WASHINGTON STATE RECREATION AND CONSERVATION OFFICE
Salmon Recovery Funding Board

PROPOSED
Salmon Recovery Funding Board Meeting Agenda

February 27, 2013
Natural Resources Building, Room 172, Olympia, WA 98504

Time: Opening sessions will begin as shown; all other times are approximate.

Order of Presentation:
In general, each agenda item will include a presentation, followed by board discussion and then public comment. The board makes decisions following the public comment portion of the agenda item.

Public Comment:
If you wish to comment at a meeting, please fill out a comment card and provide it to staff. Please be sure to note on the card if you are speaking about a particular agenda topic. The chair will call you to the front at the appropriate time.

You also may submit written comments to the Board by mailing them to the RCO, attn: Rebecca Connolly, Board Liaison at the address above or at rebecca.connolly@rco.wa.gov.

Special Accommodations:
If you need special accommodations to participate in this meeting, please notify us at 360/902-3086 or TDD 360/902-1996.

WEDNESDAY, FEBRUARY 27

OPENING AND WELCOME

9:00 a.m. **Call to Order** *Chair*

- Determination of Quorum
- Introduce New Policy Director, Nona Snell
- Review and Approval of Agenda (Decision)
- Approval of December Meeting Minutes ***(Decision)***

MANAGEMENT AND PARTNER REPORTS (Briefings)

9:05 a.m. **1. Management Report** *Kaleen Cottingham*

A. Director's Report
- Legislative Updates *Nona Snell*
- Policy Updates: Status of Manual 18 Changes *Brian Abbott*
- Performance Update (written only) *Rebecca Connolly*

B. Financial Report

9:20 a.m. **2. Salmon Recovery Management Report**

- Grant Management, Governor's Salmon Recovery Office, and Monitoring *Brian Abbott*
  - Role of GSRO and Regions in Light of Contractor's Report
  - Regional and Lead Entity Contracts for 2013-15 Biennium
  - Video Update
  - PCSRF Application *Marnie Tyler*
  - Salmon Recovery Conference *Sarah Gage*
  - State of Salmon in Watersheds Report *Jennifer Johnson*
- Completed Projects of Note *Grant Managers*
  - Port Susan and other projects

10:40 a.m. **BREAK**

10:50 a.m.	**3. Reports from Partners**	
	A. Council of Regions Report	*Jeff Breckel*
	B. Lead Entity Advisory Group Report	*Cheryl Baumann*
	C. Regional Fisheries Enhancement Groups	*Lance Winecka*
	D. Board Roundtable: Other Agency Updates	*SRFB Agency Representatives*
	General Public Comment: *Please limit comments to 3 minutes*	

BRIEFINGS

11:20 a.m.	**4. Report on Estuary and Salmon Restoration Program (ESRP)**	*Betsy Lyons, WDFW* *Mike Ramsey*
11:50 a.m.	**5. Family Forest Fish Passage Program Presentation and Video**	*Dave Caudill* *Laura Till, WDFW* *Rick Kuykendall, DNR* *Michelle Peterschick, DNR*
12:15 p.m.	**6. Service Recognition: Craig Partridge**	*Chair Hover*
12:30 p.m.	**LUNCH**	
1:15 p.m.	**7. Overview of Monitoring Program** • Current funding approach • Status of monitoring assessment to be completed in October • Decisions for 2013 needed in May	*Brian Abbott* *Keith Dublanica*

DECISIONS

1:30 p.m.	**8. Stream Habitat Restoration Guidelines Monitoring Chapter Update** **Decision:** Approve use of up to $25,000 in federal fiscal year 2012 Pacific Coastal Salmon Recovery Fund (PCSRF) dollars to fund the update.	*Brian Abbott*

BRIEFINGS

1:45 p.m.	**9. Monitoring Program Findings & Results**	
	• Background of Intensively Monitored Watersheds (IMW) Program	*Brian Abbott*
	• Approach and Context for Board's Program & Funding	*Keith Dublanica*
	• Relationship to Status & Trends Monitoring	
	• Findings and Results at IMW Locations	*Correigh Greene, Northwest*
	• Skagit IMW	*Fisheries Science Center*
2:30 p.m.	**BREAK**	

2:45 p.m.	**Item 9, Continued**	
	• Findings and Results at IMW Locations	
	• Straits IMW	*Bill Ehinger, Ecology*
	• Lower Columbia IMW	*Tim Quinn, WDFW* *Mara Zimmerman, WDFW*
	• Hood Canal IMW	*Kirk Krueger, WDFW*
3:45 p.m.	**ADJOURN**	

Salmon Recovery Funding Board Summarized Meeting Agenda and Actions, December 6-7, 2012

Agenda Items without Formal Action

Item	Follow-up Actions
Item 1: Management Reports	There were no follow-up actions.
Item 2: Salmon Recovery Management Reports	There were no follow-up actions.
Item 3: Reports from Partners	There were no follow-up actions.
Item 4: Lead Entity Consolidation	There were no follow-up actions.
Item 7: Communication Plan Updates	There were no follow-up actions.
Item 8: State of the Salmon in Watersheds Report	There were no follow-up actions.
Item 11: Assessment of Roles and Responsibilities for the Governor's Salmon Recovery Office	There were no follow-up actions.

Agenda Items with Formal Action

Item	Formal Action	Follow-up Actions
Minutes	Approved Minutes from September 2012	There were no follow-up actions.
Item 5: 2012 Grant Round	Approved $1,195,165 in SRFB funds for projects and project alternates in the Hood Canal Region. Approved $2,700,000 for projects and project alternates in the Lower Columbia Region. Approved $360,000 for projects in the Northeast Region. Approved $6,795,035 in SRFB funds for projects and project alternates in the Puget Sound Region. Approved $1,258,333 in PSAR funds for projects in the Puget Sound Region. Approved $1,598,400 for projects and project alternates in the Snake River Region. Approved $1,953,000 for projects and project alternates in the Upper Columbia Region. Approved $1,620,000 for projects and project alternates in the Coastal Region. Approved $1,776,600 for projects and project alternates in the Yakima Mid-Columbia Region.	There were no follow-up actions. The Washington Coast Region has asked that the board consider inviting the Wild Fish Conservancy to do a briefing on its Grays Harbor Juvenile Fish Use Assessment project.
Item 6A: Manual 18 Administrative Updates	Approved incorporating the criteria regarding acclimation ponds into Manual 18.	Staff to distribute Manual 18 for stakeholder comment before completing it in January 2013.

Item 6B: Manual 18 Review Panel Policy Recommendations	Adopted the recommendations of the Review Panel to update Manual 18 policies regarding knotweed control, beaver reintroduction projects, and Review Panel evaluation criteria.	Staff to consider the salmon recovery niche of knotweed strategy as part of its policy work during 2013. Staff will work with Member Troutt to address his concerns about the streambank stabilization language, and will share the resulting draft language with the board.
Item 9: Board Meeting Schedule	Approved the revised dates for 2013.	Staff to notify the code reviser and post the dates on the RCO web site.
Item 10: Approve Funding and Scope of Work for Monitoring Program Assessment	Approved the use of $75,000 in 2012 monitoring funds for an assessment of the board's monitoring strategy.	Final report to the board in October 2013.

SALMON RECOVERY FUNDING BOARD SUMMARY MINUTES

Date: December 6, 2012
Place: Olympia, WA

Salmon Recovery Funding Board Members Present:

Bud Hover, Chair	Okanogan County	**Bob Everitt**	Department of Fish and Wildlife
Harry Barber	Washougal	**Carol Smith**	Conservation Commission
Josh Brown	Kitsap County	**Craig Partridge**	Department of Natural Resources
Phil Rockefeller	NWPCC	**Melissa Gildersleeve**	Department of Ecology
David Troutt	Olympia		

Josh Brown arrived at 1:55 p.m. Mike Barber was excused.

It is intended that this summary be used with the notebook provided in advance of the meeting. A recording is retained by RCO as the formal record of meeting.

Opening and Welcome

Chair Bud Hover called the meeting to order at 9:03 a.m. and a quorum was determined.

Phil Rockefeller moved to adopt the agenda.
Seconded by: David Troutt
Motion: APPROVED

David Troutt moved to adopt the September 2012 minutes.
Seconded by: Harry Barber
Motion: APPROVED

Item 1: Management Reports

Director Cottingham presented information as described in her director's report, focusing on the reviews of the salmon recovery structure, audits, hiring of a new policy director, information technology initiatives such as the online application tool, and training. She also explained the status of salmon-related budget requests for the state capital and operating budgets. She also addressed the constitutional amendment, and reminded the board about their responsibilities to adhere to the laws about lobbying during the legislative session.

Item 2: Salmon Recovery Management Reports

Brian Abbott reviewed the information from the management report. Grant manager Kat Moore reviewed the recently completed Bear River project; the board funded the design work but not the restoration. She reviewed future plans for the site and the effects of the restoration. Chair Hover asked if the outreach issues had been resolved. Moore responded that there was a new refuge manager and some new officials, and that they were working on the issues but that they had not been resolved. Member Troutt asked if they had adopted a Comprehensive Conservation Plan. Moore said they had. She then discussed the

Condit Dam Removal, which is not a board-funded project, but the board will be participating in several related habitat and restoration projects. She shared a National Geographic video of the dam removal.

Item 3: Reports from Partners

Council of Regions: Jeff Breckel presented the Council of Regions report. He noted the work that they have been doing with regard to the assessment of GSRO, the review of monitoring support, and their work with agencies to accomplish recovery plans, and noted specific items they would be discussing with each agency. They are looking forward to working with Conservation Commission on legislative initiatives and the same with Ecology. Rockefeller asked what the legislative initiatives might be; Breckel responded that included support for the conservation districts and support for the state match on programs like the conservation reserve enhancement program (CREP). On the State of the Salmon report, it has been a significant undertaking. They have invested a great deal of time and are anxious to see it come together.

Lead Entity Advisory Group: Darcy Batura presented information about leadership within various lead entities and shared a printed report. They are considering changing the name of the LEAG, and have developed a communications group. They are looking at improving their web site to do a better job at telling their story and using videos.

Regional Fisheries Enhancement Groups: Lance Winecka noted that RFEGS are working to secure their federal funding, continuing their work to secure funding through the egg and carcass program with WDFW, and doing more educational outreach to the legislature.

Mendy Harlow presented information about their approach to controlling knotweed in riparian areas. She noted how they are able to use other funds to control the knotweed, and then use board funds to replant the areas. Member Troutt asked what their regional strategy looks like. Harlow responded that they focus first on freshwater, then on estuaries, and then on areas that don't have transport issues (e.g., terrestrial areas). They also address data collection and reporting, and use shared control methods so that they are using effective amounts. There also is a shared public outreach, monitoring, and lessons learned component. Member Barber asked how knotweed ranks compared to other salmon recovery needs. He and Hover suggested it should be a class A weed, rather than a class B weed, thereby requiring landowners to do the work. Member Troutt asked if the strategy gets to the watershed level. Harlow responded that it does get to that level, and often gets to the parcel-by-parcel level. Winecka noted that the lead entity is developing a similar plan in the Nisqually area. Member Rockefeller asked if there is a policy to deal with knotweed each time it is encountered. Harlow responded that they deal with it when it is encountered, so that they do not spread it in the process of doing other work. She also noted that they are able to use less herbicide over time as the plants die back. Member Smith asked if they work with conservation districts and others, and share methodologies and maps with them to achieve a strategic approach and funding strategy. Harlow responded that they do.

Washington Department of Fish and Wildlife (WDFW): Member Bob Everitt noted that Jennifer Quan has been selected to fill the vacancy left by Sara LaBorde during the summer. She likely will be taking on the board position in 2013. He also noted the federal sequestration of funds could result in a 7.8 percent reduction in funds for the hatchery program. WDFW will not do much with regard to the hydraulic permit program during legislative session, but is working on a web-based system to make it more efficient.

Conservation Commission: Member Carol Smith noted that they will be seeking funding from the legislature for the voluntary stewardship program. Once funding is found, there will be a technical panel

and recovery plans to deal with agricultural lands in critical areas. They also will be seeking funding for CREP, which is designed for riparian restoration toward salmon recovery. There is a lot of interest in the legislation to exempt landowners who participate in conservation efforts from civil liability.

Department of Natural Resources: Member Craig Partridge had no updates.

Department of Ecology: Member Melissa Gildersleeve updated the board on watershed planning grants. They will know if there is money after the legislative session.

Northwest Power Council: Member Rockefeller noted that the Northwest Power Council will be initiating year-long process to develop an updated fish and wildlife program for the Columbia Basin. They like to hear from the public, tribes, and fish and wildlife agencies. This is an opportunity for a strategic repositioning of the program efforts funded by Bonneville.

General Public Comment

There was no general public comment.

Item 4: Lead Entity Consolidation

Julie Morgan, Derek Van Marter, and Lloyd Moody presented this topic. Julie Morgan noted that the genesis of the effort was a letter from RCO Director Cottingham asking the region to explore the idea in the effort to reduce costs and improve efficiencies. She described the process, including actions and decision points, noting the RCO's involvement in the process. Morgan noted that cities, lead entities, and tribes were involved in the process, giving input and helping to design the structure. She shared how tasks would be administered by the region under the new structure. She provided a draft of the report, noting that a final report would be submitted to Director Cottingham the next week. A single lead entity coordinator would be hired, and would start in January 2013. Lead entities and tribes were integral to the transition process. She shared a list of organizations that wrote letters of support, noting that some were not interested in the process, while others increased their engagement and asked for annual updates. She noted that they will maintain separate citizen committees to respect local preferences. They also met with project sponsors to understand their concerns; their preferences will be reflected in the regions.
Van Marter thanked the board for letting them handle it locally rather than top-down. The cost savings will be 10 percent. Director Cottingham noted that additional budget reductions would not be added to that. Chair Hover noted it relieves perceived conflicts of interest and saves money.

Member Troutt asked if the new lead entity has been formed; she noted that it would happen on January 1, but the paperwork is in place. He asked how they would manage two citizen committees. Van Marter responded that they already maintain three citizen committees and submit one regional list, and explained the process of developing the project list.

Item 5: 2012 Grant Round

Brian Abbott thanked salmon section staff for their hard work in 2012 to make the grant round work. He also acknowledged Marnie Tyler for her work in helping to create the funding report.

Abbott described the 2012 grant round timeline, noting the major milestones leading up to the funding meeting. He noted that for Puget Sound Acquisition and Restoration (PSAR) funds, the funding table includes some returned funds. The total that the board is approving includes those funds. He also noted that the project of concern for the Hood Canal region had been cleared by the Review Panel, and staff was recommending that the board approve the list with the project clear and approved as an alternate.

Patty Michak gave an overview of the Review Panel comments, explaining what they found worked well and what did not. They have asked that they reduce the review cycles from four to three in the 2013 grant cycle. They noticed this year that there are some projects that are setting the stage for future high-cost, large-scale projects; the Review Panel is concerned that funding may not exist. Member Barber asked if the projects could be sequenced. Michak responded that many would be, but that some construction projects cannot be sequenced, or would incur additional costs if they were because equipment would be staged multiple times.

Comments from the Regions

Hood Canal: Richard Brocksmith and Richard Carlson presented information about the application process, noting that they included more community involvement in 2012. Brocksmith noted that they have complete agreement on the list between the citizen and technical committees, and they are very proud of their list. Member Troutt asked if the Regional Implementation Technical Team (RITT) reviewed Hood Canal projects. Brocksmith responded that they review the 3-year work plan. For summer chum, they work directly with NOAA domain team, which has greater technical expertise. Chair Hover asked what the issue was on the project of concern. Brocksmith responded that the project was proposed narrowly, so it didn't provide enough material to satisfy the Review Panel. It took them a lot of time to get from a concept to a detailed proposal, and there was a lot of miscommunication. Member Troutt asked about how the funding for project six (#12-1385, Dosewallips and Duckabush Acquisitions 2012) would be applied. Brocksmith responded that the partial funding would go to the higher priority acquisition first, as a condition of the citizens' committee. Brocksmith then discussed results of the projects, in terms of escapement and spatial diversity.

Lower Columbia: Jeff Breckel stated that there was a good process in 2012. Most of the projects were designed and implemented to build on work that was already done in the subbasins. They have two projects that are related to knotweed. This has been a concern for their technical review panel, but these provide systemic approaches. Both projects are proposed by the conservation district, and both focus on finding the uppermost extent of the knotweed. He addressed a few projects with conditions, and noted that the local technical committee agreed with the conditions. Breckel concluded by stating that they had a good turnout and good support from sponsors, resulting in a good list.

Northeast: Nick Bean presented. He noted that they had a typical year that resulted in two good projects. They are going through a transition process. Kelley Jorgenson provided really good comments for the project sponsors, and that worked well, making it a clean grant round process. Director Cottingham reminded the board that these projects are funded with state funds because the Northeast has no anadromous fish.

Puget Sound: Jeannette Dorner reviewed their selection process, noting that there was good progress on coordinating the Review Panel and the RITT. In 2012, there were 52 projects for Puget Sound. Dorner highlighted a few projects of note: Rocky Bay Estuary Acquisition, Lower Ohop Creek Protection and Restoration, and Fir Island Farm Restoration. She thanked the board for the thorough review and selection process, and thanked RCO staff for their support and assistance. Director Cottingham noted that she and Dorner attended a ribbon-cutting at Port Susan the day before.

Snake River: Steve Martin noted that he appreciates the regional allocation framework because, when combined with the three-year workplan, it provides a great degree of predictability. That works well for planning. He thanked the board, but took time to also thank the landowners who allow the work on

private property, the sponsors, grant manager Kay Caromile, the Review Panel, and the rest of the RCO. He noted that projects are becoming more complex, and are requiring more integration of multiple funding sources and partners. They have Bonneville Power Administration, tribes, and the city of Dayton as sponsors this year.

Upper Columbia: Julie Morgan and Derek Van Marter presented. Van Marter thanked the board and said that the success in Washington is due to the top-down approach that makes resources available to the local decision makers. He then reviewed regional highlights, and the need to have a way to share the story and line up funding for large-scale projects. He noted that they have started to work with others on related issues like forest health. Morgan then discussed how fish are responding, sharing adult abundance figures for sockeye, steelhead, and spring Chinook. Van Marter concluded the presentation, stating that their ongoing success is dependent on voluntary involvement of landowners, so they are continuing to work on the landowner liability issue.

Washington Coast: Miles Batchelder thanked the board and the RCO. He also noted that it remains important to fund preservation of healthy populations along with recovery. This was a good grant round for them, with a good process that resulted in a strong list. He noted that having Road Maintenance and Abandonment Plan (RMAP) projects be eligible is important to them because so much prime habitat is on timber company land. He also noted that the Wild Fish Conservancy is doing the third round of funding on the Grays Harbor Juvenile Fish Use Assessment. He wants to have the sponsor present results to the board. He mentioned the Wein's Farm Riparian Acquisition, which has 100 feet of water rights; this is an important first step to do some water rights banking in the Chehalis Basin. He also noted that the regional plan is near completion.

Klickitat Lead Entity: John Foltz from the Klickitat Lead Entity presented information about the three projects they are proposing and the numbers of steelhead. Member Gildersleeve asked about the relationship to Condit Dam. He responded that the extent of the restoration is still up in the air, so they are waiting to do any work until the issue is resolved. Member Rockefeller asked when he thought that might be sorted out. Foltz responded that he thought that sponsors would step in soon for simple revegetation projects because the need is great. They need to start looking at the projects and planning soon.

Yakima Basin: Alex Conley discussed the Yakima Basin, reminding the board of the diversity of the region and the types of projects that they are doing. They are working with a number of partners to do different types of work, which may or may not be funded by the board. He shared data about how fish are responding to the work, noting that some populations are doing better than others. He also shared 2012 highlights of their process and list. He thanked the board, staff, and Review Panel for their support and work.

Josh Brown moved to approve $1,195,165 in SRFB funds for projects and project alternates in the Hood Canal Region, as listed on Funding Table 2012-01, dated December 6, 2012.
Seconded by: David Troutt
Motion: APPROVED

Josh Brown moved to approve $2,700,000 for projects and project alternates in the Lower Columbia Region, as listed on Funding Table 2012-02, dated December 6, 2012.
Seconded by: Phil Rockefeller
Motion: APPROVED

Director Cottingham noted that this includes projects for the Klickitat County lead entity.

Josh Brown moved to approve $360,000 for projects in the Northeast Region, as listed on Funding Table 2012-03, dated December 6, 2012.
Seconded by: **David Troutt**
Motion: **APPROVED**

Josh Brown moved to approve $6,795,035 in SRFB funds for projects and project alternates in the Puget Sound Region, as listed on Funding Table 2012-04, dated December 6, 2012.
Seconded by: **David Troutt**
Motion: **APPROVED**

Josh Brown moved to approve $1,258,333 in PSAR funds for projects in the Puget Sound Region, as listed on Funding Table 2012-04, dated December 6, 2012.
Seconded by: **David Troutt**
Motion: **APPROVED**

Chair Hover noted that unallocated funds would be awarded through the process noted in Manual 18.

Josh Brown moved to approve $1,598,400 for projects and project alternates in the Snake River Region, as listed on Funding Table 2012-05, dated December 6, 2012.
Seconded by: **David Troutt**
Motion: **APPROVED**

Phil Rockefeller moved to approve $1,953,000 for projects and project alternates in the Upper Columbia Region, as listed on Funding Table 2012-06, dated December 6, 2012.
Seconded by: **David Troutt**
Motion: **APPROVED**

Phil Rockefeller moved to approve $1,620,000 for projects and project alternates in the Coastal Region, as listed on Funding Table 2012-07, dated December 6, 2012.
Seconded by: **David Troutt**
Motion: **APPROVED**

Phil Rockefeller moved to approve $1,776,600 for projects and project alternates in the Yakima Mid-Columbia Region, as listed on Funding Table 2012-08, dated December 6, 2012.
Seconded by: **David Troutt**
Motion: **APPROVED**

Director Cottingham noted that this includes one project for the Klickitat County lead entity.

Item 6A: Manual 18 Administrative Updates

Brian Abbott and Marnie Tyler presented the information as described in the staff memo. They highlighted changes to the grant round schedule, clarifications to the allowable uses policy, and clarifications to how mitigation funding can be used in conjunction with board funds. In addition, they are proposing changes to the design requirements for phased and large scale restoration projects. The board was concerned about projects getting funded for construction before design was complete, and supported the staff effort.

Director Cottingham clarified that the allowable uses policy question about acclimation ponds applied to land acquired with board funds. She stated that she wanted to ensure that staff could give consistent responses to sponsor requests. The board expresses reservations about any policy that would be too prescriptive, and asked a number of questions about the word "temporary," landowner preferences, community support, relationship to implementation plans, relationship to salmon recovery, and ground disturbance. They asked staff to provide revised criteria via email. Marnie Tyler clarified that the board was asking for revised criteria that ensured that acclimation ponds were consistent with original purpose, had no ground disturbance, promoted a naturalized setting, and minimized visual impacts. Abbott clarified that the policy was designed to allow proposals that met those criteria to be approved more easily; others would go through an allowable uses process.

Abbott and Tyler also discussed the addition guidance related to managing invasive species and cultural resources. Abbott concluded by discussing the next steps of stakeholder involvement.

Revised Acclimation Pond Language

On the second day of the meeting, December 7, 2012, Marnie Tyler, Brian Abbott, and Marc Duboiski presented follow-up information about acclimation ponds. Duboiski noted that the typical temporary pen was installed for 6 to 8 weeks and showed some examples at project sites. Tyler presented the following revised draft criteria for allowing acclimation ponds on board-funded sites, without the allowable uses process:

- Proposed use is consistent terms of existing board conservation easement between the sponsor and landowner.
- Salmon Recovery Region or Lead Entity has reviewed and approved supplementation proposal for consistency with the salmon recovery plan.
- Listed species are not harmed or negatively affected.
- Proposed use is consistent with sponsor/landowner board conservation easement terms.
- The acclimation pond is a natural pond, wetland, or stream channel (off-channel or side channel)
- Temporary structures only during juvenile rearing season. Usually 6-8 weeks in the Spring (March through May). Structures removed after acclimated juveniles are released.
- No excavation or construction of ponds is allowed. No earth moving, water diversion, or substantial alteration to the existing habitat conditions is conducted. Efforts taken to use least impactful methods to achieve project goals.

Member Gildersleeve noted that they have seen a number of these operations, and that they can affect water quality. She asked that the criteria include a requirement that they have all required permits, and that the sponsors contact the Department of Ecology. Member Troutt was concerned that if there is excavation, that it would automatically be disallowed; Tyler clarified that it meant that they just needed additional review. Member Rockefeller asked who decides if a project meets the criteria. Tyler responded that the sponsor would be able to make the determination, but the grant manager must be notified. Director Cottingham noted that it was consistent with compliance policy.

Public Comment

Julie Morgan, Upper Columbia Salmon Recovery Board, commented that they forwarded this request to RCO because acclimation ponds are consistent with hatchery best practices. They are trying to get fish into smaller acclimation areas so they rear in more natural settings.

Josh Brown moved to incorporate the criteria into manual 18.
Seconded by: Phil Rockefeller
Motion: APPROVED

Item 6B: Manual 18 Review Panel Policy Recommendations

Patty Michak presented information about the Review Panel recommendations, as described in the memo.

Knotweed: Member Barber asked how the questions that were proposed addressed who else was doing the work. Member Partridge asked how the questions would get at the bigger strategy and wants to look at the salmon niche. Michak acknowledged that the questions do not get at broad strategy, and that the Review Panel wanted to do that work in 2013.

Director Cottingham noted that part of the problem is that knotweed is on the "Class B" list and there is a funding gap. Director Cottingham asked if RCO staff need to add this to the policy list for 2013, starting with an assessment of the funding picture. Member Partridge thought that would be a good idea. Member Troutt suggested that staff should consider how effective the investment has been to date; he would not want to see funding reduced if it is making a difference. Chair Hover said that he would prefer a strategic approach with an end date. Member Barber noted that they can do a great job, but that their funding should be going to salmon. Member Brown agreed, and suggested that they also need to be coordinated with the right local partners. He noted that the board cannot do everything, and counties can put an assessment in place.

Public Comment

Scott Moore, Watershed Steward, Snohomish County, had two knotweed projects approved today and is also the chair of the King County Noxious Weed Control Board. In Snohomish County, the work was tied closely with the salmon habitat, so this funding made sense. Their project was flagged as a project of concern; he welcomed the questions and concern. He hopes to participate in developing the questions for the guidelines. Ten years is not unreasonable for surveying for doing stewardship. He thinks knotweed is a threat to any salmon project. He is concerned that knotweed control is not considered restoration unless there is planting as well; it takes three years of treatment before it makes sense to plant.

Jill Silver, 10,000 Years Institute, also has board-funded knotweed projects and shared weed booklets with the board. She has done a number of salmon recovery restoration projects, but started dealing with knotweed when it invaded the Hoh River. She expressed concern that knotweed and other invasive species could reverse the benefits of the restoration projects that the board has funded. She encouraged the board to think of itself as a funder of knotweed control in salmon habitat.

Beavers: Member Everitt noted that agencies have been asked to come up with beaver management plans, and asked how the idea of relocation fits. Director Cottingham noted that this is not about managing problem beavers.

Stream Bank Stabilization: Member Troutt commented that he was uncomfortable with the language and thought that there were some difficult definitions. He offered to work directly with RCO staff to address his concerns. The result will be shared with the board by email.

Public Comment:

Richard Brocksmith, Hood Canal Coordinating Council, commented that they are trying to find guidance that balances multiple interests. Before there are huge changes, they should look at all perspectives on the issue.

Evaluation Criteria:

Public Comment:

Alex Conley, Yakima Basin Fish & Wildlife Recovery Board, commented on the evaluation criteria. He suggested that the terms "large" and "cost effectiveness" be defined. They will make those noted during the stakeholder comment period. He suggested that the definition be made based on dollar amounts.

Josh Brown moved to adopt the recommendations of the Review Panel to update Manual 18 policies regarding knotweed control, beaver reintroduction projects, bank stabilization projects, and Review Panel evaluation criteria.
Seconded by: Phil Rockefeller

David Troutt moved to amend the motion to remove the bank stabilization portion of the motion.
Seconded by: Harry Barber
Motion: APPROVED
Main Motion: APPROVED

Item 7: Communication Plan Updates

Susan Zemek presented the plan update, as described in the staff memo, along with quotes from the stakeholder survey that highlighted successes and challenges. She also shared statistics about web use and media coverage. The proposed plan was attached to the memo.

Rockefeller asked for a copy of the presentation. Brown asked if the news articles specifically mentioned the RCO; Zemek responded that they mentioned either the RCO or the boards. He also asked about the note about recognizing top ranking projects through RCO awards. Director Cottingham explained how they do "big check" ceremonies and ribbon cuttings on the RCFB side; part of the communication plan will be to find ways to do this on the SRFB side. She noted that board members also participate; SRFB members indicated an interest in playing the same role. Josh noted he would also be willing to do op-ed pieces. Board members suggested projects that highlight partnerships or complex approaches would be good. Troutt also offered the idea of social marketing, and to have measurable goals about target audiences.

Director Cottingham noted that this is a five-year plan, and that she wants to be very cautious about social media.

Meeting adjourned at 4:37 p.m.

SALMON RECOVERY FUNDING BOARD SUMMARY MINUTES

Date: December 7, 2012
Place: Olympia, WA

Salmon Recovery Funding Board Members Present:

Bud Hover, Chair	Okanogan County	**Bob Everitt**	Department of Fish and Wildlife
Harry Barber	Washougal	**Carol Smith**	Conservation Commission
Josh Brown	Kitsap County	**Craig Partridge**	Department of Natural Resources
Phil Rockefeller	NWPCC	**Melissa Gildersleeve**	Department of Ecology
David Troutt	Olympia		

Mike Barber was excused.

It is intended that this summary be used with the notebook provided in advance of the meeting. A recording is retained by RCO as the formal record of meeting.

Opening and Welcome

Chair Bud Hover called the meeting to order at 9:03 a.m. and a quorum was determined.

Item 8: State of the Salmon in Watersheds Report

Jennifer Johnson shared a preview of the web site, which is scheduled to launch on December 28. She highlighted ways in which the site will offer live data by navigating through select pages at the state level and for the Snake Region. Member Barber noted the continued absence of nutrient data; Director Cottingham reminded the board that if other agencies do not collect the information, the RCO cannot report it. Board members expressed concerns about the presentation of some data. For example, David Troutt was concerned about the use of pie charts to show harvest data. Member Brown asked if the board could be more involved in the presentation of data in future reports. Member Troutt noted that abundance is still a focus, and wants more emphasis on VSP parameters. Johnson responded that they continue to have the discussion with WDFW. Scott Boettcher, subcontractor to Paladin Data Systems, and Tim Smith, who have partnered on the site, also thanked the board and noted that the move to the web is a huge effort that brings greater transparency to the work. Member Barber commented that he was glad to see that the data split hatchery from wild fish.

Director Cottingham said that they would launch the site on December 28, and then announce it in mid-January after it is tested for major glitches. There will be an update in May to add video.

Public Comment

Alex Conley, Yakima Basin Fish Recovery Board, thanked Jennifer for her work, and noted that it was a lot more work than anyone anticipated. This process has been a new way of working with a lot more back and forth communication about sharing and integrating data. It has been the best peer review that has been done yet. He believes that these discussions need to continue.

Item 9: Board Meeting Schedule

Rebecca Connolly presented the schedule as described in the memo. She noted that one board member had announced a conflict with the May meeting dates and proposed an alternate date. The board approved the alternate date of May 21-22, 2013.

Josh Brown moved to approve the revised dates as presented.
Seconded by: David Troutt
Motion: APPROVED

Item 10: Approve Funding and Scope of Work for Monitoring Program Assessment

Neil Aaland presented the information as described in the staff memo. He then presented a draft scope to produce an updated SRFB Monitoring Strategy with recommendations for implementation. The scope of work includes three major tasks:

- Review the three components of current strategy and evaluate their effectiveness in meeting program goals
- Review/evaluate the monitoring components of the regional salmon recovery plans and determine which elements are appropriate for state funding
- Evaluate how information is exchanged on monitoring results and make recommendations on changes

The work also would include evaluating (1) how current SRFB monitoring fits into monitoring in Washington currently being conducted by federal agencies, (2) current funding levels for SRFB monitoring and whether the present three major components are funded at appropriate percentages, and (3) whether (and how) a portion of funding should be reserved for regional monitoring or ad-hoc activities. The cost would be about $75,000 and would be done through a competitive process. The final report would be done in October.

Director Cottingham noted that due to the timeline, the board may need to make funding decisions in May 2013 based on the existing paradigm. She noted that the assessment also would include a transition strategy if it recommended changes.

Member Troutt asked that a tribal representative be added to the steering committee. Member Rockefeller suggested involvement of Bonneville Power Administration and Northwest Power and Conservation Council. Member Gildersleeve asked if there would be a peer review of the strategy. Director Cottingham responded that it would be an investment strategy, not a scientific strategy.

Member Rockefeller noted that the monitoring should at minimum supply data for the high level indicators noted in the State of the Salmon report, and asked if the contractor's approach would look at all of the different types of monitoring to get to high level indicators. Director Cottingham responded that the use of NOAA funds is governed by their guidelines, but that some of the initial information indicates that some respondents think there should be a shift in the funding priorities.

Public Comment

Tim Quinn, Department of Fish and Wildlife, commented that he applauded the effort, but the fundamental way to evaluate a monitoring program is decide what questions they want to answer with their monitoring. He encouraged the board to think through what they want to know as part of the effort. It also is important to know how important each question is. Some of the work already has been reviewed.

He also suggested that it is important that the board fully understand what each of the monitoring programs can do.

Jeff Breckel, Lower Columbia Fish Recovery Board, said that he is pleased with Neil's presentation and the proposal. One of the strongest points is the need to consider what is going on across the state with monitoring. State of the Salmon is showing what is going on in the watersheds. The board should see what is going on and be strategic about filling its needs and the unmet needs in the regions.

Phil Rockefeller moved to approve the use of $75,000 in 2012 monitoring funds for an assessment of the board's monitoring strategy.
Seconded by: Josh Brown
Motion: APPROVED

Item 11: Assessment of Roles and Responsibilities for the Governor's Salmon Recovery Office

Kaleen Cottingham presented this topic, beginning with an overview of the background and responsibilities of the Governor's Salmon Recovery Office. She noted that their focus has moved from advocacy and policy to operations, and that some stakeholders have expressed concern about this shift. In light of this situation, she hired the consultant to assess the roles and responsibilities of the office, and described the work of the consultant to date. She noted that the consultant was unable to attend, and asked board members for feedback on the questions in the board memo.

All board members noted that there has been a change in the role of the GSRO over time, especially for the GSRO executive coordinator. Board members noted that in the past, the coordinator played a larger role with regard to the governor's policy on salmon recovery and provided a single "voice" for salmon recovery messaging at the state level. Some board members expressed a desire to have the GSRO return to the governor's office; Director Cottingham responded that the assessment was bound by the current legal structure. It was suggested that the GSRO could potentially have a stronger role despite the legal structure.

Most board members agreed that high-level advocacy, integration across agencies and programs, serving as a point person/agency for state and federal efforts, and coordination were all important functions for the GSRO. Some board members, however, believed that if functions such as coordination or advocacy were institutionalized across agencies, then they could be removed from the GSRO.

Board members also discussed a broader role for the regional boards in doing the advocacy work for salmon recovery.

Public Comment

Jim Kremer, citizen, remarked that what is happening in the state is a grand experiment, and referenced the discussion on monitoring. He said that it is interesting to see something become institutionalized, and you lose the gravitas and innovation. He suggested that thinking about how to build on the role of the regions is an important way to think about this, and that the power of salmon recovery is in bringing all of the local resources together to solve problems.

Steve Martin, Snake River Recovery Region, noted that there is a lot of institutional knowledge and encouraged the board to include more people in the conversation. Salmon recovery is going to take both regions and GSRO. For example, he represented the regions in a conversation with Commerce about the

fact that they are losing habitat faster than they can restore it. It would have been better if there was someone there from GSRO.

Meeting adjourned at 10:58 am.

Minutes approved by:

_____ _____

Bud Hover, Chair Date

WASHINGTON STATE RECREATION AND CONSERVATION OFFICE
Salmon Recovery Funding Board

Salmon Recovery Funding Board Briefing Memo

Item **1A**

Meeting Date: February 2013

Title: Director's Report

APPROVED BY RCO DIRECTOR KALEEN COTTINGHAM

Summary

This memo is the director's report on key agency activities, including operations, agency policy issues, legislation, and performance management. Information specific to salmon grant management report and the fiscal report are in separate board memos.

Board Action Requested

This item will be a:

- ☐ Request for Decision
- ☐ Request for Direction
- ☒ Briefing

In this Report

Agency Operations

Staff Working on Federal Grant for Salmon Recovery

The 2013 Pacific Coastal Salmon Recovery Fund (PCSRF) grant announcement was posted on January 9, 2013 by the National Oceanic and Atmospheric Administration (NOAA). Pre-applications are due on February 14; the final applications are due March 14. The estimated total available will be $65 million, although the maximum grant request has been lowered to $25 million.

Like previous applications, the 2013 proposal will be a multi-partner effort between the Salmon Recovery Funding Board, the Recreation and Conservation Office, the Department of Fish and Wildlife, and the Northwest Indian Fisheries Commission. I recently met with these partners to

kick off Washington's preparation of our annual grant application. Washington will submit a draft application February 14 and will request the maximum allowable award of $25 million.

The application will request funds for habitat projects, hatchery reform projects, monitoring, administration, and database upgrades. The request will be aligned with the federal priorities established by NOAA in 2012.

PRISM Online

This month, we launched the new PRISM online, a web-based program that allows people to apply for grants online using PCs, Macs, and mobile devices such as iPads and other tablets. Designed as an application wizard, the system will guide applicants through the application step-by-step. As they complete each page, applicants can check for errors and determine if they have successfully completed that portion of their applications. Attachments that must be included with each application will be identified and a mapping tool will allow applicants to map the location of their projects. Users will see customized screens that show projects associated with their organizations or for which they are a contact. Users will also be able to see the location of their projects on a map. From this screen, users will be able to start new grant applications. We also enhanced our existing Project Search feature on our Web site with mapping capability, so now people looking for project information can see a map of the project location.

Meetings with Partners

- For the next several months, the **Conservation Commission** will have an interim director. I met with Ray Ledgerwood to let him know about our programs and the rich history that we have with providing funding for the conservation districts (primarily salmon recovery) and with our efforts next year to review and streamline our farmland preservation program.
- **Ag Forestry Leadership Program** – I was invited again this year to speak on a panel of state agency directors to the Ag-Forestry Leadership program. I spoke about working on multi-agency panels.
- In December, I joined the National Oceanic and Atmospheric Administration in briefings of our **congressional delegation** staff members about salmon recovery in Washington. I talked about the grants we give and some successful projects.
- **Port Susan Bay ribbon cutting** – I was joined by Mike Ramsey, Kay Caromile, and Elizabeth Butler at the Port Susan Bay estuary restoration ribbon cutting near Stanwood at the mouth of the Stillaguamish River. After 11 years and about $4 million in funding, The Nature Conservancy and dozens of partners gathered to celebrate the removal of 1.3 miles of dike that returned 150 acres of farmland to naturally functioning estuary – creating jobs, restoring salmon habitat, and improving flood protection for neighbors. The state provided a majority of the funding, of which $2.1 million was from the salmon recovery fund, Puget Sound Acquisition and Restoration fund, and Estuary and Salmon Restoration Program fund, all of which flowed through RCO.

Communications Report

Communications staff spent most of the month preparing for the launch of the *State of Salmon in Watershed Executive Summary* and Web site, as well as preparing materials for the legislative session, such as a new lead entity directory.

Legislative and Budget Update

The 2013 legislative session is well under way; it is scheduled to adjourn on April 24. Governor Inslee is hiring policy staff and setting his legislative agenda. We have been meeting with both new and experienced legislators, including those who have new committee assignments, to provide general information about RCO's programs and budget and to answer specific questions.

At this time, four main bills related to the Salmon Recovery have had public hearings. We have testified on these bills and are working with legislators, other agencies, and stakeholders to minimize the impacts to our programs.

Bill	Description
HB 1194	Landowners who allow a habitat project to be built on their land may not be held civilly liable for property damages resulting from the project. The habitat project must be included on a habitat project list and may or may not be funded by the board. This bill has been voted out of committee.
SB 5054	The Department of Fish and Wildlife, Department Natural Resources, and State Parks must provide a request to, and receive approval from, the Legislature before acquiring property. The agencies must submit a request for real property acquisition to the Legislature and Office of Financial Management. Major elements of the request must include: 1) an operations and maintenance plan; 2) specified information on payments in lieu of taxes (PILT). The bill was voted out of committee.
SB 5057	A nonprofit organization may not restrict public access to real property for public recreational purposes beyond any restrictions in effect at the time the organization acquires the property if funds from the state were used to purchase the property of if the land was transferred from a local, state, or federal agency or tribal government where the property was acquired with funds from the state. State agencies must condition any grants or land transfers to nonprofit organizations to be consistent with these provisions on access for outdoor recreation. The bill amended and passed out of committee. The amendment allows

Bill	Description
	restricted access under two circumstances: 1) the access must be consistent with the statutory conditions of a funding program; or 2) the access must address specified risks to cultural resources, natural resources, or adjacent landowners.
SB 5276	The bill requires any city, county or state agency owning land designated as agricultural by a comprehensive plan or regulations adopted under the Growth Management Act to protect the land for future agricultural use. We provided examples where this would have prevented current restoration projects, using Smith Island and Leque Island as examples of current SRFB funded projects on public land designated as agricultural land. We will participate in a work group to draft a compromise bill.

Several other bills have been introduced that could affect either the RCO programs or staff.

February 22 is the policy cutoff; that is, the last day for a policy bill to be passed out of policy committees in the house in which it originated. March 1 is the fiscal cutoff; that is, the last day for a bill to be voted out of the budget committee in the house in which it originated.

Operating Budget

Governor Chris Gregoire released her proposed 2013-15 operating, capital, and transportation budgets on December 18. The following is a summary of the operating and capital budgets, and the impact on the RCO.

RCO's general fund budget was not cut except for minor adjustments. We had submitted three operating budget decision packages. Two of the decision packages, the Habitat Work Schedule and the State Lands Inventory, did not receive funding. The Invasive Species program was shifted to the Aquatic Land Enhancement Account, as we requested. If needed, we still have time to work on funding for the Habitat Work Schedule in the 2014 supplemental budget. Some members of the Legislature remain interested in the State Lands Inventory.

The proposed budget restores the three percent temporary salary reduction and includes a contingent salary increase based on revenue forecasts. The budget also includes $38.6 million for a new salary step that was negotiated in 2008 and 2010, but delayed both years.

Capital Budget

Governor Chris Gregoire weighed agency requests for natural resource funding in the capital budget against the Puget Sound Partnership's assessment of how the programs relate to the cleanup of Puget Sound. This table summarizes RCO's budget requests and the funding included in the capital budget. The first part of the table includes the Salmon Recovery Funding

Board programs, the second part is the Recreation Conservation Funding Board programs, and the third are other programs.

	RCO Request	Gov Gregoire	Variance
Salmon Recovery Funding Board Programs			
Puget Sound Estuary & Salmon Restoration Program (ESRP)	$10,000,000	$10,000,000	--
Puget Sound Acquisition & Restoration (PSAR)	$80,000,000	$80,000,000	--
Salmon Recovery Funding Board (SRFB) *State*	$40,000,000	$15,000,000	($25,000,000)
Salmon Recovery Funding Board (SRFB) *Federal*	$60,000,000	$60,000,000	--
Recreation and Conservation Funding Board Programs			
Aquatic Lands Enhancement Account (ALEA)	$6,600,000	$6,000,000	($600,000)
Boating Facilities Program (BFP)	$9,663,000	$6,363,000	($3,300,000)
Boating Infrastructure Grants (BIG)	$2,200,000	$2,200,000	--
Firearms and Archery Range Recreation (FARR)	$800,000	$800,000	--
Land and Water Conservation Fund (LWCF)	$4,000,000	$4,000,000	--
Nonhighway and Off-Road Vehicle Activities (NOVA)	$8,500,000	$8,500,000	--
Recreational Trails Program (RTP)	$5,000,000	$5,000,000	--
Wash. Wildlife and Recreation Program (WWRP)	$90,000,000	$65,450,000	($24,550,000)
Youth Athletic Facilities	$3,000,000	--	($3,000,000)
Other Programs			
Family Forest Fish Passage Program (FFFPP) *DNR's Request*	$10,000,000	$2,000,000	($8,000,000)
Total	**$329,763,000**	**$265,313,000**	**($64,450,000)**

Other Factors Affecting RCO's Budget

Governor Inslee has indicated he will release his own version of the budgets shortly after the Economic and Revenue Forecast Council's revenue forecast, which is due on March 20. His budget may be a set of guiding principles or a full budget bill. The Legislature typically releases budgets on the same timeline.

The Legislature will develop and negotiate a final budget before fiscal year 2013 ends on June 30. The March revenue forecast may affect the amount of general fund and bonds available for appropriation in the 2013-15 biennium. Staff will update the board with specific information regarding each iteration of the budgets throughout the session.

Policy Update

Throughout 2012, RCO staff worked on the priorities presented in a tiered approach to the board in April 2012. These priorities were identified through board, stakeholder, and staff observations, including feedback from the regions, lead entities, project sponsors, the Technical Review Panel, and grant staff.

The policy items were categorized into four tiers: 1) Items that staff must address during 2012; 2) items staff will address in 2012 as time allows; 3) items to focus on at a later date because of the complexity and time necessary to resolve them and RCO staff's time availability; and 4) items addressed in other forums or through other RCO processes.

The Manual 18 revision released on January 31 included updates that addressed the items in tiers one, two, and four, as discussed with the board at meetings last year. This includes the policies reviewed by the board in December 2012 (beaver relocation, review panel criteria, acclimation ponds, knotweed control, and bank stabilization techniques within habitat restoration projects).

At this time, RCO staff is focusing on the salmon recovery conference, assessment of monitoring, and recommendations of the GSRO assessment. We are not aware of other critical policy revisions to Manual 18 or updates that need to be addressed during 2013, other than the items listed below.

Knotweed Control

This issue was raised by the Review Panel. The board asked that knotweed projects be part of a larger strategic plan for watershed riparian restoration, or at a minimum, be part of a strategic plan for knotweed eradication at a sub-watershed scale. As noted above, staff has begun incorporating the two-pronged approach requested by the board in the revised Manual 18. The current version of Manual 18 requires sponsors to complete a series of supplemental questions for knotweed project proposals that will clarify the project's goals, objectives, timeline, and strategy. In 2013, staff and the Review Panel will work with lead entities to understand which lead entities have a strategic watershed riparian restoration plan within their strategy and which ones would need to develop a plan.

Salmon Recovery News

NOAA Launches 'Situation Assessment' in the Columbia Basin

The National Oceanic and Atmospheric Administration (NOAA) recently launched a situation assessment to identify key challenges facing the salmon recovery effort and help inform solutions in the Columbia Basin. The federal fish agency has invited 150 entities to participate in an interview-based process to better understand issues and interests of involved parties and situation dynamics. The list includes entities representing federal, state, and tribal governments,

as well as well as power, agriculture, navigation, recreation, environmental, and other interests. Recently, RCO along with the Columbia Basin regional organizations participated in a conference call with NOAA and were briefed on the assessment. NOAA stated the intent of the assessment process is to "build on the momentum of our positive collaborations with local watershed councils, recovery boards, and other local groups during the past few years and take another step forward. We want to ensure our existing and future recovery plans are comprehensive and integrated. I don't know what this will mean for RCO, so stayed tuned.

Update on Sister Boards

Recreation and Conservation Funding Board (RCFB)

The RCFB met January 31. The board heard several briefings: One from State Parks on its transformation strategy, one from RCO staff on compliance work, one on an overview of the data we have collected for the state's strategic outdoor recreation plan, and one on the findings of the 2012 grant cycle surveys and the implications for process changes before the 2014 application cycle. Staff also presented a list of policy development topics for 2013 and demonstrated new online tools that improve the usability of PRISM. Finally, the board ended its one-day meeting with discussions of how sustainability was presented in the 2012 grant cycle and how it can recognize 'legacy' projects.

Washington Invasive Species Council

The Invasive Species Council is continuing their work to identify the location and impacts of 15 priority invasive species in the Puget Sound Basin. Existing data are being compiled to create maps of invasive species presence, which will be made available to state and local agencies for planning purposes. The Council has recently added language into the SEPA Environmental Checklist guidance document to include considerations of invasive species. They have also just finished working with the Salmon Recovery Funding Board to include a question on invasive species in Manual 18. The purpose of the questions in both SEPA and Manual 18 is to limit the unintended spread of invasive species during construction and restoration work. Their next meeting is March 14.

Habitat and Recreation Lands Coordinating Group

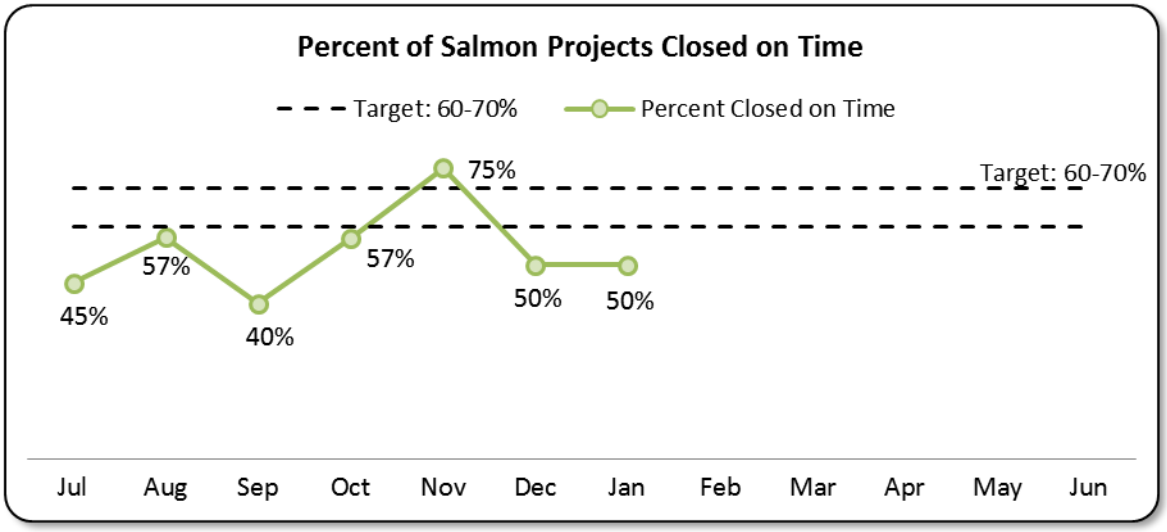
The lands group submitted its annual progress report and 2013 action plan to the Office of Financial Management. Among the 2012 highlights were the extension of the lands group to 2017, work to improve the visibility of land maintenance funding and the economic benefits of state land purchases, the fourth State Land Acquisition Coordinating Forum, and the 2012 biennial forecast of state land acquisitions. The 2013 action plan includes the second *State Land Acquisition Performance Monitoring Report*, coordination workshops for planners to discuss the details of projects to purchase state lands, the fifth State Land Acquisition Coordinating Forum, and, if funding is approved, an update to the state lands inventory.

Performance Measures

All data are for salmon grants only, as of February 1, 2013.

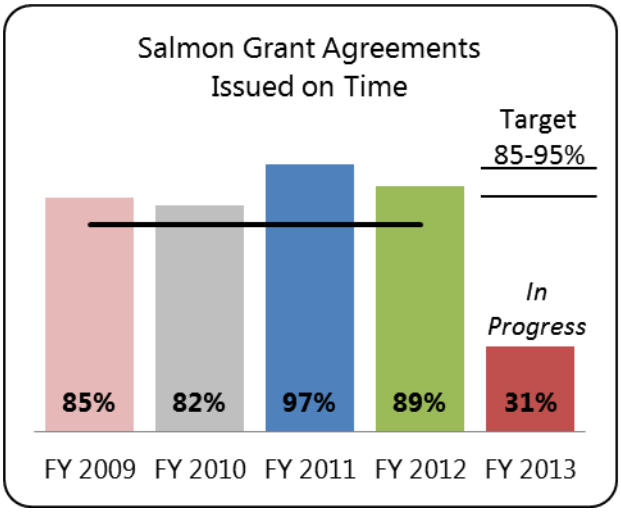
Measure	Target	FY 2013 Performance	Indicator
Percent of salmon projects closed on time	60-70%	55%	🟡
% salmon grant projects issued a project agreement within 120 days after the board funding date	85-95%	31% *(in progress)*	🟢
% of salmon grant projects under agreement within 180 days after the board funding date	95%	26% *(in progress)*	🟢
Cumulative expenditures, salmon target by fiscal month	40.4% *(as of FM18)*	35.3% *(as of FM18)*	🟡
Bills paid within 30 days: salmon projects and activities	100%	90%	🟢
Percent of anticipated stream miles made accessible to salmon	100%	99%	🟢

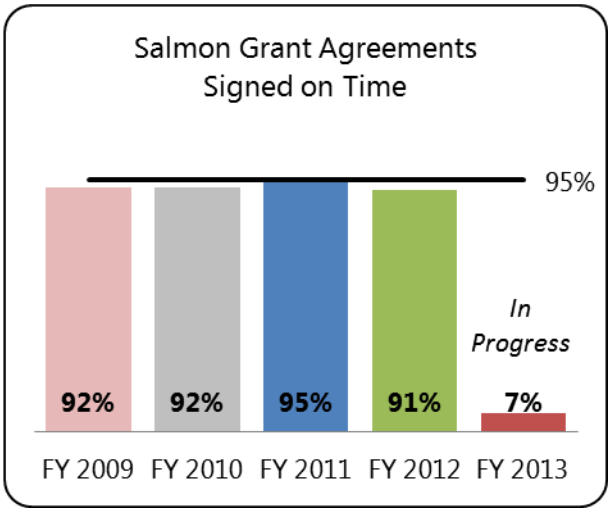
Projects Closed on Time



Ninety-four projects have been due for closure since July 1. Of those, 52 were closed on time, 18 were closed late, and 25 remain open. Staff members made a tremendous effort to close projects from the "backlog" in December.

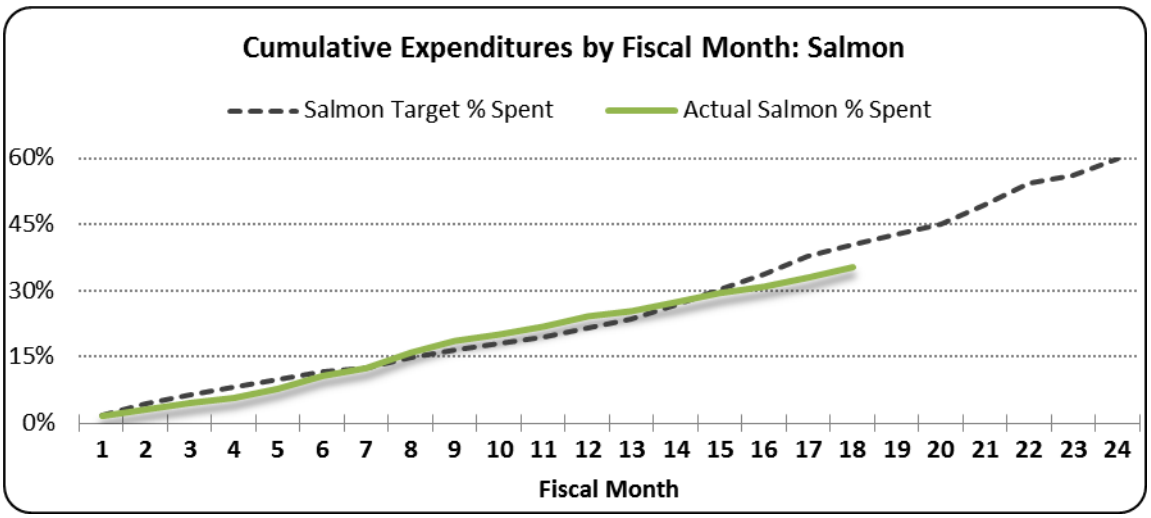
Project Agreements Issued and Signed on Time





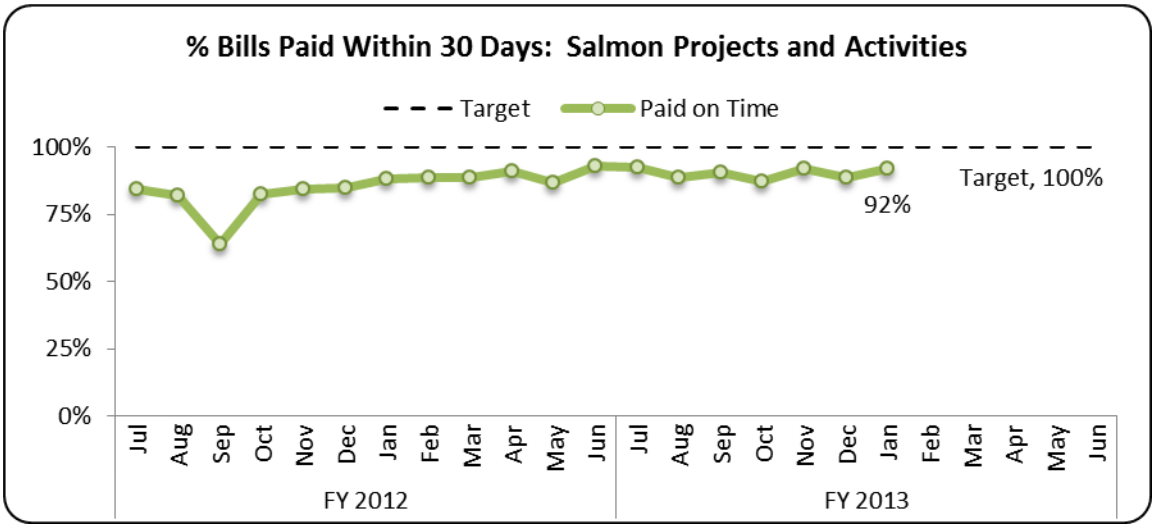
As of February 1, staff had issued 34 project agreements for grants awarded in December 2012. The deadline for issuing the agreements is April 4. Project sponsors had signed and returned eight of the agreements; the deadline for signing the agreements is June 3.

Cumulative Expenditures by Fiscal Month



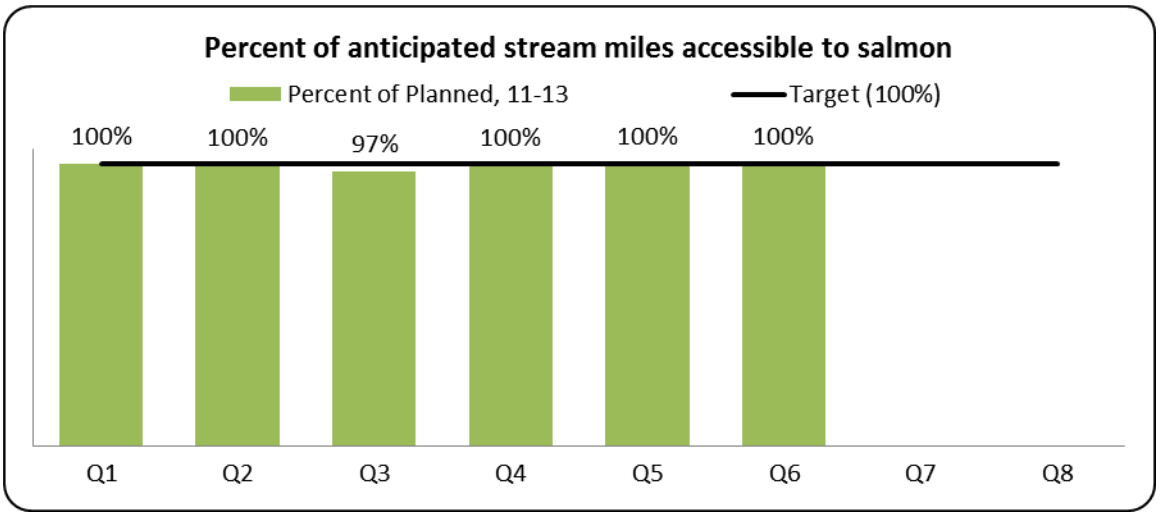
Expenditures are lagging behind expectations and the stretch targets set for this biennium. Fiscal staff is hopeful that project sponsor will begin to expend funds and submit invoices for work completed in the spring.

Bills Paid on Time



Between July 1 and January 31, there were 1075 invoices due for salmon recovery projects and activities (e.g., lead entities, regions, and review panel). Of those, 970 were paid on time, 88 were paid late, and 17 remain unpaid. The average number of days to pay a bill was 12.

Stream Miles Made Accessible



This is one of many measures that the RCO collects about the benefits of projects. The measure compares the number of stream miles expected to be opened (at application) to the number of miles actually made accessible at project closure. Over 160 miles have been made accessible since July 1, 2011. Not all projects include this measure.

WASHINGTON STATE RECREATION AND CONSERVATION OFFICE
Salmon Recovery Funding Board

Salmon Recovery Funding Board Briefing Memo

Item **1B**

Meeting Date: February 2013
Title: Management Status Report: Financial Report
Prepared By: Mark Jarasitis, Chief Financial Officer

APPROVED BY RCO DIRECTOR KALEEN COTTINGHAM

Summary

This financial report reflects Salmon Recovery Funding Board (board) activities as of December 31, 2012.

The available balance (funds to be committed) is $17.2 million. The amount for the board to allocate is $0.5 million, and the amount for other entities to allocate is $16.7 million.

Board Action Requested

This item will be a:

- ☐ Request for Decision
- ☐ Request for Direction
- ☒ Briefing

Balance Summary

Fund	Balance
Current State Balance	$59,498
Current Federal Balance – Projects, Hatchery Reform, Monitoring	$6,144,879
Current Federal Balance – Activities	$392,318
Lead Entities	$8,378
Puget Sound Acquisition and Restoration (PSAR) & Puget Sound Restoration (PSR)	$427,958
Estuary and Salmon Restoration	$3,564,670
Family Forest Fish Passage Program (FFFPP)	$6,610,701
Puget Sound Critical Stock	$0

Salmon Recovery Funding Board Budget Summary

For the Period of July 1, 2011 - June 30, 2013, actuals through 10/31/2012 (fm16) 11/1/2012
Percentage of biennium reported: 66.6%

	BUDGET	COMMITTED		TO BE COMMITTED		EXPENDITURES	
	new & reapp. 2011-13	Dollars	% of budget	Dollars	% of budget	Dollars	% of comm
GRANT PROGRAMS							
State Funded 03-05	$829,178	$829,178	100%	$0	0%	$467,864	56%
State Funded 05-07	$1,992,436	$1,957,976	98%	$34,460	2%	$681,784	35%
State Funded 07-09	$3,377,100	$3,377,100	100%	$0	0%	$460,142	14%
State Funded 09-11	$4,676,704	$4,656,198	100%	$20,506	0%	$4,536,705	97%
State Funded 11-13	$9,700,000	$9,695,468	100%	$4,532	0%	$1,479,607	15%
State Funded Total	**$20,575,418**	**$20,515,919**	**100%**	**$59,498**	**0%**	**$7,626,102**	**37%**
Federal Funded 2007	$6,771,390	$6,771,390	100%	$0	0%	$6,771,390	100%
Federal Funded 2008	$12,772,515	$12,695,984	99%	$76,531	1%	$5,583,890	44%
Federal Funded 2009	$11,189,547	$11,139,089	100%	$50,458	0%	$6,242,908	56%
Federal Funded 2010	$24,028,172	$23,969,454	100%	$58,718	0%	$12,137,063	51%
Federal Funded 2011	$24,728,261	$22,886,220	93%	$1,842,041	7%	$6,845,371	30%
Federal Funded 2012	$21,340,000	$16,830,552	79%	$4,509,448	21%	$0	0%
Federal Funded Total	**$100,829,885**	**$94,292,689**	**94%**	**$6,537,196**	**6%**	**$37,580,622**	**40%**
Lead Entities	$6,124,540	$6,116,162	100%	$8,378	0%	$3,230,240	53%
Puget Sound Acquisition and Restoration	$37,892,542	$37,464,584	99%	$427,958	1%	$16,580,415	44%
Estuary and Salmon Restoration	$11,009,147	$7,444,477	68%	$3,564,670	32%	$3,386,303	45%
Family Forest Fish Passage Program	$14,868,397	$8,257,696	56%	$6,610,701	44%	$3,584,205	43%
Puget Sound Critical Stock	$4,301,643	$4,301,643	100%	$0	0%	$1,864,997	43%
Subtotal Grant Programs	**$195,601,572**	**$178,393,170**	**91%**	**$17,208,402**	**9%**	**$73,852,884**	**41%**
ADMINISTRATION							
SRFB Admin/Staff	$4,439,720	$4,439,720	100%	-	0%	$3,151,132	71%
Technical Panel	$598,777	$598,777	100%	-	0%	$365,451	61%
Subtotal Administration	**$5,038,497**	**$5,038,497**	**100%**	**-**	**0%**	**$3,516,583**	**70%**
GRANT AND ADMINISTRATION TOTAL	**$200,640,069**	**$183,431,667**	**91%**	**$17,208,402**	**9%**	**$77,369,467**	**42%**

WASHINGTON STATE RECREATION AND CONSERVATION OFFICE
Salmon Recovery Funding Board

Salmon Recovery Funding Board Briefing Memo

Item **2**

Meeting Date: February 2013
Title: Salmon Recovery Management Report
Prepared By: Brian Abbott, Salmon Section Manager and GSRO Coordinator

APPROVED BY RCO DIRECTOR KALEEN COTTINGHAM

Summary

The following are some highlights of work being done by the salmon section staff in the Recreation and Conservation Office (RCO) and the Governor's Salmon Recovery Office.

Board Action Requested

This item will be a:

- ☐ Request for Decision
- ☐ Request for Direction
- ☒ Briefing

Grant Management

Wrapping up the 2012 Grant Cycle and Starting the 2013 Grant Cycle

The Salmon Recovery Funding Board (board) approved funding for over 100 projects at the December 6-7, 2012 meeting. Since then, staff has been developing project agreements with sponsors and routing them electronically for signature.

At the same time, staff members have been gearing up for the 2013 grant round. The board approved the administrative changes and minor policy clarifications for inclusion in Manual 18 at the December 2012 meeting. Staff completed a draft of the document and made it available to lead entities and regional organizations to review through the first two weeks of January 2013. Staff posted the manual to the RCO web site in late January. It is available at: http://www.rco.wa.gov/documents/manuals&forms/Manual_18.pdf.

RCO staff is in the process of scheduling Review Panel site visits for the 2013 grant round. We will have the calendar completed by February 28. Staff also is in the process of scheduling application workshop(s) for March. Like last year, we will record the workshop and have it available online for future reference.

Family Forest Fish Passage Program Projects Underway

RCO staff has been working closely with partner agencies to get the additional $10 million to projects that remove fish passage barriers in small, private forests. More information is in Item 5.

Salmon Metric Project Almost Complete

We are in the final stages of collecting the PCSRF metrics. All of the metrics have been collected, and we are processing the project final reports. Clean-up work remains and will need to transfer the data to NOAA, but we have reached a major project milestone. RCO received an extension from NOAA to February 28, 2013 to complete the project. Special thanks go to Sarah Gage for her patience and persistence (in a friendly way) and to the Salmon Section staff who did extra work collecting and reviewing final reports.

Viewing Closed Projects

Attachment A lists projects that have closed between November 1, 2012 and January 31, 2013. To view information about a project, click on the blue project number[1]. From that link, you can open and view the project attachments (e.g., design, photos, maps, and final report).

Amendments Approved by the Director

In December 2011, the board asked that this report include a list of major scope and cost increase amendments approved by the director. The table below shows the major amendments approved between November 1, 2012 and January 15, 2013. Staff processed a total of 203 amendments during this period, but most were minor revisions related to the metrics update project or time extensions.

Number	Name	Sponsor	Program	Type	Amount/Notes
11-1573	S. Fork Asotin Stream Channel Restoration	WDFW	Salmon Federal	Restoration	Cost Increase - $13,045 Cultural resources and additional wood
10-1794	Camp Creek Culvert Replacement	Pacific Salmon Coalition	Salmon State	Restoration	Cost Increase - $50,000 Increased construction costs
11-1263	Middle Pilchuck River Habitat Enhancement	Sound Salmon Solutions	State Salmon	Restoration	Cost Decrease - $81,200 Property owner did not grant permission for the in water restoration work
10-1852	Howard Miller Steelhead Park Off Channel Enhancement	Skagit Fish Enhancement Group	Puget Sound Acquisition and Restoration	Restoration	Cost Increase - $22,891 Increased cost of construction

[1] Must be connected to the internet; Depending on the computer, you may have to right click and select "open hyperlink."

Number	Name	Sponsor	Program	Type	Amount/Notes
09-1447	Lower Finney Supplemental LWD	Skagit Fish Enhancement Group	Puget Sound Acquisition and Restoration	Restoration	Cost Decrease - $22,891 Project scope completed under budget remainder moved to #10-1852
11-1285	McDonald Creek Restoration	Chehalis Basin Fisheries Task Force	Salmon Federal	Restoration	Cost Increase - $7,000 Storm related damage
09-1623	Lower Wenatchee River Flow Enhancement Project	Trout Unlimited	Salmon Federal	Restoration	Cost Increase - $98,678 Bid was much higher than expected. Other funds provided $151,322.

Grant Administration

The following table show projects funded by the board and administered by staff since 1999. Information is current as of February 5, 2013.

- Staff is working with sponsors to place the "pending" projects under agreement, following approval at the board meeting in December 2012.
- Active projects are under agreement. Sponsors are working on implementation, with RCO staff support for grant administration and compliance.

	Pending Projects	Active Projects	Completed Projects	Total Funded Projects
Puget Sound Acquisition and Restoration	3	94	135	232
Salmon Federal or State Projects	97	217	1,182	1,496
	100	**311**	**1,317**	**1,728**

This table does not include projects funded through the Family Forest Fish Passage Program or the Estuary and Salmon Restoration Program, although RCO staff support those programs through grant administration.

Governor's Salmon Recovery Office

State of the Salmon in Watersheds Report

The 2012 State of Salmon made its debut in January. This web-based report can now reach a large audience with one click to the State of Salmon in Watersheds report and interactive Web site. The Web site puts online what previously was available as a printed biennial report to the Legislature, provides more maps and data, and shares more perspectives from regional salmon recovery organizations around the state. The printable Executive Summary is easy to understand, as are the stories about salmon recovery in the online report. Many of the online charts are

data-driven, showing data that can be easily updated using the state's data.wa.gov tools. This new way of reporting makes data more accessible to the public, and makes all the data providers more transparent and accountable.

SRFB Monitoring Investment Strategy Assessment

In December, the board approved funds for an assessment of its monitoring strategy. Governor's Salmon Recovery Office (GSRO) staff developed and advertised a request for qualifications and quotations (RFQQ). Two firms responded to the RFQQ. Staff has assembled an evaluation team to score the proposals, and will announce the successful contractor in February.

Role of GSRO in Light of Contractor's Report

As noted at the December board meeting, the RCO worked with an independent consultant to assess the roles and structure of the Governor's Salmon Recovery Office. The work was done through interviews and surveys with staff and key partners. The report, entitled "An Assessment of the Governor's Salmon Recovery Office and Recommendations for the Future," was completed December 20, 2012.

The report presents the key findings from the interviews and surveys, the consultant's interpretation of the mutual interests of the parties, and recommendations for the future role, responsibilities and organizational structure of the GSRO.

Staff has discussed the recommendations and considering the options. The RCO director will make a final decision on the recommendations after the Legislature sets the 2013-15 biennial budget.

Regional and Lead Entity Contracts for 2013-15 Biennium

Staff will initiate discussions with lead entities to prepare the scope of work for next biennium. GSRO staff also will schedule annual reviews with each regional organization in the coming months. Part of the review will establish the scope of work for the next biennium.

At the May 2013 board meeting, staff will present capacity funding options for lead entities and regions that the board will consider based on the budget established by the Legislature and funding that may be available from the federal Pacific Coastal Salmon Recovery Fund grant.

Other Topics of Note

Salmon Video Update

In September 2012, the board approved funds for staff to work with a consultant to create a video component to the State of the Salmon Web site. Fourteen companies responded to a request for qualifications and quotations (RFQQ). The evaluation team included six representatives: two from regional organizations, one from a lead entity, and three GSRO/RCO

staff. Five companies were invited to an interview; North 40 Productions, LLC was selected to complete this project. Work will begin soon.

Salmon Recovery Conference

The 2013 Salmon Recovery Conference will be held on May 14-15 in Vancouver, Washington at the Vancouver Convention Center. Sarah Gage will organize this effort for RCO, with other staff and organizations providing input and assistance along the way. RCO staff will be working through February to complete a draft conference agenda. Staff will also be working with a planning committee to review the timeline, consider potential keynote speakers, workshop presentations, exhibitors, and other details.

Attachments

A. Salmon Projects Closed Between November 1, 2012 and January 31, 2013

Salmon Projects Closed Between November 1, 2012 and January 31, 2013

Number	Name	Sponsor	Program	Closed On
10-1807	South Fork DS of Hutchinson Creek ELJ Design	Nooksack Indian Tribe	Puget Sound Acq. & Restoration	11/2/12
07-1722	Simmons Creek Restoration	Underwood Conservation District	Salmon Federal Projects	11/2/12
10-1525	Big Quilcene Estuary Acquisition Planning	Hood Canal Salmon Enhancement Group	Salmon Federal Projects	11/2/12
10-1744	QIN F-15 Road Impounded Pond Enhancement Design	Quinault Indian Nation	Salmon Federal Projects	11/2/12
11-1299	Trib to Steven's Creek Fish Passage Improvement	Grays Harbor Conservation District	Salmon Federal Projects	11/5/12
10-1745	QIN F-17 Road Impounded Pond Enhancement Design	Quinault Indian Nation	Salmon Federal Projects	11/6/12
10-1557	QIN Trib to N.F. Moclips Open Channels Project	Quinault Indian Nation	Salmon Federal Projects	11/6/12
10-1743	QIN Open Channels in Cook Creek Basin	Quinault Indian Nation	Salmon Federal Projects	11/6/12
07-1847	SF Nooksack Chinook Supplementation	Lummi Nation	Puget Sound Acq. & Restoration	11/7/12
05-1560	Stillaguamish Riparian Restoration Crew2	Stillaguamish Tribe of Indians	Salmon Federal Projects	11/7/12
09-1391	Gold Basin Landslide Feasibility and Design	Stillaguamish Tribe of Indians	Salmon State Projects	11/8/12
10-1733	Clear Creek Fish Passage Design Project	Wahkiakum Co. Public Works	Salmon Federal Projects	11/8/12
08-1916	Project Development White Salmon Tributaries	Mid-Columbia RFEG	Salmon Federal Projects	11/13/12
10-1520	Royal Arch Reach Acquisitions - Phase II	Seattle Public Utilities	Puget Sound Acq. & Restoration	11/20/12
10-1891	QIN S.F. Salmon River Culvert Replacement Design	Quinault Indian Nation	Salmon Federal Projects	11/21/12
09-1772	Eschbach Park Levee Setback & Restoration Design	Yakima County Public Services	Salmon Federal Projects	11/28/12
10-1754	WRIA 13 Nearshore Acquisition Assessment	Capitol Land Trust	Salmon Federal Projects	11/28/12
11-1556	Spurgeon Creek Acquisition & Restoration	Capitol Land Trust	Puget Sound Acq. & Restoration	12/4/12

Number	Name	Sponsor	Program	Closed On
08-1571	Stillaguamish Knotweed Control & Riparian Rest.	Sound Salmon Solutions	Salmon Federal Projects	12/6/12
08-1768	Cashmere Pond Off-Channel Habitat	Chelan County Natural Resource	Salmon Federal Projects	12/6/12
07-1874	Lower Dungeness River Floodplain Acquisition II	Clallam County Community Development	Puget Sound Acq. & Restoration	12/6/12
09-1472	Nason Creek LWP Floodplain Reconnection Assessment	Chelan County Natural Resource	Salmon Federal Projects	12/10/12
10-1125	Mill Creek Conf./Green River Design	City of Kent	Salmon Federal Projects	12/11/12
10-1795	Davis Slough Hydrologic Connectivity	Skagit Fish Enhancement Group	Salmon Federal Projects	12/13/12
10-1542	East Fork Lewis River Helicopter Log Jams	Mount St. Helens Institute	Salmon Federal Projects	12/24/12
10-1734	Indian Creek Fish Passage Correction	Underwood Conservation District	Salmon State Projects	12/26/12
07-1770	Juvenile Salmon Prey Base Protection (WRIA2)	KWIAHT	Puget Sound Acq. & Restoration	12/27/12
09-1458	Deer Lagoon Restoration Assessment 2009	Wild Fish Conservancy	Salmon State Projects	12/31/12
06-2288	Dosewallips Floodplain Acquisition II	Jefferson County Public Health	Salmon State Projects	12/31/12
07-1845	San Juan Derelict Fishing Net Removal	NW Straits Marine Cons Found	Salmon State Projects	12/31/12
10-1789	Wild Salmon Recovery in San Juan County	Friends of the San Juans	Puget Sound Acq. & Restoration	12/31/12
09-1633	Big Beef Creek Conservation	Great Peninsula Conservancy	Puget Sound Acq. & Restoration	12/31/12
08-1996	Skokomish River GI, Phase 2 & 3	Skokomish Tribe	Salmon Federal Projects	12/31/12
07-1591	Shorecrest Lagoon Protection	Whidbey Camano Land Trust	Puget Sound Acq. & Restoration	12/31/12
07-1638	Snow/Salmon Cr. 2007 Riparian Project	Jefferson Co Cons District	Puget Sound Acq. & Restoration	12/31/12
09-1459	Whidbey Island-Swan Lake Restoration 2009	Skagit Fish Enhancement Group	Puget Sound Acq. & Restoration	12/31/12
07-1632	Salmon Estuary Wood Waste Removal and Restoration	North Olympic Salmon Coalition	Puget Sound Acq. & Restoration	1/2/13

Number	Name	Sponsor	Program	Closed On
10-1898	Carpenter Creek Estuary Restoration	Kitsap County Community Development	Salmon State Projects	1/2/13
07-1743	SF Stillaguamish Knotweed Control	Sound Salmon Solutions	Puget Sound Acq. & Restoration	1/3/13
11-1577	President Channel Shoreline	San Juan County Land Bank	Puget Sound Acq. & Restoration	1/3/13
09-1383	Nisqually River Knotweed CWMA	Pierce Co Conservation District	Salmon Federal Projects	1/3/13
06-1712	Traylor- Frazer Creek -R4	Okanogan Conservation District	FFFPP Grants	1/4/13
08-1864	Ala Spit Restoration	Island County Health Department	Salmon Federal Projects	1/4/13
06-2343	Skokomish Confluence Reach	Forterra	Salmon State Projects	1/7/13
02-1589	Smoke Farm North Floodplain Acquisition & Restoration	Forterra	Salmon State Projects	1/8/13
08-2012	Sadilek- Unnamed Trib to Clallam River	North Olympic Salmon Coalition	FFFPP Grants	1/8/13
07-1811	Lower Dungeness River Floodplain Acquisition	Clallam County Community Development	Puget Sound Acq. & Restoration	1/14/13
09-1460	Upper Rattlesnake Creek Restoration	Mid-Columbia RFEG	Salmon Federal Projects	1/18/13
10-1820	Chatman Conservation Easement Acqusition	Blue Mountain Land Trust	Salmon Federal Projects	1/18/13
06-2208	McMurray- Clugston Creek R4	Stevens County Conservation District	FFFPP Grants	1/23/13
09-1473	Peshastin Creek Reconnection Alternatives Analysis	Chelan Co Natural Resource	Salmon Federal Projects	1/24/13
09-1672	Chico Creek Inst. Restoration Phase 2 Construction	Kitsap County Community Development	Puget Sound Acq. & Restoration	1/29/13
09-1649	Jimmycomelately Riparian Protection	North Olympic Land Trust	Puget Sound Acq. & Restoration	1/30/13

Washington Council of Salmon Recovery Regions
Report to the Salmon Recovery Funding Board
February 2013

Over the past several months the regional organizations have primarily focused on the development of the 2012 State of the Salmon report by writing narratives, assisting in developing website structure and reviewing data provided by the Departments of Ecology and Fish and Wildlife. They also held two conference calls to prepare for an all-day in-person meeting scheduled for February 28. Discussion topics will include progress on reviewing the roles and responsibilities of the Governor's Salmon Recovery Office, continued collaboration on key salmon recovery issues with state natural resource agencies, progress on contracting to assess monitoring activities funded by the SRFB, and preliminary discussion on the regional organizations' 2013-2015 biennial contracts.

The Lead Entity Advisory Group's February 2013 Report

To the Salmon Recovery Funding Board

The Lead Entity Advisory Group has been involved with working on improved communications, outreach and education, with efforts lead by its communications committee.

Lead Entities are working closely with RCO on an update of our statewide Lead Entity Directory. Each Lead Entity has supplied new project photographs, and updated information about project sponsors, citizens and technical committee members. Thanks to RCO staffers Brian Abbott, Susan Zemek and Stephanie Fuderich as well as GSRO's Lloyd Moody for their support and efforts on this important outreach tool. This document had been produced a few years ago but had not been updated.

Copies of this document will be available online and in hard copy. In addition, lead entities will be able to make copies of their respective pages to post on HWS or web pages, provide to legislators, funders, and others interested in salmon recovery.

In lieu of a lead entity meeting by conference call on February 12th, LEAG sponsored a Lead Entity Legislative Day instead. Some Lead Entity Coordinators from around the state as well as stakeholders and regional directors traveled to Olympia on February 12th to meet with their legislators. Some lead entities will do this on other dates later this month and other lead entities have met previously with legislators or more recently in their home districts.

Thanks to RCO's Nona Snell who helped provide guidance and information for participants. Thanks to Amy Hatch Wineka of the Thurston and Mason Lead Entities who worked with the LEAG communications committee on a Restoration Works! information sheet which can be provided to legislators and other elected officials. A copy is included in this report.

February 12th was also the day of Pacific County Lead Entity Coordinator Michael Johnson's memorial service. Mike, 41, passed away unexpectedly February 2nd. He had served as the Coordinator of Pacific County's Lead Entity in a part-time capacity since 2001. In addition, he was active with the Washington Coast Sustainable Salmon Coalition where he was Vice President of Planning, as well as chairing the Pacific Coast Marine Resources Committee and serving as District Manager of both the Grays Harbor and Pacific Conservation Districts.

In December of 2011, Mike received the State District Partnership Award from Roylene Rides, Washington state conservationist director for the Natural Resources Conservation Service (NRCS).

According to the Chinook Observer, Fred Colvin, vice chairman of the Washington State Conservation Commission (WSCC) and Mark Clark, WSCC executive director, honored the Pacific Conservation District for being selected as conservation district of the year out of 12 counties in Southwest Washington. The newspaper reported the State Partnership Award the Pacific Conservation District received was the only one given in 2011 in Washington.

Member Report:

Green/Duwamish and Central Puget Sound Watersheds

The Green/Duwamish and Central Puget Sound Watersheds (WRIA 9) Lead Entity has released an implementation progress report which covers restoration efforts from 2005 to 2011. This Report provides a snapshot of the accomplishments the Green/Duwamish and Central Puget Sound Watersheds team has made over the past six years implementing the WRIA 9 Salmon Habitat Plan. Considering the funding challenges and other barriers faced over the years in getting habitat projects and programs on the ground, the Implementation Progress Report demonstrates positive and significant steps forward, and the strength and importance of partnerships to help make that happen.

The Watershed Ecosystem Forum has secured over **$36,500,000** in WRIA 9-directed funding since Salmon Habitat Plan adoption in 2005. The funding went toward key projects and programs in the most important locations of the watershed to recover the Green River Chinook salmon population.

While the Implementation Progress Report shows progress made and reason to celebrate, it also reinvigorates a call to action. The number of natural origin spawners in 2009 was only **207 fish**, the lowest count since 1981. This unprecedented low number of salmon is a sign that not all is well and there is more work to be done.

Here's a link to an online copy of the report:

http://www.govlink.org/watersheds/9/plan-implementation/ImplementationProgressReport.aspx

-Report submitted by Doug Osterman & Karen Bergeron



RESTORATION WORKS

It Works for the ECONOMY

- Lead Entities coordinate projects that represent an investment in local and rural economic development through family-wage job creation and retention.
- Lead Entities spearhead efforts to recover and sustain salmon populations necessary for viable recreational and commercial fisheries throughout Washington State.
- Restoration funds invested by Washington State are leveraged 3 to1.
- Businesses locate in Washington State because of the quality of life provided by abundant and beautiful natural resources.

It Works LOCALLY

- In 1999, Washington State worked with NOAA Fisheries to allow watersheds to write their own local recovery plans for ESA-listed species.
- This action kept decisions local and not in the hands of the Federal government
- Lead Entities are the backbone for locally-based recovery efforts, bringing together Tribes, federal and state agencies, local governments, citizens, non-profits, business, and technical experts to make local decisions.
- Hundreds of citizens volunteer statewide on Lead Entity these projects and committees.
- Lead Entities are the nexus for science based, citizen supported salmon habitat recovery efforts, providing a coordinated, efficient, and effective response to ESA.

It Works for the ENVIRONMENT

- Lead Entities work locally to restore and protect those resources to the benefit of people who live and work here, as well as the creatures that depend upon the habitat.
- Lead Entities provide a local, balanced, coordinated, common-sense approach to recovery.

The Salmon Recovery Planning Act (RCW 77.85) created Lead Entities in 1999. They are administered by the Recreation and Conservation Office

The Regional Fisheries Enhancement Group will present a video for their update to the board.

WASHINGTON STATE RECREATION AND CONSERVATION OFFICE
Salmon Recovery Funding Board

Salmon Recovery Funding Board Briefing Memo

Item **4**

Meeting Date: February 2013

Title: Report on Estuary and Salmon Restoration Program (ESRP)

Prepared By: Betsy Lyons, Washington Department of Fish and Wildlife
Mike Ramsey, Grant Manager

APPROVED BY RCO DIRECTOR KALEEN COTTINGHAM

Summary

The Salmon Recovery Funding Board (board) will be briefed on the Estuary and Salmon Restoration Program (ESRP) at the February meeting. This memo provides background on the program.

Board Action Requested

This item will be a:

- ☐ Request for Decision
- ☐ Request for Direction
- ☒ Briefing

Background

In 2001, the Washington Department of Fish and Wildlife and the U.S. Army Corps of Engineers (Corps) initiated the Puget Sound Nearshore Ecosystem Restoration Project to identify the problems and solutions for nearshore degradation in Puget Sound. Five years later, the Washington Department of Fish and Wildlife created the Estuary and Salmon Restoration Program to support the priorities of that broad restoration effort.

The Estuary and Salmon Restoration Program provides grants to protect and restore the Puget Sound nearshore. The program initially advanced "urgent and obvious" early action projects, but also was envisioned as a long-term program that could implement the nearshore restoration actions in Puget Sound that were not a good fit for the Corps.

Organization

Estuary and Salmon Restoration Program (ESRP) is cooperatively managed by WDFW, the Recreation and Conservation Office (RCO) and the Puget Sound Partnership (PSP) through an interagency agreement. They work together, but have separate responsibilities that reflect each agency's strengths.

- WDFW provides technical leadership, leads the evaluation process, and manages the overall program.
- The RCO provides fiscal support and contract administration. Grant funding for the program is part of the agency's capital budget.
- The PSP supports the program through the state funding process, endorses the actions as a restoration component of the Action Agenda, and participates in the project evaluation process. The Leadership Council endorses the projects lists.

The Estuary and Salmon Restoration Program fosters strategic partnerships to meet its mission of nearshore ecosystem restoration. The three managing agencies – WDFW, RCO, and PSP – rely on the combined expertise of other agencies to support program and policy development, project selection, and program management. These other partners include:

- Army Corps of Engineers
- National Oceanic and Atmospheric Administration
- Environmental Protection Agency
- Navy
- Fish and Wildlife Service
- Geologic Survey
- Department of Natural Resources
- Northwest Straits Commission
- Northwest Indian Fisheries Commission
- The Nature Conservancy
- Pacific Northwest National Laboratory
- University of Washington

Funding and Grants

Most of the program's funding comes from state bond funds appropriated by the legislature in the state capital budget. The National Oceanic and Atmospheric Administration's Community Based Restoration Program, the U.S. Fish and Wildlife Service, and Environmental Protection Agency have provided some federal funding.

In 2006, the Legislature appropriated $2.5 million in capital funds to WDFW to fund habitat restoration and protection projects in Puget Sound through ESRP. Since then, the program has received and invested $26.5 million in state capital funds and an additional $2.5 million in federal partnership funds in restoration or protection projects[1].

The Grant Process

All phases of project development – from feasibility through monitoring – are eligible for funding.

[1] The appropriation for the Estuary and Salmon Restoration Program was in the budget for WDFW until the 2009-11 biennium. In the 2009-11 biennium, it was shifted to the RCO with a $7 million appropriation. In 2011-13, it received $5 million.

The Estuary and Salmon Restoration Program distributes funds through a competitive project selection and evaluation process. First, WDFW solicits project proposals through a Request for Proposals, which lists the criteria that projects must meet. The project proposals are then evaluated by a multi-disciplinary technical review team composed of members from multiple agencies and organizations throughout Puget Sound. This team ranks projects against the criteria to develop a ranked list of projects called an Investment Plan. The plan includes the projects, funding recommendations, and additional provisions (e.g., developing funding conditions). This evaluation process identifies the most sound and promising restoration and protection opportunities that are ready to advance for implementation to the Legislature and Governor for funding.

New versus Portfolio Projects

Applications are received and evaluated either as "new" or "portfolio" projects. New proposals may include requests for a single or multiple phases of a project, depending on complexity of the project and anticipated timeline. More complex projects often need to be implemented in phases over multiple grant cycles. To keep these important, well-deserving projects moving forward, program staff developed a streamlined "portfolio" process. A "portfolio" project begins as a request for funding for feasibility and design only. After that work is completed and approved by ESRP, and the project is showing good progress, the project is eligible for the portfolio process. The remaining phases require the applicant to submit a simplified application that is reviewed by program staff, rather than going through the full technical review each grant competition. The projects also may receive priority funding in future funding cycles. Typically, two to four portfolio requests are submitted each grant cycle.

Funding Schedule and the 2013-15 Biennial Request

Most ESRP funding is distributed in the first year (odd numbered year) of each biennium. The Washington Department of Fish and Wildlife conducts the Request for Proposals and project evaluation process during the late summer or early fall of even-numbered years. Successful projects are presented to the Governor and Legislature for inclusion in the biennial budget.

In preparation for the 2013 legislative session, the Salmon Recovery Funding Board and RCO asked the Governor to include $10 million for ESRP in the state capital budget. Governor Gregoire's budget proposal to the Legislature included the full $10 million. The 2013 Investment Plan has been developed and was endorsed by the PSP Leadership Council on February 7.

A summary and the project lists for the 2013 ESRP investment plan can be found here: http://www.pugetsoundnearshore.org/esrp/files/2013_draft_investment_plan.pdf

Completed Projects

Typical projects include nearshore restoration and protection activities that restore natural ecosystem processes and functions. Examples of previously funded projects include:

- Protection of nearshore and wetland habitat
- Restoration of salmon habitat and estuaries
- Removing or breaching dikes
- Removing bulkheads to restore sediment supply and transport to beaches
- Feasibility and design
- Decommissioning roads and fill removal
- Monitoring

Staff from the RCO and WDFW will share examples of upcoming and completed projects of note at the February board meeting.

WASHINGTON STATE RECREATION AND CONSERVATION OFFICE
Salmon Recovery Funding Board

Salmon Recovery Funding Board Briefing Memo

Item **5**

Meeting Date: February 2013
Title: Family Forest Fish Passage Program Presentation and Video
Prepared By: Dave Caudill, Grant Manager

APPROVED BY RCO DIRECTOR KALEEN COTTINGHAM

Summary

This memo provides an overview of the Family Forest Fish Passage Program and a brief update on its progress in implementing projects related to the funding in the 2012 supplemental budget. Recreation and Conservation Office (RCO) and partner agency staff will describe the program in more detail and share a video at the February meeting.

Board Action Requested

This item will be a:

- ☐ Request for Decision
- ☐ Request for Direction
- ☒ Briefing

Program Background

As part of Washington's salmon recovery efforts, all private forest owners are required to fix artificial, in-stream fish barriers. In May 2003, the state Legislature committed to helping small forest landowners pay for these repairs by creating the Family Forest Fish Passage Program (FFFPP). Landowners enrolled in the program will not be required to correct their fish passage barriers until the state can provide financial assistance.

The FFFPP provides funding to repair or remove fish passage barriers for small forest landowners[1]. Funding comes from the Legislature through the sale of general obligation bonds. The program is implemented by three state agencies; each provides different program services:

- The Small Forest Landowner Office at the Department of Natural Resources (DNR) assists landowners, provides outreach, and looks for additional funding sources.

[1] A small forest landowner is a landowner that harvests fewer than 2 million board feet of timber each year from lands owned in Washington. To put this amount in perspective, a 40-acre stand of healthy second growth timber yields about 2 million board feet of timber. This amount would fill about 400 log trucks.

- The Washington Department of Fish and Wildlife (WDFW) evaluates and ranks projects, and provides information on fish barriers, fish species, habitat, and watershed groups.
- The Recreation and Conservation Office (RCO) administers program funding and manages program contracts, billing, and reimbursement.

The projects can be sponsored by the landowner or by another organization (e.g., a conservation district, Regional Fisheries Enhancement Group, local non-profit organization, tribe, etc.) More information about the program is in an August 2011 memo to the Salmon Recovery Funding Board (board)[2].

Since inception, FFFPP partners have completed 188 projects. This includes 16 projects completed in 2012: twelve finished as scheduled with typical FFFPP funding, and four projects used supplemental budget funding (see below).

2012 Supplemental Budget Update

The 2012 state supplemental budget included $10 million in additional funds for the program. This funding was a significant increase for FFFPP, and came with an ambitious goal of completing about 100 projects by December 31, 2014.

WDNR, WDFW, and RCO developed a plan to accomplish the work on time. Plan elements include outreach to eligible landowners and project sponsors, more frequent reviews of applications, and grant management.

Since last summer, RCO grant manager Dave Caudill has been working closely with partner agencies to award the additional funds to projects that remove fish passage barriers on their, privately owned forest land roads. Forty-eight projects were approved for funding in 2012-13. The list of projects for the 2014 construction season is under development.

Of the 48 projects currently funded, four are complete (as noted above) and 44 others are now being designed and prepared for 2013 construction. The partner agencies will provide more information to the board at the February meeting.

Video Description

The partner agencies developed a video to educate landowners, salmon restoration professionals, and others involved or interested in the recovery of salmon on small forest landowner properties. The video incorporates footage of FFFPP projects before, during, and after construction along with discussions by program experts about benefits of the program and testimonials from landowners who have participated in the program.

The partner agencies will share the video with the board at the February meeting.

[2] The memo is available at http://www.rco.wa.gov/documents/salmon/agendas/2011/08/S0811_8.pdf.

WASHINGTON STATE RECREATION AND CONSERVATION OFFICE
Salmon Recovery Funding Board

Salmon Recovery Funding Board Briefing Memo

Item **6**

Meeting Date: February 2013
Title: Service Recognition: Craig Partridge
Prepared By: Rebecca Connolly, Board Liaison

APPROVED BY RCO DIRECTOR KALEEN COTTINGHAM

Summary

Salmon Recovery Funding Board (board) member Craig Partridge has announced his retirement from state service. The board is asked to recognize his service.

Board Action Requested

This item will be a:
- ☒ Request for Decision
- ☐ Request for Direction
- ☐ Briefing

Proposed Motion Language

Move to approve resolution 2013-01, recognizing the service of Craig Partridge to the board.

Background

Board member Craig Partridge was appointed to the board in 1999 as the designee for the Department of Natural Resources. Craig has remained on the board since then, serving a key role in the development of the state's bottom-up approach to salmon recovery. During his tenure, the board established and refined the policies and structure for its approach to salmon recovery, provided millions of dollars for projects and monitoring, and worked hard to ensure efficiencies, accountability, and effectiveness.

In February, Craig announced that he would retire from state service on April 30, 2013. The board will be asked to recognize his service at the February 27, 2013 meeting. Craig is the longest-serving member of the board.

Staff Recommendation

Staff recommends that the board approve the service of board member Craig Partridge with the attached resolution.

Attachments

Resolution 2013-01

WASHINGTON STATE
RECREATION AND CONSERVATION OFFICE
Salmon Recovery
Funding Board

A Resolution to Recognize the Service of

Craig Partridge

To the Residents of Washington State and the Salmon Recovery Funding Board

WHEREAS, from 1999 through 2013, Craig Partridge served the citizens of the state of Washington and the Washington Department of Natural Resources as the agency's designee on the Salmon Recovery Funding Board (board); and

WHEREAS, as the board's longest-serving member, Mr. Partridge's dedication and commitment to the board over the years gave him a "big picture" perspective of issues that helped the board promote salmon recovery by protecting and restoring salmon habitat; and

WHEREAS, Mr. Partridge's intellect, deep understanding of key issues, and exceptional ability to perceive the policy implications of complex situations, provided the board with insight that helped it to develop strong program policies that promoted sound investments of public moneys and respected the state's "bottom up" approach to salmon recovery; and

WHEREAS, during his tenure, the board funded over 1,700 projects, creating a state and federal investment of more than $376 million in Washington's salmon recovery effort; and

WHEREAS, Mr. Partridge plans to retire from state service at the end of April 2013; and

WHEREAS, members of the board wish to recognize his support, leadership, and service, and wish him well in future endeavors;

NOW, THEREFORE BE IT RESOLVED, that on behalf of the residents of Washington and in recognition of Mr. Partridge's dedication and excellence in performing his responsibilities and duties as a member, the board and its staff extends their sincere appreciation and compliments on a job well done.

Approved by the Salmon Recovery Funding Board
in Olympia, Washington on February 27, 2013

Bud Hover Board Chair	Harry Barber Citizen Member	Josh Brown Citizen Member
Phil Rockefeller Citizen Member	David Troutt Citizen Member	Melissa Gildersleeve Washington Department of Ecology
Carol Smith Washington State Conservation Commission	Jennifer Quan Washington Department of Fish and Wildlife	Mike Barber Washington Department of Transportation

WASHINGTON STATE RECREATION AND CONSERVATION OFFICE
Salmon Recovery Funding Board

Salmon Recovery Funding Board Briefing Memo

Item **7**

Meeting Date: February 2013

Title: Overview of Monitoring Program

Prepared By: Brian Abbott, Salmon Section Manager and GSRO Coordinator
Keith Dublanica, GSRO Science Coordinator

APPROVED BY RCO DIRECTOR KALEEN COTTINGHAM

Summary

This memo and the staff presentation at the February board meeting will provide a brief overview of the monitoring program funded by the Salmon Recovery Funding Board (board). This is intended to provide (1) an update on the contractor hired to develop the board's monitoring investment strategy, (2) the context for the request to fund a monitoring chapter in the Stream Habitat Restoration Guidelines (Item 7), and (3) the briefing on the Intensively Monitored Watersheds program (Item 8).

Board Action Requested

This item will be a:

- ☐ Request for Decision
- ☐ Request for Direction
- ☒ Briefing

Background

The state of Washington applies for a federal Pacific Coastal Salmon Recovery Fund (PCSRF) grant each year to fund salmon recovery projects throughout the state. The Washington State award has ranged from about $23 million to $28 million in each of the last ten years. The PCSRF grant program requires that 10 percent of the overall state award be dedicated to monitoring efforts.

Current Funding Approach

The board currently has a strategic approach to allocating the monitoring funding. This approach was developed in 2003 and has been informed by several key efforts: 1) the Washington Comprehensive Monitoring Strategy; 2) the Framework for Monitoring Salmon Population Listed under the Federal Endangered Species Act and Associated Freshwater Habitats; and 3) the board's 2003 Monitoring and Evaluation Strategy for Habitat Restoration and

Acquisition Projects[1]. The board's monitoring strategy is focused on effectiveness and validation monitoring and provides:

- Prioritized monitoring by type and category;
- Estimated costs over ten years; and
- Metrics agreed upon by the board, NOAA Fisheries, Oregon Watershed Enhancement Board, and Bonneville Power Administration.

The board has been using its strategy to guide key monitoring funding decisions and to determine monitoring priorities. In 2009, the board asked the Monitoring Forum to review its monitoring priorities and either (a) reaffirm and/or (b) provide additional recommendations.

Based on its strategy (and the Forum's review), the board allocates most of its monitoring funding to three larger, longer-term monitoring efforts:

- Project effectiveness monitoring:
- Fish-in/fish-out (as its status and trends monitoring component): and
- Intensively monitored watersheds (IMW).

The different types of monitoring are designed to answer different questions. The fish-in/fish-out monitoring is done in conjunction with the IMW monitoring at the IMW complexes. More information may be found in Item 8.

Effectiveness Monitoring	Fish in/Fish Out (Status & Trends)	IMW Monitoring
•Do habitat restoration projects work? •Can we actually improve fish habitat?	•Estimate the status of fish populations and track over time indicators of habitat, water quality, water quantity, and other factors that impact watershed health	•Does habitat restoration actually increase fish production and abundance?

Status of monitoring assessment to be completed in October 2013

In December 2012, the board approved up to $75,000 for an assessment of its monitoring program and the development of a Monitoring Investment Strategy.

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[1] *"The Washington Comprehensive Monitoring Strategy and Action Plan for Watershed Health and Salmon Recovery* http://www.rco.wa.gov/documents/monitoring/Executive_Report_final.pdf; *"Washington State Framework for Monitoring Salmon Populations Listed under the Federal Endangered Species Act and Associated Freshwater Habitats:* http://www.rco.wa.gov/documents/monitoring/Framework_Document.pdf; *"Monitoring and Evaluation Strategy for Habitat Restoration and Acquisition Projects"* http://www.rco.wa.gov/documents/monitoring/SRFB_Monitoring_Strategy.pdf

A Request for Qualifications/Quotations was posted on December 31, 2012. Staff evaluated and ranked the responses, interviewed the respondents, and identified an apparent successful contractor. The RCO expects to enter into a contract with Stillwater Sciences in mid-February, and hold a "kick-off" meeting with the contractor and the steering committee before the end of the month. The contractor will provide a draft assessment to RCO in mid-April. Staff will brief the board in May and then work with the consultant and steering committee throughout the summer to refine the draft strategy. Staff will present a final report with recommendations at the board's October meeting. The recommendations will be designed for implementation with federal fiscal year 2014 PCSRF funds.

Funding decisions for 2013 that will be needed in May 2013

Some of the existing monitoring contracts expire before the assessment will be completed, so the board will need to make decisions about the use of 2013 PCSRF monitoring funds and existing contracts in May. The RCO director has approved bridge funding for the Tetra Tech contract to start the preliminary field work and landowner/sponsor outreach for the effectiveness monitoring sites. The bridge funding extends the current effectiveness monitoring contract until the May meeting, when the board will be asked to approve funding for the remainder of the field season as noted below. The board will also be asked to approve funding for the IMW work during the 2013 field season.

Monitoring Type	Monitoring Performed by	Estimated Timeline for Work and Contract[2]
Effectiveness Monitoring	Tetra Tech	June 1, 2013 through June 30, 2014
IMW Monitoring	Washington Department of Fish and Wildlife	June 1, 2013 through June 30 2014

Depending on the amount of PCSRF funds available, the board also may be asked to authorize a subgroup that would recommend an allocation of any remaining unobligated monitoring funds.

Next Steps

At the board's request, during the February board meeting, scientists from the Departments of Ecology and Fish and Wildlife will update the board on the current status and findings of the intensively monitored watersheds monitoring. Due to scheduling conflicts, the update on the Tetra Tech project effectiveness monitoring will be presented at the May board meeting.

RCO staff will prepare detailed funding requests for monitoring contracts at the May 2013 meeting.

[2] The actual contract timeline may vary, depending on the recommendations of the monitoring assessment.

WASHINGTON STATE RECREATION AND CONSERVATION OFFICE
Salmon Recovery Funding Board

Salmon Recovery Funding Board Briefing Memo

Item **8**

Meeting Date: February 2013

Title: Stream Habitat Restoration Guidelines Monitoring Chapter Update

Prepared By: Brian Abbott, Salmon Section Manager and GSRO Coordinator

APPROVED BY RCO DIRECTOR KALEEN COTTINGHAM

Summary

Project sponsors and others have identified a need for an update to the Stream Habitat Restoration Guidelines Monitoring Appendix. The board will be asked to fund the work at the February meeting.

Board Action Requested

This item will be a:

- ☒ Request for Decision
- ☐ Request for Direction
- ☐ Briefing

Proposed Motion Language

Move to approve use of up to $25,000 in federal fiscal year 2012 Pacific Coastal Salmon Recovery Fund (PCSRF) dollars dedicated to monitoring to fund the update.

Background

The Stream Habitat Restoration Guidelines (Guidelines) promote a process-based natural stream restoration that rehabilitates aquatic and riparian ecosystems. The Guidelines provide consistent standards and techniques for restoration planners, designers, policy makers, and regulatory staff while also setting the standard for restoration practices across the region. These guidelines were developed in partnership with multiple state and federal agencies, as well as local groups focused on habitat restoration in Washington.

Although the new edition of the Guidelines[1] issued in April 2012 had significant revisions and additions, the *Appendix J, Monitoring*, was not updated due to resources and timing. The appendix is intended to provide general guidelines for monitoring stream restoration projects. The information currently in that appendix is from the 2004 edition.

[1] The update can be found at: http://wdfw.wa.gov/publications/01374/wdfw01374.pdf

Effect on Projects and Sponsors

Project sponsors and Recreation and Conservation Office (RCO) staff who work on salmon recovery projects have noted that the lack of a monitoring appendix update in the Guidelines has been a challenge for implementation monitoring and inspections. As written, the Guidelines do not provide sufficient project-specific information. A further complication is that – due to its brevity -- the monitoring appendix is inconsistent with RCO's more thorough guidance, which also tends to focus on effectiveness monitoring rather than project implementation monitoring.

Board Decision Requested

The board is being asked to approve the use of up to $25,000 in federal fiscal year 2012 Pacific Coastal Salmon Recovery Fund (PCSRF) dollars to fund the update to the Stream Habitat Restoration Guidelines Appendix J. This funding would be part of the 10 percent dedicated to monitoring, of which $158,000 of the 2012 grant remains to be allocated.

The update will establish a baseline that is consistent with current monitoring protocols and will provide better guidance for implementation monitoring of board projects either by project sponsors or during RCO final inspections.

Staff Recommendation

Staff recommends approval of the proposal.

Proposal

RCO staff and members of the Aquatic Habitat Guidelines Committee are proposing that Appendix J be updated. The scope of work would be as follows:

- Scope Item 1
  - Further define monitoring types using regionally accepted definitions;
  - Provide descriptions for the monitoring variables described to help identify the specific data elements required to calculate them;
  - Provide additional information from regional references; and
  - Add a discussion of sample designs, quality assurance procedures, and analysis approaches.
- Scope Item 2
  - Make general recommendations for project-specific monitoring based on project types identified in the Guidelines and objectives associated with those projects;
  - Provide examples of monitoring approaches and protocols used to evaluate the effectiveness of specific project types and how these data can be used to evaluate design criteria developed for the project during the design and implementation phases; and

    - Document case studies illustrating projects in which monitoring data were used to provide additional information on project performance that improved the understanding of project function and could be used to demonstrate project effectiveness.
- Scope Item 3
    - Develop specific procedures and data forms that could be used to actually monitor projects that are included in the techniques described in the Stream Habitat Restoration Guidelines. Discussion of data analysis procedures would also be included, and examples of graphical representations of data would be provided.
    - Additional elements within this approach consist of the following:
        - Include specific field procedures and data collection forms by project type as attachments ;
        - Provide illustrated examples of data presentation for project level monitoring and for comparison across project types; and
        - Analyze cost-effectiveness of project types for which monitoring data have been collected.
- Scope Item 4
    - Provide assistance in creating the RCO/Salmon Recovery Funding Board final inspection documentation procedure for future monitoring and compliance activities.
- Scope Item 5
    - Develop a presentation to convey the content of the monitoring appendix to those who may be interested in obtaining additional training in Stream Habitat Restoration Guidelines.

Analysis

Investing funding for this update is consistent with the current monitoring program and would provide a better link between habitat restoration actions and post project monitoring to help answer the question of project effectiveness. The utility of an updated monitoring appendix will extend beyond board-funded projects. Greater consistency in monitoring will benefit everyone when trying to understand the impact of stream restoration projects on salmon recovery. In short, this project will give anyone who wishes to conduct implementation or effectiveness monitoring the basic tools and knowledge to complete the task at specific restoration sites.

Next Steps

If approved, RCO staff will work to draft a scope of work. We will assess current monitoring contracts to determine if it would be appropriate to add this work through a contract amendment, or may award the contract through a competitive bid process. The work would start this spring and be completed over the summer of 2013.

WASHINGTON STATE RECREATION AND CONSERVATION OFFICE
Salmon Recovery Funding Board

Salmon Recovery Funding Board Briefing Memo

Item **9**

Meeting Date: February 2013

Title: Monitoring Program Findings and Results: Intensively Monitored Watersheds

Prepared By: Keith Dublanica, GSRO Science Coordinator
Bill Ehinger, Department of Ecology
Tim Quinn, Washington Department of Fish and Wildlife

APPROVED BY RCO DIRECTOR KALEEN COTTINGHAM

Summary

The Salmon Recovery Funding Board (board) supports the Intensively Monitored Watersheds (IMW) program, and has asked for annual updates on IMW progress. In particular, the board requested an analysis of the Skagit River Estuary IMW before the 2013 funding decision, which is scheduled for May. This memo will highlight the integration of fish-in/fish-out monitoring within the IMWs and provide an update of preliminary findings and results. Presentations at the meeting will give additional detail, with an emphasis on the Skagit and Straits IMWs

Board Action Requested

This item will be a:

- ☐ Request for Decision
- ☐ Request for Direction
- ☒ Briefing

Background

The Intensively Monitored Watershed (IMW) program is designed to determine whether restoration efforts result in more salmon by comparing changes in salmon production among experimental treatment (restoration) and control (no restoration) watersheds.

The Salmon Recovery Funding Board (board) funds four IMW complexes. Three – Hood Canal, Strait of Juan de Fuca and the Lower Columbia – are conducted in freshwater habitat, while the fourth – the Skagit River Estuary – is conducted in estuarine habitat.

Each IMW includes two distinct elements: (1) implemented restoration projects and (2) monitoring to determine if those restoration projects are improving habitat conditions and fish abundance and productivity. The restoration and monitoring elements are managed and funded separately.

- *Restoration projects* can be funded through many sources, which may include the board's grant process.
- The board funds the *monitoring element* as part of its overall monitoring program.

2012 Board Funding and IMW Program Review

The board receives annual updates on the progress of the IMW program. In 2012 -- as in previous years -- the board expressed some concerns about the length of the program commitment, whether there would be widespread applicability of the results, and the potential "disconnects" between the monitoring and restoration components.

Following in-depth discussions by the board in June and August, the board funded all four IMWs. The board also incorporated a review of the program into its overall monitoring assessment, which is being conducted by an independent contractor and is due in October 2013.

Finally, the board requested a review of the Skagit River Estuary IMW before the May funding discussions. Staff is hopeful that the board's questions about the Skagit IMW, as well as any questions about the IMW program generally, can be answered at the February meeting, before the funding request for a one-year extension is presented in May 2013.

Fish-in/Fish-out Monitoring

The board funds fish-in/fish-out monitoring as the status and trends component of its overall monitoring program. This monitoring compares the number of smolts that leave an area to the number of returning adult salmon that return to the spawning grounds in following years. With this monitoring, productivity can be tracked as well as carrying capacity estimated.

The National Oceanic and Atmospheric Administration (NOAA) identified 28 Major Population Groups (MPGs) and found that a minimum of 86 primary populations may require monitoring to effectively assess delisting criteria in Washington State.

Since there is insufficient funding to monitor all 86 salmon populations and their habitats at the level of intensity suggested by NOAA, Washington State has focused on the most important populations. Washington State monitors juvenile migrants at the mouths of 34 rivers. With this approach, the state can gather information on 70 of the primary populations.

The board contributes to a portion of the Department of Fish and Wildlife's fish-in/fish-out monitoring. The work is accomplished through a contract with the Department of Fish and Wildlife (WDFW). The work is done in various tributaries throughout the state. WDFW also conducts fish-in/fish-out monitoring in the Hood Canal and Lower Columbia IMWs through a separate contract with the Department of Ecology. The board contributes about 7 percent of the total funding for WDFW fish-in/fish-out monitoring.

Every IMW design incorporates fish-in/fish out monitoring as an essential tool for determining if restoration actions are affecting fish productivity. Using the board's funds in this manner not

only fills gaps in the statewide "fish-in/fish-out" framework but also promotes the success of those IMWs in the most comprehensive way

Staff from WDFW will present findings from the fish-in/fish-out monitoring as part of the IMW presentations at the board meeting in February.

Analysis

In February, staff from the Governor's Salmon Recovery Office (GSRO), Department of Ecology (Ecology), Washington Department of Fish and Wildlife (WDFW), and local partners will present information about the findings and results at each of the board-funded IMW complexes. The following are brief summaries for each of the sites. Attachments A through D are more in-depth documents.

Skagit River Estuary

This IMW is conducted by WDFW, the Skagit River Systems Cooperative, and National Marine Fisheries Service.

Purpose

This IMW is designed to examine the responses of Skagit River Chinook salmon to reconnection and restoration of estuarine habitat. It does this through long-term monitoring of juvenile Chinook salmon rearing in tidal delta channels, nearshore, and offshore estuarine habitats.

Results of population monitoring directly address three general questions:

1. Are salmon limited during the early estuarine life stages by capacity and connectivity constraints?
2. Does broad-scale restoration influence local population density?
3. Has estuary restoration resulted in population or system-level responses?

Design

The amount of restoration work that has been completed in the tidal delta to date is about 12 percent of the overall goal documented in the *Skagit River Chinook Recovery Plan 2005*. Such restoration actions include tide gate removal or replacement, removal of dikes to reconnect drained tidelands, and restoring access to existing habitat.

Preliminary Results/Findings

Our results show that 1) additional restoration in the Skagit River tidal delta is needed to address capacity and connectivity limitations, 2) local restoration improved rearing densities for juvenile Chinook salmon, and 3) system-wide responses can be detected using a before/after control-impact (BACI) design. The number of fish using the nearshore habitat is not yet at the increase expected, possibly due to access. More and varied restoration actions in tidal and delta areas are needed.

These findings also shed light on the utility of extensive monitoring to document effects of restoration. Responses to restoration would have been impossible to determine without long-

term, pre-restoration status monitoring and WDFW's juvenile migrant trapping throughout both pre- and post-restoration phases. For example, we identified tidal delta habitat as the limiting factor based on (1) WDFW's long-term smolt monitoring and (2) the Skagit River System Cooperative's monitoring of juvenile chinook's use of habitat within the delta and Skagit Bay. Monitoring of transitional estuarine rearing habitats at multiple life stages is helping to pinpoint the contribution of various rearing areas within the Skagit tidal delta.

Strait of Juan de Fuca Intensively Monitored Watershed

This IMW is conducted by Ecology, the Department of Fish and Wildlife, Lower Elwha Tribe, and NOAA fisheries in partnership with Weyerhaeuser.

Purpose

The Strait of Juan de Fuca IMW tests the watershed scale response of steelhead and coho to restoration.

Design

The "Straits" IMW includes two treatment watersheds (East Twin River and Deep Creek) and one control watershed (West Twin River).

- Restoration treatments were completed in 2011, and include large woody debris placement, road removal, culvert removal, off-channel habitat creation, and riparian planting.
- Monitoring of physical habitat and densities of summer parr began in 2004. Smolt and adult monitoring predates the IMW program, and began as early as 1998 in Deep Creek. Project-scale habitat monitoring began in the mid-1990s.

Preliminary Results/Findings

Fish responses may need between 7 and 10 years before a "signal" or response to the treatment can be quantified. However, preliminary results suggest that there are some improvements in pool habitat and small increases in steelhead adults and smolts in East Twin River and coho adults in Deep Creek. Given that restoration treatments were completed only recently, and habitat typically does not respond immediately to treatment a minimum of seven to ten years of monitoring are needed after implementation of the last treatments to determine if there is a watershed-scale fish response to the restoration actions.

The treatments in these basins have been predominantly the installation of large woody debris structures, but an additional treatment of off-channel enhancements also has been discussed. An in-depth comprehensive report of the Straits is due in June 2013. That report will include the conclusions to date and recommendations about additional treatments.

Lower Columbia Intensively Monitored Watersheds

This IMW is conducted by the Lower Columbia Fish Recovery Board, NOAA, the Department of Fish and Wildlife, Ecology, and Weyerhaeuser.

Purpose
The Lower Columbia Intensively Monitored Watersheds study evaluates the response of coho and Chinook salmon and steelhead to habitat restoration actions.

Design
The study focuses on three adjacent watersheds (Mill, Abernathy, and Germany creeks) that flow into the Lower Columbia River. The study is designed as a before-after control-impact study with Mill Creek as the control watershed and Abernathy and Germany creeks as the treatment watersheds. In Germany Creek, completed restoration projects include a culvert replacement, a large woody debris and off channel project, and bank stabilization as well as three years of watershed scale carcass analog treatments. In Abernathy Creek, completed or in-progress restoration projects include road abandonment and road removals, channel restructuring, and large woody debris placements. Additional projects, identified in the Abernathy and Germany Creeks Intensively Monitored Watershed Treatment Plan, are yet to be implemented.

The abundance, survival, and distribution of all three species are assessed annually at three life stages – spawner, summer parr (coho and steelhead only), and outmigrant (smolts). Habitat characteristics, such as large woody debris counts and pool frequency, are quantified on an annual basis. Water quality characteristics, such as flow and temperature, are measured on a continuous basis at gaging stations in each watershed while water chemistry is measured monthly.

Preliminary Results/Findings
Pre-project monitoring began in 2005 with an additional four years of collecting outmigrant fish data before this time. Currently, post-project monitoring includes two years of data from Germany Creek. Restoration in Abernathy Creek has not yet been substantive enough for "post-treatment" monitoring. Two years of data are insufficient to draw conclusions with any amount of certainty.

As discussed by the board at the June and August 2012 meetings, securing results from the monitoring component of this IMW is heavily reliant on successful implementation of additional restoration treatments. The board tabled a discussion of its involvement in funding such restoration until May 2013, to allow the Lower Columbia Fish Recovery Board to work with partners on a broad funding strategy and landowner outreach.

Hood Canal Intensively Monitored Watersheds

Monitoring for this IMW is conducted by Ecology, the Department of Fish and Wildlife, and Weyerhaeuser, in partnership with the University of Washington facility on Big Beef Creek, the Hood Canal Coordinating Council, and the Hood Canal Salmon Enhancement Group.

Purpose
The Hood Canal Intensively Monitored Watersheds study evaluates the response of coho and steelhead to habitat restoration actions.

Design

The study focuses on four adjacent watersheds (Little Anderson, Big Beef, Seabeck, and Stavis creeks) that flow out of the Kitsap Peninsula into eastern Hood Canal. The study is designed as a before-after control-impact study with Stavis Creek as the control watershed and Seabeck, Big Beef, and Little Anderson creeks as the treatment watersheds. In Little Anderson Creek, completed restoration projects include one culvert replacement and two large woody debris additions. In Seabeck Creek, completed and in-progress restoration projects include three culvert replacements and one undersized bridge replacement. In Big Beef Creek, final plans are being developed to remove bank armoring and reconnect a wetland in the lower watershed.

The abundance, survival, and distribution of coho are assessed each year at three life stages – spawner, summer parr, and outmigrant. Habitat characteristics, such as large woody debris counts and pool frequency, are quantified on an annual basis. A stream flow gaging station, located on Big Beef Creek, provides an index of seasonal flows for the four watersheds.

Preliminary Results/Findings

Pre-project monitoring began in 2005 with an additional 14-25 years of outmigrant fish data prior to this time. Post-project monitoring includes three years on Little Anderson Creek. Post-project monitoring on Seabeck Creek will begin in 2013, now that three culvert replacements and one undersized bridge replacement were implemented. At the February meeting presenters will provide a summary of their three-years of monitoring on Little Anderson Creek, but substantive conclusions cannot yet be cited.

Next Steps

Staff from WDFW, Ecology, and other partners will present key results and findings to the board in February, and answer questions about the monitoring. The board will be asked to fund continuing monitoring efforts in May 2013.

Attachments

A. Monitoring Population Responses to Estuary Restoration by Skagit River Chinook Salmon

B. Strait of Juan de Fuca Intensively Monitored Watershed Draft 2013 Synthesis Report

C. Intensively Monitored Watersheds Synthesis Report Lower Columbia River 2013

D. Intensively Monitored Watersheds Synthesis Report Hood Canal 2013

Monitoring Population Responses to Estuary Restoration by Skagit River Chinook Salmon

Intensively Monitored Watershed Project
Annual Report, 2011

by

Correigh M. Greene
Fish Ecology Division, Northwest Fisheries Science Center
2725 Montlake Boulevard East
Seattle, Washington 98112-2907

and

Eric M. Beamer
Skagit River System Cooperative
11426 Moorage Way
La Conner, Washington 98257-0368

EXECUTIVE SUMMARY

While much restoration in Pacific Northwest estuaries has been implemented in order to improve rearing conditions for juvenile Chinook salmon, no studies to date have documented population responses in the focal stock to these restoration efforts. With this intention, we examined the responses of Skagit River Chinook salmon to reconnection and restoration of estuarine by implementing long-term monitoring of juvenile Chinook salmon rearing in tidal delta channels, nearshore, and offshore estuarine habitats. These habitats are strongly associated with rearing stages of juvenile Chinook salmon, especially in fish of wild origin.

This report focuses on results of population monitoring through 2010 and addresses three general questions: 1) Are salmon limited during the early estuarine life stages by capacity and connectivity constraints? 2) Does broad-scale restoration influence local population density? and 3) Has estuary restoration resulted in population- or system-level responses? Our results showed that 1) restoration in the Skagit River tidal delta is needed to address capacity and connectivity limitations, 2) local restoration did improve rearing densities for juvenile Chinook salmon, and 3) system-wide responses can be detected using a before/after control-impact (BACI) design. In addition, it appears capacity limitations still exist in the Skagit River tidal delta, as judged from recruitment patterns into shoreline habitat, and that further tidal delta restoration is warranted. Thus far, we estimate that the amount of restoration work completed in the tidal delta is 12% of goal of the *Skagit River Chinook Recovery Plan*, and our monitoring work corroborates this estimate.

These findings also shed light on the utility of extensive monitoring in order to document effects of restoration. Responses to restoration would have been impossible to determine without extensive pre-restoration status monitoring and juvenile migrant trapping throughout both pre- and post-restoration phases. Monitoring of transitional estuarine rearing habitats at multiple life stages is helping to pinpoint the contribution of potential rearing areas within the Skagit tidal delta.

Further monitoring as part of the Intensively Monitored Watershed Project (IMW) is needed to refine our ability to detect change at a population level and to examine the sensitivity of other life-stage specific monitoring metrics (nearshore recruits, adult returns) to restoration in the tidal delta. Finally, ongoing monitoring is shedding important light on the status and trends of multiple species of importance in the Skagit River estuary, including Chinook and coho salmon, bull trout, Pacific herring, and surf smelt.

CONTENTS

INTRODUCTION

Juvenile Chinook salmon are well known for utilizing "pocket estuaries" such as nearshore lagoons, marshes, and other estuarine habitats within the tidal delta for rearing during migration (Reimers 1973; Healey 1980; Beamer et al. 2003). Several studies have linked population responses to availability of estuary habitat, either by examining return rates of experimental groups given access to different habitat zones (Levings et al. 1989) or by comparing survival rates among populations with varying levels of estuary habitat degradation (Magnuson and Hilborn 2003).

These studies support the hypothesis that estuarine habitat is vital for juvenile Chinook salmon; however, these coarse-scale studies provide no information on how estuarine habitat restoration at a watershed scale contributes to population characteristics. This knowledge is critical to understanding how to restore Chinook salmon populations, many of which have lost rearing habitat with the conversion of Puget Sound estuaries to agriculture and urbanization land uses. Our goal in this multi-year study was to understand changes in population characteristics (primarily abundance, productivity, and life history diversity) of wild Chinook salmon in response to reconnection and restoration of estuarine habitat.

To accomplish this goal, we intensively monitored Skagit River Chinook salmon populations. Monitoring focused on two general methodologies to examine responses of juveniles to estuary restoration: 1) long-term monitoring of the population in three estuarine habitat types: the tidal delta, shoreline, and nearshore (subtidal neritic), and 2) tagging studies during tidal delta and offshore habitat phases to examine survival. Monitoring started in 1995, while the tagging studies commenced in 2005. These programs allow us to examine changes in abundance as fish migrate out of the estuary.

In addition, the long time-series of data produced by this monitoring allows us to examine the effects of large-scale restoration projects in the tidal delta, which commenced in 2001 and will continue in future years. In previous years, monitoring focused on index sites, which allowed us to obtain accurate data on population trends. However, these data may have produced biased estimates of total abundance because index sites were not randomly chosen. Starting in 2005, we modified sampling methodologies to include both random and index sites in order to allow both estimates of population trends and unbiased estimates of abundance.

Given the reliance of juvenile Chinook salmon on estuary habitat and the amount of historical habitat loss, we would expect Skagit River estuary restoration to have disproportionate benefits to Chinook populations. Starting in 2000, a systematic effort to restore estuary habitat has resulted in seven successful projects with over 750 acres of restored habitat (Table 1). These projects include improvements to capacity (amount of

rearing habitat), connectivity (connection among rearing areas), or both. With the exception of Deepwater Slough, all efforts count toward the recovery goal objectives for estuary restoration.

In addition to restoration in the tidal delta, habitat protection and restoration in other habitats is necessary to achieve stated Chinook salmon population recovery goals of the Skagit Chinook Recovery Plan (SRSC and WDFW 2005). Our previous research demonstrates that wild juvenile Chinook salmon at freshwater rearing (Beamer et al. 2005a; Zimmerman et al. in review), tidal delta (Beamer et al. 2005b; Beamer et al. in review), and nearshore life stages (Beamer et al. 2005b) contribute to population productivity. Thus, existing juvenile Chinook production depends on the existing habitat quantity and quality which must be protected. Simply protecting existing habitat represents 61% of what is needed to achieve the population goals of the Skagit Chinook Recovery Plan. In addition to protecting existing habitat, successful restoration (across all habitats) is predicted to increase juvenile Chinook production representing the remaining 39% of what is needed to achieve the Chinook population goals of the Skagit Chinook Recovery Plan. About 12% of the restoration needed to achieve the juvenile Chinook carrying capacity objective in the tidal delta has been completed through year 2012 (Table 1). The Fisher Slough tidal marsh restoration project was completed last year, and progress on four other tidal delta restoration projects is expected in the next five years.

Additional nearterm restoration will comprise around 21% of all planned tidal delta restoration. The design study for Fir Island Farms has been recommended for funding by ESRP for the current funding cycle which is awarded in July 2013. Construction funding would follow design and is anticipated for the next funding cycle. McGlinn Island Causeway project has a completed preliminary design report and is expected to be constructed within the next five years. Cottonwood Island and Deepwater Slough Phase 2 were also listed as near-term projects on the Skagit's Lead Entity's 2012 version of their implementation plan. Pocket estuary restoration projects located in the nearshore also influence juvenile Chinook salmon life history types monitored by the IMW. Restoration of pocket estuary habitat increases carrying capacity for fry migrants, resulting in their larger size (compared to those that do not rear in pocket estuaries) and an increased their marine survival. With increased pocket estuary rearing capacity, the expected response measured by the Skagit IMW is a change in fry migrant size at the time of year when pocket estuary rearing ends (May/June). Three pocket estuary restoration projects have been completed through year 2012 with another project scheduled to be built within two years (Table 2).

All constructed tidal delta restoration projects have been monitored for fish response within their project area (Table 1). For near-term tidal delta restoration projects, monitoring sites related to the McGlinn Island project have been sampled since 2005 as

part of the predicted sub-system response to changed connectivity. In addition, two of three constructed pocket estuary restoration projects have been monitored for fish response within their project area (Table 2). Pre-restoration monitoring started in 2011 for Dugualla Heights, the only near-term pocket estuary restoration project.

This report focuses on results of population monitoring through 2010, and addresses three general questions relevant to the response of Chinook salmon to estuary restoration: 1) Is estuary residence by juvenile salmon limited by tidal delta capacity and connectivity? 2) Does restoration influence local change in density? and 3) Has estuary restoration improved residency at a system-wide level?

Table 1. Restoration projects in the Skagit River tidal delta, dates, benefit to salmon, their restored acreage, and status of fish effectiveness monitoring.

Site	Year completed	Benefit to salmon (connectivity, capacity, both)	Restored acres	Effectiveness monitoring status
Constructed				
Deepwater Slough	2000	Both	221	2001-2003
Smokehouse Floodplain	2005-8	Capacity	43	2004-present
Milltown Island	2006-7	Capacity	212	2012-present
South Fork dike setback	2007	Capacity	40	2012, 2014&15
Swinomish Ch. fill removal	2008	Capacity	12	2005-present
Wiley Slough	2009	Both	161	2012-present
Fisher Slough	2010-11	Capacity	68	2009-present
Total constructed			**757**	
Nearterm				
Fir Island Farms	2014/15	Capacity	130	
Cottonwood Island	< 5 yrs	Capacity	169	
Deepwater Slough Phase 2	< 5 yrs	Capacity	268	
McGlinn Island Causeway	< 5 yrs	Primarily connectivity	10	2005-present
Total possible			**577**	

Table 2. Pocket estuary restoration projects in the Skagit Bay nearshore, dates, benefit to salmon, their restored acreage, and status of fish effectiveness monitoring.

Site	Year completed	Benefit to salmon (connectivity, capacity, both)	Restored acres	Effectiveness monitoring status
Constructed				
Lone Tree Lagoon and Creek	2006	Capacity	0.5	2004-2009
Crescent Harbor	2010	Capacity	206	2011-present
Turners Bay	2011	Capacity	7.7	
Total constructed			**214.2**	
Nearterm				
Dugualla Heights	2013/14	Capacity	6.4	2011-present

STUDY AREA

The Skagit River estuary is part of the larger Puget Sound fjord estuary, and comprises several habitat types of varying salinity, with a tidal delta between the North and South Forks. These tidal delta habitats are adjacent to the more marine environment of Skagit Bay (Figure 1). Our estuarine study sites consisted of blind tidal channels within the Skagit River tidal delta and of shoreline and nearshore (subtidal neritic) areas of Skagit Bay.

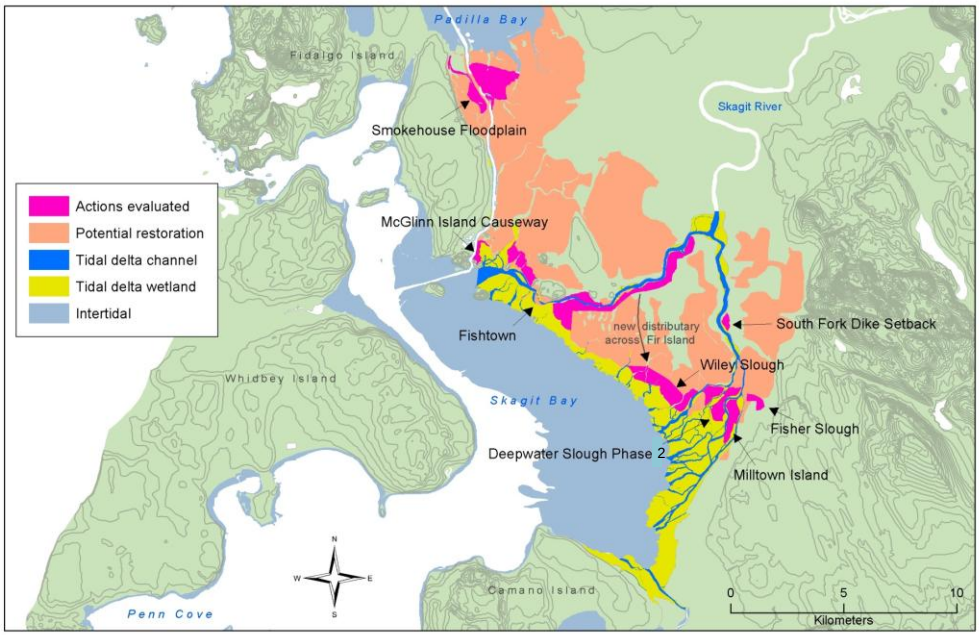

Figure 1. The Skagit River estuary, areas within the restoration plan (peach) and actual restoration sites within the historical footprint of the tidal delta (pink). Details on project size and date completed are shown in Table 1.

The Skagit River tidal delta is a prograding-to-neutral fan delta with numerous distributary channels. When describing tidal delta habitat, we refer to *the tidal estuarine mixing zone* as the area of river channels and wetlands where freshwater is tidally mixed with marine water (Day et al. 1989), and which includes the channeled emergent and scrub-shrub marshes where freshwater mixes with salt water. In contrast, the *riverine tidal zone* is the area of river channels and wetlands where freshwater is tidally pushed but not mixed with marine water. Within these areas a diversity of estuarine habitats are formed and maintained by tidal and riverine processes, creating a mosaic of wetlands and channels. These include blind tidal channels, which served as our fish sampling units within the tidal delta.

The shoreline of Skagit Bay is 127.4 km in length, and its intertidal area is 8,838 ha. Skagit Bay shorelines include a mixture of beach types, which vary based on differences

in adjacent upland geologic material (bedrock, glacial sediments, and recent coastal or river sediments) and also based on shoreline gradients, and geomorphic process within longshore-drift cells. Beaches that dominate much of Skagit Bay were the sampling units for this study. Nearshore restoration is focused on pocket estuaries (Figure 2).

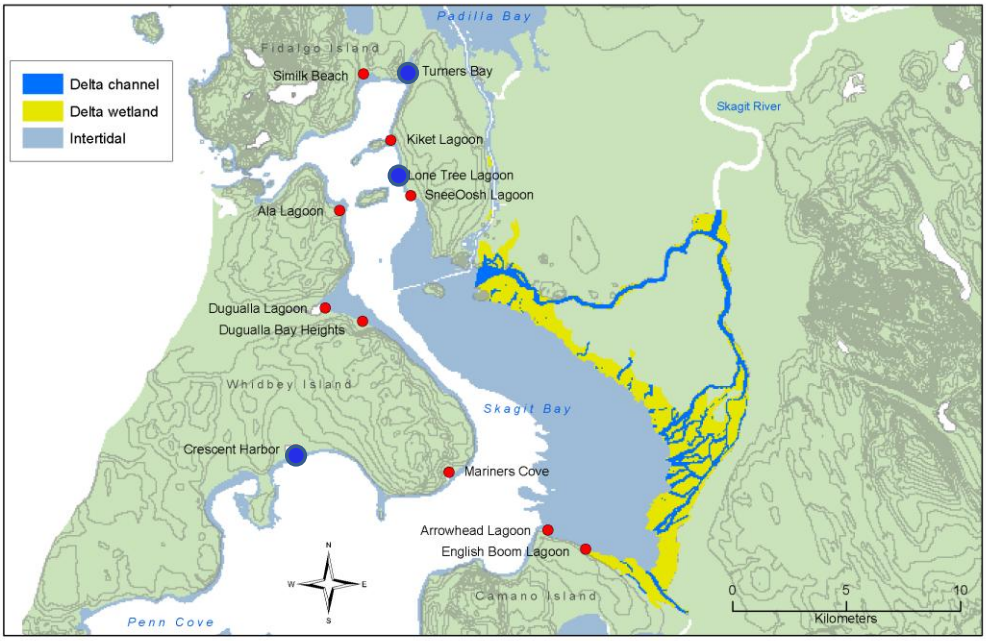

Figure 2. Location of pocket estuary projects in the recovery plan. Red dots are restoration projects identified in the Skagit Chinook Recovery Plan. Blue dots are locations of restoration projects completed as of year 2012. Details on project size and year completed are shown in Table 2.

Landscape analyses have indicated that despite considerable areas of extant shoreline and tidal delta, the Skagit River has lost much estuarine habitat to agricultural and residential development (Collins et al. 2003). Prior to diking, dredging, and filling (circa 1860s) the tidal delta footprint of the Skagit River was 11,483 ha (Collins et al. 2003), while in 1991 it was 3,118 ha (Beamer et al 2005). In addition, much remaining estuarine habitat in the Skagit tidal delta has been disconnected from floodplain and tidal processes. Contiguous estuarine habitat areas remain in the vicinity of Fir Island, with a fringe extending from southern Padilla Bay to the north end of Camano Island. These estimates account for gains in delta habitat area caused by progradation between the 1860s and 1991 (Beamer et al. 2005) and for indirect loss of habitat resulting from changes in tidal process and sediment deposition (Hood 2004). In sum, 73% of tidal delta has been disconnected from floodplain and tidal processes, and 24% of the Skagit Bay shoreline has been armored to protect land uses adjacent to accretion shoreforms or eroding sediment source bluffs (McBride et al., unpublished data).

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METHODS

Intensive monitoring efforts in the Skagit River allowed us to examine abundance at several life stages: freshwater rearing in Skagit River, estuarine rearing in the tidal delta, estuarine shoreline rearing in Skagit Bay, and nearshore neritic residency. Freshwater rearing data are essential for considering downstream abundance measures in the context of total size of the juvenile migration. Measurements in the lower river, tidal delta, and nearshore provide multiple metrics to evaluate population responses to restoration, and to measure the abundance of different life history types and their response to restoration.

Research prior to initiation of the IMW revealed four juvenile life history types in the Skagit River: yearlings, parr migrants, delta fry, and fry migrants. Of these, only delta fry rear extensively in the tidal delta. Yearlings and parr migrants rear extensively in freshwater habitats, while fry migrants rear extensively in pocket estuaries and other nearshore habitats (Beamer et al. 2005). Hence, tidal delta restoration is not expected to greatly affect yearlings and parr migrants, but it could increase production of delta fry and reduce the frequency of fry migrants if competition in the tidal delta caused density-dependent migration to nearshore habitats (Greene and Beechie 2004).

Freshwater Abundance

Abundance of all juvenile wild Chinook salmon in the Skagit River is estimated based on catches from a juvenile fish trap operated by the Washington Department of Fish and Wildlife (WDFW) at river kilometer (rkm) 39.1 in the city of Mount Vernon. Freshwater juvenile monitoring provided both abundance and life history data, including abundance by migrant type (fry, parr, yearling), juvenile body size, migration timing, and tissue for genetic analysis (Kinsel et al. 2008).

Operation of this trap began in 1990 for the purpose of estimating coho smolt production. The focus of this trapping operation has expanded over time, and the trap is now used to estimate the annual number of wild juvenile Chinook salmon migrating from the entire Skagit Basin (Seiler et al. 1998). The juvenile trap is operated each year beginning in mid-January and continuing through the end of July. This time frame was selected based on results from three extended trapping seasons conducted in the mid-1990s.

The trap is actually two traps: an inclined-plane and a screw trap. The rectangular inclined plane trap (1.8 × 4.9 m) is fished by lowering the trap approximately 1 m into the water at an oblique angle. Fish swimming within a 2-m^2 cross-sectional area near the surface are then caught, forced onto the inclined plane, and washed into a collection box.

The screw trap (2.5-m diameter) is fished by lowering it completely into the water. Fish swimming downstream enter the 2.35-m^2 cross-sectional entryway of the trap, and the rotation of plates within the trap forces fish into a collection box.

Annual catches from these traps are highly correlated with each other (R = 0.99), and in this analysis we focus on results of the inclined plane trap. This trap catches only a portion of the total number of juvenile Chinook migrating from the Skagit River. Therefore, total abundance was estimated using a mark-recapture study design in order to expand the catch by a calibration factor (Volkhardt et al. 2007). Catches missed during trap outages were estimated, and these estimates were included in the final estimate.

To evaluate trap efficiencies during the juvenile migration period, a known number of marked fish (dye or fin-clip) were released upstream, and a portion of these were recaptured in the trap. Releases of marked fish were conducted throughout the juvenile migration period in order to account for differences in trap efficiency due to changing river conditions. The resulting trap efficiency data was applied to catch data in order to estimate total migrant abundance (Zimmerman et al. in review).

Abundance in Tidal Delta

To measure abundance in tidal delta habitats, we sampled unmarked subyearling Chinook juveniles in blind channels using fyke traps. Fyke trapping followed the methods of Levy and Northcote (1982) with nets constructed of knotless nylon (0.3-cm mesh) with a cone (diameter 0.6 to 2.7 m) sewn into the net. Fish entered the net as water was draining the channel on an ebb tide. We used a lead line to sink the net bottom to the benthos and a float line to maintain the top of the net at the water surface. Overall net dimensions (length and depth) varied depending on cross-sectional dimensions of the channel, but all nets were sized to completely block fish access at high tide.

We captured fish by setting the fyke trap across the mouth of the blind channel site at high tide and "fishing" the channel throughout one ebb tide cycle. Fish were captured as they moved out of the channel with the receding tide. We sampled index sites twice a month from February through August during spring tide series. This effort started with four index sites in 1992 and was expanded to six sites in 1995. Index sites were selected to represent the three estuarine wetland zones present within the Skagit delta (emergent, scrub-shrub, and riverine tidal), as well as the two major delta rearing areas associated with Chinook salmon (North and South Fork Skagit River).

Trap recovery efficiencies (REs) were derived by releasing a known number of marked fish upstream from the trap at high tide. Catches of juvenile Chinook salmon were adjusted by the RE, which was unique to each site and was related to hydraulic

characteristics of the site during trapping (e.g., change in water surface elevation during trapping or water surface elevation at the end of trapping). We conducted 5-8 different mark and recapture tests at each site. Data from these tests were used either to calculate average RE at the site or to develop a regression model. Regression models were used to convert raw catch data from a given day to an expanded number of Chinook salmon that were present within the habitat upstream from the fyke trap on that day. Average RE for the six fyke trap sites ranged 29-57%. To calculate juvenile Chinook density for each fyke trap set, we use the adjusted catch divided by the topwidth channel area of the blind channel upstream from the trap. Topwidth channel area was measured in the field.

Abundance in Skagit Bay Shoreline

To measure density of unmarked Chinook salmon rearing along shoreline habitats, we used a beach seine (37- × 3.7-m) with knotless nylon mesh (0.3-cm). The net was deployed by fixing one end on the beach and the other on a boat, which set the net across the current and returned to the beach at a point upstream at a distance of approximately 60% of the net length (~22 m). The set was held open against the tidal current for a few minutes, and then the boat returned to the shoreline edge and both ends of the net were retrieved, yielding a catch in the bunt section.

We made three seine sets per site on each sampling day. Habitat area sampled with the large-net beach seine varied among sample sites and days because tow times, set widths, and tidal current velocities moving past the site all varied dynamically. Tow time, set width and water surface velocity were measured for each beach seine set in order to calculate a set area. Juvenile Chinook catch for each set was then adjusted by set area to calculate Chinook density. Average set area for the six large net beach seine sites in Skagit Bay was 486 m^2.

We also conducted 34 mark and recapture tests to estimate RE for beach seine methods. Two groups of marked fish were introduced to each seined area. The first was released just before setting the net and the second just prior to closing the net and retrieving it to shore. Overall RE for the six beach seine sites was consistently high, averaging 84.5% (±10.1% CI). Since RE for beach seining was consistently high, we did not adjust the "raw" juvenile Chinook catch by RE for beach seine sites.

Abundance in Skagit Bay Nearshore

We sampled subtidal neritic (surface and subsurface) areas of Skagit Bay using a Kodiak surface trawl (3.1-m high × 6.1-m wide), towed between two boats, each with a 15.2-m towline connected to a bridle on the net. Mesh sizes in the net were 7.6 cm stretch in the forward section, 3.8 and 1.9 cm in the middle sections, and 0.6 cm in the cod end.

The primary vessel (13.7 m long, 174 hp inboard diesel) towed the left wing of the trawl and the second vessel (5.5 m long, 225 hp gasoline outboard) towed the right wing, with both vessels moving in an upcurrent direction. The net was towed at the surface for 10 minutes per tow, at 900-1000 rotations per minute (RPM) on the engine of the primary vessel and a typical towing speed of 2-3 knots. Distance was recorded with a mechanical flow meter (General Oceanics model 2030) deployed by the smaller vessel. Area swept was calculated as distance traveled multiplied by width of the net opening.

Measures of Abundance

Measures of abundance varied for each life stage. During the freshwater migration season, abundance was measured using the total number of juvenile migrants calculated by WDFW from trap operations. In addition, we also used the total abundance of fish migrating as fry, because it is this life history component that is most likely to rear in the tidal delta and therefore benefit from restoration. For measures of abundance in the tidal delta and shoreline, we used two indices: density and cumulative density. Density was measured as average density across blind channel index sites and months.

Cumulative density was a measure of abundance per unit area over the entire rearing period. Cumulative Chinook salmon density was estimated for blind channel habitat during February-August (over 200 d) and for shoreline habitat during February-October (over 270 d). Both measures encompassed the entire utilization curve of juvenile Chinook salmon in each habitat. Cumulative density (fish × d × ha^{-1}) was calculated as

$$C = \sum_{m=F}^{L} D_m n_m \qquad \text{Eq. 1}$$

where D_m is average monthly density, n_m is number of days in the month, and F and L is the first and last month (m) sampled, respectively.

Both density and cumulative density have interesting properties when viewed in the context of restoration. In a given stream segment, restoration that improved local abundance or survival should result in increases in the density metric; this change would reflect the direction we normally predict after restoration. However, the prediction is different for restoration at larger spatial and temporal scales because an overall increase in habitat capacity should reduce density. Hence, the predicted outcome following system-wide restoration would be a reduction in either or both density metrics. Outside the tidal delta, we expect restoration to increase recruitment, thereby resulting in an increase in density metrics.

Sampling Effort

We use differing levels of survey effort for the three main types of sampling in the Skagit River estuary. Table 3 summarizes the number of sites, frequency, and duration of sampling. One major change that has occurred since the beginning of funding through the Intensively Monitored Watersheds project (IMW) has been a shift from an index-only sampling design to a sampling design that employs both random and index sites. As shown in Table 3, this change has added a substantial number of sites.

Table 3. Sampling effort in different habitats monitored through the Skagit River Intensively Monitored Watersheds project and number of index and random sampling sites for each habitat type pre- and post-IMW funding.

Habitat	Years*	Duration	Frequency	Index sites per sampling	Random sites per sampling
Mainstem	1990-2011	Feb-Jul	Daily	1	
Tidal delta	1992-2006	Feb-Jul	Biweekly	8	
	2007-2011			16	2
Shoreline	1995-2006	Feb-Oct	Biweekly	6	
	2007-2011			11	12
Nearshore	2001-2004	Apr-Oct	Monthly	12	
	2005-2011			4	15

* IMW funding commenced in 2005.

RESULTS

Is Tidal Delta Habitat Limiting Estuary Residence?

Central to the idea that restoration will improve the productivity of Skagit River Chinook salmon is the assumption that estuarine habitat is limited such that rearing juveniles compete with each other. We used our pre-and post-restoration monitoring data to test this assumption for Chinook salmon life stages associated with transition through tidal delta and shoreline habitats. We hypothesized that in the Skagit River tidal delta, reductions in habitat capacity have led to strong density dependence, and that population density can be reduced via restored connectivity and increased capacity of tidal delta habitats. To test this hypothesis, we examined three density-dependent relationships:

1) Average density of juvenile Chinook salmon in the tidal delta × total juvenile Chinook salmon outmigrants (expanded from freshwater migrant trap data)
2) Size of Chinook fry (fish < 50 cm) in the tidal delta × total juvenile migrants
3) Cumulative density of Chinook salmon fry in shoreline habitats × density juvenile Chinook salmon in the tidal delta.

We regressed two variables (average density in the tidal delta and size of Chinook fry) against total size of the general population of freshwater juvenile migrants (measured at the juvenile migrant trap in Mt. Vernon). Average density in the tidal delta was used on the assumption that high densities discourage longer residency; therefore we would expect a higher incidence of fry-sized migrants in these habitats after restoration. All variables exhibited a strong density-dependent response: average density increased as a function of total juvenile migrants to an asymptote of approximately 2500 fish/ha at a juvenile migration population size of approximately 4.5 million (Figure 3A). Average size of fry exhibited a concomitant decline as a function of total freshwater migrant population size, leveling off at approximately the same number of freshwater outmigrants (Figure 3B). Cumulative density of fry measured in beach seines increased sharply at densities matching the asymptote of average density vs. total juvenile migrants (Figure 3C).

Although capacity is a strong system-wide limiting factor, additional limitations exist at local levels due to differences in habitat connectivity. We calculated connectivity relative to the general population of freshwater migrants using a function that included both distance from the mainstem source and channel width nearest the sampling location (Beamer et al. 2005, Appendix D). As shown in Figure 4, local density varied over several orders of magnitude at lower levels of connectivity, but appeared to level off above these levels.

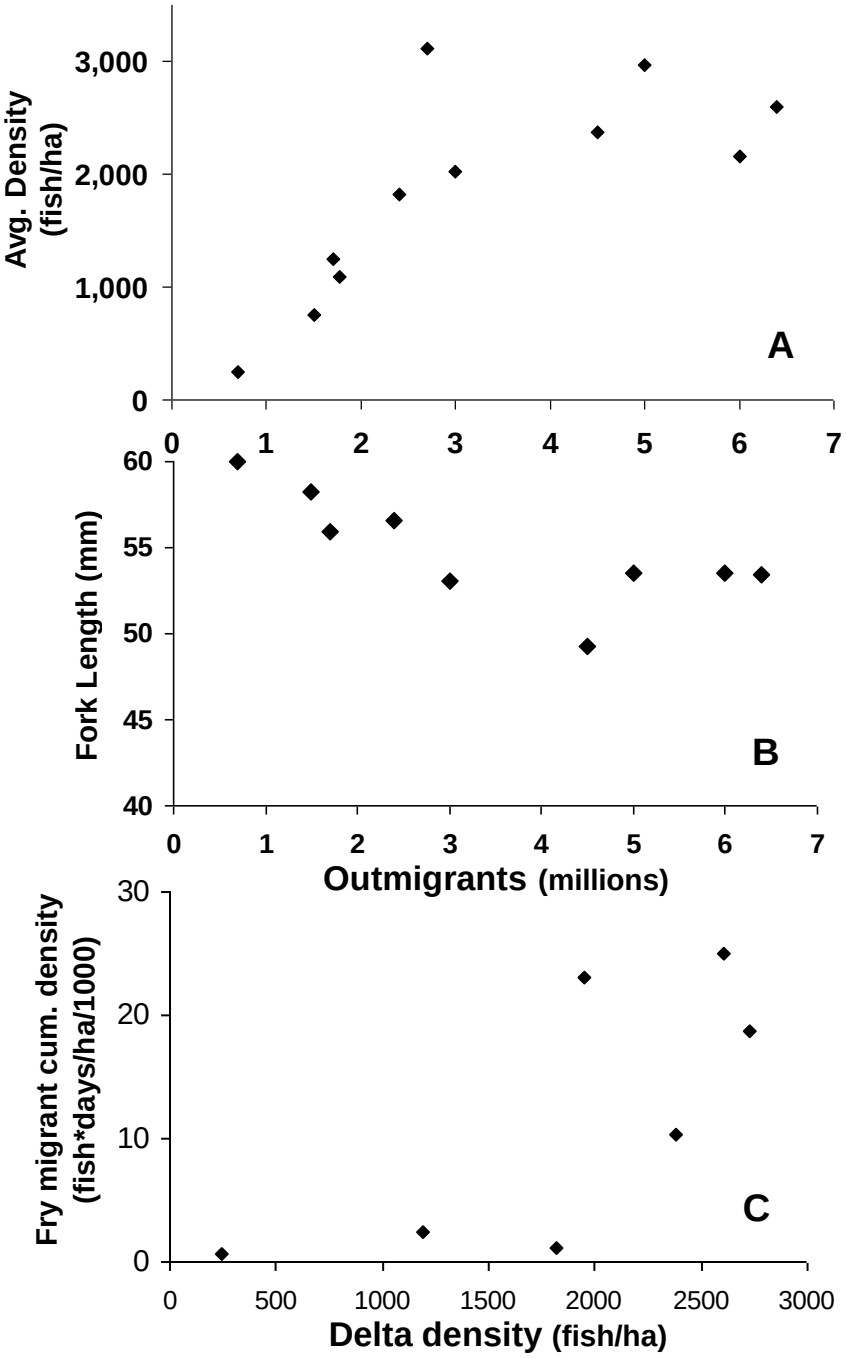

Figure 3. Panels A and B show average density (A) and length (B) of juvenile Chinook salmon rearing in the tidal delta as a function of total freshwater juvenile migrants. Panel C shows cumulative density of fry migrants (length < 50 mm) captured along shorelines as a function of density in the tidal delta.

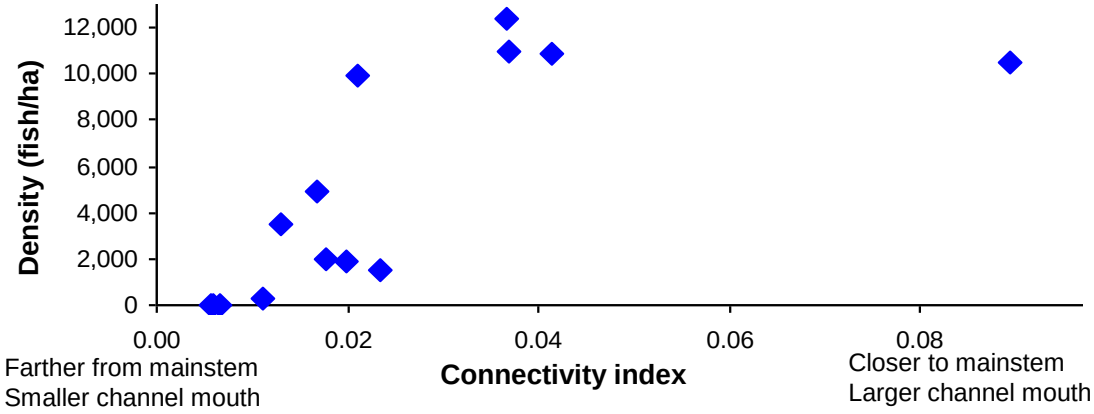

Figure 4. Density of subyearling Chinook salmon measured in 2002 at sites of varying levels of connectivity, with lower connectivity at further distances from the mainstem (bifurcation of the North and South Fork Skagit River) and for smaller channel entrances (Beamer et al. 2005).

Do We See Positive Local Effects of Restoration from Completed Projects?

Given the existence of habitat limitations in the Skagit River tidal delta, we would expect to see increases in local juvenile Chinook salmon density in response to habitat restoration, after which densities at treatment (restored) sites should match those at reference (natural) sites. We tested this hypothesis by examining data collected as part of effectiveness monitoring of the Deepwater Slough restoration project (completed in 2000), as well as the Smokehouse Floodplain and Swinomish Channel setbacks (both completed in 2008).

Deepwater Slough restoration resulted in large improvements in both connectivity and capacity. Deepwater Slough was historically a distributary, but had been impounded at its upstream end, causing it to function as a blind channel (Figure 5). Removal of the impoundment as well as a number of dikes in the Deepwater Slough area consequently increased the amount of channel and tidally influenced wetlands by 89 ha. Effectiveness monitoring of this site employed a post-treatment/reference design, and results exhibited treatment effects that were strong in the first 2 years but leveled off by 2003 (Figure 6).

Additional effectiveness monitoring studies employing before/after control-impact (BACI) designs have also documented increases in local density of juvenile Chinook salmon following estuary restoration of the Swinomish Channel. Restoration here has led to more moderate increases in local density, due to the disconnectedness of the Swinomish Channel from the Skagit River mainstem and to idiosyncrasies of restoration at specific sites (e.g., limited connectivity resulting from installation of self-regulating tide gates, Greene et al. 2012).

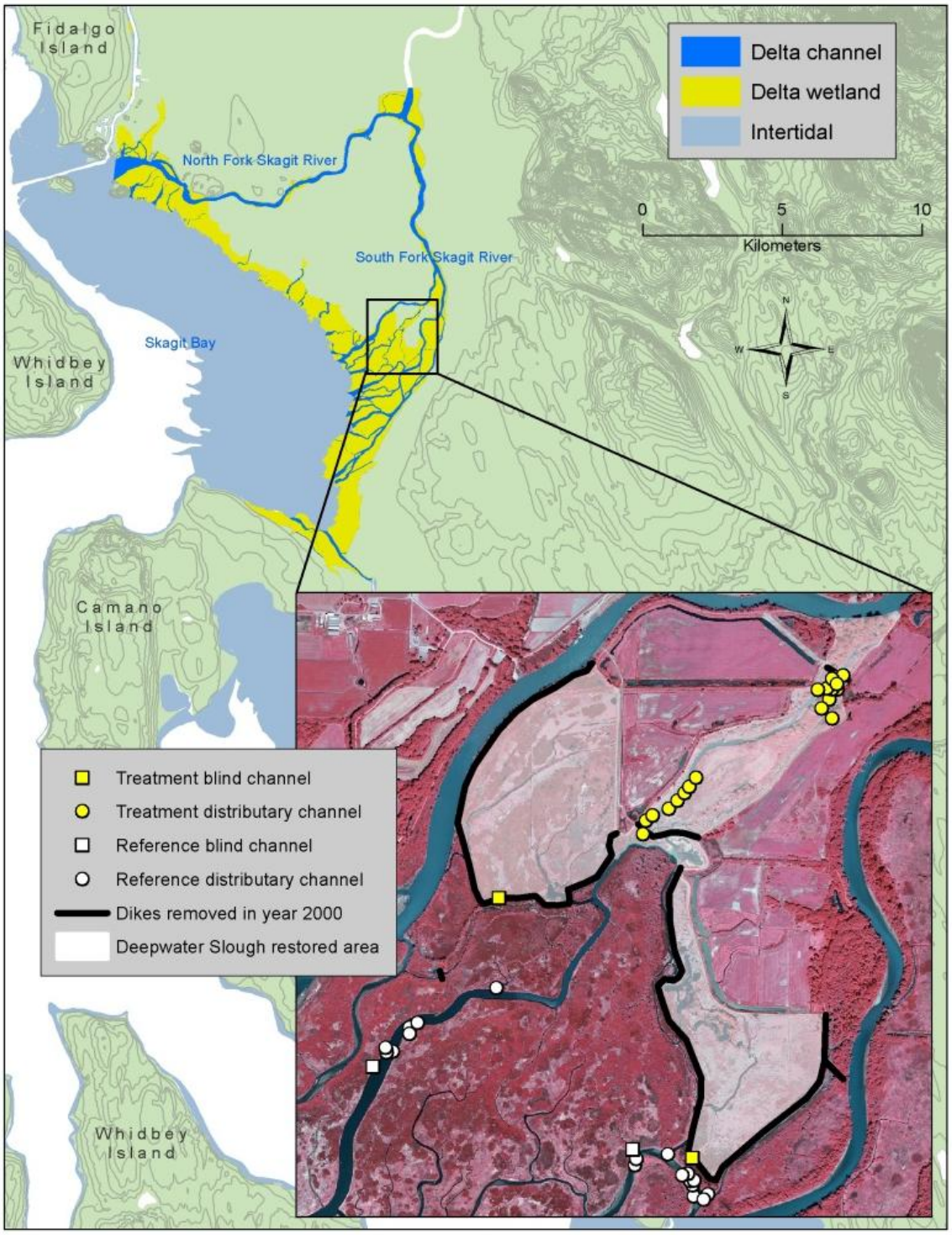

Figure 5. The Deepwater Slough restoration and monitoring design, showing location in the Skagit estuary, the area restored, and effectiveness monitoring sites.

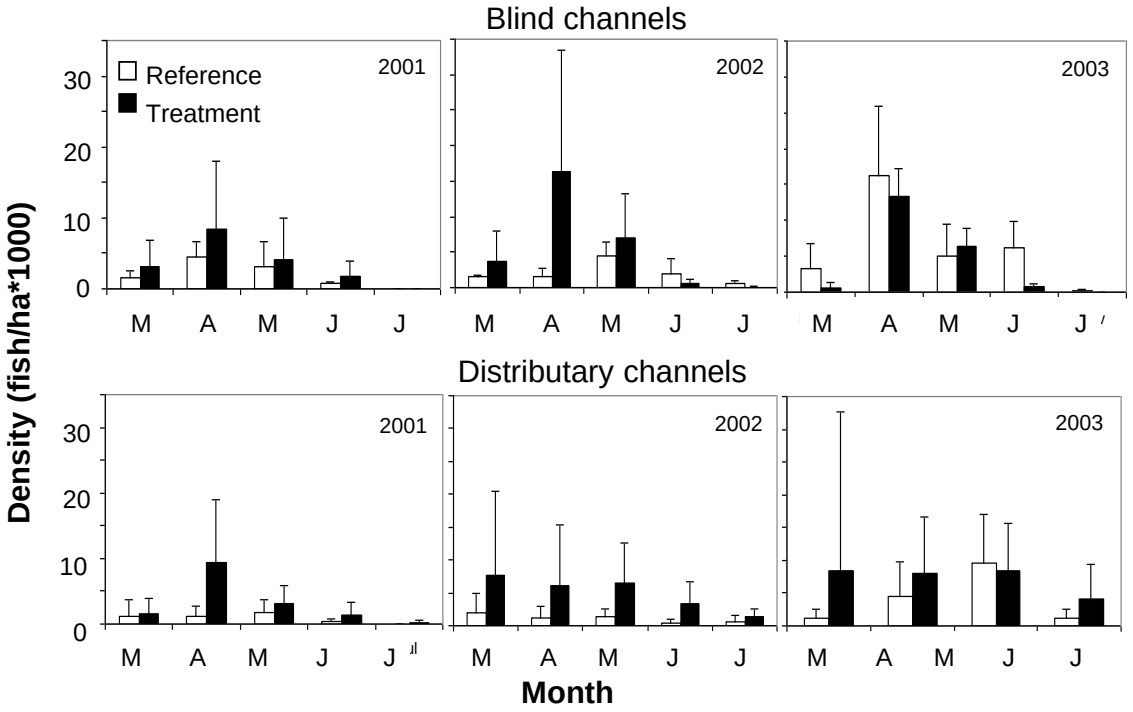

Figure 6. Post-restoration densities of juvenile Chinook salmon captured in control and treatment blind and distributary channels during Deepwater Slough restoration monitoring, 2001-2003.

Does Tidal Delta Restoration Improve Residency at a System-Wide Level?

If these improvements had measurable improvements to the Skagit River population, we would expect to see at least two population responses: juvenile Chinook salmon cumulative density should *decrease* in habitat areas of the South Fork Skagit River relative to the North Fork. This would be expected because fish are rearing over an increased amount of slough habitat in the South Fork, but the same amount in the North Fork (where no restoration occurred). This hypothesis was tested using a BACI design, with sites on the North Fork Skagit River used as the control. Second, if restoration strongly improves survival or capacity, recruits to Skagit Bay shoreline should increase following restoration, and the percentage of recruits that are fry migrants should decrease.

We tested the first prediction by regressing cumulative density in the South Fork Skagit River (treatment) against cumulative density in the North Fork (control) for years before and after restoration in the South Fork. Results supported a measurable response, with the slope of the regression shifting lower following restoration. This indicated that restoration along the South Fork coincided with reductions in cumulative density there, compared with densities in the North fork across the entire time period (Figure 7). Note that as more restoration was completed, cumulative density in the South Fork tended to shift farther away from the pre-restoration line.

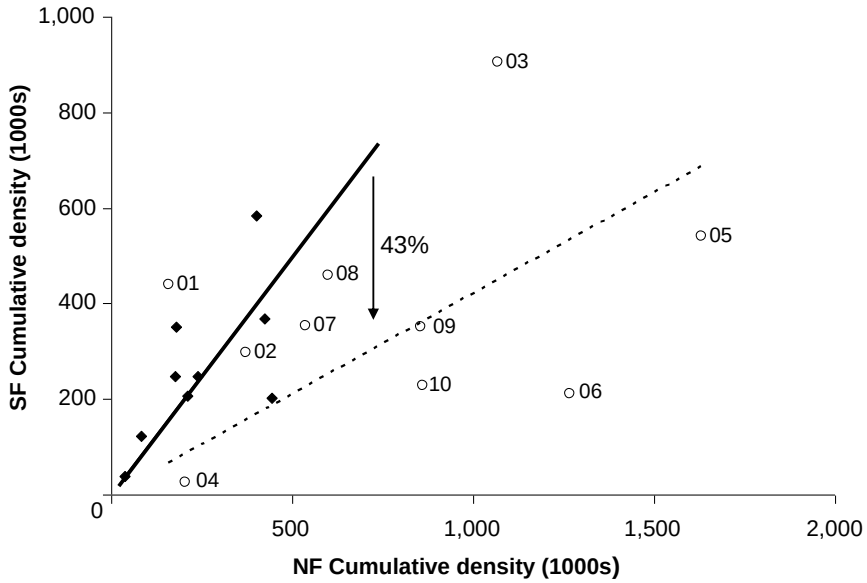

Figure 7. Changes in the relationship between cumulative density in the South Fork Skagit River (where restoration occurred) and that in the North Fork (no restoration). Black line and closed diamonds represent pre-restoration data (outmigrant years 1993-2000), and dashed line and open circles (labeled by year) represent post-restoration data.

The second prediction was tested by calculating the proportion of the shoreline cumulative density composed of fry migrants and measuring this against the number of fry outmigrants measured at the Skagit River trap. In these cases, we used a before-after design, since fish rearing in North Fork and South Fork have at least partially mixed by the time they are sampled in Skagit Bay, and there is no reference population that can be directly compared with the Skagit. As shown in Figure 8, both recruitment metrics did not exhibit an obvious difference before and after restoration in the South Fork commenced, and continued to exhibit strong density dependence over the entire time series. The upper limit to the fry migrant proportion was quite similar before (0.342, one year) and after (0.336, average of five years) initial restoration at Deepwater Slough (Fig. 8B). These findings suggest that restoration in the tidal delta needs much greater effort or more years of study in order to observe noticeable changes in recruitment.

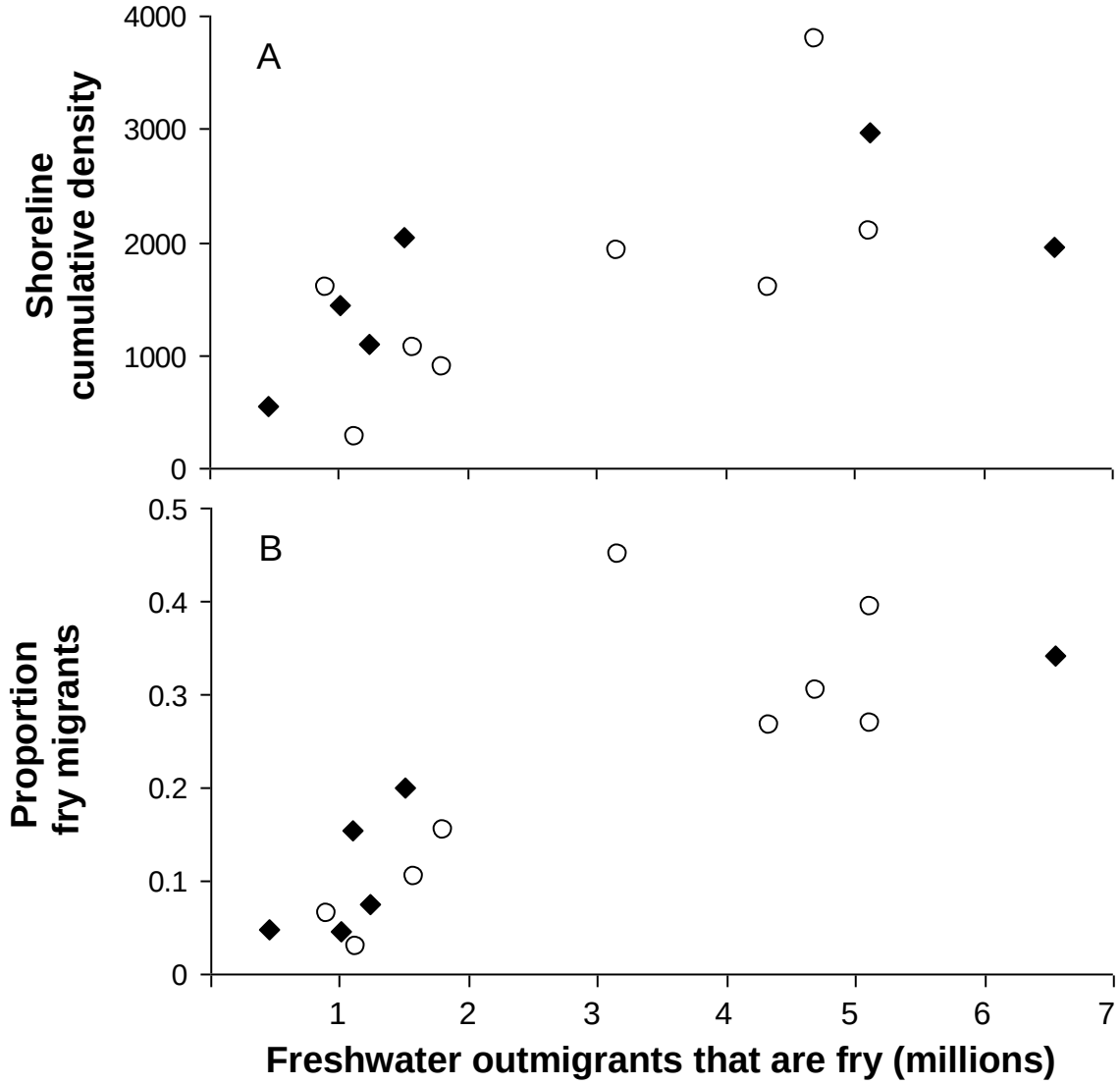

Figure 8. A) Shoreline cumulative density of juvenile Chinook salmon in Skagit Bay and B) the proportion of shoreline cumulative density composed of fry migrants as functions off the number of freshwater outmigrants that are fry (which would likely utilize the tidal delta for rearing. Closed diamonds represent pre-restoration data, and open circles represent post-restoration data.

CONCLUSIONS AND FUTURE WORK

This report documents that 1) restoration in the Skagit River tidal delta is needed to address capacity and connectivity limitations, 2) local restoration improves densities of rearing of juvenile Chinook salmon, and 3) system-wide responses can be detected using a BACI design. In addition, it appears capacity limitations still exist in the Skagit River tidal delta as judged from recruitment patterns (Fig. 8), and that further tidal delta restoration is warranted. Thus far, the amount of restoration completed in the tidal delta is roughly 12% of the Chinook Recovery Plan's objective for estuary habitat restoration (Beamer et al. 2005), and our work completed thus far corroborates this estimate.

These findings also shed light on the utility of extensive monitoring in order to document effects of restoration. Our findings would have been impossible to document without extensive pre-restoration status monitoring and outmigrant trapping throughout both pre- and post-restoration phases. Monitoring at multiple life stages during estuarine transitions helps pinpoint the contribution of rearing potential in the Skagit tidal delta.

Further monitoring as part of the IMW will help refine our ability to detect change at a Chinook salmon population level by providing additional data points across the broad span of possible outmigration sizes. In addition, it will enable us to examine the sensitivity of other life stage-specific monitoring (e.g., nearshore recruits) to restoration in the tidal delta. Finally, the monitoring effort is shedding important light on the status and trend of multiple species of importance in the Skagit estuary and nearshore that are caught incidentally with juvenile Chinook salmon during monitoring efforts, including coho salmon, bull trout, and Pacific herring and surf smelt (e.g., Reum et al. 2011). These results should be useful to examine restoration in the tidal delta in the context of the estuary foodweb.

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Strait of Juan de Fuca Intensively Monitored Watershed
Draft 2013 Synthesis Report

Prepared for the Salmon Recovery Funding Board
by the IMW Oversight Committee
February 2013

Executive Summary

The Strait of Juan de Fuca Intensively Monitored Watershed was initiated in 2004 to test the watershed scale response of steelhead (*Oncorhynchus mykiss*) and coho salmon (*O. kisutch*) to watershed restoration. The "Straits" IMW includes two treatment watersheds (East Twin River and Deep Creek) and one control watershed (West Twin River). Restoration treatments completed include LWD placement, road removal, culvert removal, off-channel habitat creation, and riparian planting. Monitoring of physical habitat and coho and steelhead parr densities began in 2004 using the EPAs EMAP site selection and sampling protocols. Smolt and adult monitoring predates the IMW program, and began as early as 1998 in some watersheds. Preliminary results suggest some improvements in pool habitat and small increases in steelhead adults and smolts in East Twin and coho adults in Deep Creek. Given that restoration treatments were completed fairly recently and habitat typically does not respond immediately to treatment, additional years of monitoring are needed to determine watershed-scale fish response to restoration.

Introduction

Despite hundreds of millions of dollars invested in habitat and watershed restoration in the Pacific Northwest every year, many questions exist about their success. Most monitoring and evaluation to date has focused on reach-scale response to restoration (Roni et al. 2008). While many of these reach or project scale efforts have shown localized reach-scale improvements in fish habitat and juvenile fish numbers (e.g., Cederholm et al. 1997; Roni and Quinn 2001; Morley et al. 2006; Roni et al. 2006)) little information exists on the population or watershed scale response to restoration activities. To address this pressing need, the Intensively Monitored Watershed (IMW) program was developed to evaluate the efficacy of habitat restoration in increasing salmon production at a watershed scale (Bilby et al. 2005). The basic premise of the IMW program is that the complex relationships controlling salmon response to habitat conditions are best understood by intensive monitoring of physical, chemical and biological parameters in selected treatment and control watersheds.

The intensively monitored watersheds (IMW) program has been funded by the Salmon Recover Funding Board (SRFB) since June 2003. There are three sets of IMW complexes in western Washington focusing on coho salmon (*Oncorhynchus kisutch*), and steelhead (*O. mykiss*) and cutthroat trout (*O. clarki*). In this report, we report on the preliminary results of the first nine years of monitoring of the Strait of Juan de Fuca IMW complex (Straits IMW).

Study Area

The Straits IMW is composed of three watersheds: West Twin River, East Twin River, and Deep Creek; (48°10’00 N, 123°55’00 W). The watersheds range in size from 34 to 45 km^2 with elevation ranges from approximately 915 m in the headwaters to sea level (Table 1). Precipitation averages 190 cm per year and occurs primarily between October and May as rain with occasional brief snowfalls (Olympic National Forest 2002). The geology of these watersheds is characterized by Crescent Formation volcanic rock in the upper watershed, marine sedimentary rock in the lower watershed, and terraces of glacial deposits in the lower watershed floodplain (Olympic National Forest 2002). Three vegetation zones are found in the watershed: the Sitka Spruce *Picea sitchensis* zone in the

valley bottom, the Western Hemlock *Tsuga heterophylla* zone in the low to mid elevations, and Silver Fir *Abies amabilis* zone in the headwaters (Olympic National Forest 2002).

The primary land use within both basins for the last 100 years has been forestry (Olympic National Forest 2002; Bilby et al. 2005). All three watersheds have a history of intensive logging, fire, instream salvage and intentional LWD removal beginning in the early 20th century. As a result, much of the instream wood that historically created pools and regulated the movement of sediment and organic matter in these watersheds has been depleted. Wood loss contributed to channel incision at some sites, isolating the floodplain and reducing access to off-channel habitats. In the headwaters of these drainages, mid-slope roads were constructed in the 1970's and 1980's to access stands of old-growth timber on very steep slopes. Shallow, rapid landslides generated from clearcuts and roads have degraded fish habitat and water quality. For example, during a large storm event in November of 1990, landslide debris dammed several locations in Deep Creek and generated a very large dam-break flood. This event traveled from the headwaters to the estuary and caused widespread damage (scour, sedimentation, redistribution of LWD, loss of pools).

Table 1. Characteristics of three study watersheds.

	East Twin River	West Twin River	Deep Creek
Drainage area (km^2)	36.2	33.9	44.0
Max. Elevation (m)	425	340	304
Geology	Quaternary alluvium, Pleistocene continental glacial drift, Tertiary marine, Tertiary volcanic		
Ownership	28.4% Private, 71.6% Public		
Total reach length (km)	89.7	92.8	103.8
Mean precipitation	190 cm		

The three watersheds are almost completely owned by USFS, WDNR and two private forestry companies. Because of improvements in state forest practice rules, and the relatively young age of recently harvested timber, very little new timber harvest is expected in the complex and natural recovery of riparian forests is underway. New harvest on private lands will be subjected to regulation under the state's Forest Practices Rules (based on the Forest and Fish Agreement). Moreover, a large proportion of federal lands in Deep Creek are managed as late-successional reserves under the Presidents Forest Plan. This assures that our restoration treatments will not be confounded by forestry-related land management activities.

Fish species present in the three basins include coho salmon, steelhead/rainbow trout, cutthroat trout *O. clarki*, chum salmon *O. keta*, Pacific lamprey *Lampetra tridentata*, Western brook lamprey *L. richardsoni*, torrent sculpin *Cottus rhotheus* and reticulate sculpin *C. perplexus*. Coho salmon and other anadromous fishes are found below river kilometer (rkm) 5.8 on East Twin, approximately rkm 6.3 on the West Twin, and rkm 7.1 on Deep Creek (Olympic National Forest 2002) (Figure 1).

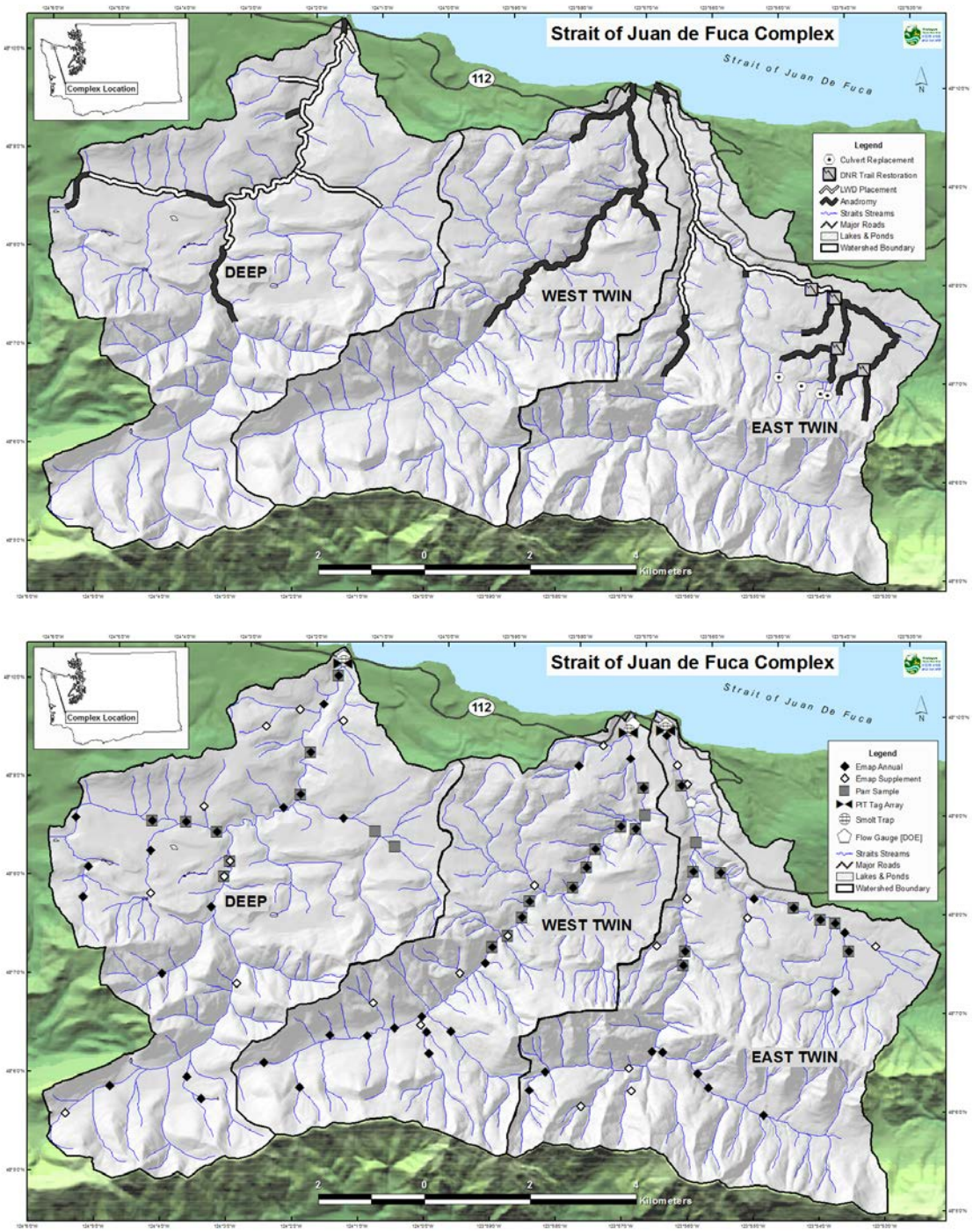


Figure 1. Maps of three study watersheds showing restoration measures and anadromous fish limits (Top), and locations of monitoring sites (Bottom).

Methods

Objectives and hypotheses

The overall objectives of the Straits IMW are to measure the response of juvenile and adult salmon and steelhead to watershed scale restoration and, through intensive monitoring, to understand the complex physical, chemical and biological relationships that control salmon population level response to restoration. The specific questions addressed in this report are:

1. What are the trends in habitat and fish abundance and survival in study watersheds?
2. Is there a detectable habitat and fish response to restoration?

Experimental Design

Initially, the Straits IMW program was designed to use a before-after control-impact (BACI) experimental design with two treatment watersheds (East Twin River and Deep Creek) and one control watershed (West Twin River) (reference). However, collecting several years of pre-project data was not possible and initial restoration efforts began on the two treatment watersheds at the same time or slightly before (Deep Creek) baseline habitat monitoring. Therefore, rather than a comparison of before and after data, this monitoring program focuses on an intensive post-treatment design (Hicks et al. 1991; Roni et al. 2005) and examining differences in trends in fish and habitat through time and among treatment and control watersheds. With this type of design rather than comparing the difference in habitat conditions and fish abundance before and after restoration, the temporal trends are compared between the treatment and control watersheds following treatment. Thus it is important that the control watershed is representative of treatment watersheds, which is the case for the three study streams selected.

Restoration treatments

A watershed assessment completed in 2000 demonstrated low levels of large-woody, loss of floodplain habitat and overwinter habitat, young riparian conditions, and high levels of mass wasting due to poorly constructed logging roads. Restoration measures implemented from 2000 to 2012 were designed to address these problems in East Twin River and Deep Creek. More than 3 million dollars was spent on restoration in

the two basins during our study period (Table 2; Figure 1). Because most restoration was completed recently, the full physical and biological response to restoration measures has not yet occurred. Because treatments in the study watersheds were extensive, covering much of the anadromous zone, the monitoring was developed specifically to look at watershed or population level responses to restoration rather than individual stream reaches.

Table 2. Summary of restoration measures implemented in treatment watersheds (East Twin and Deep Creek). (RM-river mile)

Stream	Year	Amount	Description
Deep Cr	1996	$150,000	Placed LWD in mainstem Deep (RM 0.2-2.5). Initial treatments low profile log and rock structures.
	1998	$150,000	Placed LWD in mainstem Deep (RM 0.2-2.5). Initial treatments low profile log and rock structures.
Deep Cr	1997	$280,000	First large-scale restoration in watershed. Replaced undersized culvert on Gibson Creek with railcar bridge; placed LWD in Gibson Creek (RM 0.1-0.4); Placed LWD in upper Deep (RM 2.6-3.5) at 54 locations: off channel complex constructed at RM 0.9.
	2005	$300,000	10 logjams mainstem Deep (RM0.2-1.3)
	2009-2011	$400,000	USFS 3040 road treatments
	2007-2010	$200,000	Helicopter LWD placement in EF Deep (60 pieces) and 105 key pieces in mainstem Deep (RM 0.2-1.2) and 200 pieces in the WF Deep (RM 0.5-1.7)
	2012	$300,000	Helicopter LWD placement in upper Deep (RM 2.5-3.5)
Total		$1,780,000	

East Twin	Year	Amount	Description
	2000		Twins Deep Watershed Analysis Completed
	2000	$50,000	E. Twin OC Pond/Riparian Planting 0.5 mile (22K)
	2002		LEKT begins Smolt trapping in ETwin
	2002-2006	$850,000	Helicopter placement Upper ETwin (32 keys)/Sadie(75 logs): Ground based treatments .8 mile reach (30 keys and logs); ground based treatments (RM 0.3-1.0) 15 logjams (30 keys/60 logs); ORV access blocked to Sadie and logjam constructed at Powerlines; riparian plantings 1.5 miles
	2007	$500,000	Culvert corrections headwaters of Sadie Creek (4 tributaries)
	2009-2010	$120,000	USFS 3040 road treatments
	2011	$100,000	Helicopter placement to Susie (20 keys) and lower East Twin (RM 0.3-1.2) 25 Keys/120 Logs)
Total		$1,600,000	

Habitat monitoring

The Straits IMW sampling plan and field methods are adapted from the US EPA, Environmental Monitoring and Assessment Program (EMAP, http://www.epa.gov/emap). Sampling locations were identified using a random, spatially balanced design that was stratified by stream order (Strahler 1957; Stevens and Olsen 2004). This allows statistically valid descriptions and comparisons of watersheds. Based on an analysis of data in 2006, the number and location of some sites were changed in 2007 to assure all were located in fish bearing reaches. Because of the change in sampling locations, we report on only those samples collected from 2007 to 2011.

Habitat survey methods follow EMAP protocols, which consist of measures and counts made at and between 21 equally spaced cross-sections at each site. Cross-sections are positioned along a length of stream that is the longer of either 40 bankfull widths or 300 m. Substrate, LWD, habitat type, bankfull width, depth are collected at each transect

(see Crawford 2008a,b,c for details on methods). The following metrics were calculated for each site and then averaged among all sites sampled to provide an annual index of watershed condition: count of LWD in bankfull channel, mean thalweg depth, proportion of pools, percent fines(sediment <2mm), median particle size (D50).

Flow & Water Quality

Flow and water quality (dissolved oxygen, temperature) are monitored continuously by stream gauges located at the mouth of each stream (Figure 1). Mean daily flows averaged 39, 41 and 52 cubic feet per second (cfs) in East Twin, West Twin, and Deep Creek respectively. Stream temperature averaged approximately 8 ° C in all three streams ranging from 0 to 19 °C. While temperatures were near optimal for salmonids for both summer and winter, high flow events in fall and winter are suspected to impact overwinter survival and egg incubation in the three study streams. To examine the effect of high flow events, we calculated the number of flow events from September to May that exceeded 100 cfs for each study stream for each year. We then examined whether the number of days of flows greater than 100 cfs each year was correlated with annual estimates of overwinter survival, parr abundance and smolt production.

Fish monitoring

Juvenile abundance (WEYCO) – Single pass electrofishing was conducted at 10 randomly selected EMAP sites in each watershed to enumerate juvenile fish abundance and mark juvenile coho and steelhead to determine overwinter survival (Figure 1). Electrofishing occurred in August and early September each year. A 50 to 75 meter reach at each site was isolated with block nets and a single downstream pass was made provide an index of fish numbers at those sites. Three-pass electrofishing was conducted in one to five reaches in each stream each year. Population estimates based on three-pass electrofishing were calculated using Carle and Strub (1978). A simple linear regression was developed between single-pass electrofishing and three-pass electrofishing populations estimates and used to adjust abundance estimates of juvenile coho, steelhead parr (>60mm) and steelhead fry(<60mm) in reaches were only single pass electrofishing was conducted. Total wetted area of each reach was calculated by wetted width and length measurements taken during electrofishing of each reach. The number of fish per

square meter at all sites sampled in each watershed was averaged to produce a single index of parr abundance for each watershed and year.

Each fish captured was anesthetized, identified to species, measured, and weighed. Beginning in 2005, all juvenile coho larger than 55 mm and juvenile steelhead greater than 60 mm were marked with PIT tags in East and West Twin. PIT tagging in Deep Creek commenced in 2009. Prior to using PIT tags fish were adipose

Table 3. Types of habitat data collected and number of years collected, by stream and organization. LEKT = Lower Elwha Klallam Tribe, WDFW = Washington Department of Fish and Wildlife, NOAA = NOAA Northwest Fisheries Science Center, DOE = Department of Ecology, WEYCO = Weyerhaeuser Company.

	Years of data collection		
	East Twin	West Twin	Deep Creek
Habitat			
TFW Habitat Surveys (LEKT)	2002, 2007, 2013	2005, 2011	1992, 1995, 1997, 2003, 2009, 2013
EMAP Habitat Surveys (WDFW)	2004 to Present	2004 to Present	2004 to Present
Pebble Counts/ x-sections			1998, 1999, 2002, 2005, 2009
Flow, Temp., WQ (DOE)	2004 to Present	2004 to Present	2004 to Present
Temp, DO (LEKT)	1998, 2007 summer temps		1996, 1999, 2000, 2005 summer temps
Fish			
Adults (LEKT, WDFW)	2000 to present	2000 to present	2000 to present
Summer parr (WDFW)	2004 to present	2004 to present	2004 to present
Smolts (LEKT)	2002 to present	2002 to present	1998 to present
PIT tagging (NOAA,LEKT, WEYCO)	2004 to present	2005 to present	2009 to present

fin clipped, but this was discontinued due to inconsistent enumeration of marked fish at smolt traps and concerns marked fish would be mistaken as hatchery fish. To increase the total number of juvenile coho salmon tagged, additional multiple-pass electrofishing was conducted in three to five additional reaches in East in West Twin from 2005 till present and from 2009 till present in Deep Creek. Fish tagged in these additional reaches are included in estimates of overwinter survival, but were not used as index of abundance.

Smolts and Adults – Smolt production for each watershed is estimated by the Lower Elwha Klallam Tribe using weir type smolt traps. The traps are located just above tidewater in each stream and operated during smolt outmigration period. The traps include a channel spanning weir that forces all smolts into a trap box. While the vast majority of smolts are captured in the trap, trap efficiency estimates are made periodically to correct for any fish that may slip through the weir during high flows.
Coho and steelhead adults/redd surveys are conducted by the LEKT and WDFW throughout the spawning season in major spawning areas in all three streams. These numbers are converted to total spawners using the area under the curve (AUC) method.

Survival estimates – Stationary multiplex PIT tag readers were installed 300 to 500 m above tidewater in the East Twin and West Twin rivers in 2004 and summer 2009 in Deep Creek. To maximize our probability of detecting PIT tagged fish, each reader included two antenna arrays each composed of three antennas that spanned the stream under most flows (see Roni et al. 2012 for a detailed description). This configuration allowed for the detection of PIT tagged fish emigrating from the watersheds to the marine environment and estimation of overwinter survival of PIT tagged coho. Outmigration timing and survival for tagged steelhead were not estimated in part because of steelhead may smolt at ages 1 to 4, which made it difficult to distinguish among age classes and returning adults.

For each stream and year, survival from tagging in August and September to out-migration was estimated in two steps. First, we calculated the total number of tagged juvenile coho that out-migrated each month based on the last detection date from

September through June. Then we corrected those numbers based on the PIT tag reader efficiency. Because each PIT tag reader included two antenna arrays in each stream, we calculated the combined efficiency of both arrays (detected fish ÷ combined efficiency; Zydlewski et al. 2006; see Roni et al. 2012 for details).

The combined efficiency was used to correct monthly rates of detection and survival for each stream. Annual survival from tagging to out-migration was calculated by summing the total monthly-corrected detections by the total number of fish tagged that year. We examined each tagging cohort separately from 1 September to 30 June because all tagged fish were last detected during this period, few or no fish emigrated in July and August, and we detected no two-year old juvenile coho. In addition, we classified fish as fall/winter (F/W) migrants if they emigrated before or on January 31 and spring migrants if they emigrated between 1 February and 30 June. The peak spring migration typically took place during April or May, with few fish emigrating before March or after mid-June. We calculated the proportion of F/W migrants by dividing the number of F/W (corrected for efficiency) by the total number of migrants detected (corrected for efficiency).

Using a combination of PIT tagged coho detected and undetected in the smolt trap, we also estimate the total summer parr population in the watershed. Coho smolt to adult survival was calculated for each brood year as the proportion of smolts that returned approximately 18 months later. Steelhead smolt-to-adult survival was not calculated because of variable age of return of adults. Smolts per spawner for coho was estimated by dividing the total number of smolts produced from spawning adults 2 years prior.

Statistical analysis

We examined trends in time for all physical variables with two types of analysis. First, we simply examined the trends for each river and parameter through time using simple linear regression. Second, to examine the "restoration response" we took the difference between treatment and control pairs (East Twin minus West Twin and Deep Creek minus West Twin) for each parameter and year. West Twin served as the control watershed for both East Twin and Deep Creek. We then used simple linear regression to examine whether there was a detectable positive (or negative) temporal trend in restoration response in the parameter of interest. A 0.10 level of significance was used for all statistical tests.

Preliminary Results

Temporal Trends in Individual Watersheds

The three watersheds tracked each other well through time for all habitat parameters. Only pool frequency showed increasing trend through time though it was significant in East and West Twin but not Deep Creek (Table 4; Figure 2). Trends in mean summer parr density were not significant for juvenile coho, steelhead or trout fry for any of the study streams (Table 4). Total summer parr populations, estimated from mark-recapture estimates, showed no significant trend in East Twin or Deep Creek, but a decreasing

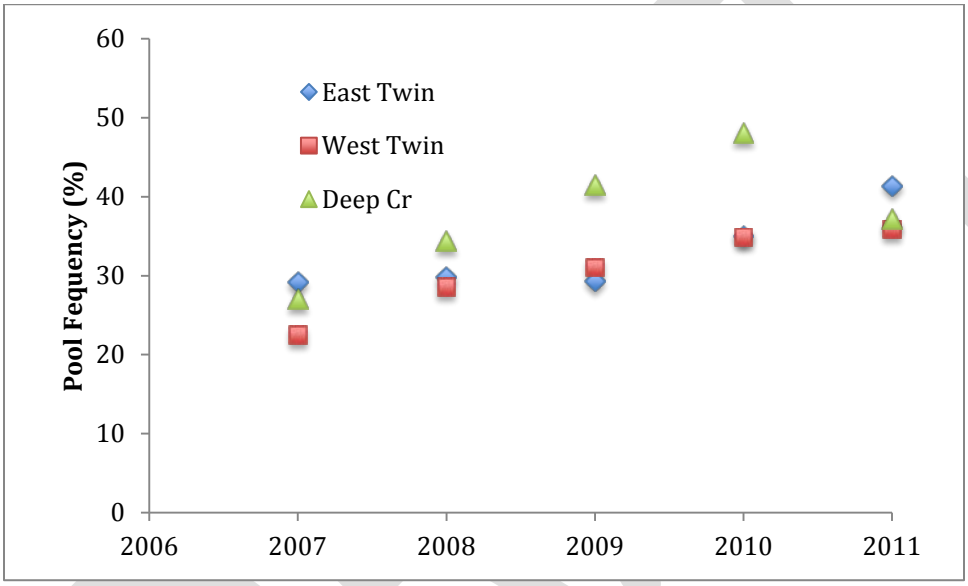


Figure 2. Trend in mean pool frequency for three study watersheds.

trend through time in West Twin (Table 4; Figure 3). Coho smolt production showed no significant trend in West and Deep Creek, but a slight negative trend in East Twin (Table 4; Figure 3, $r^2 = 0.24$). Steelhead smolt production showed a negative trend through time in West Twin ($r^2 = 0.24$ and Deep Creek ($r^2 = 0.47$), but not East Twin (Table 4, Figure 4). Trends in coho adult abundance were not significant in East Twin or Deep Creek (Table 4), but showed a negative trend through time in West Twin (Figure 3; $r^2 = 0.30$). Adult steelhead returns showed a significant negative trend for all three streams (Table 4; Figure 4), which is consistent with other streams in the region. Coho smolt to adult survival showed a negative trend in Deep Creek $p = 0.042$; $r^2 = 0.29$, but no trend in East

or West Twin (Table 4; Figure 5). Overwinter survival in West Twin showed a weak positive trend (Table 4; Figure 5, $r^2 = 0.50$;). Our PIT tagging efforts have indicated that large numbers of coho parr emigrate in the fall and winter rather than in the spring as smolts suggesting that overwinter habitat is limiting. Therefore, we also examined the percentage of coho that emigrate in the fall. There was, however, no significant trend in percent of coho fall migrants in either East or West Twin (Table 4). We began PIT tagging in Deep Creek in 2009 and thus did not have sufficient data to examine trends in Deep Creek. No trend was detected between number of peak flows during fall and winter and fish survival or abundance ($p < 0.50$).

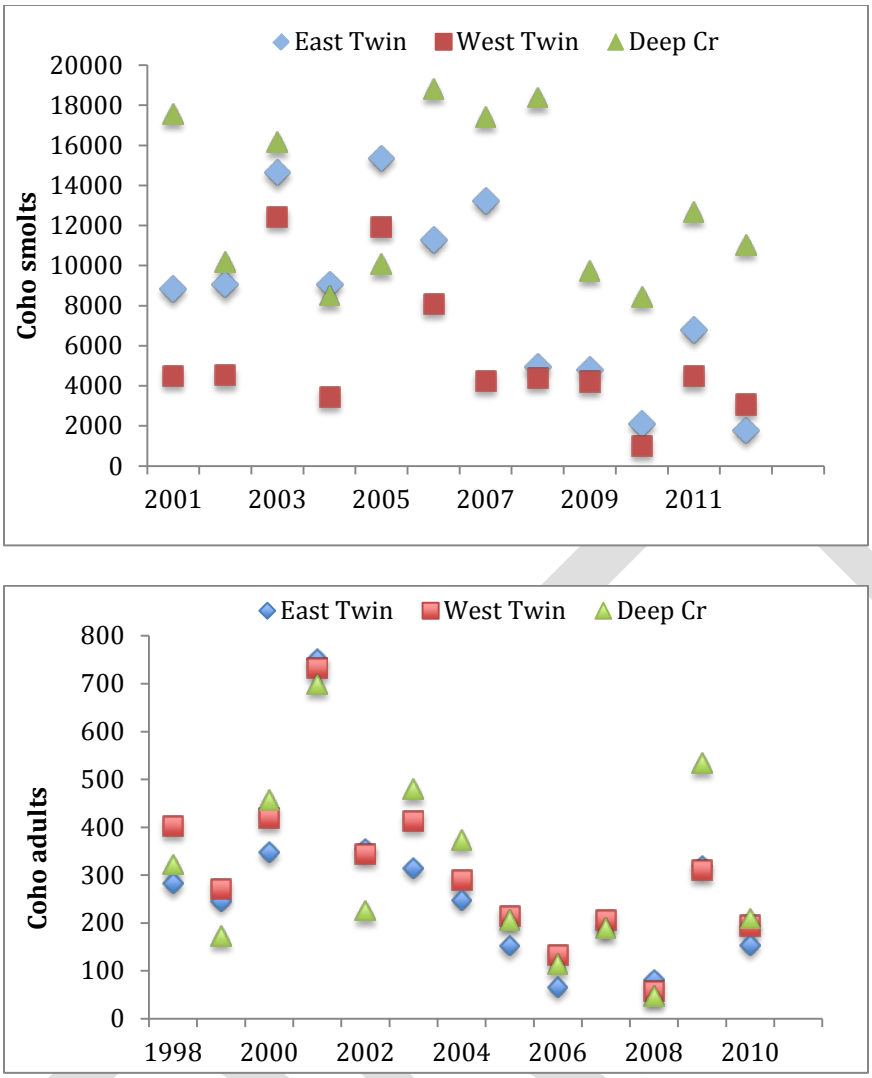


Figure 3. Coho smolts and adults abundance for each of three watersheds through study period.

We also examined smolts produced per adult spawner. This represents the productivity of the population. Coho smolts produced per spawner showed a positive trend for all three streams, though the trend was strongest in East Twin and Deep Creek the two treatment streams (Table 4; Figure 6). No trend in smolts per spawner was apparent for steelhead, but steelhead smolt at ages 1 to 4 making calculation of the number of smolts per spawners extremely difficult. No correlation was detected between number of high flow events (>100 cfs) and fish abundance or survival for any life stage ($p < 0.50$).

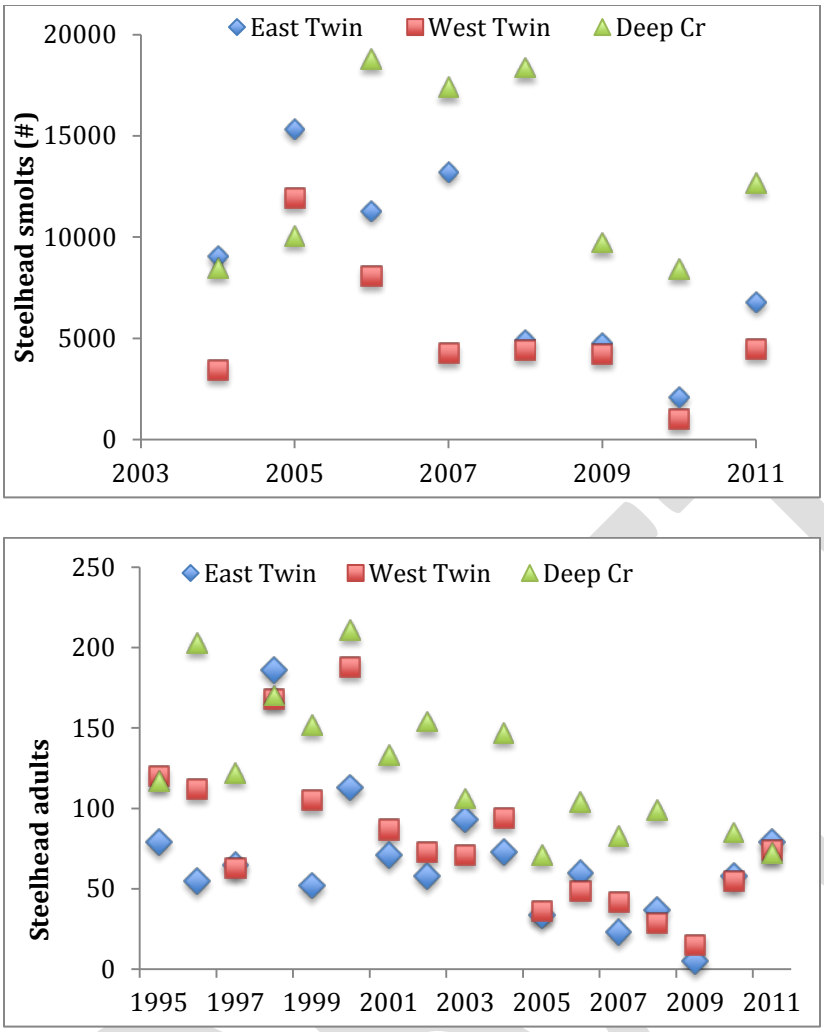
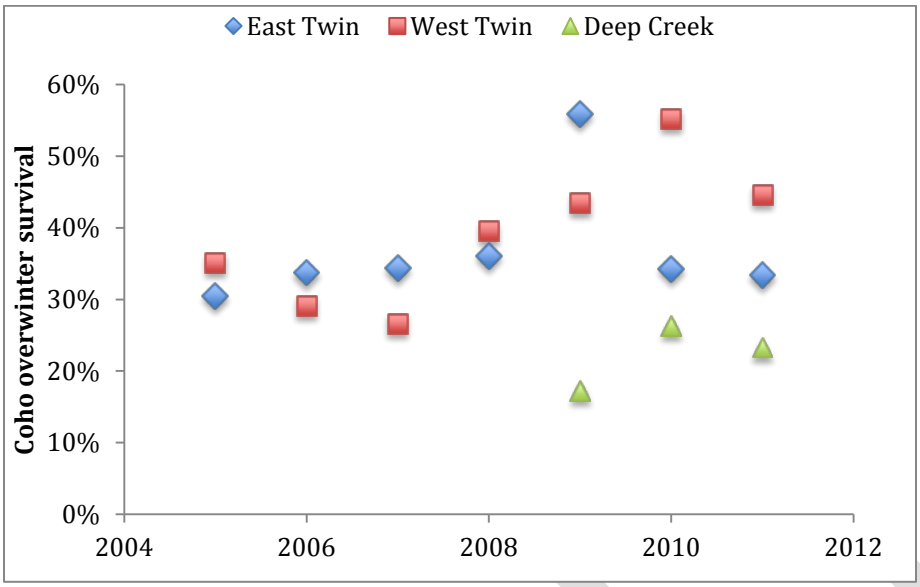


Figure 4. Steelhead smolt and adult abundance for three study watersheds. A similar negative trend is noted for other Strait of Juan de Fuca watersheds.



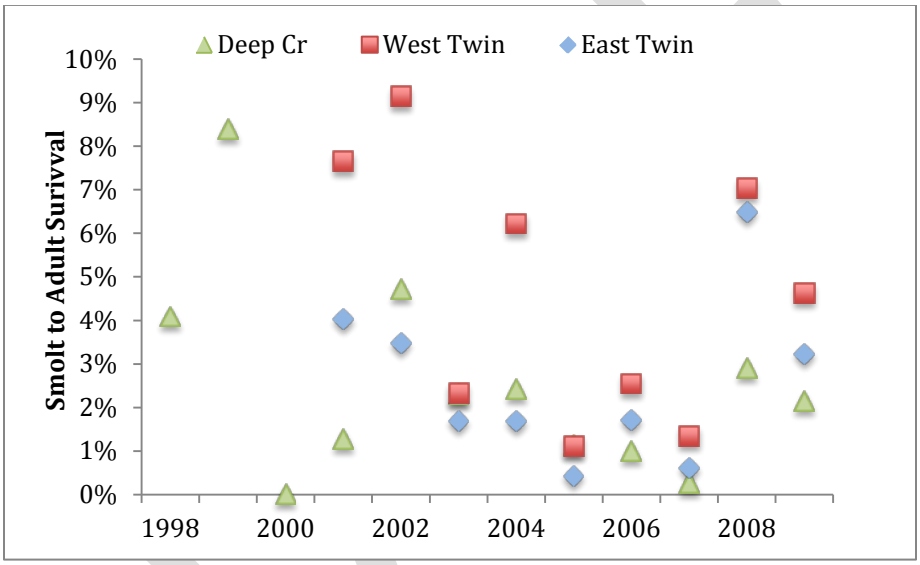


Figure 5. Trends in coho overwinter survival (parr to smolt) and smolt to adult survival.

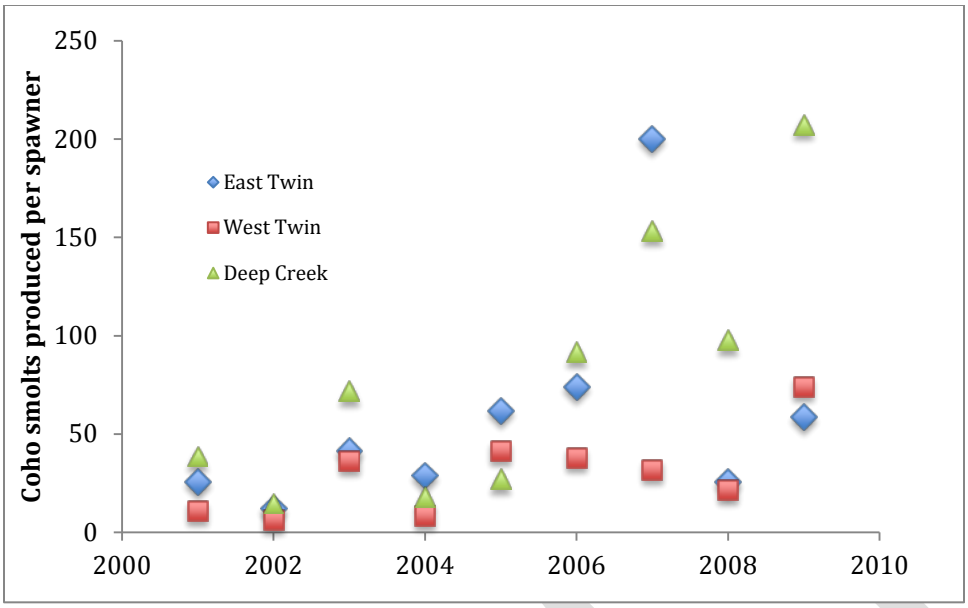


Figure 6. Coho smolts produced per spawner. (Number of smolts produced from fish spawning two years prior).

Treatment-Control Pairs

When we looked at the difference between treatment and control watershed pairs, no trend in restoration response was detected for either watershed pair (East Twin vs. West or Deep Cr vs. East Twin) for any of the habitat metrics (LWD, Thalweg, percent pool, fines, D50), juvenile fish densities (coho, steelhead, trout fry, adult coho, adult steelhead), or for overwinter or for smolt to adult survival (Table 5). Positive trends were detected for steelhead adults and smolts for East Twin - West Twin (Figure 7) and adult coho in Deep Creek – West Twin (Table 5; Figure 8). Similarly coho smolts per spawner showed a significantly increasing trend through time in Deep - West Twin, but not for East Twin -West Twin (Table 5; Figure 9). This suggests restoration is leading to improved conditions for steelhead in East Twin and coho in Deep Creek relative to the control stream (West Twin)

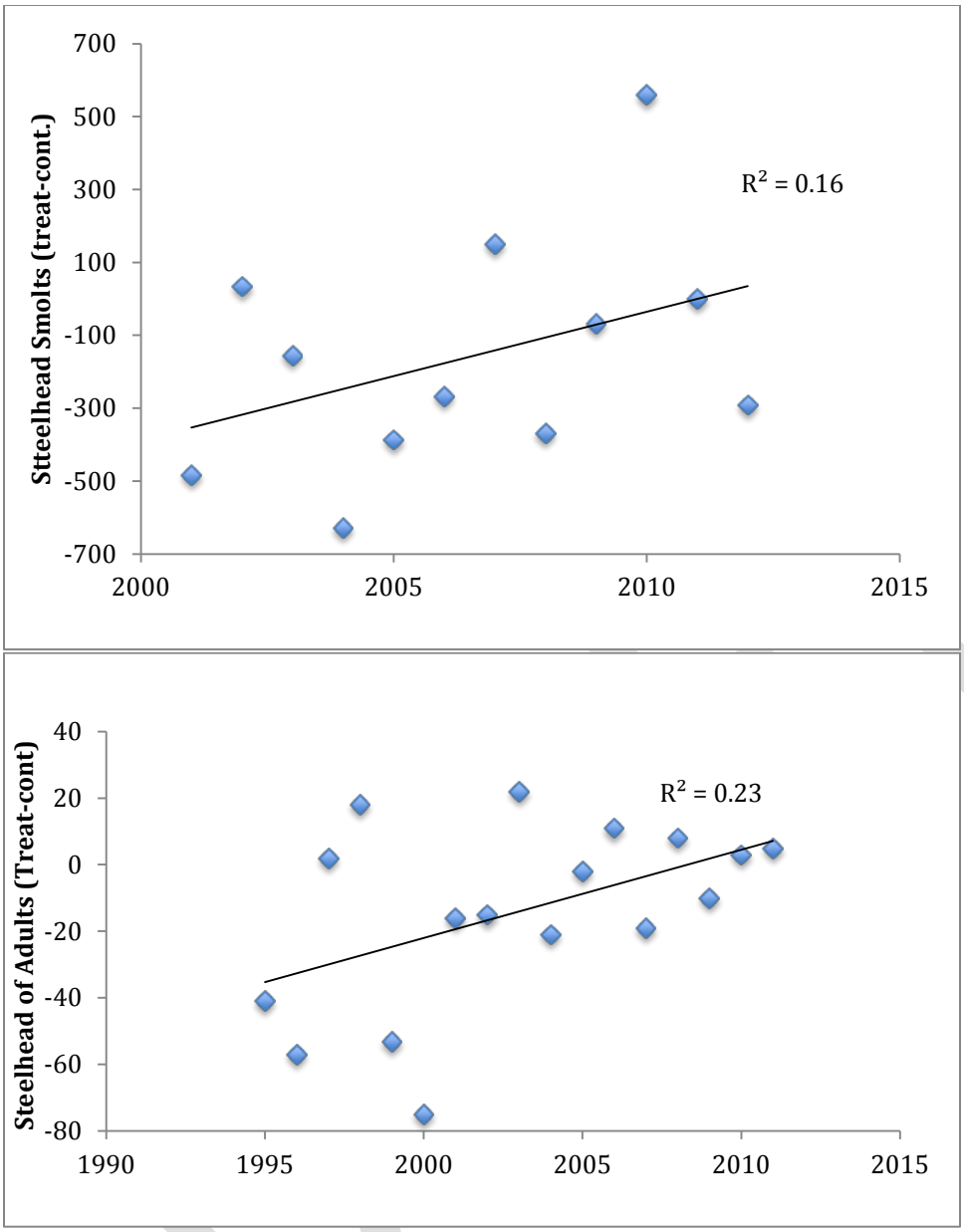


Figure 7. Difference between East Twin (treatment) and West Twin (control) steelhead returning smolts (top) and adults. This suggests improving conditions for steelhead in East Twin as a result of restoration measures. Relationship for Deep Creek (Deep Creek minus West Twin) was not significant for steelhead.

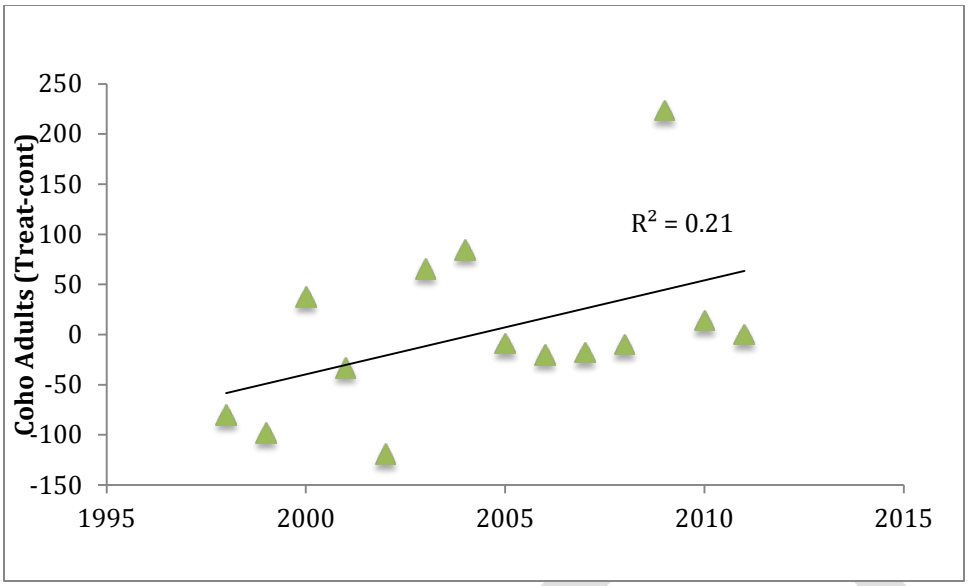


Figure 8. Difference between Deep Creek (treatment) and West Twin (control) coho returning adults. This suggests improving conditions for coho in Deep Creek as a results of restoration. Not shown is relationship for East Twin minus West Twin, which was not significant.

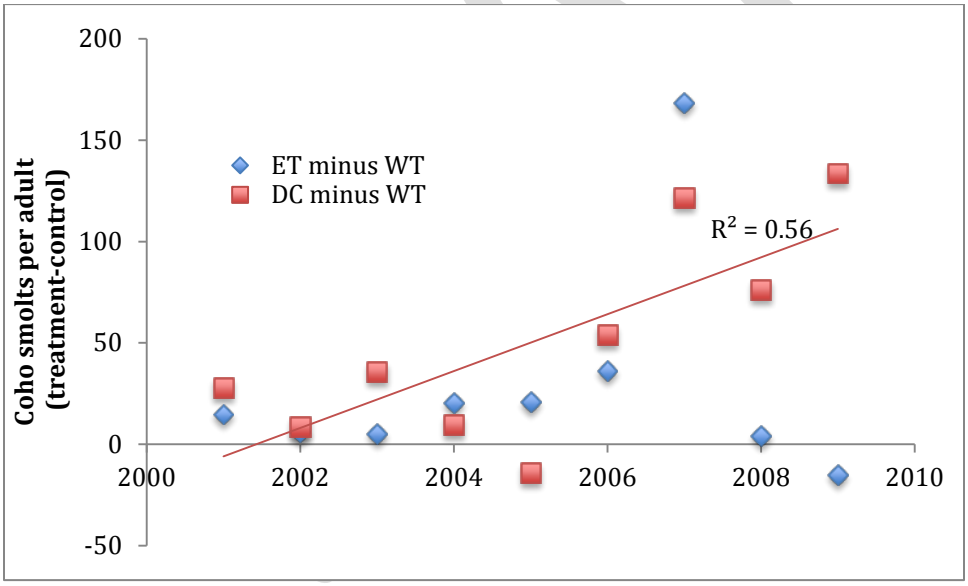


Figure 9. Difference in treatment (East Twin or Deep Creek) and control (West Twin) coho smolts per adult (spawner). Relationship for Deep Creek is positive and significant suggesting improving conditions for coho in Deep Creek..

Discussion

Restoration actions were implemented throughout the first 9 years of monitoring in the Straits IMW complex and the full physical response to restoration is not expected for a few years. Despite this, we have seen some promising trends. Pool frequency, which is directly related to addition of LWD, appears to be increasing in all watersheds. Most encouraging is the response to restoration in East Twin and Deep Creek when corrected for the control (West Twin). This suggests that relative to the control, steelhead adults and smolts are increasing in East Twin (Figure 7) and coho adults returns are increasing in Deep Creek (Figure 8). In addition, the number of coho smolts produced per returning adult is increasing over time in Deep Creek. This suggests improving conditions in East Twin for steelhead and Deep Creek for coho as a result of restoration. Should the physical habitat conditions such as pool area continue to improve, we would expect these trends to continue. Moreover, these results are consistent with what we might expect for the two treatment watersheds in terms of habitat suitability for steelhead and coho: Deep Creek has more floodplain and low gradient habitat and appears to be more suitable for coho and East Twin is more confined and has larger substrate and appears to be better steelhead habitat.

While these preliminary results are encouraging, most of the restoration work was just recently completed. Additional monitoring of two to three generations (6 to 9 years for coho) is needed to confirm that these initial trends are the result of restoration actions implemented in East Twin and Deep Creek.

Table 4. Results of regression analysis for trends in key parameters through time for each stream individually. r^2 and linear regression equation only reported for significant relationships ($p < 0.10$).

Metric	P value, r^2 East Twin	West Twin	Deep Creek
Thalweg depth	0.64	0.92	0.16
Instream LWD	0.44	0.63	0.43
Pool Frequency	0.09; r^2 =0.56	0.01; r^2 = 0.90	0.17
Fines	0.94	0.72	0.95
Coho parr densities	0.57	0.83	0.89
Steelhead parr densities	0.24	0.25	0.64
Trout fry densities	0.20	0.57	0.26
Coho parr population	0.37	0.07; r^2 = 0.43	0.74
Coho smolt production	0.08; r^2 = 0.24	0.25	0.40
Steelhead smolt production	0.24	0.07, r^2 = 0.24	0.01, r2 = 0.47
Adult coho	0.10	0.03, r^2 = 0.96	0.34
Adult steelhead	0.078, r^2 = 0.14	0.004, r^2 = 0.40	0.003 , r^2 =0.44
Coho overwinter survival	.54	.04; r2 = 0.50	NA
% of fall coho fall migrants	.13	.78	NA
Coho - Smolt to adult survival	0.84	0.36	0.05, r^2= 0.27
Coho overwinter survival	0.537	0.045; r^2 = 0.50	NA
% of fall migrants	0.133	0.788	NA
Smolts/spawner	0.25	.043; r^2 = 0.39	0.02, r^2 = 0.40

Table 5. Results of regression analysis of difference between treatment and control watershed pairs for key metrics.

Metric	P value, r^2 & Equation East -West Twin	Deep Cr-West Twin
Thalweg depth	0.404	0.40
Instream LWD	0.663	0.158
Pool Frequency	0.511	0.324
Fines	0.554	0.733
Coho parr densities	0.452	0.960
Steelhead parr densities	0.353	0.266
Trout fry densities	0.38	0.969
Coho smolt production	0.220	0.696
Steelhead smolt production	0.096, r^2= 0.19	0.851
Adult coho	0.202	0.070; r^2=0.20
Adult steelhead	0.051; r^2=0.18	0.772
Coho overwinter survival	0.322	NA
% of fall coho fall migrants	0.624	NA
Smolt to adult survival	0.11	0.40
Smolts per adult	0.638	0.02; r^2 = 0.50

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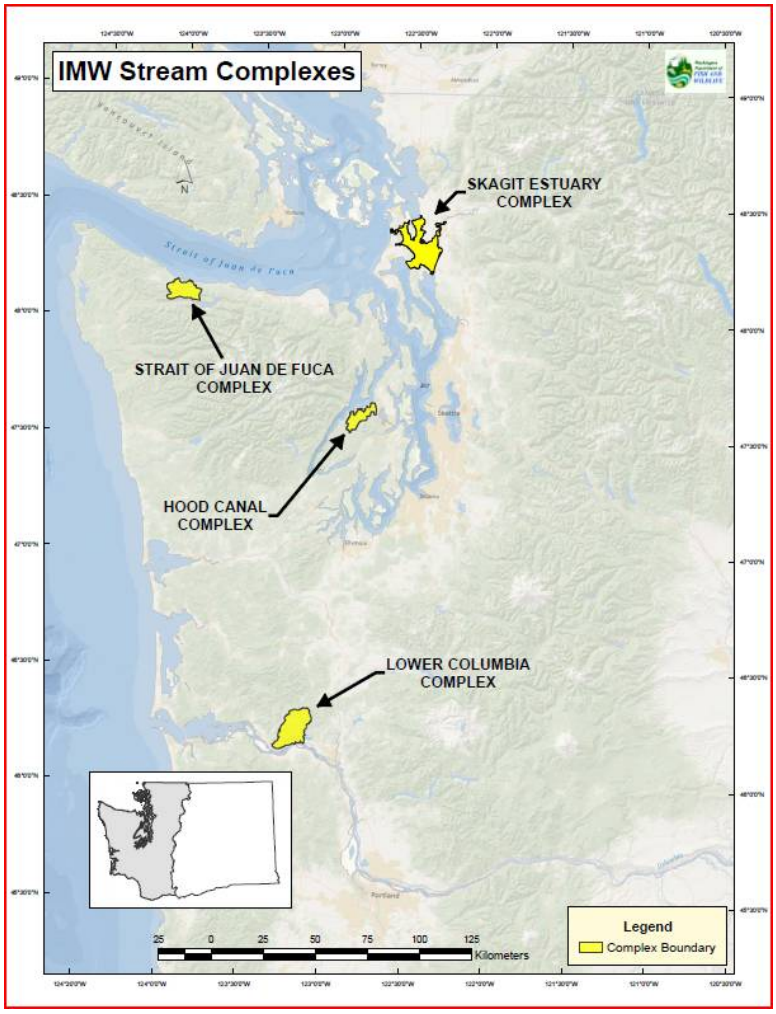
Intensively Monitored Watersheds Synthesis Report

Lower Columbia River

2013



Prepared for the Salmon Recovery Funding Board

Prepared by the IMW Oversight Committee

IMW Oversight Committee

Eric Beamer – Skagit River Systems Cooperative
Robert E. Bilby - Weyerhaeuser Co.
William J. Ehinger – Washington Department of Ecology
Correigh Greene – Northwest Fisheries Science Center, NOAA
Kirk Krueger – Washington Department of Fish and Wildlife
Mike McHenry – Lower Elwha Klallam Tribe
Timothy Quinn - Washington Department of Fish and Wildlife
Phil Roni – Northwest Fisheries Science Center, NOAA
Mara Zimmerman – Washington Department of Fish and Wildlife

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Executive Summary

The Lower Columbia Intensively Monitored Watersheds study evaluates the response of coho and Chinook salmon and steelhead to habitat restoration actions. The study focuses on three adjacent watersheds (Mill, Abernathy, and Germany creeks) which flow into the Lower Columbia River. The abundance, survival, and distribution of all three species are assessed annually at three life stages – spawner, summer parr (coho and steelhead only), and outmigrant. Habitat characteristics, such as large woody debris counts and pool frequency, are quantified on an annual basis. Water quality characteristics, such as flow and temperature, are measured on a daily basis at stations in each watershed. The study is designed as a before-after control-impact study with Mill Creek as the control watershed and Abernathy and Germany creeks as the treatment watersheds. In Germany Creek, completed restoration projects include a culvert replacement and bank stabilization as well as three years of watershed scale carcass analog treatments. In Abernathy Creek, completed or in-progress restoration projects include road abandonment and removals, channel restructuring, and large woody debris placements. Additional projects, identified in the Abernathy and Germany Creeks Intensively Monitored Watershed Treatment Plan, are yet to be implemented. Pre-project monitoring began in 2005 with an additional four years of outmigrant data prior to this time. Currently, post-project monitoring includes two years of data from Germany Creek. Restoration in Abernathy Creek has not yet been substantive enough for "post-treatment" monitoring.

Introduction

Since the listing of many populations of salmon in the Pacific Northwest under the US endangered species act beginning in the 1990s, millions of dollars have been dedicated to the restoration of freshwater habitat (NRC 1996). However, little is known about the efficacy of these restoration efforts for increasing salmon production (Roni et al. 2002, Katz et al. 2007). The most effective means of determining the contribution of restoration actions to salmon recovery is to implement experimental, watershed-scale studies (Roni 2005). Such studies are the only means of reliably determining the effectiveness of restoration actions for restoring salmon populations. This document describes the history, goal, methods and current results of such an experiment being conducted in the Lower Columbia River Intensively Monitored Watershed complex at the request of the Salmon Recovery Funding Board; one of four IMW complexes and experiments in Washington.

History – Results of the Intensively Monitored Watersheds (IMW) program should have important implications for stream restoration and salmon recovery as well as the direction and funding of future intensive watershed-scale research studies. Although rarely conducted, such intensive, watershed-scale studies provide the foundation of our knowledge about the freshwater habitat requirements of salmonid fishes. Environmental management in North America has been substantially influenced by the results of a few intensive, watershed-scale research studies. For example, land use practices have changed as a result of studies conducted on experimental watersheds such as the H.J. Andrews Experimental Forest in Oregon (e.g., Ackers 2004; http://andrewsforest.oregonstate.edu/index.cfm) and the Hubbard Brook Ecosystem Study in New Hampshire (e.g., Hart 1966; http://www.hubbardbrook.org/). These successful efforts spawned several intensive, watershed-scale studies in the Pacific Northwest to evaluate the response of salmon to forest practices. For example, the Alsea Watershed Study evaluated the response of coho salmon and cutthroat trout to logging methods in several small watersheds on the Oregon coast (Moring and Lantz 1975; http://www.ncasi.org/programs/areas/forestry/alsea/default.aspx). Results from this study provided much of the technical rationale for measures to protect aquatic habitat incorporated into the forest practice regulations of Oregon and Washington in the early 1970s. Similar studies have not been conducted to assess the efficacy of restoration actions on salmonid production, especially in watersheds with urban and rural development.

Following the first petition to list Pacific salmon under the US Endangered Species Act in 1991 the WA state legislature requested a statewide strategy for recovering salmon that included monitoring. In response, in 1999 the "Statewide Strategy to Recover Salmon: Extinction is Not an Option," that made monitoring recommendations, was published. In 2000 the WA state legislature created a Monitoring Oversight Committee (MOC) whose task was to develop a statewide strategy for monitoring watershed health and salmon recovery. In 2002 the MOC published the Washington Comprehensive Monitoring Strategy and Action Plan for Watershed Health and Salmon Recovery (or Comprehensive Monitoring Strategy; CMS). Following recommendations of the Monitoring Design Team (MDT 2002: http://www.rco.wa.gov/documents/monitoring/IMW-1_SRFB_proposal.pdf), who developed a monitoring design for the Forest and Fish Report, the CMS provided a sound rational for the need for and design of Intensively Monitored Watersheds. In 2002, the Government Accountability Office stated that "data to quantify the effects of these [salmon restoration] actions on fish populations are generally not

available," (GAO-02-612) but desirable for determining the benefits of expenditures. Also, additional and better evidence that habitat actions are improving salmon survival was requested in the 2011 judicial review of the Columbia-Snake Basin biological Opinions.

In 2003, the Salmon Recovery Funding Board (SRFB) requested that the Washington Department of Fish and Wildlife and the Washington Department of Ecology review the Salmon Recovery Index Watershed monitoring program and make recommendations toward meeting their goal of evaluating the effectiveness of salmon habitat restoration. These recommendations (SIWMRB 2003; http://www.rco.wa.gov/documents/monitoring/IMW-1_SRFB_proposal.pdf) were implemented in 2004 and became the IMW Program. In 2006, the SRFB requested review of the IMW Program plan by the Independent Science Panel (ISP 2006; http://www.rco.wa.gov/documents/monitoring/ISP_IMW_Rpt_2006-1.pdf). The ISP found that the IMW Program was "…a state-of-the-art intensive monitoring program to test and validate salmon habitat restoration strategies… [with a] solid scientific conceptual framework, fundamentally robust study designs, and a well-qualified interagency team of scientists…" The ISP also suggested that, "Serious weaknesses include an apparent disconnect between how treatments (i.e., the habitat improvement actions) are selected and funded, in relation to experimental design and monitoring needs, and uncertainty about the duration of the commitment to fund the long term nature of the IMW program."

Goal – The goals of the IMW Program are to determine whether freshwater habitat restoration actions, as currently conducted in Washington state, measurably increase salmonid survival and production and to explain why or why not. The basic premise of the IMW Program is that the complex interactions between salmonids and their habitat can best be understood with concentrated monitoring and research efforts at a few locations.

Methods

The IMW Program is designed to maximize our ability to detect changes in salmon production as a result of habitat restoration treatments while minimizing the probability of detecting spurious treatment effects by using a Before-After-Control-Impact (BACI) study design (Underwood 1991, 1992, 1994, Smith 2002). A BACI study uses one or more non-manipulated sites or watersheds (i.e., reference) as an experimental control to account for variation not due to treatments (Steward-Oaten and Bence 2001), thereby increasing our certainty that changes observed are due to treatments and reducing the time required to detect treatment effects.

The IMW watersheds are carefully selected to fulfill the requirements of the BACI experimental design. While perfect replicates are not possible in field studies (Dutilleul 1993, Scheiner and Gurevitch 2001), we use the fact that salmon population changes in spatially proximate watersheds are often similar (Bradford 1999) to provide reasonable replicate treatment and reference watersheds. We also use measurements of environmental conditions to account for failures to meet the assumptions of the experimental design (Bendetti-Cecchi 2001, Steinbeck 2005) and to strengthen our analyses by elucidating mechanisms that effect production. Our primary objective is to quantify changes in the survival and production of coho and Chinook salmon and steelhead due to habitat restoration treatments

by comparing their survival and production before and after habitat restoration treatments by using a BACI design to control for other environmental factors. Project monitoring can determine if projects have anticipated effects on habitat and are used by salmon, but they cannot determine whether they increase the survival and production of salmon.

Study Area – The Lower Columbia IMW complex is comprised of the Mill, Abernathy, and Germany creek watersheds (Figure 1). Mill (control watershed), Abernathy and Germany creeks are located in Wahkiakum and Lewis counties in the Grays/Elochoman basin (WRIA 25) and flow south into the lower Columbia River at River Mile (RM) 53.8, 54.2, and 56.2, respectively.

As a result of volcanic flows and glacial water flows, the Lower Columbia IMW watersheds are characterized by sequences of upper Tertiary volcanic (~85%) and Columbia River Quaternary sedimentary (~13%) rock Table 1). Sedimentary rock and steep slopes enable erosion and mass wasting events, especially during long intense rain events. Average annual rainfall is 160 cm per year. The Lower Columbia IMW watersheds initiate in relatively steep uplands and flow through relatively confined channels in a dendritic drainage pattern. Channels are relatively steep throughout Abernathy and Germany creeks, but Mill Creek is less steep.

The watersheds of the Lower Columbia IMW complex are extensively managed for logging. Over 80% of the complex is early seral stage forest and less than 1% is rural residential. Highway 4 crosses the creeks near their mouths and a relatively large number of logging roads, including decommissioned roads and several stream crossings, are present in the watersheds.

Coho slamon (*Oncorhynchus kisutch*), Chinook salmon (*O. tshawytscha*), and steelhead (*O. mykiss*) are the focal species in this complex. Tule Fall Chinook and coho are part of the Coastal Major Population Group for Lower Columbia Evolutionary Significant Unit (ESU). Winter-run steelhead are part of the Southwest Washington distinct population segment (DPS). Although hatchery strays spawn in all three creeks, direct hatchery plants on Mill and Germany creeks have not occurred since the late 1990s. On Abernathy Creek, an integrated winter-run steelhead brood stock program is implemented by the Abernathy Fish Technology Center as part of an ongoing reproductive success study.

Restoration Measures – Restoration treatments are primarily selected based on the results of analyses conducted to develop the Abernathy and Germany Creeks Intensively Monitored Watershed Treatment Plan (HDR, Inc. 2009) that was developed for the Lower Columbia Fish Recovery Board (LCFRB). The restoration treatments identified in the "Treatment Plan" are designed to improve in-stream, side channel and floodplain habitat conditions and are coordinated with the LCFRB Habitat Work Schedule.

Few physical habitat restoration treatments have been completed. However, in Germany Creek a blocking culvert was replaced and a bank was stabilized with bioengineered armoring by Sierra Pacific Industries on their land. The Columbia Land Trust also restored some side channel habitat in 2009 and armored a tidal portion of the mainstem using concrete dolos in 2012 (Figure 2). Restoration was initiated in Abernathy Creek in 2004 with a road abandonment followed by limited riparian invasive species removal and replanting in 2008. Currently, the Cowlitz Tribe is leading a road removal, channel restructuring and LWD placement project covering about 1 mile of the stream (Figure 2). Starting in

2010 the Lower Columbia River Fish Enhancement Group, in cooperation with the IMW Scientific Oversight Committee, has conducted a nutrient enhancement treatment in Germany Creek.

Water Quality and Quantity Monitoring – Gauge stations have been operated near the mouth of each Lower Columbia watershed since 2005 (Figure 1). Continuous data collected from each gauge includes stage height, temperature, turbidity, dissolved oxygen, and conductivity. Stream flow is calculated based on a stage height-flow relationship developed for each gage. Extreme high flow events are difficult to measure due to the timing of getting to the site during the event and because of the highly variable flow velocities across the channel cross section during flow events in the flood plain. Because of this flows exceeding two times the maximum measured flow used to develop the stage height-flow regression equation were estimated using a regression equation comparing Chinook River mean daily flow to each of the three study watersheds.

Habitat Monitoring - The IMW Project began collecting habitat and fish data in the Lower Columbia IMW Complex in 2005. The IMW habitat sampling plan and field methods are adapted from the US EPA, Environmental Monitoring and Assessment Program (EMAP, http://www.epa.gov/emap) as described in Peck et al. (draft, http://www.epa.gov/emap/html/pubs/docs/groupdocs/surfwatr/field/ewwsm01.html) and Crawford (2008a, 2008b,2008c) for the SRFB. These methods are recommended in the CMS (Crawford et al. 2002).

Sampling locations are identified using a random, spatially balanced design (Stevens and Olsen 2004) that is stratified by stream order (Strahler 1954). This allows statistically valid descriptions and comparisons of watersheds. Some sampling locations were changed in 2006 to include a greater number of locations where fish presence is more likely. Preliminary analysis in 2006 suggested that repeated measures sampling, rather than a rotating panel, would allow the collection of more samples in each year and likely provide better change detection via repeated measures analysis. Starting in 2007 at least twenty locations are sampled every year in each watershed in each complex (Table 3). New sampling locations are selected to include the greatest number of previously sampled locations, maintaining the original sampling design. Sampling rotates among watersheds about weekly to minimize seasonal bias (e.g., stream drying as summer progresses).

Samples consist of measures and counts made at and between 21 equally spaced cross sections. Cross sections are positioned along a length of stream that is the longer of either 40 bankfull widths or 300 m. Measurements at each cross-section include bankfull width (0.0 m), wetted width (0.0 m), bar width (0.0 m), bankfull height (0.00 m), water depth (≥5 points 0.00 m), and distance between transects (0.0 m). A compass bearing is taken between transects and can be used to calculate sinuosity. A tally of whether the cross-sections are in pools, riffles or glides is made.

Substrate size class of a randomly selected particle is tallied at each location where depth is measured. Substrate classes include smooth bedrock and rough bedrock, boulder, cobble, coarse gravel, fine gravel, sand, fines, hardpan, wood, and other. If present, the type of pool is noted (e.g., plunge pool). Large wood is tallied by position (bridging or in the bankfull channel) and size class. Large wood size classes are determined by three ranges of diameter and three ranges of length. When found, dry channels are

sampled and all possible measurements are made (e.g., depth is not measured). Presence of a backwater or side channel crossed by cross-sections is recorded. The occurrence of fish visually observed is recorded and species are identified is possible.

Project monitoring is also conducted as part of habitat monitoring. When appropriate, we use a protocol similar to that described above to collect data pertinent to detecting site-scale changes to habitat conditions at and near the locations of restoration actions. Where appropriate, additional information is also collected to more precisely measure changes. For example, fish use is assessed using snorkel surveys when appropriate and possible. Where restoration project sites overlap with habitat monitoring sites, those data are used for project monitoring.

Fish Monitoring – Coho and Chinook salmon and steelhead are the focal species for the population abundance and survival estimates in the Lower Columbia IMW watersheds. Abundance and biological characteristics are monitored at three life history stages. Parr are collected by electrofishing and seining in index reaches during late summer. Outmigrants are captured in smolt traps operated during the spring. Adult escapement is estimated using a combination of a resistance board weir (Abernathy Creek) and weekly to bi-weekly spawning surveys conducted on each watershed.

Densities and biological characteristics of coho and steelhead parr are estimated from stream surveys in late August/early September conducted each summer since 2005 (Figure 1). Parr are collected by electrofishing and seining at ten 50-meter index sites selected in each creek using a spatially balanced probabilistic sample design. Most of the index reaches have been sampled annually since 2005, although one site on Germany Creek was changed in 2010 because a landowner denied access to the previous site. Fish densities are estimated from a 3-pass depletion study design based on electrofishing collections in each reach (Temple and Pearsons 2007). Biological data collected includes species, life stage (subyearling, yearling+), fork length (mm), and weight (g). Coho parr longer than 55-mm FL are PIT tagged and abundance of coho parr at the watershed scale is estimated using a mark-recapture study (Kinsel et al 2009). The incidence of tagged fish among out-migrating coho smolts the following spring is used to back-calculate total watershed abundance of coho parr during the late summer months (Volkhardt et al 2007).

Outmigrants are captured in smolt traps operated annually between January and June near the mouth of each creek (Figure 1). Juvenile salmonids are sorted by species and life stage and sampled for PIT tags. In collaboration with USFWS Abernathy Fish Technology Center, steelhead smolts on Abernathy Creek are also sampled for mark status (ad-clip, no mark) and multiple tag types (PIT, CWT, No Tag). A random subsample of outmigrants (~10%) are measured and weighed (beginning 2010) on a weekly basis throughout the season. Scales are collected from one in ten steelhead smolts and aged by the WDFW Scale Lab. The number of outmigrants is estimated by species using a mark-recapture study design (Kinsel et al. 2009) appropriate for single partial capture traps (Carlson 1998, Volkhardt et al. 2007).

Spawner abundance, diversity (pHOS), and distribution are determined annually (see Kinsel et al 2009 for full description of the methods). Chinook spawner surveys are conducted weekly between early September and early November. Estimates are based on a carcass tagging protocol and a Jolly Seber mark-recapture estimator (Seber 1973). Coho spawner surveys are conducted bi-weekly between early

October and late January. Coho spawner estimates in Abernathy Creek are derived from mark and recapture protocols of live coho conducted in cooperation with the USFWS Abernathy Fish Technology and based on a Darroch's stratified Petersen estimator (Darroch 1961, Bjorkstedt 2005). Coho spawner estimates for Mill and Germany creeks are based on smolt production, Abernathy smolt-to-adult return and proportion hatchery spawners. Steelhead spawner surveys are conducted on a bi-weekly basis and counts of observed redds are expanded to a total abundance based on assumed sex ratio and redds/female. Temporal and spatial distribution is determined from on repeat surveys of the full extent of known anadromy in each watershed.

Results

Water Quality and Quantity Monitoring – The hydrology in the Lower Columbia IMW watersheds is rain-driven. Variation in stream flows is notable among years (Table 2). Annual peak flows occur during the months of November through January and vary among years. Between 2005 and 2012, the highest winter flows occurred over the 2008-2009 winter. Annual low flows occur during the months of July and August with the lowest monthly average (between 2005 and 2012) occurring in the summer of 2009.

Average monthly stream temperatures range between 3.2°C and 17.3°C (Table 3). The highest temperatures are consistently observed in the month of August, also the month with the lowest summer flows. The lowest temperatures are observed during the months of December, January, and February.

Habitat Monitoring – Preliminary analysis of basin-wide habitat data supports the use of BACI analyses and comparisons of treatment and control watersheds in the Lower Columbia IMW complex. Few temporal trends or large differences among years are found for most habitat attributes within a watershed and similar patterns are observed for most attributes among the watersheds in the complex. For example, counts of LWD within the channel appear to be relatively similar in all Lower Columbia IMW watersheds from 2008 through 2011 after an apparent decline from 2007 (Table 6, Figure 3). The apparent decline in LWD from 2007 to 2008 was likely due to a few very large flow events that occurred during winter 2007 – 2008 storms. As might be expected, the number of pieces of LWD bridging the channel remained relatively low and consistent in all watersheds (Table 6, Figure 4), likely because few trees of sufficient size to bridge these relatively large streams occur in their riparian zones. Relations such as these support the contention that these watersheds are functioning similarly with respect to their dominant physical processes (i.e., the flow of water and sediment) and that they are on similar recovery trajectories and are thus suitable for our analyses.

Some habitat attributes, such as pool frequency (Table 7, Figure 5) and side channel frequency (Figure 6), are relatively rare within all years in all watersheds. The low abundance of some habitat attributes, especially side channels in the Lower Columbia IMW watersheds, suggests that these habitats might be limiting salmon survival and production. Restoration treatments that increase the frequency of these habitat attributes might be expected to increase survival and production of salmon and measuring their frequency will provide strong inference regarding the efficacy of restoration practices.

Fish Monitoring – Between 2005 and 2012, annual freshwater production in Mill, Abernathy, and Germany creeks ranged from 14,000 to 32,000 coho salmon smolts, 13,000 to 3.7 million Chinook salmon outmigrants, and 6,000 to 12,000 steelhead smolts.

With the exception of 2005, the highest production of outmigrant Chinook salmon has consistently come from Mill Creek, the control watershed. Mill Creek has also had the highest Chinook spawner abundance in most years. Chinook outmigrants are primarily fry size (< 45-mm FL) indicating little to no freshwater rearing above the trap (Table 14).

Coho spawners in Abernathy and Germany creeks have been an average of 42.4% and 20.8% the number of spawners in Mill Creek between 2007 and 2011 (Table 15). When compared to the relative number of spawners, late summer coho parr were disproportionately higher in Abernathy and Germany creeks than Mill Creek. Coho parr in Abernathy and Germany creeks were 84% and 119% the number of coho parr in Mill Creek, respectively (Table 8). When compared to the relative number of late summer parr, coho smolts were disproportionately lower in Abernathy and Germany creeks than in Mill Creek. Coho smolts in Abernathy and Germany creeks were just 48.8% and 28.9% the smolt abundance from Mill Creek (Table 11). At the parr stage, average fork lengths were comparable among watersheds (Table 9). However, at the smolt stage, coho smolts in Abernathy and Germany creeks were an average of 106% and 110% the length of coho smolts from Mill Creek (Table 12).

Steelhead spawners were consistently higher in Abernathy and Germany creeks than Mill Creek between 2005 and 2011 (Table 15). Although Abernathy Creek has consistently had the most steelhead spawners, Germany Creek has consistently produced the most steelhead smolts (Table 11). Mill Creek has consistently had the lowest numbers of steelhead spawners and smolts throughout the years of monitoring. At the smolt stage, lengths of steelhead smolts from Abernathy and Mill creeks were comparable but steelhead smolts from Germany creek are an average of 108% longer than those produced from Mill Creek (Table 13).

Discussion

Habitat – Annual habitat monitoring is sufficient to identify trends in several habitat attributes that importantly effect salmon survival and production. The IMW watersheds are relatively small in area, and a large proportion (often greater than 1/3 of stream length) of each watershed is sampled each year. Repeated measure sampling using a precise and easily replicated method improves our ability to detect trends and annual differences (Roper et al. 2003). Also, preliminary analysis of habitat attribute trends suggests that the IMW Project study design is fundamentally robust and that the treatment and reference watersheds are on similar trajectories following historical disturbances. Further, identifying some strong relations between annual measures of some habitat attributes and fish survival and production statistics could support the contention that we are monitoring the correct habitat attributes and fish statistics with sufficient precision to detect meaningful changes in habitat and treatment (restoration) effects.

Fish – The fish monitoring data support the use of a BACI design to evaluate the effects of habitat restoration on salmon and steelhead populations in the Lower Columbia IMW watersheds. Smolt

production, the cumulative result of all freshwater effects, is correlated among watersheds for each species with the exception of Germany Creek where a before-after comparison will be most useful for comparing treatment effects on coho salmon (Zimmerman et al. 2012). Life stage specific patterns in abundance, when compared among watersheds, provide insight into the habitats which may limit freshwater production prior to restoration actions.

Patterns in coho abundance vary across life stages among the three watersheds, suggesting that factors limiting survival of each life stage may differ among watersheds. The major difference occurs in Mill and Germany creeks while Abernathy is intermediate in abundance for all life stages. Coho spawner abundance is highest in Mill Creek and lowest in Germany Creek. By the late summer parr stage, coho abundance is estimated to be highest in Germany Creek and lowest in Mill Creek, a result which could only occur if egg-to-parr survival was disproportionately low in Mill Creek as compared to Abernathy and Germany creeks. By the spring smolt stage, coho abundance is estimated to be highest in Mill Creek and lowest in Germany Creek. This suggests that parr-to-smolt survival is a greater bottleneck for coho salmon in Germany Creek than for Mill Creek. These results suggest that the limiting life stage and its associated habitat may differ between Mill and Germany and to some extent Mill and Abernathy creeks. Egg-to-parr survival (lower in Mill) would be influenced by spawning and summer rearing habitat (substrate size, spawning and incubation flows, pool frequency). Parr-to-smolt survival (lower in Abernathy and Germany) would be influenced by overwinter rearing habitat (side channels). and may explain the lack of a correlation in annual coho smolt production between these two watersheds.

Patterns in steelhead abundance may also be affected by different factors among the IMW watersheds, even though steelhead smolt production is generally correlated across watersheds (Zimmerman et al. 2012). For example, although Abernathy Creek is a larger watershed with higher spawning escapements, annual steelhead smolt production from Abernathy Creek is an average of 1.7 times the control stream (Mill Creek) whereas steelhead production from Germany Creek is an average of 3.6 times of the control stream.

Conclusions – The habitat and fish monitoring being conducted as part of the IMW project are being completed as planned and will very likely prove sufficient to address the study questions. Within the Lower Columbia IMW complex, habitat restoration has been too recent or too limited to draw conclusions on their effectiveness from the current monitoring data available. Within seven to ten years following the completion of restoration treatments the IMW project should reliably determine whether restoration treatments increase salmon survival and production and provide valuable guidance that will improve the efficiency of future habitat restoration that is intended to increase salmon survival and production. To ensure the success of the IMW Program and reduce the cost of long-term monitoring, restoration treatments must be implemented in the IMW treatment watersheds and ongoing monitoring must continue.

Recommendations – We recommend continuation of habitat and fish monitoring in all three of the Lower Columbia IMW watersheds. We suggest that in Germany and Abernathy creeks projects that are intended to facilitate the creation and maintenance of side channel habitat and channel roughness (complexity) be implemented. Several such projects have been identified by HDR, Inc. (2009) in their

treatment plan prepared for the LCFRB. Few habitat restoration projects have been completed in these watersheds and any opportunity to complete restoration projects, especially those that improve fish passage, alleviate sediment recruitment (e.g., added upstream roughness and bank vegetation) and increase channel complexity should be carefully considered and prioritized.

Table 1. Characteristics of Mill (ML), Abernathy (AB), and Germany (GR) in the Lower Columbia Intensively Monitored Watersheds study.

Characteristic	ML	AB	GR
Drainage area (km^2)	75.8	75.0	58.6
Max. Elevation (m)	273	285	362
Geology	Upper Tertiary Volcanic - Columbia River basalt		
Ownership	44.2% Private, 40.2% Public, 13.9% Unknown		
Mean precipitation	160 cm/year		

Table 2. Monthly stream flow (cfs) in Mill, Abernathy, and Germany creeks, 2004-2012. Data are arithmetic monthly mean flows measured at Washington Department of Ecology stream gauges 25F060, 25E060, 25D050 respectively. Data are now available (---) prior to June 2004.

Mill	Year	J	F	M	A	M	J	J	A	S	O	N	D
	2004	---	---	---	---	---	33.4	11.5	28.0	74.5	72.1	111.0	128.2
	2005	114.0	63.2	85.4	123.0	64.5	34.1	16.7	11.1	10.7	15.0	97.4	188.9
	2006	412.6	170.4	103.0	63.4	35.1	39.0	15.4	9.0	9.1	13.1	346.4	254.7
	2007	210.2	193.0	208.1	70.2	32.9	19.6	13.5	9.9	8.2	27.3	67.1	305.4
	2008	264.8	238.4	110.6	96.4	44.4	59.1	20.6	15.3	9.9	17.8	149.3	140.8
	2009	296.6	56.7	116.2	138.9	102.1	28.0	13.6	8.8	8.2	26.6	255.1	137.8
	2010	214.8	106.0	112.9	149.7	94.1	101.1	25.7	15.2	20.7	55.8	194.2	247.3
	2011	264.5	136.5	270.5	214.6	86.7	40.8	26.2	12.5	15.0	24.9	148.3	125.7
	2012	264.4	223.9	252.7	125.2	88.5	52.4	30.9	14.1	11.8	85.3	251.4	286.4
	Average	255.2	148.5	157.4	122.7	68.5	45.3	19.3	13.8	18.7	37.5	180.0	201.7
Abernathy	2004	---	---	---	---	---	32.9	25.7	51.5	83.6	74.7	98.8	135.8
	2005	130.6	77.4	91.9	126.2	67.7	37.5	21.8	12.7	12.4	47.7	143.6	193.1
	2006	356.5	127.0	91.0	71.5	29.9	34.3	15.2	8.7	9.2	12.9	302.0	211.9
	2007	180.4	174.1	244.2	74.0	37.9	21.9	13.4	8.9	8.1	39.3	51.7	237.3
	2008	205.1	209.9	135.6	107.0	41.6	48.9	16.2	14.8	9.8	18.4	159.1	135.4
	2009	314.4	61.5	111.8	124.7	99.4	24.0	11.6	8.1	9.9	29.7	224.8	123.6
	2010	218.0	101.3	100.9	141.0	77.5	87.3	24.4	12.0	22.4	58.2	151.5	239.7
	2011	248.9	114.2	275.5	192.4	80.5	36.4	20.7	11.1	11.8	31.0	146.0	126.9
	2012	247.6	192.6	267.9	136.6	99.2	45.3	23.8	11.9	9.2	84.8	249.8	284.0
	Average	237.7	132.3	164.9	121.7	66.7	40.9	19.2	15.5	19.6	44.1	169.7	187.5
Germany	2004	---	---	---	---	---	29.5	10.4	25.1	59.9	67.5	94.9	115.1
	2005	109.2	69.7	84.5	117.6	76.0	37.4	19.0	8.0	7.9	34.4	143.4	162.0
	2006	313.4	131.1	91.1	64.3	31.0	37.1	11.0	4.7	5.0	8.8	297.1	215.8
	2007	190.1	170.7	201.7	63.8	28.4	14.4	9.7	5.8	5.2	44.1	70.0	241.5
	2008	217.8	226.4	150.0	112.2	42.1	43.0	12.4	11.4	7.4	17.2	165.3	162.8
	2009	284.7	66.3	123.0	134.2	102.8	23.2	9.4	5.0	5.7	22.5	223.9	131.3
	2010	209.9	103.8	107.2	142.8	69.7	81.2	23.2	12.9	17.8	56.4	159.0	225.3
	2011	233.5	115.8	288.8	200.5	77.0	31.9	16.5	8.3	8.1	30.6	158.5	116.8
	2012	241.1	193.6	252.8	146.3	107.9	48.3	23.2	9.3	6.2	78.2	235.3	270.7
	Average	225.0	134.7	162.4	122.7	66.9	38.4	15.0	10.1	13.7	40.0	171.9	182.4

Table 3. Monthly temperature (C) in Mill, Abernathy, and Germany creeks, 2004-2012. Data are arithmetic monthly mean temperatures measured at Washington Department of Ecology stream gauges 25F060, 25E060, 25D050 respectively. Data not available (---) prior to June 2004.

Watershed	Year	J	F	M	A	M	J	J	A	S	O	N	D
Mill	2004	---	---	---	---	---	14.2	15.6	15.7	12.4	11	7.2	6.4
	2005	5.3	4.7	7.5	8.5	10.7	13.1	14.2	15.0	13.9	10.6	7.0	5.2
	2006	7.3	5.2	6.3	8.3	10.7	12.7	14.3	14.3	12.5	9.1	7.3	6.1
	2007	3.9	5.9	7.4	8.2	10.2	12.2	15.1	15.1	12.6	8.8	6.3	5.9
	2008	4.9	5.6	6.1	7.3	9.1	10.8	13.7	14.3	12.2	8.9	8.0	4.3
	2009	4.8	4.3	6.3	7.6	9.8	13	15.5	15.3	13.3	9.6	7.7	3.9
	2010	7	6.7	6.9	8.0	9.2	10.6	13.4	14.2	13	9.9	7.7	6.7
	2011	6.7	5.7	7.1	7.7	8.6	9.8	12.2	14.8	10.6	10.2	6.4	4.5
	2012	4.9	5.8	5.9	8.2	9.5	11.2	13.8	14.8	12.7	9.4	8.0	8.1
	Average	5.6	5.5	6.7	8.0	9.7	12.0	14.2	14.8	12.6	9.7	7.3	5.7
Abernathy	2004	---	---	---	---	---	14.4	16.3	16.3	12.5	11.4	7.2	6.4
	2005	5.3	4.8	7.6	8.6	11.2	12.6	15	15.1	12	10.1	7.0	5.0
	2006	7.7	9.1	10.7	12.3	13.9	15.3	15.1	14.7	13	9.3	7.6	6.2
	2007	3.7	5.8	7.3	8.3	10.5	12.6	15.7	15.1	13	9	6.3	5.6
	2008	4.3	5.1	5.6	6.5	10.4	11	14.2	14.7	12.7	9.2	7.9	4.2
	2009	4.3	3.7	4.7	7.1	9.4	12.8	15.8	15.4	13.4	9.3	7.0	3.2
	2010	6.2	6	6.4	7.3	8.7	10.2	13.5	14.3	12.6	9.4	6.6	6.0
	2011	5.1	4.3	5.5	6.4	8.5	11.3	13.4	14.8	13.5	9.6	6.0	4.1
	2012	4.4	5.1	5.2	7.6	8.9	10.6	13.7	14.8	12.7	9.1	7.4	6.1
	Average	5.1	5.5	6.6	8.0	10.2	12.3	14.7	15.0	12.8	9.6	7.0	5.2
Germany	2004	---	---	---	---	---	14.9	16.9	16.7	12.8	10.2	7.3	6.4
	2005	5.3	4.9	7.7	8.2	11.1	12.5	15.2	16.4	12.7	11	7.0	5.0
	2006	7	4.9	6.1	8.6	11.2	13.0	16	15.4	13.5	9.8	7.5	5.8
	2007	4.4	5.8	7.2	8.4	10.7	13.2	16.3	15.5	13.4	9.1	6.4	5.4
	2008	4.1	5.0	5.0	6.4	10.6	11.3	15	15.3	13.1	9.5	8.0	4.0
	2009	4.2	4.0	5.0	7.6	10.8	14.1	17.3	16.8	14.7	10.2	7.5	3.6
	2010	6.5	6.4	6.9	7.8	9.3	11.0	14.8	15.8	13.9	10.3	7	6.2
	2011	5.5	4.5	5.8	6.8	9.1	12.2	14.8	16.1	14.8	10.5	6.5	4.4
	2012	4.7	5.4	5.5	8.1	9.6	11.4	15.1	16.3	13.9	9.8	7.8	7.7
	Average	5.2	5.1	6.2	7.7	10.3	12.6	15.7	16.0	13.6	10.0	7.2	5.4

Table 4. Number of habitat sampling locations by watershed in the Lower Columbia (LC) IMW complexes, 2005 to 2012. Watersheds are Mill (ML), Abernathy (AB), and Germany (GR) creeks.

Year	ML	AB	GR
2005	10	8	9
2006	10	10	10
2007	25	24	24
2008	25	24	24
2009	25	24	24
2010	25	24	23
2011	25	26	23
2012	25	26	24
Total	170	166	161

Table 5. Bankfull width, wetted width, and thalweg depth measured in Mill (ML), Abernathy (AB), and Germany (G) creeks in the Lower Columbia IMW. Data are mean and standard deviation (*italic)* for each year and include sites that were sampled more than twice from 2005 through 2011.

	Bankfull width (m)			Wetted width (m)			Thalweg depth (m)		
Year	ML	AB	GR	ML	AB	GR	ML	AB	GR
2005	4.64	7.06	5.60	3.60	5.20	3.92	0.21	0.21	0.18
	3.83	*4.73*	*4.20*	*3.18*	*3.87*	*3.37*	*0.19*	*0.16*	*0.12*
2006	4.89	7.41	6.49	3.54	5.11	3.80	0.21	0.23	0.18
	3.64	*4.79*	*5.87*	*2.88*	*3.85*	*3.86*	*0.16*	*0.17*	*0.17*
2007	5.34	8.08	7.61	3.77	5.14	4.56	0.22	0.25	0.24
	3.63	*5.15*	*5.81*	*2.86*	*3.84*	*4.11*	*0.23*	*0.23*	*0.22*
2008	5.33	8.13	7.74	3.69	5.31	4.78	0.25	0.27	0.25
	3.55	*5.08*	*5.72*	*2.76*	*3.55*	*4.27*	*0.30*	*0.19*	*0.22*
2009	4.96	7.38	6.92	3.54	4.93	4.09	0.22	0.27	0.22
	3.41	*4.84*	*5.06*	*2.65*	*3.58*	*3.60*	*0.18*	*0.19*	*0.22*
2010	4.94	7.43	6.30	3.91	5.65	4.39	0.26	0.28	0.24
	3.49	*5.14*	*4.85*	*3.04*	*4.40*	*3.99*	*0.23*	*0.19*	*0.20*
2011	5.01	7.36	6.44	3.86	5.46	4.76	0.23	0.27	0.26
	3.58	*4.86*	*4.88*	*2.94*	*3.99*	*3.99*	*0.22*	*0.18*	*0.18*
Average	4.39	6.61	5.89	3.24	4.60	3.79	0.20	0.22	0.20

Table 6. Bridging and in-bankfull large wood debris measured in Mill (ML), Abernathy (AB), and Germany (GR) creeks in the Lower Columbia IMW. Data are mean and standard deviation (*italic)* of counts for each year and include sites that were sampled more than twice, 2005 to 2011.

	Bridging Wood			In-Bankfull Wood		
Year	ML	AB	GR	ML	AB	GR
2005	26	9	8	40	33	27
	31	*9*	*7*	*24*	*23*	*13*
2006	21	25	20	55	53	51
	17	*13*	*15*	*36*	*28*	*30*
2007	28	15	18	72	61	56
	27	*14*	*18*	*46*	*35*	*43*
2008	6	3	3	28	19	28
	6	*4*	*4*	*18*	*21*	*23*
2009	8	4	10	25	22	23
	12	*5*	*11*	*15*	*23*	*23*
2010	7	4	5	21	17	27
	10	*5*	*7*	*15*	*20*	*19*
2011	12	6	9	34	31	27
	14	*6*	*11*	*21*	*25*	*26*
Average	13.5	8.25	9.13	34.38	29.5	29.88

Table 7. Pools and side channel frequency in Mill (ML), Abernathy (AB), and Germany (GR) creeks in the Lower Columbia IMW. Data are mean and standard deviation (*italic)* of counts for each year and include sites that were sampled more than twice, 2005 to 2011.

	Pools			Side Channels		
Year	ML	AB	GR	ML	AB	GR
2005	48	29	33	1	0	1
2006	25	32	21	0	0	1
2007	98	83	75	0	1	3
2008	126	97	102	0	3	4
2009	194	154	133	3	7	5
2010	161	137	124	4	4	4
2011	182	154	144	5	3	6
Average	104.3	85.8	79.0	1.9	2.6	3.4

Table 8. Coho parr abundance during the summer rearing period (late August, early September) in Mill (ML), Abernathy (AB), and Germany (GR) creeks, 2005 through 2011. Data are abundance and coefficient of variation (%) by summer rearing year.

	ML		AB		GR	
Year	*N*	*CV*	*N*	*CV*	*N*	*CV*
2005	41,343	25.4%	47,377	22.9%	110,475	37.5%
2006	50,417	20.6%	34,555	21.2%	64,293	25.4%
2007	80,880	22.9%	32,064	23.6%	198,639	27.5%
2008	35,378	18.8%	188,289	37.6%	102,556	28.6%
2009	56,718	18.9%	106,044	27.4%	6,159	12.7%
2010	66,194	22.3%	26,601	18.9%	154,689	33.1%
2011	105,644	37.3%	88,440	29.8%	125,432	27.5%
Median	56,718		47,377		110,475	

Table 9. Biological characteristics of coho parr during the summer rearing period (late August, early September) in Mill (ML), Abernathy (AB), and Germany (GR) creeks, 2005 to 2012. Data are fork length and weight of electrofished parr by summer rearing year (average, 1 standard deviation).

		ML		AB		GR	
Characteristic	Year	Average	SD	Average	SD	Average	SD
Length (mm)	2005	71.3	8.7	74.4	8.3	74.4	8.2
	2006	74.3	8.7	79.9	9.0	78.2	8.2
	2007	72.4	8.8	71.6	9.4	68.3	10.4
	2008	68.7	10.0	73.1	8.1	72.9	8.1
	2009	71.5	10.1	75.4	6.8	72.9	10.2
	2010	72.5	9.6	71.6	9.0	70.3	8.3
	2011	71.5	10.9	72.3	9.1	71.8	9.0
	2012	69.0	9.1	72.2	8.6	78.1	6.5
	Average	71.4	1.8	73.8	2.8	73.3	3.5
Weight (g)	2005	4.4	1.7	5.0	1.6	5.2	2.2
	2006	5.1	1.9	6.2	1.9	5.8	1.8
	2007	4.5	1.7	4.5	2.1	4.3	2.0
	2008	3.8	1.8	3.9	1.6	4.5	1.6
	2009	4.4	1.9	5.0	1.4	4.7	2.0
	2010	4.7	2.0	4.4	1.6	4.4	1.7
	2011	4.4	2.1	4.6	1.7	4.8	1.8
	2012	4.1	1.8	4.6	1.7	5.9	1.4
	Average	4.4	0.4	4.8	0.7	4.9	0.6

Table 10. Biological characteristics of steelhead parr during the summer rearing period (late August, early September) in Mill (ML), Abernathy (AB), and Germany (GR) creeks, 2005 to 2012. Data are fork length and weight for parr > 60 mm FL by summer rearing year (average, 1 standard deviation).

		ML		AB		GR	
Characteristic	Year	Average	S.D.	Average	S.D.	Average	S.D.
Length (mm)	2005	92.8	23.6	91.2	27.7	91.8	27.4
	2006	87.3	24.6	91.8	24.4	89.4	26.7
	2007	83.9	25.7	88.2	23.0	85.1	27.6
	2008	97.4	23.8	98.0	35.4	90.2	29.5
	2009	91.2	22.1	79.6	24.2	81.5	25.3
	2010	93.5	26.8	103.2	32.5	92.1	28.4
	2011	93.0	24.3	92.5	34.4	92.1	29.5
	2012	95.6	24.9	95.7	30.2	85.1	25.3
	Average	91.8	4.4	92.5	7.0	88.4	4.0
Weight (g)	2005	11.1	7.7	11.5	9.5	10.9	9.5
	2006	8.6	6.4	10.1	8.3	9.7	9.1
	2007	8.2	8.8	10.2	9.0	8.5	8.7
	2008	11.0	7.3	14.1	15.2	11.9	11.2
	2009	8.9	5.9	6.4	7.6	9.0	10.2
	2010	11.1	12.0	15.1	14.1	12.1	10.5
	2011	10.5	7.7	12.6	14.5	12.3	11.0
	2012	11.7	7.9	12.0	10.8	10.2	8.9
	Average	10.1	1.4	11.5	2.7	10.6	1.5

Table 11. Juvenile outmigrant abundance during spring outmigration (January – June) from Mill (ML), Abernathy (AB), and Germany (GR) creeks. Data are abundance (N) and coefficient of variation (% CV) for the 2005 through 2012 outmigration.

		ML		AB		GR	
Watershed	Year	*N*	*% CV*	*N*	*% CV*	*N*	*% CV*
Coho	2005	15,170	6.9%	11,764	5.0%	5,033	8.4%
	2006	7,778	3.0%	5,174	5.5%	2,466	4.0%
	2007	12,261	10.4%	5,202	15.4%	2,715	6.9%
	2008	10,930	4.6%	5,699	6.6%	3,826	3.6%
	2009	7,023	4.2%	4,020	6.0%	2,634	7.6%
	2010	13,332	5.2%	4,341	7.9%	1,133	5.0%
	2011	11,425	6.7%	14,268	8.9%	6,744	12.0%
	2012	8,918	10.2%	8,106	10.3%	5,350	21.3%
	Median	11,178		5,451		3,271	
Steelhead	2005	1,279	26.0%	2,409	4.1%	7,309	10.7%
	2006	814	10.3%	2,059	10.5%	3,164	5.3%
	2007	805	9.9%	1,493	16.6%	4,141	4.5%
	2008	1,256	7.5%	1,192	15.2%	3,699	4.6%
	2009	2,097	9.6%	1,624	10.1%	4,887	6.7%
	2010	1,635	8.8%	3,891	6.7%	6,104	4.3%
	2011	1,307	15.5%	5,345	7.6%	4,527	12.5%
	2012	1,760	20.4%	4,516	36.5%	5,145	7.5%
	Median	1,293		2,234		4,707	
Chinook	2005	246,475	5.0%	529,521	5.0%	2,882,618	5.6%
	2006	372,221	2.6%	139,400	3.8%	166,532	2.1%
	2007	20,424	6.3%	4,014	15.1%	977	1.3%
	2008	29,995	9.8%	10,780	13.5%	17,129	7.1%
	2009	7,897	31.4%	408	6.8%	4,318	10.0%
	2010	144,352	3.7%	90,473	3.4%	23,515	7.3%
	2011	263,163	3.1%	155,952	3.3%	162,599	3.1%
	2012	400,590	2.7%	69,572	5.4%	266,272	6.0%
	Median	195,414		80,023		93,057	

Table 12. Biological characteristics of coho smolts during spring outmigration from Mill (ML), Abernathy (AB), and Germany (GR) creeks, outmigration years 2005 to 2012. Data are fork length and weight (average and 1 standard deviation) and median (*) outmigration date. Weight data are not available prior to 2011 (---).

		ML		AB		GR	
Characteristic	Year	Average	SD	Average	SD	Average	SD
Length (mm)	2005	104.0	13.8	102.3	14.4	111.5	14.5
	2006	102.4	13.4	108.3	15.2	110.4	16.4
	2007	100.9	13.4	97.4	17.9	111.1	14.0
	2008	97.3	14.9	112.6	12.8	108.7	14.7
	2009	100.1	13.5	112.3	12.9	109.2	21.0
	2010	100.6	15.0	110.8	15.7	119.3	13.0
	2011	102.7	43.9	105.2	53.8	112.0	15.6
	2012	102.7	33.2	107.3	34.5	112.8	36.9
	Average	101.3	2.1	107.0	5.3	111.9	3.3
Weight (g)	2005	---		---		---	
	2006	---		---		---	
	2007	---		---		---	
	2008	---		---		---	
	2009	---		---		---	
	2010	---		---		---	
	2011	11.7	3.9	12.7	4.5	15.1	5.2
	2012	11.5	3.9	12.6	4.6	15.0	4.7
	Average	11.6	0.1	12.7	0.1	15.2	0.1
Outmigration Date	2005	25-Apr-05	*	10-May-05	*	03-May-05	*
	2006	13-May-06	*	16-May-06	*	14-May-06	*
	2007	09-Apr-07	*	23-Apr-07	*	10-May-07	*
	2008	16-May-08	*	18-May-08	*	21-May-08	*
	2009	23-Apr-09	*	16-May-09	*	18-May-09	*
	2010	06-May-10	*	07-May-10	*	11-May-10	*
	2011	03-May-11	*	04-May-11	*	25-Apr-11	*
	2012	26-Apr-12	*	29-Apr-12	*	22-Apr-12	*
	Median	April 29		May 8		May 10	

Table 13. Biological characteristics of winter steelhead smolts during spring outmigration from Mill (ML), Abernathy (AB), and Germany (GR) creeks, outmigration years 2005 to 2012. Data are fork length and weight (average, 1 standard deviation), and median (*) outmigration date. Weight data are not available prior to 2011 (---).

		ML		AB		GR	
Characteristic	Year	Average	SD	Average	SD	Average	SD
Length (mm)	2005	161.5	20.9	164.4	18	171.4	26.4
	2006	159.7	19.3	161.0	16.3	170.9	21.6
	2007	157.4	20.1	158.6	23.2	172.2	23.8
	2008	153.5	18.9	161.9	20.7	178.2	19.8
	2009	148.9	19.9	162.2	20.1	163.8	22.2
	2010	158.2	20.4	161.6	18.8	167.2	20.2
	2011	160.1	17.3	162.8	16.7	174.4	13.9
	2012	163.9	18.4	157.6	12.6	172.6	17.4
	Average	157.9	4.7	161.3	2.2	171.3	4.4
Weight (g)	2005	---		---		---	
	2006	---		---		---	
	2007	---		---		---	
	2008	---		---		---	
	2009	---		---		---	
	2010	---		---		---	
	2011	40.2	16.2	43.6	22.1	50.4	14.1
	2012	42.0	16.3	38.8	9.2	49.9	17.0
	Average	41.1	1.3	41.2	3.4	50.2	0.4
Outmigration Date	2005	28-Apr-05	*	01-May-05	*	01-May-05	*
	2006	28-Apr-06	*	10-May-06	*	10-May-06	*
	2007	25-Apr-07	*	05-May-07	*	05-May-07	*
	2008	04-May-08	*	15-May-08	*	13-May-08	*
	2009	22-Apr-09	*	04-May-09	*	09-May-09	*
	2010	30-Apr-10	*	07-May-10	*	05-May-10	*
	2011	07-May-11	*	09-May-11	*	06-May-11	*
	2012	24-Apr-12	*	11-May-12	*	02-May-12	*
	Median	April 28		May 8		May 5	

Table 14. Biological characteristics of tule fall Chinook outmigrants during spring outmigration from Mill (ML), Abernathy (AB), and Germany (GR) creeks, outmigration years 2005 to 2012. Data are fork length (average, 1 standard deviation) and median (*) outmigration date.

		ML			AB			GR		
Characteristic	Year	Average	SD		Average	SD		Average	SD	
Length (mm)	2005	40.6	6.8		46.6	15.2		48.2	16.9	
	2006	42.9	9.3		49.0	13.6		52.9	17.2	
	2007	39.0	6.4		37.8	4.7		45.9	9.3	
	2008	40.0	8.5		41.8	9.5		44.6	10.6	
	2009	41.1	9.7		44.8	14.6		46.2	14.3	
	2010	37.9	8.0		37.8	3.8		42.5	12.4	
	2011	38.9	4.9		38.0	2.7		41.6	10.2	
	2012	38.0	3.3		43.0	10.7		44.0	11.0	
	Average	39.8	1.7		42.3	4.3		45.7	3.6	
Median Date	2005	18-Feb-05	*		02-Mar-05	*		06-Mar-05	*	
	2006	08-Mar-06	*		27-Feb-06	*		10-Mar-06	*	
	2007	30-Mar-07	*		07-Mar-07	*		13-May-07	*	
	2008	28-Mar-08	*		01-Apr-08	*		23-Mar-08	*	
	2009	28-Mar-09	*		27-Mar-09	*		05-Apr-09	*	
	2010	01-Mar-10	*		21-Feb-10	*		25-Feb-10	*	
	2011	25-Feb-11	*		04-Mar-11	*		20-Feb-11	*	
	2012	26-Feb-12	*		21-Feb-12	*		17-Mar-12	*	
	Median	March 4			March 3			March 13		

Table 15. Spawner abundance in Mill (ML), Abernathy (AB), and Germany (GR) creeks. Data are abundance and coefficient of variation (%),2005 through 2011 return years. Coefficient of variation (% CV) for each estimate is provided where available.

		ML		AB		GR	
Species	Year	*N*	*% CV*	*N*	*% CV*	*N*	*% CV*
Coho	2005	---	---	---	---	---	---
	2006	---	---	---	---	---	---
	2007	753	---	501	11.6%	239	---
	2008	1,301	---	552	8.8%	271	---
	2009	2,868	---	1,495	7.0%	1004	---
	2010	1,351	---	773	19.3%	507	---
	2011	1,115	---	363	18.2%	95	---
	Median	1,301		552		271	
Steelhead	2005	26	---	116	---	132	
	2006	60	---	154	---	184	
	2007	44	---	200	---	132	
	2008	38	---	248	---	242	
	2009	26	---	302	---	68	
	2010	22	---	218	---	158	
	2011	16	---	156	---	98	
	Median	26		200		132	
Chinook	2005	639	12.7%	797	5.5%	684	5.6%
	2006	384	12.7%	105	34.5%	92	28.9%
	2007	257	19.8%	129	200.2%	88	87.9%
	2008	241	11.3%	49	47.2%	457	4.8%
	2009	1,274	34.2%	348	23.4%	69	38.1%
	2010	1,041	6.0%	407	23.6%	1,128	6.6%
	2011	1,171	5.1%	178	22.4%	445	20.2%
	Median	639		178		445	

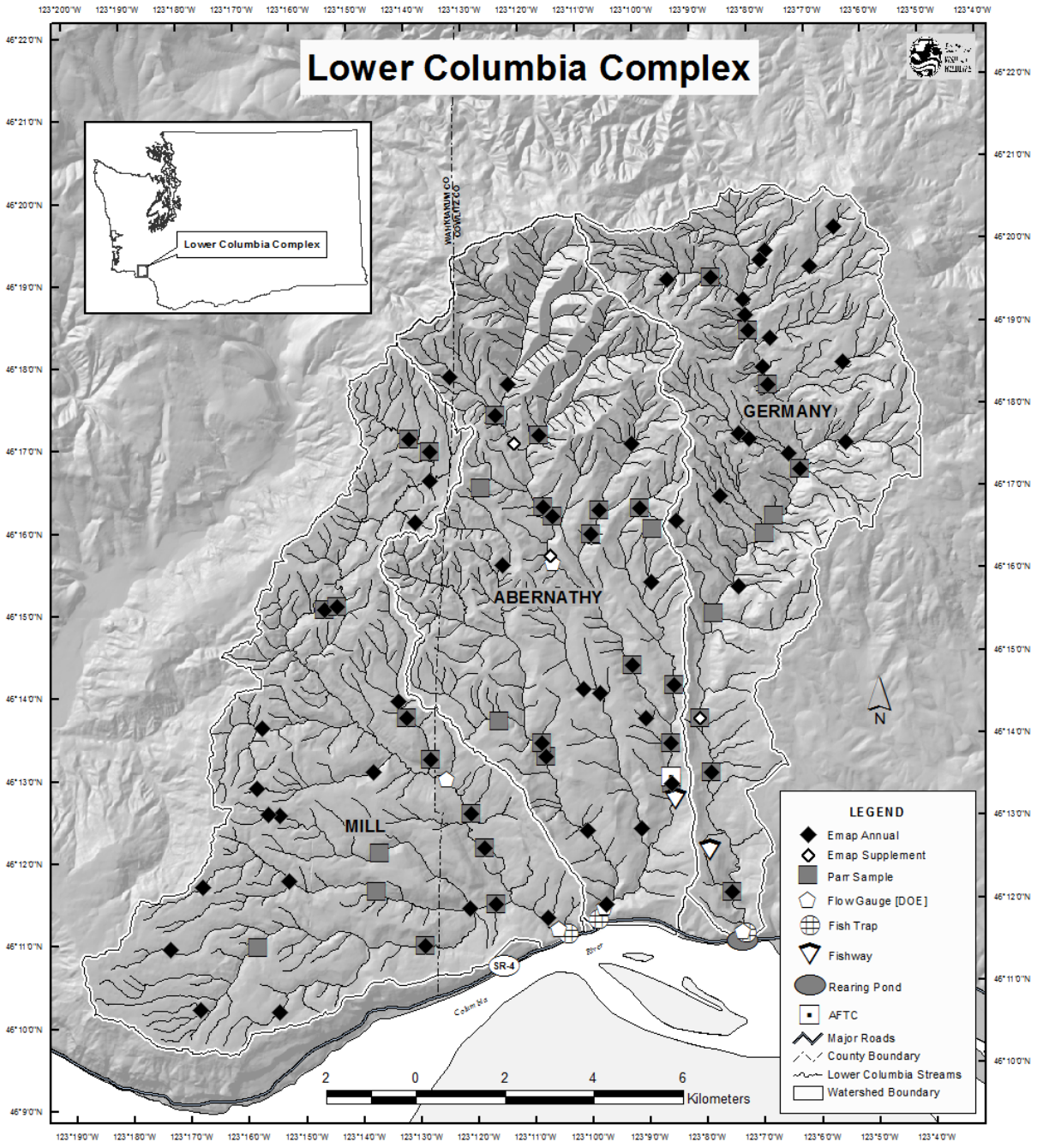

Figure 1. Fish, habitat, and water quality sampling locations in the Lower Columbia IMW Complex (Mill, Abernathy, Germany creeks) in southwestern Washington.

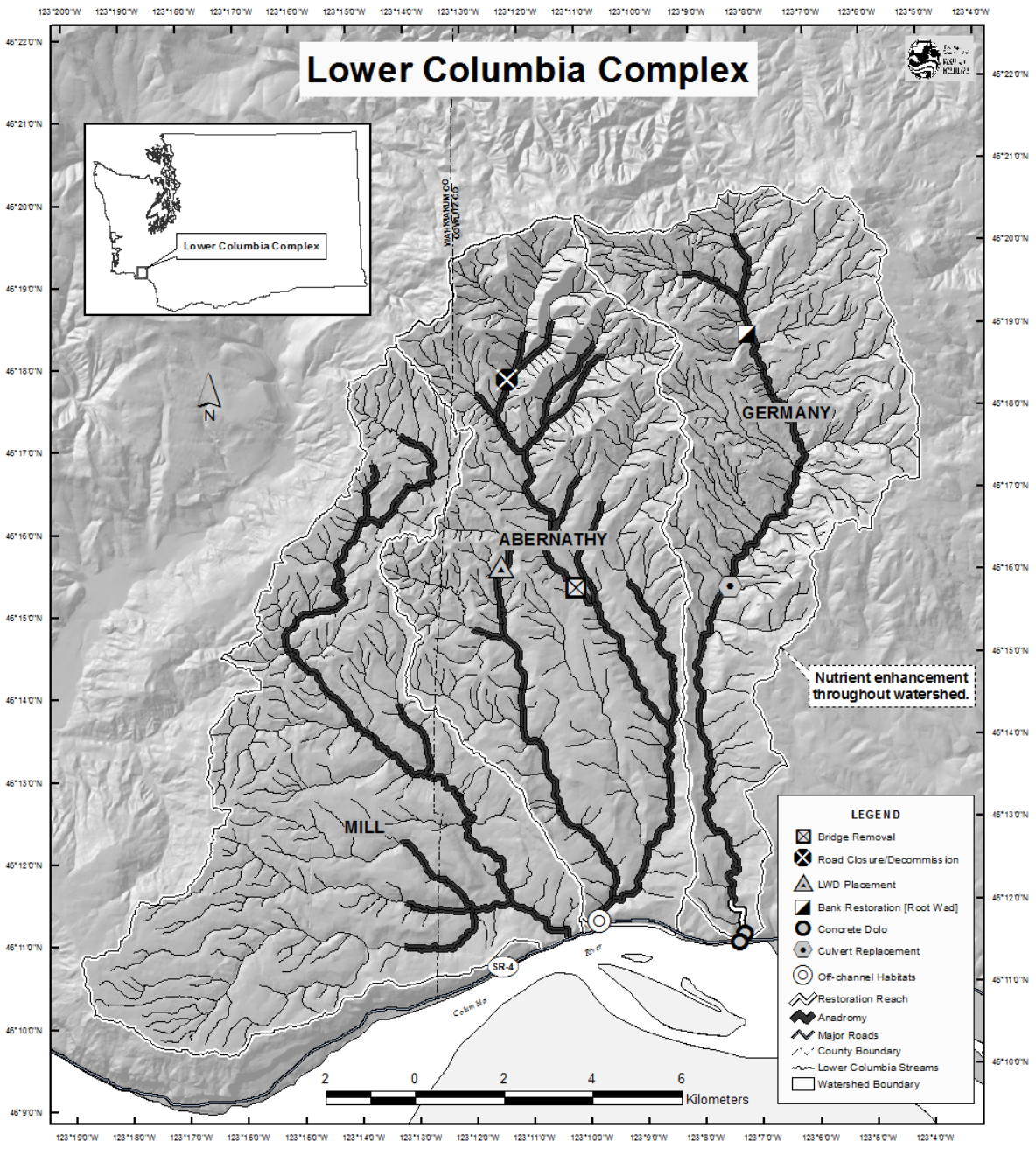

Figure 2. Locations of completed restoration projects and extent of known anadromy for salmonid species in the Lower Columbia Intensively Monitored Watersheds Complex, southwest Washington.

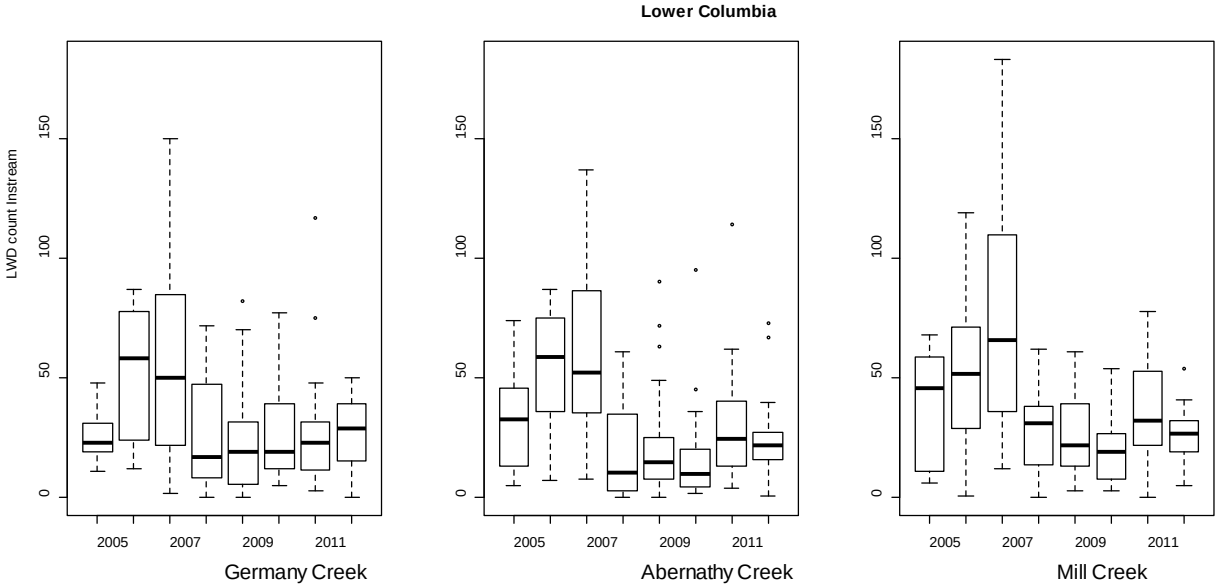

Figure 3. In-bankfull channel large wood debris boxplots of median, quartiles, maximum and minimum and outlier counts in the three Lower Columbia IMW watersheds in 2004 through 2012.

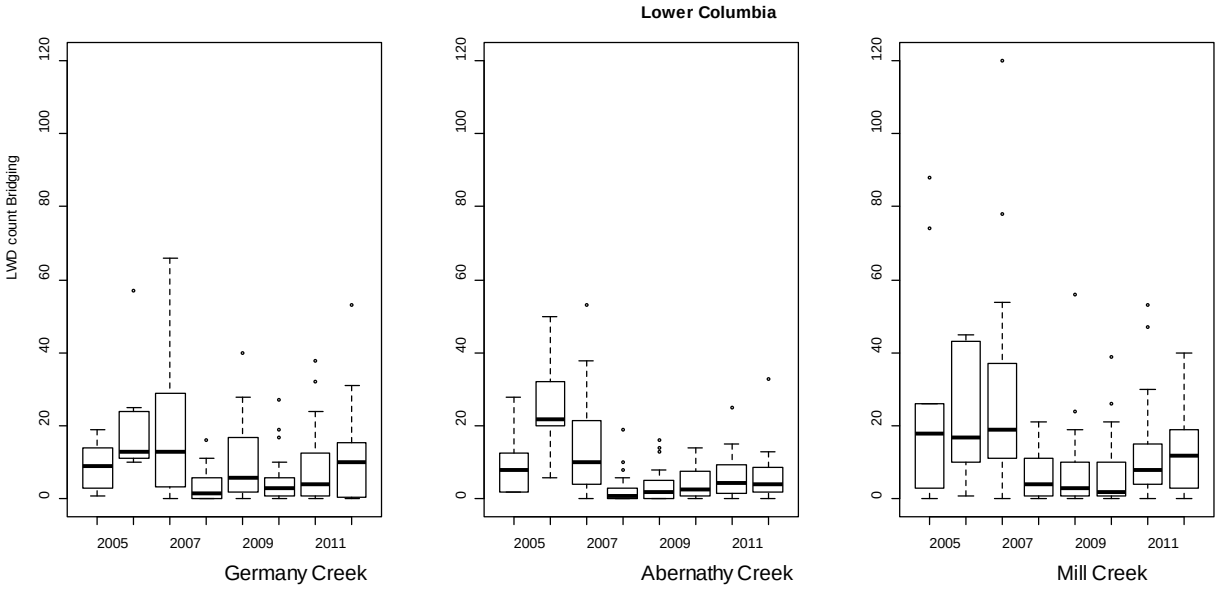

Figure 4. Bridging large wood debris boxplots of median, quartiles, maximum and minimum and outlier counts in the three Lower Columbia IMW watersheds in 2004 through 2012. Bridging LWD crosses stream but is out of the bankfull channel.

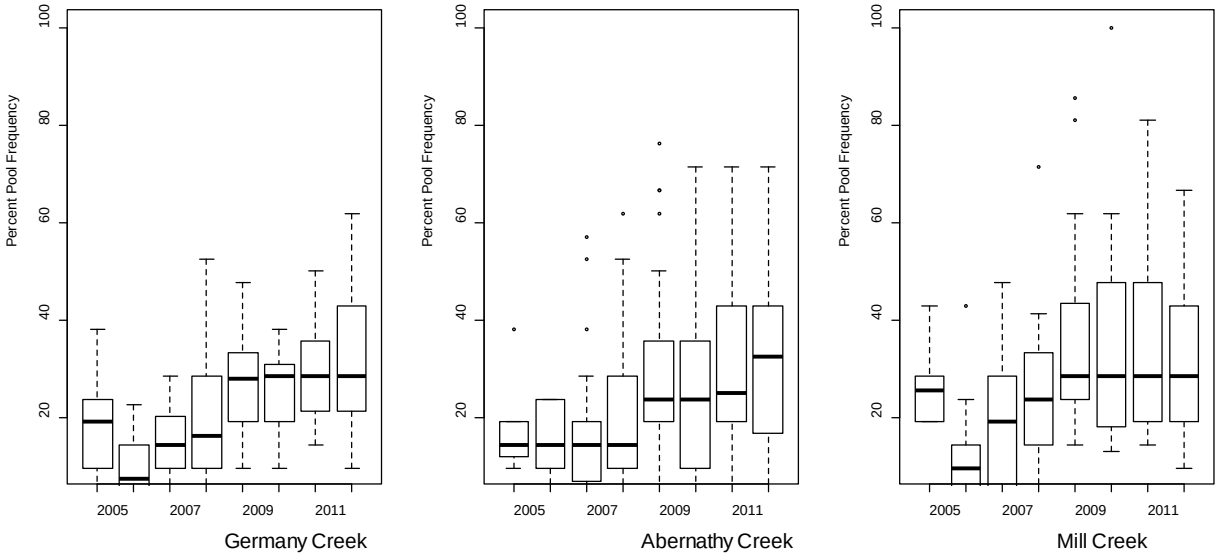

Figure 5. Percent of cross-sections where pools were present in Lower Columbia IMW watersheds. Boxplots of median, quartiles, maximum and minimum and outlier counts, 2004 to 2012.

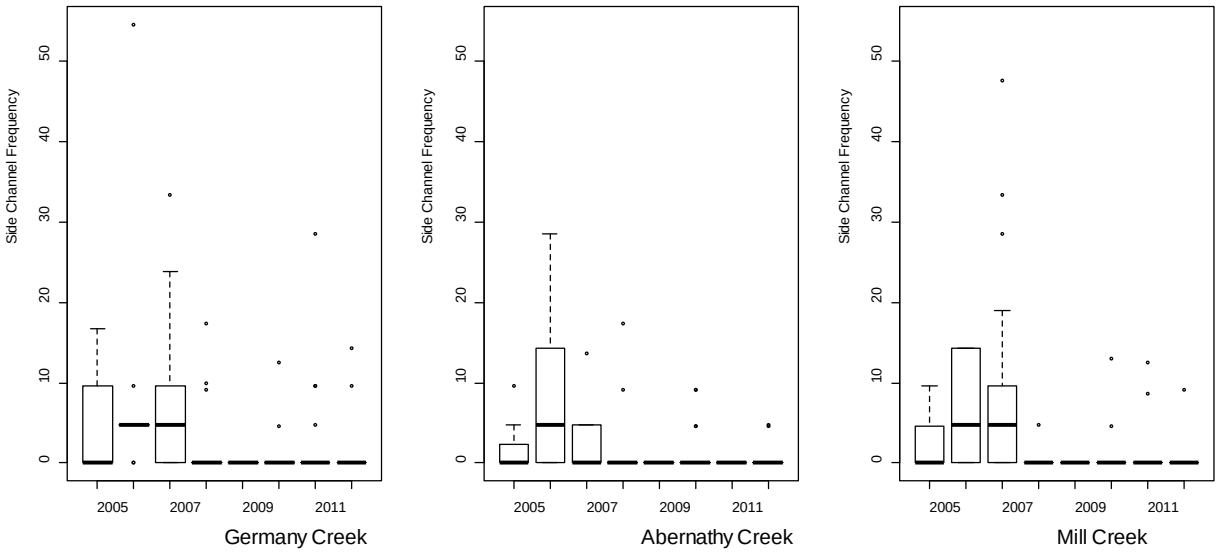

Figure 6. Percent of cross-sections where side-channels were present in Lower Columbia IMW watersheds. Boxplots of median, quartiles, maximum and minimum and outlier counts, 2004 to2012.

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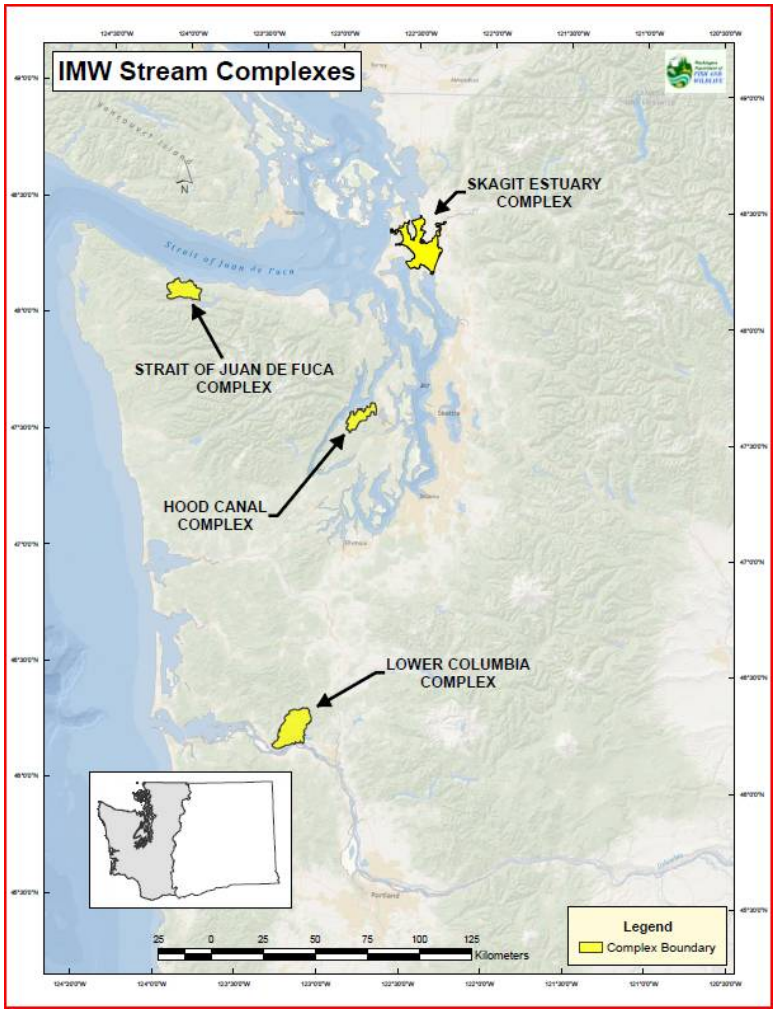
Intensively Monitored Watersheds Synthesis Report

Hood Canal

2013



Prepared for the Salmon Recovery Funding Board

Prepared by the IMW Oversight Committee

IMW Oversight Committee

Eric Beamer – Skagit River Systems Cooperative
Robert E. Bilby - Weyerhaeuser Co.
William J. Ehinger – Washington Department of Ecology
Correigh Greene – Northwest Fisheries Science Center, NOAA
Kirk Krueger – Washington Department of Fish and Wildlife
Mike McHenry – Lower Elwha Klallam Tribe
Timothy Quinn - Washington Department of Fish and Wildlife
Phil Roni – Northwest Fisheries Science Center, NOAA
Mara Zimmerman – Washington Department of Fish and Wildlife

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Executive Summary

The Hood Canal Intensively Monitored Watersheds study evaluates the response of coho salmon to habitat restoration actions. The study focuses on four adjacent watersheds (Little Anderson, Big Beef, Seabeck, and Stavis creeks) which flow out of the Kitsap Peninsula into eastern Hood Canal. The abundance, survival, and distribution of coho salmon are assessed annually at three life stages – spawner, summer parr, and outmigrant. Habitat characteristics, such as large woody debris counts and pool frequency, are quantified on an annual basis. A stream flow gaging station, located on Big Beef Creek, provides an index of seasonal flows for the four watersheds. The study is designed as a before-after control-impact study with Stavis Creek as the control watershed and Seabeck, Big Beef, and Little Anderson creeks as the treatment watersheds. In Little Anderson Creek, completed restoration projects include one culvert replacement and two large woody debris additions. In Seabeck Creek, completed and in-progress restoration projects include three culvert replacements and one undersized bridge replacement. In Big Beef Creek, final plans are being developed to remove bank armoring and reconnect a wetland in the lower watershed. Pre-project monitoring began in 2005 with an additional 14-25 years of outmigrant fish data prior to this time. Post-project monitoring includes three years on Little Anderson Creek. Post-project monitoring on Seabeck Creek will begin in 2013.

Introduction

Since the listing of many populations of salmon in the Pacific Northwest under the US endangered species act beginning in the 1990s, millions of dollars have been dedicated to the restoration of freshwater habitat (NRC 1996). However, little is known about the efficacy of these restoration efforts for increasing salmon production (Roni et al. 2002, Katz et al. 2007). The most effective means of determining the contribution of restoration actions to salmon recovery is to implement experimental, watershed-scale studies (Roni 2005). Such studies are the only means of reliably determining the effectiveness of restoration actions for restoring salmon populations. This document describes the history, goal, methods and current results of such an experiment being conducted in the Hood Canal Intensively Monitored Watershed complex at the request of the Salmon Recovery Funding Board; one of four IMW complexes and experiments in western Washington.

History – Results of the Intensively Monitored Watersheds (IMW) program should have important implications for stream restoration and salmon recovery as well as the direction and funding of future intensive watershed-scale research studies. Although rarely conducted, such intensive, watershed-scale studies provide the foundation of our knowledge about the freshwater habitat requirements of salmonid fishes. Environmental management in North America has been substantially influenced by the results of a few intensive, watershed-scale research studies. For example, land use practices have changed as a result of studies conducted on experimental watersheds such as the H.J. Andrews Experimental Forest in Oregon (e.g., Ackers 2004; http://andrewsforest.oregonstate.edu/index.cfm) and the Hubbard Brook Ecosystem Study in New Hampshire (e.g., Hart 1966; http://www.hubbardbrook.org/). These successful efforts spawned several intensive, watershed-scale studies in the Pacific Northwest to evaluate the response of salmon to forest practices. For example, the Alsea Watershed Study evaluated the response of coho salmon and cutthroat trout to logging methods in several small watersheds on the Oregon coast (Moring and Lantz 1975; http://www.ncasi.org/programs/areas/forestry/alsea/default.aspx). Results from this study provided much of the technical rationale for measures to protect aquatic habitat incorporated into the forest practice regulations of Oregon and Washington in the early 1970s. Similar studies have not been conducted to assess the efficacy of restoration actions on salmonid production, especially in watersheds with urban and rural development.

Following the first petition to list Pacific salmon under the US Endangered Species Act in 1991 the WA state legislature requested a statewide strategy for recovering salmon that included monitoring. In response, in 1999 the "Statewide Strategy to Recover Salmon: Extinction is Not an Option," that made monitoring recommendations, was published. In 2000 the WA state legislature created a Monitoring Oversight Committee (MOC) whose task was to develop a statewide strategy for monitoring watershed health and salmon recovery. In 2002 the MOC published the Washington Comprehensive Monitoring Strategy and Action Plan for Watershed Health and Salmon Recovery (or Comprehensive Monitoring Strategy; CMS). Following recommendations of the Monitoring Design Team (MDT 2002: http://www.rco.wa.gov/documents/monitoring/IMW-1_SRFB_proposal.pdf), who developed a monitoring design for the Forest and Fish Report, the CMS provided a sound rational for the need for and design of Intensively Monitored Watersheds. In 2002, the Government Accountability Office stated that "data to quantify the effects of these [salmon restoration] actions on fish populations are generally not available," (GAO-02-612) but desirable for determining the benefits of expenditures. Also, additional

and better evidence that habitat actions are improving salmon survival was requested in the 2011 judicial review of the Columbia-Snake Basin biological Opinions.

In 2003, the Salmon Recovery Funding Board (SRFB) requested that the Washington Department of Fish and Wildlife and the Washington Department of Ecology review the Salmon Recovery Index Watershed monitoring program and make recommendations toward meeting their goal of evaluating the effectiveness of salmon habitat restoration. These recommendations (SIWMRB 2003; http://www.rco.wa.gov/documents/monitoring/IMW-1_SRFB_proposal.pdf) included were implemented in 2004 and became the IMW Program. In 2006 the SRFB requested review of the IMW Project plan by the Independent Science Panel (ISP ISP 2006; http://www.rco.wa.gov/documents/monitoring/ISP_IMW_Rpt_2006-1.pdf). The ISP found that the IMW Project was "…a state-of-the-art intensive monitoring program to test and validate salmon habitat restoration strategies… [with a] solid scientific conceptual framework, fundamentally robust study designs, and a well-qualified interagency team of scientists…" The ISP also suggested that, "Serious weaknesses include an apparent disconnect between how treatments (i.e., the habitat improvement actions) are selected and funded, in relation to experimental design and monitoring needs, and uncertainty about the duration of the commitment to fund the long term nature of the IMW program."

Goal – The goals of the IMW Program are to determine whether freshwater habitat restoration actions, as currently conducted in Washington state, measurably increase salmonid survival and production and to explain why or why not. The basic premise of the IMW Program is that the complex interactions between salmonids and their habitat can best be understood with concentrated monitoring and research efforts at a few locations.

Methods

The IMW Program was designed to maximize our ability to detect changes in salmon production as a result of habitat restoration treatments while minimizing the probability of detecting spurious treatment effects by using a Before-After-Control-Impact (BACI) study design (Underwood 1991, 1992, 1994, Smith 2002). A BACI study uses one or more non-manipulated sites or watersheds (i.e., reference) as an experimental control to account for variation not due to treatments (Steward-Oaten and Bence 2001), thereby increasing our certainty that changes observed are due to treatments and reducing the time required to detect treatment effects.

The IMW watersheds are carefully selected to fulfill the requirements of the BACI experimental design. While perfect replicates are not possible in field studies (Dutilleul 1993, Scheiner and Gurevitch 2001), we use the fact that salmon population changes in spatially proximate watersheds are often similar (Bradford 1999) to provide reasonable replicate treatment and reference watersheds. We also use measurements of environmental conditions to account for failures to meet the assumptions of the experimental design (Bendetti-Cecchi 2001, Steinbeck 2005) and to strengthen our analyses by elucidating mechanisms that effect production. Our primary objective is to quantify changes in the survival and production of coho salmon and steelhead due to habitat restoration treatments by comparing their survival and production before and after habitat restoration treatments by using a BACI design to control for other environmental factors. Project monitoring can determine if projects have anticipated

effects on habitat and are used by salmon, but they cannot determine whether they increase the survival and production of salmon.

Study Area – The Hood Canal IMW complex is comprised of the Little Anderson, Big Beef, Seabeck and Stavis creek watersheds (Figure 1). Stavis Creek is the control watershed in this complex. The watersheds are located in Kitsap County, western Kitsap Peninsula, Water Resource Inventory Area (WRIA) 15, and flow north into Hood Canal. . Coho salmon are the focal species in this complex. Habitats associated with freshwater rearing of coho salmon vary by life stage as described in Table 1.

The Hood Canal IMW watersheds have relatively low maximum elevation and topographic relief (Table 2). Also as a result of glaciations, the Hood Canal IMW streams initiate in a relatively flat upland plateau with associated wetlands and have relatively steep mid-reaches that decline in gradient near the mouth (Booth et al. 2003). The few relatively high gradient stream reaches are likely sources of bedload that is deposited in lower gradient reaches. Glacial (Vashon) till and alluvium is the dominant geology of these watersheds. Glacial till and alluvium are fairly resistant to erosion, but subsurface flow across less-permeable clay layers creates locations of erosion, especially where crossed by stream channels and roads (Booth and Jackson 1997). Average annual rainfall is 105 cm per year. Substantial flooding that occurred in 2004 and 2007 caused road crossing failures and changes to channel geometry.

The watersheds of the Hood Canal IMW complex were some of the first to be commercially logged in Washington, with logging underway by 1870. Extensive logging of the uplands was conducted in the 1920's through the 1940's. Most of these watersheds have likely been logged more than once. Some evidence for the use of splash dams has been noted in Seabeck Creek and instream large wood was removed through the 1970's. Currently, the majority of each of these watersheds is forested and ownership is a patchwork of public and private land (Krueger et al. 2010, 2012). However, rural residential development is ongoing in all watersheds and urban development is occurring in the Little Anderson Creek watershed. Paved roads cross the creeks near their outlets. Road crossings are relatively rare and most occur at small tributaries (Krueger et al. 2010, 2012). These watersheds are likely affected by historical land uses, including an abandoned railroad grade that appears to contribute substantial sediment (of a range of sizes) to these streams, especially in Big Beef and Seabeck creeks, and ongoing urbanization, especially in Little Anderson Creek.

Restoration Measures – Restoration treatments are primarily selected based on the results of a Limiting Factors Analysis (Kuttle 2003), a channel and sedimentation investigation by Stillwater Sciences (2008) and opportunities identified by the Lead Entities. Restoration treatments were initiated in 2003 with the replacement of a blocking culvert with a spanning bridge on Seabeck Highway over Little Anderson Creek (Figure 2). A relatively small addition of Large Wood Debris (LWD) just upstream of the bridge was completed by the Hood Canal Coordinating Council in 2005 and a large addition of LWD covering much of the main stem was completed by the Hood Canal Salmon Enhancement Group (HCSEG) and Hood Canal Coordinating Council (HCCC) in 2009 (Figure 2). In Seabeck Creek, three blocking culverts were replaced between 2009 and 2012 and an undersized bridge was replaced in 2012. An undersized bridge near the outlet is planned for replacement in 2013. In Big Beef Creek a blocking culvert was repaired in 2008 and final plans are being developed to remove bank armoring and reconnect a large wetland in lower Big Beef Creek (personal communication, Renee Scherdnik, HCSEG). This

project was submitted to the SRFB for funding in 2012, but was not funded. A revised proposal will be submitted in 2013. The HCCC and HCSEG have also cooperated with the IMW Scientific Oversight Committee to help identify restoration actions and priorities and have repeatedly demonstrated support for the IMW Program and cooperated on project monitoring.

Habitat Monitoring – The IMW Project began collecting habitat data in the Hood Canal IMW Complex in 2004, and this complex benefits greatly from the collection of fish and stream flow data and several scientific studies completed in Big Beef Creek starting in the 1970's. The IMW habitat sampling plan and field methods are adapted from the US EPA, Environmental Monitoring and Assessment Program (EMAP, http://www.epa.gov/emap) as described in Peck et al. (draft, http://www.epa.gov/emap /html/pubs/docs/groupdocs/surfwatr/field/ewwsm01.html) and Crawford (2008a, 2008b,2008c) for the SRFB. These methods are recommended in the CMS (Crawford et al. 2002). Additionally, several carefully selected GIS analyses are being conducted to facilitate better understanding of the structure and function of each watershed.

Sampling locations are identified using a random, spatially balanced design (Stevens and Olsen 2004) that is stratified by stream order (Strahler 1954). This allows statistically valid descriptions and comparisons of watersheds. Some sampling locations were changed in 2006 to include a greater number of locations where fish presence is more likely. Preliminary analysis in 2006 suggested that repeated measures sampling, rather than a rotating panel, would allow the collection of more samples in each year and likely provide better change detection via repeated measures analysis. Starting in 2007 at least twenty locations are sampled every year in each watershed in each complex (Table 3). New sampling locations are selected to include the greatest number of previously sampled locations, maintaining the original sampling design. Sampling rotates among watersheds about weekly to minimize seasonal bias (e.g., stream drying as summer progresses).

Samples consist of measures and counts made at and between 21 equally spaced cross sections. Cross sections are positioned along a length of stream that is the longer of either 40 bankfull widths or 300 m. Measurements at each cross-section include bankfull width (0.0 m), wetted width (0.0 m), bar width (0.0 m), bankfull height (0.00 m), water depth (≥5 points 0.00 m), and distance between transects (0.0 m). A compass bearing is taken between transects and can be used to calculate sinuosity. A tally of whether the cross-sections are in pools, riffles or glides is made.

Substrate size class of a randomly selected particle is tallied at each location where depth is measured. Substrate classes include smooth bedrock and rough bedrock, boulder, cobble, coarse gravel, fine gravel, sand, fines, hardpan, wood, and other. If present, the type of pool is noted (e.g., plunge pool). Large wood is tallied by position (bridging or in the bankfull channel) and size class. Large wood size classes are determined by three ranges of diameter and three ranges of length. When found, dry channels are sampled and all possible measurements are made (e.g., depth is not measured). Presence of a backwater or side channel crossed by cross-sections is recorded. The occurrence of fish visually observed is recorded and species are identified is possible.

Project monitoring is also conducted as part of habitat monitoring. When appropriate, we use a protocol similar to that described above to collect data pertinent to detecting site-scale changes to habitat

conditions at and near the locations of restoration actions. Where appropriate, additional information is collected to more precisely measure changes. For example, laser levels were used to precisely measure channel shape at the locations of Large Wood Debris restoration actions in Little Anderson Creek in 2009 and 2010 and fish use is assessed using snorkel surveys and electrofishing.

In the Hood Canal IMW Complex we are also conducting the "Hydrogeology Study" in which additional habitat and fish data are analyzed to better understand the structure and function of each watershed and how the physical (habitat) processes affect the survival and production of coho salmon. This study is designed to identify the specific habitat mechanisms that limit salmon production and survival so that restoration treatments can be specifically directed at those limitations and where they will be most effective. For example, if summer habitat availability or redd scour is limiting production in a watershed during most years, habitat restoration can be directed to increase the availability of summer habitat at locations where parr are usually found or to reduce redd scour where spawning usually occurs.

Fish Monitoring –Coho salmon are the focal species for the population abundance and survival estimates in the Hood Canal IMW watersheds, although steelhead in Big Beef Creek are also included in the annual monitoring efforts. Abundance and biological characteristics are monitored at three life history stages. Parr are collected by electrofishing and seining in index reaches during late summer. Smolts are captured in weirs operated during the spring. Adult escapement is enumerated at the Big Beef Creek weir and estimated for the other three watersheds. Spatial distribution and timing of spawning activity is summarized based on comprehensive spawner surveys on each of the four watersheds.

A probabilistic sampling design was used to assign index sites for summer parr surveys. Parr are collected by electrofishing and seining at ten 50-meter index sites in each creek sampled each summer since 2004 (Figure 1). Densities and biological characteristics of coho and steelhead parr are estimated from these collections. Densities are estimated from a 3-pass depletion study design based on electrofishing collections in each reach (Temple and Pearsons 2007). Biological data collected includes species, life stage (subyearling, yearling+), fork length (mm), and weight (g). Abundance of coho parr at the watershed scale is estimated using a mark-recapture study (Kinsel and Zimmerman 2011). Since 2004, coho parr have been captured and marked in late July and early August and steelhead parr longer than 85-mm fork length (FL) have been PIT tagged. The following spring, all smolts (marked and unmarked) are captured in weirs during the outmigration period. The incidence of marked fish among out-migrating coho smolts was used to back-calculate total watershed abundance of coho parr during the late summer months (Volkhardt et al 2007). Recaptures of tagged steelhead smolts provide a measure of overwinter growth rate.

Outmigrants are captured in creek-spanning weirs operated annually between March and June near the mouth of each creek (Kinsel and Zimmerman 2011). A random subsample of smolts (~10%) are measured and weighed (beginning 2010) each week. Scales are collected from 1 in 3 steelhead smolts and aged by the WDFW Scale Lab. Coded-wire tags, applied to Big Beef Creek coho smolts in good condition, are used to estimate marine survival (escapement and harvest) and smolt-to-adult return rates. All CWT codes are submitted to the Pacific States Marine Fisheries Commission's (PSMFC) Regional Mark Processing Center (RMPC) database.

Adult coho salmon are captured in a creek-spanning weir in Big Beef Creek and the spatial and temporal coho spawner distributions are quantified through spawner surveys conducted bi-weekly over the entire known spawning extent in all four watersheds (October through January). Spawner surveys record the number of live fish, carcasses, and redds observed by 100-m reaches in each watershed. Sex, mark status (ad-clip, no mark), tag status (CWT, no tag), fork length, and scales (age) are sampled from live coho (Big Beef only) and carcasses. Spawning escapement is a direct count of fish passed above the weir in Big Beef Creek and a smolt-to-adult return based estimate in Little Anderson, Seabeck, and Stavis creeks (Kinsel and Zimmerman 2011). Ad-marked (hatchery origin) coho salmon are not passed upstream of the Big Beef Creek weir.

Results

Habitat Monitoring – Preliminary analysis of watershed-wide habitat data supports the use of BACI analyses and comparisons of treatment and reference watersheds in the Hood Canal IMW complex. For example, measures of stream size are similar among the four watersheds (Table 4). When temporal trends or large differences among years are found for an attribute within a watershed, similar patterns are observed for that attribute in the other watersheds in the complex. For example, counts of LWD within the channel appear to be increasing in all Hood Canal IMW watersheds from 2008 through 2011 after an apparent decline from 2007 (Table 5, Figure 3). The apparent decline in LWD from 2007 to 2008 is likely due to a few very large flow events that occurred during winter 2007 – 2008 storms. As might be expected, an associated decline in the number of pieces of LWD bridging the channel is found in all watersheds (Table 5, Figure 4). Relations such as these support the contention that these watersheds are functioning similarly with respect to their dominant physical processes (i.e., the flow of water and sediment) and that they are on similar recovery trajectories and are thus suitable for our analyses.

As anticipated, some habitat attributes, such as pool frequency, are highly variable among years within watersheds and among watersheds (Table 6, Figures 5 and 6). Such differences among years within a watershed and among watersheds and years might help explain differences in salmon survival and subsequent smolt production. When such relations are found they can be used to better direct restoration treatments toward the production of specific habitat types (e.g., pools) that appear to be limiting survival and production. Further, they can be used to account for some natural annual variability in survival and production in statistical analyses (e.g., the BACI analysis) to more quickly and certainly detect treatment effects.

Fish Monitoring – The four Hood Canal IMW watersheds have produced between 95,000 and 405,000 coho smolts annually over the duration of the IMW study (Table 9). Coho smolts are consistently shorter from Stavis Creek (the control watershed) than the other three "treatment" watersheds (Table 8). These differences existing prior to any habitat treatment occurring.

The most notable trend for coho salmon has been the downward trend in spawner abundance in all four watersheds over the IMW project period (Table 10). Since monitoring in Big Beef Creek began in 1978, abundance has trended upwards and downward over time following changes in ocean conditions and marine survival rates (Zimmerman 2012). The recent downward is due to declining smolt-to-adult return rates over the study period (Table 11). Trends in coho spawner abundance are mirrored by a

declining trend in spring smolt production in Little Anderson and Stavis creeks and to some extent Seabeck Creek (Table 7). Big Beef Creek smolt production, however, has not declined over the study period. Indeed, the 2011 production of 57,000 smolts was the highest observed since monitoring began in this watershed in 1978.

Survival from one life stage to the next was parsed between spawner/egg and summer parr and between summer parr and spring smolt. This division represents survival to the life stage associated with summer rearing habitat (egg to summer parr) and the life stage associated with overwinter rearing habitat (parr to smolt). Survival between life stages can be density-dependent (nonlinear or lack of relationship) or density-independent (linear relationship). When density-dependent survival occurs, that life stage and its associated habitat can be identified as an important limiting factor for freshwater production.

Density-dependent survival from the egg-to-parr or parr-to-smolt life stages was not evident in all populations (Figure 7). In Little Anderson Creek, egg-to-parr and parr-to-smolt correlations are linear but highly variable – suggesting that environmental variables are contributing to freshwater production rates irrespective of the number of spawners (Figure 7a, 7b). In Big Beef Creek, the egg-to-parr correlation is clearly density dependent suggesting that summer habitat capacity is limiting in this watershed (Figure 7c, 7d). Parr-to-smolt correlation in Big Beef Creek is linear and a tightly correlated function, indicating that density-independent survival has been relatively consistent across years during the over-winter rearing period. In Seabeck Creek, both egg-to-parr and parr-to-smolt correlations are linear and tightly correlated (Figure 7e, 7f). In Stavis Creek, egg-to-parr correlations are linear (density-independent) while the parr-to-smolt relationship appears to be non-linear suggesting that overwinter rearing habitat is an important limiting factor for coho production in this watershed (Figure 7g, 7h).

Fish-Habitat Relations – Preliminary results of the Hydrogeology Study suggest that different life stages and different habitats are likely limiting survival of coho parr among the four Hood Canal IMW watersheds. For example, while some studies have found that higher stream flows during the spawning period result in greater geographic extent of spawning salmon and, subsequently, greater parr survival and smolt production, we have found little relation between the duration of high flows during the spawning period and the geographic distribution of coho redds. Geographic distribution of coho redds appears much more closely related to the number of spawning coho. Importantly, greater geographic extent of spawning coho does appear to improve smolt production in Little Anderson Creek (Pearson Correlation = 0.91), but the opposite relation is apparent in Big Beef (Pearson Correlation = - 0.90) and Seabeck (Pearson Correlation = - 0.78) creeks. Note that Pearson correlation coefficients range from 1 to -1 whereas R^2 ranges from 0 to 1 for these analyses. Preliminary analyses suggest that perhaps lack of winter refuge habitat (e.g., side channels) or summer habitat (e.g., pools) is limiting production in Big Beef and Seabeck creeks. High variability of coho parr abundance should aid in these analyses (Table 12). The frequency of pools explains a great deal of variability in annual coho smolt production in Big Beef Creek ($R^2 = 0.97$) and Seabeck Creek ($R^2 = 0.86$), but a similar relation has not been found for the other watersheds. Side channels are usually very rare in any of the Hood Canal IMW watersheds (Table 6, Figure 6), but the frequency of side channels explains a large amount of variability ($R^2 = 0.66$) in smolt production in Stavis Creek. Additional analyses and data from at least the production of coho spawned in 2012 will be needed to reliably address such questions.

Discussion

Habitat – Annual habitat monitoring is sufficient to identify trends in several habitat attributes that importantly effect salmon survival and production. The IMW watersheds are relatively small in area, and a large proportion (often greater than 1/3 of stream length) of each watershed is sampled each year. Repeated measure sampling using a precise and easily replicated method improves our ability to detect trends and annual differences (Roper et al. 2003). Also, preliminary analysis of habitat attribute trends suggests that the study design for the IMW Program is fundamentally robust and that the treatment and reference watersheds are on similar trajectories following historical disturbances. Further, identifying some strong relations between annual measures of some habitat attributes and fish survival and production statistics could support the contention that we are monitoring the correct habitat attributes and fish statistics with sufficient precision to detect meaningful changes in habitat and treatment (restoration) effects.

Fish – The life cycle framework for considering life cycle bottlenecks to survival suggested that density-dependent limitations on coho production is occurring in at least two of the four watersheds. For example, in Big Beef Creek, egg-to-parr survival is a density dependent function of the number of spawners. Because this life stage is associated with summer rearing habitat (Table 1), one would look to enhancing these habitats as a means to alleviate bottlenecks to freshwater survival. In comparison, parr-to-smolt survival survival in Stavis Creek appears to be a nonlinear function of parr abundance. Because this life stage is associated with overwinter rearing habitat (Table 1), one would look to enhancing these habitats as a means to alleviate bottlenecks to freshwater survival in this watershed. However, since Stavis Creek is the control watershed for the BACI design, we do not recommend this type of restoration action in the near future.

Conclusions – The habitat and fish monitoring being conducted as part of the IMW Program are being completed as planned and will very likely prove sufficient to address the study questions. Within seven to ten years following the completion of restoration treatments the IMW Program should reliably determine whether restoration treatments increase salmon survival and production and provide valuable guidance that will improve the efficiency of habitat restoration that is intended to increase salmon survival and production. Preliminary analyses suggest that restoration projects are improving habitat conditions and that coho production is responding (Figure 8). However, to ensure the success of the IMW Program and reduce the cost of long-term monitoring, it is imperative that restoration treatments be implemented in the IMW treatment watersheds and that ongoing monitoring continues.

Recommendations – We recommend continuation of habitat and fish monitoring in all four of the Hood Canal IMW watersheds. Opportunities remain to remove at least one culver that is a barrier to fish passage in Little Anderson Creek. Little restoration work has been completed in Big Beef Creek and few relatively inexpensive restoration opportunities are available. However, side channel habitat in lower Big Beef Creek is rare and the project to reconnect existing wetlands near the University of Washington Big Beef Research Station has great potential to improve survival and production of coho in this system. Few restoration projects have been completed in Seabeck Creek, but those that have been completed show promise for addressing the likely bottlenecks to production. Any restoration opportunities, especially

those that restore fish passage and alleviate sediment recruitment (e.g., added upstream roughness and bank vegetation) and sediment transport constriction (e.g., undersized culverts) should be prioritized for implementation.

Table 1. Some life history-stage specific habitat requirements of coho salmon during freshwater rearing. The life stage specific requirements of the fish means that monitoring designs must incorpoate the appropriate spatial and temporal scale of data collection to encompass different life stages and their associated habitat.

Life History Stage	Habitat
Spawning and egg incubation	Gravel bedded riffles and pool tail outs in proximity of cover suitable for adult spawners (e.g., deep pools, undercut banks, debris jams)
Early fry rearing	Low velocity areas with cover in close proximity to food source. Typically associated with shallow, channel margin habitat with cover from wood and overhanging vegetation
Summer rearing	Pool habitat with cover in close proximity to food source. Typically found in low gradient channels with a pool/riffle morphology
Winter rearing	Low velocity areas with cover. Often associated with off-channel habitat on floodplains including low gradient tributaries, secondary channels and ponds

Table 2. Characteristics of Little Anderson (LA), Big Beef (BB), Seabeck (SE), and Stavis creeks in the Hood Canal Intensively Monitored Watersheds study.

Characteristic	LA	BB	SE	ST
Drainage area (km^2)	12.9	36.6	13.3	17.4
Max. Elevation (m)	117	151	113	126
Geology	Quaternary sediment (glacial till and alluvium)			
Ownership	72.9% Private, 27.1% Public			
Mean precipitation	105 cm per year			

Table 3. Number of habitat sampling locations in each year by watershed in the Hood Canal (HC) IMW complex from 2004 through 2012. Watersheds are Little Anderson (LA), Big Beef (BB), Seabeck (SE), and Stavis (ST) creeks.

Year	LA	BB	SE	ST
2004	7	7	9	5
2005	8	12	17	3
2006	8	3	11	10
2007	27	29	27	28
2008	24	21	24	24
2009	22	26	22	28
2010	24	25	23	24
2011	27	28	31	28
2012	26	30	31	27
Total	96	98	110	98

Table 4. Bankfull width, wetted width, and thalweg depth measured in Little Anderson (LA), Big Beef (BB), Seabeck (SE), and Stavis (ST) creeks in the Hood Canal IMW, 2005 to 2011. Data are mean and standard deviation (*italic)* for each year and include sites that were sampled more than twice.

	Bankfull width (m)				Wetted width				Thalweg depth (m)			
Year	LA	BB	SE	ST	LA	BB	SE	ST	LA	BB	SE	ST
2004	3.93	7.06	4.84	5.29	2.65	3.95	1.81	2.64	0.12	0.21	0.08	0.16
	4.07	*5.13*	*2.71*	*3.12*	*3.11*	*3.19*	*2.13*	*2.01*	*0.11*	*0.19*	*0.10*	*0.16*
2005	2.89	4.22	2.84	4.03	1.85	2.13	0.51	1.40	0.10	0.13	0.04	0.07
	1.63	*3.23*	*1.66*	*1.17*	*1.77*	*2.22*	*1.02*	*1.08*	*0.09*	*0.18*	*0.09*	*0.09*
2006	3.17	8.13	3.99	6.22	1.38	4.27	1.06	3.79	0.08	0.26	0.07	0.21
	2.24	*7.07*	*2.10*	*3.26*	*1.03*	*2.88*	*1.30*	*2.77*	*0.08*	*0.22*	*0.12*	*0.19*
2007	3.87	7.81	3.89	6.83	1.80	4.35	1.10	3.56	0.10	0.22	0.06	0.21
	2.25	*6.67*	*1.99*	*4.02*	*1.65*	*4.52*	*1.73*	*2.73*	*0.10*	*0.36*	*0.11*	*0.18*
2008	4.42	8.38	4.88	6.74	1.58	3.52	1.06	3.25	0.10	0.19	0.06	0.18
	2.92	*6.27*	*2.50*	*3.57*	*1.61*	*3.44*	*1.72*	*3.38*	*0.09*	*0.20*	*0.11*	*0.17*
2009	3.20	5.66	4.11	5.92	2.38	3.95	2.43	3.67	0.15	0.23	0.15	0.22
	1.88	*3.91*	*1.93*	*3.77*	*1.53*	*2.60*	*1.91*	*2.63*	*0.08*	*0.18*	*0.12*	*0.17*
2010	3.85	7.30	4.66	6.50	2.09	4.21	1.30	3.65	0.11	0.22	0.06	0.18
	3.32	*4.85*	*2.24*	*3.60*	*2.00*	*3.62*	*1.87*	*3.29*	*0.15*	*0.36*	*0.10*	*0.16*
2011	4.07	6.53	4.17	5.85	2.57	4.96	2.81	4.15	0.15	0.25	0.16	0.23
	2.89	*4.41*	*2.00*	*2.91*	*2.08*	*3.90*	*1.83*	*2.93*	*0.11*	*0.20*	*0.14*	*0.17*
Mean	3.68	6.88	4.17	5.92	2.04	3.92	1.51	3.26	0.11	0.21	0.09	0.18

Table 5. Bridging and in-bankfull large wood debris measured in measured in Little Anderson (LA), Big Beef (BB), Seabeck (SE), and Stavis (ST) creeks in the Hood Canal IMW, 2005 to 2011. Data are mean and standard deviation (*italic)* of counts for each year and include sites that were sampled more than twice.

	Bridging Wood				In-Bankfull Wood			
Year	LA	BB	SE	ST	LA	BB	SE	ST
2004	35	60	27	43	67	89	56	107
	17	*57*	*21*	*18*	*33*	*49*	*34*	*79*
2005	38	40	53	47	125	77	75	122
	15	*39*	*47*	*5*	*100*	*60*	*30*	*44*
2006	27	22	34	30	45	27	42	52
	10	*10*	*21*	*12*	*13*	*15*	*32*	*24*
2007	21	11	21	24	84	86	85	89
	16	*11*	*24*	*14*	*32*	*68*	*37*	*30*
2008	23	18	18	28	58	48	58	73
	13	*16*	*12*	*18*	*23*	*25*	*27*	*21*
2009	26	23	17	34	83	59	57	85
	19	*22*	*15*	*25*	*35*	*40*	*31*	*39*
2010	20	11	14	23	80	74	75	97
	15	*14*	*13*	*18*	*34*	*35*	*52*	*43*
2011	6	8	15	12	128	111	99	136
	6	*16*	*16*	*19*	*60*	*69*	*42*	*45*
Mean	24.5	24.13	24.88	30.13	83.75	71.38	68.38	95.13

Table 6. Frequency of pools and side channels in Little Anderson (LA), Big Beef (BB), Seabeck (SE), and Stavis (ST) creeks in the Hood Canal IMW, 2005 to 2011. Data are mean and standard deviation (*italic)* of counts for each year and include sites that were sampled more than twice.

	Pools				Side Channels			
Year	LA	BB	SE	ST	LA	BB	SE	ST
2004	38	58	51	46	1	3	1	0
2005	21	66	34	16	1	0	0	0
2006	15	11	42	59	0	0	0	0
2007	67	189	76	163	8	13	4	20
2008	43	67	29	78	9	5	6	9
2009	65	142	54	162	0	2	0	0
2010	133	220	105	181	7	3	0	1
2011	69	82	45	97	6	18	0	11
Mean	56.4	104.4	54.5	100.3	4.6	6.3	1.6	5.9

Table 7. Smolt abundance during spring outmigration from Little Anderson (LA), Big Beef (BB), Seabeck (SE), and Stavis (ST) creeks, 2005 to 2012.

Species	Year	LA	BB	SE	ST
Coho	2005	1,969	32,949	2,725	9,667
	2006	1,743	38,579	1,829	8,043
	2007	1,075	29,911	787	6,749
	2008	96	27,416	828	2,850
	2009	1,101	45,399	626	3,474
	2010	214	24,396	496	1,663
	2011	917	57,271	1,153	1,549
	2012	566	20,815	1,030	2,168
	Median	996	31,430	929	3,162
Steelhead	2005	---	1,641	---	---
	2006	---	929	---	---
	2007	---	887	---	---
	2008	---	925	---	---
	2009	---	1,005	---	---
	2010	---	703	---	---
	2011	---	312	---	---
	2012	---	716	---	---
	Median		906		

Table 8. Biological characteristics of coho smolts during spring outmigration from Little Anderson (LA), Big Beef (BB), Seabeck, (SE), and Stavis (ST) creeks, 2005 to 2012. Data are fork length (1 S.D.), weight (1 S.D.), and median outmigration date.

Characteristic	Year	LA	BB	SE	ST
Length (mm)	2005	96.6 (8.1)	103.8 (10.3)	96.0 (9.2)	91.9 (9.3)
	2006	97.5 (7.7)	101.9 (8.0)	96.7 (7.5)	93.3 (8.2)
	2007	96.5 (8.2)	102.5 (10.5)	108.1 (9.5)	93.5 (12.2)
	2008	93.8 (2.7)	105.3 (10.4)	104.3 (9.5)	96.0 (7.6)
	2009	101.6 (8.1)	101.1 (12.6)	95.5 (8.4)	92.6 (7.7)
	2010	117.3 (11.1)	106.3 (14.3)	102.0 (8.0)	95.6 (8.2)
	2011	98.5 (7.9)	105.7 (9.3)	98.0 (8.4)	96.1 (8.8)
	2012	100.4 (9.6)	103.8 (12.0)	100.2 (7.6)	91.7 (9.9)
	Average	100.3 (7.3)	103.8 (1.9)	100.1 (4.5)	93.8 (1.8)
Weight (g)	2005	---	---	---	---
	2006	---	---	---	---
	2007	---	---	---	---
	2008	---	---	---	---
	2009	---	---	---	---
	2010	16.2 (6.8)	12.8 (5.2)	11.4 (2.8)	9.1 (2.4)
	2011	10.3 (2.9)	12.2 (3.4)	10.1 (2.3)	9.7 (2.6)
	2012	11.2 (3.2)	12.4 (6.8)	11.1 (2.6)	8.6 (3.2)
	Average	12.6 (3.2)	12.4 (0.3)	10.9 (0.7)	9.1 (0.6)
Median Out Date	2005	06-May	30-Apr	04-May	01-May
	2006	11-May	09-May	10-May	11-May
	2007	13-May	04-May	09-May	13-May
	2008	17-May	13-May	10-May	20-May
	2009	14-May	10-May	09-May	12-May
	2010	08-May	02-May	29-Apr	12-May
	2011	09-May	15-May	10-May	20-May
	2012	10-May	08-May	07-May	03-May
	Average	11-May	07-May	07-May	11-May

Table 9. Biological characteristics of steelhead smolts from Big Beef Creek, 2005 to 2012. Data are fork length (1 S.D.), weight (1 S.D.), median outmigration date, and percent age 1, 2, and 3 year old smolts during the spring outmigration.

Year	Length (mm)	Weight (g)	Median Outmigration Date	Percent Age 1	2	3	4
2005	200.8 (33.2)	---	25-Apr	---	---	---	---
2006	180.9 (15.8)	---	17-Apr	---	---	---	---
2007	181.4 (25.2)	---	23-Apr	---	---	---	---
2008	171.8 (17.2)	---	29-Apr	---	---	---	---
2009	164.3 (23.2)	---	23-Apr	20.2	50.0	29.8	0.0
2010	176.1 (21.2)	55.0 (16.9)	18-Apr	1.5	83.6	10.4	4.5
2011	176.1 (27.6)	55.8 (23.0)	27-Apr	11.7	64.9	20.8	2.6
2012	173.0 (21.7)	53.9 (21.7)	22-Apr	Data not yet available			
Average	178.1 (10.7)	54.9 (0.9)	23-Apr	11.1 (9.3)	66.2 (16.8)	20.3 (9.7)	2.4 (2.3)

Table 10. Coho spawners in Stavis, Seabeck, Big Beef, and Little Anderson Creeks, return years 2003 to 2011. Data are the estimated escapement (N) into these watersheds and the number of redds, live coho, and carcasses observed during bi-weekly surveys. Big Beef Creek escapement is the number of coho released above the weir.

Year	LA	BB	SE	ST
2003	56	4,925	313	1,469
2004	39	4,224	247	1,180
2005	23	1,186	102	411
2006	24	529	30	114
2007	49	1,219	51	230
2008	17	536	16	116
2009	5	943	34	118
2010	9	412	10	41
2011	9	782	16	42
Median	23	943	34	118

Table 11. Summary of coho spawner data from Big Beef Creek weir, return years 2003 to 2011. Data for coho passed upstream to spawn are the number of females, males, and jacks. Data for fish returning to the weir are proportion of hatchery origin coho (pHOS), smolt-to-adult return rate (SAR), and the marine survival ([escapement + harvest]/smolts). Hatchery coho are not passed above the weir to spawn in Big Beef Creek.

	Passed Upstream to Spawn			Returns to the Weir		
Year	Female	Male	Jack	pHOS	SAR (%)	MS (%)
2003	2,147	2,500	278	6.7%	18.32%	19.97%
2004	2,041	1,932	251	5.2%	12.64%	22.22%
2005	624	497	65	14.3%	4.16%	15.72%
2006	238	171	120	6.9%	0.78%	5.24%
2007	659	531	29	1.5%	2.66%	11.30%
2008	220	221	95	2.6%	1.48%	4.18%
2009	525	388	30	4.1%	3.88%	13.40%
2010	131	87	194	9.5%	0.59%	2.03%
2011	343	261	178	13.6%	1.78%	7.38%

Table 12. Coho parr abundance during the summer rearing period in Little Anderson (LA), Big Beef (BB), Seabeck (SE), and Stavis (ST) creeks, 2004-2011. Data are abundance (*N*) and associated coefficient of variation (*CV*).

	LA		BB		SE		ST	
Year	*N*	*CV*	*N*	*CV*	*N*	*CV*	*N*	*CV*
2004	18,014	15.6%	244,516	8.3%	40,276	9.5%	102,487	10.4%
2005	21,927	18.0%	247,920	5.7%	16,619	9.0%	60,870	8.7%
2006	4,517	10.8%	141,546	5.5%	4,492	10.0%	26,420	5.9%
2007	11,209	43.6%	171,430	7.2%	10,319	10.3%	59,664	11.4%
2008	9,123	12.0%	224,097	5.2%	7,541	10.1%	29,727	9.8%
2009	---	---	83,499	5.0%	1,525	11.0%	10,414	10.5%
2010	4,107	12.9%	290,089	6.5%	8,891	9.2%	13,650	12.3%
2011	2,467	15.2%	91,351	5.8%	4,579	7.6%	7,243	10.7%
Median	9,123		197,764		8,216		28,074	

Table 13. Biological characteristics of coho parr during the summer rearing period in Little Anderson (LA), Big Beef (BB), Seabeck (SE), and Stavis (ST) creeks. Data are parr fork length (1 S.D.) and weight (1 S.D.). for summer rearing years 2004 to 2012.

Characteristic	Year	LA	BB	SE	ST
Length (mm)	2004	---	---	---	---
	2005	52.5 (8.5)	53.3 (8.7)	56.8 (9.3)	50.1 (8.7)
	2006	56.8 (6.6)	57.0 (9.0)	59.0 (10.8)	59.2 (8.7)
	2007	56.7 (7.3)	58.9 (8.3)	63.0 (9.6)	57.9 (10.6)
	2008	54.2 (7.7)	54.9 (9.1)	55.8 (6.9)	57.1 (6.6)
	2009	---	61.3 (7.4)	64.5 (6.0)	62.7 (6.6)
	2010	69.0 (5.6)	61.9 (9.0)	65.6 (5.4)	66.0 (5.8)
	2011	60.4 (5.9)	58.7 (7.6)	66.0 (4.8)	64.3 (6.4)
	Average	58.2 (5.9)	58.0 (3.2)	61.5 (4.3)	59.6 (5.3)
Weight (g)	2004	---	---	---	---
	2005	1.9 (1.1)	1.9 (1.0)	2.4 (1.2)	1.6 (1.0)
	2006	2.1 (0.8)	2.4 (1.2)	2.7 (1.6)	2.5 (1.1)
	2007	2.1 (0.9)	2.7 (1.1)	3.2 (1.5)	2.6 (1.4)
	2008	1.9 (0.8)	2.0 (1.0)	2.0 (0.8)	2.1 (0.8)
	2009	---	2.9 (1.1)	3.2 (0.9)	2.9 (0.9)
	2010	3.9 (1.0)	3.0 (1.5)	3.3 (1.0)	3.5 (1.0)
	2011	2.6 (0.8)	2.7 (1.2)	3.7 (0.8)	3.2 (1.0)
	Average	2.4 (0.8)	2.5 (0.4)	2.9 (0.6)	2.6 (0.6)

Table 14. Length and weight of steelhead parr during the summer rearing period in Big Beef Creek. Data are fork length (1 S.D.), weight (1 S.D.) for parr > 60 mm FL by summer rearing years 2005 through 2011.

Characteristic	Year	Average	S.D.
Length (mm)	2005	111.1	27.2
	2006	100.9	36
	2007	108.2	14.6
	2008	107.9	19.3
	2009	122.2	15.1
	2010	118.4	27.1
	2011	120.8	24.4
	Average	112.8	7.3
Weight (g)	2005	16.6	9
	2006	15.2	16.8
	2007	14.4	5.8
	2008	14	11.2
	2009	21.7	8.4
	2010	20.6	17.7
	2011	22.1	21.9
	Average	17.8	3.6

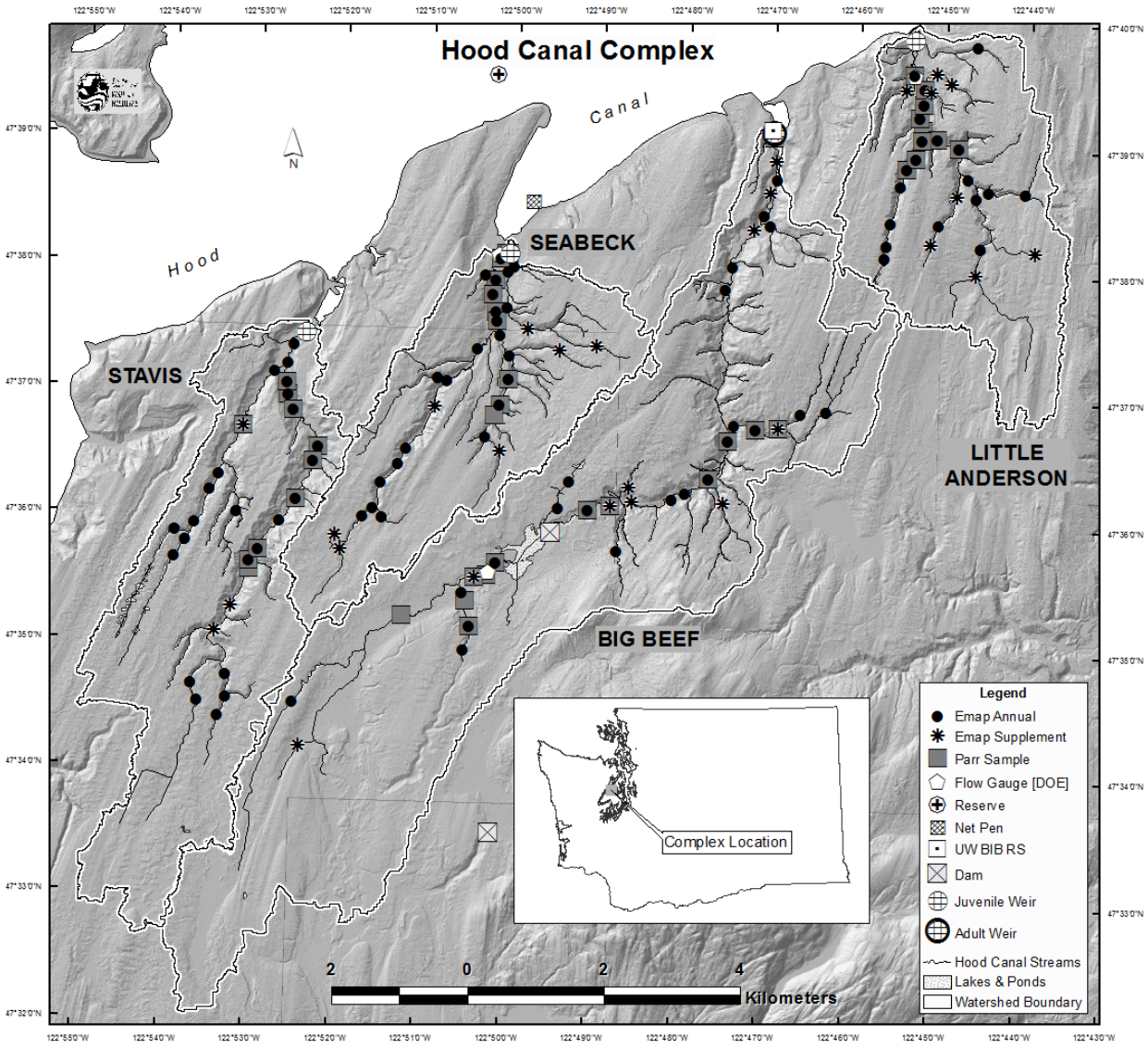

Figure 1. Fish, habitat, and water quality sampling locations in the Hood Canal IMW Complex (Little Anderson, Big Beef, Seabeck, and Stavis creeks) in western Washington. Topography is depicted using LiDAR data collected in 2001 by the Puget Sound LiDAR Consortium.

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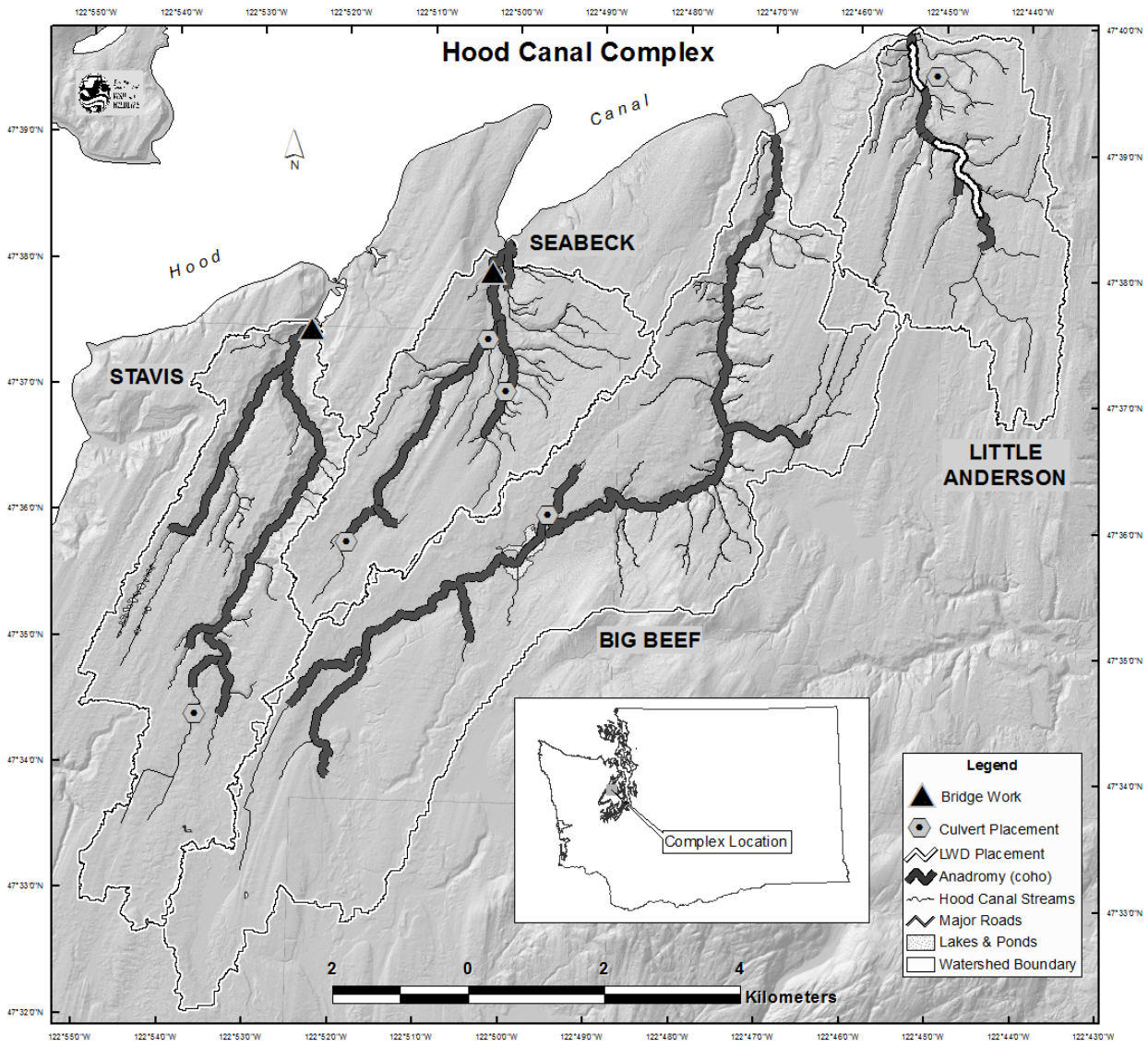

Figure 2. Locations of restoration projects and extent of known anadromy in Little Anderson, Big Beef, Seabeck, and Stavis creeks, the Hood Canal Complex, Washington. Note that roads and other attributes are not shown for clarity.

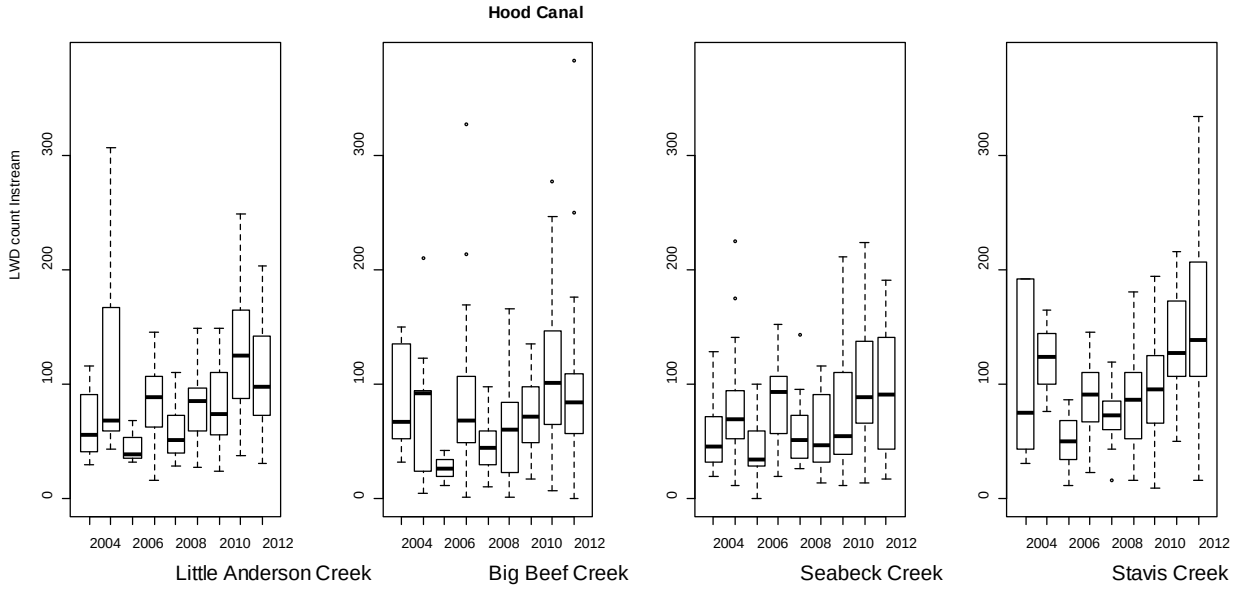

Figure 3. In-bankfull channel large wood debris in the four Hood Canal IMW watersheds, 2004 to 2011. Boxplots of median, quartiles, maximum and minimum and outlier counts are shown.

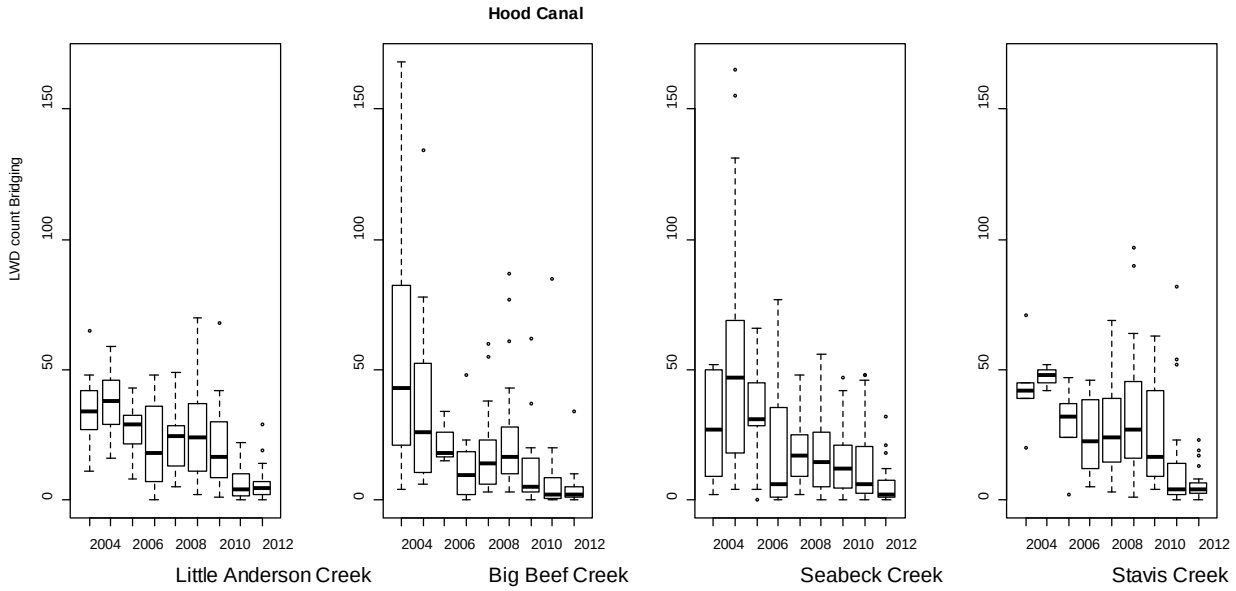

Figure 4. Bridging large wood debris in the four Hood Canal IMW watersheds, 2004 to 2011. Bridging LWD crosses stream is out of the bankfull channel. Boxplots of median, quartiles, maximum and minimum and outlier counts are shown

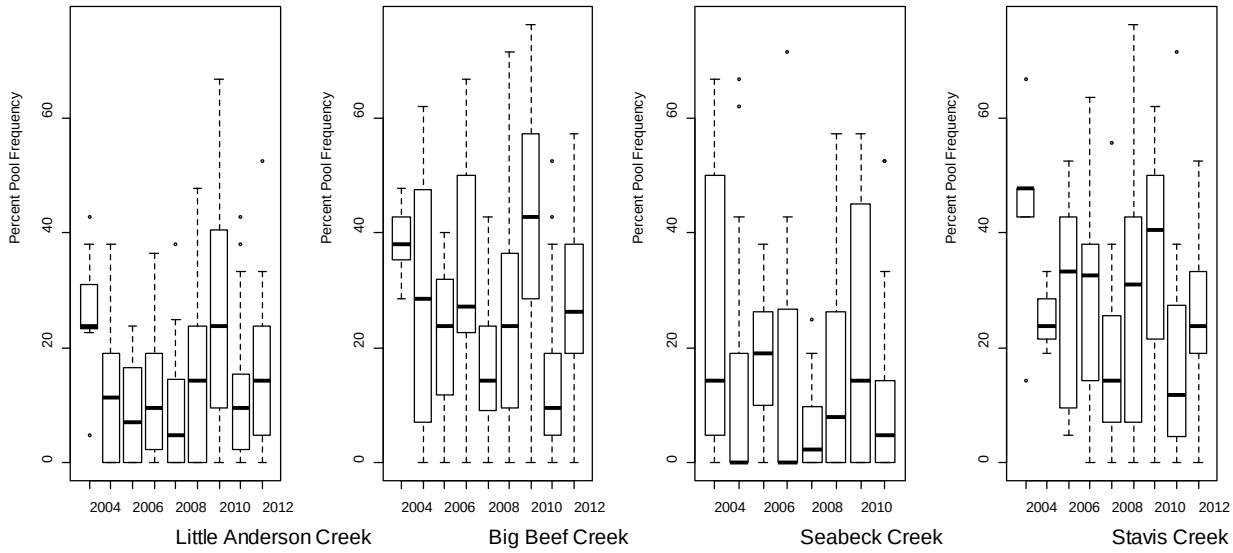

Figure 5. Percent of cross-sections where pools were present in four Hood Canal IMW watersheds, 2004 to 2011. Boxplots of median, quartiles, maximum and minimum and outlier counts are shown.

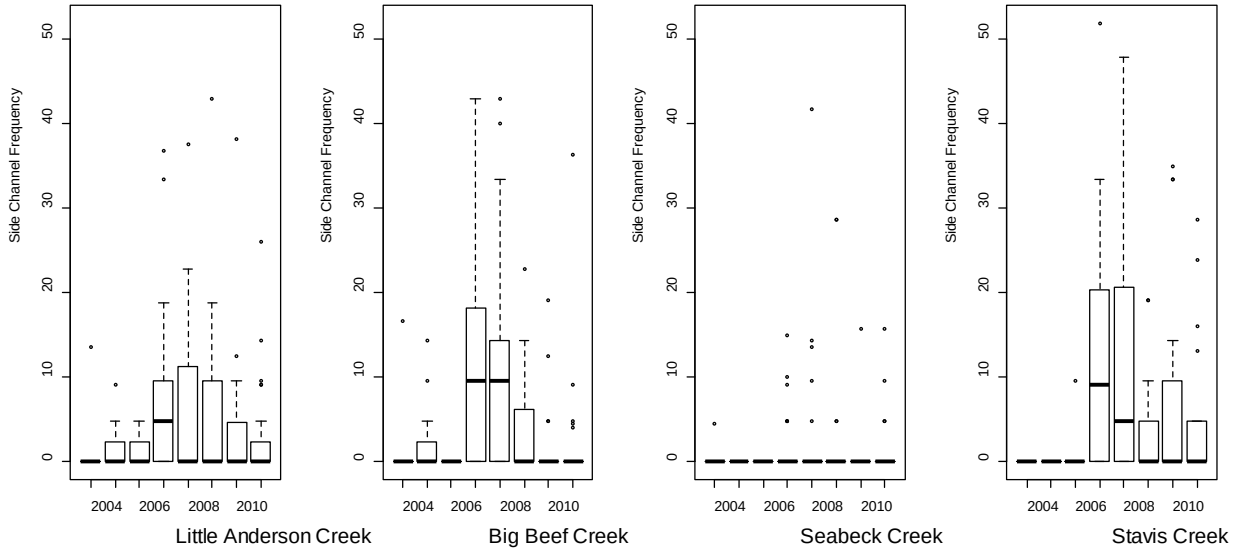

Figure 6. Percent of cross-sections where side channels were present in four Hood Canal IMW watersheds, 2004 to 2011. Boxplots of median, quartiles, maximum and minimum and outlier counts are shown.

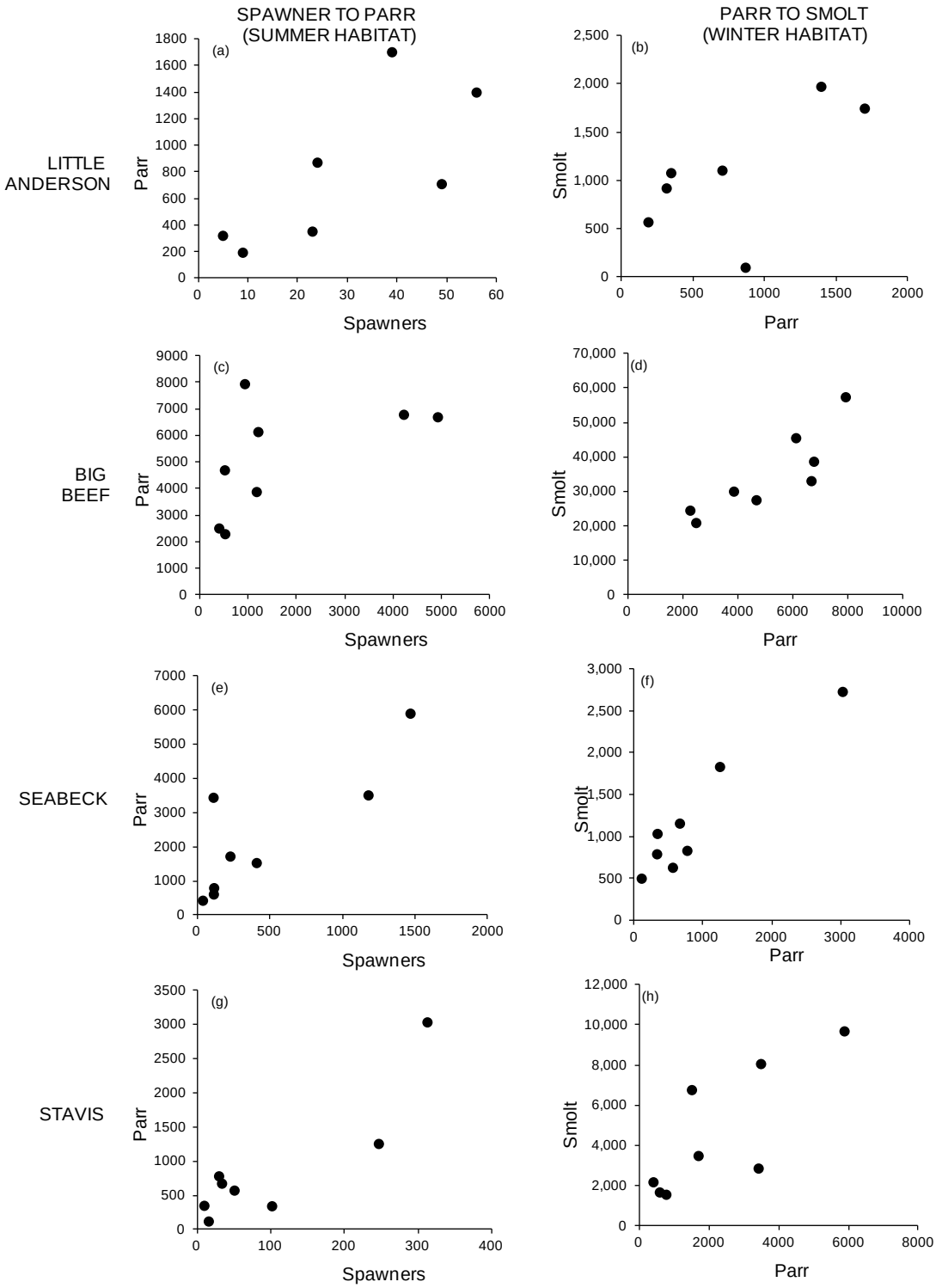

Figure 7. Life stage specific recruitment curves for coho salmon in the Hood Canal IMW complex. Coho spawner (egg) to summer parr curve represents survival in the summer rearing habitat. Coho parr to smolt curve represents survival in the winter rearing habitats. A linear relationship indicates density-independent survival and a curvilinear relationship indicates density dependent survival during the given life stage.

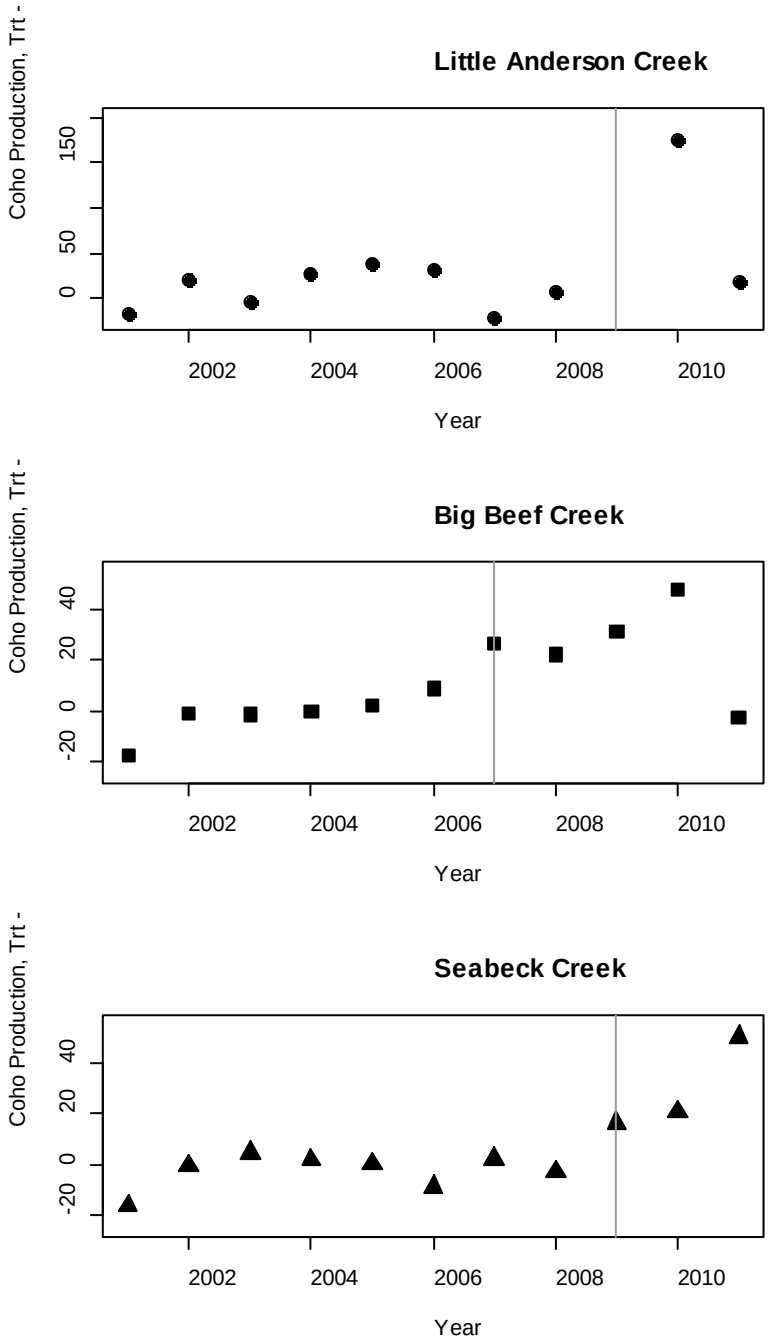

Figure 8. Annual number of smolts per spawner in Little Anderson, Big Beef and Seabeck creeks adjusted for the annual number of smolts per spawner in Stavis Creek (reference watershed) from 2001 through 2011. Vertical lines indicate the year in which substantial restoration treatments were initiated.

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