U.S. Fish and Wildlife Service

Fisheries Collaboration with National Wildlife Refuges

FY2016 Progress Report

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On the cover: *Tidal slough adjacent to the Little Nestucca River, Nestucca Bay National Wildlife Refuge, Oregon (Photo: S. Lohr).*

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FISHERIES COLLABORATION WITH NATIONAL WILDLIFE REFUGES
FY2016 PROGRESS REPORT

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Executive Summary – The missions of National Wildlife Refuges (NWRs) and the Columbia River Fish and Wildlife Conservation Office (CRFWCO) share several complementary elements concerning aquatic species and habitats. Thus, the goal for CRFWCO activities with NWRs is to conduct cooperative work in an efficient and effective manner to conserve aquatic resources. Objectives were to: 1) Continue to conduct annual meetings to exchange information and coordinate among NWRs, CRFWCO, Fish and Aquatic Conservation Program (FAC), and other Service programs; 2) Assist in the development of Comprehensive Conservation Plans (CCPs) for various NWRs; 3) Conduct field-based activities contributing to conservation of aquatic resources at NWRs; 4) Provide analytical technical assistance and reviews on aquatic resources for NWRs; 5) Establish sentinel sites at NWRs to assess evidence of climate change in physical attributes and aquatic communities in streams; 6) Ensure data generated through collaborative work is managed and reported according to the Region 1 Information Management Strategy; and 7) Disseminate to the public the work and findings of collaborative efforts between CRFWCO/FAC and NWRs through development and publication of annual reports. For Objective 1, the CRFWCO and R1 Refuge Branch of Biology organized and hosted a workshop that was attended by 44 individuals in FY2016. Notes and actions items were developed. For Objective 2, the CRFWCO responded to requests from the I & M Initiative to assist with the preparation of Inventory and Monitoring Plans, which were supportive of CCPs. For Objective 3, the CRFWCO conducted or assisted with two projects involving field-based activities contributing to conservation of aquatic resources at NWRs. These were: post habitat restoration assessment of fish at Nestucca Bay NWR, and fish species inventory at McFadden's Marsh, W.L. Finley NWR. For Objective 4, the CRFWCO provided non-field-based technical assistance for several short-term activities (e.g., reviews of literature and habitat restoration documents). For Objective 5, FAC, R1 Refuges, NWRs, and Water Resources previously initiated the pilot project to develop and implement a long-term aquatics monitoring program for climate change at NWRs, and implementation in the field was continued during FY2016. For Objective 6, a data management plan template was completed and database development is underway. For Objective 7, progress reports have been developed to disseminate information about our collaborative efforts and aquatic resources.

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Introduction

The U.S. Fish and Wildlife Service (USFWS) is increasing interaction and collaboration among its programs, which is reflected in various plans. For instance, the Fish and Aquatic Conservation(FAC) Program strategic plan notes work within USFWS (i.e., among programs) to conserve aquatic species (USFWS 2015), the Pacific Region Fisheries Program Strategic Plan supports cross-program collaboration to provide varied expertise for aquatic habitat conservation and management issues (USFWS 2008; see Regional Objectives 2.1-2.4 relative to cross-program collaboration), and the National Wildlife Refuge System has committed to working with programs throughout the USFWS and other conservation partners to achieve shared conservation goals (USFWS 2011). Capitalizing on diverse expertise and achieving shared conservation goals among programs, including associated field stations, and other partners ultimately improves efficiency of the USFWS, potentially allowing the USFWS to expand conservation delivery.

The Columbia River Fish and Aquatic Conservation Office (CRFWCO) has a history of working with National Wildlife Refuges (NWRs), primarily within its geographic area of responsibility (i.e., Columbia River basin below McNary Dam, waters in Oregon excluding the Klamath River basin, and small tributaries of Willapa NWR; see Figure 1), on aquatic resource issues. This work history has contributed to the missions of both the CRFWCO and NWRs. The mission of the CRFWCO is to:

- Assist in the status review of imperiled natural stocks;
- Evaluate management measures for recovery;
- Assist in recovery efforts for imperiled stocks; and
- Work to prevent the need for future listings under the Endangered Species Act.

The mission of the NWR system is: "To administer a network of lands and waters for the conservation, management and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." The mission, as well as administrative processes and guidance for determining management direction of NWRs, was included in the National Wildlife Refuge System Improvement Act of 1997, which amended earlier legislation. The legislation mandated that wildlife and wildlife conservation must come first in administering the system. Several policies and Director's Orders have been developed to assist in complying with the provisions of the legislation.

In applying NWR policies and orders, overall management direction and specific activities on each NWR, or individual management unit of a NWR, are determined by several factors. The foremost factor is that management achieves the purposes for which a NWR or unit was established, and in so doing, contributes to fulfilling the NWR System mission. Implicit within fulfilling the NWR System mission is the maintenance and, where appropriate, restoration of biological integrity, diversity, and environmental health of NWRs, as well as management of legislatively mandated trust species. Trust species include migratory birds, inter-jurisdiction fish, some marine mammals, and species listed under the federal Endangered Species Act. The relations among NWR purpose, NWR System mission, directives, and legislative mandates influence management goals, objectives, and strategies described in Comprehensive Conservation Plans (CCPs) developed for each NWR.

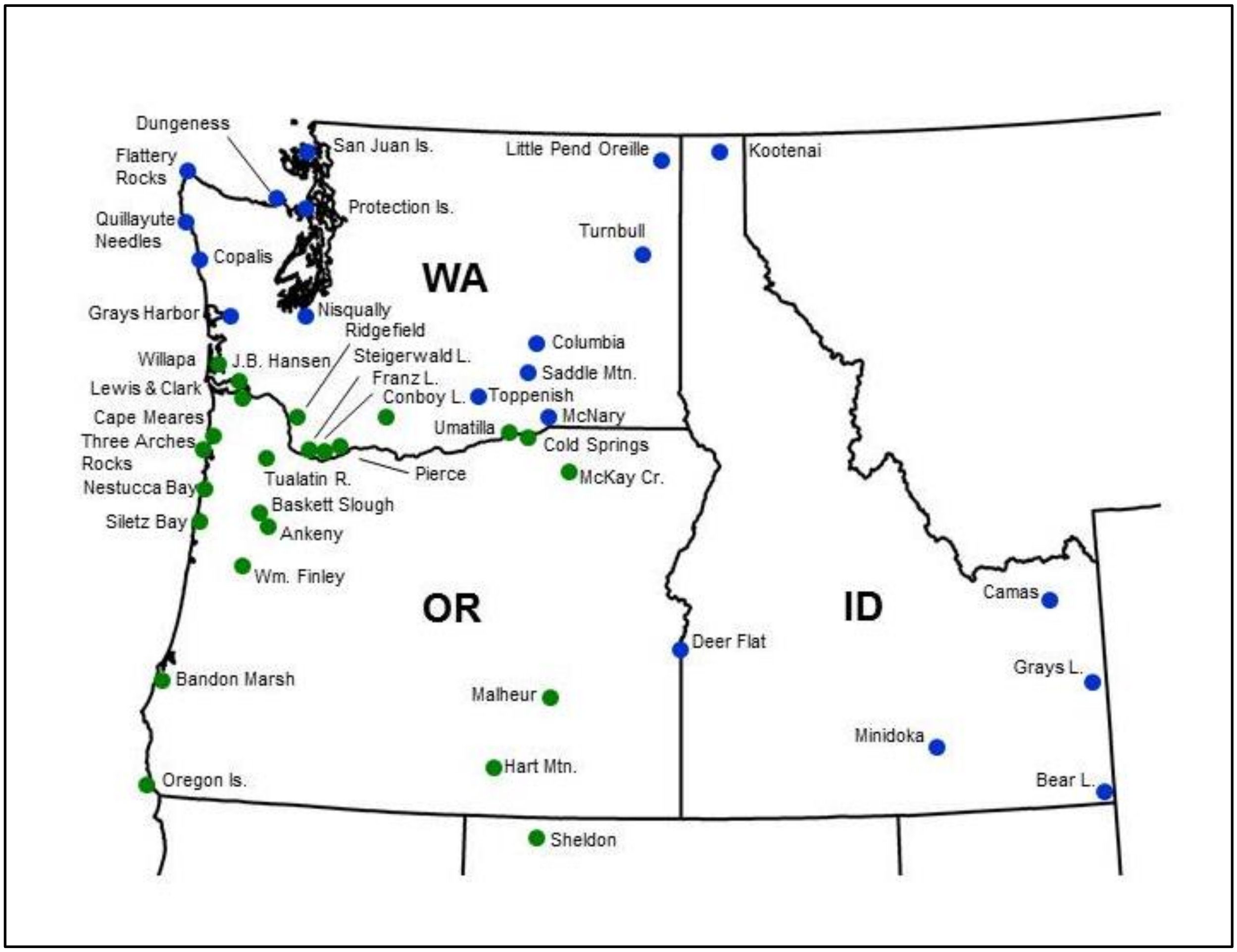

Figure 1. Locations of National Wildlife Refuges in Idaho, Oregon, and Washington within the general geographic area of responsibility of the CRFWCO (green circle) and outside the general area of responsibility (blue circle).

The missions of NWRs and the CRFWCO share several complementary elements. These concern aquatic species and habitats that may be subject to the purposes for which a NWR was established, as well as the maintenance and potential restoration of biological integrity, diversity, and environmental health relative to aquatic species and habitats. Thus, the CRFWCO and NWRs have sought to promote effective information exchange between programs, as well as the Fish and Wildlife Conservation Offices (FWCOs) within Region 1 and other USFWS programs, to increase opportunities for collaborative work. This Annual Report describes the CRFWCO collaborative activities with NWRs during FY2016. The goal of the activities was to conduct cooperative work with NWRs in an efficient and effective manner to conserve aquatic resources and apply strategic habitat conservation. Objectives were to: 1) Continue to conduct annual meetings to exchange information and coordinate among NWRs, CRFWCO, FAC, and other Service programs; 2) Assist in the development of Comprehensive Conservation Plans (CCPs) and associated step-down plans such as inventory and monitoring plans (IMPs) for various NWRs; 3) Conduct field-based activities contributing to conservation of aquatic resources at NWRs; 4) Provide analytical technical assistance and reviews on aquatic resources for NWRs; 5) Establish sentinel sites at NWRs to assess evidence of climate change in physical attributes and aquatic communities in streams; 6) Ensure data generated through collaborative work is managed and reported according to the Region 1 Information Management Strategy; and 7) Disseminate to the public the work and findings of collaborative efforts between CRFWCO/FAC and NWRs through development and publication of annual reports.

Relationship to the Fisheries Program Strategic Plan

Implementation of this project demonstrates application of the Pacific Region's 2009-2013 Fisheries Program Strategic Plan. The following National goals (NG) and Regional objectives (RO) have been addressed by this project during FY2016, and brief descriptions from the CRFWCO perspective and examples (in parentheses) are provided.

NG1 Open, interactive communication between the Fisheries Program and its partners.

RO1.1 Develop and maintain relationships with partners throughout the Pacific Region.

- Project encouraged collaborative partnerships with NWRs in Region 1 and maintained partnerships with NWRs individually (e.g., for specific projects or issues) and collectively (e.g., 2016 annual meeting).

RO1.2 Implement a means of providing feedback to ensure the long-term success of partnerships.

- Feedback was encouraged through annual workshops where topics varied based on a variety of ongoing or recent activities and feedback (e.g., 2016 annual meeting).

RO1.3 Improve data collection and management and internal and external reporting to reduce redundancy and improve access and usefulness for ourselves and our partners.

- Fisheries technical assistance and data are often identified as aquatic resource needs of NWRs. Data, assessments, and recommendations were provided to NWRs to the extent possible (e.g., fish use data for Nestucca Bay NWR).

NG2 America's streams, lakes, estuaries, and wetlands are functional ecosystems that support self-sustaining communities of fish and other aquatic resources.

RO2.3 Coordinate with Service NWRs and NFHs to identify and implement opportunities for increasing the quantity and improving the quality of aquatic and riparian habitat.

- Assisted in evaluating conceptual plans to restore aquatic habitat on NWRs, made recommendations on improvements to projects, and assisted with developing environmental compliance documents (e.g., provided input on proposed actions on NWRs in lower Columbia River and reviewed draft assessments).

NG3 Self-sustaining populations of native fish and other aquatic resources that maintain species diversity, provide recreational opportunities for the American public, and meet the needs of tribal communities.

RO3.1 Collaborate with Ecological Services (ES) Program, National Oceanographic and Atmospheric Administration Fisheries (NOAA Fisheries) and others, to recover fish and other aquatic resource populations protected under the ESA.

- Participated on multi-agency technical teams to provide technical assistance in developing long-term management plans for NWRs where listed species occur (e.g., planning teams for projects).

RO3.2 Maintain healthy, diverse, self-sustaining populations of fish and other aquatic resources

- Participated on multi-agency technical teams to provide technical assistance in developing long-term management plans for NWRs (e.g., planning teams for IMPs).

Approach

To promote effective information exchange, NWRs and the CRFWCO held an initial workshop in 2005 that informed the CRFWCO of aquatic resource issues and needs at NWRs, informed NWRs about fisheries expertise at the CRFWCO and results of ongoing work, and explored possibilities for cooperative efforts. Outcomes of the workshop (USFWS 2005) were identification of contacts for issues concerning CRFWCO work with NWRs (i.e., at CRFWCO, Regional Office—FAC, NWR—Supervisor, Branch of Biology), and commitments from the CRFWCO to assist with development of CCPs, work with NWRs to determine fisheries needs, and jointly pursue funding (e.g., proposals submitted for Cross Program Recovery (CPR) funds, entered into the Fishery Operational Needs System (FONS)) for needs that cannot be addressed with existing resources.

The initial workshop and its outcomes established an overall approach that has been followed to address the goal of conducting cooperative work with NWRs to conserve aquatic resources and associated objectives of this project, which, in addition, has encouraged direct communication between the CRFWCO and individual NWRs.

Objective 1: Continue to conduct workshops to exchange information and coordinate among NWRs, CRFWCO, FAC, and other Service programs.

With the exception of 2006, workshops have been held annually since 2005 (see USFWS 2005, 2007, 2009a, 2009b; Lohr et al. 2012, 2014, 2015, 2016b). A central focus of the workshops has been to provide a forum to discuss aquatic resource issues and needs at NWRs as well as present results of ongoing fisheries work. The workshops also provide opportunities to consider various topics (e.g., regional and national initiatives, resource assessments by other agencies or universities) and engage additional USFWS programs. Extensive notes summarizing presentations and discussion are taken, and action items are generated at or after workshops to address aquatic resource needs and initiatives. Workshops are scheduled in the spring to reduce conflicts with the typical field season, and topics often are at the request or suggestion of participants.

In addition, the CRFWCO conducts reviews to assess and direct activities of overall projects. The project review process consists of an open seminar to provide information about a project to those interested, and is followed by a meeting among pertinent CRFWCO personnel to develop action items intended to improve the project.

Objective 2: Assist in the development of Comprehensive Conservation Plans (CCPs) and associated step-down plans (e.g., Inventory and Monitoring Plans—IMPs).

The CRFWCO has contributed to the development of CCPs for all NWRs that have requested assistance. Most often, CRFWCO personnel have conducted various tasks as a member on an extended planning team. These tasks include: Literature search and review to provide technical information pertinent to aquatic resources, issues and species; Assistance in the crafting of objectives, habitat attributes, management strategies, and rationale; Technical review of drafts; and Participation in team meetings and briefings.

The CRFWCO also has assisted with various inventory or monitoring assessments and plans that contribute to CCP implementation. These assessments and plans were conducted by the National Wildlife Refuge System's Natural Resource Program Center (NRPC) and Inventory and Monitoring Initiative (I & M Initiative), which provide a coordinated approach to support resource management and conservation.

Objective 3: Conduct field-based activities contributing to conservation of aquatic resources at NWRs

At the 2005 workshop, the CRFWCO committed to work with NWRs in determining fisheries needs and likely actions necessary to address them. Overall, past experiences have found that most fishery needs and associated actions can be placed in one of three categories: 1) Requiring expertise beyond that at the CRFWCO or outside its purview, for which suggestions on accessing appropriate expertise may be made; 2) Requiring extensive field-based activities; and 3) Requiring technical assistance without field-based activities (see Objective 4, below).

Examples of field-based activities contributing to conservation of aquatic resources include assessments of habitat restoration actions on targeted habitat attributes and aquatic species, and also relatively broad-scale inventories for the presence and distribution of aquatic habitats and species. Because the costs of conducting such activities typically exceed existing resources of NWRs and the CRFWCO, funding is pursued internally (e.g., through CPR, FONS, I&M Initiative) and externally (e.g., U.S. Army Corps of Engineers).

Objective 4: Provide analytical technical assistance and reviews on aquatic resources for NWRs.

Non-field-based technical assistance includes a suite of activities such as providing information concerning aquatic resources, reviewing permitting or other documents, and participating on technical advisory groups. Because these activities do not incur the costs typically required for extensive field work, the CRFWCO attempts to fulfill these needs to the greatest extent possible with existing personnel and funds.

Objective 5: Establish sentinel sites at NWRs to assess evidence of climate change in physical attributes and aquatic communities in streams.

To support implementation of the Service's Strategic Plan for Climate Change (USFWS 2010a) relative to fisheries and aquatic resources in Region 1, Fisheries Project Leaders identified areas of emphasis during their coordination meeting in 2011. These areas were NFH programs and operation, key aquatic species, and aquatic resources at NWRs. All areas of emphasis were intended to support actions primarily addressing a better understanding of the status and trends of aquatic species and their habitats relative to climate change, potential adaptation strategies, and inventory and monitoring. For the third area, the primary action was for FWCOs to assist NWRs to design and implement a long-term aquatic monitoring program for evaluating effects of climate change.

This objective is being addressed by a pilot project to develop and implement of a long-term aquatics monitoring program for climate change at NWRs on the mainland of Region 1, which is being conducted through extensive collaboration among Refuges, FWCOs, and Water Resources. The goal of the monitoring program is to evaluate evidence of climate change in physical attributes at NWRs and associated changes in aquatic communities. Specific objectives are to:

1. Establish long-term sentinel sites representing mainland NWRs across the range of ecoregions in Region 1.
2. Describe how physical attributes vary through time.
3. Describe how biological attributes vary through time.
4. Analyze for potential temporal change in attributes by ecoregion.
5. Assess relationships in physical and biological attributes by ecoregion.

Objective 6: Ensure data generated through collaborative work is managed and reported according to the Region 1 Information Management Strategy.

The Regional Information Management Strategy (RIMS) has been developed to "create the knowledge, expertise, and infrastructure to implement best practices for managing, safe guarding, and sharing our conservation data and information assets to ultimately improve delivery of conservation on the ground." For implementation, RIMS includes regional policy and guidance for the development of data management plans (DMPs), which describe best practices for the collection, creation, procurement, and use of scientific data. Data associated with our collaborative work are being collected and managed in accordance with RIMS.

Objective 7: Disseminate to the public the work and findings of collaborative efforts between CRFWCO/FAC and NWRs through development and publication of annual reports.

Informing the public of our collaborative work and pertinent results is an integral aspect of the USFWS. Activities and results are described in progress reports, which are posted on the CRFWCO website. Additional venues are used to convey information about our work and aquatic resources issues to the public as well as other USFWS programs.

Products

Activities and associated products for addressing each of the seven project objectives during FY2016 are discussed below.

Objective 1: Continue to conduct workshops to exchange information and coordinate among NWRs, CRFWCO, FAC, and other Service programs.

The CRFWCO and Regional Branch of Refuge Biology organized and hosted a workshop on May 11, 2016. A total of 44 individuals participated in the workshop, which included three USFWS programs (Table 1). For FAC, representatives from each FWCO (i.e., Columbia River, Idaho, Mid-Columbia, and Western Washington), Abernathy Fish Technology Center, and the Regional Office attended. For the Refuge Program, representatives from eight NWR units attended, in addition to the Regional Office (Regional Chief, Branch of Refuge Biology, and I&M Initiative). Ecological Services also participated.

Table 1. Number of individuals that participated in the 2016 annual meeting.

Program/office	**Individuals**
Fish and Aquatic Conservation	
CRFWCO	8
FWCOs	4
Abernathy Fish Technology Center	3
Regional Office	4
Refuges	
NWRs[1]	13 (8)
Regional Office	9
Ecological Services	1
Other[2]	2
Total individuals	44

[1] Number of NWR units represented in parentheses (NWR complexes were considered a single unit).
[2] U.S. Geological Survey and Oregon State University.

The agenda, notes, list of attendees, actions items, and presentations have been compiled (see Appendix A). The goal and objectives for the workshop are presented here.

Workshop Summary

Goal— Provide a forum to promote effective information exchange and coordination among NWRs, Fisheries, PFW, and other Service programs.

Objectives—
1. Update of results and activities by NWRs to address aquatic resource issues and needs.
2. Update of results and activities by Fisheries and others at NWRs.
3. P Updates on management planning and activities of other programs.
4. I Identify and discuss aquatic resource issues and needs at NWRs.
5. Explore opportunities for cooperative efforts among NWRs, Fisheries, PFW, and others.
6. Develop action items.

Objective 2: Assist in the development of Comprehensive Conservation Plans (CCPs) and associated step-down plans (e.g., Inventory and Monitoring Plans—IMPs).

The USFWS Division of Refuges has developed a systematic approach for the comprehensive conservation planning process (USFWS Manual 602 FW 3), including preplanning, adoption of a final plan, implementation, and plan review and revision. Because time necessary to produce a final CCP may be several years, the CRFWCO has assisted with tasks for CCPs at various stages of development (i.e., ranging from preparation for preplanning to review of public drafts), as well as activities supportive of completed CCPs such as development of IMPs and Water Resource Inventory and Assessments (WRIAs).

Work by the CRFWCO related to CCPs during FY2016 was exclusively focused on IMPs. Refuges' I & M Initiative requested assistance on the development of IMPs at 12 NWR units, Bear Lake, Camas, Conboy Lake, Franz Lake, Julia Bulter Hansen, Lewis and Clark, Oxford Slough, Pierce, Ridgefield, Steigerwald, Toppenish, and Tualatin NWRs. The CRFWCO either reviewed the IMP materials and provided comments to NWRs or provided the request and materials to the appropriate FWCO for NWRs in their geographic area.

Objective 3: Conduct field-based activities contributing to conservation of aquatic resources at NWRs.

The CRFWCO engaged in or assisted with two projects consisting of field-based activities contributing to conservation of aquatic resources at NWRs during FY2016. These were: post habitat restoration assessment of fish at Nestucca Bay NWR, and fish species inventory at McFadden's Marsh, W.L. Finley NWR. Brief summaries of the projects are presented here along with citations of reports containing project details and findings.

Post habitat restoration assessment of fish at Nestucca Bay NWR

At Nestucca Bay NWR, 82 acres of tidal marsh was restored in 2007 by removing 0.7-mile portion of a dike and directly reconnecting almost 4,000 feet of tidal channels. The CRFWCO conducted seasonal fish surveys both immediately prior to and after construction of the habitat restoration project (Cook and Hudson 2007; U.S. Fish and Wildlife Service 2010b), primarily with funding from the National Fish and Wildlife Foundation. Fish diversity and salmonid use of the NWR appeared higher after construction of the restoration project, however, surveys were limited to a single year, and additional surveys were recommended.

The CRFWCO intends to repeat fish surveys at habitat restoration sites at long-term intervals (≥ 5 years) to better assess possible changes over time. During summer FY2015, the CRFWCO initiated seasonal surveys of fish presence and distribution at Nestucca Bay NWR based on previously used sample locations (Figure 2), and completed surveys during FY2016 (Figure 3). A total of 12 taxa were collected at Nestucca Bay NWR during FY2015—FY2016: Coastal Cutthroat Trout, Chinook Salmon, Coho Salmon, Chum Salmon, steelhead (hatchery origin), Threespine Stickleback, Shiner Surfperch, Pacific Staghorn Sculpin, Sculpin *spp.*, Gunnel, and Bay Pipefish.

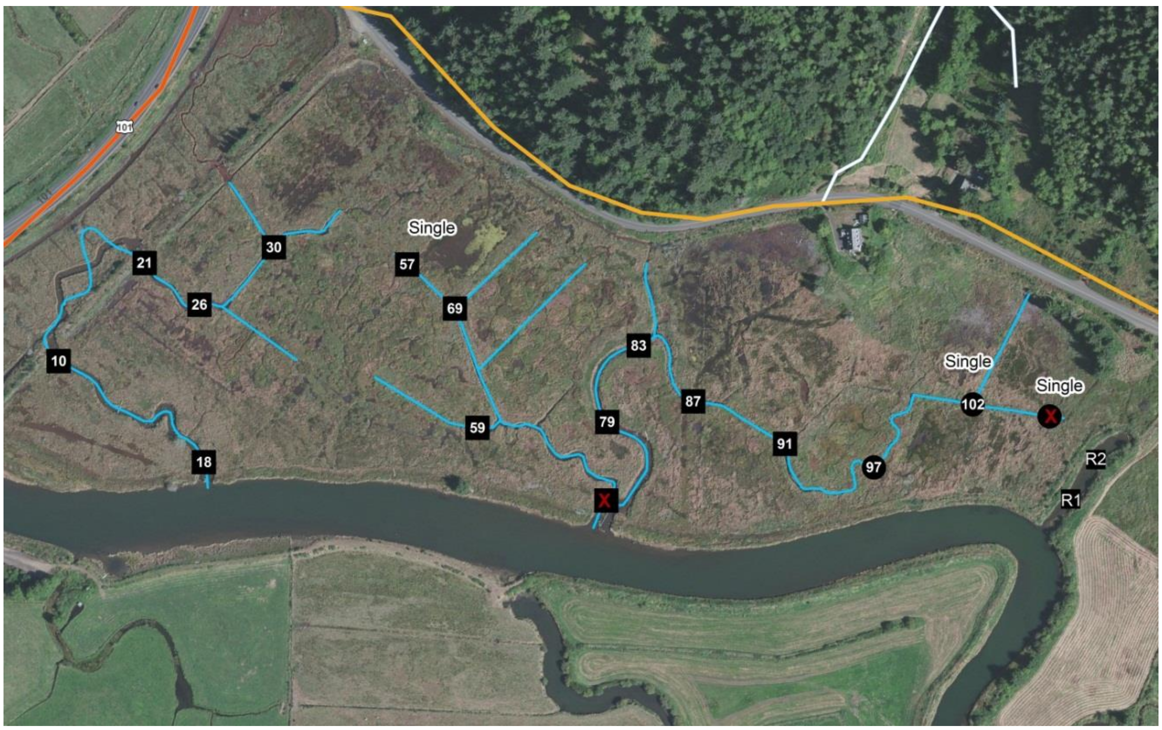

Figure 2. Tidal channels (blue lines) adjacent to the Little Nestucca River with sample locations (numbered boxes and circles) at Nestucca Bay NWR. (Map by B. Silver)

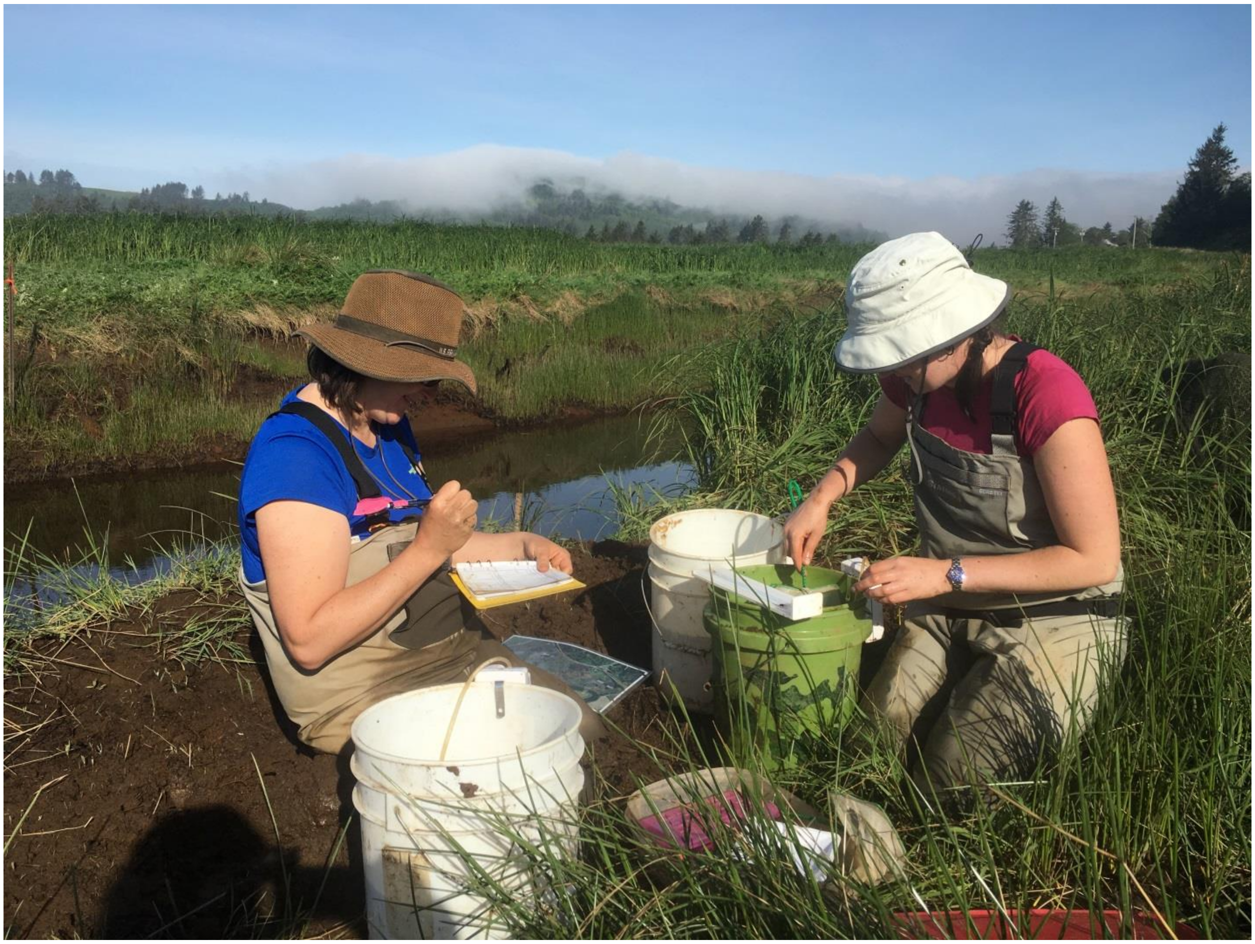

Figure 3. Biologists recording data to characterize fish presence and distribution at Nestucca Bay NWR during FY2016. (Photo by S. Lohr)

Fish species inventory at McFadden's Marsh, W.L. Finley NWR

McFadden's Marsh is formed by berms constructed on the floodplain adjacent to Muddy Creek at W.L. Finley NWR. High stream flows spread across the floodplain during winter-spring inundating the marsh, and as flows recede, water is impounded in the marsh using a series of water-control structures. Storage of water in the marsh allows for management of desirable aquatic vegetation benefitting waterfowl, amphibians, and other taxa. Due to concerns about fish entrapment, the NWR worked with Oregon Department of Fish and Wildlife (ODFW) to design a fish inventory for the marsh to provide information needed for water rights and fish passage decisions. The NWR conducted the survey during spring 2016 (Macal 2016) and requested assistance from the CRFWCO. The CRFWCO assisted by: offering review and technical information on survey approaches, loaning sampling equipment (e.g., fish traps, seines, temperature loggers, a water quality meter), and providing personnel and gear to electrofish areas of the marsh.

Figure 4. McFadden's Marsh looking north from Bruce Road during March 2016, William L. Finley NWR. (Photo by R. Macal)

Objective 4: Provide non-field-based technical assistance on aquatic resources for NWRs.

Non-field-based technical assistance has previously been described as consisting of long-term activities (i.e., those that spanned fiscal years and often led to additional tasks) and short-term activities (i.e., those that typically concluded within a matter of days or less). Non-field-based technical assistance during FY2016 consisted of short-term activities, which included:

- Attending briefing on development of habitat restoration project at Steigerwald NWR and providing review of conceptual designs.
- Participating in interagency meeting to discuss habitat and natural resource issues at Wapato Lake NWR. Provided comments to assist in developing habitat restoration and management alternatives.
- Making site visits and review on various habitat restoration, fish passage, and screening issues at NWRs (e.g., habitat restoration planning for Chicken Creek at Tualatin NWR, planned road construction adjacent to Neskowin Marsh at Nestucca Bay NWR, pump screen plans at Ankeny NWR).

- Providing technical review of habitat restoration proposals, design documents, and special use permit applications (e.g., Westport Slough at Lewis and Clark NWR, Alder Island at Siletz Bay NWR, Campbell Lake at Ridgefield NWR, and fish surveys at Sheldon NWR).
- Processing invertebrate samples (i.e., material separation, subsampling, and taxonomic determination) collected in floodplain habitats at Ridgefield NWR.

Objective 5. Establish sentinel sites at NWRs to assess evidence of climate change in physical attributes and aquatic communities in streams.

This objective is being addressed by a pilot project to develop and implement a long-term aquatics monitoring program for climate change at NWRs on the mainland of Region 1. The pilot project is being conducted collaboratively with FAC, Region 1 Refuges, NWRs, and Region 1 Water Resources. Each of the four FWCOs is implementing monitoring activities at individual NWRs. Major activities for the pilot project during FY2016 included:

- Secured funding from Natural Resource Program Center—Water Resources ($60K total) to support each FWCO to implement the second year of field surveys and data collections (e.g., fish and habitat surveys, maintenance of temperature and temperature/pressure loggers, analyses/reporting).
- Completed progress report (Lohr et al. 2016a) describing all activities up to and including the initial year of field implementation (FY2015), and made joint presentation of results at the annual workshop.

Objective 6. Ensure data generated through collaborative work is managed and reported according to the Region 1 Information Management Strategy.

For the aquatic monitoring pilot project, assistance with data and database development/management is being provided by expertise within Refuges, FAC, and Water Resources. Activities to date have been completion of a data management plan template prior to initiating field surveys in FY2015. The template identified the types, sources, and formats of project data, primarily habitat and vertebrate survey data generated during field trips, and water temperature and stream flow data recorded using data loggers. All habitat and vertebrate survey data are recorded on standard forms developed by the U.S. Environmental Protection Agency (EPA). Because habitat data for a relatively small number of survey sites can be efficiently processed using existing agency spreadsheets (P. Kaufmann, EPA, pers. comm.), we modified a Excel workbook developed by Virginia Department of Natural Resources for the pilot project. An Access database has been developed for vertebrate survey data. Files of both the workbook and database were distributed to each FWCO with instructional materials for their use in FY2015. During FY2016, both files were revised based on input from the FWCOs and instructions are being updated. After entering data for each sentinel site, files are provided to the CRFWCO where a master copy will be compiled and stored with supporting information. A database for temperature and stream flow data presently is being developed. Data generated for other collaborative work are available in electronic formats at the CRFWCO, and resulting reports will be posted on the office website.

Objective 7. Disseminate to the public the work and findings of collaborative efforts between CRFPO/FAC and NWRs through development and publication of annual reports.

Progress reports on Fisheries Collaboration with National Wildlife Refuges have been completed for FY2013 and FY2014—FY2015 (Lohr et al. 2015, 2016b), and posted on the CRFWCO website.

Conclusions

There was extensive collaboration between the CRFWCO and NWRs on conservation of aquatic resources during FY2016. The other three FWCOs in Region 1 and Abernathy Fish Technology Center participated in annual meetings, highlighting overall healthy collaboration between the FAC Program and NWRs. During the period addressed by this report, the CRFWCO was involved in activities supportive of CCPs (i.e., through IMP development), which not only provided a means for FAC input into NWR planning, but also encouraged cross-program interactions that fostered professional relationships. Field-based activities, which have been made possible through various funding sources, have generated information for assessing the efficacy of habitat restoration actions and establishing baselines, both of which will improve our knowledge base and management of aquatic resources by the USFWS. Conducting non-field-based activities have provided fisheries technical assistance to a substantial variety of issues, which has supported the missions of FAC, Refuges, and the USFWS overall. Work on the pilot project to develop and implement a long-term monitoring program at NWRs has entailed close coordination among FWCOs, as well as individual NWRs, Refuge's Branch of Biology and I & M Initiative, and Water Resources. Following Region 1 information management strategy has provided a consist approach in all steps of data acquisition, documentation, and storage, which encourages dissemination of information concerning collaborative activities of the CRFWCO in a variety of venues.

Acknowledgements

We would like to thank the numerous individuals who have contributed to and supported collaborative work described in this report, namely personnel of the Region 1 National Wildlife Refuge System, Branch of Refuge Biology, Inventory and Monitoring Initiative, NWR complexes and individual units in Washington, Oregon, and Idaho; Region 1 Fish and Aquatic Conservation Program, Idaho FWCO, Mid-Columbia River FWCO, Western Washington FWCO, CRFWCO; Region 1 Water Resources; and many others.

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APPENDIX A: 2016 NWR-FISHERIES WORKSHOP AGENDA, NOTES, ATTENDEES, ACTION ITEMS, AND PRESENTATIONS

NWR-FISHERIES MEETING AGENDA
May 11, 2016
Columbia River Fish and Wildlife Conservation Office
1211 SE Cardinal Court, Suite 100
Vancouver, WA 98683

Goal: Provide a forum to promote effective information exchange and coordination among NWRs, Fisheries, PFW, and other Service programs.

Objectives:
1. Update of results and activities by NWRs to address aquatic resource issues and needs.
2. Update of results and activities by Fisheries and others at NWRs.
3. Updates on management planning and activities of other programs.
4. Identify and discuss aquatic resource issues and needs at NWRs.
5. Explore opportunities for cooperative efforts among NWRs, Fisheries, PFW, and others.
6. Develop action items.

10:00-10:05	Welcome and overview of workshop
10:05-10:35	Post restoration monitoring on the Nisqually Delta (Glynnis Nakai and Melanie Davis)
10:35-11:05	The efficacy of using electrical waveforms to kill the embryos of invasive Common Carp (William Simpson/Doug Peterson)
11:05-11:35	Modeling the effects of control efforts on a population of Common Carp (Cyprinus carpio) in a shallow eutrophic desert lake (James Pearson)
11:35-12:05	Redband Rainbow Conservation Assessment, Kootenai GMU: What it could mean for Cascade Creek (Mike Faler)
12:05-1:00	Lunch
1:00-1:30	Landscape Conservation Design: Updates and where we are heading (Kevin O'Hara and Khem So)
1:30-2:10	Progress on the pilot project to develop a long-term aquatic monitoring program for climate change at Region 1 refuges (FWCOs)
2:10-2:30	Break
2:30-4:30	Open discussion of updates, plans, and activities affecting aquatic resources for each NWR, Office, and Program attending
4:30	Wrap-up

NWR-FISHERIES MEETING NOTES
May 11, 2016
Columbia River Fish and Wildlife Conservation Office
1211 SE Cardinal Court, Suite 100
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10:00-10:05 Welcome and overview of workshop

10:05-10:35 Post restoration monitoring on the Nisqually Delta (Glynnis Nakai and **Melanie Davis**)

- Several dike removals in Nisqually Delta to restore habitats (marsh and mud-flat)
- Brown Farm Dike was removed in 2009, restoring 308 hectares at the NWR to tidal influence
- Success criteria: how much habitat is available (opportunity potential); are there sufficient prey resources (capacity); and are individuals, birds and fish, using newly-available habitat (realized function)?
  - Opportunity potential – *channel morphology* using aerial photography, LIDAR (42% increase in channel area that can be used by salmon); water quality (temperature and salinity); *sediment flux* using surface elevation tables (SETs) and PVC sediment pins – would eventually like to see the subsided areas increase in elevation with sediment deposition, grow some vegetation, and be available habitat in response to sea-level rise (most deposition is happening inland, erosion is happening further out in the delta).
  - Capacity – *vegetative colonization* (recolonization happening at the 2 m elevation level with inundation-tolerant species) measured using "marsh haircuts" and modeled biomass; *invertebrate prey* (benthic, terrestrial, pelagic, and epifaunal prey) – saw a lot of arthropod species and fly larvae at restored site, Red Salmon reference site had a lot more prey that use vegetation and fall into the water (e.g., spiders).
  - Realized function – *salmon habitat use* – juvenile Chinook salmon using restored channels the year after restoration, are also feeding and growing in the channels at rates similar to sites in the rest of the refuge (greater use of restored area in spring, higher-elevation sites in summer, fall); *waterbird habitat use* with ground surveys

(restoration sites have highest diversity, and high abundance with a lot of dabbling ducks, diving ducks, seabirds, and geese) and heat maps

- Take-home message: long-term monitoring and measuring immediate responses is crucial; important to combine field techniques with models and spatial analysis to look at the big picture; and using whole ecosystem approach is key
- Pulling info together for several deliverables: summary on web site; pamphlet for the public; technical documents; and lessons learned.
- Q: Were restoration metrics in the CCP or restoration plan? A: Looking at these now relative to the current findings.

10:35-11:05 The efficacy of using electrical waveforms to kill the embryos of invasive Common Carp (**William Simpson**/Doug Peterson)

- Carp are extremely invasive in the US – high fecundity and rapid growth, ecosystem engineers via rooting and excretion (removing macrophytes and stirring sediments may increase water turbidity and nutrient balance), and are generalists that tolerate poor water quality (i.e., can do well in eutrophic systems with little vegetation).
- In Malheur, carp were established in 1952 some types of emergent vegetation had disappeared by 1955. Waterfowl production is only 10-20% of historic levels due in part to disappearance of emergent vegetation. Multiple rotenone applications have been ineffective in long-term reduction of carp abundance.
- Electricity used as management tool for fish conservation, removal of invasive fish, and fish barriers; many factors affect fish response (water conductivity, exposure duration, number of exposures; waveform, and fish development/size).
- Potential challenges for using electricity to kill carp embryos: small embryos are more shock resistant (2.1 mm vs 6.5 mm for carp and steelhead), Do conditions conducive to killing embryos coincide with spawning? Carp spawning follows spring high water, high water may reduce conductivity. With low lake conductivity, less power is transferred to embryos. Too much conductivity can exceed an electrofisher’s power capacity (but power absorbed by embryo plateaus at some level regardless of power applied to water).
- Goal: investigated survival of carp embryos exposed to waveforms of electrofishers, looking at shape and polarity of waveform (sinewave AC, and square pulsed DC), and intensity of waveform.
- Carp capture and spawning – looked for carp spawning in shallows to see if they were expressing gametes, spawned them, and placed embryos in incubators.
- Tests –used five developmental stages (blastula (8h), gastrula (17h), organogenesis (35h), active movement (50h), and pigmentation (69h)); four voltage gradients (10, 15, 20, 25 V/cm shocked for 30 seconds, plus control), and two waveforms.. Full factorial design conducted with six replicates for each treatment combination.
- Not much difference in survival between the AC and pulsed DC waveforms for the first four developmental stages – survival low (<40% at 10 V/cm despite low conductivity, which is higher mortality than for other cyprinids); the pigmentation stage is very resistant to shocking, had to use high voltage to increase mortality.
- Best conductivities to shock at 60—300 microS/cm.

- Unknowns for application as a control tool: what is the typical water conductivity in spawning areas? How does conductivity interact with lake surface area (would help to identify preferred spawning locations or attract spawning fish)? Can we maintain 10 V/cm on Malheur Lake using a boat electrofisher? Are hatched carp vulnerable to electrofishing (would improve electrofishing efficiency if yes since carp develop quickly, steelhead larvae are vulnerable)?
- Q: Modeling for efficiency of killing embryos – if you leave three, is that too much? How much is enough? A: Starting to look into that (next talk).
- Q: In addition to mortality, did you look at sublethal effects? A: We looked out for effects, and saw things in earlier work with steelhead. We did not see a lot with carp; they may be more resistant to shocking (not specifically quantified, but looked for odd conditions).
- Linda Beck: just got funded for $100K to take electrofishing into the field; hoping that hitting more than one life stage will be more successful than targeting a single life stage.

11:05-11:35 Modeling the effects of control efforts on a population of Common Carp (*Cyprinus carpio*) in a shallow eutrophic desert lake (**James Pearson**)

- Objectives: 1) create population model to simulate recruitment, growth, and death of carp in Malheur Lake; 2) use the model to look at potential management strategies for effective carp removal (e.g., commercial harvest, egg shocking) and identify potential solutions for stakeholders and the community; and 3) examine lake fluctuations for targeting carp removal.
- Impacts from carp (high turbidity, decreased aquatic vegetation and waterfowl production) can potentially be reversed if carp biomass is reduced to < 100 kg/ha.
- Model: age-based population model, annual time-step, deterministic.
- Preliminary results: 325 kg/ha total biomass (mature + nonmature carp); growth coefficient and length are both most important parameters in terms of the global sensitivity analysis.
- Avian predation (by terns, cormorants, and pelicans): thought to be significant contribution to carp mortality. Bioenergetics model constructed to determine rates of avian predation. Combined with the carp population model, predation reduced the total biomass to 267 Kg/Ha total biomass.
- Carp control methods + carp population model:
    - Egg electroshocking: total biomass reduced to 159 kg/ha if 50% of eggs can be removed each year.
    - Commercial harvest (large adults >250 mm, age 3+): 50% removal = 113 kg/ha, 70% = 96 kg/ha (goal met). Can 70% of adults be removed every year forever?
    - Combination of methods (egg shocking, avian predation, commercial harvest that affect all life stages—eggs, non-mature, and mature carp): 30% removal = 84 kg/ha. What combination will get to target numbers? More to explore.
- Do lake fluctuations influence carp removal and efficiency? At low lake levels, carp are at a higher density in a smaller area, so may have higher efficiency for harvest, egg shocking, and avian predation. When lake increases in size, carp density will be low, and may continue to decline (?). Unique lake needs unique solutions.

- Continuing to work on lake fluctuations and combination of removal methods.
- Contact info: James Pearson 530-400-9226 jpearson@usgs.gov
- Q: What factors control lake size? Ability to predict lake size based on those factors could be used to strategize removals based on those predictions? A: Linda Beck – do have some control over diversion dams on the Blitzen River; are working on putting a structure in that will reduce spawning habitat in the river and keep the lake contained.
- Q: Are there impacts to redband trout from electrofishing; and could Blitzen River management have unintended impacts to redband trout which are concentrated when lake level is low. A: Redband are not in the lake in spring when carp are spawning– though bullhead and tui chub are. Redband could be there in the winter. PIT tag arrays detected one redband by Mud Lake in 10,000 data points collected.
- Q: What kind of commercial use is there for carp? A: Commercial fishermen tested filets – at this point, only using for fertilizer, but may use carp for human consumption in the future.

11:35-12:05 Redband Rainbow Conservation Assessment, Kootenai GMU: What it could mean for Cascade Creek (**Mike Faler**)

- Redband trout in Cascade Creek – distribution is entirely on Kootenia NWR (from what we know now), and is 97% pure (3% intergressed genetically).
- Kootenai Geographical Management Unit (GMU) Team (Service, IDFG, MFWP, Forest Service, and Kootenai Tribe) – conducted assessment of redband trout in the basin.
- Team identified three populations in the Lower Kootenai (of which Cascade Creek is one). Believe that 823 km of streams were historically occupied; 198 km currently occupied. The other two populations are associated with barriers to prevent introgression with cutthroat or introduced rainbow trout; not much is known about the populations except for Cascade Creek.
- Team is using 3R framework: Representation (protecting and restoring genetic and life history diversity), Resilience (sufficiently large populations and intact habitats), Redundancy (sufficient numbers of populations that are less than 10% hybridized).
- Cascade Creek – have never sampled upstream of the switchback; supposedly some excellent habitat farther upstream. Will be able to have access, and may find a source population that contributes to the redband that have been observed in Cascade Creek thus far.
- Goals for Cascade Creek: maintain or enhance redundancy by maintaining Cascade Creek conservation population; improve public perception about conservation of interior redband trout and potentially develop and promote a sport fishery. Actions in Cascade Creek include:
    - Replace existing diversion with a new screened diversion (traveling screen) to reduce or eliminate the population sink. (Service; potentially in 2017).
    - Sample upstream of the lower waterfall to verify distribution of redband in Cascade Creek. (Service/Kootenai Tribe; 2016)
    - Assess feasibility of expanding the distribution of Cascade Creek redband trout into the upper watershed if they are not present above the lower waterfall. (Service, USFS, IDFG, Kootenai Tribe; 2018)

    - Evaluate the feasibility of utilizing rearing space at Twin Rivers Hatchery for the production of redband trout. (Kootenai Tribe; 2016)
- Q: Evidence of redband reproduction in Cascade Creek? A: Age 0 fish are present every year sampled. There is no population estimate, but would guess there are 300-500 individuals of all age classes. Potential concern with inbreeding.

12:05-1:00 Lunch

1:00-1:30 Landscape Conservation Design: Updates and where we are heading (**Kevin O'Hara** and **Khem So**)

- Landscape Conservation Design: Willamette Valley Conservation Study and the Columbia Plateau
- LCD is a partnership-driven process to assess current and future biological and socioeconomic conditions, and depict spatially explicit desired future conditions (maps) resulting in a suite of management strategies for achieving those conditions on a landscape scale.
- Initially started as a "refuge thing", but now the Partners and Coastal Programs must consider LCDs when updating 5-year management plans. LCCs take on a "convener" role. Get involved! It's important for everyone to get involved at this point.
- Willamette Valley Work Plan: LCDs inform cross-program planning.
- Region 1 – developed the Bear River project in cooperation with Region 6, and then have moved into the Willamette Valley ecoregion. Also now working in the Columbia Plateau and the NW Basin and Range LCD (the Great Basin LCC is now stepping up into the convener role especially here). Also have a Columbia Coastal LCD.
- LCDs: what is an LCD? Four cornerstones:
    - *People*: value driven based on stakeholder needs within the landscape, so stakeholder driven (multi-jurisdiction and multi-sector); decision-makers and implementers of both conservation and utilization.
    - *Purpose*: co-produce and use interdisciplinary science to identify priorities and coordinated adaptation strategies that protect biodiversity of ecosystem services and increase the resilience and sustainability of socioecological systems that support priority resources for future generations despite uncertainty and change.
    - *Process*: transparent, deliberative, and iterative, integrates societal values using best available science to inform the identification of landscape configurations and coordinated adaptation strategies to support priority resources for future generations. Assess current landscape conditions and assess plausible futures developed through participatory stakeholder processes or other methods agreed to by landscape stakeholders.
    - *Products*: portfolio of spatial designs, coordinated adaptation strategies, must be capable of guiding development of unit-specific planning, assessment, and decision-making to step-down to individual management units.
- LCDs and aquatic resources – two examples in Willamette Valley and the Columbia Plateau.
- Willamette Valley Conservation Study:

    - Riverine Objectives – Willamette Futures Study identified high restoration potential and low social constraints (habitat characteristics); cold water refugia, OWEB anchor habitats, zones of influence, flood inundation maps. Priority areas analyzed using Marxan.
    - Fish habitat elements – map of priority conservation areas overlapped with fish habitat elements.
    - WVCS riparian focus – many overlap with the fish habitat elements (32 priority conservation areas that would benefit fish).
- Columbia Plateau – Arid Lands Initiative
    - Open standards – conservation planning process to identify eight conservation targets and performed two assessments: viability of the eight targets, and a threats assessment. Then translated to spatial priorities.
    - Developed products that mapped out priority core areas for terrestrial habitats (did not include riverine systems).
    - Great Northern LCC funded the Washington Habitat Connectivity Group to create the "one map" that shows priority areas.
    - Riverine Priorities Project (funded by GNLCC and Climate Science group): identify riverine priority areas and develop a classification of riverine habitat types. Added climate vulnerability to previous work; working on riverine classification, prioritization, etc. Data mining: available online. Not focusing on salmon/steelhead (already a lot of efforts on those species); focus on bull trout, redband trout, Pacific lamprey, waterbirds and shorebirds, riparian birds, beaver.
    - Talked with various partners who emphasized:
        - Priorities for protection and restoration – protection: high potential, biological value, current condition; restoration: high potential, biological value, and low current condition.
        - Habitat potential – Channel mapping, flow type, connectivity.
        - Biological value – habitat diversity (did not start with salmon).
        - Current condition – watershed condition dataset and longitudinal connectivity.
        - Changing climate – vulnerability.
        - Marxan – everything goes into Marxan, which sets priority reaches, watersheds for riverine systems that are important for protection or restoration.
- Lessons learned:
    - Third-party conveners are your friend (LCCs, Arid Lands Initiative).
    - The States are your best friends.
    - Involve decision-makers early and often.
    - Agree on a work plan early but maintain flexibility for using new information.
    - Do not let the perfect be the enemy of the good (enough).
    - Thicken your hide – there will be storms that will subside.

1:30-2:10 Progress on the pilot project to develop a long-term aquatic monitoring program for climate change at Region 1 refuges (FWCOs) (**Sam Lohr, Mike Faler, RD Nelle**)

- Project has been discussed during past meetings. 2015 was the first year of implementation in the field.
- Goal: evaluate evidence of climate change in physical attributes at NWRs and changes in aquatic communities by establishing sentinel sites at NWRs in R1 ecoregions (Marine West Coast Forest, Northwestern Forested Mountains, and North American Deserts). Objectives: describe how physical and biological attributes vary through time, analyze for temporal changes and relationships.
- Approach: collaborative between Refuges, Fisheries, and Water Resources. Needs to be sustainable, use existing data, and maintains consistency in habitats/attributes. Three phases (reconnaissance, baseline, long-term).
- Methods: Joint assessment to identify candidate sentinel sites (geospatial analysis provided by Water Resources), temperature/flow using EPA Best Practices Guidance, and habitat/vertebrate surveys during low flow period using EPA EMAP protocols.
- Status: five sentinel sites (Willapa, WL Finley, Little Pend Oreille, Kootenai, Malheur). Data loggers installed 2014/2015, and initial habitat (1x) and vertebrate surveys (3x) and invertebrate collections occurred in 2015; plan to repeat surveys and maintain loggers 2016-2017 to complete 3-year baseline phase. Funding received from NRPC (2014, 2016) and R1 I&M (2015).
- Results from 2015 were presented for each of the five sentinel sites. These included:
    - Maps showing survey reaches and locations of data loggers.
    - Summaries of channel, riparian, and aquatic habitat characteristics.
    - Fish assemblage information (species collected and counts).
    - Water temperatures.
- Plans/recommendations for 2016: surveys earlier in the season, complete database for loggers, compare temperatures to projections, determine approach for invertebrate samples, establish photo points.

2:10-2:30 Break

2:30-4:30 Open discussion of updates, plans, and activities affecting aquatic resources for each NWR, Office, and Program attending

- **Idaho FWCO** (Mike Faler) – Office recently completed report for mountain whitefish project in the Lochsa River. Water temperatures and timing of spawning runs were assessed in the 1990s to investigate climate change; current project repeated the work during the last few years. Observed slight increase, but not significant, in water temperatures between the two periods, as well as later dates for the spawning run.

- **Willamette Valley-William L. Finley NWR** (Brian Root) – There are fish passage, entrapment, and screening issues among NWRs in the WV complex. These involve water rights associated with structures constructed in the 1990s for which ODFW assessed in 2008. Fish entrapment is a concern at McFadden's Marsh. The NWR is sampling fish within the marsh to document potential for entrapment. To date, coastal cutthroat trout, western brook lamprey, and other fish have been collected. The ability to maintain wetland habitat supporting vegetation, roosting sites, turtles, frogs, etc. would be lost if the water right is canceled. The NWR is working with ODFW on these issues.

- **Willamette Valley-Baskett Slough and Ankeny NWRs** (Graham Evans-Peters) – Graham made a presentation on wetland management and issues at the two NWRs. There are six impoundments at Baskett Slough NWR for which some have certified water rights and others are on backlog (some with and without passage requirements). The NWR is working with ODFW passage coordinator on meeting passage requirements. Rock weir and fish ladder approaches are being considered if requirements cannot be met operationally. Fish in the system include largescale sucker, northern pikeminnow, and coastal cutthroat trout. The Ankeny NWR pump in Sidney Ditch is not self-cleaning and does not meet NMFS standards (surface area/volume). The NWR is working with ODFW, and they may be able to design/build a retrofit. Additional funding and Fisheries assistance may be needed on these issues.

- **Conboy Lake NWR** (Sara McFall) – The NWR is continuing efforts to control introduced bullheads and bullfrogs within managed wetlands. Over the summer-fall, 53,000 bullheads were removed as well as 500 bullfrogs and 2,000 bullfrog tadpoles. About 300 bullhead stomachs have been preserved to look at diets and predation on spotted frogs. Fyke nets were used.

- **Steigerwald NWR** (Alex Chmielewski) – The NWR is behind a levee along the Columbia River, surrounded by private lands, and contains lower Gibbons Creek (confined in a constructed elevated channel, has high bed load). The Lower Columbia Estuary Partnership is working on designs for habitat restoration at the NWR to increase habitat for listed salmon (e.g., levee removal/setbacks, floodplain connectivity, need to protect SR-14). In addition to LCEP, the NWR is working with the Army Corps of Engineers, WDFW, and WDOT. The Friends of the Gorge is talking with an adjacent landowner about a land purchase. BPA is the major source of funding. Earliest date to possibly start construction would be in 2018.

- **Willapa NWR** (Will Ritchie) – Several monitoring and assessment activities going on at the NWR. Two phases of the Bear River restoration project have been completed, resulting in removal of five miles of levees. Construction of an interior levee is underway. The USGS is surveying invertebrates, vegetation, and water quality as part of a SSP project. Presently the NWR is in the third year looking at changes in fish use and diets (chinook, coho, chum salmon; Pacific lamprey; and 8-10 marine species. Continuing adult salmon surveys in 6-8 streams. Volunteer is monitoring mussels.

- **Tualatin River and Wapato Lake NWRs** (Trevor Sheffels) – Progressing with restoration planning at Wapato Lake—starting NEPA, and EA should be out in the fall. The USGS is continuing hydrologic modelling, including streams at the NWR. NEPA will address a range of alternatives. Restoration planning also is progressing with the Chicken Creek project at Tualatin River NWR. Idea is to reroute the creek from its channelized location (~0.5 mile length) back into its historic channel (~1.25 mile length).

Partners are looking at site preparations for vegetation and how to used beaver in the system. Lamprey surveys were conducted at the NWR last year.

- **RO FAC** (Howard Schaller) – Noted that FWCOs can help NWRs with lamprey identification and surveys. The information collected at NWRs would contribute to the lamprey data clearinghouse.

- **Mid-Columbia FWCO/Toppenish NWR** (RD Nelle) – The FWCO is continuing to monitor steelhead entrainment at the NWR using PIT tag arrays in collaboration with the Yakama Tribe, which operates a rotary screw trap upstream and tags fish. In 2013-2014, 29 unique tags (out of 25K tagged) were detected at the NWR, and during 2014-2015, 10 unique tags (out of 4K tagged) were detected. So far this year, 76 tags have been detected.

- **I&M Initiative** (Kevin Kilbride) – Would like to have feedback from NWRs about the aquatic monitoring pilot project.

- **RO NWR/FAC** (Kevin Foester) – Kevin and Roy appreciated the meeting and encourages all to continue cross-program interactions.

- **RO FAC** (Don Campton) – Reminder to all that deadline is approaching to submit SSP proposals.

4:30 Wrap-up

2016 Attendees

Name	**Office**
Eric Anderson	Ridgefield NWRC
Mark Bagdovitz	RO FAC
Marian Bailey	Nisqually NWRC
Linda Beck	Malheur NWR
Justin Bohling	Abernathy FTC
Don Campton	RO FAC
Alex Chmielewski	Ridgefield NWRC
Dan Craver	*RO NWRS*
Kari Dammerman	Columbia River FWCO
Melanie Davis	USGS WERC
Roy Elicker	RO FAC
Joe Engler	RO Refuge Biology
Graham Evans-Peters	Baskett Slough NWR
Mike Faler	Idaho FWCO
Bridgette Flanders	RO Refuge Biology
Kevin Foester	RO NWRS
Steve Haeseker	Columbia River FWCO
David Hand	Columbia River FWCO
Mike Hudson	Columbia River FWCO
Jeff Jolley	Columbia River FWCO
Kevin Kilbride	RO Refuge I&M
Marci Koski	Columbia River FWCO
Matt Lloyd	Willapa NWRC
Sam Lohr	Columbia River FWCO
Rachel Maxey	Columbia River FWCO
Sara McFall	Conboy Lake NWR
Kelly Moroney	*Oregon Coast NWRC*
Glynnis Nakai	Nisqually NWRC
RD Nelle	Mid-Columbia FWCO
Kevin O’Hara	RO NWRS
James Pearson	USGS/OSU
Chris Peery	Idaho FWCO
Doug Peterson	Abernathy FTC
Miranda Plumb	Western Washington FWCO
Will Ritchie	Willapa NWR
Brian Root	Willamette Valley NWRC
Howard Schaller	RO FAC
Trevor Sheffels	Tualatin River NWRC
Will Simpson	Abernathy FTC
Khem So	RO NWRS
Shawn Stephensen	*Oregon Coast NWRC*

Erin Stockenberg	RO Refuge I&M
Curtis Tanner	Western Washington FWO
Tim Whitesel	Columbia River FWCO

--italicized listings attended via phone

Requests and Action Items

1. Nisqually NWR and partners to continue monitoring aspects of the restoration project, including food-web connectivity, blue carbon, sediment deposition; pull together information on the project web site; and develop lessons learned and other documents.

2. Malheur NWR and AFTC to continue assessing the effects of electricity on carp survival and evaluate using electrofishing in the field to help control carp.

3. Malheur NWR and OSU/USGS to continue working with the carp population model to explore combinations of factors to achieve the carp biomass target, effects of fluctuating lake levels, and how these may relate to avian predation.

4. Idaho FWCO and partners to survey upper Cascade Creek to determine distribution of redband trout and assess feasibility of expanding distribution, install a new screened diversion at Kootenai NWR, and evaluate feasibility of using Twin Rivers Hatchery for redband trout production.

5. Everybody is encouraged to get involved in the number of landscape conservation design initiatives that are underway in the region (e.g., in the Columbia Plateau, Willamette Valley, Lower Columbia/NW Coast, and NW Basin and Range).

6. All FWCOs to continue working with NWRs on implementing surveys for the second field season of the aquatic monitoring pilot project.

7. Willamette Valley NWR Complex requests fishery assistance (e.g., technical, perhaps additional funding) to address potential fish entrainment in McFadden's Marsh at W.L. Finley NWR, new pump screen at Ankeny NWR, and fish passage requirements at Baskett Slough NWR.

8. Columbia River FWCO to continue providing review and technical assistance requested for management planning and habitat restoration at Steigerwald, Tualatin River, and Wapato Lake NWRs.

9. FAC encourages NWRs to provide pertinent information to the lamprey data clearinghouse and seek assistance from FWCOs for lamprey identification and surveys.

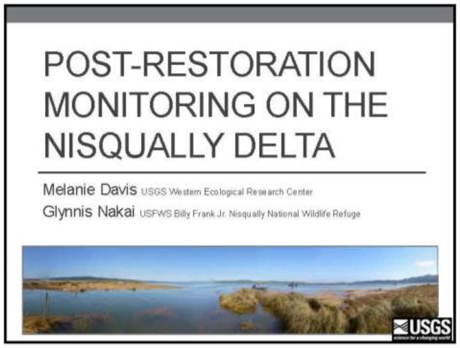
10. Mid-Columbia FWCO to continue working with Toppenish NWR to monitor steelhead entrainment.

11. I&M requests feedback from NWRs about the aquatic monitoring pilot project.

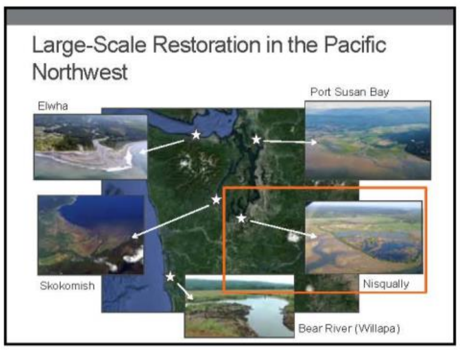
12. The ARDs encourage all to continue cross-program interactions.

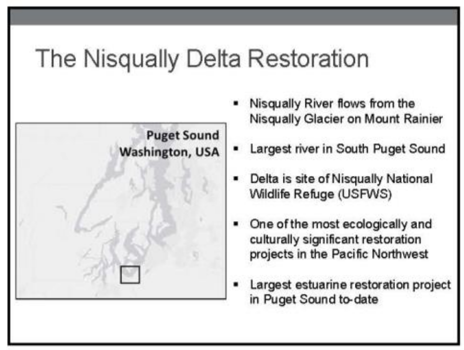
Meeting Presentations

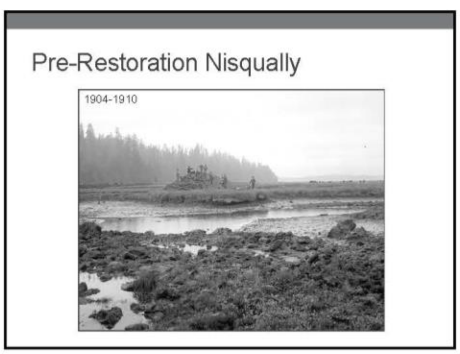
Presentation: Post restoration monitoring on the Nisqually Delta. Presented by Melanie Davis


POST-RESTORATION MONITORING ON THE NISQUALLY DELTA
Melanie Davis USGS Western Ecological Research Center
Glynnis Nakai USFWS Billy Frank Jr. Nisqually National Wildlife Refuge
USGS

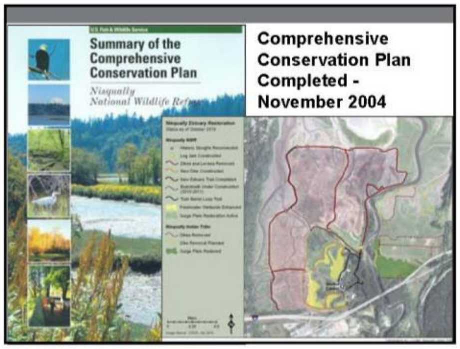

Large-Scale Restoration in the Pacific Northwest

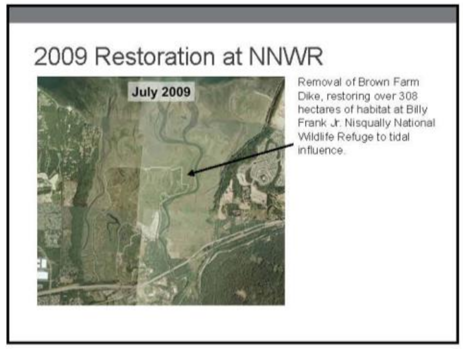

Large-Scale Restoration in the Pacific Northwest
Elwha
Port Susan Bay
Skokomish
Nisqually
Bear River (Willapa)


The Nisqually Delta Restoration
Puget Sound
Washington, USA
Nisqually River flows from the Nisqually Glacier on Mount Rainier
Largest river in South Puget Sound
Delta is site of Nisqually National Wildlife Refuge (USFWS)
One of the most ecologically and culturally significant restoration projects in the Pacific Northwest
Largest estuarine restoration project in Puget Sound to-date


Pre-Restoration Nisqually
1904-1910


September 1997

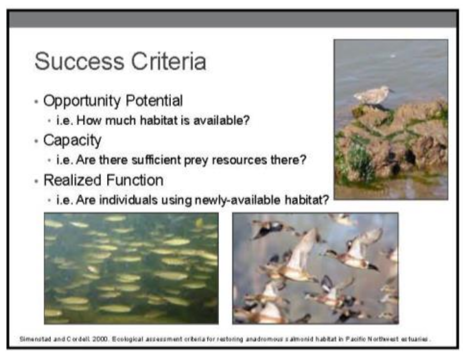

Summary of the Comprehensive Conservation Plan
Nisqually National Wildlife Refuge
Comprehensive Conservation Plan Completed - November 2004

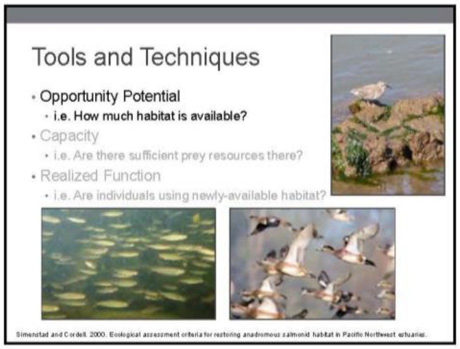

2009 Restoration at NNWR
July 2009
Removal of Brown Farm Dike, restoring over 308 hectares of habitat at Billy Frank Jr. Nisqually National Wildlife Refuge to tidal influence.

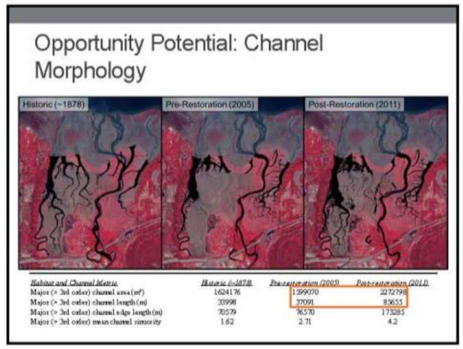

2009 Restoration at NNWR
Late September 2009
November 2009


2009 Restoration at NNWR
July 2009

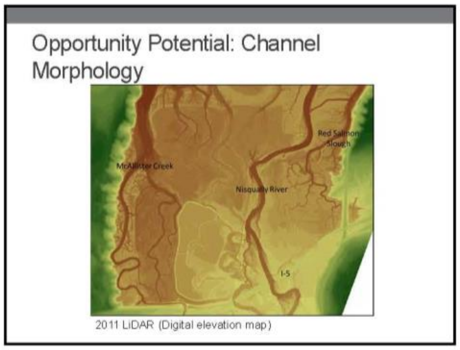

2009 Restoration at NNWR
July 2010

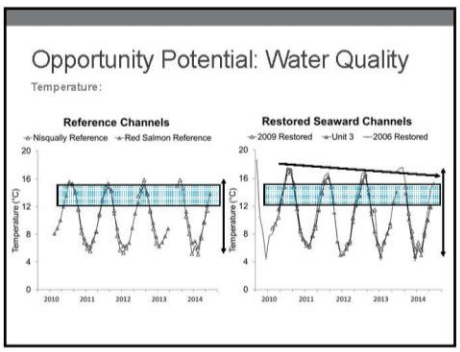

Success Criteria
Opportunity Potential
i.e. How much habitat is available?
Capacity
i.e. Are there sufficient prey resources there?
Realized Function
i.e. Are individuals using newly-available habitat?
Simenstad and Cordell. 2000. Ecological assessment criteria for restoring anadromous salmonid habitat in Pacific Northwest estuaries.

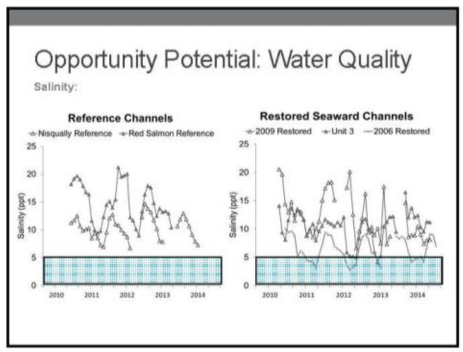




Habitat and Channel Metric	Historic (~1878)	Pre-restoration (2005)	Post-restoration (2011)
Major (> 3rd order) channel area (m²)	1624176	1599070	2272798
Major (> 3rd order) channel length (m)	33998	37091	85655
Major (> 3rd order) channel edge length (m)	70579	76570	173285
Major (> 3rd order) mean channel sinuosity	1.62	2.71	4.2







Opportunity Potential: Sediment Flux

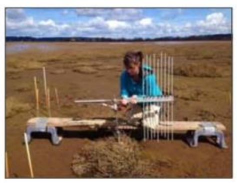
Alder Dam

Opportunity Potential: Sediment Flux

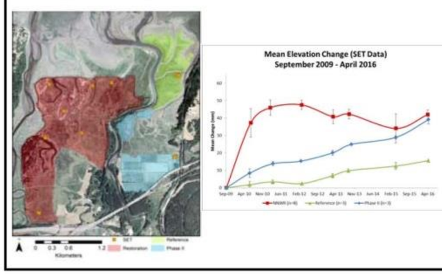
Surface Elevation Tables (SETs)

Opportunity Potential: Sediment Flux

- SETs
- Pros:
  - Permanent
  - Protected from debris
  - Minimal shifting (30 m deep)
- Cons:
  - Expensive
  - Require consistent measurement by trained individual
  - Results offset by disturbance



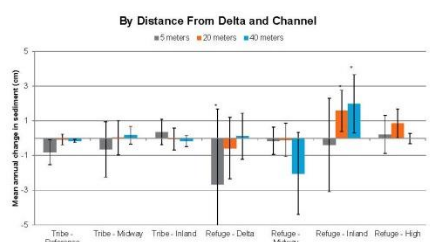
Opportunity Potential: Sediment Flux

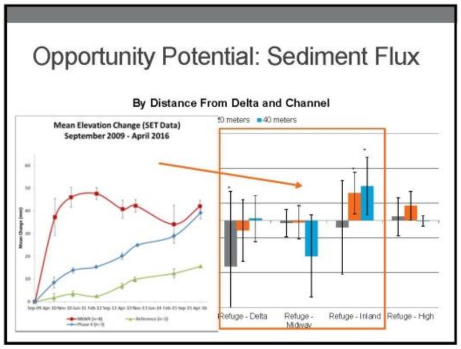


Opportunity Potential: Sediment Flux

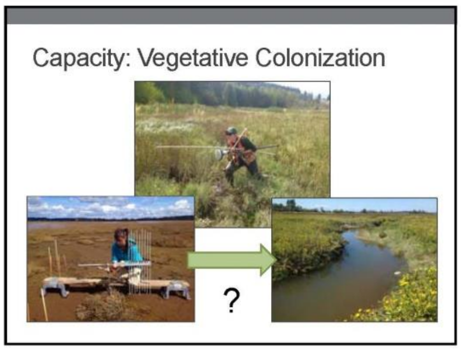
- PVC Sediment Pins
- Pros:
  - Less expensive
  - Easy to install and remove
  - Measuring takes seconds
- Cons:
  - Subject to settling and movement
  - Vulnerable to large woody debris
  - Scouring

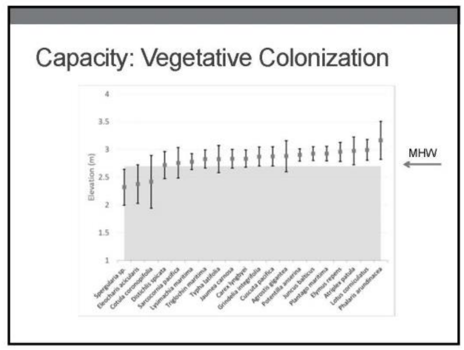
Opportunity Potential: Sediment Flux

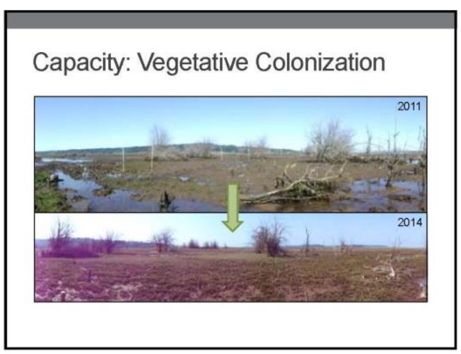


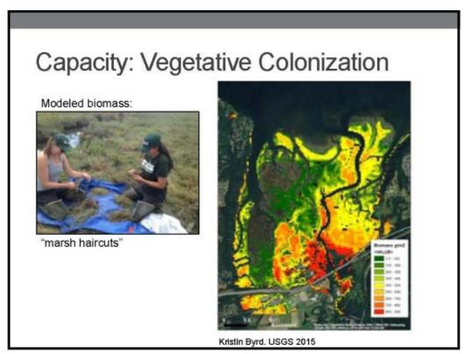

Opportunity Potential: Sediment Flux
By Distance From Delta and Channel
Mean Elevation Change (SET Data)
September 2009 - April 2016
40 meters
Refuge - Delta
Refuge - Midway
Refuge - Inland
Refuge - High

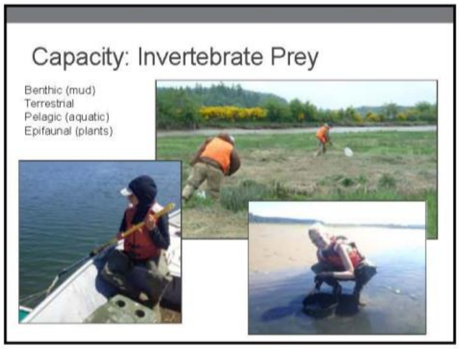

Tools and Techniques
• Opportunity Potential
• i.e. How much habitat is available?
• Capacity
• i.e. Are there sufficient prey resources there?
• Realized Function
• i.e. Are individuals using newly-available habitat?
Simenstad and Cordell. 2000. Ecological assessment criteria for restoring anadromous salmonid habitat in Pacific Northwest estuaries.

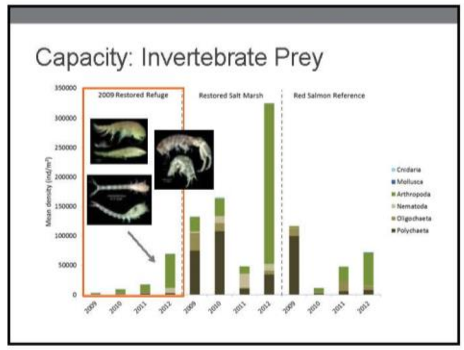

Capacity: Vegetative Colonization
?

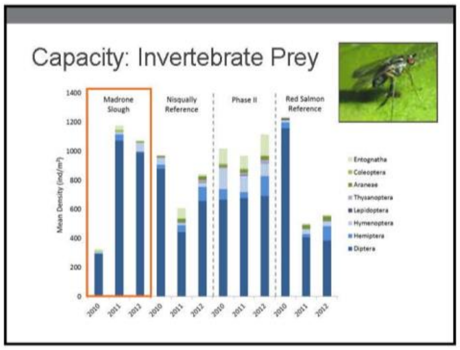

Capacity: Vegetative Colonization
Elevation (m)
MHW

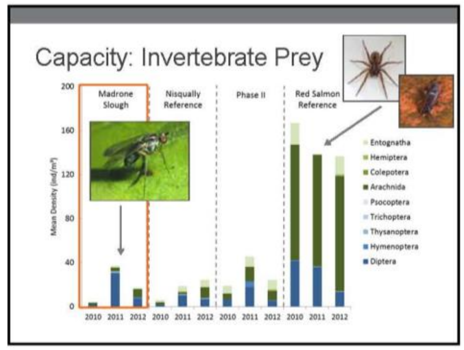

Capacity: Vegetative Colonization
2011
2014

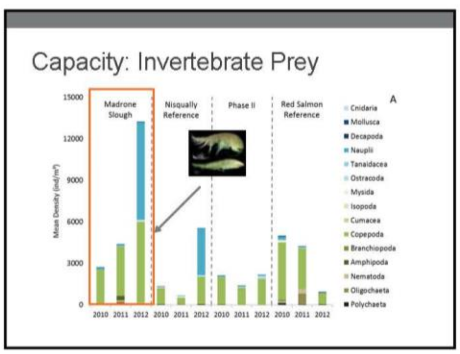

Capacity: Vegetative Colonization
Modeled biomass:
"marsh haircuts"
Kristin Byrd. USGS 2015

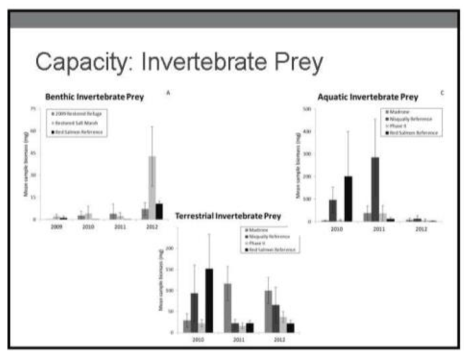

Capacity: Invertebrate Prey
Benthic (mud)
Terrestrial
Pelagic (aquatic)
Epifaunal (plants)


Capacity: Invertebrate Prey
2009 Restored Refuge
Restored Salt Marsh
Red Salmon Reference
Cnidaria
Mollusca
Arthropoda
Nematoda
Oligochaeta
Polychaeta


Capacity: Invertebrate Prey
Madrone Slough
Nisqually Reference
Phase II
Red Salmon Reference
Entognatha
Coleoptera
Araneae
Thysanoptera
Lepidoptera
Hymenoptera
Hemiptera
Diptera

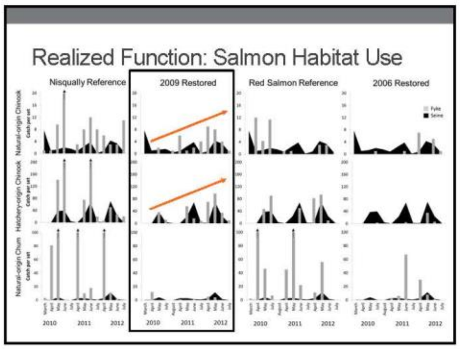

Capacity: Invertebrate Prey
Madrone Slough
Nisqually Reference
Phase II
Red Salmon Reference
Mean Density (ind/m²)
Entognatha
Hemiptera
Colepotera
Arachnida
Psocoptera
Trichoptera
Thysanoptera
Hymenoptera
Diptera

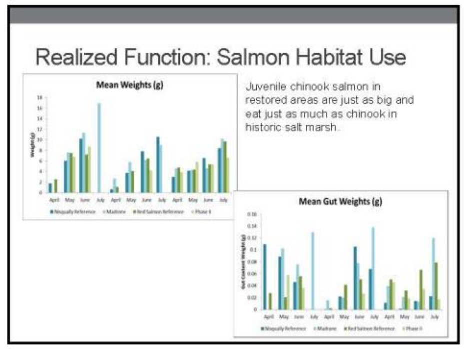

Capacity: Invertebrate Prey
Madrone Slough
Nisqually Reference
Phase II
Red Salmon Reference
Mean Density (ind/m²)
Cnidaria
Mollusca
Decapoda
Nauplii
Tanaidacea
Ostracoda
Mysida
Isopoda
Cumacea
Copepoda
Branchiopoda
Amphipoda
Nematoda
Oligochaeta
Polychaeta

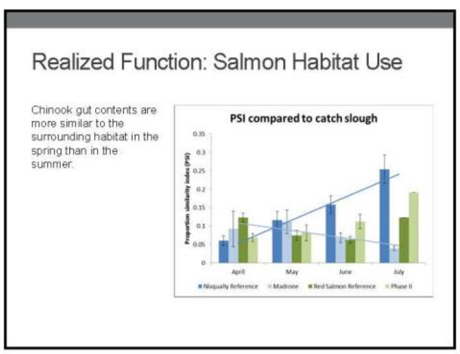

Capacity: Invertebrate Prey
Benthic Invertebrate Prey
Aquatic Invertebrate Prey
Terrestrial Invertebrate Prey

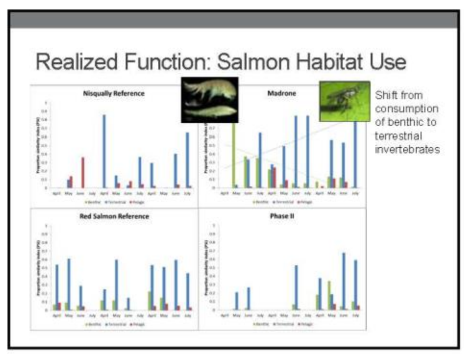

Tools and Techniques
• Opportunity Potential
• i.e. How much habitat is available?
• Capacity
• i.e. Are there sufficient prey resources there?
• Realized Function
• i.e. Are individuals using newly-available habitat?
Simenstad and Cordell. 2000. Ecological assessment criteria for restoring anadromous salmonid habitat in Pacific Northwest estuaries.


Realized Function: Salmon Habitat Use


Realized Function: Salmon Habitat Use
Nisqually Reference
2009 Restored
Red Salmon Reference
2006 Restored
2010
2011
2012

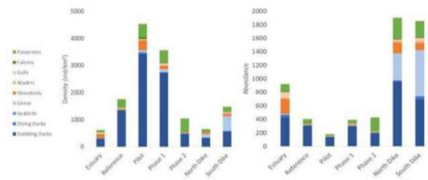

Realized Function: Salmon Habitat Use
Mean Weights (g)
Juvenile chinook salmon in restored areas are just as big and eat just as much as chinook in historic salt marsh.
Mean Gut Weights (g)


Realized Function: Salmon Habitat Use
Chinook gut contents are more similar to the surrounding habitat in the spring than in the summer.
PSI compared to catch slough
Proportion similarity index (PSI)
April
May
June
July
Nisqually Reference
Madrone
Red Salmon Reference
Phase II

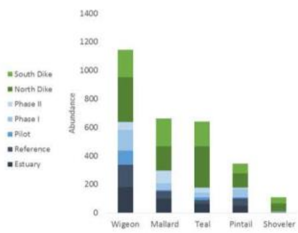

Realized Function: Salmon Habitat Use
Nisqually Reference
Madrone
Shift from consumption of benthic to terrestrial invertebrates
Red Salmon Reference
Phase II

Realized Function: Waterbird Habitat Use

Realized Function: Waterbird Habitat Use



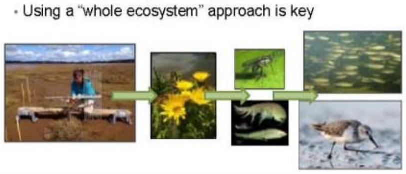
Realized Function: Waterbird Habitat Use



Realized Function: Waterbird Habitat Use

The Take-home Message:

- Long-term monitoring is crucial in addition to measuring immediate responses
- Combine field techniques with forecasting models and spatial analysis to get the big picture
- Using a "whole ecosystem" approach is key

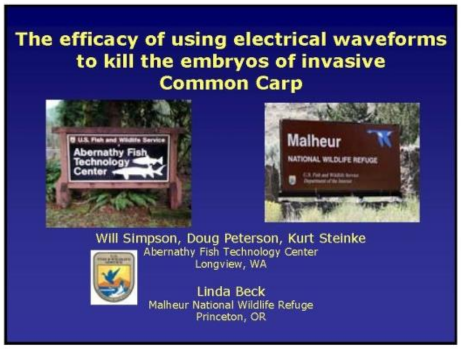


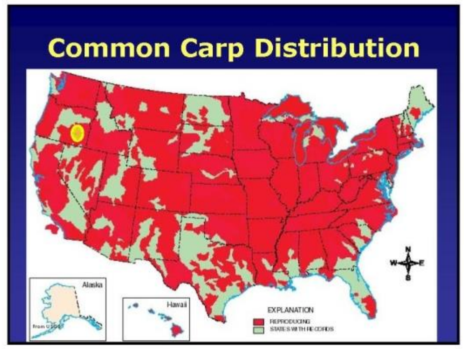
Moving Forward

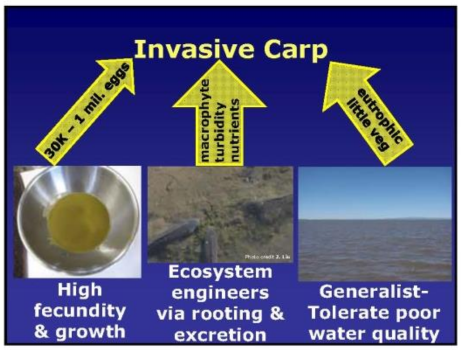
- Foodweb connectivity (ESRP)
- Stable isotope analysis
- Blue carbon – carbon flux, vegetation, and sediment accretion
- Sediment deposition, elevational changes in the face of climate change

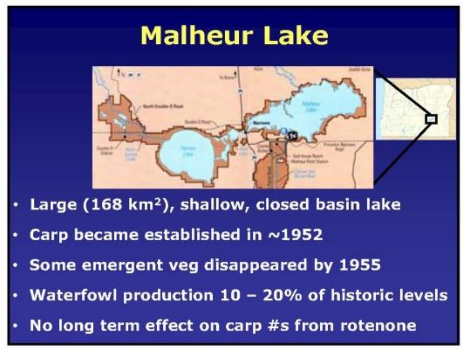
Partners and Collaborators
USGS WERC:
I. Woo
J. Takekawa
H. Minella
H. Allgood
M. Holt
A. Smith
L. Belleveau
S. Kaviar
K. Lovett
S. De La Cruz
K. Turner
L. Shakeri
S. Blakely
A. Hissem
J. Donald
A. Munguia
L. Lamere
Nisqually Indian Tribe:
J. Cutler
W. Duval
E. Perez
A. David
USFWS Collaborators:
G. Nakai
J.E. Takekawa
J. Barham
D. Roster
M. Bailey
Refuge volunteers
USGS
science for a changing world
WASHINGTON STATE
Recreation and Conservation Office

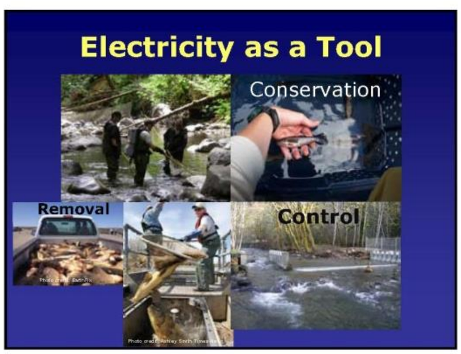
Presentation: The efficacy of using electrical waveforms to kill the embryos of invasive Common Carp. Presented by Will Simpson

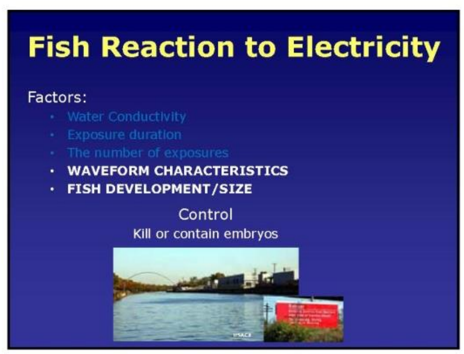

The efficacy of using electrical waveforms to kill the embryos of invasive Common Carp
U.S. Fish and Wildlife Service
Abernathy Fish Technology Center
Malheur
NATIONAL WILDLIFE REFUGE
Will Simpson, Doug Peterson, Kurt Steinke
Abernathy Fish Technology Center
Longview, WA
Linda Beck
Malheur National Wildlife Refuge
Princeton, OR


Common Carp Distribution
Alaska
Hawaii
EXPLANATION
REPRODUCING


Invasive Carp
30K – 1 mil. eggs
macrophyte
turbidity
nutrients
eutrophic
little veg
High fecundity & growth
Ecosystem engineers via rooting & excretion
Generalist- Tolerate poor water quality

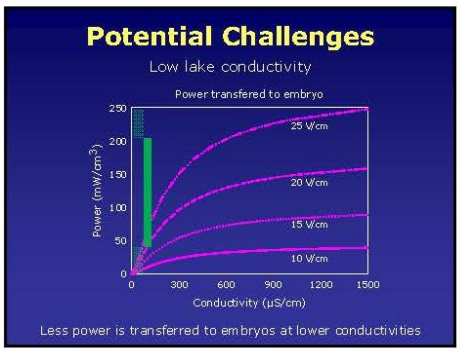

Malheur Lake
Large (168 km²), shallow, closed basin lake
Carp became established in ~1952
Some emergent veg disappeared by 1955
Waterfowl production 10 – 20% of historic levels
No long term effect on carp #s from rotenone

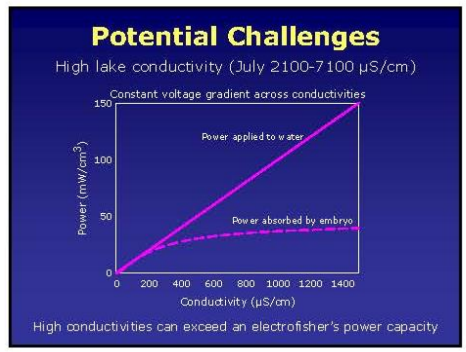

Electricity as a Tool
Conservation
Removal
Control

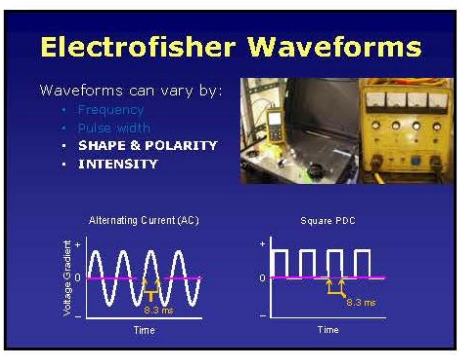

Fish Reaction to Electricity
Factors:
Water Conductivity
Exposure duration
The number of exposures
WAVEFORM CHARACTERISTICS
FISH DEVELOPMENT/SIZE
Control
Kill or contain embryos


Potential Challenges
Small embryos > shock resistant
AQUATIC ECO-SYSTEMS, INC.
Carp (2.1mm)
Steelhead (6.5mm)


Potential Challenges
Lake conductivity
• Do conditions conducive to killing embryos coincide with spawning?
• Carp spawning follows spring high water
• High water may reduce water conductivity


Potential Challenges
Low lake conductivity
Power transfered to embryo
Power (mW/cm3)
250
200
150
100
50
0
25 V/cm
20 V/cm
15 V/cm
10 V/cm
0
300
600
900
1200
1500
Conductivity (µS/cm)
Less power is transferred to embryos at lower conductivities

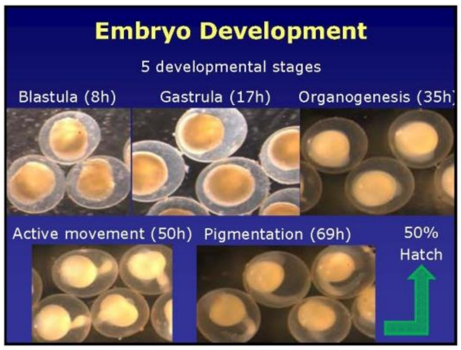

Potential Challenges
High lake conductivity (July 2100-7100 µS/cm)
Constant voltage gradient across conductivities
Power (mW/cm3)
150
100
50
0
Power applied to water
Power absorbed by embryo
0
200
400
600
800
1000
1200
1400
Conductivity (µS/cm)
High conductivities can exceed an electrofisher's power capacity


Electrofisher Waveforms
Waveforms can vary by:
• Frequency
• Pulse width
• SHAPE & POLARITY
• INTENSITY
Alternating Current (AC)
Square PDC
Voltage Gradient
+
0
–
8.3 ms
8.3 ms
Time
Time

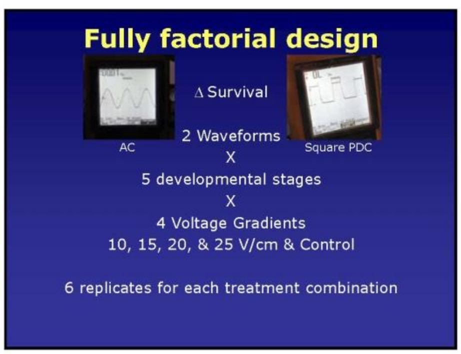

Shocking Equipment
Shocking box
• AC waveform
Coffelt VVP-15
• Square PDC waveform
Shocking chamber

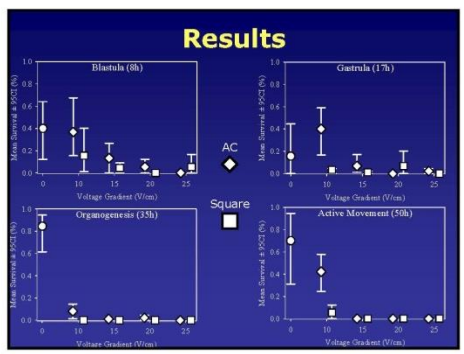

Setup
Recirculating tank system

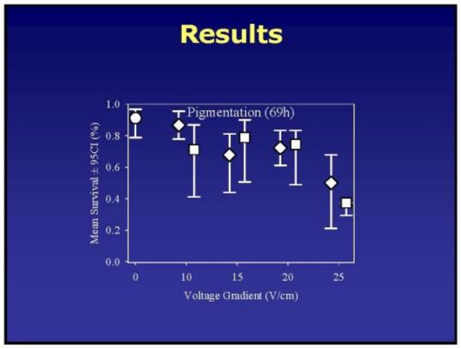

Carp Capture and Spawning

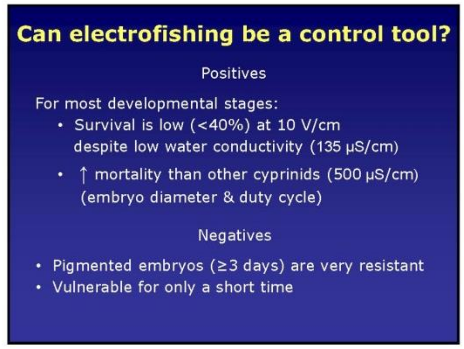

Embryo Development
5 developmental stages
Blastula (8h)
Gastrula (17h)
Organogenesis (35h)
Active movement (50h)
Pigmentation (69h)
50% Hatch

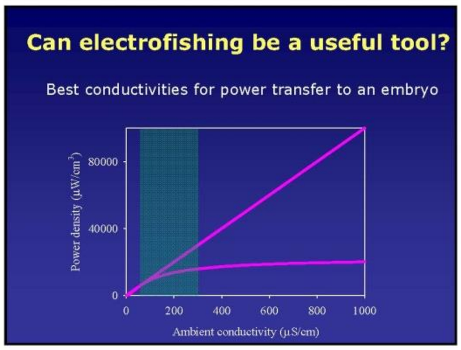

Embryos removed
Counted
Hatched in holding tanks
Shocked

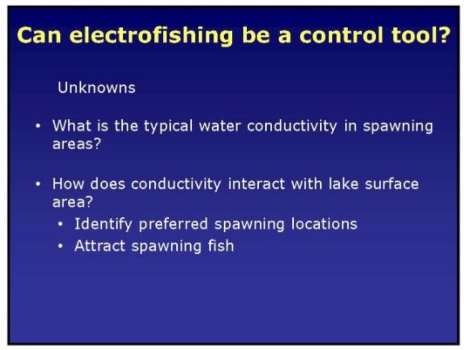

Fully factorial design
Δ Survival
AC
Square PDC
2 Waveforms
X
5 developmental stages
X
4 Voltage Gradients
10, 15, 20, & 25 V/cm & Control
6 replicates for each treatment combination


Results
Blastula (8h)
Gastrula (17h)
Organogenesis (35h)
Active Movement (50h)
AC
Square
Voltage Gradient (V/cm)


Results
Pigmentation (69h)
Mean Survival ± 95CI (%)
Voltage Gradient (V/cm)
1.0
0.8
0.6
0.4
0.2
0.0
0
10
15
20
25


Can electrofishing be a control tool?
Positives
For most developmental stages:
• Survival is low (<40%) at 10 V/cm despite low water conductivity (135 µS/cm)
• ↑ mortality than other cyprinids (500 µS/cm) (embryo diameter & duty cycle)
Negatives
• Pigmented embryos (≥3 days) are very resistant
• Vulnerable for only a short time


Can electrofishing be a useful tool?
Best conductivities for power transfer to an embryo
Power density (µW/cm³)
80000
40000
0
0
200
400
600
800
1000
Ambient conductivity (µS/cm)


Can electrofishing be a control tool?
Unknowns
• What is the typical water conductivity in spawning areas?
• How does conductivity interact with lake surface area?
• Identify preferred spawning locations
• Attract spawning fish


Can electrofishing be a control tool?
Unknown: Can we maintain 10 V/cm on Malheur Lake?


Can electrofishing be a useful tool?
Unknowns
• Are hatched carp vulnerable to electrofishing?

Acknowledgements

Peter Brown – Montana Co-op Fish Research Unit

Malheur Refuge Fire Crew and Staff

Alan Temple – USFWS

Presentation: Modeling the effects of control efforts on a population of Common Carp (*Cyprinus carpio*) in a shallow eutrophic desert lake. Presented by James Pearson

Modeling a Population of Invasive Common Carp (*Cyprinus carpio*) in Malheur Lake:
The Potential to Promote Long-term Ecological Restoration

James Pearson
Jason Dunham, Ryan Bellmore, & Linda Beck

Research Objectives

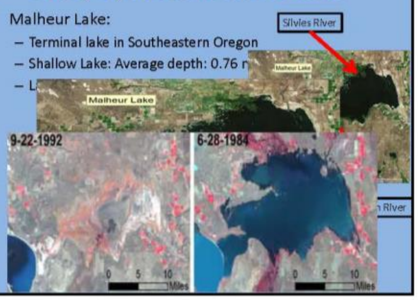
1) Create a unique carp population model to simulate the dynamics (recruitment, growth, and death) of the carp in Malheur Lake

2) Use the population dynamics model to explore alternative carp control measures
   - Commercial Harvest
   - Egg Electroshocking
   - Combination

3) Examine the potential for lake fluctuations to enable the targeting of carp and increase removal efficiencies

Study System: Malheur Lake

- Malheur Lake:
  - Terminal lake in Southeastern Oregon
  - Shallow Lake: Average depth: 0.76 m



Historic Conditions

- Malheur Lake:
  - Freshwater Marsh
    - Clear Stable State
    - Abundant Food for Waterfowl

Current Conditions

- Highly Turbid Environment
  - Decreased:
    - Aquatic Vegetation
    - Waterfowl Production

The MNWR CCP hypothesizes this current state is linked to the introduction of the invasive Common carp (*Cyprinus carpio*)

- Physically uproot aquatic vegetation
- Suspending sediment in the water column

However…

Impacts can potentially be reversed if the carp biomass is reduced < 100 Kg/Ha

What makes modeling the right choice?

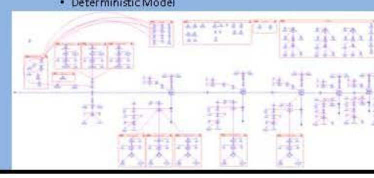
Rationale

- Inability to control carp over the last 65 years
- Greater understanding of the carp population
  - Complex processes involved in a population
- Evaluating Management Strategies
  - Effectively asses costs/benefits of management actions
- Integration of data from field experiments
- Ability to present possible solutions to stakeholders

Objective #1:
Create a unique carp population model to simulate the dynamics (recruitment, growth, and death) of the carp in Malheur Lake

Approach

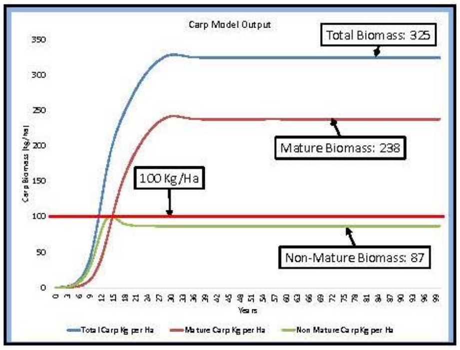
- Model
  - Age-based Population Model
    - Incorporate:
      - Basic Population Dynamics Parameters
    - Annual Time-step
    - Deterministic Model



Carp Population Dynamic Model Parameters

Parameter	Formula	Citation
Von Bertlanffy Growth Model	$L_{(t)} = L_{\infty}(1 - e^{-k(t-t_0)})$	unpubl. data; Colvin et al., 2012
Length to Weight Equation	$W = aL^{b}$	unpubl. data; Beck, 2014
Ricker Stock Recruitment Model	$R = aSe^{-\beta S}$	Brown & Walker, 2004
Probability of Maturity	[illegible]	Brown & Walker, 2004
Instantaneous Mortality Rate	$M = 0.06(-\frac{L}{L_{\infty}})^{-1.5}$	Bajer et al., 2015
Annual Finite Mortality	$V_{(t)} = 1 - e^{-M} + 10^{-x} \cdot D$	Bajer et al., 2015

Preliminary Results:
Carp Population Model



How do we ensure the model works correctly?

Model Analysis

- Stress the Model
  - Shift Parameter
    - Very Unscientific
      - » Check Multiple Outputs
        - Biomass
        - Population
        - Total Mortality
- Sensitivity Analysis:
  - Model Parameter Variability
    - Single Perturbation Analysis
    - Global Sensitivity Analysis
      - » Random Forest Package (R)
        - Ranks parameters

What about avian predation?

Avian Predation

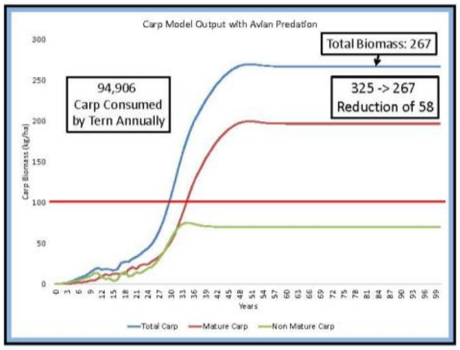
- Avian Predation
  - Hypothesized:
    - Significant contributor to the annual carp mortality in Malheur Lake
- Most prevalent avian piscivores:
  - **Caspian Terns** (*Hydroprogne caspia*)
  - **Double Crested Cormorants** (*Phalacrocorax auritus*)
  - **American White Pelicans** (*Pelecanus erythrorhynchos*)

How do we determine the rates of avian predation?

- **Construct a bioenergetics model:**
  - Observers:
    - Bird Species Present
    - Colony Size
    - Days Present
    - Diet Composition
  - Known:
    - Field Metabolic Rates
    - Carp Energy Densities

Quantifying the effect of predators on endangered species using a bioenergetics approach: Caspian terns and juvenile salmonids in the Columbia River estuary (Roby et al., 2003)

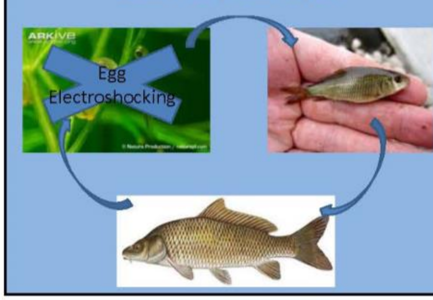
Preliminary Results:
Carp Population Model
with Avian Predation



Objective #2:
Use the population dynamics model to explore alternative carp control measures (Commercial Harvest and Egg Electroshocking)

Egg Electroshocking

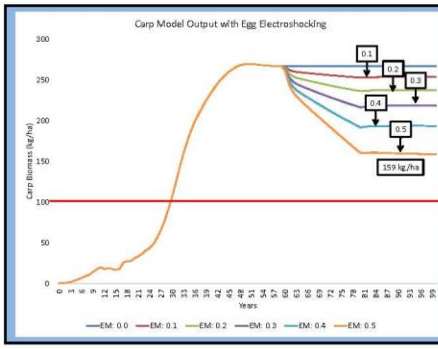
Basic Carp Life Cycle



Egg Electro-shocking

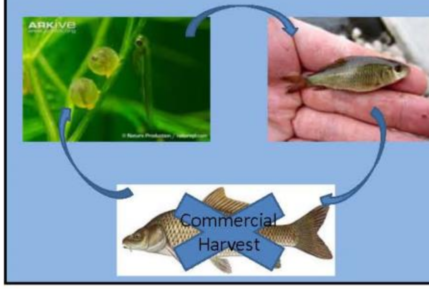
- Egg Electroshocking Mortality
  - USFWS Researchers

Preliminary Results:
Egg Electroshocking



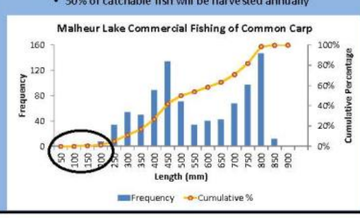
Commercial Harvest

Basic Carp Life Cycle

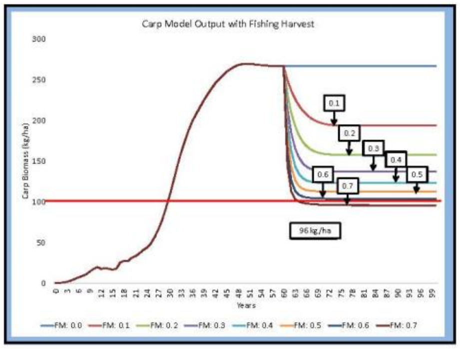


Commercial Harvest

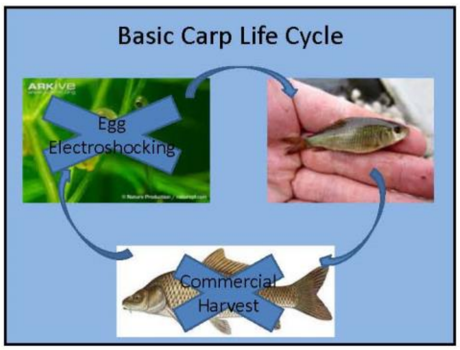
- Annual Commercial Fishing Mortality (*f*)
  - Carp > 250mm (Age 3+)
  - Ex: *f = 0.3*
    - 30% of catchable fish will be harvested annually



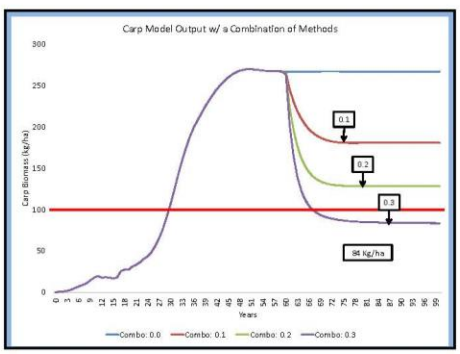
Preliminary Results:
Fishing Mortality



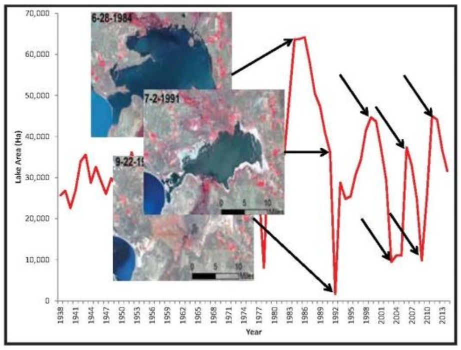
Combination of Methods

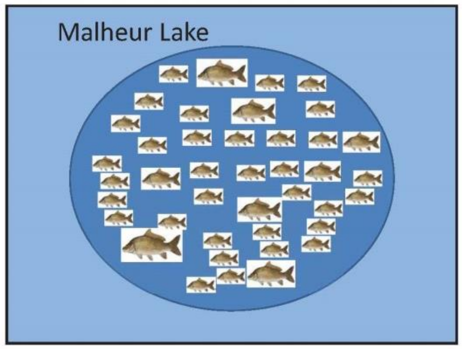


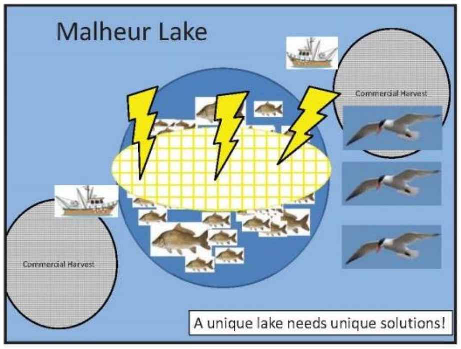
Preliminary Results:
Combination of Removal Efforts



Objective #3:
Examine the potential for lake fluctuations to enable the targeting of carp and increase removal efficiencies







Future Work

- Lake fluctuations
- Combination of Removals
- Density Dependent & Lake Fluctuation Effect on Avian Predation

Special Thanks

- Oregon State University
  - Don Lyons
- United States Geological Survey
  - Jason Dunham
  - Ryan Bellmore
- USFW: Malheur National Wildlife Refuge
  - Chad Karges
  - Linda Beck

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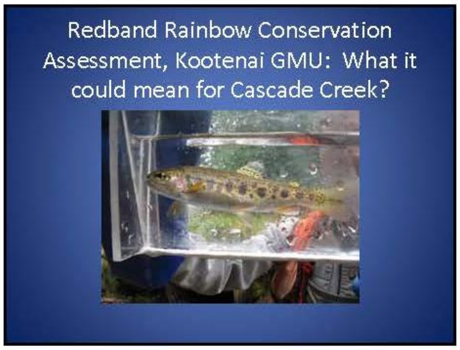
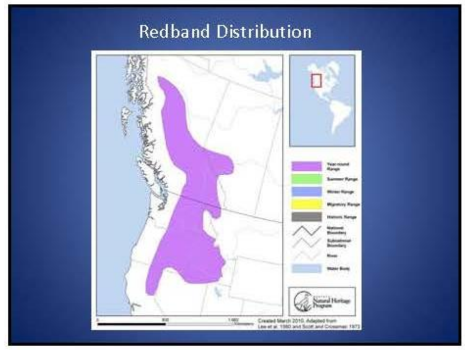
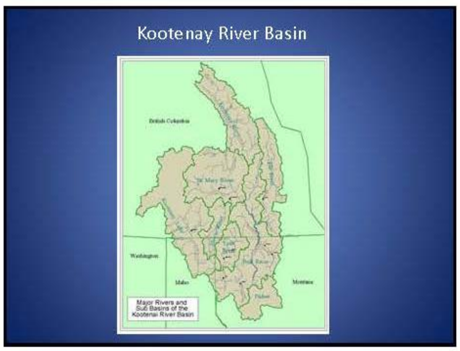
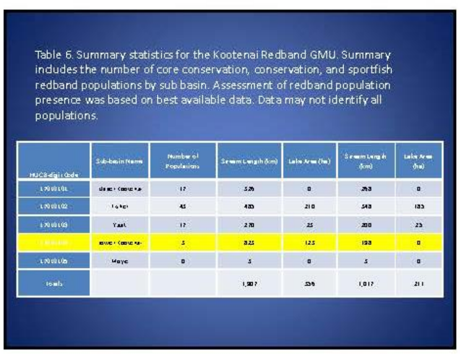
jpearson@usgs.gov

Presentation: Redband Rainbow Conservation Assessment, Kootenai GMU: What it could mean for Cascade Creek. Presented by Mike Faler

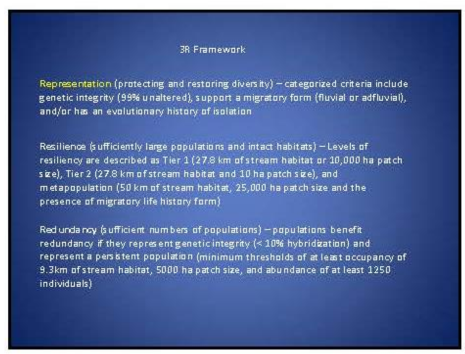








HUC8-digit Code	Sub-basin Name	Number of Populations	Stream Length (km)	Lake Area (ha)	Stream Length (km)	Lake Area (ha)
17010101	Upper Kootenai	17	525	0	250	0
17010102	Fisher	45	485	210	540	185
17010103	Yaak	17	270	25	200	25
[illegible]	Lower Kootenai	5	825	125	198	0
17010105	Moyie	0	5	0	5	0
Totals			1,807	535	1,017	211



3R Framework

Representation (protecting and restoring diversity) – categorized criteria include genetic integrity (99% unaltered), support a migratory form (fluvial or adfluvial), and/or has an evolutionary history of isolation

Resilience (sufficiently large populations and intact habitats) – Levels of resiliency are described as Tier 1 (27.8 km of stream habitat or 10,000 ha patch size), Tier 2 (27.8 km of stream habitat and 10 ha patch size), and metapopulation (50 km of stream habitat, 25,000 ha patch size and the presence of migratory life history form)

Redundancy (sufficient numbers of populations) – populations benefit redundancy if they represent genetic integrity (< 10% hybridization) and represent a persistent population (minimum thresholds of at least occupancy of 9.3km of stream habitat, 5000 ha patch size, and abundance of at least 1250 individuals)

3R Framework

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Redundancy (sufficient numbers of populations) – populations benefit redundancy if they represent genetic integrity (< 10% hybridization) and represent a persistent population (minimum thresholds of at least occupancy of 9.3km of stream habitat, 5000 ha patch size, and abundance of at least 1250 individuals)

Fish Passage/Fish Habitat

Goal:
Maintain or enhance Redundancy

Objective:
Maintain Cascade Creek conservation population

Action:
Replace existing diversion with a new screened diversion to reduce or eliminate the population sink (FWS; 2017)

Population Assessment

Goal:
Maintain or enhance Redundancy

Objective:
Maintain Cascade Creek conservation population

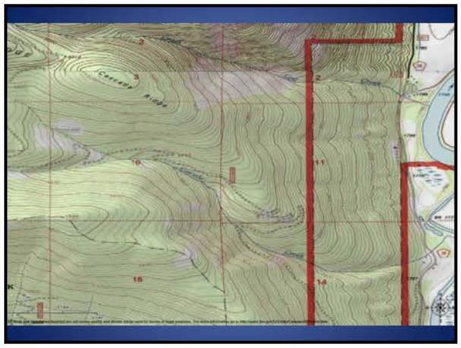
Action:
Action: Sample upstream of the lower waterfall to verify distribution of IRBT in Cascade Creek (FWS/Kootenai Tribe; 2016)

Population Enhancement/Expansion

Goal:
Maintain or enhance Redundancy

Objective:
Maintain Cascade Creek conservation population

Action:
Action: Assess feasibility of expanding the distribution of Cascade Creek IRBT into upper watershed (FWS, USFS, IDFG, Kootenai Tribe; 2018)



Fish Production

Goal:
Improve public perception about conservation of IRBT

Objective:
Develop and promote sport fisheries for IRBT in the Kootenai GMU

Action:
Evaluate the feasibility of utilizing rearing space at Twin Rivers Hatchery for the production of IRBT (Kootenai Tribe; 2016)

Interior Redband Trout

Presentation: Landscape Conservation Design: Updates and where we are heading.
Presented by Kevin O'Hara and Khem So

Today's Discussion

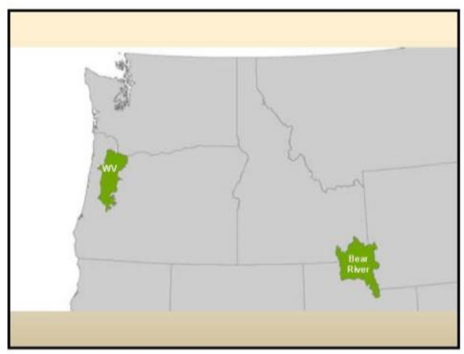
- **Landscape Conservation Design**
  - **Overview**
  - **Where we are today**
- **LCDs and Aquatic Resources**
  - **Willamette Valley Conservation Study**
  - **Columbia Plateau**
- **Lessons Learned**

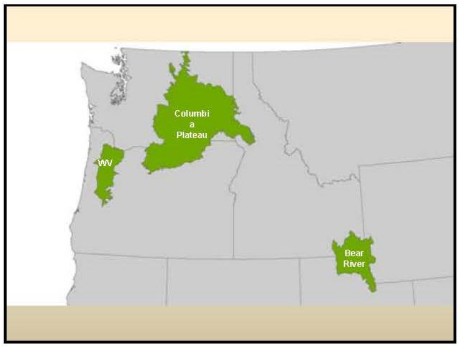
LCD Defined (602 FW 5)

- LCD is a **partnership-driven process** that
- **assesses current** and anticipated **future biological** and **socioeconomic conditions**,
- depicts **spatially-explicit desired future conditions**, and
- **produces** a suite of **management strategies** for achieving those conditions on a landscape scale.

LCD Process in Transition

- **Initially interpreted as a "refuge thing"**
- **Partners and Coastal Programs must consider LCDS when updating 5-year plans**
- **LCCs taking on "convener" role**
- **LCDs inform cross-program planning**
  - **Willamette Valley Work Plan**
- **Bottom Line: Get involved**





LCD: Four Cornerstones

- **People**
- **Purpose**
- **Process**
- **Products**

People

- **LCDs are values driven** based on **stakeholder needs** within the landscape
- **Stakeholder-driven**
  - Multi-jurisdiction (Fed, State, Local)
  - Multi-sector (Industry, NGOs, Academia)
- **Decision-makers and** the on-the-ground **implementers** of both **conservation** and **utilization** activities within the landscape

Purpose

- To **co-produce** and use **interdisciplinary science**
- to **identify priorities** and **coordinated adaptation strategies**
- that **protect** biodiversity and ecosystem services
- and **increase the resilience** and sustainability of **socio-ecological systems that support priority resources** for **future generations** despite uncertainty and change

Process

- Transparent, deliberative, and iterative
- **Integrates societal values** and multi-jurisdiction/ sector interests with the best available **science**
- To inform the **identification of landscape configurations** (i.e., spatial designs) **and coordinated adaptation strategies** (i.e., strategic plans)
- that ensure current and plausible future landscapes are able **to support priority resources for future generations** despite uncertainty and change

LCD Process

- **Assess current landscape conditions** described in terms of vulnerabilities, risks, and opportunities associated with the interests of landscape stakeholders (e.g., FWS trust resources)
- **Assess plausible futures** developed through **participatory stakeholder processes** (i.e., qualitative and/or quantitative **scenario planning** processes) **or other methods agreed to by landscape stakeholders**

LCD Products

- A **portfolio of spatial designs** (blueprints) and
- **Coordinated adaptation strategies** (strategic plans).
  - Who does what where
- Must be capable of **guiding development** of **unit-specific planning, assessment, and decision-making**
  - **Step-down to individual management units**

Willamette Valley Conservation Study Riverine Objectives

- **Numerous studies identify priority areas**
- **Slices (Willamette Futures Study)**
  - **High restoration potential/ low social constraints**
- **Cold water refugia**
- **OWEB anchor habitats**
- **Corps prioritized revetments for removal (zones of influence)**
- **2-year flood inundation map**

Willamette/Santiam Confluence
Zones of Influence
Ankeny NWR

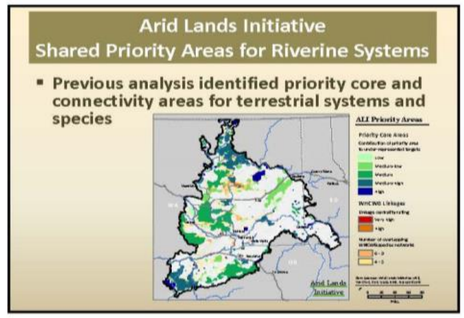
Willamette Valley Conservation Study – Fish Habitat Elements

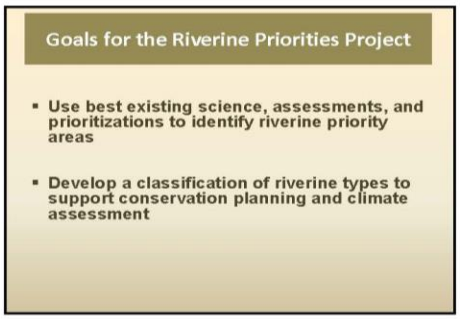
WVCS Riparian Focus

32 PCAs
Wetlands: 8,500 ac.
Anchor Habitats: 6,500 ac.
Cold Points: 1,100 ac.
Zones of Influence: 5,100 ac.

Protected: 1,950 ac.
Unprotected: 21,700 ac.


Arid Lands
Initiative
Great Northern
LANDSCAPE CONSERVATION COOPERATIVE
The Nature Conservancy
Protecting nature. Preserving life.
WASHINGTON STATE DEPARTMENT OF
Natural Resources
Audubon
USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service


Arid Lands Initiative
Shared Priority Areas for Riverine Systems
Previous analysis identified priority core and connectivity areas for terrestrial systems and species
ALI Priority Areas


Goals for the Riverine Priorities Project
Use best existing science, assessments, and prioritizations to identify riverine priority areas
Develop a classification of riverine types to support conservation planning and climate assessment


Project Progress to Date
Develop a core team (WDFW, USFWS, NPPC)
Data exploration
Identify partner goals
Expert input
Riverine classification
Prioritization
Outreach
Climate vulnerability
Photo: George Wesley & Bonita Dannells under CC BY-NC-ND 2.0


Data Mining
DATA BASIN
Atlas of Riverine and Riparian Assessments and Priorities in the Mid-Columbia Region
Photo: George Wesley & Bonita Dannells under CC BY-NC-ND 2.0


Riverine Priorities for the ALI
Don't focus on salmon/steelhead
Functioning riverine systems
Representativeness of types
Bull trout
Redband trout
Pacific lamprey
Waterbirds and shorebirds
Riparian birds
Beaver
Photo: George Wesley & Bonita Dannells under CC BY-NC-ND 2.0

WHO WE TALKED TO


Photo: George Wesley & Bonita Dannells under CC BY-NC-ND 2.0

- ✓ **Mike Green**, Migratory Birds & Habitat Program, USFWS
- ✓ **Lee Benda**, TerrainWorks
- ✓ **Tim Beechie**, Northwest Fisheries Science Center, NOAA
- ✓ **Julian Olden**, School of Aquatic and Fishery Sciences, UW
- ✓ **Marie Winkowski**, Science Division, Fish Program, WDFW
- ✓ **John Pierce**, Science Division, Wildlife Program, WDFW
- ✓ **David Theobald**, Senior Scientist, CSP
- ✓ **Tim Whitesel**, Columbia River Fisheries Program, USFWS
- ✓ **Mike Hudson**, Columbia River Fisheries Program, USFWS
- ✓ **Meade Krosby**, Climate Impacts Group, UW

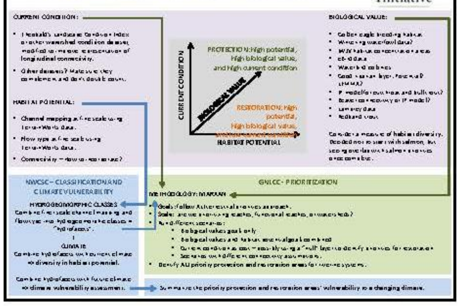
WHAT WE HEARD


Photo: George Wesley & Bonita Dannells under CC BY-NC-ND 2.0

- ✓ Consider priorities for **protection** and **restoration**.
- ✓ **Habitat potential** should be one dimension of priorities. Based on physical, geomorphological, process-based variables.
- ✓ **Biological value** should be one dimension of priorities: species data, or important areas for species.
- ✓ **Current condition** should be another dimension of priorities. Will be used differently to inform protection or restoration priorities.
- ✓ **Connectivity** is key, particularly longitudinal connectivity.
- ✓ Methods – everyone who gave an opinion recommended **scoring or Marxan**.

HOW WE ARE MOVING FORWARD

Arid Lands Initiative



Lessons Learned

- Third-party conveners are your friend
  - LCCs, Arid Lands Initiative
- But the State is your best friend
- Involve decision-makers early and often
- Agree on a work plan early
- But maintain flexibility – new info
- Don't let the perfect be the enemy of the good (enough)
- Thicken your hide – prepare for "storming" before "norming" and "preforming"

Sally Jewell (4/19/16)

- "We know that healthy, intact ecosystems are fundamental to the health of our wildlife – and our nation.
- But if their integrity is undermined by a haphazard web of transmission lines, pipelines and roads, where does that leave us 50 years from now? Or 500?

Sally Jewell (4/19/16)

- What we need is smart planning, on a landscape-level, irrespective of manmade lines on a map. We need to take a holistic look at an ecosystem – on land or in the ocean – to determine where it makes sense to develop, where it makes sense to protect the natural resources, and where we can accomplish both.

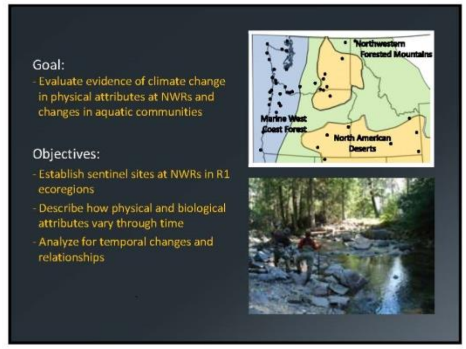
Sally Jewell (4/19/16)

- This isn't a pie-in-the-sky idea. We need look no further than the greater sage-grouse conservation effort to see what's possible when people work together across a landscape....
- That's the model for the future of conservation. That big-picture, roll-up-your-sleeves, get-input-from-all-stakeholders kind of planning is how land management agencies should orient themselves in the 21st century."

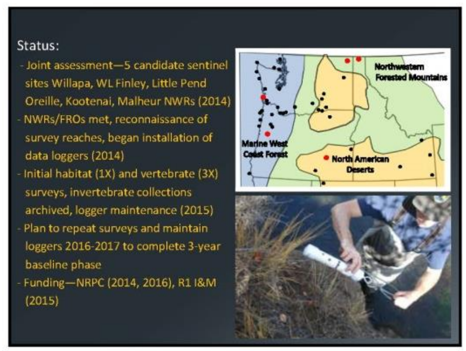
Thank You

Presentation: Progress on the pilot project to develop a long-term aquatic monitoring program for climate change at Region 1 refuges. Presented by Sam Lohr, Mike Faler, and RD Nelle


Progress on the Pilot Project to Develop a Long-term Aquatic Monitoring Program for Climate Change at Region 1 Refuges


Goal:
- Evaluate evidence of climate change in physical attributes at NWRs and changes in aquatic communities
Objectives:
- Establish sentinel sites at NWRs in R1 ecoregions
- Describe how physical and biological attributes vary through time
- Analyze for temporal changes and relationships
Northwestern Forested Mountains
Marine West Coast Forest
North American Deserts

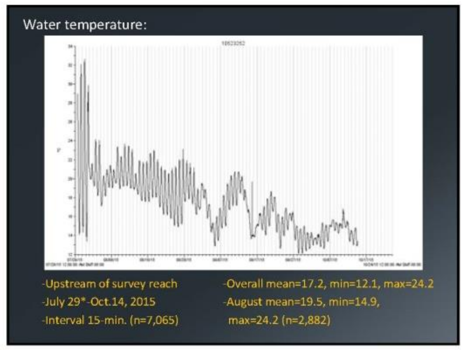

Approach:
- Collaboration—Refuges, Fisheries, Water Resources
- Desired qualities—sustainable, existing data, consistency in habitats/attributes
- Three phases (reconnaissance, baseline, long-term)
Methods:
- Joint assessment to identify candidate sentinel sites
- Temperature/flow using EPA Best Practices Guidance (EPA 2014)
-Habitat/vertebrate surveys using EPA EMAP protocols (Peck et al. 2006)

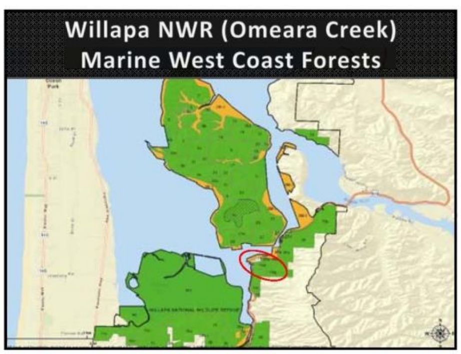

Status:
- Joint assessment—5 candidate sentinel sites Willapa, WL Finley, Little Pend Oreille, Kootenai, Malheur NWRs (2014)
- NWRs/FROs met, reconnaissance of survey reaches, began installation of data loggers (2014)
- Initial habitat (1X) and vertebrate (3X) surveys, invertebrate collections archived, logger maintenance (2015)
- Plan to repeat surveys and maintain loggers 2016-2017 to complete 3-year baseline phase
- Funding—NRPC (2014, 2016), R1 I&M (2015)
Northwestern Forested Mountains
Marine West Coast Forest
North American Deserts

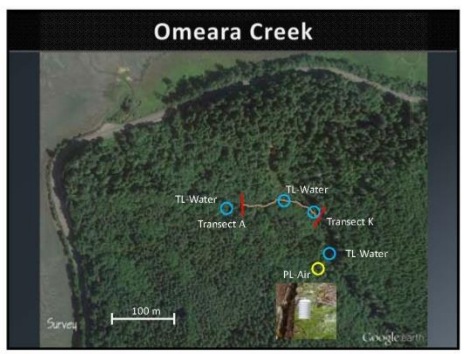

Results 2015

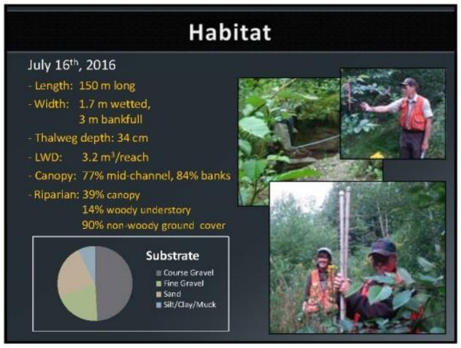

W.L. Finley NWR (Muddy Creek)-Marine West Coast Forest

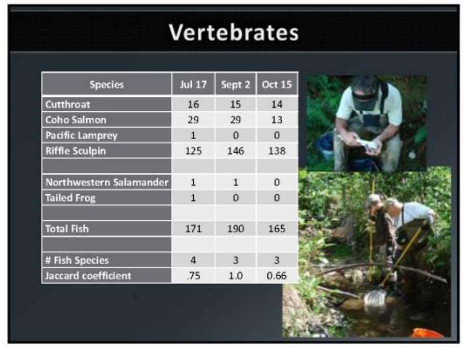
Species	Sept 15	Oct 14
Mosquitofish	18	35
Northern pikeminnow	8	4
Redside shiner	15	5
Reticulate sculpin	35	15
Threespine stickleback	1	0
Western brook lamprey	0	1
--No. species	5	5
--Jaccard coef.	0.8	0.8



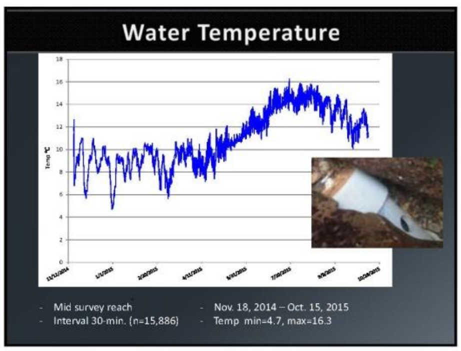


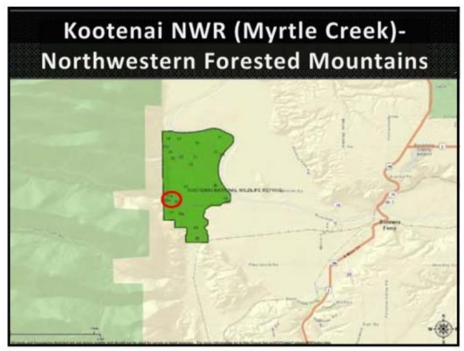


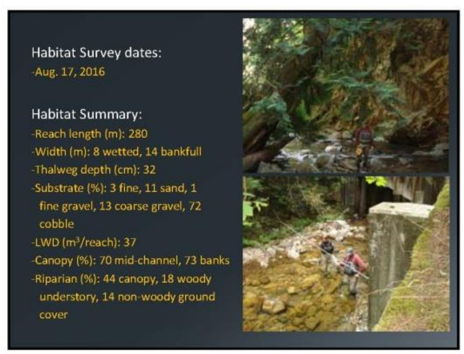


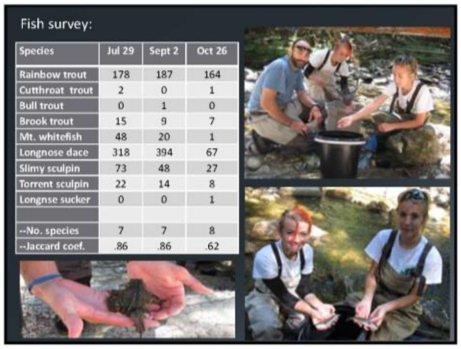


Species	Jul 17	Sept 2	Oct 15
Cutthroat	16	15	14
Coho Salmon	29	29	13
Pacific Lamprey	1	0	0
Riffle Sculpin	125	146	138
Northwestern Salamander	1	1	0
Tailed Frog	1	0	0
Total Fish	171	190	165
# Fish Species	4	3	3
Jaccard coefficient	.75	1.0	0.66

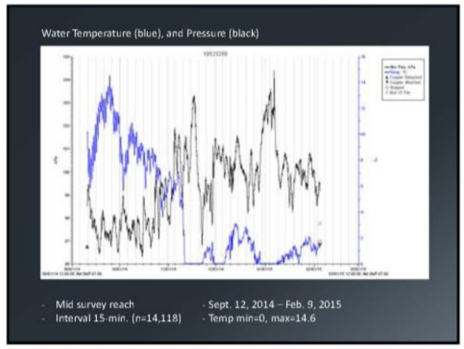


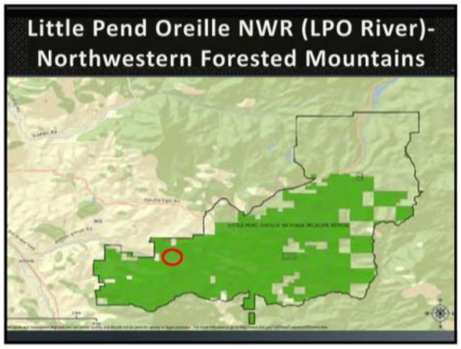


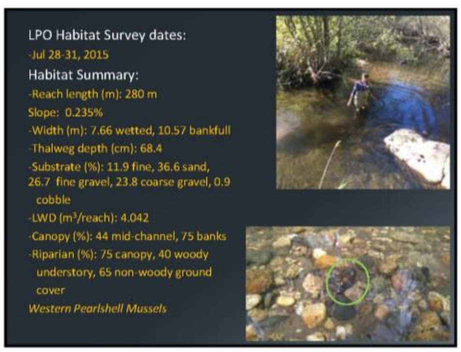




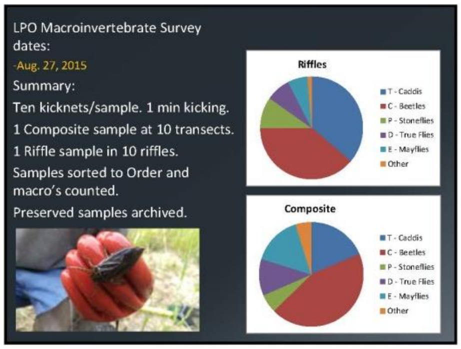
Species	Jul 29	Sept 2	Oct 26
Rainbow trout	178	187	164
Cutthroat trout	2	0	1
Bull trout	0	1	0
Brook trout	15	9	7
Mt. whitefish	48	20	1
Longnose dace	318	394	67
Slimy sculpin	73	48	27
Torrent sculpin	22	14	8
Longnse sucker	0	0	1
--No. species	7	7	8
--Jaccard coef.	.86	.86	.62

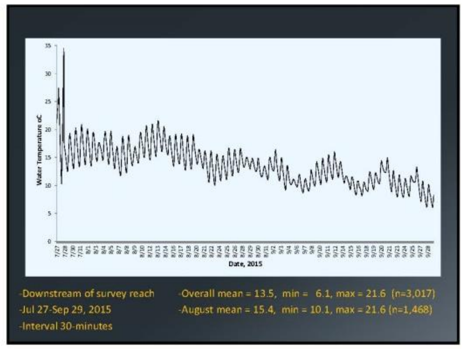


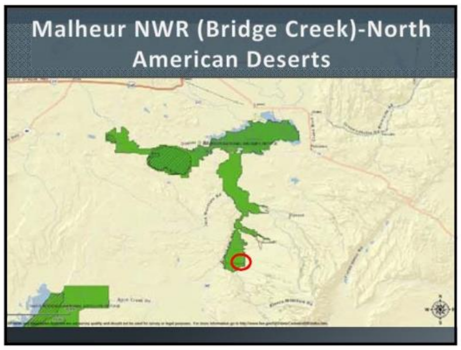


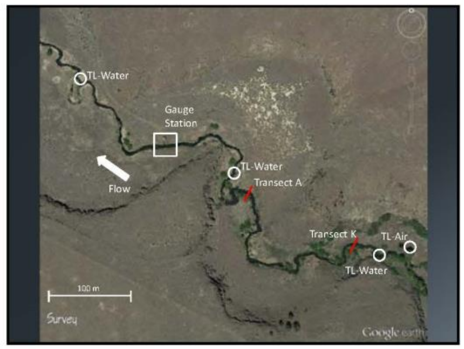


Species	Jul 28	Aug 27	Sep 29
Temp °C	12-17	12-16.5	5.5-10
Rainbow trout	10	4	9
E. Brook trout	70	64	55
Brown trout	11	9	7
Shorthead sculpin	49	77	27
Trout total	91	78	71
Fish total	140	155	98
--No. species	4	4	4
--Jaccard coef.	1	1	1

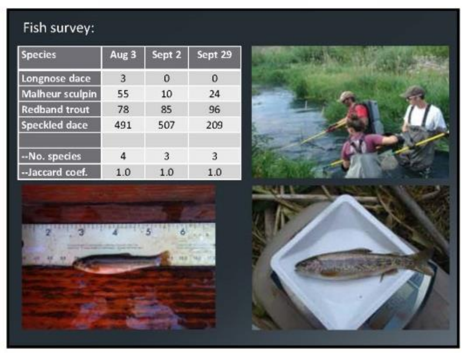

LPO Macroinvertebrate Survey dates:
-Aug. 27, 2015
Summary:
Ten kicknets/sample. 1 min kicking.
1 Composite sample at 10 transects.
1 Riffle sample in 10 riffles.
Samples sorted to Order and macro's counted.
Preserved samples archived.
Riffles
T - Caddis
C - Beetles
P - Stoneflies
D - True Flies
E - Mayflies
Other
Composite
T - Caddis
C - Beetles
P - Stoneflies
D - True Flies
E - Mayflies
Other

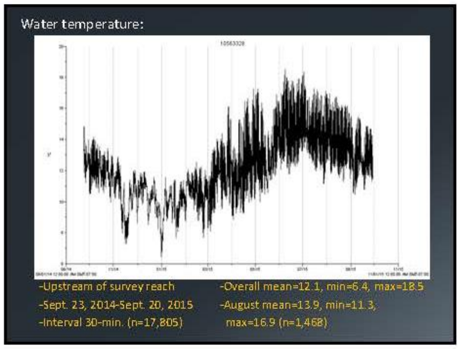

Water Temperature oC
Date, 2015
-Downstream of survey reach
-Jul 27-Sep 29, 2015
-Interval 30-minutes
-Overall mean = 13.5, min = 6.1, max = 21.6 (n=3,017)
-August mean = 15.4, min = 10.1, max = 21.6 (n=1,468)


Malheur NWR (Bridge Creek)-North American Deserts


TL-Water
Gauge Station
Flow
TL-Water
Transect A
Transect K
TL-Air
TL-Water
100 m
Survey
Google earth

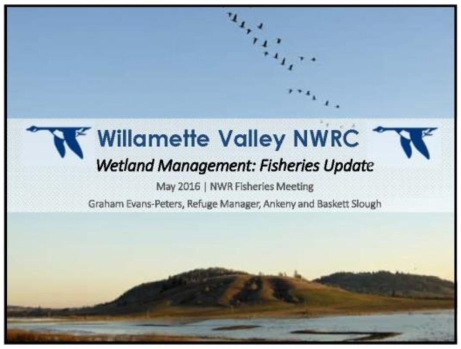

Survey dates:
-Aug. 3, Sept. 2, Sept. 29
Habitat:
-Reach length (m): 240
-Width (m): 4.9 wetted, 5.6 bankfull
-Thalweg depth (cm): 61
-Substrate (%): 51 fine, 21 sand, 15 fine gravel
-LWD (m^3/reach): 0.1
-Canopy (%): 19 mid-channel, 77 banks
-Riparian (%): 0 canopy, 30 woody understory, 60 non-woody ground cover

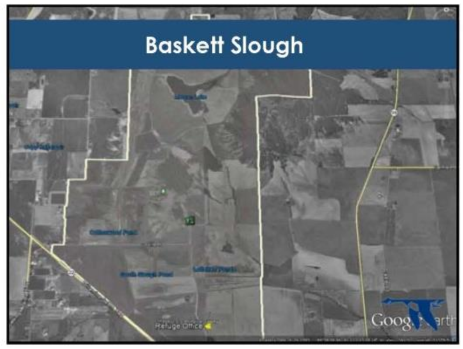

Fish survey:
Species | Aug 3 | Sept 2 | Sept 29
Longnose dace | 3 | 0 | 0
Malheur sculpin | 55 | 10 | 24
Redband trout | 78 | 85 | 96
Speckled dace | 491 | 507 | 209
--No. species | 4 | 3 | 3
--Jaccard coef. | 1.0 | 1.0 | 1.0

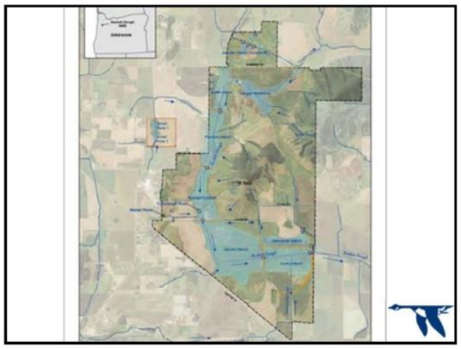

Water temperature:
-Upstream of survey reach
-Sept. 23, 2014-Sept. 20, 2015
-Interval 30-min. (n=17,805)
-Overall mean=12.1, min=6.4, max=18.5
-August mean=13.9, min=11.3,
max=16.9 (n=1,468)


2016 Plans/Recommendations:
-Begin surveys earlier in season
-Logger maintenance/download
-Complete database for loggers
-Summarize temperatures, compare
to projections
-Describe fish assemblage structure
-Determine approach for invertebrate
samples
-Establish photo points

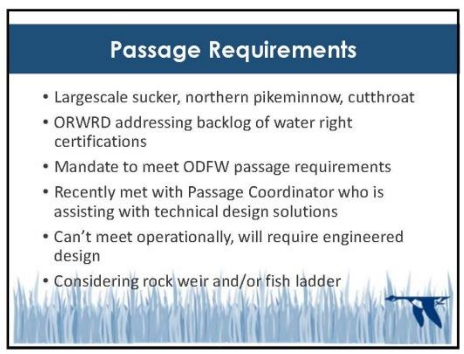
Discussion Topic: Willamette Valley NWRC Wetland Management: Fisheries Update. Presented by Graham Evans-Peters


Willamette Valley NWRC
Wetland Management: Fisheries Update
May 2016 | NWR Fisheries Meeting
Graham Evans-Peters, Refuge Manager, Ankeny and Baskett Slough

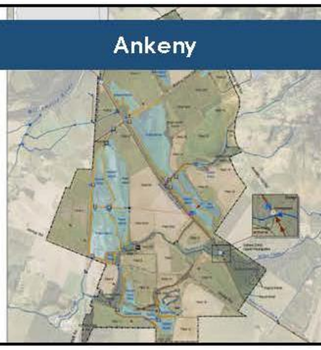

Baskett Slough
Refuge Office




Baskett Slough NWR
Water Right Status: 1/12/16
Moffitti: certified 11/2015
Morgan Reservoir: certified 70's & '97
Parvipus: certified 10/2008
Taverner: permit; proposed cancelation
Vancouver: permit, backlog
Cackler: certified 11/2015, no requirements
Dusky: permit backlog
Refuge Office


Passage Requirements
• Largescale sucker, northern pikeminnow, cutthroat
• ORWRD addressing backlog of water right certifications
• Mandate to meet ODFW passage requirements
• Recently met with Passage Coordinator who is assisting with technical design solutions
• Can't meet operationally, will require engineered design
• Considering rock weir and/or fish ladder

Ankeny



Fish Screen Upgrade

- Current concrete box structure/panel screen design
- Isn't self-cleaning nor large enough surface area/volume per NMFS
- Working with ODFW on voluntary fish screen upgrade; bolt on self cleaning pump screen
- Challenge due to retrofitting and low water of Sidney Ditch
- ODFW may be able to Design/Build, but funding is uncertain

U.S. Fish and Wildlife Service
Columbia River Fish and Wildlife Conservation Office
1211 SE Cardinal Court, Suite 100
Vancouver, WA 98683

December 2016