

# WASHINGTON SEA GRANT PROGRESS REPORT

for the period 2/1/2008 – 1/31/2009

WSG Project Number: **R/F-159**  
Project Title: Recolonization of the upper Cedar River by anadromous salmonids

Principal Investigator(s) and Affiliation:  
**Thomas Quinn** University of Washington, School of Aquatic and Fishery Sciences

## 1. ABSTRACT ELEMENTS

### OBJECTIVES

Anadromous salmonids were denied access to 27 km of stream habitat in the upper Cedar River system by a diversion dam in 1900. Absent for over a century, adult salmon were allowed into these mainstem and tributary habitats by dam modification in 2003. Our initial study documented colonization and choice of breeding locations by salmon in this new habitat, and the distribution and growth of juveniles. We propose to continue this work, using DNA parentage to assess the reproductive success of the colonists. Our long-term purposes are two-fold. With respect to the Cedar River, we seek to establish a scientific basis for evaluating the success of the re-colonization effort by regular sampling of the numerical, ecological and genetic changes in the population. Our broad-scale objective is to use the Cedar River to test general hypotheses regarding the processes of natural and human-assisted population expansion.

### METHODOLOGY

All adult coho and Chinook salmon arriving at the dam's bypass facility will be anesthetized, measured, and sampled for DNA. Juveniles from two brood years have already been collected from tributary and mainstem habitats, measured, weighed, and sampled for DNA. DNA sampling of adults in the parental and returning generations will reveal the extent to which the first colonists produced offspring that returned. Alternatively, the habitat could continue to receive only strays from the populations below the dam. Parentage analysis of both juveniles and adult offspring will reveal which adult traits were associated with reproductive success such as body size, date of spawning, and wild or hatchery origin.

### RATIONALE

After decades of extirpating salmon from spawning and rearing habitat by dams, we are beginning to plan and initiate reintroduction programs by removing or circumventing the dams. The choice of reintroduction approach (active or passive) will depend on the perceived benefits in terms of rapid population expansion and persistence. It is essential that information be collected from the very beginning of such studies to document the successes and failures, facilitating learning from these special restoration programs. This project addresses the goals of the Fisheries and Marine Resources subprogram by providing information "to restore genetic diversity and sustainability [of] fisheries stocks."

## 2. ACCOMPLISHMENTS AND OUTCOMES

During the past year we accomplished the following:

- 1) Continued collaborating with Seattle Public Utilities staff to sample adult coho and Chinook salmon ascending the Landsburg Dam,
- 2) Continued collaborating with NOAA-Fisheries staff to study the ecology, movement, growth and survival of juvenile coho salmon, rainbow trout, and cutthroat trout in the Cedar River watershed above Landsburg Dam,
- 3) Extracted DNA from small samples of fin tissue and processed the samples at 10 microsatellite loci,
- 4) Published papers in scientific journals and reported the results at national and local meetings,
- 5) Met often with managers of the fisheries, land, and water to discuss the implications of our work.

## 3. IMPACTS

**Sea Grant documents the success of natural recolonization of Pacific salmon habitat.**

**Current:** Despite substantial funding for stream restoration projects, limited evaluation of outcomes has restricted our ability to learn from mistakes and replicate our achievements. Specifically, if salmon are given access to habitat from which they had been excluded (e.g., by dams, culverts and other barriers to migration), will they enter this habitat. If so, will they successfully reproduce and build a self-sustaining population? In our study, the number of adult salmon making use of the new habitat, as well as the widespread movements of some salmon above the dam, suggest that exploration is an innate component of salmon breeding behavior. This intrinsic aptitude for dispersal into new areas bodes well for similar projects elsewhere.

**Impact:** The results showing the ability of natural processes to re-establish salmon populations in areas from which they had been excluded argues against releases of hatchery-produced fish and in favor of natural recolonization. Disseminating the rates and processes of salmon recolonization in the Cedar River will help managers throughout the region identify migration barriers suitable for removal or circumvention. High-profile dam removal or modification projects such as the Elwha and Klamath rivers and smaller, less publicized projects will all benefit from our findings, and we are communicating our results widely.

## 4. PERFORMANCE MEASURES

The modification of Landsburg Diversion Dam, costing millions of dollars, was undertaken for the explicit purpose of enhancing salmon runs by providing them with access to high quality habitat from which they had been excluded for a century. Salmon entered this habitat but those fish would otherwise have spawned elsewhere. Thus in the first years the project did not produce any new fish, only redistribute existing fish. Our project is determining whether or not the population is now self-recruiting, and this is the critical piece of information needed to determine whether or not it was a success. The information that we are collecting is being provided to the legal co-managers of the fisheries (the Washington Department of Fish and Wildlife and the Muckleshoot Indian Tribe), the managers of the water supply (Seattle Public Utilities) and NOAA-Fisheries (the agency responsible for recovery of the Chinook salmon that are listed under the Endangered Species Act). In addition, one contentious question during the recolonization process was whether or not hatchery-origin salmon should be allowed to access the

newly opened habitat or whether access should be limited to wild salmon. Our genetic analyses will help inform this decision by determining the relative reproductive success of wild and hatchery-produced salmon.

*Actual (reporting period covered by this report):*

Information services provided to management: The Cedar River Anadromous Fish Committee has used our information in making decisions regarding the recolonization process, as has the Cedar River Habitat Conservation Plan review committee.

*Anticipated (12-month period following this reporting period):*

Continued and increased use of the information is anticipated as our DNA analysis determines whether or not the populations are self-recruiting, and whether wild and hatchery Chinook salmon had equal reproductive success.

## **5. PUBLICATIONS**

**Please refer to instructions for hardcopy reprint requirements and citation formats.**

### **A. Journal articles:**

Anderson, J. H., P. M. Kiffney, G. R. Pess and T. P. Quinn. 2008. Summer distribution and growth of juvenile coho salmon during colonization of newly accessible habitat. *Transactions of the American Fisheries Society* 137: 772-781.

Kiffney, P.M, G.R. Pess, J.H. Anderson, P. Faulds, K. Burton, and S.C. Riley. 2009. Changes in fish communities following recolonization of the Cedar River, WA after 103 years of local extirpation. *River Research and Applications* 25: 438-452.

### **B. Theses and dissertations:**

### **C. Book chapters:**

### **D. Book or Monograph:**

### **E. Paper in Proceedings**

### **F. Proceedings or Symposia:**

### **G. Technical reports:**

### **H. Advisory publications (e.g. handbooks, manuals, guides):**

### **I. Magazine articles:**

Anderson, J.H. 2008. Above the dam: coho salmon colonize Washington's Cedar River. *The Osprey* 60: 9-11.

### **J. Media Placements:**

### **K. Other publications (e.g., videos, DVDs, software, websites):**

## **6. PRESENTATIONS - inc. Conference (Poster or Oral), Seminar & Public**

### **George Pess**

A comparison of differences in juvenile coho salmon (*Oncorhynchus kisutch*) performance between survivors and non-survivors in a recently colonized stream. Puget Sound/Georgia Basin Conference in Seattle, WA. February 2009.

Annual update on the Cedar River recolonization project to staff of Seattle Public Utilities at North Bend, WA. February 2009.

*Oncorhynchus mykiss* population structure response to environmental changes in the Cedar River, Washington. Oregon American Fisheries Society meeting in Bend, Oregon. Lead author was Brad Thompson, USFWS. February 2009.

### **Joseph Anderson**

Reproductive success of Chinook and coho salmon during colonization of newly accessible habitat. Puget Sound and Georgia Basin Ecosystem Conference, Seattle, WA. February/2009.

Reproductive success of coho salmon during colonization of newly accessible habitat. Coastwide Salmonid Genetics Conference, Olympia, WA. June 2008.

Reproductive success of coho salmon during colonization of newly accessible habitat. Annual General Meeting, Washington – British Columbia Chapter, American Fisheries Society, Bellingham, WA. March 2008.

Reproductive success of coho salmon during colonization of newly accessible habitat. Cedar River Council meeting, Renton, WA. February 2008.

Reproductive success of coho salmon during colonization of newly accessible habitat. Watershed Management Office, Seattle Public Utilities, Cedar Falls, WA. January 2008.

Reproductive success of coho salmon during colonization of newly accessible habitat. Graduate Student Symposium, School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA. January 2008.

### **Thomas Buehrens**

Growth, movement and survival of coastal cutthroat and rainbow trout during invasion by Pacific salmon. Puget Sound Georgia Basin Ecosystem Conference, Seattle, WA, February 2009.

## **7. PATENTS AND COPYRIGHTS**

## **8. NEW BUSINESSES OR JOBS CREATED**

## **9. LIST ALL STUDENTS SUPPORTED BY OR AFFILIATED WITH THIS PROJECT**

\_\_\_\_\_ no students involved (check here if no students were involved in the project)

Student Name: Joseph Anderson  
Department: School of Aquatic and Fishery Sciences  
Major/Degree field: Aquatic and Fishery Sciences  
Major Professor: Thomas Quinn  
Student Type Ph.D.  
Dissertation/Thesis title: Reproductive success of coho salmon during colonization of newly accessible habitat.  
Date of graduation: Anticipated Spring 2010  
Total support period: Fall 2003 to present  
Type of support: RA, research costs, conferences, field travel, etc.  
Current employment if applicable: Currently pursuing Ph.D. degree

Student Name: William Atlas  
Department: School of Aquatic and Fishery Sciences  
Major/Degree field: Aquatic and Fishery Sciences  
Major Professor: Thomas Quinn  
Student Type B.S.  
Dissertation/Thesis title:  
Date of graduation (actual or anticipated): June 2008  
Total support or affiliation period: October 2006 – March 2009  
Type of support: Hourly, then monthly employment and training in lab techniques  
Current employment if applicable: University of Washington, will enter graduate school at Simon Fraser University in Burnaby, B.C. in fall 2009.

Student Name: George Pess  
Department: School of Aquatic and Fishery Sciences  
Major/Degree field: Aquatic and Fishery Sciences  
Major Professor: Thomas Quinn  
Student Type Ph.D.  
Dissertation/Thesis title: Patterns and processes of salmon colonization  
Date of graduation (actual or anticipated): May 26, 2009  
Total support period: :Fall 2005 to present  
Type of support: research costs for field work  
Current employment if applicable: Currently completing his Ph.D. degree, will work full time for NOAA-Fisheries upon graduation

Student Name: Thomas Buehrens  
Department: School of Aquatic and Fishery Sciences  
Major/Degree field: Aquatic and Fishery Sciences  
Major Professor: Thomas Quinn  
Student Type M.S.  
Dissertation/Thesis title: Ecology of rainbow and cutthroat trout in the Cedar River system  
Date of graduation: Anticipated Fall 2010.  
Total support period: Fall 2008 to present:  
Type of support: research costs, logistic support

Current employment if applicable: Currently pursuing M.S. degree

## **10. INTERACTIONS**

We have developed an excellent collaborative relationship with two local agencies: Seattle Public Utilities (SPU) and the National Marine Fisheries Service (NMFS). In addition to their in-kind funding of research costs, SPU has assisted us immensely in the sampling and tagging of adult salmon at the fish ladder and logistical support for field work. NMFS ecologists Peter Kiffney and George Pess are investigating salmon recolonization in the Cedar River from community and ecosystem perspectives. This provides an excellent comparison to our work, which has focused on behavioral ecology, and our combined projects will provide a detailed and comprehensive picture of salmon colonization. In addition, sampling of juvenile salmon and PIT tagging conducted by NMFS scientists has provided samples of DNA for our project and data on movements of individuals that we would not otherwise obtain.

## **11. OUTREACH AND INFORMATION/TECHNOLOGY TRANSFER**

In addition to the scientific presentations by Joseph Anderson indicated in item 6 (above), the P.I. (Thomas Quinn) and doctoral student Joseph Anderson described the results in presentations to local anglers clubs and to the Cedar River Anadromous Fish Committee (the local inter-agency group that is responsible for decisions regarding the management of the river). These presentations are an important part of the outreach because they inform the user groups (recreational and tribal fishermen) who will benefit from the expanding fish runs.

## **12. FUTURE ACTIVITIES**

During the final years of the project we will focus our efforts on 1) continued collection and processing of DNA samples from returning adult salmon to determine the realized reproductive success of the fish that initially colonized the Cedar River above Landsburg Dam, and 2) analysis and report preparation for the data on adults and juveniles, 3) completion of the doctoral dissertation of Joseph Anderson, and 4) preparation of proposals to other agencies in an effort to continue support .