The Columbia Basin Collaborative

Revised Recommendation 1-24-24

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 this recommendation is 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."

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

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Stocks most benefited
Stocks receiving secondary benefit