PRELIMINARY RESEARCH PROPOSAL (COE)(FY05)

Title:	Electronic recovery of ISO-PIT tags from piscivorous bird colonies in the Columbia River Basin
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PROJECT SUMMARY

Annually, piscivorous birds prey upon millions of juvenile salmonids *Oncorhynchus* spp., many of which have been PIT tagged, as they emigrate from the Columbia River Basin (Roby et al. 1998; Ryan et al. 2001). We propose to continue the sampling initiated in 1998 by using modified PIT-tag detection equipment (Ryan et al. 2001) to detect PIT tag codes on piscivorous bird colonies in the Columbia River Basin and characterize prey selectivity by avian predators on juvenile salmonids. PIT-tag detections in the estuary will be used to support decisions made in an environmental impact statement that will be used to manage the impacts of avian predation on

juvenile salmonids in the Columbia River estuary. In addition, PIT-tag detections in the McNary Dam reservoir will be used to evaluate the impacts of avian predation on survival in the Lower Monumental to McNary Dam reach. These detections will be used in conjunction with studies attempting to locate areas of salmonid mortality not directly attributed to Snake River dams and McNary Dam (Eppard et al. 2003).

In 2005, we will identify piscivorous bird colonies that may impact juvenile salmonids, which in previous years have been Caspian tern *Caspia sterna*, double-crested cormorant *Phalacrocorax auritas*, gull *Larus* spp., heron *Ardea alba, A. herodias,* and *Nycticorax nycticorax*, and American white pelican *Pelecanus erythrorhynchos* colonies. Once the birds complete their nesting season and abandon the site, we will deploy electronic PIT-tag detection equipment on each colony and detect all tag codes that can be feasibly recovered. In addition, we will plant PIT tags with known codes on the surface of the colonies before nesting begins and use these codes to evaluate sample-gear detection efficiency for each site.

While large numbers of PIT-tagged salmonids emigrate from above Bonneville Dam, virtually no PIT tagging is conducted on rivers and streams that empty directly into the Columbia River estuary. We speculate that juvenile salmonids from these streams may have longer estuarine residence times than upstream migrants, and thus, more exposure to predators. To evaluate this, we will PIT tag spring chinook salmon *O. tshawytcha*, fall chinook salmon *O. tshawytcha*, steelhead *O. mykiss*, and coho salmon *O. kisutch* from estuary streams. Further, the spring chinook salmon will be released at intervals to evaluate whether vulnerability to predation varies with time of release.

The goals of our study are to: 1) survey piscivorous bird colonies in the Columbia River Basin for PIT tags, with an emphasis on lower Columbia River and estuarine sites, to provide information for bird management activities and assess overall predation levels; 2) compare the vulnerabilities of fish of different species, rearing types, and migration and dam passage histories to avian predators; 3) compare the vulnerability of juvenile salmon released directly into the Columbia River estuary to those emigrating from upstream of Bonneville Dam; and 4) evaluate how the bird colonies' different physical environments affect tag sampling efficiency.

BACKGROUND

Rice Island, at river kilometer (RKm) 34, is a dredge-material-disposal island in the Columbia River estuary that has supported a colony of Caspian terns and double-crested cormorants since 1987. Approximately 8,000 breeding pairs of Caspian terns inhabited Rice Island annually and consumed millions of juvenile salmonids from the Columbia River (Roby et al. 1998) until 2001. The large number of PIT-tagged juvenile salmonids released into the Columbia River Basin in recent years (over 1 million in 1999) led us to believe that a significant number of tags were being deposited on Rice Island bird colonies and could be detected.

In 1998, National Marine Fisheries Service (NOAA Fisheries) personnel modified PIT-tag equipment previously used in water (Ledgerwood et al. 1997) to detect PIT-tag codes on land from fish captured by piscivorous birds in the Columbia River Basin (Ryan et al. 2001). The modified PIT-tag detection electronics were used to detect PIT-tag codes from fourteen bird colonies on ten islands in the mainstem Columbia River. The colony locations ranged from East Sand Island near the mouth of the Columbia River to Island 18 (RKm 549) about 30 km upstream from the confluence of the Snake and Columbia Rivers. Tag codes were also detected

on cormorant nests located on channel markers in the estuary. Tag detection efforts resulted in the detection of over 360,000 unique tag codes dating back to 1987 (Ryan et al. 2000; Ryan et al. in press), the first year PIT tags were released into the Columbia River Basin (Prentice et al. 1990).

Concern over impacts from the Caspian tern colony on Rice Island prompted managers to initiate a tern relocation experiment (Anonymous 1998) designed to relocate a portion of the colony farther downstream in the Columbia River estuary to East Sand Island (RKm 8) near sources of alterative prey in brackish water. The relocation effort successfully attracted approximately 1,400 breeding pairs to East Sand Island in 1999 and 9,100 breeding pairs in 2000 (Collis et al. 2000), leaving approximately 600 breeding pairs on Rice Island. Since 2001, all tern nesting in the Columbia River estuary have been on East Sand Island (CBRW 2001). The major tag detection location through 1999 was the Caspian tern colony located on Rice Island. Since 2000, the major tag detection location has been the East Sand Island tern colony (Ryan et al. 2003; Glabek et al. 2003).

While we successfully detected large numbers of PIT tags from piscivorous bird colonies and evaluated vulnerability (Collis et al. 2001; Ryan et al. 2001), these vulnerabilities have only been available for juvenile salmonids emigrating upstream from Bonneville Dam because few juvenile salmonids have been PIT tagged from streams that discharge directly into the Columbia River estuary (PSMFC 1996). In 2001, we tagged 3,000 juvenile spring chinook salmon, fall chinook salmon, and steelhead each from estuary streams for comparison to those emigrating from above Bonneville Dam. In 2002 and 2003, we repeated this effort and expanded it by increasing the number of fall and spring chinook salmon released during the tern and cormorant nesting season and by including wild coho salmon.

OBJECTIVES

Objective 1-- Detect juvenile salmonid PIT tags on piscivorous bird colonies in the Columbia River Basin.

In 2005, we will identify piscivorous bird colonies that may impact PIT-tagged juvenile salmonids, including Caspian tern, double-crested cormorant, gull, and American white pelican colonies. We will focus on colonies located in two areas--the Columbia River estuary and McNary Dam reservoir. In the estuary, the focus will be on East Sand Island to support the evaluation of Caspian tern relocation efforts to reduce impacts on juvenile salmonids (USACE 2001), along with the continued evaluation of the impacts from the growing number of double-crested cormorants nesting in the estuary. PIT tags in McNary Dam reservoir will be used to help identify areas that directly affect reach survival. Tag detections in this area will also be used by other researchers (Eppard et al 2003) to aid in survival estimates through Snake River and McNary Dams providing areas of mortality not attributed to dam passage. Additional tag location efforts will be sample if identified as potential areas of impact on PIT tagged salmonids. Each site will be surveyed for PIT tags using established techniques (Ryan et al. 2001).

Objective 2--Utilize PIT tag detections on piscivorous bird colonies to evaluate the relative vulnerability of different salmonid groups to avian predation and support survival estimates for juvenile salmonids through various river reaches.

Using the PIT-tag detections collected under Objective 1, we will assess the relative vulnerability of juvenile salmonids of different species, rearing, migration, and dam passage histories to avian predators. To date, these data have been used to evaluate the relative vulnerability of transported vs river-run salmonids, hatchery vs wild, and species vulnerability to

piscivorous birds nesting in the Columbia River estuary (Ryan et al. 2003). We will also use these data to provide similar comparisons for colonies upstream of the estuary, along with an analysis of vulnerability based on bypass history. In addition, PIT-tag detections on estuarine bird colonies comprise an important data set that will be used, in part, to estimate survival through the hydropower system to the tailrace of Bonneville Dam.

Objective 3-Compare vulnerability of salmonids released directly into the estuary to salmonids detected at Bonneville Dam.

While our effort under Objective 2 allows vulnerability to avian predation to be assessed for salmon stocks released above Bonneville Dam, it does not address the vulnerability of stocks released directly into the Columbia River estuary, which may have longer estuarine residence times and higher vulnerability to avian predation than salmonids released above Bonneville Dam. The vulnerability of these stocks is becoming increasingly important because of current efforts to relocate the world's largest Caspian tern colony farther downstream in the Columbia River estuary. PIT-tagging several groups of salmonids released into the estuary will provide a comparison of vulnerability with salmonid stocks released above Bonneville Dam.

Objective 4–Estimate the detection efficiency of PIT tags planted on the surface of piscivorous bird colonies after being subjected to a single season of nesting activity.

Detection rates of known PIT tags planted on piscivorous bird colonies before, during, and after the nesting season will allow juvenile salmonid PIT-tag detections to be expanded to estimate the total number of PIT tags deposited on each colony. In cooperation with researchers from Oregon State University (OSU), we will use predation from a know population of PIT-tagged salmonids held in a net-pen to aid in the estimates of detection efficiency and deposition

rate. In addition, we will also use the detection efficiency data to assess how different physical environments affect sampling (detection) efficiency.

RELEVANCE

The NOAA Fisheries 2000 Biological Opinion (NMFS 2000), Actions 102 and 104, specify that avian predation on juvenile salmonids be evaluated using juvenile salmonid PIT-tag information, and Action 103 specifies that predation by white pelicans in the McNary Dam reservoir be quantified.

METHODS

Predatory bird colonies will be identified in collaboration with OSU, Willamette University (WU), and Columbia River Inter-Tribal Fish Commission (CRITFC) researchers by surveying islands in the Columbia River. These initial surveys will be based on previous research conducted by OSU, NOAA Fishseries, and CRITFC. After birds vacate the colonies (late-July), NOAA Fisheries will conduct ground surveys and determine the appropriate method required for efficient recovery of ISO-tag information, either the flat-plate antenna or pole mounted antennas (Ryan et al. 2001).

PIT-Tag Recovery

Target bird colonies will be surveyed, boundaries documented, and transect lines established within the colonies to ensure sampling coverage is complete. We anticipate tag recovery efforts will be concentrated on the same colonies and islands that were previously

sampled in 2001 (Glabek et al. 2003), with the omission of Little Memaloose and Three Mile Canyon Islands. Where appropriate, the flat-plate detector will be deployed passing in one direction over the entire colony for one complete pass. We will then pass the detector perpendicular to the initial direction to detect additional tags not previously detected due to orientation or other problems (in 1998 our second pass over the tern colony on Rice Island yielded about 20% additional tags). We will continue additional passes until numbers of new detections decline to <10%. For example, in 1998 the third pass on Rice Island yielded 6% new tags. Where it is not logistically practical to deploy the flat-plate antenna, we will use pole mounted antennas and sample each colony two complete times in opposite directions (Ryan et al. 2001; Ryan et al. 2003). If the second pass yields more than 6% new tags or more than 500 new tags, we will complete a additional passes until this goal is reached.

Estuarine Vulnerability

Juvenile salmon will be PIT tagged from hatcheries and released directly into the Columbia River estuary. We plan to tag hatchery steelhead from the Elochoman River, hatchery fall chinook and coho salmon, and naturally-reared coho salmon from the Chinook River (Sea Resources Hatchery), and spring chinook salmon from a NOAA Fisheries ocean-entry survival study reared in net-pens in Blind Slough (William Muir, NOAA Fisheries, Pers. commun., December 2003). We will tag 3,000 steelhead, fall chinook salmon, and coho salmon at each of the designated hatcheries. One group of 3,000 naturally-reared coho salmon will be PIT-tagged by Sea Resources hatchery personnel. The PIT-tagged salmonids will be released during the Caspian tern and double-crested cormorant nesting seasons. In addition, we will tag and release

6 groups of 2,000 spring chinook salmon at the Blind Slough net-pen site that will be released at evenly spaced intervals throughout the spring of 2003.

PIT-Tag Sampling Efficiency

To evaluate the detection efficiency of known PIT tags deposited on piscivorous bird colonies, we will deposit 300 PIT tags on the surface of approximately 10 colonies prior to the nesting season and an additional 150 to 300 tags on these colonies immediately prior to tag recovery efforts. After tag recovery efforts have been completed, detection efficiencies will be calculated for each location for both pre-nesting tags and post nesting tags. In addition, on East Sand and Crescent Island tern colonies we will plant tags at varying times throughout the nesting season. The recovery rates of these tags will be used to help established when tags are being lost.

SCHEDULE

Once the birds vacate their nesting colonies in late July and after the pair-trawl work has been completed, the ISO-tag electronics from the pair-trawl operation will be transferred to this study. We will conduct initial site visits to assess logistical requirements for colonies we have not previously sampled. ISO-tag recoveries from bird colonies will begin as early as August 2005 and continue through December 2005.

DATA ANALYSIS AND STATISTICS

Using descriptive statistics, we will estimate the total number of PIT tags detected at each colony site by species, and rearing, migration, and dam passage histories and compare the total detected to total released for individual groups.

EXPECTED RESULTS AND APPLICABILITY

The results of recovery efforts obtained using the flat-plate and hand held antennas from 1998 to 2003 yielded over 360,000 unique PIT-tag codes, including several fish species, runs, and rearing types dating back to 1987. The 2005 effort should provide 60,000 to 80,000 unique migration year 2005 ISO tags from salmonids emigrating from the Columbia River Basin. The continued collection of PIT tag codes adds to a body of data that is and will be used to assess and inform several key issues related to the operation and configuration of the FCRPS and the effects of avian predation on smolt survival through the Columbia River Basin and estuary. PIT tag detections at upriver sites are particularly important to the question of what is causing the downward trend in steelhead in-river survival. For example, the Lower Granite Dam to Bonneville Dam survival in 2002 was 26%. This is well below the 2000 Biological Opinion requirement for operation of the FCRPS, and the action agencies will need to address this issue. One cause of this reduced survival might be avian predation in the McNary Dam reservoir where 7.6% of in-river migrating steelhead detected at Lower Monumental Dam were subsequently detected on the Crescent Island tern colony in 2002 (Ryan et al. in prep).

PIT tag detections will also allow us to look for potential effects from passing through the FCRPS and experiencing conditions of passage routes. For example, we will continue to use

these data to evaluate the differences between species, ESUs, transported and in-river passage, potential effects of delayed mortality and passage through bypass systems. Moreover, these data are currently being used and will continue to be used to aid the USFWS and COE to decide what reduction in tern predation will be needed to generate the necessary response in the lambdas of key salmonid ESUs. The 2005 detections will estimate loss and vulnerability and may be used to estimate survival through the hydropower system to the tailrace of Bonneville Dam.

COLLABORATIVE ARRANGEMENTS

Collaboration with OSU, WDFW, and CRITFC researchers identifying piscivorous bird colonies will continue. Tag detection records will be uploaded to the PIT-Tag Information System (PTAGIS) regional database (PSMFC 1996), providing researchers in the region access to data on avian predation. Tagging of juvenile salmonids near the estuary will be completed with the cooperation of Sea Resources and Elochoman Hatchery personnel, along withNOAA Fisheries researchers evaluating effects of ocean-entry timing. Sea Resources plans to PIT tag naturally-reared coho and chinook salmon, cutthroat trout, and steelhead in the Chinook River watershed that we will use in our assessment of avian predation. PIT tags implanted in spring chinook salmon by the NMFS ocean-entry survival study will also be used to estimate variability in avian predation impacts in the estuary to improve the analysis of the relationship between SARs and ocean conditions at the time of entry.

TECHNOLOGY TRANSFER

Information acquired during the proposed work will be transferred in the form of

written and oral research reports as required. Because we must rely on the accuracy of the data being loaded into PITAGIS, a draft report will be provided to the COE by 1 April 2006 and the final report will be completed after appropriate review.

KEY PERSONNEL

Brad Ryan	- Project Leader and Research Fishery Biologist
Richard Ledgerwood	- Research Fishery Biologist
Gene Matthews	- Acting Program Manager
Steven Smith	- Statistician
Benjamin Sandford	- Statistician

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