U.S. Fish and Wildlife Service

Fisheries Collaboration with National Wildlife Refuges

FY2014-FY2015 Progress Report

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On the cover: *Bridge Creek, a tributary to the Donner und Blitzen River, at Malheur National Wildlife Refuge (Photo: S. Lohr).*

The correct citation for this report is:

Lohr, S.C., M.L. Koski, and T.A. Whitesel. 2016. Fisheries Collaboration with National Wildlife Refuges, FY2014-FY2015 Progress Report. U.S. Fish and Wildlife Service, Columbia River Fisheries Program Office, Vancouver, WA. 149 pp.

FISHERIES COLLABORATION WITH NATIONAL WILDLIFE REFUGES
FY2014-FY2015 PROGRESS REPORT

Study funded by

U.S. Fish and Wildlife Service
Fisheries Operating Needs System
A-206, A-226, A-299

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Final
April 4, 2016

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FISHERIES COLLABORATION WITH NATIONAL WILDLIFE REFUGES FY2014-15 PROGRESS REPORT

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Executive Summary – The missions of National Wildlife Refuges (NWRs) and the Columbia River Fisheries Program Office (CRFPO) share several complementary elements concerning aquatic species and habitats. Thus, the goal for CRFPO 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, CRFPO, Fisheries, 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 CRFPO/Fisheries and NWRs through development and publication of annual reports. For Objective 1, the CRFPO and R1 Refuge Branch of Biology organized and hosted workshops that were attended by 46 and 30 individuals in FY2014 and FY2015, respectively. Notes and actions items were developed. For Objective 2, the CRFPO responded to requests from Refuges's I & M Initiative to assist with the preparation of Inventory and Monitoring Plans, which were supportive of CCPs at six NWRs. For Objective 3, two projects involving field-based activities contributing to conservation of aquatic resources at NWRs were conducted. These were: Restoration monitoring at Bandon Marsh NWR, for which the final report was completed, and Fish surveys at Nestucca Bay NWR were initiated. For Objective 4, the CRFPO provided non-field-based technical assistance for several short-term activities (e.g., reviews of literature and regulatory documents). For Objective 5, Fisheries, R1 Refuges, NWRs, and Water Resources initiated the pilot project to develop and implement a long-term aquatics monitoring program for climate change at NWRs. For Objective 6, a data management plan template was completed and database development is underway. For Objective 6, progress reports are being developed and other venues were used 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 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 Fisheries Program Office (CRFPO) 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 CRFPO and NWRs. The mission of the CRFPO 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.

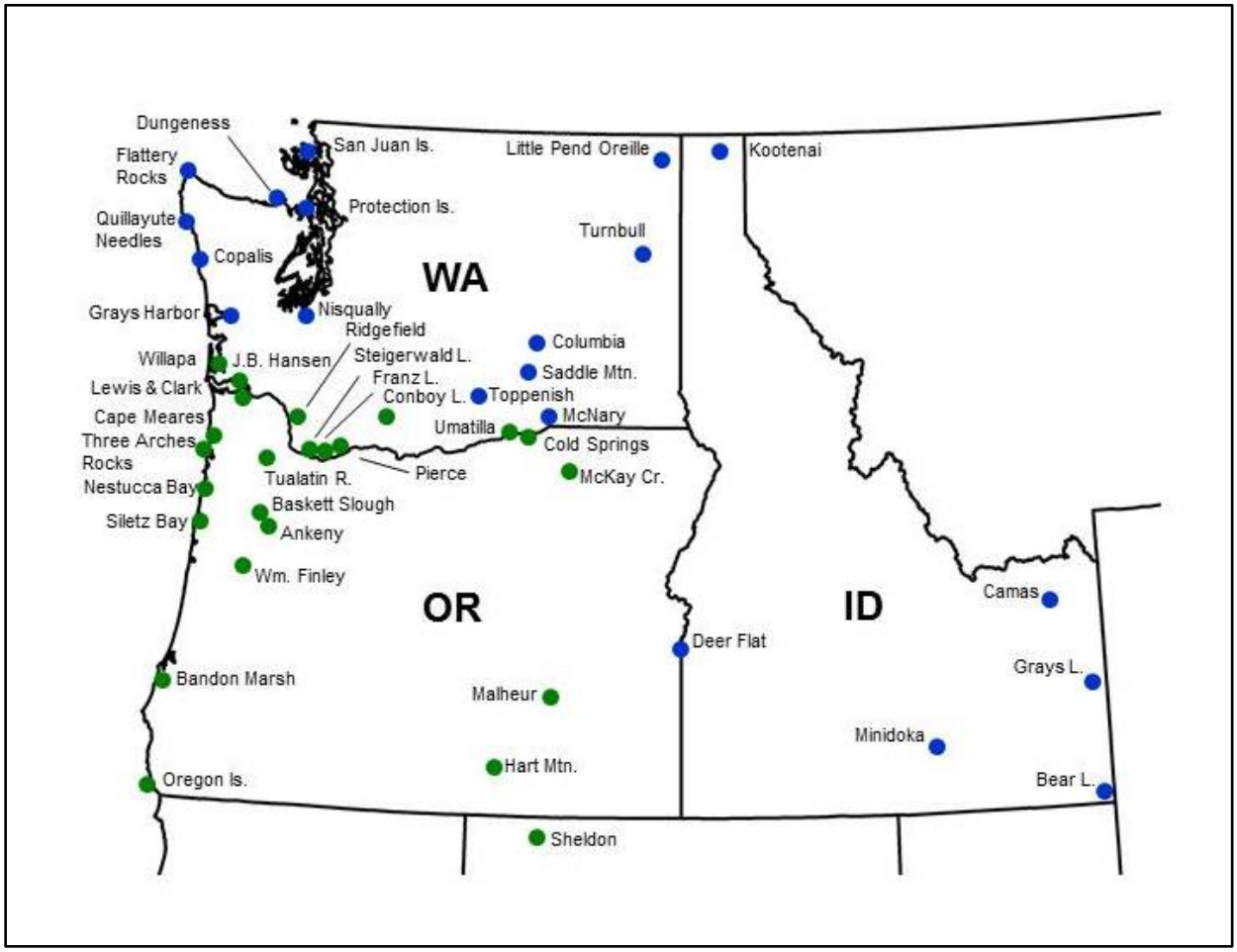

Figure 1. Locations of National Wildlife Refuges in Idaho, Oregon, and Washington within the general geographic area of responsibility of the CRFPO (green circle) and outside the general area of responsibility (blue circle).

The missions of NWRs and the CRFPO 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 CRFPO and NWRs have sought to promote effective information exchange between programs, as well as other USFWS programs, to increase opportunities for collaborative work. This Annual Report describes the CRFPO collaborative activities with NWRs during FY2014 and FY2015. 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, CRFPO, Fisheries, 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 CRFPO/Fisheries 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 FY2014 and FY2015, and brief descriptions from the CRFPO 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., 2014 and 2015 annual meetings).

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., 2014 and 2015 annual meetings).

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 Bandon Marsh 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 Environmental 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., extended teams for CCPs).

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., extended teams for CCPs).

Approach

To promote effective information exchange, NWRs and the CRFPO held an initial workshop in 2005 that informed the CRFPO of aquatic resource issues and needs at NWRs, informed NWRs about fisheries expertise at the CRFPO and results of ongoing work, and explored possibilities for cooperative efforts. Outcomes of the workshop (USFWS 2005) were identification of contacts for issues concerning CRFPO work with NWRs (i.e., at CRFPO, Regional Office—Fisheries, NWR—Supervisor, NWR—Branch of Biology), and commitments from the CRFPO 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 CRFPO and individual NWRs.

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

With the exception of 2006, workshops have been held annually since 2005 (see USFWS 2007; 2008, 2009a, 2009b; Lohr et al. 2012, 2014). 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 CRPFO 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 CRFPO 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 CRFPO has contributed to the development of CCPs for all NWRs that have requested Fisheries assistance. Most often, CRFPO 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 CRFPO 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 CRFPO 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 CRFPO 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 CRFPO, 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 CRFPO 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 2010) 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 National Fish Hatchery programs and operation, key aquatic species, and aquatic resources at National Wildlife Refuges (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 Fisheries 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 R1, which is being conducted through extensive collaboration among Refuges, Fisheries, 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[1] 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 CRFPO/Fisheries 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 CRFPO 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 FY2014 and FY2015 are discussed below.

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

The CRFPO and Regional Branch of Refuge Biology organized and hosted workshops on May 8, 2014 and May 13, 2015. During FY2014 and FY2015, a total of 46 and 30 individuals, respectively, participated in the workshops, which included up to 5 USFWS programs (Table 1). For the Fisheries Program, representatives from each Fishery Resource Office (i.e., CRFPO, Idaho, Mid-Columbia, and Western Washington), Abernathy Fish Technology Center, and Regional Office attended. For the Refuge Program, representatives from up to 10 NWR units attended, in addition to the Regional Office (Regional Chief, Branch of Refuge Biology, and I&M Initiative). Ecological Services and Water Resources also were represented.

Table 1. Number of individuals by USFWS program and office that participated in the annual meetings during 2014 and 2015.

Program/office	Year	
	2014	2015
Fisheries		
CRFPO	14	7
Fishery Resource Office/Fish Technology Center	7	6
Regional Office	4	1
Refuges		
NWRs[1]	10 (6)	8 (4)
Regional Office	5	6
Ecological Services	3[2]	2
Water Resources	2[3]	--
Other	1[4]	--
Total individuals	46	30

[1] Number of NWR units represented in parentheses (NWR complexes were considered a single unit).

[2] Included individual in a joint Ecological Services-Fisheries position.
[3] Included individual in a joint Water Resources-Refuges position.
[4] Oregon Department of Fish and Wildlife.

The agenda, notes, list of attendees, actions items, and presentations have been compiled for each workshop (see Appendix A and Appendix B for FY2014 and FY2015, respectively). The goal and objectives for each workshop are presented here.

2014 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. Provide information on status and results of programs and activities of regional or broader scope.
4. Identify and discuss aquatic resource issues and needs at NWRs, updates on management planning and activities of other programs.
5. Explore additional possibilities for cooperative efforts among NWRs, Fisheries, PFW, and others.
6. Develop action items.

2015 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. 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.

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 CRFPO 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 Inventory and Monitoring Plans (IMPs) and Water Resource Inventory and Assessment (WRIA).

Work by the CRFPO related to CCPs during FY2014 and FY2015 was exclusively focused on IMPs. Refuges' I & M Initiative requested assistance on the development of IMPs at six NWR units, Little Pend Oreille NWR, Tualatin NWR, Willapa NWR, Julia Bulter Hansen NWR, Lewis and Clark NWR, and the Washington Maritime NWR Complex. The CRFPO either reviewed the draft IMP materials or provided the request and materials to the appropriate FRO for NWRs in their geographic area. In addition, the CRFPO crafted standardized descriptions of surveys associated with the NWR aquatic monitoring program pilot project for climate change (see Objective 5) to be used in IMPs for the five sentinel sites (i.e., Kootenai NWR, Little Pend Oreille NWR, Malheur NWR, Willapa NWR, and William L. Finley NWR).

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

Two projects consisting of field-based activities contributing to conservation of aquatic resources at NWRs were conducted by the CRFPO during FY2014 and FY2015. These were: Restoration monitoring at Bandon Marsh NWR, and Post habitat restoration assessment of fish at Nestucca Bay NWR. These projects were originally initiated in previous years and some activities continued during FY2014 and FY2015. The need for information that these projects have generated was identified by NWRs during the initial workshop (USFWS 2005). Brief summaries of the projects are presented here along with citations of reports containing project details and findings.

Restoration monitoring at Bandon Marsh NWR

Large-scale tidal marsh restoration, entailing dike and tide gate removal, culvert upgrades, channel and wetland construction, and infrastructure upgrades, was conducted at the Ni-les'tun Unit of Bandon Marsh NWR. All activities were completed by summer 2010 except removing the dike and tide gates, which was completed in August 2011. The goal of the monitoring project is to assess changes in the aquatic species community before and after habitat restoration by addressing four objectives—1) Describe and compare fish species community within and among restoration areas and reference areas before and after construction; 2) Describe and compare fish species distribution within and among restoration areas and reference areas before and after construction; 3) Describe and compare fish species relative abundance within and among restoration areas and reference areas before and after construction; and 4) Collect invertebrates to archive from restoration areas and reference areas before and after construction.

To characterize conditions before habitat restoration, fish (Figure 2) typically were collected on one or two occasions per season during November 2007-March 2010 (Hudson et al. 2010). Fish were collected once per season during October 2010-June 2011, which was considered an interim period for restoration and occurred during FY2011 (Silver et al. 2012). Since completion of final construction activities (i.e., removal of the dike and tide gates), fish were collected on six occasions during each FY2012 (Hudson et al. 2013) and FY2013. Prior to receiving funding

from Region 1 Refuge I&M Initiative during FY2011-FY2013, the project was largely funded by other internal sources (e.g., Challenge Cost Share, Cross Program Recovery).

Although field activities were concluded at the end of FY2013, analysis continued through FY2014 and a final project report was completed in FY2015 (Silver et al. 2015). Primary findings were that habitat restoration benefited salmonids and juvenile estuarine fish by creating habitat and increasing access to the refuge. A variety of fish species occupied newly constructed channels and those in tidally influences areas (Figure 2). The abundance and frequency of capture of estuarine fish increased after construction.

Figure 2. Example of a tidal channel at Bandon Marsh NWR. (Photo by A. Horstman)

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 CRFPO 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 2010), 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 CRFPO 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 CRFPO initiated seasonal surveys of fish presence and distribution at Nestucca Bay NWR based on previously used sample locations (Figure 3), and expects to complete surveys during FY2016.

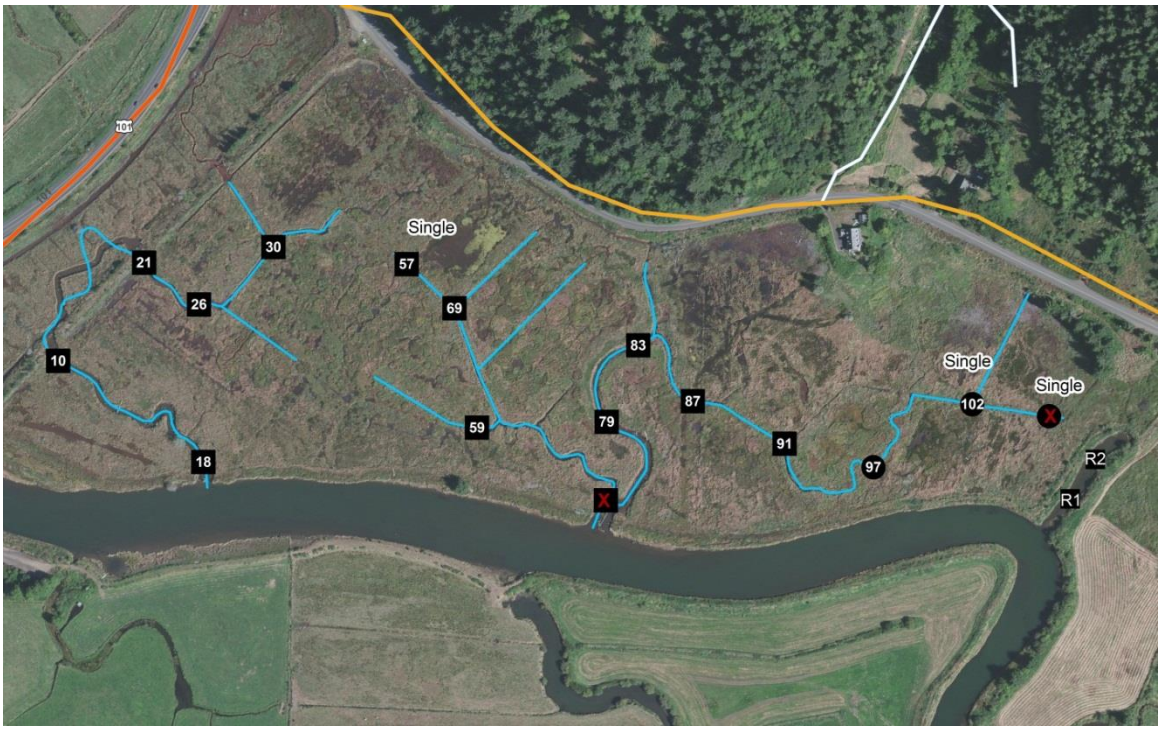

Figure 3. Tidal channels (blue lines) adjacent to the Little Nestucca River with sample locations (numbered boxes and circles) at Nestucca Bay NWR. (Map by B. Silver)

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). A continuing activity, develop and implement a long-term aquatic monitoring program for climate change at R1 NWRs, was considered a long-term activity in an earlier progress report. However, this activity is now addressed by a specific objective (see Objective 5 below). Thus, non-field-based technical assistance during FY2014-FY2015 consisted of short-term activities, which included:

- Made presentation of fish species composition and distribution at Bandon Marsh NWR to interagency workgroup addressing mosquito issues.
- Assisted in development and technical review of draft Plan and Environmental Assessment for Mosquito Control for Bandon Marsh NWR.

- Participated in interagency meeting and site visit to discuss habitat and natural resource issues at Wapato Lake NWR. Provided comments to assist in developing habitat restoration and management alternatives.
- Provided technical review and recommendations on a variety of issues (e.g., planned development adjacent to Steigerwald NWR, proposed replacement of the Hardy Creek bridge at Pierce NWR, appropriate approaches to monitor fish in streams and sloughs at Willapa NWR).
- Made site visits and comments on fish passage and screening issues at three NWRs (diversion at Ankeny NWR, water control structure at Pierce NWR, and culvert and road adjacent to the Neskowin Marsh Unit at Nestucca Bay NWR).
- Reviewed study plan and special use permit application proposed by ODFW to conduct survey of redband trout at Hart Mountain 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 of a long-term aquatics monitoring program for climate change at NWRs on the mainland of R1. All activities and results through FY2015 will be described in a separate progress report presently being developed by the four FROs involved (CRFPO, Idaho FRO, Mid-Columbia FRO, and Western Washington FRO). Major activities for the pilot project prior to and during FY2014-FY2015 included:

- Draft proposal developed by FROs was presented at the 2013 NWR-Fisheries Meeting. Recommendations were to have a broader review and develop an explicit, systematic approach to select NWRs as sentinel sites that considered various attributes (e.g., watershed conditions and vulnerability to non-climate-related stressors, relative stream reach on an NWR). (FY2013)
- A cross-program team, consisting of representatives from each FRO, R1 Refuges Branch of Biology and I&M Initiative, and Water Resources, began work on developing the approach to assess NWRs. (FY2013)
- Assessment of NWRs was completed. Five NWRs were recommended as sentinel sites representing three R1 ecoregions, Kootenai NWR, and Little Pend Oreille NWR (Northwestern Forested Mountains Ecoregion), Malheur NWR (North American Deserts Ecoregion), William L. Finley NWR and Willapa NWR (Marine West Coast Forest Ecoregion). (FY2014)
- Joint presentation by Fisheries and Refuges Branch of Biology on the monitoring program and sentinel site assessment was made during the 2014 NWR-Fisheries Meeting and to the Regional Climate Board. (FY2014)
- The Natural Resource Program Center—Water Resources, provided funding ($48K) to purchase equipment (e.g., temperature and pressure loggers) and conduct reconnaissance visits to each sentinel site. Equipment was procured and multi-point accuracy checks (EPA 2014) were performed on all loggers and thermometers. FROs met with NWRs, reconnaissance visits made to each sentinel site, and logger deployment began. (FY2014)

- Region 1 I & M Initiative proved funding to each FRO to initiate field surveys ($60K total). FROs jointly conducted surveys at Willapa NWR as training to apply habitat and vertebrate assessment protocols. Surveys initiated at all five sentinel sites. (FY2015)

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, Fisheries, 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 EMAP. 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 spreadsheet 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 spreadsheet and database have been distributed to each FRO with instructions materials for their use. After entering data for each sentinel site, files will be provided to the CRFPO 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 CRFPO, and resulting reports will be posted on the office's website.

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

A draft progress report on FY2013 Fisheries Collaboration with National Wildlife Refuges has been completed and will be posted on the CRFPO website pending final revisions. Information on Fisheries collaboration with NWRs and fishery resources at NWRs were disseminated through two additional venues during FY2015 (Appendix C). One was a presentation, Fishery Resource Surveys on Region 1 Refuges, made for the Region 1 Inventory and Monitoring Webinar Series. Topics included: Fisheries/Refuges collaboration, completed projects (Bandon Marsh restoration monitoring, Sheldon-Hart Mountain aquatic surveys), and introduction of the pilot project to develop an aquatics monitoring program for climate change at refuges. The second was a request from R1 External Affairs for a Tumblr post focused on fish in celebration of National Wildlife Refuge Week. The posting highlighted various fish species found at select NWRs across the three mainland ecoregions in R1.

Conclusions

There was extensive collaboration between the CRFPO and NWRs on conservation of aquatic resources during FY2014-FY2015. The other three Fishery Resource Offices in Region 1 and Abernathy Fish Technology Center participated in annual meetings, highlighting overall healthy collaboration between the Fisheries Program and NWRs. During the period addressed by this

report, the CRFPO was involved in activities supportive of CCPs (i.e., primarily through IMP development), which not only provided a means for Fisheries 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 Fisheries, 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 R1 FROs, as well as individual NWRs, Refuge's Branch of Biology and I & M Initiative, and Water Resources. Following R1 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 CRFPO 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 R1 National Wildlife Refuge System, Branch of Refuge Biology, Branch of Inventory and Monitoring, NWR complexes and individual units in Washington, Oregon, and Idaho; R1 Fishery Resources, Idaho FRO, Mid-Columbia River FRO, Western Washington FRO, CRFPO; R1 Water Resources; and many others.

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APPENDIX A: 2014 NWR-FISHERIES WORKSHOP AGENDA, NOTES, ATTENDEES, ACTION ITEMS, AND PRESENTATIONS

NWR-FISHERIES WORKSHOP AGENDA
May 8, 2014
Columbia River Fisheries Program 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. Provide information on status and results of programs and activities of regional or broader scope.
4. Identify and discuss aquatic resource issues and needs at NWRs, updates on management planning and activities of other programs.
5. Explore additional possibilities for cooperative efforts among NWRs, Fisheries, PFW, and others.
6. Develop action items.

10:00-10:05 Welcome and overview of workshop (Sam Lohr)

1. Aquatic resource activities and issues at NWRs

10:05-10:35 Restoration monitoring at Bandon Marsh NWR (Mike Hudson/Brook Silver)

10:35-11:05 Developing seasonal spectral signature models to accurately assess indicators of aquatic health: Algal succession and water quality at Malheur NWR (Linda Beck)

11:05-11:35 Bullfrog and bullhead control for Oregon spotted frog at Conboy Lake NWR (Lisa Wilson)

11:35-12:05 With a little help from our friends: The enthusiasm, collaboration, and partnerships that led to the recovery of the Oregon chub (Brian Bangs)

12:05-1:00 Lunch

2. Updates and initiatives of regional or broader scope

1:00-1:30 Pacific lamprey conservation initiative (Christina Wang)

1:30-2:00 The good, bad, and ugly: Water rights in the Pacific Northwest (Tim Mayer)

2:00-2:30 Progress on the initiative to develop a long-term aquatic monitoring program for climate change at R1 NWRs (Sam Lohr and Bridgette Flanders-Wanner)

2:30-2:45 Break

3. Updates, new issues and needs, plans, activities

2:45-4:30 Open discussion of updates, plans, and activities affecting aquatic resources for each NWR, Office, and Program attending

4:30 Wrap-up

NWR-FISHERIES WORKSHOP NOTES
May 8, 2014
Columbia River Fisheries Program 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.

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5. Explore additional possibilities for cooperative efforts among NWRs, Fisheries, PFW, and others.
6. Develop action items.

10:00-10:05 Welcome and overview of workshop (Sam Lohr)

9th workshop since 2005; coordination between Fisheries office here and the Refuges; has expanded to several other FROs and NWRs. Bridgette is the co-organizer for this workshop.

1. Aquatic resource activities and issues at NWRs

10:05-10:35 Restoration monitoring at Bandon Marsh NWR (Mike Hudson/Brook Silver)

- Restoration on the Marsh occurred in 2010; collecting biological information before and after the restoration.
- Restoration: channels dug within the former agricultural lands to create tidal wetlands.
- Methods: hoop nets in Fahys Creek channel and Red Creek (incoming and outgoing tides; 2009 – 2013); Seined mainstem Coquille (2008 – 2013); GRTS sampling of 25-m reaches in new channels that were dug in tidally influenced areas (small seine up to block net); e-fished in upper Fahys Creek in spring and fall of all years. Collected invertebrates with drift nets in spring during 2008, 2009, and 2011. Samples archived at CRFPO.
- Methods: measured biodiversity in the fish community before and after restoration.

- Results: overall, the community was not substantially different pre- and post-restoration. However, the number/type of introduced species collected were significantly different, along with the estuarine species collected and reference sites. Distribution increased (fish found in constructed tidal channels); species richness increased everywhere except at the reference sites.
- Positive benefits for salmonids – increased distribution and multiple age classes of coastal cutthroat trout. However, steelhead were present in upper Fahys Creek before restoration but not afterwards. Cutthroat/steelhead hybrids were present before and after restoration.
- Refuge provided a unique opportunity for CRFPO to study coastal tidal marsh restoration; developed mutually beneficial relationship.
- Changes were still occurring last fall; hope to return every 5-10 years to resample, dependent upon priorities and funding.

10:35-11:05 Developing seasonal spectral signature models to accurately assess indicators of aquatic health: Algal succession and water quality at Malheur NWR (Linda Beck)

- Technology: Malheur Lake is about 15 miles x 11 miles across. Remote sensing by Landsat satellite (images taken every 16 days) measures light reflectance in specific wave bands. Correlations between reflectance and chlorophyll-a concentration in the lake can provide information about water quality. Models have been developed using chlorophyll-a concentrations collected when the lake was between 80 and 70K acres. Analyses using Landsat images from 1984-2013 provides a historical record of water quality trends.
- Model data: water samples were taken every 16 days at three sites in the lake, chlorophyll-a concentration was determined and other water quality parameters were recorded.
- Model development: statistical models developed using 7 wave bands of Landsat data, these were correlated with chlorophyll-a samples collected from the lake. Steps include—image processing, data filtering, tests of data leaverage, and final seasonal model.
- Assistance needed: looking for other tests of data leverage that can be done in SigmaPlot if anyone has any ideas as well as with analyzing phytoplankton (almost 200 species are present).
- Resulting model: predicts chlorophyll-a concentration as a function of wave band ratios. With the model, can then use observed wave bands from remote sensing to color in a map to determine areas of high and low water quality.

- Future work: would like to apply similar approach to develop models for emergent and submergent vegetation.
- Management implications: This represents baseline conditions when carp are present and water quality is poor. After restoration (i.e., carp removal) activities, can assess whether activities were beneficial for improving water quality.

11:05-11:35 Bullfrog and bullhead control for Oregon spotted frog at Conboy Lake NWR (Lisa Wilson)

- Conboy Lake NWR: 6,300 acres; managed wetland systems with miles of ditches and private inholdings.
- Trying to manage for Oregon spotted frog, which is proposed for threatened status under the ESA. Since 1998, counts of egg masses have been decreasing at the NWR.
- Threats: lack of water inputs, changing rain/snow patterns due to climate change, drawdowns by adjacent landowners, lack of connectivity for metamorphs, non-native predators (i.e., bullfrog, bullhead catfish that pry on smaller spotted frogs like adult females and developing eggs; also there may be some competition), and reed canary grass, which degrades habitat. Brook trout and rainbow trout are present, but not likely a problem for frogs.
- Bullfrog and bullhead removal: started trial runs in late 2013 with seining, nets, traps, poles. Electrofishing and rotenone have been considered, but rotenone use is unlikely. Efforts will start in 2014, using trapping twice a month at removal sites and control sites to evaluate success.
- Looking for ideas on how to remove bullhead and bullfrogs without harming Oregon spotted frog. Facing same problems at Tualatin NWR.
- If these invasive species can be removed or controlled in the Valley, there are few opportunities for reintroduction because the area is fairly isolated. Even though most areas go dry during the summer, there are some refugia, which would mean having adjacent landowners on board to help.
- Bullheads can come in through spillways when water levels are changed. Is there a way to capture them in these areas? Might be able to use a big-enough mesh fish screen. Linda reports using long hoop-nets baited with bread to remove bullheads.
- Bullfrog numbers (in the 1990s) seem to be self-regulating due to climate; at the northern-most distribution. Harsher winters may bring bull frog numbers down, but will likely not resolve the problem (will affect Oregon spotted frogs as well).
- Bullfrog egg masses are small, sometimes sink, and only last for a few days, so they are hard to find and collect.
- Received recovery funding to do this work.
- Common need: structured decision making models to help determine methods to use for managing various species.

- What about using extreme measures to remove bullfrogs and then reintroduce Oregon spotted frogs? Amphibian conservation hatcheries? Would likely get regulatory pushback from that idea.

11:35-12:05 With a little help from our friends: The enthusiasm, collaboration, and partnerships that led to the recovery of the Oregon chub (Brian Bangs, ODFW Native Fish Investigations Program)

- Oregon Chub: small floodplain minnow, use to be distributed throughout the Willamette Basin. Depends on water temperature >15-16°C for spawning, spawn in and seek cover in dense aquatic vegetation. Prefer off-channel habitats (sloughs, ponds, little/no flow, shallow, silt substrate, absence of non-native predatory fishes).
- Historically known from 29 locations, primarily as by-catch.
- Petitioned to list under ESA in 1990.
- Conservation Agreement in 1992 (working group formed and developed what later became the recovery plan).
- Listed as endangered in 1993.
- Factors in Decline: loss of habitat (flood-control dams, channelization, drainage of wetlands for agriculture), predation and competition by non-native fish such as largemouth bass, bluegill (currently the greatest threat).
- Recovery Plan in 1998: Collaboration between USFWS, ODFW, working group.
- Recovery thresholds: distribution, abundance, trend. Maintain populations, implement introductions, several research goals, and public outreach (privately owned lands).
- How did we get to recovery?
  - Introduction sites. Expand range, increase abundance, reduce extinction risk and loss of genetic diversity. Now 21 successful introductions in the valley. NWRs were key to providing some of these sites (moved 10% of donor population per year): from Gray Creek Swamp, seeded Cheadle Barn Pond, Display Pond, Ankeny Willow Marsh (96K chub – highly successful!) (also naturally recolonized beaver pond near Gray Creek Swamp). About 2/3 of all chub are at the 21 successful sites, 4 are on NWRs.
  - Programmatic Safe Harbor Agreement. Voluntary agreement with non-Federal landowners providing assurances that if conditions in SHA are met, they won't be held liable for take under ESA or additional management activities. USFWS issued permit to ODFW allowing ODFW to include landowners; sped up process; 8 landowners enrolled and 40% of chub populations occur on private land.
  - Willamette Partners Program. Create and foster relationships with private landowners; created habitat for over 15,000 Oregon chub (as of 2013); ODFW provide pre- and post-enhance results.

    - Habitat improvement. Restoration projects by multiple agencies, NGOs, including land purchase or protecting habitats.
    - Life history and genetic investigations: Informed management decisions with spawning requirements/timing, age structure, population structuring by subbasin.
    - Population surveys: Over 2,000 surveys at almost 900 sites during 1991-2013, documented abundance over time and resulting in discovery of 51 new populations (8 to about 80 known populations in 22 years).
    - Willamette BiOp (2008): addresses effects of Corps operations on listed species; required floodplain study of flow and habitats favoring chub over non-native fishes in connected habitats. Found about 30 new populations, movement, and assessing factors (habitat, flow, temperature, fish community) allowing chub to coexist.
- Delisting criteria met in 2012, submitted delisting proposal in 2014. ODFW, USFWS, and Corps developed post-delisting monitoring plan; will keep doing the things that have been successful. Will continue monitoring abundance and distribution for 9 years in 3 year cycles. Activities will be concurrent with existing floodplain study and continued introductions.

12:05-1:00 Lunch

2. Updates and initiatives of regional or broader scope

1:00-1:30 Pacific lamprey conservation initiative (Christina Wang)

- Apparent widespread decline throughout range, including distribution and abundance, initiated the need for developing the conservation initiative outside of the ESA process.
- 1994: NPCC F&W program started directing lamprey work; in the meantime, several working and technical workgroups formed.
- 2003: ESA petition, listing determined not warranted due to lack of information about the "listable entity" (i.e., population structure unknown) in 2004.
- 2007: USFWS Conservation Initiative started, consisting of three components 1) Rangewide Assessment and Template for Conservation Measures (2009 – 2011); 2) Conservation Agreement (signed 2012); and 3) Regional Implementation Planning (2013 – present). Initiative supports evaluation, assessment, and planning aspects of Strategic Habitat Conservation.
    - Assessment and Template: 4th code HUCs were basic units; collected demographic and threats information throughout range and used NatureServe assessment to determine conservation status. Also examined climate change vulnerability using NatureServe vulnerability index, which considers direct environmental exposure (from downscaled temperature

and moisture change) and sensitivity to change (e.g., historical conditions, dispersal, dietary versatility, species interactions). Information about mid- and end of century vulnerability will be used in conjunction with the risk assessment to determine what priority actions need to be done and where. Index is preliminary because it uses air temperature and moisture; would like to use something more applicable to aquatic species. North Pacific LCC has funded a climate change study for lamprey using info on specific changes in stream conditions (stream temperature, connectivity, and flow regimes).

  - Conservation Agreement: voluntary agreement with partners (13 tribes, 4 states, 14 federal agencies) to for a Conservation Team and work together to conserve Pacific lamprey throughout their historic range.
  - Regional Implementation Planning: identify conservation and research actions including their locations, prioritize actions, and determine implementing agencies and sources of funding. Compiling information by 4th field HUCs so that Regional Action packages by region can be brought to potential funding entities, supported by partners.

- Other conservation actions/research have been ongoing: development of Best Management Practices for lamprey (incorporates lamprey passage guidance), feeding and rearing trials, improving passage, investigating lamprey occupancy sampling and fine-scale intensive monitoring for translocation studies. Occupancy and distribution workshops will be held fall 2014.
- Lamprey Data Clearinghouse: Will compile lamprey literature and GIS data.
- Lamprey Identification Workshops: identify western brook vs. Pacific lamprey.
- Willamette Valley Conservation Study and Surrogate Species: providing information (demographic and threats info, along with regional implementation plan info).
- Role of refuges in the future? Would love help from refuge staff on implementation of the Conservation Initiative, especially with input on the Regional Implementation Planning process. We do not currently have a list of Refuges that could help; would possibly start with refuges on the coast? Columbia River Refuges would be important. Tualatin Refuge would be happy to help (within the Willamette Valley Conservation Area).
- Wanapum Dam repair: currently having discussions about how to incorporate better fish passage structures, including considerations for lamprey passage.
- Refuges should come to our workshops – we can show you how to find out whether or not you have lamprey on your refuge. CRFPO has some ability to do occupancy sampling on refuges, but we have to know in advance. We can also train people how to do this.

1:30-2:00 The good, bad, and ugly: Water rights in the Pacific Northwest (Tim Mayer)

- Irrigated agriculture accounts for 37% of freshwater withdrawals nation-wide, but this probably jumps up to 70-80% of total use in the western US.
- Attributes (e.g., purpose, point of diversion, season of use, etc.) define a water right. Attributes can be changed, but when you do, you give everyone else a "bite of the apple". Can be scrutinized for need for monitoring, reporting, use, etc.
- USFWS Water Resources Branch is putting together water rights summaries for all refuges and hatcheries in R1/R8, summarizing state water law, use and diversion maps, and issues specific to each facillity.
- Water Rights Law: managed by states, water-poor western states are "prior appropriation" doctrine (first in time, first in right); assumes that there will not be sufficient water for everyone at all times. Most eastern states have "riparian" or "regulated riparian" laws (water equally shared among among riparian landowners)
  - Vested water rights: for use in Prior Appropriation states before state laws existed; water needed to be used continuously and vested rights typically need to be recognized through adjudication.
  - Federal Reserved Water Rights: happens when U.S. reserves or acquires land for unappropriated water for the primary purposes of the reservation of land; goes through state water adjudication.
  - Use it or lose it (forfeiture in Prior Appropriation water rights): Must use your full right at least once every 5 years, initially started to prevent people from monopolizing water. For whatever reason, a lot of hatcheries and refuges are not using the full right; these can be legitimate exceptions (i.e., for conservation actions). Very state-specific; most states will provide instream flow water rights, but for surface water only (leaves water in stream/river, beneficial for environment). No groundwater rights.
  - Conjunctive use: coordinated management of surface and groundwater; Idaho has adopted same water laws for both sources of water in the Snake River Plain aquifer.
- Water Rights—The Good: FWS Policy Objective: Obtain water supplies of adequate quantity and quality (comply with law, identify and purchase water rights, monitor and report water use, find solutions to issues).
- Water Rights—The Bad: Streams are fully allocated (more rights on paper than there is water in the stream); water is expensive; use or lose may encourage water waste; and no "instream use" for groundwater rights that would protect groundwater in place.

- Water Rights—The Ugly: Snake River Plain Aquifer example – Thousand Springs water used by hatcheries with senior water rights; discharge increased up through 1950s due to canal construction and flood irrigation replenishing groundwater; discharge has been diminishing due to more efficient irrigation, ground water pumping, winter water saving and drought; pitting small number of senior users of spring discharge against large number of junior pumpers of groundwater. Idaho is using conjunctive management of water and trying to artificially recharge the aquifer during the winter to offset declines in discharge.
- How will climate change affect water rights? On everyone's mind; water availability will decrease when demand is increasing (summer). Junior priority holders are worried about it; not looking at any changes in the water rights system. Solutions: will have to promote reduction in demand instead of increasing supply.
- ESA vs. water rights? If there is a federal nexus, ESA probably trumps water rights. However, if it's a private water right, ESA may not be applicable.

2:00-2:30 Progress on the initiative to develop a long-term aquatic monitoring program for climate change at R1 NWRs (Sam Lohr and Bridgette Flanders-Wanner)

- Concept appeared in 2011 at a Fisheries Project Leaders meeting in discussion of support for the Service's Strategic Plan for Climate Change. Presented draft proposal at last year's workshop; today reporting on current proposal by addressing why, what, how, when, who, and where.
- Why? Climate change expected to change air temperature, precipitation, water temperature, and hydrologic regimes. Will affect biota – physiological tolerances, disturbance, non-native species, etc. Using NWRs because it is the Service's primary land base, established for conservation. Results are expected to inform long-term conservation needs (landscape vulnerability assessments, contribute to SHC application).
- What? Goal is to evaluate evidence of climate change in physical attributes at NWRs and changes in aquatic communities. Will use sentinel sites representing ecoregions, and will describe changes in physical and biological attributes over time.
- How do we do this? Actions need to be sustainable (biotic data only sampled during summer low-flow times) given existing resources, information and support available. Should also be consistent in habitat type, physical and biological attributes. Will use EPA environmental monitoring protocols (EMAP) to measure physical and biological attributes (e.g., community

metrics, relative abundance, sensitivities, etc.), and then will perform temporal analyses once time series is established.

- When? Phased approach: 1) recon sites and install loggers (air and water temperature, discharge – measured year-round); 2) get baseline information in the first 3 years, 3 x per year (biological data – habitat, biota during low flow period); 3) long-term sampling (every 2-5 years).
- Who? FROs in each ecoregion will perhaps monitor habitat and perform aquatic surveys and analyses; NWRs will download loggers. Potential for others to participate (WR, USGS – gauge stations?).
- Where? At least one NWR in each of three EPA Level 1 Ecoregions in R1– Northwestern forested mountains, Marine west coast forest, North American deserts. Earlier draft identified streams mostly based on prior history with FROs; concern for factors confounding climate change trends. Conducted 2-phase assessment jointly performed by Refuges, Water Resources, and Fisheries. Streams were to be: non-tidal and wadeable, diverse vertebrate fauna, watersheds relatively resistant to perturbations (development, logging in the immediate area, water diversions, etc.). Phase 1—Initial screening based on collective "wisdom", Phase 2—Geospatial assessment of stream length on NWR, drainage area, watershed ownership, and land cover types.
- Five candidate sites selected—Northwestern forested mountains (**Little Pend Oreille and Kootenai**), Marine west coast forest (**Willapa, William L. Finley**), North American deserts (**Malheur**).
- Currently in the process of finding funding for Phase 1—acquiring equipment and supporting staff for site reconnaissance and logger installation to begin Northwestern forested mountains (**Little Pend Oreille and Kootenai**), Marine west coast forest (**Willapa, William L. Finley**), North American deserts (**Malheur**). collecting data.
- Suggestion: write down process for developing and executing this study, especially with lack of funding; may be helpful for other groups interested in doing similar studies. Planning aspect and expected outcomes for SHC model?

2:30-2:45 Break

<u>3. Updates, new issues and needs, plans, activities</u>

2:45-4:30 Open discussion of updates, plans, and activities affecting aquatic resources for each NWR, Office, and Program attending

- <u>Tualatin NWR (Erin Holmes)</u>: Wapato Lake is now its own NWR; 4,300 acres approved, 800 acres acquired. The NWR working with USGS on

hydrologic study and inundation modeling (will help with habitat objectives) with Erin Stockenberg. Report will be out soon and contribute to restoration planning (e.g., potential to connect the river and streams). NWR applied for OWEB funding to restore Chicken Creek, but was not successful. Clean Water Services is looking at another stream near the NWR, and can use help with monitoring.

- Idaho FRO (Mike Faler): FRO conducted fourth year of sampling Myrtle Creek (Kootenia NWR) for bull trout, concluded that no spawning is occurring there; stream represents foraging, overwintering, and migratory habitat. Will be looking to screen Cascade Creek diversion, received grant from transportation to install a bottomless arch to replace culverts.

- Mid-Columbia NWR Complex (Kevin Goldie): Government shut-down interrupted origin plans to treat sloughs at McNary NWR; rotenone applications were made in sloughs 3 and 4 in fall, 1 and 2 in February; zooplankton samples were also taken. Plan to treat pond at Umatilla NWR this fall and also conduct turtle surveys.

- Mid-Columbia FRO (RD Nelle): At Toppenish NWR, FRO is monitoring steelhead PIT tagged by the Yakima Nation, PIT tag arrays were installed to determine if steelhead are entering the refuge. Monitoring is occurring weekly and documented fish enter and leave the refuge. Coming in through Lateral C, leave through Toppenish Creek; now with a staff member there this was the first year of monitoring – will be getting additional info. Conducting habitat assessment at Little Pend Oreille NWR this summer– looking at effects of removing cattle years ago.

- Malheur NWR (Linda Beck): Following Dan Shively's advice to form Malheur Lake Work Group (includes Jeff Jolley, Joe Engler, Bridgette Flanders-Wanner). Commercial fish harvester coming in to take 5,000 carp (by seine) in May. Writing a feasibility study for the potential to commercially fish Malheur Lake. A guy who has made organic carp fertilizer from Malheur! $30 per gallon but it covers 2 acres!!! Dan Craver working on hydrogeology manuscript of the lake (Pleistocene to present), including bathymetry (using SONAR). Installed exclosure in the lake to see if it can exclude carp, but wind fetch may kick up so much sediment that it might be hard to re-establish vegetation. Some studies concluding this summer, Boca Lake carp control (OWEB funding, 700 acres) and two spotted frog studies on distribution and status. Received OWEB grant to put together an aquatic

health database (water quality, fish species, habitat data, etc.) for the Harney County Wetland Initiative, BYU will put together the geodatabase. Trap was added to Sod House Dam, caught 30,000 carp in two months, able to pass redband trout, mountain whitefish, minnows upstream.

- Abernathy FTC (Doug Peterson): Received funding from Invasive Species Control Program to look at efficacy of efishing to kill carp embryos. Over the next year will do a series of experiments at Malheur NWR to figure out the best ways of killing fish. Will need to avoid potential impacts to redband and other species. Since refuges has funds to support control, funding for Fisheries to use technology on refuges may be feasible. The pelican is Linda's totem animal – it will take adult carp.

- Bandon Marsh NWR (Roy Lowe): Seeing rapid turnover of vegetation after restoration; increasing bird counts (least sandpiper, mallard, great blue heron), and crabs. Noticed increase in mosquitos around the refuge in 2012, received some funding for monitoring by OSU in 2013 and then had a huge explosion of salt marsh mosquitos; they are very hardy. This year, completed NEPA for treating ponded areas with Bti (just started it last week), will install 40,000 additional feet of smaller first- and second-order tidal channels to create better water circulation in the tidal marsh; will start construction in July. It would be good to repeat fish surveys of marsh in 2015 after the new channels are in, (40,000 feet was the amount of channels initially constructed). Continuing to monitor and apply Bti for mosquitos. Uncovering some great archaeology at Fahy's Creek, as sediment washes out.

- Willamette Valley NWR Complex (Damien Miller): Working on elk management plan and proposing elk hunt; farming program to provide winter habitat for geese; several listed prairie plants like lomatium and have been reintroducing Fender's blue butterfly through the conservation funding initiative. Working with watershed councils to provide fish logs for large woody debris projects like the Long Tom Watershed Council – restoring Willamette River riparian areas for salmonid habitat; looking at juvenile salmon habitat at Snag Boat Bend. Will want to pick up monitoring Oregon chub on the NWR if the state is unable. Hope to hire a biologist soon. Bullfrogs are another issue on the NWR – drain some wetlands every other year. Private lands program – working with 70 landowners to get them info about fish issues, permitting, and doing a lot of restoration.

- Ankeny NWR (Sharon Selvaggio): Working with Tim Mayer on water rights issues at Ankeny; there is a two-year project with DEQ for water quality monitoring (pesticides and bacteria) at Ankeny and Baskett Slough NWRs. Also working on a fish screen upgrade at Ankeny NWR. Wetland restoration occurring at Eagle Marsh; will be looking to shave down dikes at Ankeny to remove vegetation and deal with nutria. Converting a riparian area from blackberry to native shrubs at Ankeny – in the area of the planned nature center.

- Western Washington Fisheries (Denise Hawkins): Involved with the Lake Samammish Kokanee Work in trying to reach urban audiences (part of the Urban Refuge Partnerships Initiative). Office is looking for ways to become more involved with NWRs.

- I & M (Erin Stockenberg): [Note—For the initial workshop in 2005, CRFPO queried NWRs in its geographic area resulting in "templates" identifying NWR-specific information (e.g., NWR purposes, watersheds, etc.) and aquatic resource issues and needs. These should be updated, expanded to include NWRs throughout R1, and available.] Follow-up on survey for aquatic issues: 1) database to catalog issues identified in surveys and other refuge sites to generate reports for each refuge (primary attribute profiles), and 2) how to collect info about aquatic issues in the future that would be available to other FROs and NWRs (a dynamic system) so that information could be entered, and responses could be received through the system. Very preliminary, using DOI Google Sites. Currently contains the link to the 2005 questionnaire. Issues can be entered into the questionnaire and then responses logged back in. Just a starting point for now. Howard comment this really matches up with the RIMS concept; easy and intuitive way to capture information about refuges, aquatic resources, and results (presentations, reports, etc.). Suggestion from Linda – add a functional directory that lists staff and their areas of expertise so that you could know who to go to with questions. Joe Engler is working on that – the R1 Science Team is developing a functional directory. Erin: later this month will be giving a talk about the ServCat application that catalogs any kind of digital media (documents, photos, presentations, other sites, etc.). All the information will be harvested in ServCat and provided to the public at data.gov to improve transparency and accountability. PRIMR is also an application on ECOS; designed to catalog I&M survey activities (from field and CCPs) on Refuges; this can also be connected up to ServCat, FishNet, etc. Suggestion made to have NWR info in

sharepoint site accessible to partners involved in collaborative efforts, Rob Falk, RO IT, would be good to contact.

- Oregon Partners Program (CalLee Davenport): Partners Program is now part of the Refuge System! There are seven PFW focus areas in the state with several NWRs within some. PFW is writing a biological assessment for restoration programs, there will be a three-state programmatic BiOp covering OR, WA and ID; will be looking for input on it in the near future.

4:30 Wrap-up

2014 Attendees

Name	Office
Don Anglin	CRFPO
Brian Bangs	ODFW
Linda Beck	Malheur NWR
Jody Brostrom	*Idaho FRO*
Don Campton	RO Fisheries
CalLee Davenport	OFWO
Joe Engler	RO NWR Biology
Mike Faler	Idaho FRO
Bridgette Flanders-Wanner	RO NWR Biology
Richard Glenn	Abernathy FTC
Kevin Goldie	Mid-Columbia NWR Complex
Jana Grote	RO Fisheries
Steve Haesecker	CRFPO
David Hand	CRFPO
Denise Hawkins	Western Washington FRO
Erin Holmes	Tualatin River NWR
Amy Horstman	CRFPO/PFW
Michael Hudson	CRFPO
Rich Johnson	RO Fisheries
Jeff Jolley	CRFPO
Kevin Kilbride	I&M Initiative
Marci Koski	CRFPO
Sam Lohr	CRFPO
Michael Lotspeich	Tualatin River NWR
Roy Lowe	Oregon Coast NWR Complex
Tim Mayer	RO Water Resources
Damien Miller	Willamette Valley NWR Complex
RD Nelle	Mid-Columbia FRO
Doug Olson	CRFPO
Doug Peterson	Abernathy FTC
Steve Pilson	RO Water Resources/I&M Initiative
Brian Root	I&M Initiative—Nisqually NWR
Howard Schaller	CRFPO
Sharon Selvaggio	Baskett Slough/Ankeny NWR
Trevor Sheffels	Tualatin River NWR
Dan Shively	RO Fisheries
Brook Silver	CRFPO
Greg Silver	CRFPO
Will Simpson	Abernathy FTC
Joe Skalicky	CRFPO

Shaun Stephensen	*Oregon Coast NWR Complex*
Erin Stockenberg	I&M Initiative
Chris Swenson	RO Ecological Services
Christina Wang	CRFPO
Tim Whitesel	CRFPO
Lisa Wilson	Conboy lake NWR

--italicized listings attended via phone

Requests and Action Items

1. Malheur NWR requests assistance with analyses (e.g., tests of leverage that can be conducted with SigmaPlot) and identification of phytoplankton.

2. Conboy Lake NWR would like to hear about ideas on how to reduce bullhead and bull frogs, and also application of structured decision support models in determining methods to manage invasive species.

3. Fisheries encourages NWR participation in upcoming workshops for the Pacific lamprey conservation initiative.

4. CRFPO has some ability to conduct lamprey occupancy surveys, with adequate planning, and can train others on survey methods.

5. Tualatin NWR requests assistance with habitat restoration planning at Wapato Lake and securing funds for stream restoration.

6. Idaho FRO to work with Kootenai NWR on screening the Cascade Creek diversion and replacing culverts.

7. Mid-Columbia FRO will continue work with Toppenish NWR and the Yakima Nation investigating steelhead use of the refuge.

8. Mid-Columbia FRO will conduct habitat assessments at Little Pend Oreille NWR to evaluate effects removing cattle.

9. CRFPO to work with Tualatin NWR on lamprey surveys in streams where habitat restoration projects are being pursued.

10. Bandon Marsh NWR would like an assessment of fish distribution after construction of additional channels to improve tidal exchange in ponded areas.

11. I&M data management to continue development of online approach for documenting NWR aquatic resource issues and needs, including a functional directory.

12. Fisheries, NWRs, and WR to continue working on the long-term aquatic monitoring programs for climate change at R1 NWRs, and develop a document describing the steps involved in selecting candidate sentinel sites.

Meeting Presentations

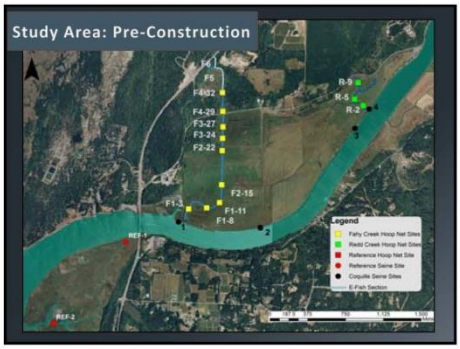
Presentation: Restoration monitoring at Bandon Marsh NWR. Presented by Brook Silver

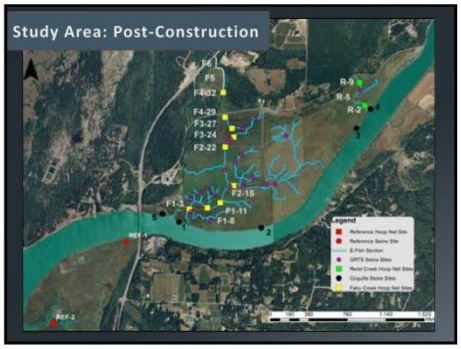
Restoration Benefits

- Improved quantity and quality of tidal wetlands in the lower Coquille River watershed
- Created foraging and rearing habitats for native salmonids and other native aquatic species

Objectives

- Community
- Distribution
- Relative abundance of fish
- Collect and archive invertebrates from restoration sites





Methods – Hoop Netting

- Double hoop net with wings
- Nets set overnight (21 hours on average)
- Pre-restoration sampling occurred once per season (2007 -2009), twice per season (2009 – 2010)
- Post-restoration sampling occurred at least once a season (2011 – 2013)

Methods – Seining Mainstem

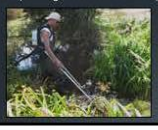
- Unbagged, 15.2 m long seine stationed at the bank, pulled out, and towed back
- Began in the mainstem Coquille River and Reference site (2009, 2008 respectively)
- Occurred on same schedule as hoop netting

Methods – Seining GRTS

- Bagged, 5 m long seine pulled upstream to a block net
- Eight randomly ordered sites on a rotating panel
- Began after restoration in new channels (2010)
- Occurred on same schedule as hoop netting

Methods - Electrofishing

- Backpack electrofisher
- Sampled upstream with one electrofisher and 1 - 2 netters
- Began fall 2007
- Completed in spring and fall all years



Methods - Invertebrates

- Three replicate drift samples collected in five reaches
- Boat drifts (4) and set drifts (6)
- Sampled once a year in spring (2008, 2009, and 2011)
- Archived at CRFPO

Methods - Biodiversity

- Community was measured using Jaccard's Coefficient
  - The similarity of species present pre and post restoration
- Biodiversity was quantified in terms of the Simpson Diversity Index
  - Takes into account species richness and evenness of abundance (but not relative abundance)
- All species encountered during monitoring were classified according to Ecological Classification
  - Compares relative abundance and frequency of occurrence
  - Dominant, Common, Occasional, and Rare

Results – Community

- Species collected pre restoration only
- Species collected post restoration only

Native species on Refuge

- Coastal Cutthroat Trout
- Chinook Salmon
- Coho Salmon
- Gunnelfish
- Hybrid CCT/STH
- Cottid spp.
- Three Spine Stickleback
- Smelt sp.
- Surf Perch
- NW Salamander
- Rough Skinned Newt
- Red Legged Frog
- Shrimp
- Crab
- Jellyfish
- Steelhead
- Northern Anchovy
- Bay Pipefish
- Starry Flounder

Introduced Species on Refuge

- Brown Bullhead
- Blue Gill
- Largemouth Bass
- Mosquito Fish
- Bull Frog
- Crawfish
- Smallmouth Bass
- Carp
- American Shad
- Crawfish sp.

Reference Sites

- American Shad
- Bay Pipefish
- Chinook Salmon
- Coho Salmon
- Gunnelfish
- Cottid spp.
- Pacific Lamprey
- Three Spine Stickleback
- Smelt sp.
- Surf Perch
- Starry Flounder
- Largemouth Bass
- Shiner
- Carp
- Jellyfish

Results – Community

- 21 fish species collected on NWR
  - 13 present during both phases
- 3 species detected on NWR pre-construction only
  - Carp, Smallmouth Bass, Steelhead
- 5 species detected on NWR post-construction only
  - Anchovy, American Shad, Bay Pipefish, Starry Flounder, Crappie
- Jaccard's Coefficient of species community for the entire refuge (Cjk = 0.619)
  - Not a substantial difference (> 0.60) according to Gauch 1982

Results – Community

- 4 salmonid species collected pre and post
  - Chinook, Coho, Cutthroat, Steelhead
  - C_{jk} = 1.00 (No difference)
- 8 introduced species collected
  - Pre and Post: Largemouth Bass, Mosquitofish, Bluegill, Bullhead
  - Pre only: Carp and Smallmouth Bass
  - Post only: American Shad, Crappie
  - C_{jk} = 0.500 (Substantially different)
- 9 estuarine species collected
  - Pre and post: Gunnel Fish, Pacific Staghorn Sculpin, Surfperch, Smelt, Three-Spined Stickleback
  - Post only: American shad, Bay pipefish, Northern Anchovy, Starry Flounder
  - C_{jk} = 0.556 (Substantially different)
- Reference sites
  - 11 species in restored area only
  - 9 species at both reference and restoration sites
  - 1 species at reference site only (Pacific lamprey)
  - C_{jk} = 0.409 (Substantially different)

Results – Species Richness

- Simpson Diversity Index across sample areas of the tidal marsh
  - The index approaches 1.0 when the number of individuals collected (richness) are evenly distributed among the number of species present (evenness of abundance)

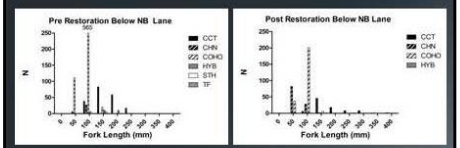
	Pre Restoration	Post Restoration
Mainstem Coquille	0.530	0.659 ↑
Redd Creek	0.598	0.693 ↑
Fahy DH	0.375	0.594 ↑
Fahy Efish	0.495	0.733 ↑
GRTS (Seine)		0.383
Reference	0.661	0.443 ↓

Results – Distribution

- Salmonids detected in all areas
  - Coho – Widespread throughout refuge
  - Chinook - Lower stream, reference, and tidal areas
  - Cutthroat, Steelhead, Hybrids- Stream and tidal areas
- Species were found in new channels
  - CCT, CHN, Coho, Mosquitofish, SCP, SKB, SP
- Multiple size classes of CCT in Fahys and Redd Cr.

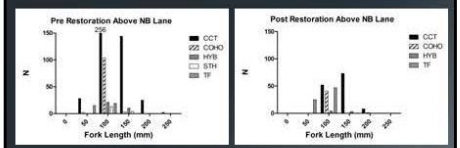
Results – Distribution of Salmonids

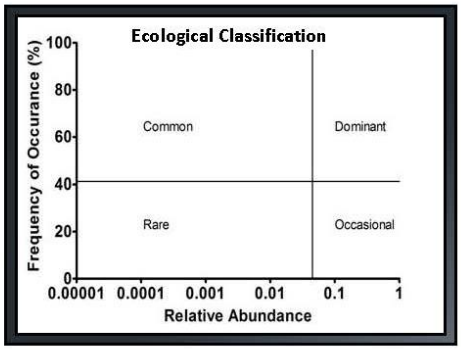
- Length frequency of salmonids captured in Fahys Creek sections below North Bank Lane
- Hoop netting

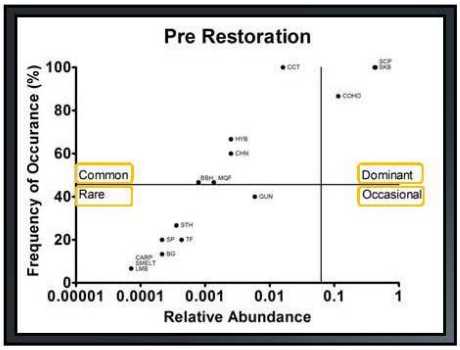


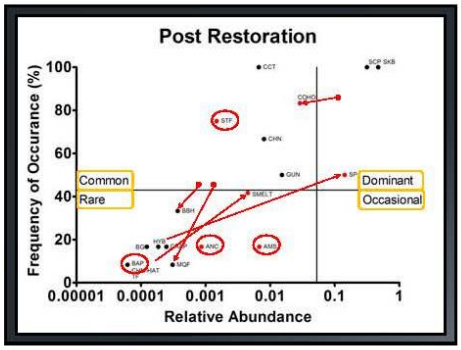
Results – Distribution of Salmonids

- Length frequency of salmonids captured in Fahys Creek sections above North Bank Lane
- Electrofishing









Results – Relative Abundance

Pre Restoration (All sites)

- Coho and CCT are frequently found in abundance
- Introduced species are rare
- Sculpin, stickleback and coho dominant species
- Dominant (SKB, SCP, COHO)
- Common (CCT, HYB, CHN, GUN, TF, STF, MQF, BBH)
- Occasional (SP)
- Rare (STH, BG, SMELT, LMB, AMS, CARP, SMB)

Post Restoration (All sites)

- Coho and CCT are frequently found in abundance
- Introduced species are rare
- Sculpin, stickleback, and surfperch dominant species
- Dominant (SCP, SKB, SP)
- Common (CCT, COHO, STF, CHN, GUN, SMELT, HYB)
- Occasional (-)
- Rare (AMS, TF, ANC, BBH, MQF, CRAP, BG, BAP, CHN-HAT, LMB, PL)

Findings - Community

- Overall community was not substantially different pre and post restoration
  - Invasive and estuarine communities were substantially different
- Refuge biodiversity significantly increased after restoration
- Restoration positively benefits salmonids
  - Sea-run coastal cutthroat trout (>350 mm) were found in Fahys Cr. post restoration
  - Chinook (> 110 mm) were collected on the mainstem post restoration
- Restoration positively benefits estuarine species
  - Four additional estuarine species present post restoration

Findings - Distribution

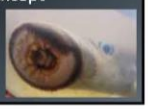
- Salmonids occupy all areas of the refuge
- There is occupancy and seasonal use of newly constructed channels
- Estuarine fish species were found behind the previously existing dike structure
- Coastal cutthroat trout and introduced species are associated with previously diked areas and streams
- Fahys Creek supports a resident population of coastal cutthroat trout

Findings – Relative Abundance

- Sculpin sp. and stickleback are dominant throughout the refuge
- In the absence of SCP and SKB, CCT and coho have the highest frequency of occurrence and relative abundance in the refuge
- Surfperch are now a dominant species
  - Due to abundance, not frequency
  - Relative abundance pushed coho out of dominance

Findings – Reference Sites

- Reference sites do not follow the same patterns as the restoration area
- Community is substantially different from restored area
- Biodiversity diminished
- No introduced species or CCT (except American shad)



Concluding Comments

- Refuge/Fisheries partnership has been mutually beneficial
- Fisheries provided a standardized sampling approach for a long-term assessment and monitoring program
- Fisheries provided technical expertise and resources to help answer other restoration questions
- Refuges provided a unique opportunity for CRFPO to be involved in tidal marsh restoration projects
- Refuges provided funding

Acknowledgements

- Refuges
  - Roy Lowe, Kevin Killbride, Dave Ledig, Bill Bridgeland, Madeleine VanderHeyden, Clint Reese
- Siletz and Coquille tribes
- Donna Allard, Shawna Castle, Justin Cook, Sheila Davis, Julie Harris, Amy Horstman, Jeff Jolley, Ryan Koch, Marci Koski, Sam Lohr, Greg Silver, Joe Skalicky
- Many seasonal employees

Presentation: Developing seasonal spectral signature models to accurately assess indicators of aquatic health: Algal succession and water quality at Malheur NWR. Presented by Linda Beck

DEVELOPING SEASONAL SPECTRAL SIGNATURE MODELS TO ACCURATELY ASSESS INDICATORS OF AQUATIC HEALTH: CHLOROPHYLL-a and Water Quality

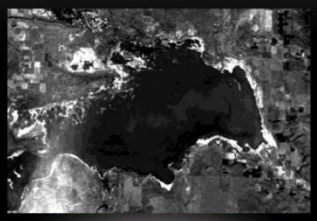
Linda Beck – Malheur NWR, Fisheries
Zola Adjei – Brigham Young University, Civil Engineering
Gustavious Williams – Brigham Young University, Civil Engineering
Jordan Miller – Friends of Malheur NWR, GIS

I&M FUNDING SUPPORT

- ~$30,000 – Grant money
- Project total = ~ $60,000
- Without this support none of the following would have been possible!!!

Thank You!!

WHY CHOOSE THIS TECHNOLOGY?



Raw satellite image of Malheur Lake retrieved from http://earthexplorer.usgs.gov

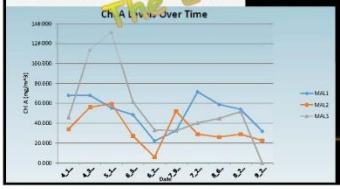
REMOTE SENSING

- Uses satellite images to measure the reflectance of sunlight from the earth surface in specific wave bands or colors.
- Correlated with field-measured concentrations of chlorophyll-a using statistical algorithms.
- Statistical correlation models then estimate chlorophyll-a concentrations from other images.
- Malheur Lake model uses historical Landsat data from 1984—2013 to provide information about historical water quality trends in Malheur Lake.

Locations of Water Quality Sampling for [illegible]

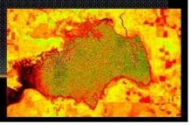
The Easy Part

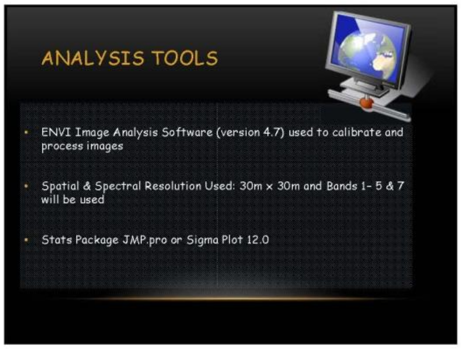
- Conductivity
- Salinity
- pH
- Temperature
- DO
- Total Depth
- Secchi Depth
- Phytoplankton



MODEL DEVELOPMENT

- Landsat 5 & 7 images from USGS Earth Explorer Database.
- Various statistical models are developed using the 7 bands of the Landsat data and the field-measured chlorophyll-a concentrations.
- Graphs are produced to analyze the statistical correlation between satellite and field measurements and help select the most appropriate model.
- The model is used with other images to determine long-term trends or current conditions.




ANALYSIS TOOLS
ENVI Image Analysis Software (version 4.7) used to calibrate and process images
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Stats Package JMP.pro or Sigma Plot 12.0

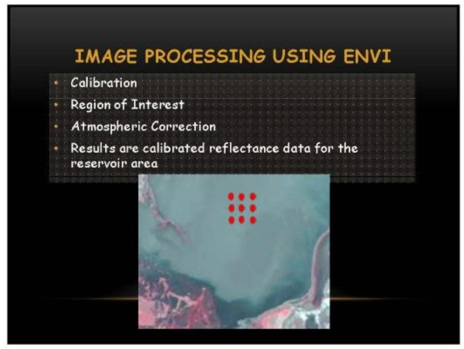
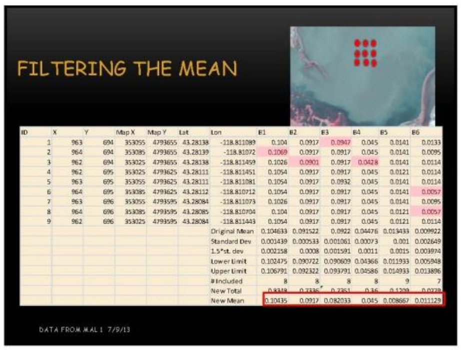


IMAGE PROCESSING USING ENVI
Calibration
Region of Interest
Atmospheric Correction
Results are calibrated reflectance data for the reservoir area


FILTERING THE MEAN
ID X Y Map X Map Y Lat Lon B1 B2 B3 B4 B5 B6
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3 962 694 353025 4793655 43.28138 -118.811459 0.1026 0.0901 0.0917 0.0428 0.0141 0.0114
4 962 695 353025 4793625 43.28111 -118.811451 0.1054 0.0917 0.0917 0.045 0.0121 0.0114
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6 964 695 353085 4793625 43.28112 -118.810712 0.1054 0.0917 0.0917 0.045 0.0141 0.0057
7 963 696 353055 4793595 43.28084 -118.811073 0.1026 0.0917 0.0917 0.045 0.0141 0.0095
8 964 696 353085 4793595 43.28085 -118.810704 0.104 0.0917 0.0917 0.045 0.0121 0.0057
9 962 696 353025 4793595 43.28084 -118.811443 0.1054 0.0917 0.0917 0.045 0.0121 0.0114
Original Mean 0.104633 0.091522 0.0922 0.04476 0.013433 0.009922
Standard Dev 0.001439 0.000533 0.001061 0.00073 0.001 0.002649
1.5*st. dev 0.002158 0.0008 0.001591 0.0011 0.0015 0.003974
Lower Limit 0.102475 0.090722 0.090609 0.04366 0.011933 0.005948
Upper Limit 0.106791 0.092322 0.093791 0.04586 0.014933 0.013896
Included 8 8 8 8 9 7
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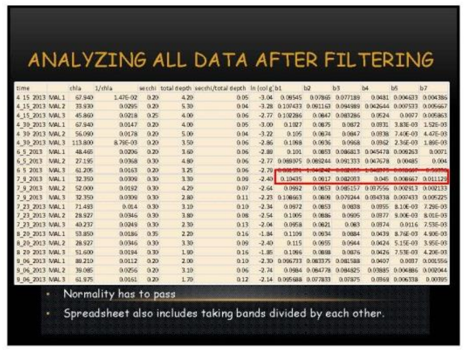
DATA FROM MAL 1 7/9/13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time chla 1/chla secchi total depth secchi/total depth b1 b2 b3 b4 b5 b7
4_15_2013 MAL 1 67.940 1.47E-02 0.20 4.20 0.05 -3.04 0.08545 0.07865 0.077189 0.0481 0.004633 0.004386
4_15_2013 MAL 2 33.930 0.0295 0.20 5.30 0.04 -3.28 0.107433 0.091163 0.094989 0.042644 0.007533 0.005667
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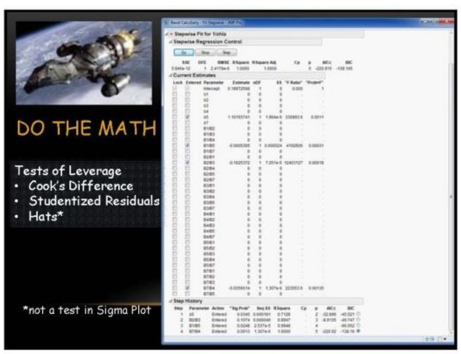
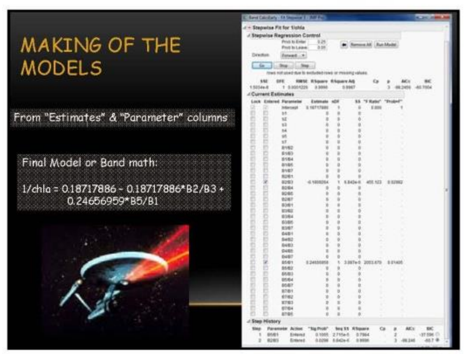
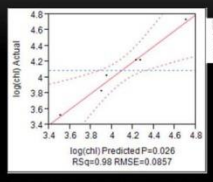
4_30_2013 MAL 3 113.800 8.79E-03 0.20 3.50 0.06 -2.86 0.1088 0.0936 0.0968 0.0362 2.36E-03 1.89E-03
6_5_2013 MAL 1 48.465 0.0206 0.20 3.60 0.06 -2.89 0.101 0.0853 0.086813 0.045478 0.009263 0.0071
6_5_2013 MAL 2 27.195 0.0368 0.30 4.80 0.06 -2.77 0.089075 0.089244 0.091333 0.047678 0.00485 0.004
6_5_2013 MAL 3 61.205 0.0163 0.20 3.25 0.06 -2.79
7_9_2013 MAL 1 32.350 0.0309 0.30 3.30 0.09 -2.40 0.10435 0.0917 0.082033 0.045 0.008667 0.011129
7_9_2013 MAL 2 52.000 0.0192 0.30 4.20 0.07 -2.64 0.0992 0.0853 0.085157 0.037556 0.002913 0.002133
7_9_2013 MAL 3 32.350 0.0309 0.30 2.80 0.11 -2.23 0.108663 0.0809 0.079244 0.034338 0.007433 0.005225
7_23_2013 MAL 1 71.493 0.014 0.30 3.10 0.10 -2.34 0.0972 0.0853 0.0838 0.0355 8.10E-03 7.29E-03
7_23_2013 MAL 2 28.927 0.0346 0.30 3.80 0.08 -2.54 0.1005 0.0886 0.0905 0.0377 9.00E-03 8.01E-03
7_23_2013 MAL 3 40.237 0.0249 0.30 2.30 0.13 -2.04 0.0958 0.0821 0.083 0.0374 0.0116 7.53E-03
8_20_2013 MAL 1 53.850 0.0186 0.35 2.20 0.16 -1.84 0.1109 0.0934 0.0884 0.0439 8.76E-03 4.90E-03
8_20_2013 MAL 2 28.927 0.0346 0.30 3.30 0.09 -2.40 0.115 0.0955 0.0944 0.0424 5.15E-03 3.95E-03
8_20_2013 MAL 3 51.600 0.0194 0.30 1.90 0.16 -1.85 0.1096 0.0898 0.0876 0.0426 7.53E-03 4.20E-03
9_06_2013 MAL 1 89.210 0.0112 0.20 2.00 0.10 -2.30 0.096733 0.083375 0.081588 0.0407 0.0037 0.001556
9_06_2013 MAL 2 39.085 0.0256 0.20 3.10 0.06 -2.74 0.0984 0.084778 0.084825 0.03885 0.004886 0.002044
9_06_2013 MAL 3 61.975 0.0161 0.20 1.70 0.12 -2.14 0.095688 0.077833 0.07875 0.0369 0.006338 0.00395
Normality has to pass
Spreadsheet also includes taking bands divided by each other.


DO THE MATH
Tests of Leverage
Cook's Difference
Studentized Residuals
Hats*
*not a test in Sigma Plot

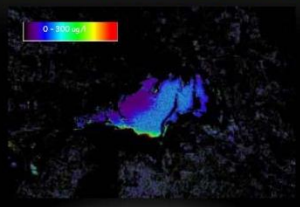

MAKING OF THE MODELS
From "Estimates" & "Parameter" columns
Final Model or Band math:
1/chla = 0.18717886 - 0.18717886*B2/B3 + 0.24656959*B5/B1

REGRESSION MODEL SAMPLE



Spring model using Bands 2, 3, and 5 in various ratios showing the correlation with measured data (6 points)

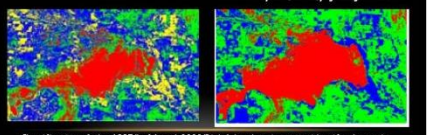
Estimated chlorophyll-a from June 28, 2010



FUTURE WORK

- Emergent Vegetation
- Newer Landsat 8 images will be explored in the future

Layout of Classifying Change in ENVI



Classification of the 1995(Left) and 2000(Right) Landsat image to identify change in Emergent Vegetation on the lake

Acknowledgements

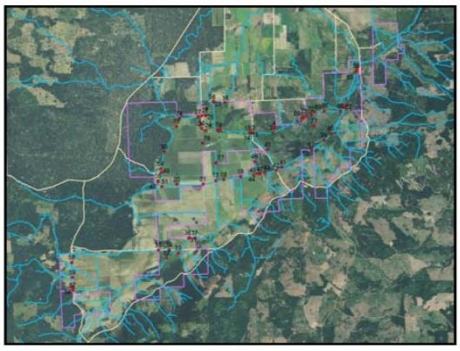
- I & M
- Kristopher Crowley
- Josh Nurre
- Anneliese Detmer

Presentation: Bullfrog and bullhead control for Oregon spotted frog at Conboy Lake NWR. Presented by Lisa Wilson

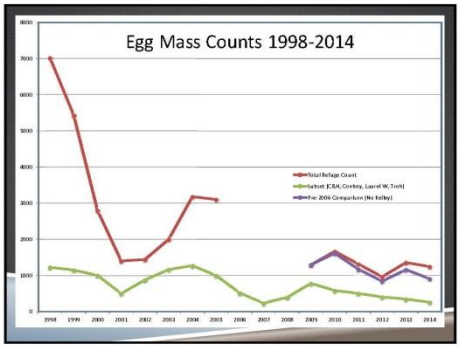
BULLFROG AND BULLHEAD CONTROL FOR OREGON SPOTTED FROGS

Conboy Lake National Wildlife Refuge

Lisa Wilson-Romine



OREGON SPOTTED FROG



THREATS

- Lack of water inputs in some units & changing snow/rainfall patterns
- Timing of drawdowns by adjacent landowners
- Lack of connectivity for metamorphs
- Introduced bullfrogs, brown bullhead, trout
- Reed canary grass

AMERICAN BULLFROG

- Introduced to Glenwood Valley in 1950's
- 2 year larval cycle
- High productivity, large body size

BULLFROG REMOVAL

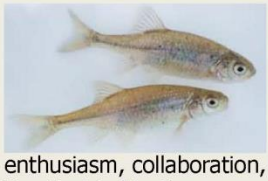
- Some trial runs in late 2013, real efforts in 2014
- Weapons of choice:
  - 5-tined gig on telescoping pole
  - Hand capture
  - Seine net
  - Dipnet
  - Fishing pole
  - Traps
- Electrofishing & Rotenone?

EVALUATING SUCCESS

- Trapping twice a month at removal sites & control sites

Presentation: With a little help from our friends: The enthusiasm, collaboration, and partnerships that led to the recovery of th Oregon chub. Presented by Brian Bangs, Oregon Department of Fish and Wildlife

With a little help from our friends



The enthusiasm, collaboration, and partnerships that led to the recovery of the Oregon chub

Brian Bangs, Paul Scheerer, and Shaun Clements
ODFW

Species Characteristics

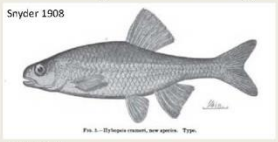
- Small floodplain minnow (<75 mm)
- Mature at ~40 mm (age 2), live to 10 yr
- Spawn from mid-May through July when water temperatures exceed 15-16°C
- Spawn and seek cover from predators in aquatic vegetation

Oregon Chub Habitat Preferences

Off-channel habitats (sloughs, ponds):

- Little or no flow
- Abundant aquatic vegetation & wood
  - Beaver ponds, sloughs and oxbows
- Depositional substrate
- Shallow (<2 meters depth)
- Absence of non-native predatory fish*

Status prior to listing



Historical surveys

- 29 locations, ~80 years, primarily by-catch

Initial surveys

- Primarily OSU (Bond, Markle, Long, Bills, Peterson) - 1970s – 1980s
- Petition to list (Markle and Peterson) - 1990

Status prior to listing

- Proposed listing raised awareness
- Conservation agreement (1992)
  - Partnerships started early, would become Oregon Chub Working Group
  - Identified priorities; Recovery Plan

Factors Implicated in Decline

- Loss of habitat
  - Construction of flood control dams
  - Channelization and revetments
  - Drainage of wetlands for bottomland agriculture
- Predation and competition by non-native fish (currently the greatest threat to recovery)

Listing process

- Markle, in the 1990 petition to list:
  "The future of this fish is certainly questionable. Federal listing as an endangered species together with the implementation of a recovery plan now in preparation could provide the means to save it"
- Listed as endangered in 1993
- Listing noted moderate threats, low recovery potential

Recovery plan - 1998

- Collaborative effort between USFWS, ODFW, and interagency members of the working group
- Outlined recovery thresholds:
  - Distribution in main subbasins
  - Abundance
  - Trend over time
- Thresholds
  - downlisting, delisting

Recovery plan - 1998

- Maintain populations
- Implement introductions
- Research
  - Monitoring
  - Life history investigations
  - Interactions with nonnative species
  - Habitat and water quality
- Public outreach

Recovery plan - 1998

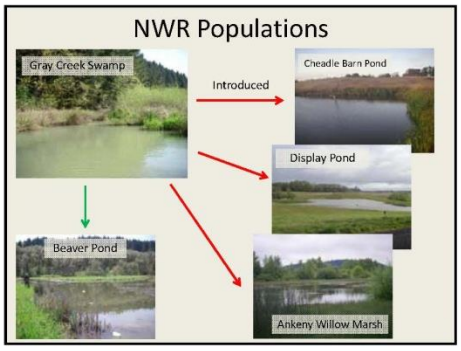
- So, specifically, how did the collaboration between the USFWS and ODFW lead to recovery?

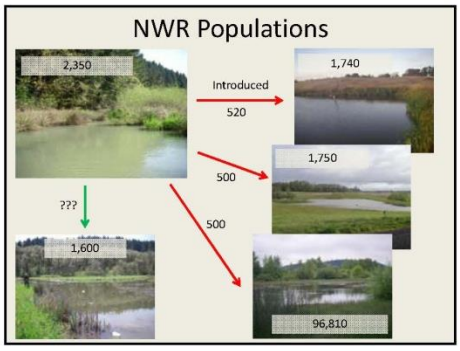
Oregon Chub Introductions

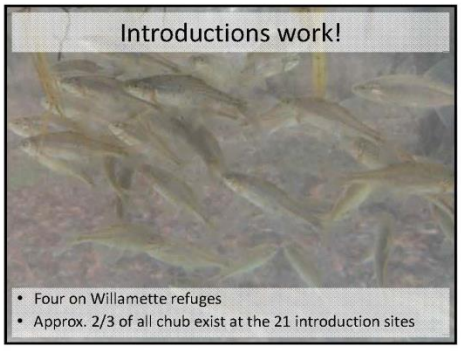
- A major recovery effort is the introduction of Oregon chub into suitable habitats
- Goal is to expand range, increase abundance, reduce extinction risk and loss of genetic diversity
- Currently 21 successful introductions

USFWS Refuges: Populations

- Finley NWR:
  - Gray Creek Swamp – only Mary's River population


NWR Populations
Gray Creek Swamp
Introduced
Cheadle Barn Pond
Display Pond
Beaver Pond
Ankeny Willow Marsh


NWR Populations
2,350
Introduced
520
1,740
500
1,750
???
1,600
500
96,810


Introductions work!
• Four on Willamette refuges
• Approx. 2/3 of all chub exist at the 21 introduction sites


Programmatic Safe Harbor Agreement
• Voluntary agreement involving private or other non-Federal property owners
• Landowners receive assurances that if they meet the conditions of SHA that USFWS will not require any additional management activities


Programmatic Safe Harbor Agreement
• Programmatic: USFWS issued permit to ODFW
• ODFW issues CI to landowners under the permit
• Vastly sped up the process to enroll landowners, start introduced populations
• 8 landowners have Safe Harbor or similar agreements


Willamette Partners Program
• Work with private landowners critical (40%)
– Partners Program instrumental in creating and fostering relationships with landowners
– Creating amazing habitats
– >15,000 Oregon chub (2013)

Willamette Partners Program

- Technical expertise
- Experience
- Relationships with funding, permitting agencies

Willamette Partners Program

- Collaborative – enhancement ideas, candidness
- ODFW has been able to provide pre- and post-enhancement results
- Also made introductions with landowners

Luckiamute

- Partners Program helped to discover first population in this subbasin since 1949
- Relationship with landowner

Habitat improvement

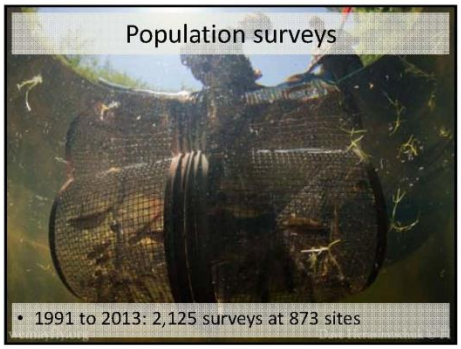
- Numerous projects created, improved habitat
- Purchased or protected habitats
- Every agency, NGO has done some form of habitat project

Life history and genetic investigations

- Life history
  - Spawning requirements, timing
  - Age structure
- Genetic investigations
  - Population structuring by subbasin

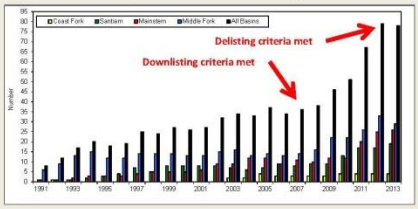
➢Informed management decisions

Population surveys



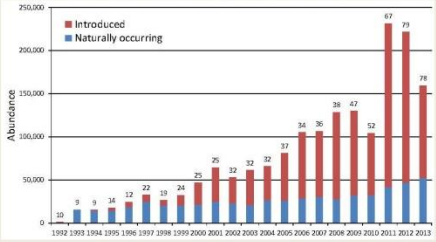
- 1991 to 2013: 2,125 surveys at 873 sites

Population surveys



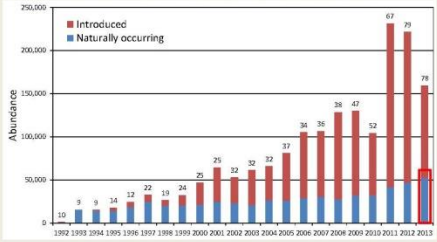
- Introductions (21), discovery of new pops. (51)
  - From 8 to ~80 populations in 22 years

Oregon chub populations



In 2013, 2/3 of all Oregon chub occur in the 21 introduced sites (107,000 of 159,000 total)

Oregon chub populations



In 2013: 70,000 chub either on a refuge, in a habitat created by Partner's Project, or private land with SHA

2008 Willamette BiOp

Effect of Corps operations on ESA listed species

- Coincided with a shift in focus
- ESA mandated – provided funds, staff time

Up to then, chub managed in isolation (low connectivity)

- Historically thrived in dynamic floodplain habitats
- Non-native fishes are the greatest threat to recovery
  - ➢ Yet sometimes they coexist
- Little genetic exchange

Floodplain Study (ACOE BiOp)

Initiated in 2009

Study of the flow and habitat requirements that favor chub over non-native fishes in connected habitats.

Floodplain Study (ACOE BiOp)

- Discovered chub well distributed in floodplain habitats (~30 new pops)
- Documented movement
- Started to piece together habitat, flow, temperature, and fish community elements that allow chub to coexist with nonnative species

Recovery

- Only achievable through close knit collaboration with working group, passion of many individuals
- Combination of:
  - Habitat improvement, conservation
  - Success with introductions
  - Increased knowledge, better management
  - Discovery of new populations
- Met delisting criteria in 2012,
  - USFWS submitted delisting proposal in Feb. 2014

Delisting proposal announcement

So we're done right?

- USFWS, ODFW, and Corps developed a post-delisting monitoring plan
- Builds on the success of the recovery plan
  - Oregon chub distribution and abundance
  - Potential adverse changes to habitat from environmental or anthropogenic factors
  - Distribution of nonnative fishes in Oregon chub habitats
- Three 3-year cycles (9 years total)

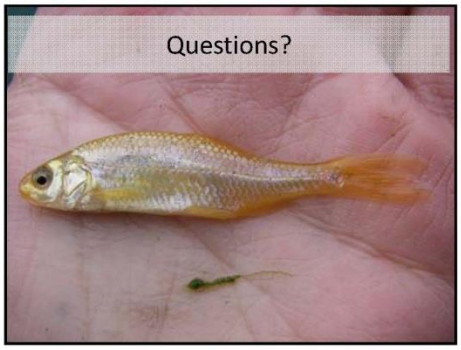
Post-delisting monitoring plan

- Concurrent with existing floodplain study
  - Continue to make flow and temperature recommendations to benefit chub, floodplain habitats
- Employ successful management techniques during PDM, such as introductions

Big steps on the road

Conclusions

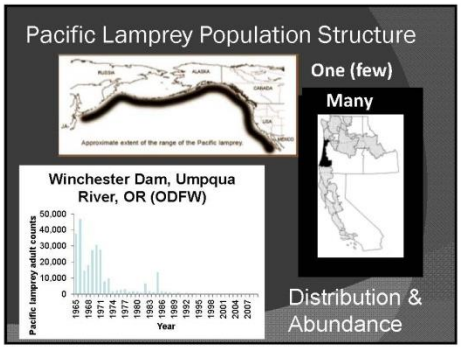
- ESA Listing
  - Attention, provided some initial funds
- Establishing refuge populations
  - Safeguard against extinction
  - Programmatic Safe Harbor
- Willamette BiOp
  - Large influx of funding; ask important questions
  - Restore the species floodplain habitats
- PDM
  - Continued attention to the species
  - Continue to meet recovery goals
  - Decision to delist correct


Questions?

Presentation: Pacific lamprey conservation initiative. Presented by Christina Wang

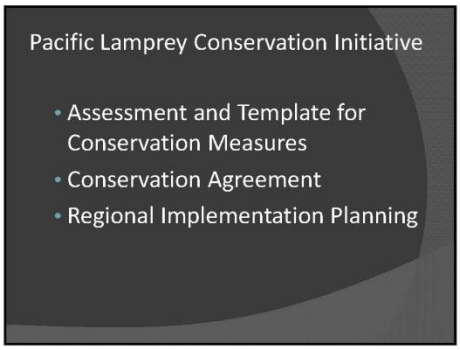

Pacific Lamprey
Conservation Initiative
Christina Wang


Falls at Willamette Falls

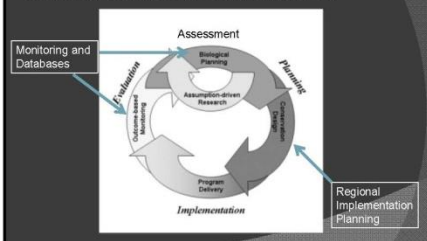

Pacific Lamprey Population Structure
One (few)
Many
Approximate extent of the range of the Pacific lamprey
Winchester Dam, Umpqua River, OR (ODFW)
Pacific lamprey adult counts
Year
Distribution & Abundance


Need for Conservation Initiative
• Apparent widespread decline throughout the range
• Ecologically important to aquatic habitats
• Significant to Native American cultures
• Concern of status from many partners


Lamprey Conservation Timeline
• 1994 - NPCC F&W program directs lamprey work
• 1995 - Formation of Technical Workgroup
• 2003 - Petition to list Pacific Lamprey
• 2004 - Finding that listing not warranted
• 2004 - CRITFC Lamprey Summit I
• 2007 - Corps Adult Passage Plan
• 2007 - USFWS Conservation Initiative
• 2008 - Fish Accords
• 2008 - Tribal Summit II/Tribal plan
• 2012 – Conservation Agreement
• 2013 – Regional Implementation Planning

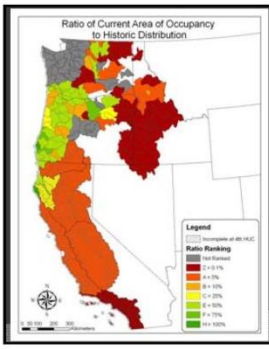

Pacific Lamprey Conservation Initiative
• Assessment and Template for Conservation Measures
• Conservation Agreement
• Regional Implementation Planning

Lamprey Strategic Habitat Conservation



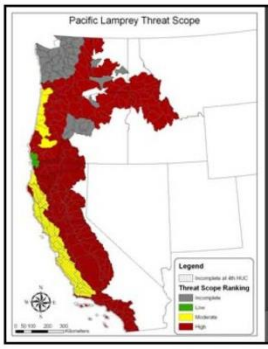
Regional Management Units

4TH code Hydrologic Units



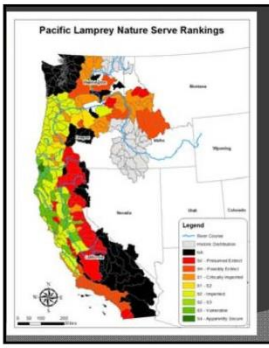
Demographics

- Historic distribution
- Current distribution
- Abundance
- Population size
- Short term trend



Threats

- Passage
- Flow management
- stream and floodplain degradation
- Water quality
- Predation
- Climate change



S1	Middle Fork Willamette
S1	Coast Fork Willamette
S2	Upper Willamette
S2	Mckenzie
S2	North Santiam
S2	South Santiam
S2	Middle Willamette
S2	Yamhill
S2	Molalla-Pudding
S2	Tualatin
S1	Clackamas
S1	Lower Willamette

- Low chance of rescue from healthy areas

Climate Change Vulnerability

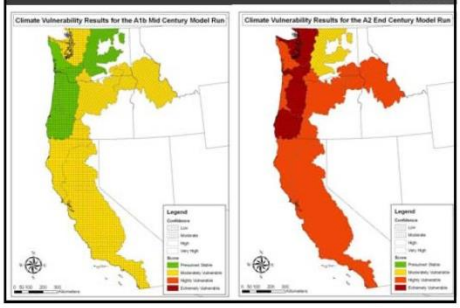
Application of NatureServe

- Need for systematic climate change assessment by region
- Employed NS vulnerability index:
  - Direct environmental exposure from projections of downscaled temperature and moisture by region
  - Species sensitivity to environmental change

Climate Change Risk Assessment

- Indirect exposure:
  - Sea level rise, distribution relative to barriers
- Species specific sensitivity:
  - Historical temperature and precipitation, dispersal, dietary versatility, species interactions
- Exposure to climate change:
  - Magnitude of predicted temperature and moisture change from downscaled model runs

Climate Vulnerability Index



Pacific Lamprey NatureServe Results

		Climate Vulnerability Index	
Region	**Rank**	**A1B -Mid**	**A2-End**
Columbia River			
Lower Col./Willamete	S2	PS	EV
Snake	SH,S1	MV	HV
Oregon Coast			
North Oregon Coast	S2	PS	HV
South Oregon Coast	S2	PS	EV

Application of Risk and Climate Change Assessments

Lower Col./Willamette	S2	PS	EV

- S2 Threats:
  - Stream & flood plain degradation
  - Dewatering & flow management
- CC Vulnerability is PS mid century
- Sensitivity to End Century Vulnerability
  - Stabilize stream temperature
  - Remove barriers

North Pacific LCC Climate Change study

- Modify Climate Change Vulnerability Index - specific information on changes in stream conditions
- Identify sensitivity for specific environmental changes:
  - stream temperature
  - hydrologic regime
  - physical connectivity disruptions

Conservation Agreement- 2012

- Signatories - 13 Tribes, 4 states, 14 federal agencies
- Signatories and supporters to form Conservation Team

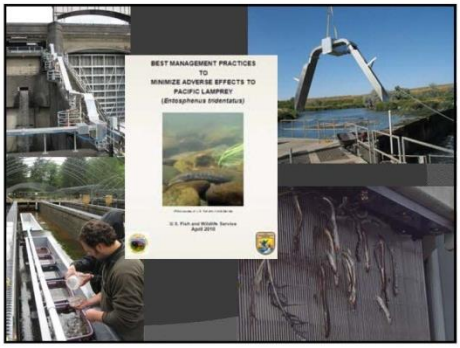
Conservation Agreement- 2012

Achieve long-term persistence of Pacific Lamprey and support traditional tribal cultural use of Pacific Lamprey throughout their historic range in the United States.

Regional Implementation Planning

- Efficiently use limited resources and swiftly implement Pacific lamprey actions
- Identify and prioritize needed actions and research
- Identify implementing agencies and funding sources

Region:	Mid-Columbia; HUC: Umatilla	What and Why	Where	
	Threats / Actions	Description of Actions	Subbasin / Watershed	Literature
Threat #1	Adult Migration			
Action 1.1	Passage Improvement	Installed four lamprey passage structures: 3 mile, Maxwell, Dillon and Feed 2009-2012. Next planned LPSs are Westland, Brownell and Stanfield. Per radiotelemetry results determined prioritization.	Lower Umatilla River	Pacific Lamprey Research and Restoration Project Oct Lite
Action 1.2	Passage Improvement	Lateral tributary passage structure and culvert evaluation: 1) look at salmonid survey to identify impassable structures, 2) evaluate salmonid passage criteria for lamprey, 3) prioritize structures and culverts for improvements	Umatilla basin	Guidelines for Salmonid Passage at Stream Crossings NMFS (NMFS 2001)
Action 1.3	Passage Improvement	Implementation of BMPs and lateral tributary passage structure and culvert improvements.	Umatilla basin	Best Management Practices to Minimize Adverse Effects to Pacific Lamprey - USFWS 2010
Action 1.4	Prevention of Canal Assess	Prevent adults from entering canal (both inlets & outlets), which could be a significant issue considering the potential high level of pheromone attraction stemming from canal waters.	Lower Umatilla River	Pacific Lamprey Research and Restoration Project Oct Lite 2008



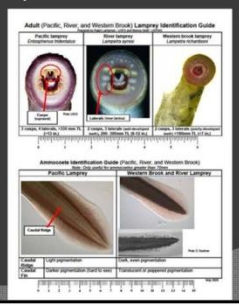
Lamprey Occupancy and Distribution Workshops

- Working with partners on lamprey occupancy sampling
- Broad scale probabilistic sampling
- Finer scale intensive monitoring
- Workshops – Fall 2014

Lamprey Data Clearinghouse

- FWS has made a commitment to partners to create database for lamprey information
  - Literature
  - GIS data

Lamprey Identification Workshops



Willamette Valley Conservation Study & Surrogate Species

- Providing information on Pacific Lamprey
- Demographic and threat information
- Information from regional implementation planning

Pacific Lamprey Conservation Initiative

http://www.fws.gov/pacific/Fisheries/sphabcon/Lamprey/index.cfm

Presentation: The good, bad, and ugly: Water rights in the Pacific Northwest. Presented by Tim Mayer

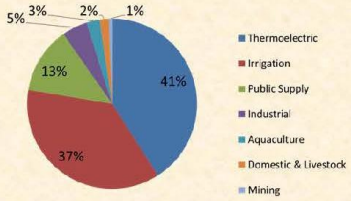
U.S. Fish & Wildlife Service

Water Rights: The Good, the Bad and the Ugly

Western Water Rights Discussion

U.S. Fish & Wildlife Service

Total Freshwater Withdrawals in 2005 in the U.S.



U.S. Fish & Wildlife Service

Use of Water

Consumptive versus Non-Consumptive

Agricultural crops	Most energy use
Wetlands	Residential
Some power production	Instream flows
	Hatcheries

U.S. Fish & Wildlife Service

Water Right Attributes

Quantity *(flow rate/total volume)*

Season of use

Purpose *(irrigation, wildlife, fish culture, instream flow, residential)*

Point(s) of diversion

Place of use

Priority date

U.S. Fish & Wildlife Service

Water Right Summaries

Goal: All R1/R8 Facilities

State water law summary

Summary of facility water rights w/ map(s) discussing the water right attributes and showing the place of use and point of diversion for each right

Relevant water right issues, specific to facility

U.S. Fish & Wildlife Service

USFWS VESTED RIGHT CLAIMS & FEDERAL RESERVED RIGHT CLAIM
KLAMATH MARSH NATIONAL WILDLIFE REFUGE

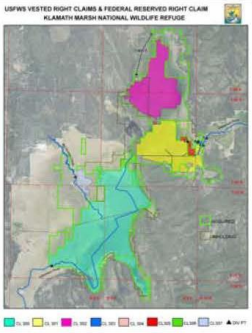
Klamath Marsh NWR

Map showing:

Place of Use

Point of Diversion

For 8 USFWS water rights



U.S. Fish & Wildlife Service

Water Rights are Mostly Governed by Individual State Laws

Most Western States' are "**Prior Appropriation**."

Most Eastern States are "**Riparian**" or "**Regulated Riparian**."

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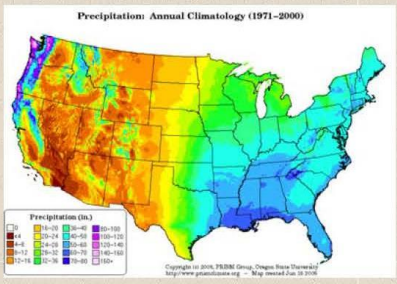
Average Annual Precipitation Totals in the US



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Water Doctrine

Orange = Prior Appropriation
Blue = Riparian
Green = Regulated Riparian
Gray = Hybrid

U.S. Fish & Wildlife Service

Prior Appropriation Water Rights (Western States)

"First in time, first in right"

- **Priority date** is date of filing and initiation of the right
- Generally **requires a diversion** and **beneficial use**
- Requires a **permit**
- May be **lost for non-use**

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Riparian Water Rights (Eastern States and CA)

- Right attaches to **riparian land**, quantity imprecise
- **Shortages** are **shared equally**
- Cannot be lost through **non-use**
- In CA (hybrid of appropriative and riparian), riparian rights are senior to appropriative rights

U.S. Fish & Wildlife Service

Hypothetical Fully Appropriated Stream

Total Streamflow = 4 cfs
4 water rights
1 cfs Priority 1900
1 cfs Priority 1920
1 cfs Priority 1940
1 cfs Priority 1960

U.S. Fish & Wildlife Service

Appropriative Water Rights

Total Streamflow drops to 3 cfs
4 water rights
1 cfs Priority 1900
1 cfs Priority 1920
1 cfs Priority 1940
0 cfs Priority 1960

U.S. Fish & Wildlife Service

Riparian Water Rights

Total Streamflow drops to 3 cfs
4 water rights
0.75 cfs
0.75 cfs
0.75 cfs
0.75 cfs

U.S. Fish & Wildlife Service

Vested Water Rights (Prior Appropriation States)

- Use existed before state Water Codes were enacted
  - Oregon: surface water 1909, groundwater 1955
  - Washington: surface water 1917, groundwater 1945
  - Idaho: surface water 1963, groundwater 1971
- Priority date is **date of initiation of the right**
- Water has to have been used continuously to prove a vested right.
- Legally established/recognized through a **water right adjudication**

U.S. Fish & Wildlife Service

Federal Reserved Water Rights Doctrine

*…When the United States **reserves** land (or **acquires** land in some instances), the United States **expressly** or **impliedly** reserves the quantity of **unappropriated** water necessary to accomplish the "very" **(primary) purposes** of the reservation…*

U.S. Fish & Wildlife Service

Federal Reserved Water Rights

- Applies to federally reserved lands
- **Priority date** is the **date of the reservation**
- Includes **present and future uses**
- **Can't be lost** through non-use
- Amount necessary for the **primary purpose** of the reservation
- Legally established/quantified through **state water right adjudications**

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Prior Appropriation Water Rights (Western States) *"Use it or Lose it"*

Forfeiture or Relinquishment

In most prior appropriation states, you must use your full right at least once every 5 years

U.S. Fish & Wildlife Service

Conjunctive Use of Water

Surface water

Groundwater

U.S. Fish & Wildlife Service

Instream Flow Water Rights

Surface water only

U.S. Fish & Wildlife Service

Water Right Law Summaries

Oregon, Washington, Idaho, California, Nevada

U.S. Fish & Wildlife Service

Water Rights – The Good

FWS Policy Objective: Obtain water supplies of adequate quantity and quality, and the legal rights to use that water…

U.S. Fish & Wildlife Service

Water Rights – The Good

FWS Policy:

- Comply with state water law.
- Identify/purchase water rights on acquisitions.
- Monitor and report water use as required by permit, monitor impacts and protect water rights.
- Seek to negotiate solutions to resolve conflicts, avoid litigation if possible.

U.S. Fish & Wildlife Service

Water Rights – The Bad

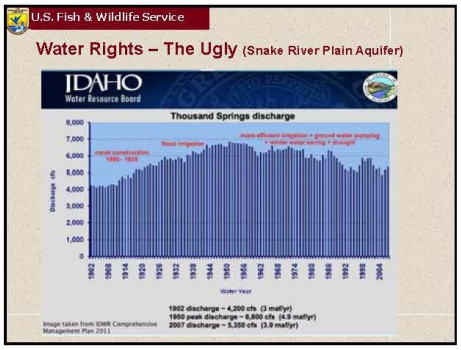
Streams fully allocated

"Use or lose" may encourage waste

Water Over-priced

No "instream-use" for groundwater rights

"WIN-lose" proposition


U.S. Fish & Wildlife Service
Water Rights – The Ugly (Snake River Plain Aquifer)
IDAHO
Water Resource Board
Thousand Springs discharge
1902 discharge ~ 4,200 cfs (3 maf/yr)
1950 peak discharge ~ 6,800 cfs (4.9 maf/yr)
2007 discharge ~ 5,350 cfs (3.9 maf/yr)


U.S. Fish & Wildlife Service
Solutions?
Water rights acquisition (small scale solution)
Demand-side instead of supply-side solutions
Multi-party, watershed collaborative approaches


U.S. Fish & Wildlife Service
Questions?

Presentation: Progress on the initiative to develop a long-term aquatic monitoring program for climate change at R1 NWRs. Presented by Sam Lohr and Bridgette Flanders-Wanner

Progress on the Initiative to Develop a Long-term Aquatic Monitoring Program for Climate Change at R1 NWRs

Why What How When Who Where

PACIFIC REGION NWRS-FISHERIES
Long-term Aquatic Monitoring Program
WHY

Climate change – air temperature and precipitation changes expected to affect of water temperature and hydrologic regime

Effects on biota – physiological tolerances, disturbance regime, nutrient processing rates, habitat modifications, non-native species

Why at NWRs – Service's principal land base, established for the conservation, management, and restoration of natural resources

Results inform conservation – early indication of effects, non-native species, indicate need for actions, contribute to broad-scale efforts (landscape vulnerability assessments, SHC)

PACIFIC REGION NWRS-FISHERIES
Long-term Aquatic Monitoring Program
WHAT

Goal: Evaluate evidence of climate change in physical attributes at NWRs and changes in aquatic communities

Objectives:

-Establish long-term sentinel sites representing mainland NWRs across R1 ecoregions
-Describe how physical attributes vary through time
-Describe how biological attributes vary through time
-Analyze for potential temporal change by ecoregion
-Assess relationships in physical and biological attributes by ecoregion

PACIFIC REGION NWRS-FISHERIES
Long-term Aquatic Monitoring Program
HOW

Desired Qualities:

- Sustainable for resources required
- Existing info, support
- Consistency in habitat type, physical and biological attributes

Methods:

- EPA Environmental Monitoring and Assessment Program protocols
- Components—discharge, temperature continuously recorded; water chemistry, habitat, aquatic vertebrates surveys during low flow (assemblage/community metrics)
- Temporal analyses once time series established

PACIFIC REGION NWRS-FISHERIES
Long-term Aquatic Monitoring Program
WHEN and WHO

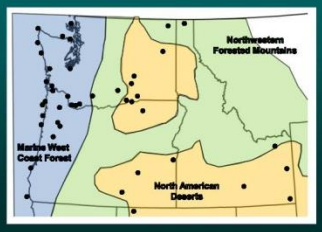
When: Phased approach

Phase 1- Reconnaissance (sites, loggers) → Phase 2- Baseline (1st 3-years, 3X/year) → Phase 3- Long-term (2-5 year intervals)

Who: Collaboration NWRS-Fisheries

--FRO matched with NWR
--FRO habitat/aquatic surveys, analyses
--NWR download loggers
--Others?

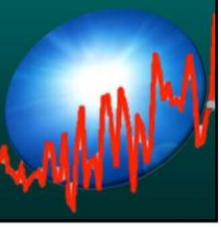
PACIFIC REGION NWRS-FISHERIES
Long-term Aquatic Monitoring Program
WHERE



PACIFIC REGION NWRS-FISHERIES
Long-term Aquatic Monitoring Program
WHERE

Site Selection:

- 2013 draft proposal based on prior history with Fisheries Resource Offices
- *Comments*: Confounding factors could obscure detection of a real climate change trend



PACIFIC REGION NWRS-FISHERIES
Long-term Aquatic Monitoring Program
WHERE

Refuges, Water Resources, & Fisheries Joint Assessment

Objectively Identify Streams:
1. Non-tidal and wadeable

PACIFIC REGION NWRS-FISHERIES
Long-term Aquatic Monitoring Program
WHERE

Refuges, Water Resources, & Fisheries Joint Assessment

Objectively Identify Streams:
1. Non-tidal and wadeable
2. Diverse vertebrate fauna

PACIFIC REGION NWRS-FISHERIES
Long-term Aquatic Monitoring Program
WHERE

Refuges, Water Resources, & Fisheries Joint Assessment

Objectively Identify Streams:
1. Non-tidal and wadeable
2. Diverse vertebrate fauna
3. Watersheds resistant to perturbations (e.g., water diversion, development, land cover change)

PACIFIC REGION NWRS-FISHERIES
Long-term Aquatic Monitoring Program
WHERE

Refuges, Water Resources, & Fisheries Joint Assessment

Two-Phased Approach – Phase ONE:

1. Initial Screening of Potential Candidates (Collective **"wisdom"** of 8 Program Representatives)

Northwestern Forested Mountains Ecoregion		
Franz Lake	Maybe?, N, Y	Indian Mary Creek
Pierce	Maybe?, Y?, N	Hardy Creek
Kootenai	N, Y, Y	Myrtle Creek
Little Pend Oreille	Y, Y, Y, Y	--Bear Creek, --Little Pend Oreille River

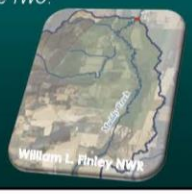
PACIFIC REGION NWRS-FISHERIES
Long-term Aquatic Monitoring Program
WHERE

Refuges, Water Resources, & Fisheries Joint Assessment

Two-Phased Approach – Phase TWO:

2. Geospatial Assessment

Key Attributes:
- Length on Refuge



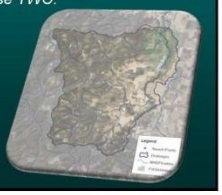
PACIFIC REGION NWRS-FISHERIES
Long-term Aquatic Monitoring Program
WHERE

Refuges, Water Resources, & Fisheries Joint Assessment

Two-Phased Approach – Phase TWO:

2. Geospatial Assessment

Key Attributes:
- Length on Refuge
- Size of Drainage Area



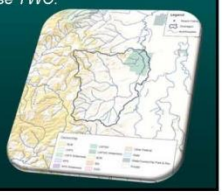
PACIFIC REGION NWRS-FISHERIES
Long-term Aquatic Monitoring Program
WHERE

Refuges, Water Resources, & Fisheries Joint Assessment

Two-Phased Approach – Phase TWO:

2. Geospatial Assessment

Key Attributes:
- Length on Refuge
- Size of Drainage Area
- Watershed Ownership



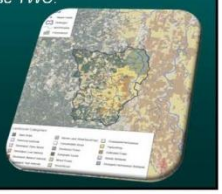
PACIFIC REGION NWRS-FISHERIES
Long-term Aquatic Monitoring Program
WHERE

Refuges, Water Resources, & Fisheries Joint Assessment

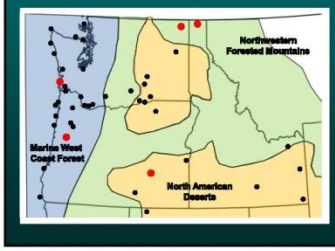
Two-Phased Approach – Phase TWO:

2. Geospatial Assessment

Key Attributes:
- Length on Refuge
- Size of Drainage Area
- Watershed Ownership
- Major Land Cover Types



PACIFIC REGION NWRS-FISHERIES
Long-term Aquatic Monitoring Program
WHERE



Little Pend Oreille

Kootenai

Willapa

William L. Finley

Malheur

PACIFIC REGION NWRS-FISHERIES
Long-term Aquatic Monitoring Program

THANK YOU!

FISHERIES PROGRAM
HOWARD SCHALLER
SAM LOHR
RD NELLE
DENISE HAWKINS
MICHEAL FALER

WATER RESOURCES
SHEILA STRACHAN
TIM MAYER
STEPHEN PILSON

BRANCH OF REFUGE BIOLOGY
JOE ENGLER
BRIDGETTE FLANDERS-WANNER

INVENTORY AND MONITORING
KEVIN KILBRIDE
BRIAN ROOT
JENNY BARNETT
ERIN STOCKENBERG

Stephen Pilson
Cartographer/GIS Analyst

PACIFIC REGION NWRS-FISHERIES
Long-term Aquatic Monitoring Program

APPENDIX B: 2015 NWR-FISHERIES MEETING AGENDA, NOTES, ATTENDEES, ACTION ITEMS, AND PRESENTATIONS

NWR-FISHERIES MEETING AGENDA
May 13, 2015
Columbia River Fisheries Program 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 (Bridgette Flanders-Wanner/Sam Lohr)
10:05-10:35	Teaching by doing: Conducting occupancy and distribution sampling for Pacific lamprey at Tualatin River National Wildlife Refuge (Jeff Jolley)
10:35-11:05	Habitat restoration and management planning at Wapato Lake National Wildlife Refuge (Curt Mykut/Erin Holmes)
11:05-11:35	Steelhead use and monitoring at Toppenish National Wildlife Refuge (Rob Randall/RD Nelle)
11:35-12:05	Little Pend Oreille National Wildlife Refuge: Exotic fish removal in McDowell Lake and planning for native trout restoration in Bear Creek (Jerry Cline)
12:05-1:00	Lunch
1:00-1:30	Submerged aquatic vegetation surveys on Bear Lake, Camas, Grays Lake, and Malheur NWRs in support of Intermountain West Wetland Working Group‘s state and transition models (Jenny Barnett)
1:30-2:00	Lake Sammamish Urban Wildlife Refuge Partnership (Brad Thompson)
2:00-2:20	Break
2:20-4:30	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 13, 2015
Columbia River Fisheries Program Office
1211 SE Cardinal Court, Suite 100
Vancouver, WA 98683

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10:00-10:05 Welcome and overview of workshop (Bridgette Flanders-Wanner/Sam Lohr)

- 10 year anniversary of this working group! Some highlights include:
  - Strengthening existing and making new working relationships (CCPs, IMPs)
  - Identifying and addressing aquatic needs…eventually (Sheldon-Hart)
  - Increasing beyond the scope of CRFPO geographic area (other FROs and NWRs)
  - Developing relationships with local breweries (Rogue – Bandon, Pelican – Ridgefield)
- Introductions

10:05-10:35 Teaching by doing: Conducting occupancy and distribution sampling for Pacific lamprey at Tualatin River National Wildlife Refuge (Jeff Jolley)

- Questions that can be addressed:
  - 1) Occupancy before/after refuge restorations (i.e., Chicken and Rock creeks – currently contains only western brook lamprey – post-restoration monitoring can track changes in occupancy over time with Pacific lamprey colonization);
  - 2) Occupancy above and below a barrier (e.g., Balm Grove Dam – 95% confidence using empirically derived detection probability); and
  - 3) Occupancy and distribution within Tualatin River basin (focused in on Fanno Creek; Pacific lamprey previously occupied, unclear if still occupied; occupancy framework can be applied to any scale – a subbasin, for example, and then scaled up to answer questions about the larger basin).
- Occupancy is related to abundance; answers questions about distribution and range; less effort required when a species is rare or cryptic.

- Detection probability: present is present, but what if you do not find it? See 2014 Guidance for Pacific Lamprey Distribution and Occupancy Sampling document resulting from a lamprey sampling workshop held at Tualatin NWR (prepared by CRFPO).
- Occupancy methods: 1) determine objectives, spatial scale; 2) identify random and spatially balanced stream reaches using GRTS approach; 3) use detection probability to select subset of reaches to achieve desired level of certainty; 4) conduct electrofishing surveys.
- Tualatin NWR planning stream restoration in Chicken and Rock creeks—Pacific lamprey occur in Tualatin River basin, although there is anecdotal information of occurrence on the NWR, there has been no systematic/quantitative surveys for lamprey.
- Project objectives were:
    - Determine if larval lamprey occupy Chicken and Rock creeks before restoration;
    - Identify species and lifestages;
    - Consider salvage options;
    - Determine if larval lamprey occupy the creeks after restoration.
- Project conclusions:
    - Larval western brook lamprey occupied both streams;
    - No Pacific lamprey detected;
    - Habitat likely suitable for rearing, more natural conditions may be conducive for Pacific lamprey;
    - Post restoration surveys can track changes in occupancy.
- Occupancy approaches can be applied to questions about potential passage barriers and distribution with the basin.
- Does NWR have appropriate habitat for lamprey? Steelhead habitat closely resembles spawning habitat for adults. Larvae burrow, so need sandy, silty depositional areas. Refuge may serve more as larval rearing habitat.
- Is water control structure a barrier on Chicken Creek? Hopefully it will be removed.
- Were fin clips taken? Yes – nothing has been done with them yet.
- What initiated this study? Last year's workshop started some of those conversations (i.e., presentation on work at Bandon NWR). Tualatin NWR started work with the Fisheries Program to look at lamprey on Tualatin.

10:35-11:05 Habitat restoration and management planning at Wapato Lake National Wildlife Refuge (Curt Mykut/Erin Holmes)

- Wapato Lake is newest addition to NWR system, #562.
- Wapato Lake restoration – why? Large scale conservation opportunity that can affect waterfowl, wetland dependent fish and wildlife, water quality, declining/rare wetlands, and connectivity with Tualatin River (historically palustrine lake). In 1930's, levees and

canals built, creeks diverted pump station built to keep water out of lake; now heavily agriculture use.

- Challenges: 5.5 miles of 20' levees (sever connectivity to Tualatin basin and limit habitat use in winter from coldwater fish species), internal ditches, canals (serve as ag water for customers on the outskirts of the lake – irrigation district concerned about effects to irrigation operations), diverted creeks, inholding (30 acres, not sure if they will participate with restoration or if they will sell later), carp, reed canary grass, mosquitoes, native coldwater fish, water quality, lakebed subsidence (lake-bed now deeper, more potential for water capacity), water quantity/availability (KEY CONCERN – this will dictate restoration strategies that are available).
- In need of hydrologic data and insights to plan for future management and restoration. How much water is available? What restoration scenarios can be supported? Is there a need for pumps and levees?
- USGS built a water budget, then built a planning tool to predict period of inundation, lake levels, inflows, outflows, habitat, based on various restoration scenarios.
- Shoreline Management Tool developed by USGS to assess the effects of changes in surface water stage on water depth and inundated area of the site; can identify aquatic or terrestrial habitat areas.
- Goal – would like to have a restoration scenario that creates an open downstream connection between Wapato Lake and Wapato Creek. Some backflow exchange would occur in the lake, and reverse direction; the WMST can't calculate that exchange, so difficult to predict lake stage during the year. Will use a HEC-RAS model to compute water exchange rate between lake and creek on a daily basis. Will inform flood conditions associated with restoration.
- Hope to develop restoration alternatives and draft EA/EIS by fall.
- Will waterfowl be considered in restoration? Yes – winter water depths are a concern, but are definitely thinking about wintering habitat for birds. If lake is too deep, will be difficult to establish vegetative communities and limit biodiversity. Goals for habitat, etc. were established in 2007 in an EA; the CCP was developed in 2014, but it incorporates a lot of flexibility because downstream users depend on quality water.

11:05-11:35 Steelhead use and monitoring at Toppenish National Wildlife Refuge (Rob Randall/RD Nelle)

- Primary use of NWR is for migratory birds with a big focus on waterfowl and hunting. Juvenile steelhead (threatened) are present in Toppenish Creek. Yakima PIT tags juvenile steelhead (4000 per year); are detected at 7 pass-through loop antenna sites on the refuge.
- Objectives:
    - Detect use of juvenile steelhead within NWR;
    - Estimate survival of juveniles;

    - Determine if there is any adult use of the refuge.
- Detected about 1% (20 juvenile steelhead) of the total tagged in FY14 (2,448); 3 successfully out-migrated, 17 had unknown fate. No adult steelhead were detected.
- Found low successful out-migration. May be due to increased predation due to delayed out-migration, non-efficient thalweg for fish passage, antenna detection efficiency may not have detected out-migrating fish. No antennas installed in the eastern end of Toppinish Creek – 20.7 km of creek where we don't know what's going on.
- Recommendations: Would like to continue monitoring steelhead for next 4 years; Improve antenna systems: Better understand fate of PIT tagged juveniles by scanning dry wetlands; Install antenna at eastern downstream terminating end of the refuge: Conduct analysis of water temperature/migration timing: Determine antenna detection efficiencies.
- Are adults staying in Toppenish Creek and not utilizing the Snake Creek areas? Yes. Juveniles are using Toppenish Creek and the wetland areas; it's a pretty small proportion of the juveniles that use the refuge complex though (1%).
- How is successful out-migration defined? Fish must be detected at one of three antennas outside of the eastern terminus of the refuge (Prosser Dam, near the confluence of Toppenish and Yakima River, RDIS). That's why we'd like to put an antenna inside the refuge at the eastern edge.
- What is the primary avian predator? Great blue herons – may want to scan those colonies for PIT tags, and other nest sites (e.g., osprey).

11:35-12:05 Little Pend Oreille National Wildlife Refuge: Exotic fish removal in McDowell Lake and planning for native trout restoration in Bear Creek (Jerry Cline)

- McDowell Lake – developed as waterfowl habitat in 1972, fishing is a major use. Fly-fishing only, all catch-and-release. Lake contains non-native tench; competes with other fish, very hardy, tolerates low oxygen levels, eat a lot. Results in emaciated trout. Tench are very difficult to kill – large, deep lake – can draw lake down about 9 feet. Lake treated with rotenone from shoreline, tench returned, used a tench trap and removed tench, another rotenone application using helicopters – no tench detected for 7-8 years, second helicopter rotenone application. Also needed to treat a series of beaver ponds upstream of lake. Also detected LOTS of sunfish and yellow perch, previously unknown. Project cost $43,000 for rotenone, personnel, and helicopter ($37,000 provided by WDFW and $6,000 by FWS Invasive Species Grant).
- Native trout restoration in the Bear Creek drainage (all within refuge) – natives: redband trout (no longer found) and westslope cutthroat trout (very low numbers). Distribution of these fish are very reduced; stocks at risk due to hyrbridization and competition with introduced trout. Suited for native trout restoration since watershed is entirely within the refuge boundary.
    - Looking at natural and man-made fish barriers; remove barriers that impede fish movement and install barriers to prevent movement of non-natives.
    - Remove non-natives from watershed using piscicides.
    - Restock Bear Creek with genetically appropriate native stock, and develop sport fish regulations to maintain native population.
    - Project budget: $33,000 to restore native fish species to 28 miles of stream.

- Do tench migrate upstream like carp do and is that how they are able to re-establish? Likely; that's why we rotenoned the beaver ponds, may be breeding upstream.
- Why separate the lake and the creek if both are being stocked with native fish? Want a barrier between the lake and the stream because fish in lake are not native (coastal rainbows). No longer stock the lake with redbands – do not want non-native trout to be able to go into Bear Creek.
- The policy of the Non-Native Species program is that non-native fish ca not be put on refuges except to support recreational fishing opportunities, so everything is kosher.
- Are rainbows in the lake producing naturally? A little bit, not enough to support a fishery. Discussions about westslope cutthroat determined that it was not able to be stocked (even if they could be self-sustaining).
- How to prevent future introductions of unwanted species in the lake? Not sure why people are putting them there – can't fish and take the fish they catch home since it's only catch and release (criminal masterminds…)! Prevention through education; in fishing regulations, but no signs are put up.
- What about timing draw-down in summer right after reproduction of tench, since they lay their eggs on emergent vegetation in the shallows? Could do that in conjunction with rotenone treatment.

12:05-1:00 Lunch

1:00-1:30 Submerged aquatic vegetation surveys on Bear Lake, Camas, Grays Lake, and Malheur NWRs in support of Intermountain West Wetland Working Group's state and transition models (Jenny Barnett)

- IWWWG formed to manage wetlands for migratory birds/wetland wildlife. Interested in adaptive management context to use state and transition models that describe ecological states, pathways and transitions. State and transition model (STM): diagram that shows our understanding of vegetation dynamics on a specific, unique ecological site (climate, soil, topography, hydrology).
- Currently focusing on semi-permanent wetlands in inter-mountain west. General, and then refuge-specific models.
- STM key ingredients include community phases (including at-risk community phase), states (including reference state and alternate states), pathways (happen naturally), transitions (require management actions), narratives (description of each state – diagnosis and indicators, feedbacks and ecological processes, and management options; transition narratives – feedbacks, thresholds; restoration narratives – restoration pathways to desirable phase).
- IWWWG 2014 pilot for semi-permanent wetland monitoring –
    - Objectives: 1) vegetation, hydrology, water quality inventory; 2) field test methods; 3) describe ecological and abiotic conditions of states and phases for

future management actions; and 4) identify preliminary indicator species and abiotic variables.
    - Contracted support for sampling design and statistical analysis (e.g., GRTS approach), and sampling methodology (e.g., vegetation rake in 1 m^2 quads, abiotic variables) and draft STM.
    - Conducted on 8 refuges in regions 1 and 6.
    - Southeast Idaho Complex was R1 sites– 3 refuges (Camas, Bear Lake, Grays Lake): little knowledge about plans for waterbird food resources, water management issues, need consistent monitoring protocol for assessing submerged aquatic vegetation.
    - Results: big time commitment (i.e., 1,842 hours total over a 2-month period for two 2-person crews to sample 30-120 points in three wetlands at each refuge); hoping to reduce number of needed samples, the complex had funding secured for a large project. Need to refine maps as much as possible and learning how to identify SAV takes time. Will refine model and collect more data in 2015-2016. Final report on Pilot will be out in September.
- The STM describes how we think a system functions ecologically. The model informs management decisions; e.g., if one phase is at risk for becoming an undesirable phase, presence of identified indicator species of that undesirable phase can trigger a management action that will mimic natural processes to keep a phase in the desirable condition.

1:30-2:00 Lake Sammamish (LS) Urban Wildlife Refuge Partnership (Brad Thompson)

- LS surrounded by a community that speaks 94 languages – very diverse! Also in an urban setting, next to Lake Washington in the Seattle area.
- LS kokanee – declined as a result of urbanization (storm runoff, development, introduced species); the FWS decided it wasn't big enough to be a listable entity, but also wanted to assist the community to support the recovery of this population. SHC – protect, reconnect, restore in a document that lists various projects; spearheaded by the Kokanee Workgroup (cities, feds, tribes, NGOs, etc.)
    - Hatchery supplementation (Fisheries Division) – in 6th year, provide $50K per year to collect broodstock from peoples' property (with permission). Big release event to engage the community in protecting and conserving this resource. Set to go for a total of 12 years.
    - Urban Wildlife Refuge Partnership – www.fws.gov/urban - 14 around the country, including LS. Very few contain federal land (watch the video on the website)!
    - Next steps at LS – expand partnership, match interpretative programs and partners who have existing or planned education programs (e.g., salmon in the classroom,

geo-caching), and tie back to LS kokanee/Pacific salmon, provide capacity and sustainable staffing for coordination. Still competing for funds on an annual basis; currently being funded through ES, Refuges, Fisheries, and perhaps NFWF and Mig Birds.

- How did the UWRP originally form? A few years ago, eight were designated, and now there is a total of 14. They do not include a typical refuge, or any refuge at all – they receive a federal designation, but it's not federal land.

2:00-2:20 Break

2:20-4:30 Open discussion of updates, plans, and activities affecting aquatic resources for each NWR, Office, and Program attending

- **Kootenai NWR** (Jerry Cline) – Deep Creek conundrum! Deep Creek, eastern boundary of refuge, comes off of the Kootenai River. There's a dike running adjacent to Deep Creek, and every year, the wetlands are filled with water pumped from a diversion that taps into Deep Creek. What is the effect on fish in Deep Creek (no T&E species, but does have redband and burbot)? Would like to screen. Challenges: creek level fluctuates seasonally – difficult to put in permanent structure; unconsolidated stream bottom (sand), so no stable substrate. Must dredge out hole in Deep Creek to get the pump low enough to pump water from Deep Creek to the pipe that goes through the dike. Difficult to screen the pump. Have previously built a fence surrounding the pump, but that can't be left in permanently (creek is too dynamic). Need a permanent sump site, or different pump, or something…withdrawing from a low-water situation is problematic and the substrate doesn't support construction.
    - Suggestions from group – breach dike, install a diversion structure, and allow water to gravity flow from Deep Creek into the wetland area? Moving the diversion point elsewhere on Deep Creek would be problematic; no other suitable site. Dig a stilling basin, or a well. See if the tribe have an engineering group come out to assess the situation.
- **Idaho FRO** (Mike Faler) – Noted that tribe has a habitat restoration project to reconnect the floodplain and Kootenai River, Deep Creek is not in it. Cascade Creek has pure redband trout and he has an ongoing assessment project. A likely recommendation will be to keep the population isolated.
- **Long-Term Aquatic Monitoring for Climate Change** (Sam Lohr) – Long-term sentinel sites have been identified at 5 refuges (Willapa, Finley, Little Pend Oreille, Kootenai, Malheur, which cover three ecoregions) to measure physical and biological changes (water temperature, discharge, habitat, fish surveys) over time. Three phases: 1) reconnaissance (check out sites, deploy loggers); 2) establish baselines annually for first

three years, fish surveys conducted 3x per year; and 3) long-term monitoring, perhaps at 2-5 year intervals.
    - Phase 1 – ongoing; received $48K from NRPC in FY14; identified site streams and reaches; purchased data loggers and began installation.
    - Phase 2 – summer-fall 2015; I&M provided $60K FY15; installation and data collection, habitat surveys (1x), biological surveys (3x), and developing Data Management Plan.
- **Mid-Columbia FRO** (RD Nelle) – Mid-Columbia FRO is still providing information about the removal of cattle and monitoring riparian vegetation at Little Pend Oreille NWR.
- **I&M** (Kevin Kilbride) – Jenny and Brian are working on I&M plans (mirroring CCP process); are in the process of identifying plans for next year. Would like comments to improve them! Got good response on call for pre-proposals, including Bandon/Nisqually "lessons learned" paper for the restoration projects on those two refuges. Refuge HGMs – 5 completed, 2 in process, a couple in draft stage. Water quality monitoring program at Ankeny in conjunction with the farming program. I&M webinar in March from Sam and Brook about Bandon and Sheldon-Hart from a Fisheries perspective.
- **Tualatin NWR** (Erin Holmes) – finished the CCP in 2013, so implementing it. Challenges come up when there are multiple landowners, but there are a lot of partners and investment. There are great opportunities to teach the public about what the refuge does. April 21, Dan Ashe came out and talked about the need to be relevant to the public no matter what work is being done.
    - (Curt Mykut)– will be doing some western pearlshell mussel surveys this summer, so depending on what is found, might have an opportunity to coordinate with Fisheries. Just planted 12.5K trees in the past 3 months for a restoration project!
- **Conboy Lake NWR** (Lisa Wilson) – continuing to work on bullfrog issue. Capture by hand at night, then seining in low areas for bullhead and bullfrog tadpoles and metamorphs. Will be continuing this one night per week; will be experimenting with fyke nets for removals. Will be doing a diet study to determine if spotted frogs are being eaten; will also be keeping track of gravidity to see when bullhead spawn. Will have cool stuff to talk about next year! Are putting in an SSP with USGS to use fyke nets to estimate population sizes of either animal through removal.
- **Refuge Branch of Biology** (Bridgette Flanders) – Science Support Partnership RFP is out; due back July 23rd. Programs that partner up tend to be very competitive. Refuges commonly partner with ES and Migratory Birds, but not as often with Fisheries. This would be a good opportunity for Refuges/Fisheries partnering to apply for an SSP-funded project! Talk with Joe and Bridgette for a review prior to submission – will help to make more competitive.
- **Western Washington Division of Fisheries** (Denise Hawkins) – Lacey involved with Nisqually 5 year restoration report; summarizing all findings from 5 years of monitoring

and research projects. Would like to have a discussion about where to go from here. What are the research needs going into the future that can be included in the IMP? The refuge is completing the CCP for the Black River Unit, IMP includes need for baseline information about what is actually there.

- **R1 Fisheries** (Jana Grote) – Will have a few vacancies in the Fisheries program – need habitat coordinator for fish passage program, and an invasive species program coordinator. The Regional Director has asked everyone to participate in the Connecting People with Nature Program – please think of ways to increase cross-program activities that engage the public.
- **CRFPO** (Sam Lohr) – Intend to conduct follow-up surveys starting in June or July at Nestucca since it's been 5 years since the restoration project. Will coordinate with the NWR and I&M (Brian Root).
- **OFWO** (CalLee Davenport) – The ES office is finishing up a three state programmatic biological opinion covering restoration activities (OR, WA, ID)
- **Education** (Jenny Barnett) – Project Edu-Bat – Jenny has two trunks if anyone needs them. Get on the Edu-Bat website to find the locations of the trunks.
- **R1 Refuges** (Kevin Foerster) – Thanks for organizing and taking the time to do this! More value to cross-program projects.

4:30 Wrap-up

2015 Attendees

Name	Office
Jenny Barnett	I&M Mid-Columbia River NWR
Jody Brostrom	*Idaho FRO*
Jerry Cline	Little Pend Oreille NWR
Carrie Cook-Tabor	WWO Fisheries
CalLee Davenport	OFWO PFW
Joe Engler	Refuge Biology
Mike Faler	Idaho FRO
Bridgette Flanders	Refuge Biology
Kevin Foerster	Refuges RO
Jana Grote	Fisheries RO
David Hand	CRFPO
Denise Hawkins	WWO Fisheries
Erin Holmes	Tualatin River NWR
Jeff Jolley	CRFPO
Kevin Kilbride	I&M
Marci Koski	CRFPO
Sam Lohr	CRFPO
Curt Mykut	Tualatin River NWR
Sara McFall	Conboy Lake NWR
Glynnis Nakai	Nisqually NWR
RD Nelle	Mid-Columbia FRO
Robert Randall	Mid-Columbia FRO
Brian Root	I&M Nisqually
Greg Silver	CRFPO
Trevor Sheffels	Tualatin River NWR
Shawn Stephensen	*Oregon Coast NWR Complex*
Brad Thompson	WWO
Christina Uh	CRFPO
Tim Whitesel	CRFPO
Lisa Wilson	Conboy Lake NWR

--italicized listings attended via phone

Requests and Action Items

1. CRFPO to continue working with Tualatin NWR on lamprey occupancy and distribution on the NWR, relative to habitat restoration planned for Chicken and Rock creeks, throughout the basin, and potential passage barriers.

2. CRFPO to continue participation on planning group to develop habitat restoration alternatives for Wapato Lake NWR.

3. Mid-Columbia FRO to continue work with Toppenish NWR assessing steelhead use and survival at the NWR.

4. Mid-Columbia FRO to assist Little Pend Oreille NWR and WDFW on plans for native trout restoration in the Bear Creek drainage.

5. IWWWG will complete report for the STM pilot project.

6. WWO Fisheries and other FWS programs to continue support of Lake Sammamish Urban Refuge.

7. Idaho FRO and all to consider issues concerning water diversion in Deep Creek and provide any additional ideas and suggestions to Kootenai NWR.

8. Mid-Columbia FRO to continue assisting Little Pend Oreille NWR on assessing riparian vegetation relative to removal of cattle grazing and other activities.

9. Fisheries to assist I&M in the development and review of IMPs.

10. Refuges and Fisheries encouraged to partner-up in the development of SSP proposals.

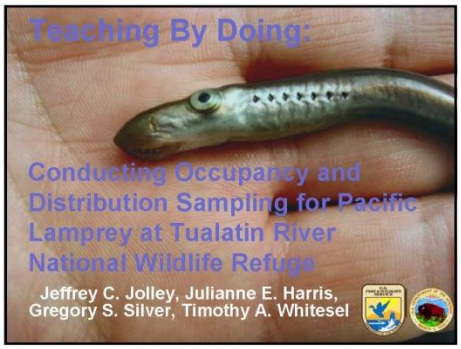
11. WWO Fisheries to continue working with Nisqually NWR on monitoring results and future needs (e.g., IMP).

12. WWO Fisheries to assist Black River Unit on its CCP and acquiring baseline information.

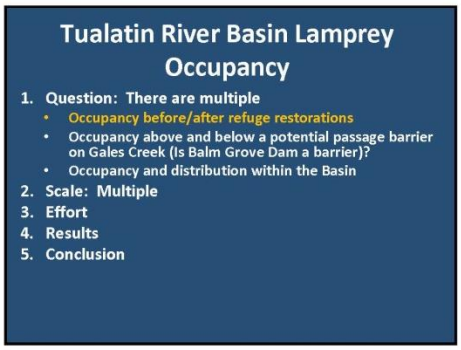
13 All encouraged to participate in Connecting People with Nature and think of cross-program activities to engage the public.

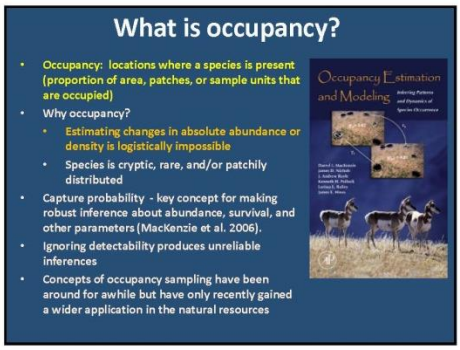
Meeting Presentations and Open Discussion Topics

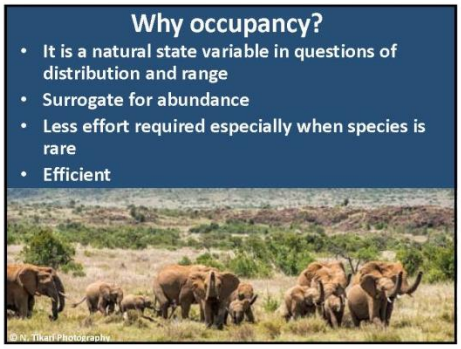
Presentation: Teaching by doing: Conducting occupancy and distribution sampling for Pacific lamprey at Tualatin River National Wildlife Refuge. Presented by Jeff Jolley

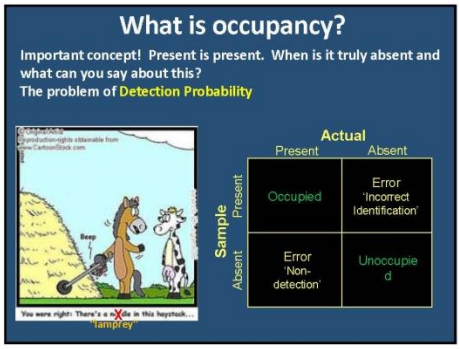

Teaching By Doing:
Conducting Occupancy and Distribution Sampling for Pacific Lamprey at Tualatin River National Wildlife Refuge
Jeffrey C. Jolley, Julianne E. Harris, Gregory S. Silver, Timothy A. Whitesel

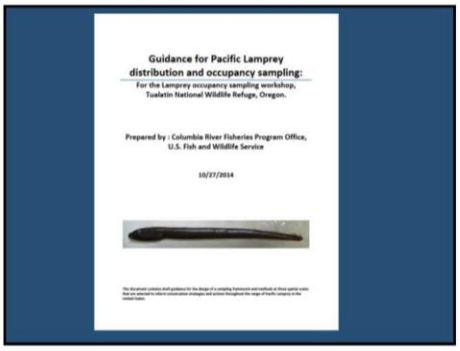

Overview
• Occupancy approach
• Refuge questions
• Tualatin Basin questions
• Regional needs


Tualatin River Basin Lamprey Occupancy
1. Question: There are multiple
• Occupancy before/after refuge restorations
• Occupancy above and below a potential passage barrier on Gales Creek (Is Balm Grove Dam a barrier)?
• Occupancy and distribution within the Basin
2. Scale: Multiple
3. Effort
4. Results
5. Conclusion


What is occupancy?
• Occupancy: locations where a species is present (proportion of area, patches, or sample units that are occupied)
• Why occupancy?
• Estimating changes in absolute abundance or density is logistically impossible
• Species is cryptic, rare, and/or patchily distributed
• Capture probability - key concept for making robust inference about abundance, survival, and other parameters (MacKenzie et al. 2006).
• Ignoring detectability produces unreliable inferences
• Concepts of occupancy sampling have been around for awhile but have only recently gained a wider application in the natural resources
Occupancy Estimation and Modeling

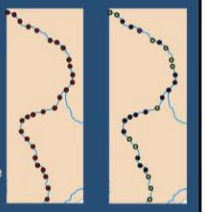

Why occupancy?
• It is a natural state variable in questions of distribution and range
• Surrogate for abundance
• Less effort required especially when species is rare
• Efficient
©N. Thatt Photography


What is occupancy?
Important concept! Present is present. When is it truly absent and what can you say about this?
The problem of Detection Probability
Actual
Present
Absent
Sample
Present
Absent
Occupied
Error 'Incorrect Identification'
Error 'Non-detection'
Unoccupied
Beep
You were right: There's a needle in this haystack...
'lamprey'

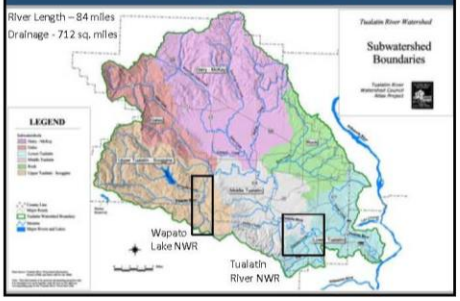


Methods

- Determine objectives and spatial scale of interest
- Use GRTS technique to identify set of random and spatially balanced stream reaches (50 m)
- Use previous knowledge of DP to select candidate set (lowest ordered reaches) to sample and achieve desired level of certainty (e.g. 80% certain that lampreys are absent when not detected)
- Conduct backpack electrofishing

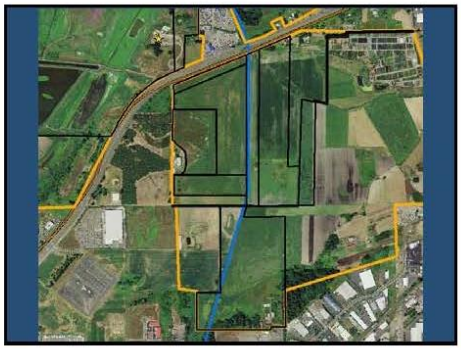


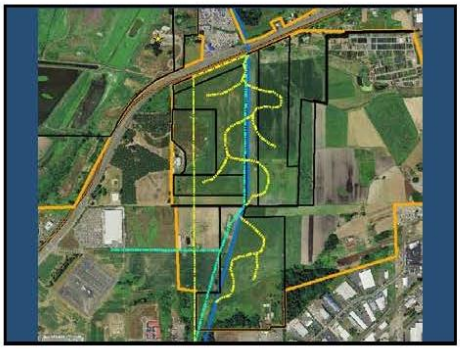
Tualatin River Watershed



Tualatin River National Wildlife Refuge

- Chicken Creek and Rock Creek stream restorations are planned
- Chicken Creek – restore creek to historical channel
- Rock Creek – historic channel unknown, create "natural channel"
- Pacific lamprey known to occur in the Tualatin River Basin
- Anecdotal information on lamprey occurrence on the refuge
- No systematic/quantitative surveys done on lamprey occupancy
- Occupancy approach can inform and all higher levels – fine scale





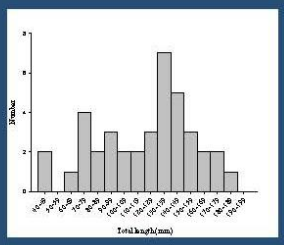
TRNWR - Objectives

- Determine if Chicken Creek and Rock Creek is occupied with larval lampreys before restorations
  - GRTS reaches
  - Creek confluence areas
- Identify species and lifestages
- *Consider salvage options*
- Determine if Chicken and Rock Creek is occupied with larval lamprey after restorations

TRNWR - Results

Stream	Reaches sampled	Reaches occupied	d	PCI	WBL larvae	WBL adult	UNID
Chicken conf.	1	1	1.0	0	3	0	0
Rock conf.	1	1	1.0	0	14	0	0
Chicken	7	5	0.7	0	15	9	1
Rock lower	7	2	0.3	0	6	4	0
Rock upper	4	0	0.0	0	0	0	0

TRNWR - Results



TRNWR - Results

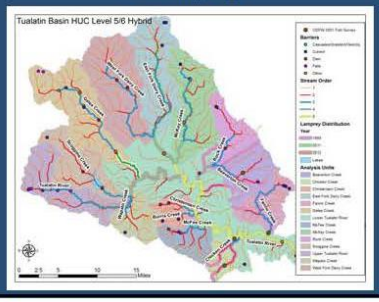
TRNWR - Results

TRNWR - Results

TRNWR - Conclusion

- Both creeks were occupied with larval WBL
- No Pacific lamprey were detected
- Habitat is likely suitable for larval rearing
- More "natural" stream may be conducive to PCL
- Post restoration monitoring can track changes in occupancy over time and look for Pacific lamprey colonization

Scaling up



Tualatin River Basin Lamprey Occupancy

1. Question: There are multiple
   - Occupancy before/after refuge restorations
   - Occupancy above and below a potential passage barrier on Gales Creek (Is Balm Grove Dam a barrier)?
   - Occupancy and distribution within the Basin
2. Scale: Multiple
3. Effort
4. Results
5. Conclusion

Balm Grove Dam – Gales Creek

Gales Creek

1. Question: Is Gales Creek occupied both above and below Balm Grove Dam?
2. Information: Gales Creek in a 3rd order stream in the Tualatin Basin. We know that it was occupied in the past. It can be sampled well at low water.
3. Detection Probability: We will use an empirically-derived DP to guide sample effort from a similar stream
4. Desired level of confidence: 95%

Sample Framework – Balm Grove

- 6 50-m reaches below dam
- 6 50-m reaches above dam

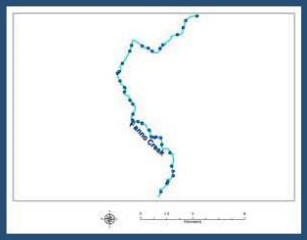
Tualatin River Basin Lamprey Occupancy

1. Question: There are multiple
   - Occupancy before/after refuge restorations
   - Occupancy above and below a potential passage barrier on Gales Creek (Is Balm Grove Dam a barrier)?
   - Occupancy and distribution within the Basin
2. Scale: Multiple
3. Effort
4. Results
5. Conclusion

Fanno Creek

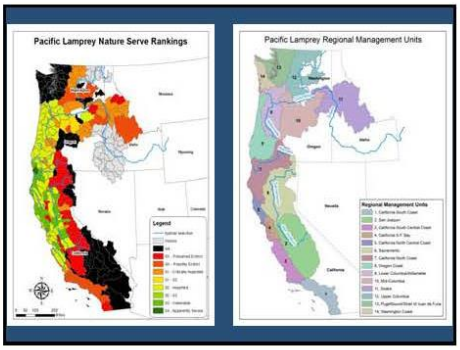
1. Question: Is Fanno Creek occupied? Has the distribution of Pacific lamprey within the Tualatin HUC4 changed?
2. Information: Fanno Creek a 3rd order stream and part of a HUC5 within the Tualatin. Historic data indicate that Pacific Lamprey previously occupied Fanno Creek, and the HUC5 of which it is part, but it is unclear if the creek is still occupied.
3. Detection probability: We will use an empirically-derived DP to guide sample effort from a similar stream
4. Desired level of confidence: 95%

Fanno Creek



Scaling Up

- Occupancy framework can be applied to ANY scale
- Choice of unit needs to be anchored in by your goals and objectives
- Results will be scale specific….but can be nested within larger scale/units and also inform in a bottom-up method



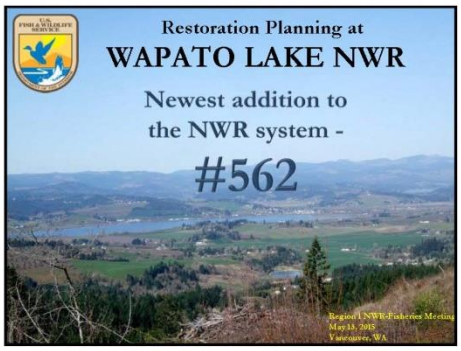
Summary

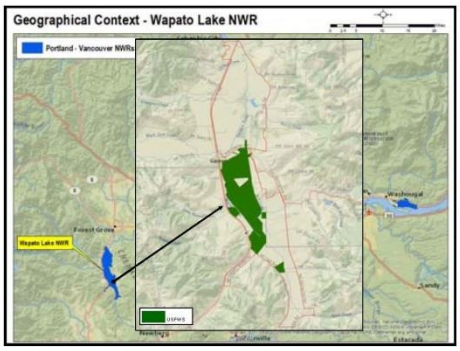
- Example – occupancy sampling in one subbasin → informs occupancy within the basin → informs occupancy within the HUC4 → informs occupancy within the RMU → informs occupancy within the range
- ∴ Adopting an occupancy approach for even a small-scale localized question can provide benefits to the landscape-scale

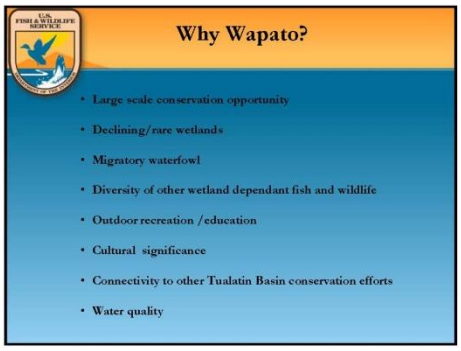
Thanks

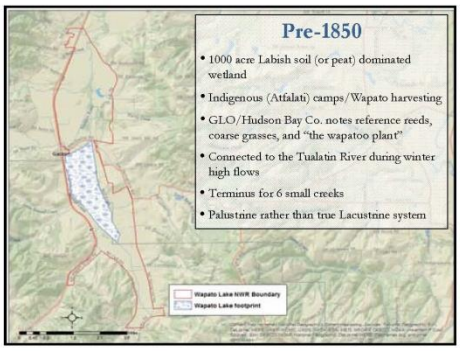
- B. Silver, D. Hines – CRFPO, USFWS
- T. Sheffels, P. Schmidt, E. Holmes – TRNWR
- R. Miller – Friends of TRNWR
- A. Olbrich– TR Watershed Council

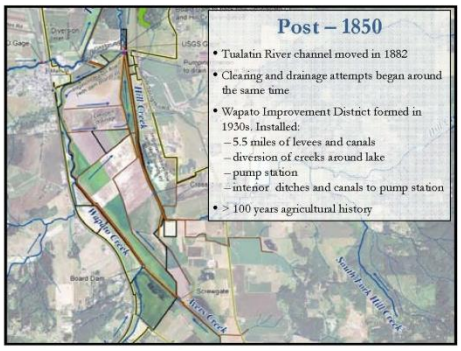
Presentation: Habitat restoration and management planning at Wapato Lake National Wildlife Refuge. Presented by Curt Mykut

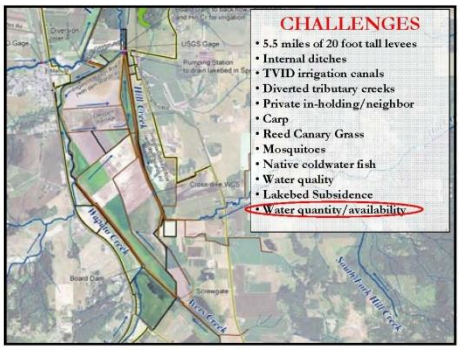

Restoration Planning at
WAPATO LAKE NWR
Newest addition to
the NWR system -
#562
Regional NWR-Fisheries Meeting
May 13, 2015
Vancouver, WA


Geographical Context - Wapato Lake NWR
Portland - Vancouver NWRs
Wapato Lake NWR
Forest Grove
Washougal
Sandy
Estacada


Why Wapato?
• Large scale conservation opportunity
• Declining/rare wetlands
• Migratory waterfowl
• Diversity of other wetland dependant fish and wildlife
• Outdoor recreation /education
• Cultural significance
• Connectivity to other Tualatin Basin conservation efforts
• Water quality


Pre-1850
• 1000 acre Labish soil (or peat) dominated wetland
• Indigenous (Atfalati) camps/Wapato harvesting
• GLO/Hudson Bay Co. notes reference reeds, coarse grasses, and "the wapatoo plant"
• Connected to the Tualatin River during winter high flows
• Terminus for 6 small creeks
• Palustrine rather than true Lacustrine system
Wapato Lake NWR Boundary
Wapato Lake footprint


Post – 1850
• Tualatin River channel moved in 1882
• Clearing and drainage attempts began around the same time
• Wapato Improvement District formed in 1930s. Installed:
– 5.5 miles of levees and canals
– diversion of creeks around lake
– pump station
– interior ditches and canals to pump station
• > 100 years agricultural history
Hagg Lake
Board Dam
Scoggins
Scoggins Creek
Tualatin River


CHALLENGES
• 5.5 miles of 20 foot tall levees
• Internal ditches
• TVID irrigation canals
• Diverted tributary creeks
• Private in-holding/neighbor
• Carp
• Reed Canary Grass
• Mosquitoes
• Native coldwater fish
• Water quality
• Lakebed Subsidence
• Water quantity/availability
Hagg Lake
Board Dam
Scoggins
Scoggins Creek
Tualatin River

Science to Inform Restoration Planning

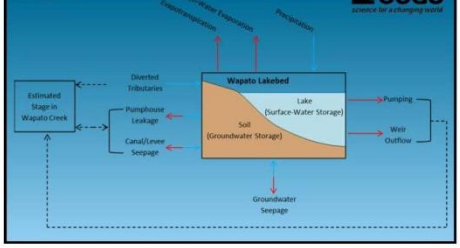
USGS science for a changing world

USFWS needs hydrologic data and insights based on sound science to properly plan for future management and restoration of Wapato Lake NWR.

- **Questions:**
  - How much water is available?
  - What restoration scenarios are possible?
  - Are pumps and levees needed?
- **Build a water budget**
  - Build digital elevation model of lakebed
  - Measure lake levels
  - Quantify inputs and outputs (e.g. stream gages)
  - Estimate unknown rates/parameters
- **Build a planning tool**
  - Allow tributaries into lake
  - Allow outflow weir and/or pumps
  - Predict lake levels, inflows, outflows

Wapato Lake Water Budget

USGS science for a changing world

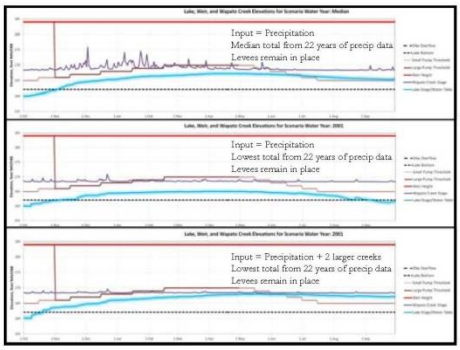


Water Management Scenario Tool

USGS science for a changing world

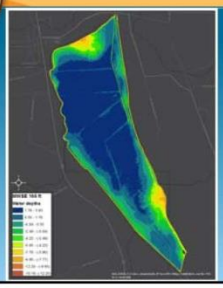
Goals of the tool:

- Inform resource managers of lake characteristics over time:
  - -Period of inundation
  - -Lake level/depth
  - -Available habitat
  - -Downstream flow
- Compare different restoration strategies across a climatic gradient



Shoreline Management Tool

USGS science for a changing world

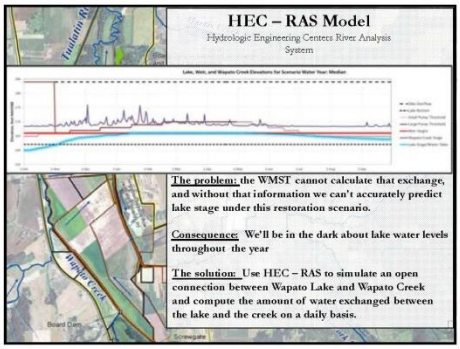


The Shoreline Management Tool (SMT) GIS based program developed to assess the effects of changes in surface-water stage on water depth and inundated area of a site.

SMT can be used to identify aquatic or terrestrial habitat areas as defined by user-specified criteria including variables such as water depth and land-surface slope

HEC – RAS Model

Hydrologic Engineering Centers River Analysis System



The problem: the WMST cannot calculate that exchange, and without that information we can't accurately predict lake stage under this restoration scenario.

Consequence: We'll be in the dark about lake water levels throughout the year

The solution: Use HEC – RAS to simulate an open connection between Wapato Lake and Wapato Creek and compute the amount of water exchanged between the lake and the creek on a daily basis.

Moving Forward

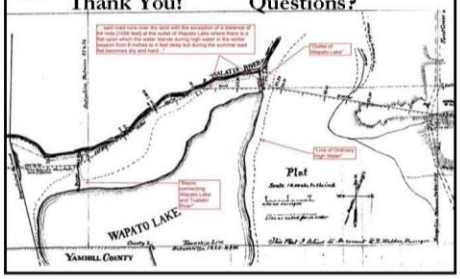
- Public outreach – ongoing
- Science Excellence on NWRs – June 11, 2015
  12 – 2
- HEC – Ras modeling results - Summer 2015
- Development of restoration alternatives – Summer 2015
- Draft EA/EIS – Fall 2015

USGS science for a changing world

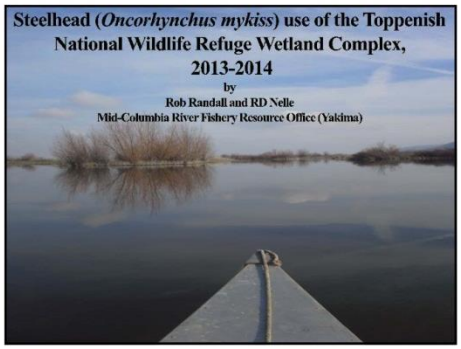
CleanWater Services

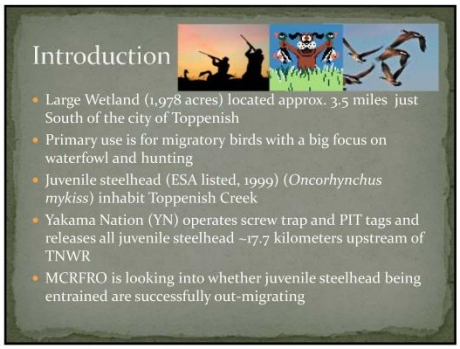
DUCKS UNLIMITED

Thank You! Questions?

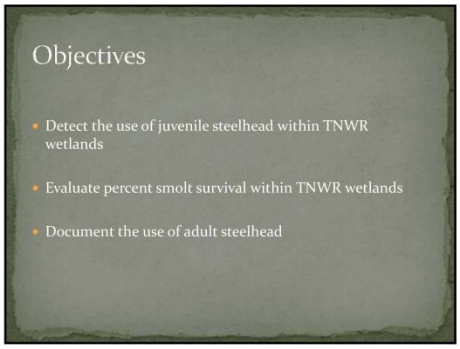


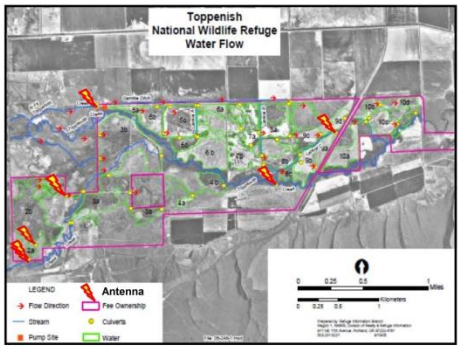
Presentation: Steelhead use and monitoring at Toppenish National Wildlife Refuge.
Presented by Rob Randall

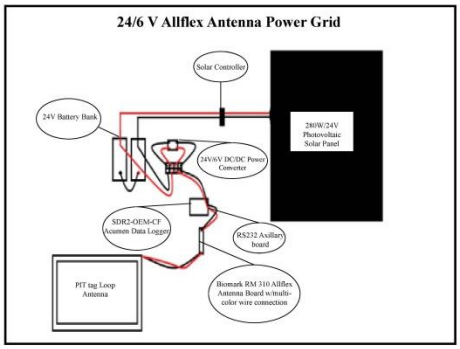

Steelhead (*Oncorhynchus mykiss*) use of the Toppenish National Wildlife Refuge Wetland Complex, 2013-2014
by
Rob Randall and RD Nelle
Mid-Columbia River Fishery Resource Office (Yakima)


Introduction
Large Wetland (1,978 acres) located approx. 3.5 miles just South of the city of Toppenish
Primary use is for migratory birds with a big focus on waterfowl and hunting
Juvenile steelhead (ESA listed, 1999) (*Oncorhynchus mykiss*) inhabit Toppenish Creek
Yakama Nation (YN) operates screw trap and PIT tags and releases all juvenile steelhead ~17.7 kilometers upstream of TNWR
MCRFRO is looking into whether juvenile steelhead being entrained are successfully out-migrating


~ 47.5 km from screw trap to confluence
Yakama Nation Fisheries
PIT tag 4,000/ year
Google earth


Objectives
Detect the use of juvenile steelhead within TNWR wetlands
Evaluate percent smolt survival within TNWR wetlands
Document the use of adult steelhead


Toppenish National Wildlife Refuge Water Flow
LEGEND
Antenna
Flow Direction
Fee Ownership
Stream
Culverts
Pump Site
Water

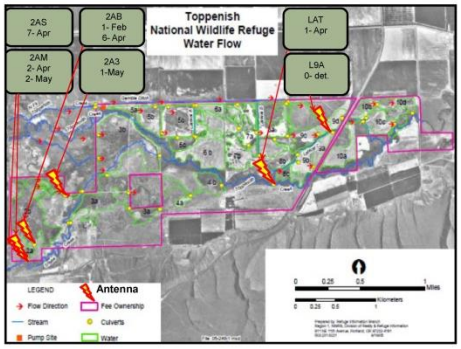

24/6 V Allflex Antenna Power Grid
Solar Controller
24V Battery Bank
280W/24V Photovoltaic Solar Panel
24V/6V DC/DC Power Converter
SDR2-OEM-CF Acumen Data Logger
RS232 Axillary board
PIT tag Loop Antenna
Biomark RM 310 Allflex Antenna Board w/multi-color wire connection

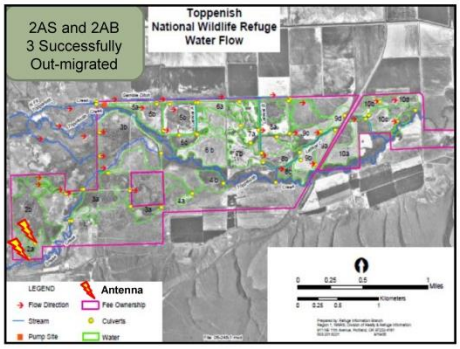
Results

- YN tagged 2,448 juvenile steelhead(October 2013 – May 2014)
- 46,470 (SE 5,008) Toppenish Creek Pop. Est.
- ~ 1% of tagged pop. detected 2013-2014 Monitoring Period (MP)

Results Cont'd

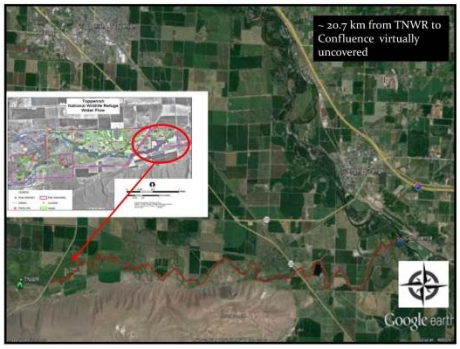
- 2013 – 2014 detections (20 juvenile steelhead); 3 successfully out-migrated with 17 having an unknown fate
- The majority of the detections occurred at the Southwestern corner of the refuge (Snake Creek Units)
- No adult steelhead were detected within 2013-2014 MP





Potential Impacts

- With 15% of 20 steelhead successfully out-migrating we can assess that a potential problem lies within TNWR
- Increased predation due to delayed out-migration
- Non-efficient thalweg for fish passage
- Antenna detection efficiency

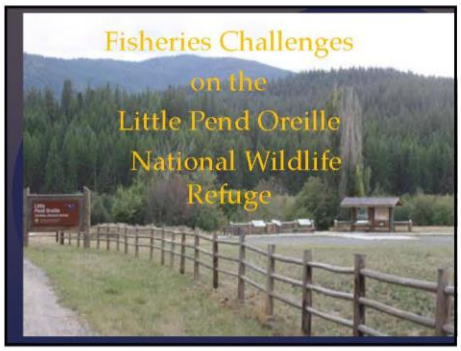


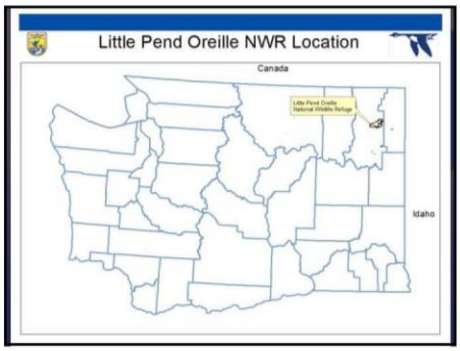
Recommendations

- Continue monitoring steelhead migration within TNWR for the next 4 years
- Improve antenna systems to function during extended periods of hot, cold and wet environmental conditions
- Better understand the fate of PIT tagged juvenile by scanning dry wetland units with a mobile towable antenna
- Install an antenna at the downstream terminating end of TNWR
- Analyze water tempenature
- Define antenna efficiencies

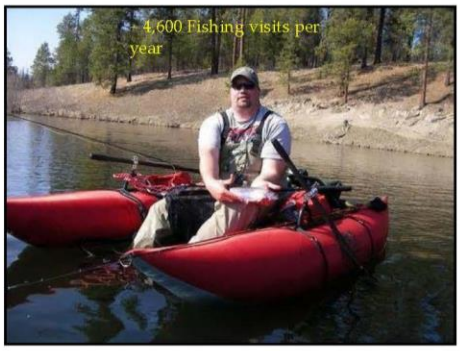
Acknowledgements

Presentation: Little Pend Oreille National Wildlife Refuge: Exotic fish removal in McDowell Lake and planning for native trout restoration in Bear Creek. Presented by Jerry Cline

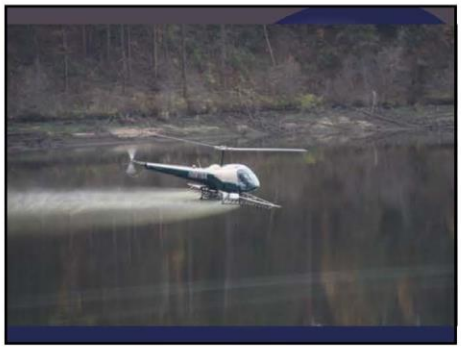

Fisheries Challenges
on the
Little Pend Oreille
National Wildlife
Refuge


Little Pend Oreille NWR Location
Canada
Idaho


~ 42,600 acres


~ 4,600 Fishing visits per
year


approx. 9 "
M. Malchoff, L. Champlain Sea Grant
Tench (Tinca tinca)
• Native to Europe and Eurasia
• Can grow 18" and 10 lbs
• Feeds on invertebrates and insect larvae
• Competes with other species and lessens water quality
• Can tolerate very low oxygen conditions



Project Budget

WDFW
- Liquid Rotenone $20,000
- Personnel $17,000

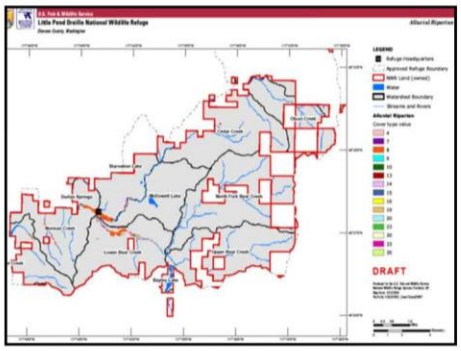
USFWS
- Invasive Spp. Grant $ 6,000
- Helicopter

$43,000

Native Trout Restoration in the Bear Creek Drainage

Redband rainbow

Westslope cutthroat



Rationale:

- Redband rainbow (*Oncorhynchus mykiss gairdneri*) and westslope cutthroat (*Oncorhynchus clarki lewisi*) are the trout sub-species native to eastern Washington streams
- Distribution has been significantly reduced throughout their original range
- Most stocks are at risk due to hybridization and competition with introduced trout
- The Bear Creek watershed is uniquely suited for native trout restoration since the watershed is completely within the refuge boundary.

Steps for restoration of native trout:

- Perform comprehensive inventory of natural and man-made fish barriers; identify potential sites for fish management structures
- Remove fish movement barriers; install fish management barriers to prevent movement of non-native fish into the Bear Creek watershed from the Little Pend Oreille River, McDowell Lake and Potter's Pond
- Remove non-native fish from the watershed using piscicides
- Restock the Bear Creek watershed with genetically appropriate native stock
- Develop sport fish regulations to maintain native population and prevent over-harvest

- Estimated cost: $33,000
- Final result: Restoration of a native fish species to 28 miles of stream within a 35 square mile watershed on a national wildlife refuge.

Presentation: Submerged aquatic vegetation surveys on Bear Lake, Camas, Grays Lake, and Malheur NWRs in support of Intermountain West Wetland Working Group's state and transition models. Presented by Jenny Barnett

State and Transition Models, SAV sampling and the Intermountain West Wetland Working Group

Pam Johnson, Camas NWR
Ty Matthews, Minidoka NWR
Jenny Barnett, I&M Initiative

INTERMOUNTAIN WEST WETLAND WORKING GROUP (IWWWG)

Who? Managers and biologists of State and Federal wildlife areas within the Great Northern LCC

Team Leaders:
Jeff Warren, I&M Zone Bio, R6
Adonia Henry, Wetland Ecologist, contracted
Kathi Irvine, Statistician, USGS
Jenny Barnett, I&M Zone Bio, R1

IWWWG

Why?

We face common issues:

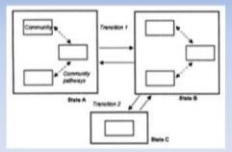
- Manage wetlands for migratory birds and other wetland-dependent wildlife
- Need to predict outcome of management actions
- Need to monitor results of management actions
- Interested in collaboration and coordination

Adaptive Management Context

- Models used to develop, apply, and monitor adaptive management strategies

Adaptive Management Context

- State and transition models describe
  - ecological states
  - pathways
  - transitions



A Note on "Models"

- Whether we admit to it or not, we ***all*** use models to manage with
- Most are conceptual models ***in our heads***
  - Non-transferable (i.e., no systemic learning)
  - Non-tested
- Overestimate our understanding of modeled system
- Does not allow improving model, i.e., understanding of the system
  - Inefficient learning
- Repeat mistakes or ineffective management

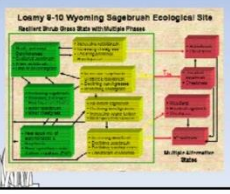
We manage ***highly dynamic*** wetland habitats for wildlife and need a tool for capturing

- ✓ Non-linear succession within wetlands
- ✓ Current state of knowledge
- ✓ Hypotheses of system response
- ✓ Learning
  (i.e. predict — manage — monitor)

- **Are State-and-Transition models that Tool?**

State and Transition Model

Dfn: …a diagram that depicts our current understanding of vegetation dynamics on an ecological site



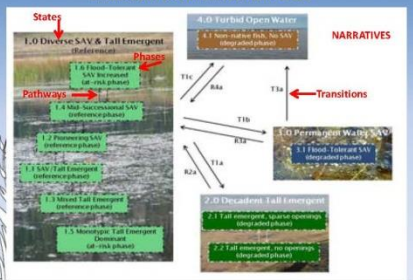
Ecological Site

Dfn: A type of land with specific physical characteristics (climate, soil, topography, hydrology) that differs from other kinds of land in its ability to produce distinctive kinds and amounts of vegetation

semi-permanent wetlands - current focus

- General model
  - Semi-permanent wetlands in the Intermountain West
- Refuge-specific models

State and transition model for **semi-permanently flooded** wetlands in the intermountain West



STM 'Key' Ingredients

Community Phases: 'Distinct plant communities…that can occur over time within a state'

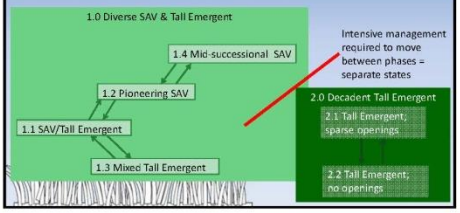
Community phases often reflect ***management-relevant*** differences

Pioneering SAV	SAV/Tall Emergent
Mid-Successional SAV	Mixed Tall Emergent Tall Emergent
Flood-Tolerant SAV	Tall Emergent Dominant
Tall emergent; sparse openings	Tall emergent; no openings

Existing monitoring data should inform process

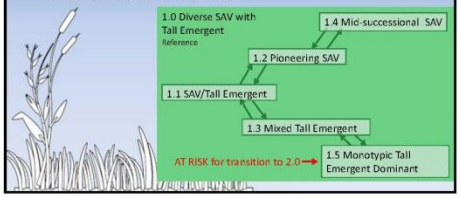
STM 'Key' Ingredients

States: Sort plant community phases according to the structures that control feedback mechanisms and ecological processes'



STM 'Key' Ingredients

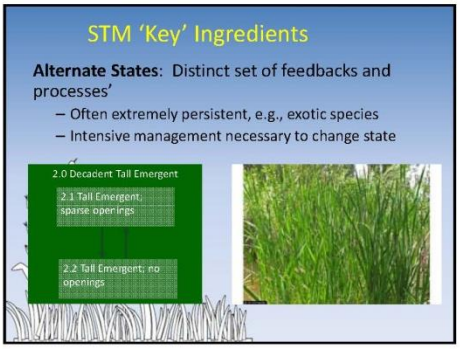
- **Reference state**: Often captures historical range of variation
- **At-risk community phase**: Most vulnerable to transition to alternate state



STM 'Key' Ingredients

Alternate States: Distinct set of feedbacks and processes'

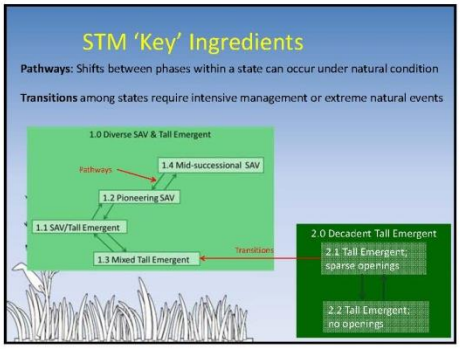
- Often extremely persistent, e.g., exotic species
- Intensive management necessary to change state



STM 'Key' Ingredients

Pathways: Shifts between phases within a state can occur under natural condition

Transitions among states require intensive management or extreme natural events



STM 'Key' Ingredients

Narrative Description of Each State

- Diagnosis and indicators of states
  - Structures that relate closely to ecological processes
    - E.g., Plant composition, canopy cover, flood duration and depth, water quality metrics
- Feedbacks and ecological processes
  - Relationships between structures and processes
    - E.g., Hydrology influences on plant composition
- Management
  - Sufficient detail to create on-the-ground actions

STM 'Key' Ingredients

Community Pathway Narratives

- Mechanisms of change among vegetation communities within a state
  - Monitoring data coupled with information on management, climate, etc., best suited for this

STM 'Key' Ingredients

Transition Narratives

- Capture changes in feedbacks and processes that cause transitions
  - Gradual processes that lead to at-risk communities
    - Land-use change that increased sedimentation and nutrient inputs to a wetland

STM 'Key' Ingredients

Transition Narratives Cont.

- Thresholds*
  - Conditions under which altered functions do not recover on their own
    - Increased sedimentation leads to shallower water, precluding flooding out of decadent tall emergent stands

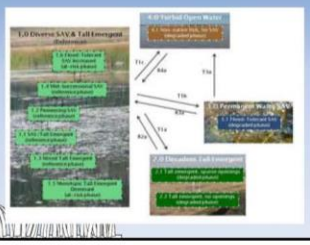
STM 'Key' Ingredients

Restoration Narratives

- Restoration pathways describe management actions necessary to move back to a reference state
  - Detailed enough that cost-benefit can be determined

Remember…

STMs nothing more than a graphical representation and accompanying narrative of what we currently know about a system



IWWG 2014 Semi-Permanent Wetland Monitoring

Pilot year objectives:

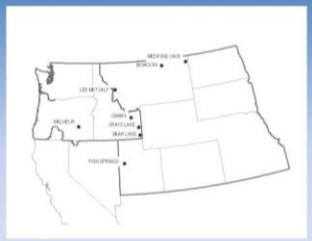
- Conduct an inventory of vegetation, hydrologic conditions, & water quality within semi-permanently flooded wetland habitats.
- Field test methodologies for collecting consistent wetland vegetation data for characterizing a wetland's current condition across diverse landscapes.

Objectives continued

- Describe, qualitatively and quantitatively, the ecological & abiotic conditions of wetland states & vegetation community phases to inform future management actions.
- Identify preliminary indicator species & abiotic variables for states and phases for streamlining future monitoring efforts to assess response to management actions.

Participants

In the summer of 2014, semi-permanent wetland monitoring was conducted across eight NWR's in Region 1 & 6.



Contracted Support

Kathi Irvine - USGS Statistician developed the sampling design and will provide statistical analysis of data.

Adonia Henry - Wetland Ecologist developed the sampling methodology, and state-and-transition model draft, assisted refuges with training, and will also assist with analysis of data.

Southeast Idaho Complex

Camas, Bear Lake and Grays Lake decided to participate in this effort to help understand and better manage the Complex wetlands, which all have their common and unique issues:

- Knowledge of wetland plant food resources on all three Refuges, for CCP waterbird focal species, is lacking or non-existent.
- Need to understand better the conditions of wetlands now, to determine management actions for the future.

- Variety of water issues –
  - Camas NWR – managed impoundments, drying up every fall.
  - Grays Lake NWR – natural system, water limited with low hydrologic regime and minimal annual variation within agreed drawdown schedule.
  - Bear Lake NWR – managed impoundments with infinite water management options within legal water decrees, managed statically high at full pool.
- Need a viable and consistent monitoring protocol to use across complex refuges, for evaluating SAV's in wetlands

Monitoring Framework

- A generalized random tessellation stratified (GRTS) sample of points was created for each unit.
- These points were made of PanelOne (PO) and OverSample (OS).
- If PO point was not a target site, then it was replaced with an OS point.

Vegetation Surveys

- Consisted of 1 X 1m quadrats.
- Used ocular estimates of percent cover unless water was too turbid to see bottom then rake samples were taken.
- No rake sampling was needed for our units.

Abiotic Variables

- Water Depth
- Secchi disc depth
- Water quality using a YSI:
  -Temperature
  - pH
  - Salinity
  - Specific Conductivity
- Soil Texture
- Soil chemical & physical characteristics

Wetland Hydrology

- A water level data-logger or staff gauge is used to measure depth and duration of flooding.
- Water levels are to be monitored from ice-out through end of October.
- Only five of our nine units had level loggers installed this year.

SEID Monitoring

Each refuge picked top three units to monitor.

Bear Lake NWR
- Bunn Lake (2,211 ac) – 120 points
- Rainbow (1,438 ac) - 120 points
- Rainbow Sub (435 ac)– 90 points

Camas NWR
- Big (92 ac) – 30 points
- 2-Way (64 ac) – 30 points
- Sandhole (254 ac) – 76 points

Grays Lake NWR
- Beavertail (919 ac) – 120 points
- Big Bend (760 ac) – 120 points
- Lakefront (498 ac)– 120 points

Bear Lake Rainbow Unit

Time Commitment

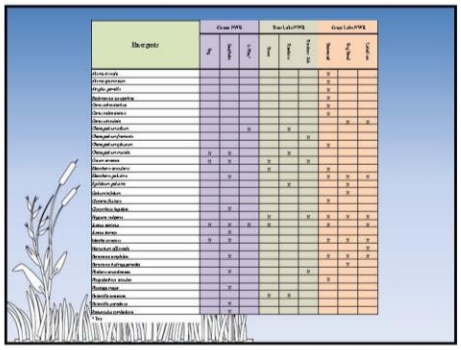
- Field data collection took approximately two months.
- Eighteen permanent, seasonal and volunteer personnel assisted in the project. In general there were two crews (2 people in each) working most days.
- Approximately 1,842 total hours.

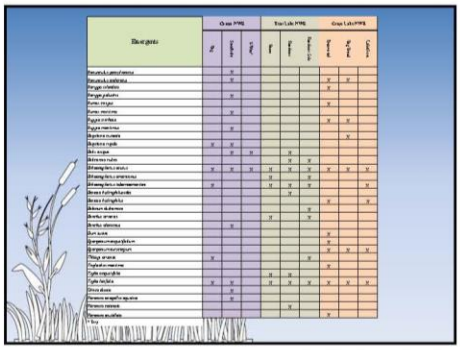
Hour Breakdown

- Field Hrs – 1,406, which is approximately 176 work days, crammed into 2 months.
- Plant ID/Soil Prep/Datalogger Hrs – 346
- Purchases/GIS Maps/Equip Const Hrs - 90

The Right Equipment is Essential

Plant Species Diversity





Lessons Learned

- With the existing number of samples, you are talking a huge time commitment.
  - This was a pilot season. Hopefully we are able to reduce the number of samples needed
  - SEID had funding secured for big project

Lessons Learned cont.

- Refine maps as much as possible to limit use of OS pts.
- Learning how to identify SAV plants takes time.

Next Steps

- Analysis of 2014 data
- IWWWG workshop
  - Discuss results and problems project wide
- Refine model
- Collect more data: 2015 & 2016

Preliminary Results

- Hierarchical, agglomerative cluster analysis with a flexible beta = -0.25 was used to cluster plots
- 14 vegetation phases identified
- Indicator Species Analysis to identify indicator species for phases.

Preliminary Community Phase Indicators

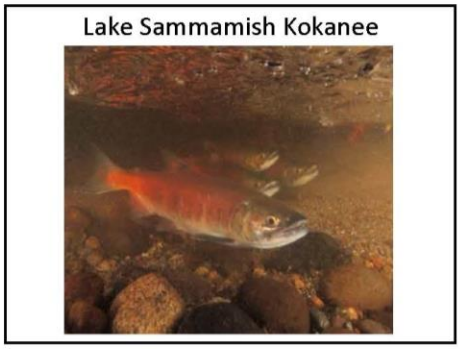
PHASE	SPECIES	COMMON NAME	INDICATOR VALUE
1	Filamentous algea		0.487
2	Schoenoplectus acutus	hardstem bulrush	0.369
3	Stuckenia pectinata	sago pondweed	0.21
4	Myriophyllum sibiricum	shortspike watermilfoil	0.495
5	Residual vegetation		0.169
6	Lemna minor	common duckweed	0.395
7	Bare substrate		0.156
8	Carex spp.	sedge	0.721
9	Cirsium arvense	Canada thistle	0.723
10	Uticularia macrorhiza	common bladderwort	0.111
11	Ruppia maritima	widgeon grass	0.29
12	Rumex crispus	curly dock	0.238
13	Typha latifolia	broadleaf cattail	0.497
14	Polygonum persicaria	spotted ladysthumb	0.798

Draft Report

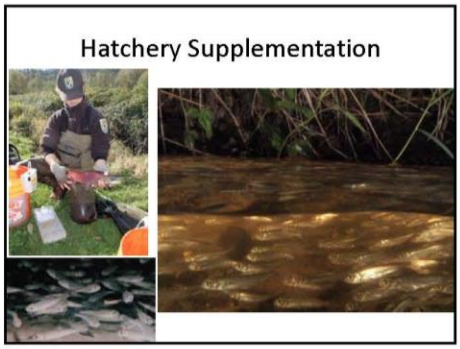
- Final report due September
- Unit by unit summaries of vegetation and water quality variables
- Stats exploring relationship between phases and abiotic variables.

Presentation: Lake Sammamish Urban Wildlife Refuge Partnership. Presented by Brad Thompson

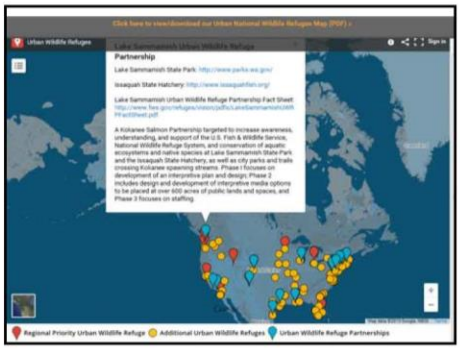

Lake Sammamish
urban
wildlife
refuge
PARTNERSHIP


Lake Sammamish Kokanee


Strategic Habitat Conservation
• Protect
• Reconnect
• Restore


Hatchery Supplementation

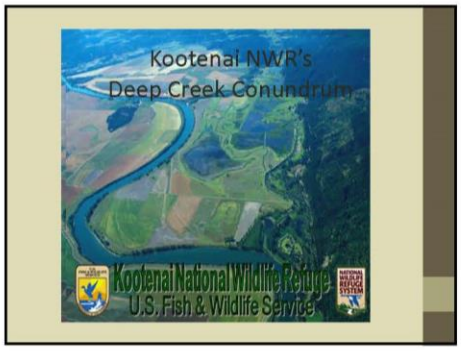

urban
wildlife
refuge
PARTNERSHIP
http://www.fws.gov/urban

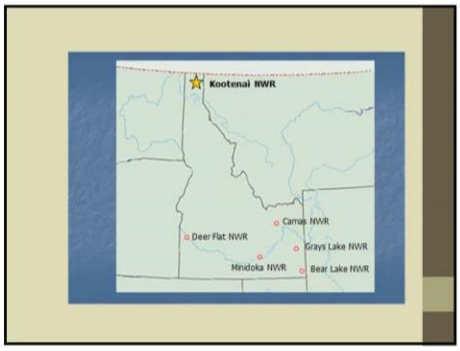

Partnership

Next Steps at Lake Sammamish

- Expand Partnership and Support
- Match Interpretative Programs and Partners
- Provide Capacity and Staffing

Discussion Topic: Kootenai NWR's Deep Creek conundrum. Jerry Cline


Kootenai NWR's
Deep Creek Conundrum
Kootenai National Wildlife Refuge
U.S. Fish & Wildlife Service


Kootenai NWR
Camas NWR
Deer Flat NWR
Grays Lake NWR
Minidoka NWR
Bear Lake NWR


Deep Creek Diversion Site


KNWR needs to pump water from Deep Creek through the dike from August through November to fill a series of wetlands.
Deep Creek Diversion Site


KNWR needs to do this without taking fish (brook, rainbow and bull trout; burbot) from the creek.
Deep Creek Diversion Site


Challenges:
• Creek level fluctuates seasonally
• Unconsolidated stream bottom
Deep Creek Diversion Site


Pump draws water from both front and back of impeller.
Must dig a sump every year to submerge the pump.

Deep Creek at low water level

Deep Creek at high water level

KNWR needs ideas!

- Does fluctuating water level and/or unconsolidated stream bottom preclude a permanently installed intake with a fish screen ?
- Can the gator pump be retrofitted with a fish screen?
- Can a permanent sump be installed in the stream bottom to eliminate digging a temporary sump each season?
- Any "outside of the box" ideas?!

Discussion Topic: Update: Pilot project to develop a long-term aquatic monitoring program for climate change at Region 1 refuges. Sam Lohr

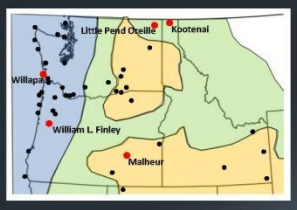
Long-term Aquatic Monitoring Program

What: Evaluate evidence of climate change in physical attributes at NWRs and changes in aquatic communities
- Establish long-term sentinel sites among ecoregions
- Describe how physical and biological attributes vary through time
- Assess temporal relationships and potential associations

How: Desired methods sustainable, use existing information, consistency in attributes and habitats
- Discharge and water temperature
- Habitat and aquatic vertebrate surveys (community/assemblage metrics)
- Temporal analyses once time series established

Long-term Aquatic Monitoring Program

Where:



When:

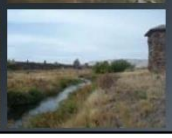
Phase 1- Reconnaissance (sites, loggers) → Phase 2- Baseline (1st 3-years, 3X/year) → Phase 3- Long-term (2-5 year intervals?)

Long-term Aquatic Monitoring Program Current Status

- Phase 1: Ongoing
  - NRPC $48K FY14
  - Met with NWRs
  - ID streams, reaches
  - Data loggers
  - Installation

Long-term Aquatic Monitoring Program Current Status

- Phase 2: Summer-fall FY15
  - I&M $60K FY15
  - Installation/data collection
  - Habitat surveys (1X)
  - Biological surveys (3X)
  - Data management plan



APPENDIX C: ANNOUNCEMENT AND PRESENTATION FOR REGION 1 INVENTORY AND MONITORING WEBINAR SERIES AND REGION 1 EXTERNAL AFFAIRS TUMBLR POST

Fishery Resource Surveys on Region 1 Refuges

"Region 1 Inventory and Monitoring" Series

Fisheries/ Refuges Collaboration:
Annual meetings, technical assistance (e.g., for management planning) and conducting specific assessments

Overview of the Bandon Marsh Restoration Monitoring Project

Overview of Aquatic surveys at Sheldon-Hart Mountain NWR Complex

Introduction to a pilot project to develop an aquatics monitoring program for climate change at refuges

March 31st, 2015
12pm - 1pm PDT
Regional Office 3E

A presentation by

Sam Lohr

Columbia River Fisheries Office, Fish Biologist

Brook Silver

Columbia River Fisheries Office, Fish Biologist

Webinar Access Information: http://www.mymeetings.com/nc/join.php?i=741680765&p=&t=c

Dial: 877-917-7936 Passcode: 3984526

Fishery Resource Surveys on Region 1 Refuges

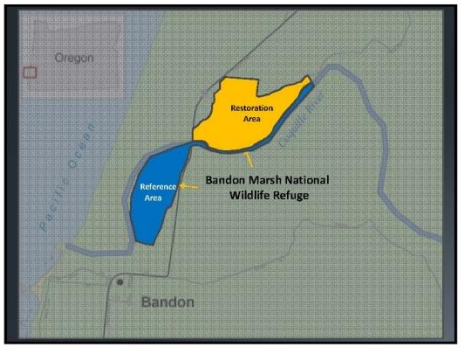
Brook Silver and Sam Lohr
Columbia River Fisheries Program Office
Vancouver, WA
March 31, 2015

Outline of Presentation

- Background
  - Fisheries/Refuges Collaboration
  - Types of collaboration to conserve aquatic resources
- Completed Projects
  - Bandon Marsh
  - Sheldon-Hart Mountain
- Recently Initiated Project
  - Aquatics monitoring program pilot project

Fisheries/Refuges Collaboration

- Annual meetings
  - Forum for effective communication
  - Identify aquatic issues and needs
  - Action items
- Types of collaboration
  - Planning (CCPs, IMPs)
  - Non-field based (review, analyses, funding)
  - Field-based (specific assessments, surveys, pilot project)



Restoration Goals

- Improve quantity and quality of tidal wetlands in the lower Coquille River watershed
- Create foraging and rearing habitats for native salmonids and other native aquatic species

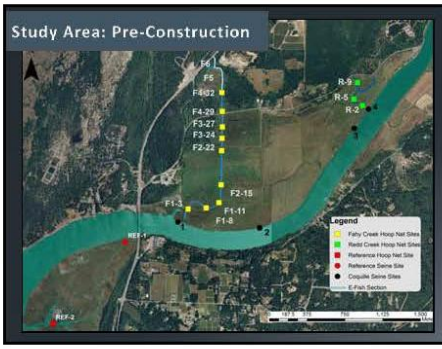
Monitoring Objectives

- Describe and compare fish species within and among restoration areas and to the reference area before and after construction
  - Community
  - Distribution
  - Relative abundance
- Collect aquatic invertebrates to archive from restoration areas and the reference area before and after construction

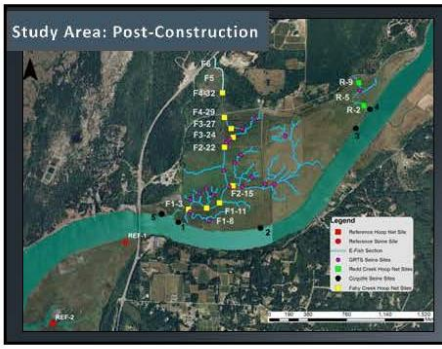
Monitoring Objectives

- Community
  - What?
  - Compare the similarity of species present before and after construction
- Distribution
  - Where?
  - Document location before and after construction
- Relative Abundance and Frequency
  - How many/how often?
  - All species encountered during monitoring were classified according to Ecological Classification
  - Dominant, Common, Occasional, and Rare

Study Area: Pre-Construction



Study Area: Post-Construction



Sample Methods – Hoop Netting

Sample Methods –Seining

Sample Methods –Seining

Sample Methods - Electrofishing

Sample Methods - Invertebrates

Results – Community

- 21 fish species were collected in the restoration area
  - 13 present during both phases of construction
- 3 species detected pre-construction only
  - Carp*, Smallmouth Bass*, Steelhead
- 5 species detected post-construction only
  - Anchovy+, American Shad+*, Bay Pipefish+, Starry Flounder+, Crappie*

+ Estuarine Species
* Introduced species

Results – Community

* Species collected pre construction only
* Species collected post construction only

Native species on Refuge

- Coastal Cutthroat Trout
- Chinook Salmon
- Coho Salmon
- Gunnelfish+
- Hybrid CCT/ST
- Cottid spp.
- Three Spine Stickleback
- Smelt sp.+
- Surf Perch+
- NW Salamander
- Rough Skinned Newt
- Red Legged Frog
- Shrimp+
- Crab+
- Jellyfish+
- Steelhead
- Northern Anchovy+
- Bay Pipefish+
- Starry Flounder+

Introduced Species on Refuge

- Brown Bullhead*
- Blue Gill*
- Largemouth Bass*
- Mosquito Fish*
- Bull Frog*
- Crawfish*
- Smallmouth Bass*
- Carp*
- American Shad+*
- Crawfish sp.*

Reference Sites

- American Shad+*
- Bay Pipefish+
- Chinook Salmon
- Coho Salmon
- Gunnelfish+
- Cottid spp.
- Pacific Lamprey
- Three Spine Stickleback
- Smelt sp.+
- Surf Perch+
- Starry Flounder+
- Largemouth Bass*
- Shrimp+
- Crab+
- Jellyfish+

+ Estuarine Species
* Introduced species

Results – Community

The overall restoration area was not substantially different after construction

- Same number of introduced and salmonid species

However, there were substantially more estuarine species post construction

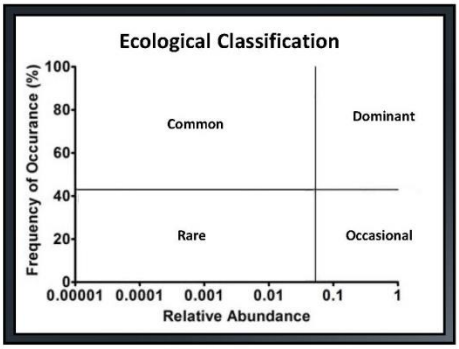
- Four additional species were present (an 80% increase)

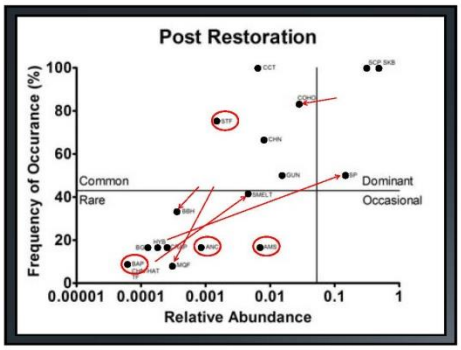
The restoration area was substantially different from the reference area

- There were fewer species in the reference area
- One species was found in the reference area only (Pacific lamprey, n = 1)

Results – Distribution

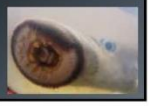
- Salmonids occupy all areas of the refuge
  - Coho - Widespread throughout the refuge
  - Chinook - Lower stream and tidal areas (Ni-les'tun Unit and Reference Area)
  - Cutthroat, Steelhead, Hybrids - Stream and upper tidal areas (Ni-les'tun Unit and Smith Tract)
- Multiple species were found in new channels after construction
  - Cutthroat, Chinook, Coho, Mosquitofish, Sculpin, Stickleback, Surf Perch (Ni-les'tun Unit)
- Resident populations of coastal cutthroat trout are found in Fahys and Redd Creek
  - Multiple size classes of Cutthroat are found in Fahys and Redd Cr. pre and post construction (Ni-les'tun Unit and Smith Tract)
  - Larger (>350 mm) sea-run coastal cutthroat trout were present in Fahys Creek after construction





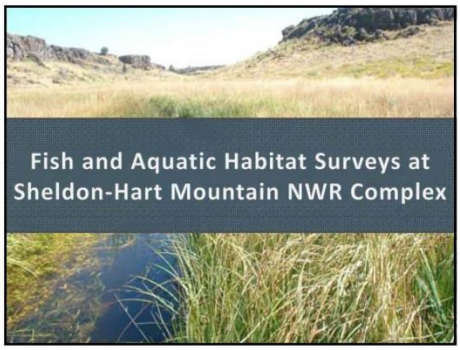
Results – Reference Sites

- Reference sites do not follow the same patterns as the restoration area
- Community is substantially different from restoration area, due to habitat differences
- No coastal cutthroat trout, there is little surface freshwater habitat



Concluding Comments

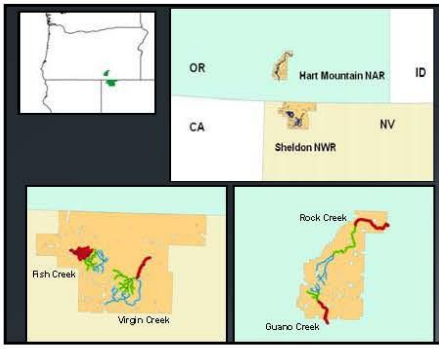
- Refuge/Fisheries partnership has been mutually beneficial
- Fisheries provided a standardized sampling approach for a long-term assessment and monitoring program
- Fisheries provided technical expertise and resources
- Refuges provided a unique opportunity for CRFPO to be involved in tidal marsh restoration projects
- Refuges provided funding



Goal: Establish a baseline for fish community and habitat information in watersheds supporting native fish

Objectives

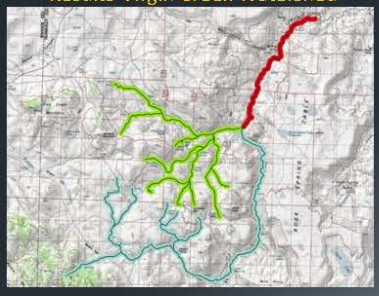
- Determine fish species present
- Watershed occupancy by fish species
- Describe distribution of fish within watersheds
- Characterize aquatic habitat



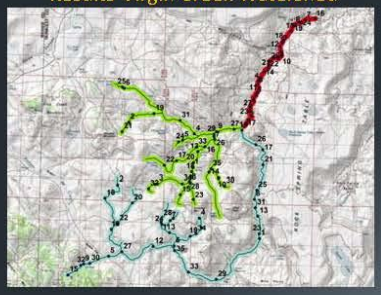
Methods

- Developing sample framework
  - NHD used in GIS to bound watershed
  - Identify sample reaches using GRTS design and three stream tiers per watershed
- Surveying for fish
  - Electrofish seven "viable" reaches per tier
  - Collect trout tissue
- Characterizing habitat
  - transects (channel, bank, riparian attributes)

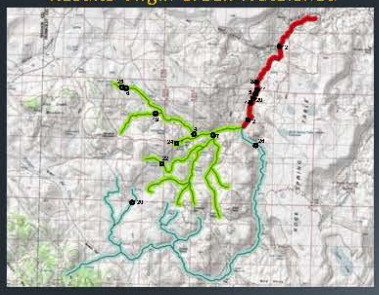
Results-Virgin Creek Watershed



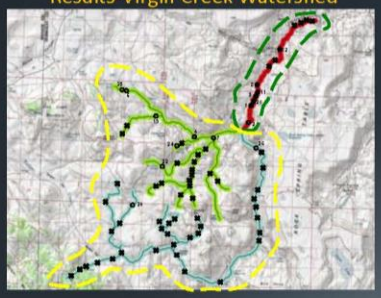
Results-Virgin Creek Watershed



Results-Virgin Creek Watershed



Results-Virgin Creek Watershed

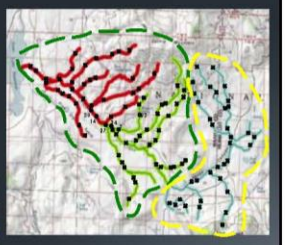


Results-Virgin Creek Watershed

- Trout
  - 65 in 5 reaches (lower tier)
  - SSDP = 0.31
  - Post hoc certainty 93% middle, 68% upper tiers
  - 38 tissue samples
- Alvord chub
  - 18 in 2 reaches (lower tier)
  - SSDP = 0.13
  - Post hoc certainty 72% middle, 57% upper tiers
  - One reach sympatric

Results-Fish Creek Watershed

- Sheldon tui chub
  - 111 in 2 reaches (lower tier)
  - 63 in 3 reaches (middle tier)
  - No viable reaches in upper tier
  - SSDP = 0.83
  - Post hoc certainty ~100%



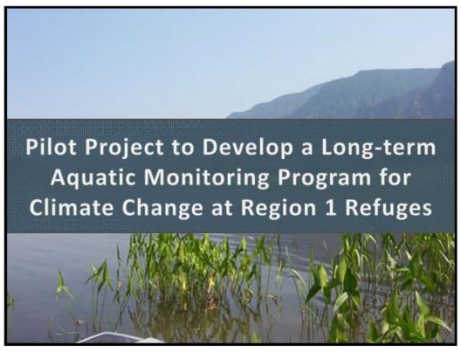
Results-Guano Creek Watershed

- Trout
  - 27 in 2 reaches (lower tier)
  - 61 in 6 reaches (middle tier)
  - 13 in 2 reaches (upper tier)
  - SSDP = 0.50

Results-Rock Creek Watershed

Conclusions-Recommendations

- Established baseline for fish presence, occupancy, distribution, and aquatic habitat in three of four watersheds
- Baseline established during season with most restrictive conditions
- Recommend monitoring physical variables predicted to be affected by climate change (e.g., water temperature, flow)
- Recommend conducting genetic analysis of trout tissue samples to inform development of management objectives and possible actions



Long-term Aquatic Monitoring Program Why

Climate change – air temperature and precipitation changes expected to affect of water temperature and hydrologic regime

Effects on biota – physiological tolerances, disturbance regime, nutrient processing rates, habitat modifications, non-native species

Why at NWRs – Service's principal land base, established for the conservation, management, and restoration of natural resources

Results inform conservation – early indication of effects, non-native species, indicate need for actions, contribute to broad-scale efforts (landscape vulnerability assessments, SHC)

Long-term Aquatic Monitoring Program What

Goal: Evaluate evidence of climate change in physical attributes at NWRs and changes in aquatic communities

Objectives:

- -Establish long-term sentinel sites representing mainland NWRs across R1 ecoregions
- -Describe how physical attributes vary through time
- -Describe how biological attributes vary through time
- -Analyze for potential temporal change by ecoregion
- -Assess relationships in physical and biological attributes by ecoregion

Long-term Aquatic Monitoring Program How

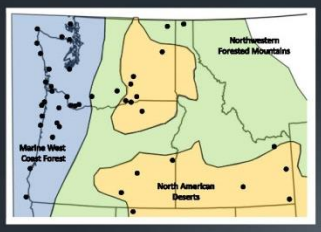
Desired Qualities:

- Sustainable for resources required
- Existing info, support
- Consistency in habitat type, physical and biological attributes

Methods:

- EPA Environmental Monitoring and Assessment Program protocols (Peck et al. 2006); EPA Best Practices for Monitoring Temperature and Flow (EPA 2014)
- Components are —
  - Discharge and Water Temperature continuously recorded
  - Water Chemistry, Habitat, and Aquatic Vertebrate surveys during low flow (assemblage/community metrics)
- Temporal analyses once time series established

Long-term Aquatic Monitoring Program Where



Long-term Aquatic Monitoring Program Where

Refuges, Water Resources, & Fisheries Joint Geospatial Assessment

Objectively Identify Streams:

1. Non-tidal and wadeable
2. Diverse vertebrate fauna
3. Watersheds resistant to perturbations (e.g., water diversion, development, land cover change)

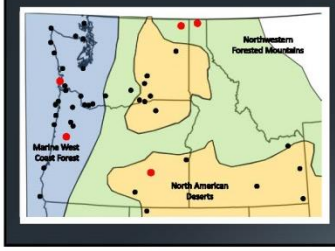
Long-term Aquatic Monitoring Program Where

Refuges, Water Resources, & Fisheries
Joint Geospatial Assessment

Key Attributes:

- Length on Refuge
- Size of Drainage Area
- Watershed Ownership
- Major Land Cover Types

Long-term Aquatic Monitoring Program Where



Little Pend Oreille
Kootenai
Willapa
William L. Finley
Malheur

Long-term Aquatic Monitoring Program When and Who

When: Phased approach

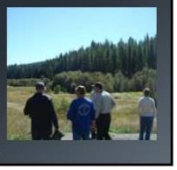
Phase 1- Reconnaissance (sites, loggers) → Phase 2- Baseline (1st 3-years, 3X/year) → Phase 3- Long-term (2-5 year intervals)

Who: Collaboration (programs/offices)

--5 Refuges, 4 Fishery Offices, Water Resources

--Fishery Offices matched with Refuges
--Temperature, flow, surveys
--Logger download, analyses

--Water Resources
--Stream gauges, temperature data



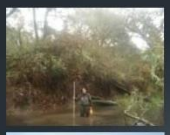
Long-term Aquatic Monitoring Program Current Status

- Phase 1: Ongoing
  - NRPC $48K FY14
  - Met with NWRs
  - ID streams, reaches
  - Data loggers
  - Installation



Long-term Aquatic Monitoring Program Current Status

- Phase 2: Summer-fall FY15
  - Anticipated funding
  - Installation/data collection
  - Habitat surveys (1X)
  - Biological surveys (3X)
  - Data management plan



Bandon Marsh NWR
Sheldon-Hart Mountain NWR Complex
Kootenai NWR
Little Pend Oreille NWR
Malheur NWR
Willapa NWR
William L. Finley NWR
Branch of Refuge Biology
Inventory and Monitoring Initiative
Natural Resources Program Center
Water Resources
Idaho FRO
Mid-Columbia FRO
Western Washington Division of Fisheries
Columbia River Fisheries Program Office

Thank You!

USFWS Pacific Region

The Refuge Life Aquatic: Havens for Our Most Iconic Fish Species

By: Sam Lohr/USFWS Fisheries Biologist

Photo: Mt. Adams and a grove of autumnal aspen trees paint an iconic Northwest scene on Conboy Lake National Wildlife Refuge. Credit: David Patte/USFWS

In celebration of National Wildlife Refuge Week (October 12-18), I truly hope that people living in the Pacific Northwest have an opportunity to visit a nearby refuge and enjoy some of the public activities allowed there. Bird watching, hiking, photography, hunting, and fishing are typical activities encouraged at many refuges. However, thinking about the types and distribution of fish at refuges in the

Northwest might not be the first thing that comes to mind as one enjoys these activities.

Photo: Did you know - the threatened but mighty bull trout can be found on Pacific Northwest refuges. Joel Sartore/National Geographic Stock with Wade Fredenberg/USFWS

There are 44 National Wildlife Refuges across Idaho, Oregon, and Washington that provide a variety of habitats where fish may spend all or a portion of their life. These refuges are found in each of three broad ecoregions. Ecoregions are areas characterized by environmental conditions to help biologists think about ecological relationships. Moving from west to east, the three ecoregions are the Marine West Coast Forest, Northwestern Forested Mountains, and North American Deserts.

Photo: Large logs placed in Redd Creek channel will provide fish habitat for coastal cutthroat trout, coho and Chinook salmon. This photo is of the Ni-les'tun Tidal Marsh Restoration Project on the Bandon Marsh National Wildlife Refuge. Credit: USFWS

The Marine West Coast Forest ecoregion includes the temperate rain forest along the mainland and offshore islands of Oregon and Washington. Over half, 23, of the refuges in the Northwest occur in this ecoregion. Some of the refuges are islands and reefs, whose adjacent waters provide habitat for marine fishes. Other refuges are in estuaries, where rivers meet the ocean to create highly productive areas, and river valleys. Anadromous fish, such as Chinook salmon, coho salmon, steelhead, and Pacific lamprey migrate through estuaries as adults on their way to upstream spawning areas, and juvenile salmon may spend considerable time rearing in tidal marshes of estuaries before migrating to the ocean.

Photo: An Oregon chub swims at Finley National Wildlife Refuge in Corvallis, Oregon. Credit: Rick Swart/Oregon Department of Fish and Wildlife.

Recent habitat restoration projects at Bandon Marsh NWR in Oregon and Nisqually NWR in Washington greatly expanded tidal marshes in estuaries by removing dikes that had reduced habitat. In addition to juvenile salmon, estuarine fishes, such as starry flounder and surf perch began using newly restored areas. For river valleys, Oregon chub is a small minnow that inhabits off-channel floodplain habitats in the Willemette River basin, including William L. Finley and Ankeny NWRs. Oregon chub were listed as endangered in 1993, and extensive work to recover the species by a partnership of agencies and landowners has led to Oregon chub being proposed for delisting.

Photo: Several species of trout can be found on National Wildlife Refuges. Credit: Trout Unlimited

The Northwestern Forested Mountains ecoregion includes the major North American mountain ranges and associated river systems in Idaho, Oregon, and Washington. Only a few, 6, of the refuges in the Northwest occur in this ecoregion. Some refuges are along rivers that anadromous fish use, whereas others are farther upstream. Pierce NWR, located just below Bonneville Dam about 140 miles upstream of the mouth of the Columbia River, has a stream that is one of the farthest upstream spawning sites for chum salmon and provides habitat for other fishes typical of the lower Columbia (e.g., coho salmon, coastal cutthroat trout, pike minnow, sculpin). Kootenai NWR, located in northern Idaho about 30 miles upstream of the Canadian border, is above the distribution of anadromous fish. Bull trout and redband trout can be found at the refuge. In addition, kokanee, which are landlocked sockeye salmon, historically spawned in Myrtle Creek at the refuge and juveniles migrated downstream to mature in Kootenay Lake, British Columbia.

Photo: Hardy Creek, which bisects the refuge from east to west, supports one of the last remaining runs of chum salmon on the Columbia River. In addition to chum salmon, the creek also supports small remnant runs of Coho, steelhead and Chinook salmon as well as a variety of native species of freshwater fish. Credit: www.refugestewards.org

The North American Deserts ecoregion includes the arid, sagebrush steppe and grassland areas of the Columbia-Snake River plateau of Idaho, Oregon, and Washington, and also the Great Basin where rivers do not flow to the ocean. Fifteen refuges occur in this ecoregion. Similar to the Northwestern Forested Mountains ecoregion, some refuges in the Desert ecoregion are along rivers and streams that anadromous fish can use as migratory corridors and perhaps rearing habitat.

in their pure form because they have hybridized with rainbow trout that were first planted in the basin around the 1920s.

Photo: Kokanee are one of the many species that have an aquatic haven on National Wildlife Refuges in the Pacific Region. Credit: Roger Tabor

Fish may not be as visible as other animals one sees at a refuge. However, refuges in the Pacific Northwest host a diverse range of fishes, some wide-ranging in our region and others found in very specific areas, of which all are integral parts of our natural heritage. Refuges have an important role in conservation of fish, wildlife, plants, and their habitats that we celebrate during National Wildlife Refuge Week.

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April 2016