

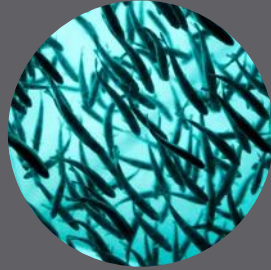
Avian Predation on Upper Columbia River Salmon and Steelhead: A Review of Research, Monitoring, and Evaluation Studies

Upper Columbia River Science Summit

January 21, 2026



PREDATOR-PREY INTERACTIONS



AVIAN PREDATION IN THE COLUMBIA BASIN



Breeding colonies of fish-eating waterbirds are widespread in the Basin and the nesting season overlaps with the smolt out-migration period.

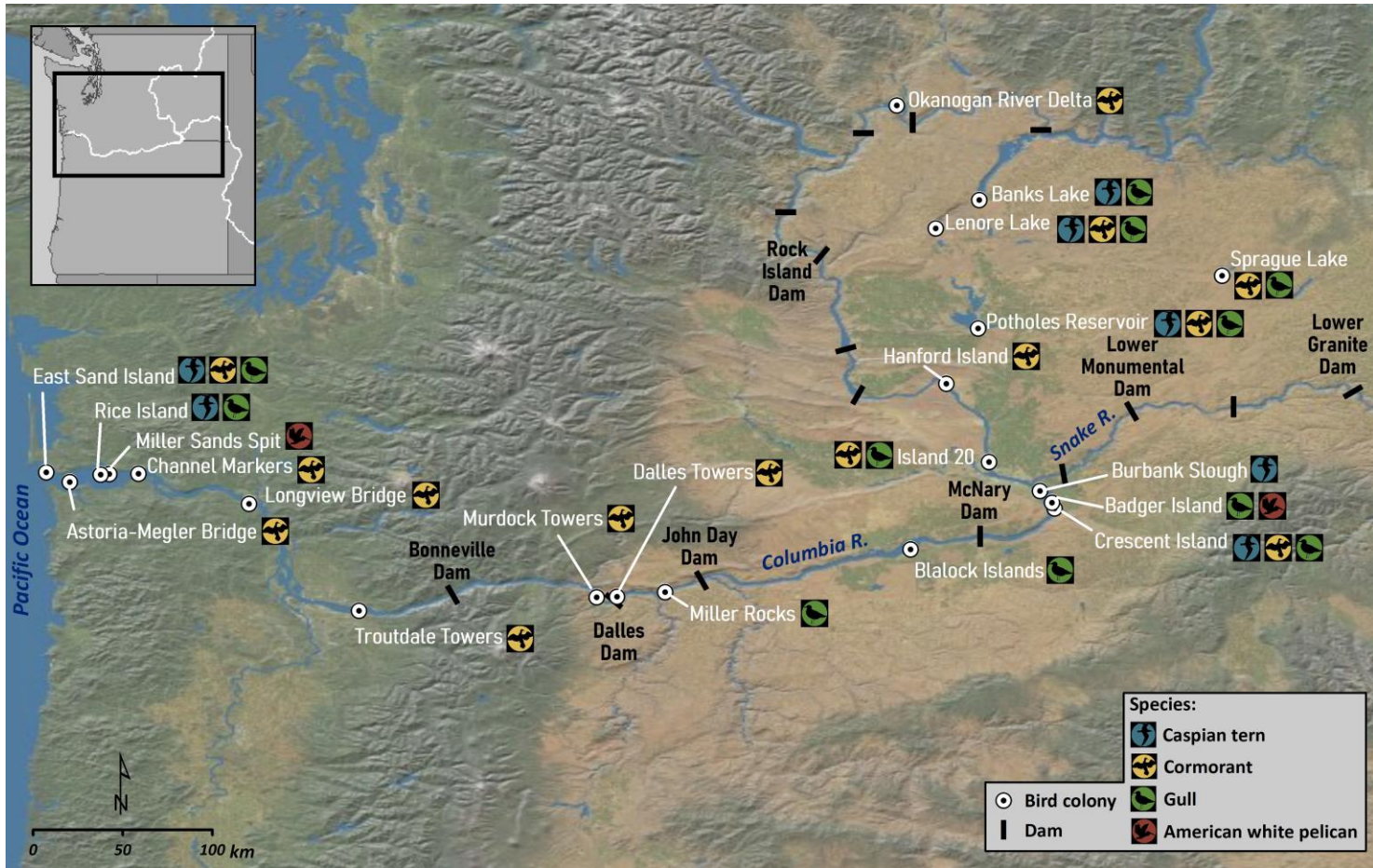


Primary species include Caspian Terns, Double-crested Cormorants, California and Ring-billed gulls, and American White Pelicans; all native species protected by the Migratory Bird Treaty Act.



Several other fish-eating waterbird species and colonies exist. Colonies are often smaller in size, and predation concerns more localized.

AVIAN PREDATION IN THE COLUMBIA BASIN



CASPIAN TERN PREDATION IN THE COLUMBIA BASIN



Multiple breeding sites. The largest colony in the world was formerly on East Sand Island in the estuary; a managed colony.



Caspian terns have one of the highest per capita (per bird) impacts on smolt survival.



Caspian terns disproportionately consume steelhead relative to salmon smolts; consumption rates can exceed 20% of available steelhead by some colonies, in some years.

DOUBLE-CRESTED CORMORANT PREDATION IN THE COLUMBIA BASIN



Multiple breeding sites. The largest colony was formerly on East Sand Island; a managed colony site.



Diet composition varies greatly based on colony size and location (freshwater versus marine).



Cormorants consume smolts in proportion to their availability, with impacts more similar amongst salmonid species (salmon and steelhead). Predation can exceed 10% of available smolts at larger-sized colonies, generally less than 5% at smaller colonies.

GULL PREDATION IN THE COLUMBIA BASIN



Multiple gull species and breeding sites. The most abundant species, numerically.



Omnivorous with a diverse diet. Steal fish from other birds and disproportionately forage for fish near dams and other areas where smolts concentrate.



Consumption rates on smolts vary considerably based on colony size and location; with rates ranging from 0% to more than 10% of available smolts.

AMERICAN WHITE PELICAN PREDATION IN THE COLUMBIA BASIN



Small number of breeding sites. Largest colony was on Badger Island in McNary Reservoir but is now on Crescent Island in McNary Reservoir (as of 2025).



Largest (by wingspan, mass, and gape) piscivorous colonial waterbird in North America. Opportunistic forages that quickly respond to changes in prey availability. Capable of long-distance foraging bouts.



Predation rates low on yearling UCR smolts in the mainstem Columbia River. Predation on subyearling smolts and fish in tributary systems (e.g., Yakima R., Umatilla R.) can be substantial in some years. Pelicans consume adult-sized fishes; including adult sockeye salmon.

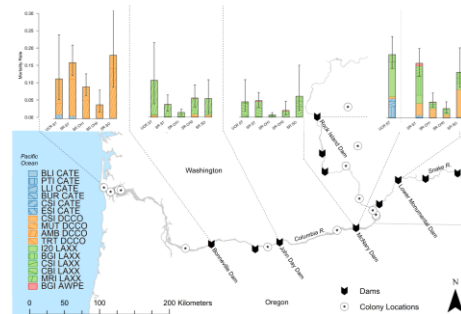
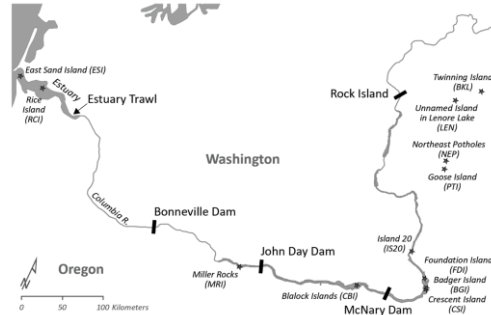
SYSTEM-WIDE EFFECTS OF AVIAN PREDATION ON SALMONIDS



UCR salmonid populations are subject to predation by multiple avian predator species and colonies during seaward migration.

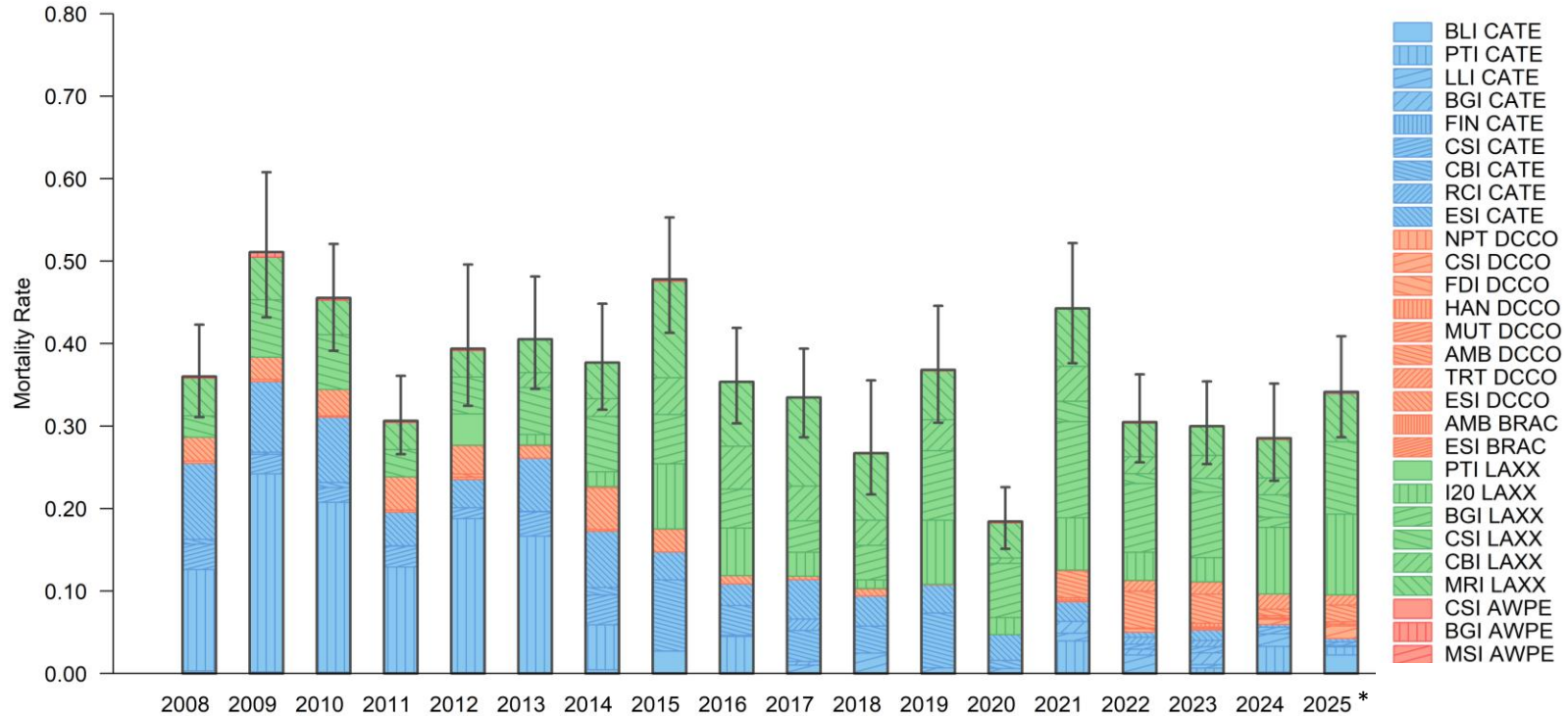


Cumulative effects of predation (from all predator species and colonies combined) can be substantial, accounting for more than 50% of all smolt losses during outmigration in some years, for some populations.



CUMULATIVE PREDATION (RIS to PACIFIC OCEAN)

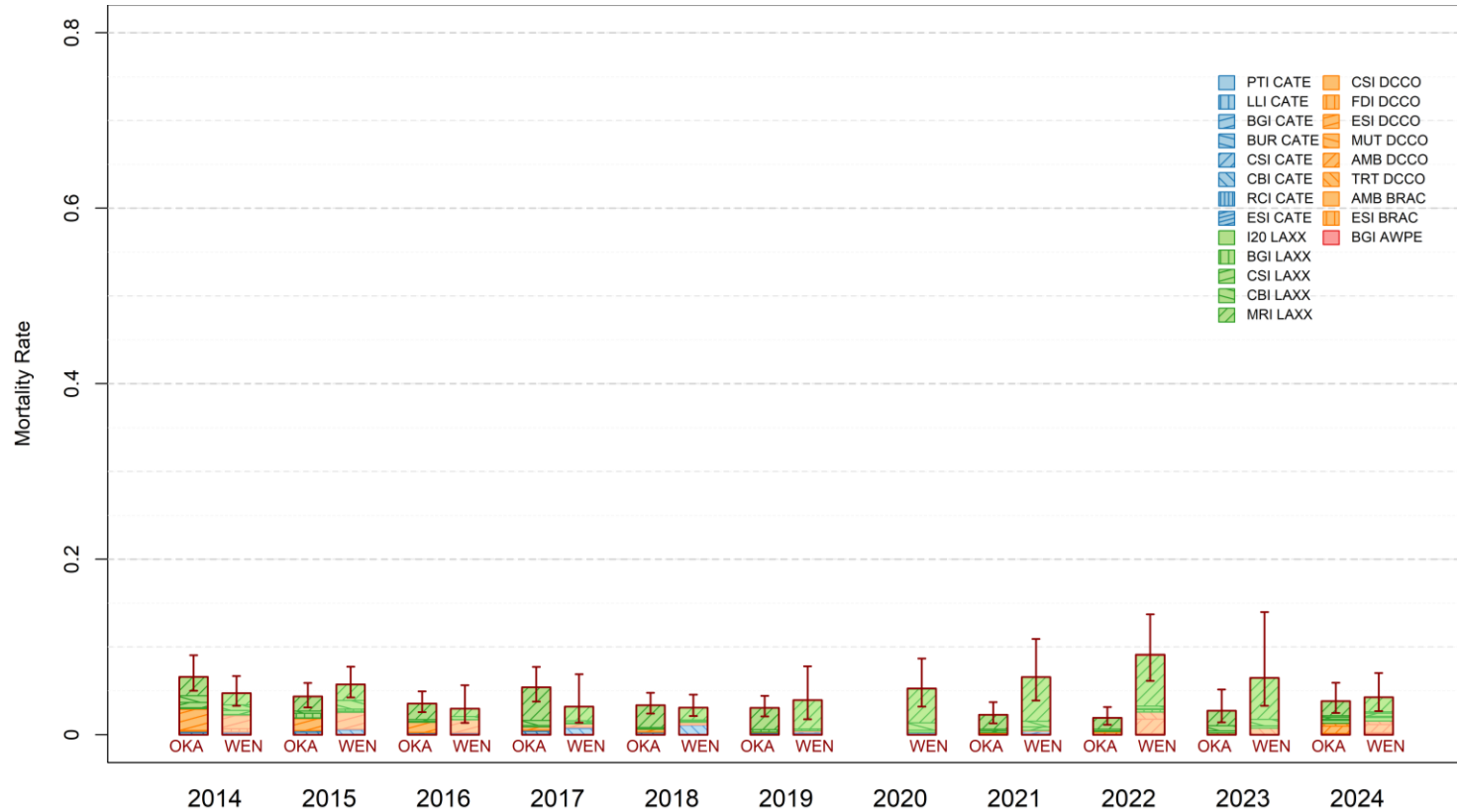
Upper Columbia River Steelhead



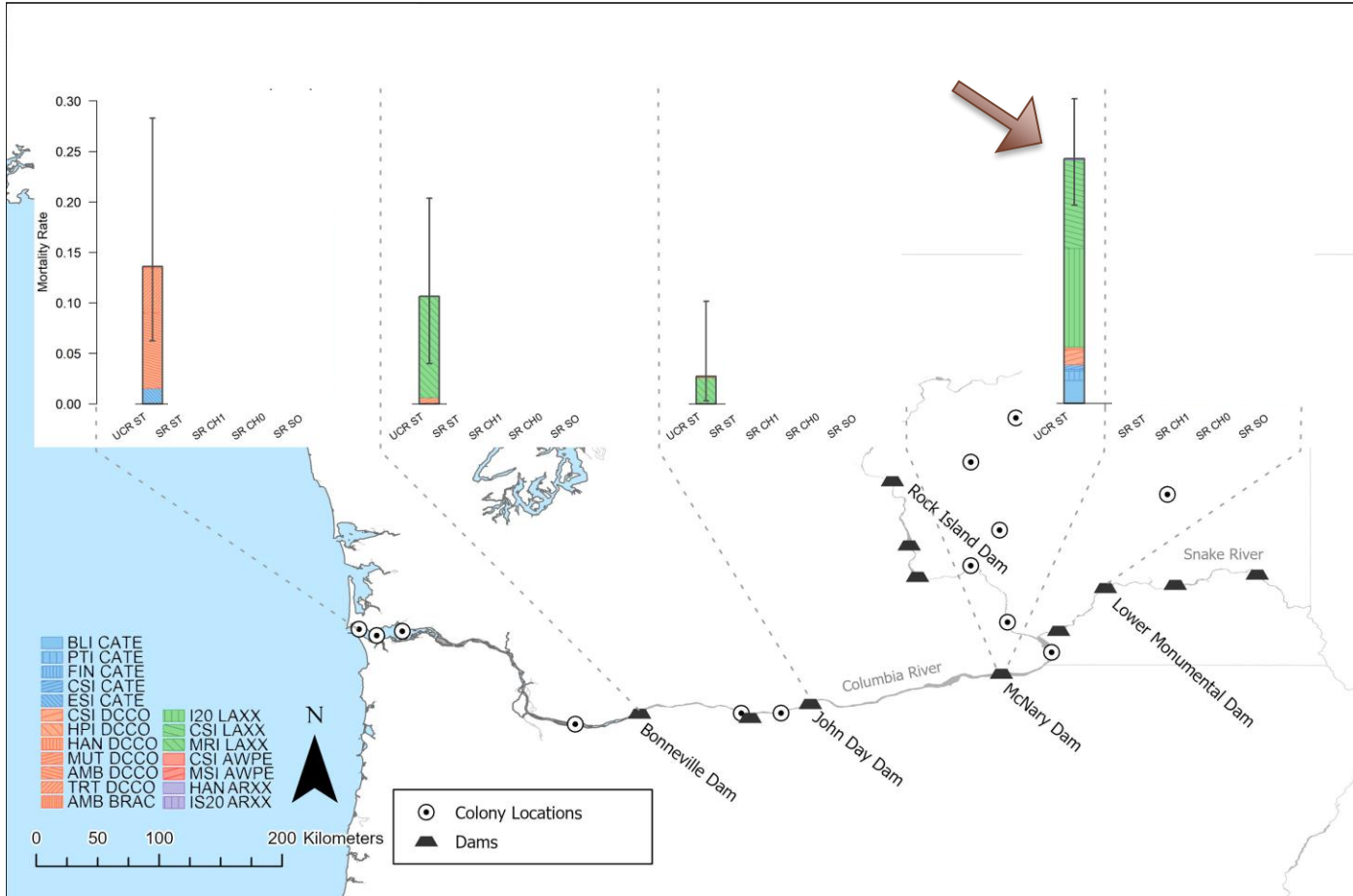
* Preliminary

CUMULATIVE PREDATION (Rel to PACIFIC OCEAN)

Wenatchee and Okanogan Sockeye Salmon



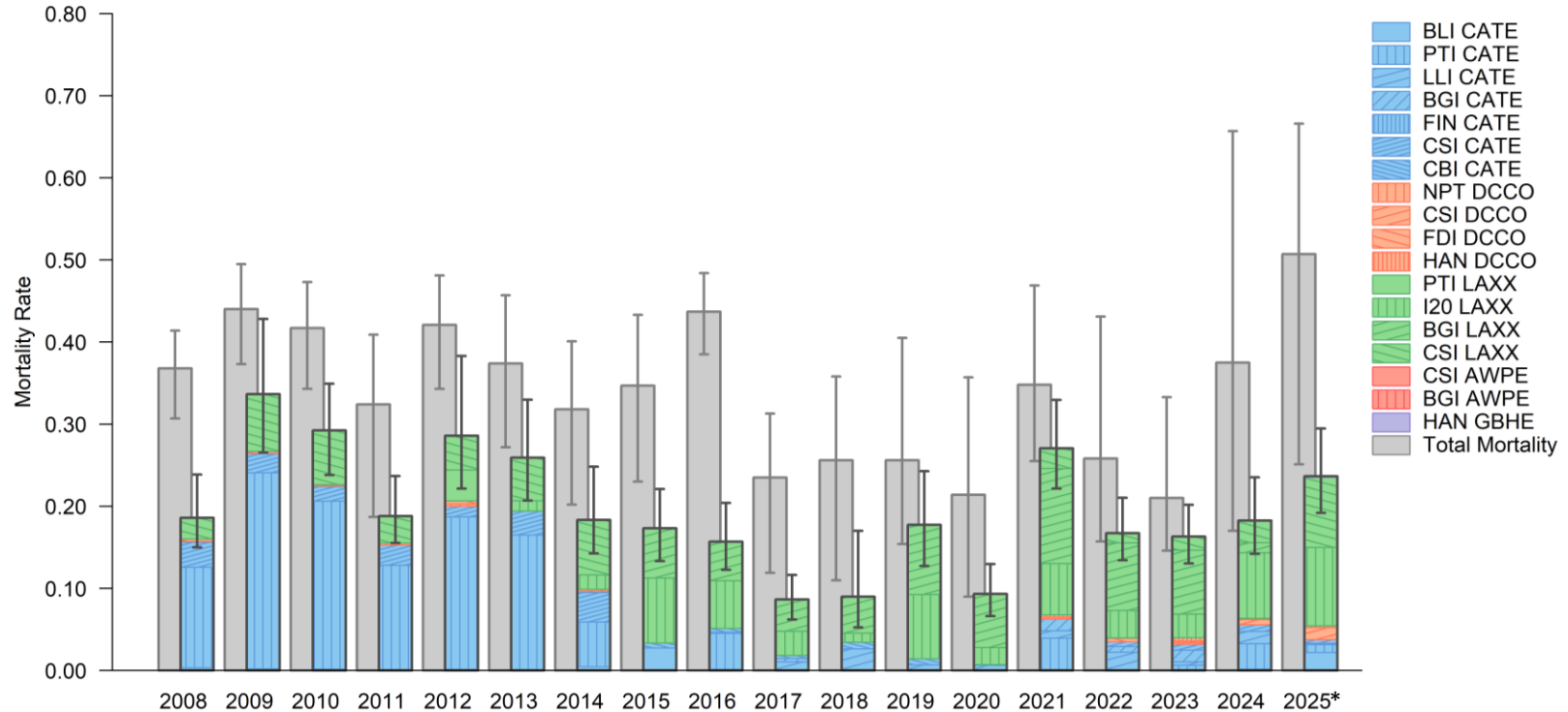
2025 REACH-SPECIFIC PREDATION RATES



Preliminary

CUMULATIVE PREDATION & SURVIVAL (RIS TO McN)

Upper Columbia River Steelhead



*Preliminary

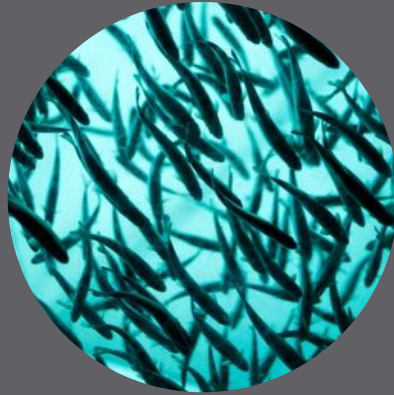
PELICAN PREDATION: ADULT SOCKEYE



- Predation by pelicans ranged annually from 1.5% to 8.5% of available adult sockeye at Bonneville Dam; average of 4.6% (all sockeye populations).
- Number consumed by pelicans ranged annually from 1,328 to 47,265 adults; average of 13,863 fish (all sockeye populations).

Year	Predation Probability	No. Counted	Estimated Consumption
2014	0.022 (0.013–0.032)	614,052	13,483 (7,558–19,957)
2015	0.085 (0.056–0.116)	510,497	47,265 (29,747–64,857)
2016	0.027 (0.015–0.044)	342,446	9,363 (4,924–14,945)
2017	0.049 (0.023–0.075)	87,582	3,277 (1,699–5,497)
2018	0.015 (0.007–0.024)	193,407	2,884 (1,289–4,747)
2019	0.022 (0.007–0.045)	62,828	1,328 (479–2,588)
2020	0.035 (0.018–0.051)	341,702	9,060 (5,068–14,165)
2021	0.080 (0.054–0.106)	151,631	12,425 (8,153–16,812)
2022	0.026 (0.014–0.043)	663,077	10,296 (5,393–17,189)
2023	0.083 (0.058–0.109)	327,601	23,951 (16,398–32,052)
Average	0.046 (0.037–0.057)	329,482	13,863 (10,891–17,577)

MANAGEMENT PLANS



AVIAN PREDATION MANAGEMENT PLANS

CASPIAN TERNS

East Sand Island, Columbia River Estuary

DOUBLE-CRESTED CORMORANTS

East Sand Island, Columbia River Estuary

CASPIAN TERNS

Goose and Crescent islands, Columbia Plateau Region

GULLS & PELICANS

No federal or state plans; Experimental management of gulls on Miller Rocks Island in the Columbia Plateau region by the Yakama Nation



TERN MANAGEMENT PLAN FOR THE COLUMBIA RIVER ESTUARY

REDUCE SIZE OF ESI COLONY

From about 10,000 to 3,125 breeding pairs using passive & active nest dissuasion

CREATE ALTERNATIVE HABITAT

For tern nesting outside Columbia Basin and attract terns to nest there

CONDUCT MONITORING

To measure action effectiveness and inform adaptive management decisions

ADAPTIVE MANAGEMENT

To prevent terns from nesting outside of main colony on East Sand Island and elsewhere in estuary



CORMORANT MANAGEMENT PLAN FOR THE COLUMBIA RIVER ESTUARY

REDUCE SIZE OF ESI COLONY

From about 15,000 to 5,600 breeding pairs nesting on East Sand Island

CULLING AND EGG OILING

Culling adults and oiling eggs (Phase I)

REDUCE NESTING HABITAT

By converting nesting habitat to intertidal wetland (Phase II)

CONDUCT MONITORING

To measure action effectiveness and inform adaptive management decisions



TERN MANAGEMENT PLAN FOR THE COLUMBIA PLATEAU

ELIMINATE TERN COLONIES

At Goose and Crescent islands using passive and active nest dissuasion

CREATE ALTERNATIVE TERN HABITAT

For tern nesting outside Columbia Basin and attract terns to nest there

CONDUCT MONITORING

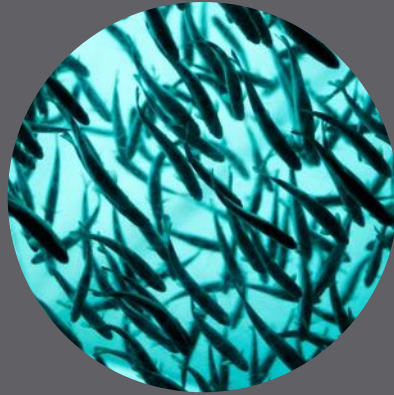
To measure action effectiveness and inform adaptive management decisions

ADAPTIVE MANAGEMENT

If terns relocate to other colonies in the Columbia Plateau, manage as necessary and possible



MANAGEMENT SUCCESS AND LESSONS LEARNED



TERN MANAGEMENT PLAN FOR THE COLUMBIA RIVER ESTUARY

COLONY SIZE REDUCED

Less than 3,000 pairs starting in 2020; colony was 694 pairs in 2025 and as low as 524 pairs in 2023 (Emerging Issue)

ALTERNATIVE HABITAT USED

Terns relocated to nesting sites outside of Basin, but sites under-utilized

PREDATION IMPACTS REDUCED

~ 80% reduction in impacts on steelhead smolts since 2020

HIGH FIDELITY TO ESTUARY

Persistent nesting attempts by terns elsewhere in the estuary, impacts largely unknown; continued adaptive management needed



CORMORANT MANAGEMENT PLAN FOR THE COLUMBIA RIVER ESTUARY

CULLING AND EGG OILING

Over 5,000 adult cormorants culled and eggs from 7,000 nests oiled (2015 - 2017)

HABITAT MODIFICATIONS

Amount of available nesting habitat on East Sand Island was reduced in 2019

COLONY MOSTLY ABANDONED

Large dispersal events from East Sand Island occurred following management

DISPERSAL TO UPPER ESTUARY

Astoria-Megler Bridge colony has grown from 300 pairs (2014) to over 5,300 pairs (2025), plus increases at other nesting sites (Lewis and Clark Bridge, Troutdale Towers); predation is now > 10% on multiple ESA-listed salmon and steelhead populations (Emerging Issue)



TERN MANAGEMENT PLAN FOR THE COLUMBIA PLATEAU

COLONY SIZE REDUCED

Little-to-no nesting at Goose Island, colony at Crescent Island initially eliminated but now re-established

DECLINE IN TERN POPULATION

~ 70% decline in the regional breeding population of terns (as of 2025)

PREDATION IMPACTS REDUCED

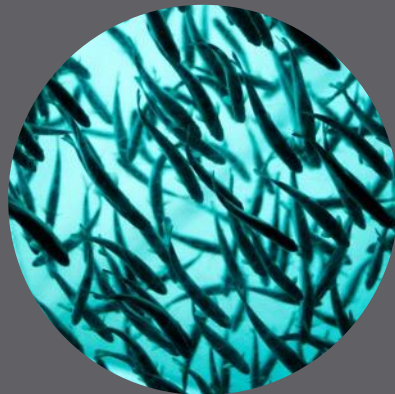
Reduction on steelhead predation achieved at some but not all colonies; greatest benefit to UCR steelhead

HIGH FIDELITY TO REGION

Crescent Is. colony re-formed, persistent nesting attempts at Goose Island and other sites; adaptive management needed and has been successful in some cases



EMERGING ISSUES



EMERGING ISSUES



Status of Caspian terns in the Pacific Flyway: ESI colony is now well below the target colony size of 3,125 pairs with little to no productivity (young). Colonies were also affected by avian influenza. As of 2024, the Pacific Flyway population has declined by an estimated 71% since 2009.

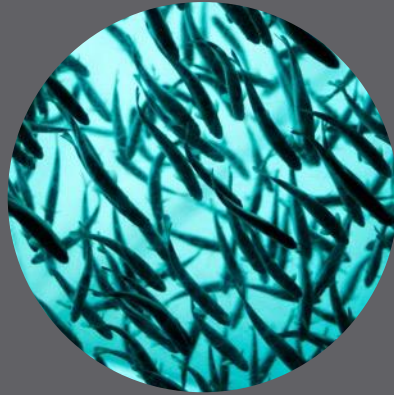


Double-crested cormorant predation in the estuary: Predation in the middle to upper estuary is now greater than that of predation by birds that formerly nested on East Sand Island in the lower estuary.



American white pelican predation: Increasing numbers of pelicans over the last two decades. Predation on smolts from select rivers and on adult Sockeye Salmon can be substantial; additional RM&E needed to more fully document predation and to better understand factors that influence fish susceptibility to pelicans.

SUMMARY



CASPIAN TERN PREDATION REDUCED AT MANAGED COLONIES

SMOLT IMPACTS REDUCED

East Sand Island impacts reduced by ~ 80% on steelhead smolts
Goose Island impacts reduced by ~ 65% on UCR steelhead

STRONG FIDELITY TO REGION

Some colonies have recently reformed (Crescent Island) and terns continue to attempt to nest at historical and new breeding sites in the region

ADAPTIVE MANAGEMENT NEEDED

To reach management objectives and to maximize the benefits to smolts from managing avian predators

STATUS OF FLYWAY POPULATION A CONCERN

To ensure long-term viability of terns in the region, a larger colony at ESI may now be warranted, as well as increases in the size and productivity of terns at other, alternative colony sites in the Pacific Northwest



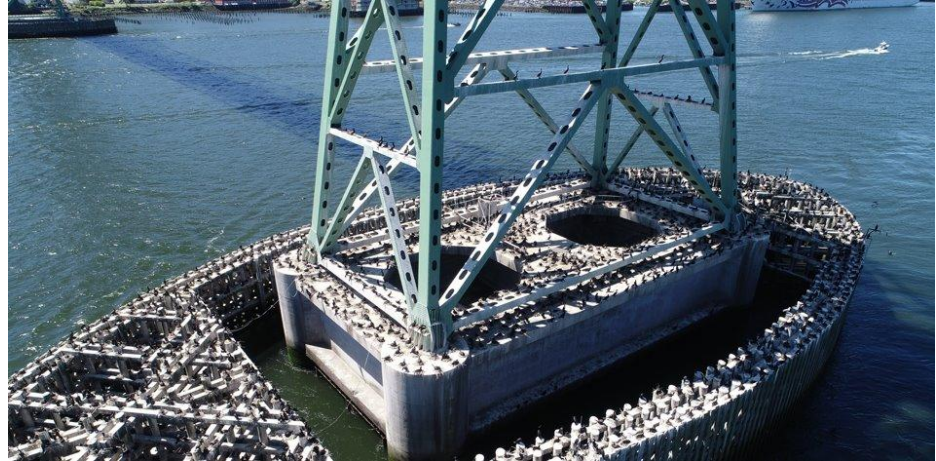
PREDATION BY DOUBLE-CRESTED CORMORANTS HAS INCREASED

SMOLT IMPACTS REMAIN SIGNIFICANT

Dissuasion of cormorants on ESI reduced the colony as intended by the Plan, but displaced cormorants relocated to colonies in the middle and upper estuary and predation impacts are now higher than those that occurred prior to management.

ADAPTIVE MANAGEMENT NEEDED

To reach management objectives, predation by cormorant nesting in the upper estuary should be reduced and the colony at ESI re-established to the size identified in the Plan (about 5,400 – 5,900 pairs).



PREDATION BY GULLS AND PELICAN IS A GROWING CONCERN

CONSUMPTION RATES VARY

Predation/consumption rates by gulls and pelicans are highly variable depending on colony and salmonid population and age-class, but predation can be substantial, particularly for colonies located near dams, diversion sites, tributaries, and other areas where fish congregate.

PELICANS CONSUME ADULT SALMONIDS

Adult Sockeye Salmon and other larger-sized fishes. Predation on adult Sockeye Salmon substantial in some years.

LIMITED OR NO MANAGEMENT

No basin-wide management plans for gulls and pelicans



MORE INFORMATION

Bird Research Northwest

- Annual Reports dating back 1997
- Over 50 peer-reviewed scientific manuscripts
- In-season project updates to inform adaptive management



www.birdresearchnw.org

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STAFF

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THANK YOU



QUESTIONS?

IMPETUS FOR MANAGEMENT



Caspian terns and double-crested cormorants nesting on East Sand Island (ESI) in the estuary depredated up to 25 million smolts annually, or roughly 15% of the surviving out-migrants prior to management (2000–2007 for terns, 1997–2014 for cormorants).



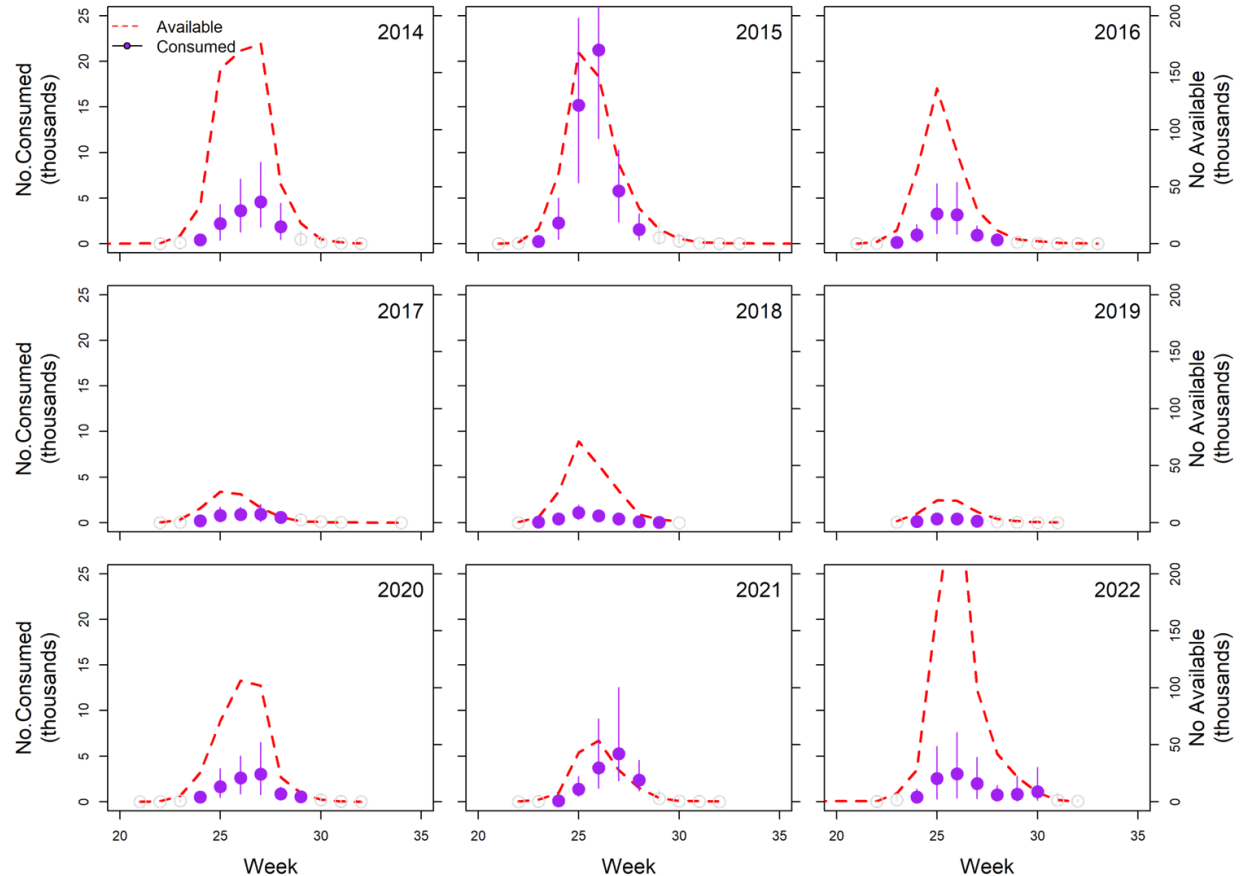
Caspian terns nesting on Crescent and Goose islands in the Columbia Plateau region consumed annually from 5% to 30% of out-migrating smolts from some listed steelhead populations prior to management (2007–2013).



Management of terns and cormorants to reduce their impacts on smolts was called for in regional planning documents.

ADULT SOCKEYE: TEMPORAL VARIATION IN PELICAN PREDATION

- Pelicans consumed adult sockeye throughout the run.
- Predation increased as sockeye abundance increased.
- Some evidence that late migrating sockeye were more susceptible to pelican predation.
- Some evidence predation was highest in years with poor environmental conditions (temp., flow).



ADDITIVE EFFECTS OF AVIAN PREDATION ON FISH SURVIVAL

To what degree does avian predation limit fish survival?



Evaluated by determining the strength and magnitude of the relationship between predation and survival. Requires accurate estimates of predation and survival and sophisticated analytical models.

Compensatory: All fish will die regardless of the level of predation.

Additive: All fish will survive in the absence of predation.

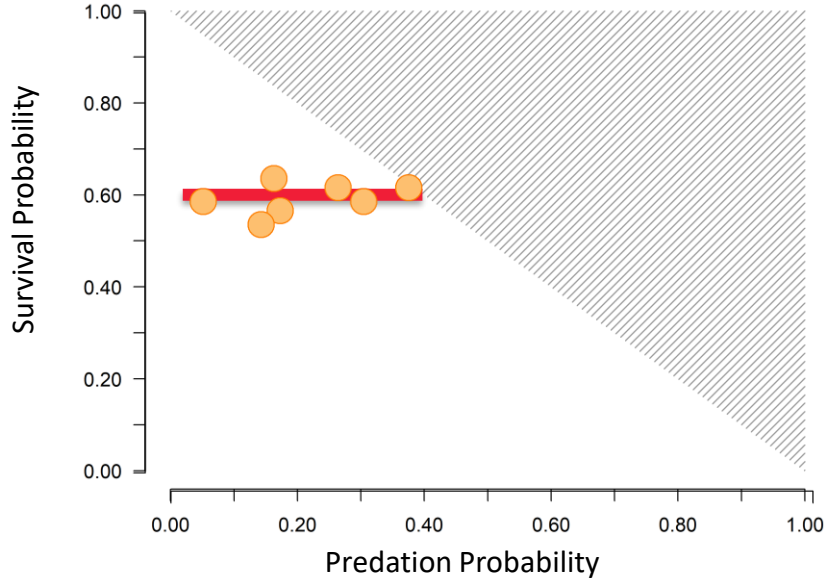
Partially Additive/Compensatory: Some, but not all, fish will survive in the absence of predation.



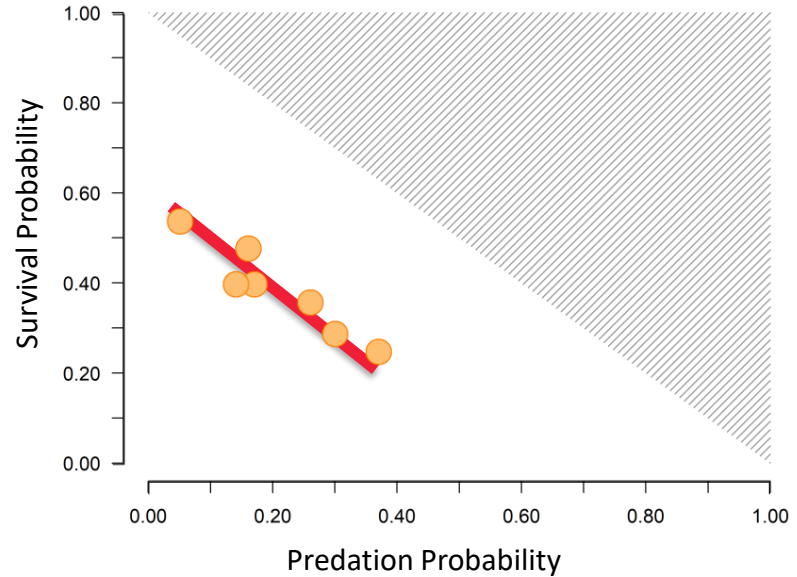
ADDITIVE EFFECTS OF AVIAN PREDATION ON SALMONIDS

Hypothetical Results

Compensatory



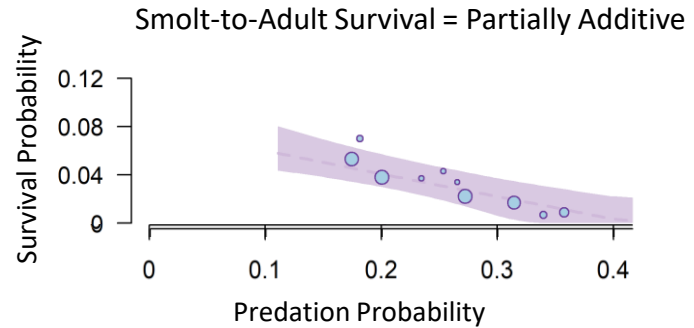
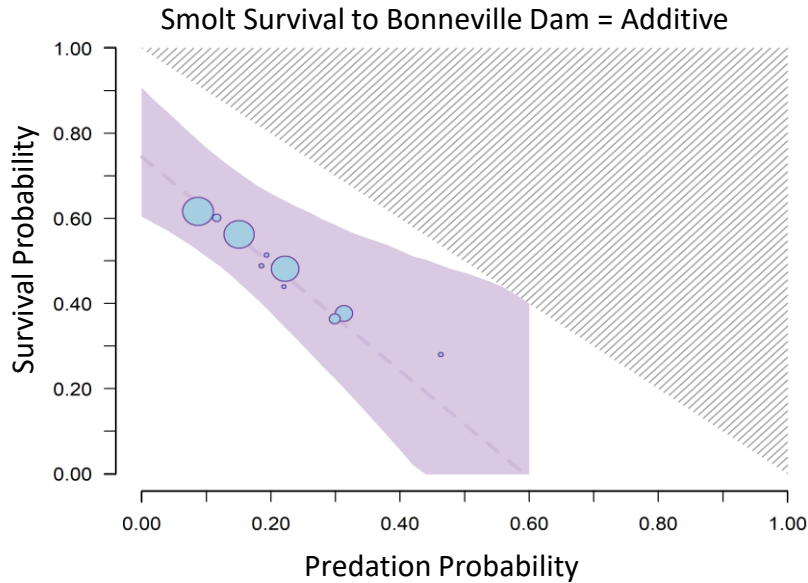
Additive



Additive relationship depicted when increases in predation are associated with decreases in survival

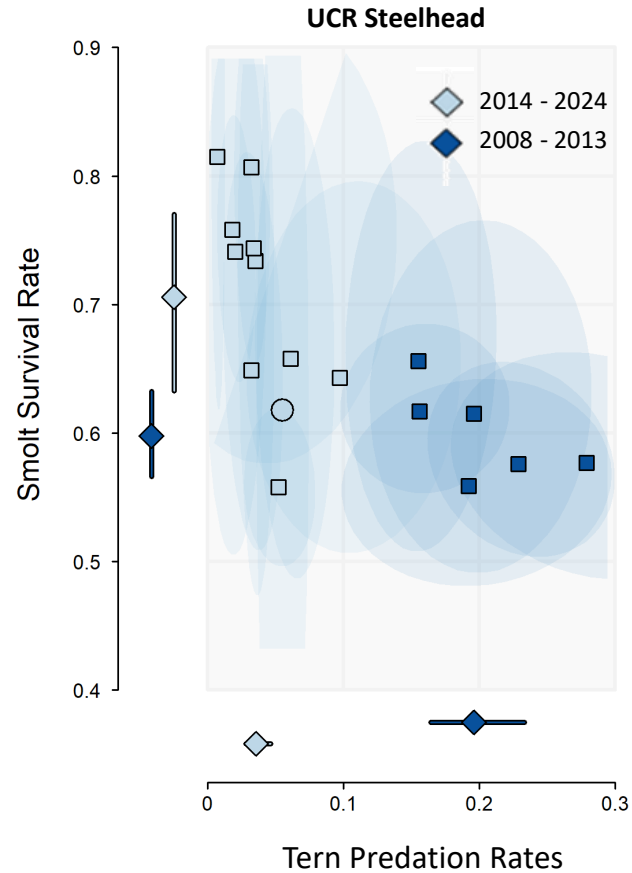
ADDITIVE EFFECTS OF AVIAN PREDATION ON SALMONIDS

Actual Results: Tern Predation on Steelhead

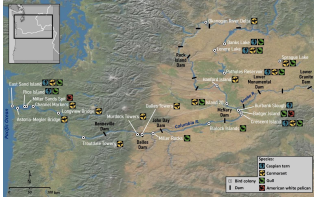


- Predation was additive during the smolt life-stage and partially additive to the adult life-stage.
- ISRP concluded that additivity was the most prudent conclusion from a management perspective based on their review of the research to-date (ISRP 2021).

INLAND TERN PREDATION RATES AND SURVIVAL



Avian Predation RM&E



Avian predation involves multiple predator species and inter-connected colonies that occur over large spatial-scales; requires system-wide studies.

RM&E is used to:

- Evaluating the efficacy of bird management actions to reduce predation.
- Developing adaptive management solutions to reduce predation.
- Identify emerging predation issues and concerns.
- Identify avian species and colonies that pose little or no threat to salmon and steelhead survival; cases where management is not warranted.
- Provides data on colony locations, sizes, and factors that limit nesting success; data critical to understanding Pacific Flyway populations and their conservation status.

