

AVIAN PREDATION ON JUVENILE SALMONIDS IN THE LOWER COLUMBIA RIVER

9702400

SHORT DESCRIPTION:

Estimate the numbers of juvenile salmonids consumed by colonial waterbirds (i.e., double-crested cormorant, Caspian tern, California gull, ring-billed gull, glaucous-winged gull) in the lower Columbia River, identify conditions and locales where avian predation is most prevalent, provide recommendations to reduce predation by fish-eating birds, and evaluate the efficacy of control measures that are implemented.

SPONSOR/CONTRACTOR: OSU/CRITFC

Oregon State University/Columbia River Inter-Tribal Fish Commission

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SUB-CONTRACTORS:

Columbia River Inter-Tribal Fish Commission

GOALS

GENERAL:

Supports a healthy Columbia basin, Maintains biological diversity, Increases run sizes or populations, Adaptive management (research or M&E)

ANADROMOUS FISH:

Hydro ops, mainstem passage, construction

NPPC PROGRAM MEASURE:

5.7B.20; 5.7B.21; 5.7B.22

RELATION TO MEASURE:

This project is designed to assess the impacts of avian predation on survival of juvenile salmonids in general, and threatened and endangered snake River salmon specifically, in the lower Columbia River. We will use bioenergetics modelling to estimate the number of juvenile salmonids eaten by avian predators in the lower Columbia River (5.7B.20) from the estuary (5.7B.21) to the head of McNary Pool, identify conditions under which predation is most prevalent, determine predator population trajectories, and provide recommendations to reduce predation by fish-eating birds (5.7B.22). These results will improve our understanding of the factors affecting salmonid survival in the Columbia River Basin and provide managers with information that should prove important in decisions regarding salmon

BIOLOGICAL OPINION ID:

1995 NMFS Hydrosystem Operations Biological Opinion: VII.A.14, XII.8, XII.9

OTHER PLANNING DOCUMENTS:

NMFS Snake River Salmon Recovery Plan: V.2.8.a.2, V.2.8.b.1; Wy-Kan-Ush-Mi Wa-Kish-Wit: 5.B.Hypothesis 6

TARGET STOCK

All salmonid stocks consumed by piscivorous waterbirds

LIFE STAGE

Juvenile

MGMT CODE (see below)

(P), (L), W

All salmonid stocks consumed by piscivorous waterbirds

Juvenile

(P), (L), W

AFFECTED STOCK

Other fish consumed by piscivorous waterbirds

BENEFIT OR DETRIMENT

Either

BACKGROUND

STREAM AREA AFFECTED

Stream name:

Lower Columbia River

Subbasin:

Lower Columbia River. However, this study could benefit juvenile salmonids from any sub-basin within the foraging range of piscivorous waterbirds nesting on the lower Columbia River

Stream miles affected:

340 (9 colonies will be studied on the lower Columbia River from the estuary to Richland, WA)

Land ownership:

Public

Hydro project mitigated:

The results from this study could be used to mitigate damages caused by birds at all lower Columbia River dams.

Habitat types:

There are nine large breeding colonies of piscivorous waterbirds (i.e., double-crested cormorant, Caspian tern, California gull, ring-billed gull, glaucous-winged gull) on the Columbia River from the estuary to the head of McNary Pool. Most of these colonies are on dredge spoil islands (e.g., Rice and Crescent Islands) or islands created by mainstem dam impoundments (e.g., Miller Rocks and Three Mile Canyon Island). Foraging activities of these birds are concentrated in and around the mainstem (i.e., maximum foraging range of most colonial waterbirds is expected to be within 60 km of nesting colony).

HISTORY:

The CRITFC received funding (\$20,589) from the Columbia Basin PIT-Tag Information System Project (BPA-9008000) to recover PIT tags from piscivorous waterbird breeding colonies. All recovered tag codes were provided to PSMFC and entered into the PITAGIS database. In 1996, BPA directly funded a photo census of all piscivorous waterbird breeding colonies in our study area. That census produced a set of high resolution photos which were then analyzed to estimate the breeding population size at each colony.

BIOLOGICAL RESULTS ACHIEVED:

Systematic sampling for PIT tags placed in juvenile salmonids was carried out at Rice Island — located in the Columbia River estuary — in 1996. These results indicate that more than 15,000 PIT tags have been deposited by terns nesting on the island, suggesting that these birds have consumed large numbers — probably millions — of tagged and untagged smolts over the years. Plans are currently underway to sample for PIT tags at a piscivorous waterbird colony on the Columbia River near the Snake River confluence. The photo census conducted in 1996 has identified the location of all large colonies of fish-eating birds on the lower Columbia River. Analysis of the photos provided estimates of the breeding population size at each colony. When compared to historical data, these results suggest that (1) the number of breeding colonies of some piscivorous waterbirds has increased and (2) most, if not all, of these breeding colonies appear to be growing.

PROJECT REPORTS AND PAPERS:

Data obtained from our PIT tag recovery study has been included in the PITAGIS database. We are currently working on a draft report that summarizes our results, to include an estimate of the total number of PIT tags at the Caspian tern colony at Rice Island. We will use these data to address questions concerning avian predation rates on juvenile salmonids and how these rates may vary by salmonid species and size, migration year, passage conditions, colony location, and avian predator species. We will report the results of the photo census conducted in 1996 in a future report submitted as part of this contract (BPA-5505900).

ADAPTIVE MANAGEMENT IMPLICATIONS:

Past work will allow more time to be spent in implementation, rather than planning, in the first year of this project. We have identified the study populations, estimated their size, established the methods to be used in censusing piscivorous waterbirds, and developed the techniques to be used in sampling for PIT tags on piscivorous waterbird breeding colonies. finally, we have established important contacts with agency personnel critical to the success of a project of this scope.

PURPOSE AND METHODS

SPECIFIC MEASUREABLE OBJECTIVES:

We will build a bioenergetics model to estimate predation by colonial waterbirds on juvenile salmonids in the lower Columbia River. Specifically, we will: (1) identify the location, size, and population trajectories of piscivorous waterbird breeding colonies, (2) investigate breeding chronology and productivity of piscivorous waterbird colonies, (3) determine diet composition of fish-eating birds, including taxonomic composition and energy content of various prey types, (4) estimate forage fish consumption rates, with special emphasis on juvenile salmonids, by breeding adults and their young, (5) identify foraging range, foraging strategies, and habitat utilization by piscivorous waterbirds, (6) recover salmon PIT tags from piscivorous waterbird colonies, and (7) compile information regarding potential mitigation techniques.

CRITICAL UNCERTAINTIES:

It is not certain whether avian predation is a significant source of mortality for juvenile salmonids. Furthermore, if avian predation is determined to be significant, we do not know if there are practical management activities to address the problem.

BIOLOGICAL NEED:

Available data suggest that predation is a major source of mortality for juvenile salmonids migrating through the mainstem Columbia and Snake rivers. Anthropogenic perturbations to the Columbia River System have exacerbated predation-related mortality and contributed to increases in populations of some predators. Piscivorous waterbird populations have increased dramatically with expanding agricultural development and the expansion of available breeding habitat in the Columbia River Basin. New islands created by dredging and impounding the Columbia River have provided safe nest sites and attracted gulls and other colonial waterbirds to breed. The breeding season of these piscivorous birds coincides with the period of out-migration of salmon smolts, potentially resulting in intense predation pressure in the vicinity of larger colonies. The chick-rearing period is the stage of the annual cycle when population energy requirements are greatest due to intense foraging activity by breeding adults and rapid growth in nestlings.

Current management practices on the Columbia and Snake rivers offer many opportunities for predators to exploit salmon as a food source. Hydroelectric dams create "bottlenecks" to salmon migration and often injure or disorient out-migrating juvenile salmonids, increasing their vulnerability to avian predators. Hatchery and juvenile transportation practices that release salmonids in mass offer avian predators additional opportunities to exploit concentrated and vulnerable prey. While extensive research has been conducted on the effects of piscivorous fishes on the survival of salmonids in the mainstem Columbia and Snake rivers, no comprehensive study of avian predation on juvenile salmonids has been undertaken.

Control measures have been implemented to protect out-migrating juvenile salmonids from avian predators at most dams. Some hatcheries are experimenting with different release strategies to reduce avian predation on hatchery-reared juvenile salmonids. Although there is evidence that some of these measures may be effective, both the extent of predation-related mortality and the efficacy of control measures is largely unknown.

HYPOTHESIS TO BE TESTED:

The testable hypotheses of this study are: (1) the magnitude of avian predation poses a significant threat to the survival of salmonids in general, and threatened and endangered snake River salmon specifically; (2) the majority of salmonid losses to avian predators occurs near breeding colonies of colonial-nesting species and at sites where smolts are concentrated at or near the water surface (e.g., dams); (3) avian predator populations are growing as a result of anthropogenic factors; and (4) expanded or new management practices directed at avian predators can significantly reduce current levels of predation by fish-eating birds.

ALTERNATIVE APPROACHES:

No alternative approaches have been proposed.

JUSTIFICATION FOR PLANNING:

The primary objectives of this research are to (1) determine whether or not piscivorous waterbirds pose a significant threat to the survival of juvenile salmonids and (2) identify conditions and locales where avian predation is most prevalent. If avian predation is determined to be a major source of mortality for juvenile salmonids in general, and threatened or endangered stocks specifically, we will develop recommendations to reduce predation by fish-eating birds and evaluate the efficacy of control measures that are implemented. This research will be important in (1) the prioritization of salmon restoration projects owing for

limited funds, (2) the implementation of appropriate measures to reduce predation by fish-eating birds, and (3) the justification for mitigation measures that might not be popular with some segments of the population. As part of our work, we will coordinate all activities with the appropriate agencies and tribes.

METHODS:

We will build a bioenergetics model to estimate the number of juvenile salmonids consumed by piscivorous waterbirds in the lower Columbia River. In building the model, we will (1) use aerial photos taken during late incubation to estimate the breeding population size of large piscivorous waterbird colonies, (2) collect diet samples from adults and their young using both lethal and non-lethal methods to determine the species composition and energy content of the diet, (3) use the doubly-labeled water technique to directly measure field metabolic rates of breeding adults during the chick rearing period, (4) use the time-activity budget method to measure field metabolic rates of breeding adults outside the chick rearing period, (5) use allometric equations from the published literature to estimate the energy requirements of young, (6) conduct ground surveys to determine the breeding chronology and productivity of piscivorous waterbirds, and (7) measure the parental provisioning rates and the growth rates of nestlings. In addition, we will (1) use transect sampling and radio telemetry methods to identify the foraging range, foraging strategies, and habitat utilization by piscivorous waterbirds, (2) use soil sieves, electronic PIT tag readers, and visual searches to recover salmon PIT tags from piscivorous waterbird colonies to address questions concerning predation rates on juvenile salmonids and how these rates may vary by salmonid species and size, migration year, passage conditions, colony location, and avian predator species, (3) compile information from the published literature and agency sources regarding potential mitigation techniques.

PLANNED ACTIVITIES

SCHEDULE:

<u>Planning Phase</u>	<u>Start</u> Jan. 1996	<u>End</u> Dec. 2000	<u>Subcontractor</u> CRITFC, see above for specific responsibilities
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Task The agency responsible and date of completion are noted in parentheses following each task.

1. Identify the breeding colonies of piscivorous waterbirds to be included in the study (OSU & CRITFC: June, 1996 and ongoing as needed).
2. Develop research methods (OSU & CRITFC: ongoing as needed).
3. Coordinate all activities with the appropriate agencies and tribes (OSU & CRITFC: ongoing as needed).
4. Obtain the necessary permits (OSU & CRITFC: ongoing as needed).
5. Hire necessary personnel and acquire equipment (OSU & CRITFC: ongoing as needed).

Assumed historic status of utilization and conservation potential:

Historically, salmon and steelhead returning to the Columbia River Basin supported the economic, cultural, and spiritual needs of the people of the Pacific Northwest.

Long term expected utilization and conservation potential for target population or habitat:

Restoration of salmonid stocks so that subsistence, commercial, and sport harvest can continue without jeopardizing the future conservation of the resource.

Contribution toward long-term goal:

Results from this study will improve our understanding of the factors affecting salmonid survival in the Columbia River Basin and provide managers with information that should prove important in decisions regarding salmon recovery.

Indirect biological or environmental changes:

If avian predation is determined to be a significant source of mortality for juvenile salmonids, mitigation measures might be implemented to reduce predation by fish-eating birds. These measures will likely cause changes in the distribution and/or number of breeding piscivorous waterbirds in the lower Columbia River by direct control or alterations of suitable breeding habitat for important predator populations (e.g., dredge spoil islands).

Physical products:

N/A

Environmental attributes affected by the project:

N/A

Changes assumed or expected for affected environmental attributes:

This project will not directly produce any near or long term changes to environmental attributes. Results from this project could be used to develop plans to reduce avian predation of juvenile salmonids, thereby, all else being equal, increasing the number of adult salmonids returning to the basin. Furthermore, the mitigation measures implemented may cause changes in the distribution and/or number of breeding piscivorous waterbirds by direct control or alterations to suitable breeding habitat of important predator populations.

Measure of attribute changes:

N/A

Assessment of effects on project outcomes of critical uncertainty:

If avian predation is found not to be a significant factor in the survival of salmonids, no mitigation will be recommended or proposed. If avian predation is an important factor in the survival of juvenile salmonids, then we will assess the feasibility of potential mitigation measures.

Information products:

This project is designed to assess the impacts of avian predation on survival of juvenile salmonids in general, and threatened and endangered snake River salmon specifically, in the lower Columbia River. We will use bioenergetics modelling to estimate the number of juvenile salmonids eaten by avian predators in the lower Columbia River from the estuary to the head of McNary Pool, identify conditions under which predation is most prevalent, determine predator population trajectories, and provide recommendations to reduce predation by fish-eating birds. These results will improve our understanding of the factors affecting salmonid survival in the Columbia River Basin and provide managers with information that should prove important in decisions regarding salmon recovery.

Coordination outcomes:

This project will be coordinated with agencies and tribes involved in both fish and wildlife management. Information gathered as part of our research will be combined with data from agency sources to define and address the problem. Regional fish and wildlife managers will work together to evaluate and implement a plan that promotes a balance between the needs of fish and wildlife.

MONITORING APPROACH

Provisions to monitor population status or habitat quality:

As part of this project, we will monitor the population status of all large piscivorous waterbird colonies over the term of the research. Other agencies or organizations (e.g., NMFS, FPC) monitor the status of juvenile salmonids.

Data analysis and evaluation:

Results from this research will be published in peer review scientific journals. This will assure that the data analysis and interpretation of results meet rigorous standards in this field of research.

Information feed back to management decisions:

The results from this study will be made available to the appropriate fish and wildlife managers so that decisions can be made regarding management of piscivorous waterbirds to increase survival of juvenile salmonids. We will make recommendations as to which measures make sense from an ecological perspective and it will be up to the resource management agencies to implement whatever mitigative measures are deemed appropriate.

Critical uncertainties affecting project's outcomes:

A multi-year study will preclude management decisions being made based on anomalous results (e.g., due to extreme weather that negatively affects predator and/or prey populations) from a single year.

EVALUATION

Incorporating new information regarding uncertainties:

We will use an adaptive management approach in conducting this research so that unforeseen circumstances can be accommodated in the research design.

Increasing public awareness of F&W activities:

The results from this research will be made available to the public through annual reports, a final completion report, and publications in peer reviewed scientific literature. In addition, the interim results of this research will be presented at meetings of professional societies at the state, regional, and national levels.

RELATIONSHIPS

RELATED BPA PROJECT

5503800 1997-98 Eval. of Juvenile Fall Chinook Stranding on the Hanford Reach

9008000 Columbia Basin Pit-tag Information System

RELATIONSHIP

We will collaborate with WDFW in their investigations of stranding effects on the Hanford Reach, specifically the impacts of piscivorous waterbirds on the survival of stranded juvenile fall chinook.

As part of our work, we will recover salmon PIT tags from piscivorous waterbird colonies. We will provide all interrogations of PIT tag codes to PSMFC to be included in the PITAGIS database.

RELATED NON-BPA PROJECT

RELATIONSHIP

Predation by birds and effectiveness of predation control measures at Bonneville, The Dalles, and John Day dams/USACE & ADC

Avian predation abatement measures are implemented and their effectiveness evaluated at these lower Columbia River dams. As part of this program, some birds that forage near dams are shot. We will work with these agencies to collect these birds for the purpose of determining diet composition. Also, we will incorporate information from their study with our work to build a more comprehensive understanding of avian predation on juvenile salmonids in the lower Columbia River.

Evaluation of facilities for collection, bypass, and transportation of outmigrating chinook salmon/USACE

Avian predation is one source of estuary mortality for radio-tagged smolts used in this study. We will work cooperatively with these agencies to collect radio tags deposited on the breeding colonies of piscivorous waterbirds. Also, we will incorporate information from their study with our work to build a comprehensive understanding of avian predation on juvenile salmonids in the Columbia River estuary.

Behavior and fate of juvenile salmonids entering the tailwaters of The Dalles Dam via spill /USACE

Avian predation is one source of upriver mortality for radio-tagged smolts used in this study. We will work cooperatively with these agencies to collect radio tags deposited on the breeding colonies of piscivorous waterbirds. Also, we will incorporate information from their study with our work to build a comprehensive understanding of avian predation on juvenile salmonids in the lower Columbia River.

OPPORTUNITIES FOR COOPERATION:

This project will be conducted cooperatively by the Oregon Cooperative Wildlife Research Unit at Oregon State University and the Columbia River Inter-tribal Fish Commission. Additional cooperators for work on colonial waterbirds in the Columbia River estuary include the U.S. Fish and Wildlife Service (POC: Al Clark, Refuge Biologist), and the Oregon Cooperative Fishery Research Unit (POC: Larry Davis and Carl Schreck). For work farther up-river, cooperators include the U.S. Fish and Wildlife Service (POC: Eric Nelson, Refuge Biologist), U.S. Army Corps of Engineers (POC: Robert Stansell, Gretchen Starke, and other Corps biologists), and the Oregon Cooperative Fishery Research Unit (POC: John Snelling and Carl Schreck). Animal Damage Control (ADC) has been charged with implementing avian predation abatement measures at lower Columbia River Dams. We will work with ADC and the Corps to collect birds shot as part of this program for the purpose of determining diet of adult birds outside the chick rearing period. Additionally, we will collaborate with the Washington Department of Fish and Wildlife (WDFW) in their study that investigates the effects of stranding on juvenile fall chinook in the Hanford Reach. We anticipate that additional collaborative and cooperative arrangements will be forged with other refuge managers and agencies currently engaged in or planning work on piscivorous birds on the Columbia River. Following the first field season, we will organize and conduct a workshop for agency personnel to exchange information, identify additional data sources, forge stronger collaborative ties, and evaluate potential mitigation actions concerning avian predation on juvenile salmonids.

COSTS AND FTE

1997 Planned: \$125,000

FUTURE FUNDING NEEDS:

PAST OBLIGATIONS (incl. 1997 if done):

<u>FY</u>	<u>\$ NEED</u>	<u>% PLAN</u>	<u>% IMPLEMENT</u>	<u>% O AND M</u>
1998	\$300,000	20%	80%	
1999	\$350,000	20%	80%	
2000	\$350,000	20%	80%	
2001	\$200,000	0%	100%	
2002	\$0			

<u>FY</u>	<u>OTHER FUNDING SOURCE</u>	<u>AMOUNT</u>	<u>IN-KIND VALUE</u>
1998	USACE	\$100,000	

OTHER NON-FINANCIAL SUPPORTERS:

The U.S. Fish and Wildlife Service (POC: Al Clark, Eric Nelsen, and others); Columbia River Research Laboratory, USGS/BRD (POC: Tom Poe); Oregon Cooperative Fishery Research Unit, OSU (POC: Carl Schreck, Larry Davis, and John Snelling); U.S. Army Corps of Engineers (POC: Rosy Masaika, Robert Stansell, Gretchen Starke, and others); USDA/Animal Damage Control (POC: Tom Halstead, John Cummings, and others); Washington Dept. Fish and Wildlife (POC:Paul Wagner and others); Oregon Dept. of Fish and Wildlife (POC: Bruce Schmidt and others); Yakama Indian Nation (POC: Lynn Hatcher); Confederated Tribes of the Umatilla Indian Reservation (POC: Gary James); Confederated Tribes of the Warm Springs Reservation of Oregon (POC:Jody Calica); Nez Perce Tribe (POC:Silas Whitman); and other agencies have pledged their cooperation and support for this work.

LONGER TERM COSTS:

Currently, this project is being proposed as a five year study (field: 1997-2000; completion of final report:2001) with an option to extend the term of the research beyond 2001, if warranted by the results. If field work is extended beyond 2000, then our expected budget would be similar to funding provided in that year (\$350,000) for as many years as we remain in the field. Costs for the final year of the project, which will be dedicated primarily to data analysis and the preparation of final reports, would be less (\$150,000-\$200,000).

1997 OVERHEAD PERCENT: OSU:41.5% on-campus rate, 26% off-campus rate (i.e., field work); CRITFC:37.9%

HOW DOES PERCENTAGE APPLY TO DIRECT COSTS:

OSU:These overhead rates apply to modified direct project costs (i.e., no overhead is charged on equipment, tuition, or sub-contracts beyond the first \$25,000); CRITFC:0% on sub-contracts and non-expendable property

CONTRACTOR FTE:

There will be two (2) graduate students (12 month appointments) and four (4) seasonal technicians (4-5 month appointments) working on this project. No portion of the Principle Investigator's time will be charged to this project.

SUBCONTRACTOR FTE:

There will be two (2) full-time regular employees (12 month appointments) and two (2) seasonal technicians (4-5 month appointments) working on this project for the CRITFC. Volunteers will also be used to assist with the salmon PIT tag recovery work.

