (which would be conducted in subsequent action items) as the inherent challenges can be addressed at each stage of the process.

### Adaptive Management:

Initially, adaptive management will occur as data gaps are filled. As additional information is collected on piscine predation, monitoring (spatial or temporal) and analyses to evaluate the performance of management actions can be adjusted. The response of predator populations to future management

actions and climate change is also of great importance. Reducing overall mortality related to the community of piscine predators, not simply a single species, is the primary objective. Hence, the PPMEP can respond with management actions consistent with responses observed by predator populations.

**Stock Benefits Report Card:**

Benefit depends on the geographic range that is chosen for implementation.

## Recommendation: Develop and fund a robust Columbia River Northern Pike and invasive nonnative fishes monitoring project

### Problem Statement

Invasive non-native fishes compromise salmonid species in the Columbia River watershed through predation, competition for food, interbreeding, disease transmission, food web disruption, and physical habitat alteration. These fish pose direct threats to salmonid restoration efforts and compromise millions of public dollars spent to protect and conserve salmonids in the Columbia River watershed. Specifically, Northern Pike *Esox lucius* (Pike) have become established in the blocked area of the Columbia River. Pike have been documented to have profound predatory impacts on native fish species assemblages when they became established in waters within the Columbia Basin. The WDFW and Tribal comanagers have taken extreme measures to suppress these expanding populations with the goal of preventing or at least slowing the progression of these fish into the anadromous portion of the Columbia Basin. The establishment of Pike within the anadromous portion of the basin would be detrimental to the recovery of ESA listed salmon and steelhead stocks, affect salmon and steelhead-based economies and would continue to degrade fishery resources that are culturally significant to Native American Tribes connected to the Columbia Basin and Washington coastal fisheries.

Other non-native invasive fish such as Fathead Minnow *Pimephales promelas*, Brook Stickleback *Culaea insonstans*, Black bullheads *Ameiurus melas*, Yellow Bullheads *A. natalis*, Brown Bullheads *A. nebulosus*, Tadpole Madtom *Noturus gyrinus*, Common Carp *Cyprinus carpio*, Tench *Tinca tinca*, Western Mosquitofish *Gambusia affinis* and American Shad *Alosa sapidissima* are present in Washington State, primarily in the lower sections of the Columbia and Snake rivers. Their predatory impacts to native salmonids are unknown. Their populations will likely spread into new waterbodies as no suppression or monitoring is currently occurring on these species.

Predatory impacts to salmonids in the Columbia River watershed by non-native game fish such as Yellow Perch *Perca flavescens*, Pumpkinseed *Lepomis gibbosus*, Bluegill *Lepomis macrochirus*, Largemouth Bass *Micropterus salmoides*, White Crappie *Pomoxis annularis*, Black Crappie *Pomoxis nigromacultus*, Brook Trout *Salvelinus fontinalis*, Lake Whitefish *Coregonus clupeaformis*, Brown Trout *Salmo trutta* and, Channel Catfish *Ictalurus punctatus* likely occur at varying levels throughout the watershed; however, no specific monitoring programs exist that include these species.

### Summary of Action:

Develop and fund a robust Columbia River Northern Pike and invasive non-native fishes monitoring project that leverages current suppression, monitoring, and research activities with new projects to fill data gaps:

1. Determine which water bodies are contributing to the increased abundance of Northern Pike or other invasive non-native fishes in the Columbia Basin.
2. Implement wide scale eDNA monitoring in key lakes, reservoirs, tributaries, tributary mouths and the mainstem Columbia River for the presence of Northern Pike and other key invasive non-native fishes.
3. Explore and implement actions to reduce or stop Northern Pike or other invasive non-native fishes from immigrating into anadromous waterbodies.

a. Suppression actions include physical removal, weirs, fences, grates or electric fences.

b. Design and implement watershed wide eradication efforts if applicable.

c. Adjust fishing regulations to allow the public to assist with harvesting fish at key locations to reduce the abundance of Northern Pike or other invasive non-native fishes in the Columbia Basin.

d. Engage in public outreach to inform the public of the problem, the planned solutions with a link to how it will help their local communities.

    i. Removal actions will increase salmon fishing opportunities which have positive economic impacts to local communities.

    ii. Removal actions will increase salmon abundance in the watershed which have positive impacts to the environment through marine derived nutrients.

    iii. Removal actions will support an increase in salmon abundance which could assist with Orca Recovery.

    iv. Removal actions will also assist with restoring culturally significant resident fish, salmon and steelhead fisheries within the entire Columbia Basin.

4. Develop Northern Pike Rapid Response plans for each "section" of the Columbia River.

    a. The WDFW is currently developing a Statewide Northern Pike Rapid Response Plan that will be finalized by the fall of 2023. This is a high-level plan with the goal of developing watershed specific plans.

    b. Plans have been developed for all of the mainstem reservoirs upstream of Priest Rapids Dam (Four Peaks Environmental 2022; McLellan et al. 2018).

    c. Funds should be made available to the WDFW (or other designated agency) to develop Northern Pike Rapid Response Plans for the Columbia Basin Irrigation District and each mainstem Columbia River Project area below Priest Rapids Dam.

    d. Monitoring and enforcement will be needed for the Northern Pike Rapid Response Plans.

5. Continue to fund Northern Pike Suppression projects in the upper Columbia River watershed beyond 2025 (the current end of most funding plans).

### Existing or New Program:

New Programs. However, each area may have resources that can be leveraged to achieve the monitoring and suppression actions.

### Benefit Provided by Action:

Basin wide reduction of Northern Pike and invasive non-native fishes will increase overall salmonid abundance.

### Stocks Benefited by the Action:

Native resident fish communities and anadromous stocks (specifically Upper Columbia River (UCR) spring and summer/fall Chinook and UCR steelhead, Sockeye and Coho) will benefit from the removal of non-native predators by reducing predation, competition for food, interbreeding, disease transmission, food web disruption, and physical habitat alterations.

The specific magnitude of the benefit is unknown at this time as regional studies need to be conducted to determine which non-native species are causing harm and to what extent.

### Data Supporting Benefits:

WDFW has data on a few irrigation drains in mid-Columbia River that currently support the movement of non-native invasive and non-native game fish into the Columbia River. However, more data on locations and species of concern is required before actions can be implemented.

### Implementing Entities:

Federal, state, tribal, local utilities and other resource stewards.

### Time Needed to Implement:

Pike and invasive non-native fish suppression and monitoring should occur throughout the year.

1. Determine fish communities and waterbodies of concern – ongoing as Northern Pike or other invasive non-native fishes increase in abundance or colonize portions of the basin - 1-10 years
2. Implement Northern Pike eDNA – year 1
3. Explore and implement actions to reduce abundance and distribution of Northern Pike or other invasive non-native fishes – Years 2-10 (and beyond)
4. Adjust fishing regulations – years 2-10 and beyond
5. Engage in public outreach – years 1-10
6. Develop Northern Pike Rapid Response Plans – 1-5 years
7. Support ongoing Northern Pike Suppression actions in the upper Columbia River – 1-10 years.

### Time Needed to Benefit Fish Populations:

Fish populations will immediately begin to benefit from actions that reduce the abundance and distribution of Northern Pike and/or invasive non-native fishes.

### Estimated Cost:

1. Determine fish communities and waterbodies of concern - $500,000
2. Implement Northern Pike eDNA - $100,000 per year for 10 years.
3. Explore and implement actions to reduce non-native fish - $500,000- $1 million per project per year.
4. Adjust fishing regulations – minimal cost covered by state management agencies.
5. Engage in public outreach - $100,000 per year
6. Develop Northern Pike Rapid Response Plans - $50,000 per plan
7. Support ongoing Northern Pike Suppression actions in the upper Columbia River - $250,000 per agency per year to supplement funding received from other sources.

### Uncertainties:

Active suppression will affect non-target fish populations. The impacts are unknown but can be monitored and mitigated (adaptive management) for each specific location and action taken.

Important to engage the public to avoid the spread of misinformation.

### Associated Regulatory Processes or Policies:

State fishery management agencies develop and implement fishing regulations.

All suppression activities in areas occupied by ESA-listed salmonids will need to be reviewed and approved by NOAA.

### Potential Challenges:

Ensuring enough funding is available to hire staff and to implement projects.

### Adaptive Management:

Fish species present and actions taken in each “section” or watershed will be different. Regional experts will need to adaptively manage each action to fit their specific watershed.

**Stock Benefits Report Card:**

Predation: Recommendation for Northern Pike and invasive non-native fishes monitoring project

| | | | Abundance | | | MAFAC Phase II Impact Priority | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sub-Region | Stock | Status | Current | MAFAC Medium goal | Current as % of Medium Goal | Tributary Habitat | Estuary Habitat | Hydro (Mainstem) | Hydro (Latent) | Hydro (Blocked) | Predation | Fishery | Hatchery | Harvest |
| Low-C | L Col R Spring Chinook | Threatened | 2,240 | 21,550 | 10% | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 3 |
| Low-C | L Col R Winter Steelhead | Threatened | 5,989 | 27,900 | 21% | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Low-C | L Col R Fall (tule) Chinook | Threatened | 12,329 | 54,100 | 23% | 1 | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 1 |
| Low-C | L Col R Coho | Threatened | 31,524 | 129,550 | 24% | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| Low-C | L Col R Summer Steelhead | Threatened | 10,594 | 29,800 | 36% | 2 | 4 | 4 | 4 | 2 | 4 | 4 | 4 | 4 |
| Low-C | Col R Chum | Threatened | 11,762 | 33,000 | 36% | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | |
| Low-C | SW WA Winter Steelhead | Threatened | 3,252 | 5,850 | 56% | 2 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Low-C | L Col R Late Fall (bright) Chinook | | 10,800 | 16,700 | 65% | | | | | | | | | |
| Low-C | L Col R Fall (bright) Chinook | Threatened | 11,000 | 11,000 | 100% | 5 | 5 | 5 | 5 | 4 | 5 | 4 | 5 | 4 |
| Mid-C | M Col Sockeye | Not Listed | 1,036 | 45,000 | 2% | 3 | 3 | 3 | 2 | 1 | 3 | 3 | | 3 |
| Mid-C | M Col R Spring Chinook | Not Listed | 11,600 | 40,425 | 29% | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Mid-C | M Col R Summer Steelhead | Threatened | 18,155 | 43,850 | 41% | 2 | 4 | 4 | 4 | 4 | 2 | 4 | 4 | 4 |
| Mid-C | M Col R Coho | Not Listed | 6,324 | 11,600 | 55% | | 5 | 4 | 5 | 5 | 5 | 4 | | 4 |
| Mid-C | M Col R Summer/Fall Chinook | Not Listed | 11,500 | 13,000 | 88% | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 4 |
| Up-C | U Col R Coho | Not Listed | 392 | 15,000 | 3% | | | | | | | | | |
| Up-C | U Col R Summer Steelhead | Threatened | 1480 | 31,000 | 5% | 1 | 1 | 2 | 1 | 1 | 1 | 3 | 2 | 3 |
| Up-C | U Col R Sockeye | Not Listed | 40,850 | 580,000 | 7% | 1 | 3 | 1 | 1 | 1 | 2 | 3 | 3 | 3 |
| Up-C | U Col R Spring Chinook | Endangered | 1430 | 19,840 | 7% | 1 | 3 | 1 | 1 | 1 | 2 | 3 | 1 | 3 |
| Up-C | U Col R Summer Chinook | Not Listed | 16920 | 78,350 | 22% | 1 | 2 | 1 | 1 | 1 | 3 | 1 | 2 | 1 |
| Up-C | U Col R Fall Chinook | Not Listed | 92,400 | 62,215 | 149% | 5 | 5 | 4 | 5 | 5 | 5 | 4 | 5 | 4 |
| Snake | Snake R Coho | Not Listed | 100 | 26,600 | 0% | | | | | | | | | |
| Snake | Snake R Sockeye | Endangered | 100 | 15,750 | 1% | 3 | 3 | 1 | 1 | 1 | 2 | 3 | | 3 |
| Snake | Snake R Spring/Summer Chinook | Threatened | 6,988 | 98,750 | 7% | 1 | 3 | 1 | 1 | 2 | 2 | 3 | 3 | 3 |
| Snake | Snake R Summer Steelhead | Threatened | 28,000 | 75,000 | 37% | 2 | 4 | 4 | 2 | 2 | 2 | 4 | 4 | 4 |
| Snake | Snake R Fall Chinook | Threatened | 8,360 | 10,780 | 78% | 5 | 5 | 4 | 4 | 4 | 5 | 4 | | 3 |
| Willam | U Will R Spring Chinook | Threatened | 4,278 | 47,850 | 9% | 1 | 2 | 3 | 3 | 1 | 3 | 3 | 2 | 3 |
| Willam | U Will R Winter Steelhead | Threatened | 2,816 | 27,805 | 10% | 1 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |

*Draft for Internal Review – 3/30/23*

Stocks most benefited
Stocks receiving secondary benefit