U.S. Fish and Wildlife Service

NWR-CRFPO Workshop 2010: A report on a workshop between National Wildlife Refuges in Region1 and the Columbia River Fisheries Program Office April 28, 2010 Vancouver, Washington

2010 Workshop Report

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On the cover: *Western pearlshell mussels in a stream. USFWS.*

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NWR-CRFPO WORKSHOP 2010: A REPORT ON A WORKSHOP BETWEEN NATIONAL WILDLIFE REFUGES IN REGION 1 AND THE COLUMBIA RIVER FISHERIES PROGRAM OFFICE APRIL 28, 2010 VANCOUVER WASHINGTON 2010 WORKSHOP REPORT

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NWR-CRFPO WORKSHOP 2010: A REPORT ON A WORKSHOP BETWEEN NATIONAL WILDLIFE REFUGES IN REGION1 AND THE COLUMBIA RIVER FISHERIES PROGRAM OFFICE APRIL 28, 2010 VANCOUVER, WASHINGTON 2010 WORKSHOP REPORT

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Executive Summary – On April 28, 2010, the Columbia River Fisheries Program Office (CRFPO) hosted a day-long workshop with National Wildlife Refuges (NWRs). The goal of the workshop was to provide a forum to promote effective information exchange and coordination among NWRs, CRFPO, Partners for Fish and Wildlife (PFW), and other Service programs. Specific objectives were to:

1. Update NWRs about results and activities by the CRFPO to address aquatic resource issues and needs;
2. Present aquatic resource issues and results of associated work at Malheur NWR;
3. Update CRFPO about aquatic resource issues, needs, and management planning at NWRs;
4. Explore additional possibilities for cooperative efforts among NWRs, CRFPO, PFW, and others; and
5. Develop action items.

The purpose of the workshop was to build upon efforts initiated during earlier workshops. The workshop was organized according to three main sessions: 1) CRFPO results and activities on aquatic resource issues and needs at NWRs; 2) Aquatic resource issues and results of associated work at Malheur NWR; and 3) NWR activities and issues concerning aquatic resources. This report summarizes the 2010 NWR-CRFPO workshop in four sections: 1) Background, which provides context relative to the initial and subsequent workshops; 2) 2010 NWR-CRFPO Workshop, which reports on each of the three workshop sessions and presents a brief conclusion; 3) Action Items, which include activities for ongoing and planned projects, and actions specifically generated through discussions at the workshop; and 4) Appendices of supporting materials.

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I. Background

Because of efforts to increase interactions between Service programs and complementary missions of National Wildlife Refuges (NWRs) and the Columbia River Fisheries Program Office (CRFPO), the CRFPO hosted a day-long workshop with NWRs[1] and representatives of programs from the regional office in July 2005. The goal of this initial workshop was to provide a forum to promote effective information exchange between NWRs and the CRFPO. The intent of exchanging information was to improve familiarity between programs, identify immediate aquatic resource issues and needs at NWRs, and explore opportunities and strategies for the programs to cooperatively work toward addressing resource issues and needs. Information presented at the workshop as well as approaches NWRs and the CRFPO intend to use in working together are summarized and described in the workshop summary report.

Since the initial workshop in 2005, NWRs and the CRFPO have been cooperatively working on several ongoing and new monitoring and evaluation projects. The CRFPO has also been working with NWRs to provide technical assistance on various issues to the extent possible with existing resources, assisting in the development of Comprehensive Conservation Plans (CCPs), and jointly pursuing various internal and external sources of funding to address aquatic resource needs. Because holding regularly-scheduled workshops is an efficient approach to exchange the most current information and encourage continued cooperative efforts to work together, we have held workshops almost annually since 2005. This report summarizes topics and discussions from the 2010 workshop, and includes supporting materials. It is the fourth workshop held since 2005. This and all previous reports are available at the CRFPO webpage (http://www.fws.gov/columbiariver/programs/RAP/refuge.html).

II. NWR-CRFPO Workshop 2010

The intent of the 2010 workshop was to build upon efforts initiated at earlier workshops with the goal of providing a forum to promote effective information exchange and facilitate a working relationship among NWRs, CRFPO, PFW, and other Service programs. Overall, the workshop focused on two broad topics: Results of activities the CRFPO has conducted at NWRs; and aquatic resource issues at Malheur NWR and results of associated work. Five objectives were addressed:

1. Update NWRs about results and activities by the CRFPO to address aquatic resource issues and needs.
2. Present aquatic resource issues and results of associated work at Malheur NWR.
3. Update CRFPO about aquatic resource issues, needs, and management planning at NWRs.

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[1]Primarily NWRs within the CRFPO geographic area of responsibility (i.e., Columbia River basin below McNary Dam, Oregon waters excluding the Klamath River basin, small tributaries of Willapa NWR).

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

The workshop was organized according to three main sessions to accomplish objectives (see agenda—Appendix A): 1) CRFPO results and activities on aquatic resource issues and needs; 2) Aquatic resource issues and results of associated work at Malheur NWR; and 3) NWR activities and issues concerning aquatic resources. This portion of the workshop report summarizes each of the sessions and present a brief conclusion. The attendance list (Appendix B), and presentations by Service personnel (Appendix C) are also included.

A. CRFPO results and activities on aquatic resource issues and needs

The intent of this session was to provide current updates and results of projects. Personnel from the CRFPO made three presentations concerning results of activities conducted over the previous year at NWRs. The following are brief summaries of each presentation followed by highlights of issues discussed.

1. Preliminary evidence that sculpin species native to the Pacific northwest do not serve as a host in the reproductive cycle of the western pearlshell mussel. (presented by Greg Silver)

Out of seven native freshwater mussels in the Pacific northwest, the western pearlshell mussel is typically the most common species inhabiting cold clean streams and rivers. However, the species has been extirpated in many large rivers and coastal streams due to a variety of factors (e.g., habitat alterations, pollution, declines of host fish necessary for development). Western pearlshell mussels possess a complex life history requiring a host fish on which parasitic larvae develop. Reproduction is believed to occur during May-July, and is complex. Fertilized eggs develop into larvae (glochidia) within a specialized area of the female's gills. Glochidia are released and must encounter a host fish on which to encyst on the gills or fins to develop. Glochidia eventually detach from the host, and burrow into the substrate until they mature. Little is known about whether western pearlshell mussel glochidia are host specific for certain species, though hosts are thought to include several salmonid and non-salmonid species (e.g., dace, shiner, sucker, and sculpin).

In 2008, Willapa NWR transferred western pearlshell mussels from the Bear River to three streams on the NWR to re-establish self-sustaining mussel populations in previously occupied areas. Because salmonids are not present in all streams at Willapa NWR and self-sustaining mussel populations require a viable host fish, the NWR asked the CRFPO to evaluate whether sculpin, which are widely distributed, are viable host for mussels. Objectives of the evaluation were to: Determine whether sculpin in the Bear River were infested with mussel larvae, and Determine whether infested sculpin were able to produce viable juvenile mussels. To address these objectives, mussels in the Bear River were inspected for signs of reproduction and sculpin collected when mussel were in reproductive condition. Half of the sculpin were sacrificed and inspected for mussel larvae, whereas the remaining sculpin were held in the lab and their containers inspected for viable mussel larvae. A total of 164 sculpin were obtained on four collections conducted during July-August after mussel exhibited signs of reproduction. No encysted glochidia were found on the gills or fins of sculpin that were immediately sacrificed, and no larvae were observed on either sculpin or in containers for fish brought into the lab. The

experiment was complicated by sculpin exhibiting high mortality in the lab. The evaluation provided preliminary evidence that sculpin do not appear to be a host for western pearlshell mussel.

Additional issues noted were that: Streams receiving a transfer of mussel should have salmonids present; Future evaluations should be conducted in areas with dense mussel beds and include positive controls.

2. Assessment of tidal inundation for a proposed dike removal project at Willapa NWR. (presented by Joe Skalicky)

Willapa NWR is considering the removal of dikes in the southern portion of Willapa Bay. Discussions at an earlier workshop led to the CRFPO conducting an assessment to estimate areas likely to be inundated if dikes were removed. The goal of the assessment was to model a range of tidal inundations, which required using terrain and tidal levels as inputs. Objectives were to: Assess input data and fill in gaps; Construct a new DEM for the area; and Assess tidal extremes and collect data in south Willapa Bay. For terrain, a LIDAR flight was conducted to collect data specifically for the 1,500 acre area in the southern portion of the bay during low water. For tidal level, four tidal elevation stations exist in Willapa Bay, however, their data were not applicable to south Willapa Bay. An existing DEM, referenced to low water, was used to develop a new DEM, which was used to simulate a range of tidal elevations and high water events in south Willapa Bay. The assessment indicated that some private lands adjacent to the NWR would be inundated with dike removal, and that some areas behind dikes had subsided. Results of the assessment are being used to develop construction plans for dike removal and internal dikes to prevent flooding of private lands. Two new tide gages were installed in south Willapa Bay that can be related to data from existing stations.

3. Assessment of salmonid populations and passage at tide gates at Tenasillahe and Welch islands. (presented by Jeff Johnson)

The U.S. Army Corps of Engineers retrofitted tide gates in a large slough on Tenasillahe Island to improve habitat conditions and salmonid access. The CRFPO recently concluded a 4-year assessment of the overall effectiveness of the retrofit, which included comparisons both before (2006-2007) and after (2008-2009) the retrofit and to reference sloughs on nearby Welch Island. Objectives were to: Describe the fish community in treatment (Tenasillahe Island) and reference (Welch Island) sloughs: Characterize aquatic habitats in treatment and reference sloughs: Assess fish passage conditions at the tide gates: and Measure juvenile salmonid growth and residence time in the treatment slough. For fish community, species composition in the treatment slough consisted of a much higher proportion of non-native species than reference sloughs both before and after tide gates were modified. For aquatic habitat, water temperature (7-day mean daily maximum) tended to warm earlier in the treatment slough than reference sloughs both before and after tide gates were modified. Also, water temperatures at the treatment slough did not differ between before- and after-retrofit periods. For fish passage conditions, retrofitted tide gates were open almost a hour longer than the original tide gates, remained open for less than five hours per day, and were open only when water was flowing out of the slough. Residence time of juvenile Chinook salmon released in the treatment slough appeared to be longer after the tide gate retrofit, and growth of fish subsequently captured was relatively high. Final report on the assessment will be available in December.

Additional issues noted were that: Sliding doors on the new tide gates were closed during the assessment, and are planned to be kept open so long as flooding is not anticipated; an overall index of salmon potentially available that may use the sloughs would assist in interpreting fish use; and size groups of juvenile salmon found in the treatment slough suggests that some fish may be overwintering there.

B. Aquatic resource issues and results of associated work at Malheur NWR

The intent of this session was to discuss aquatic issues at Malheur NWR provide updates and results of projects conducted at the NWR. Service staff and others made four presentations concerning various activities at Malheur NWR. The following are brief summaries of each presentation followed by highlights of issues discussed.

1. Geomorphic history and current channel condition of the Donner und Blitzen River, Malheur National Wildlife Refuge, Oregon. (presented by Nira Salant)

The Intermountain Center for River Rehabilitation and Restoration at Utah State University recently conducted an evaluation of the geomorphic history of the Donner und Blitzen River in the southern portion of Malheur NWR (i.e., upstream of Krumbo Lane). The purpose was to generate information for discussing alternative scenarios of river restoration. Information was obtained from hydrologic analyses, historical analyses of stream gages and aerial photos, and current surveys of river substrate, channel dimensions, and habitat. Three distinct reaches were identified: 1) Page Dam to P-Ranch (unchannelized, no restoration); 2) P-Ranch to Bridge Creek (unchannelized, restoration with rock weirs); and Bridge Creek to Krumbo Lane (channelized during 1907-1913). For the hydrologic analyses, the duration and frequency of 2-year floods have increased since the early 1970s. It is uncertain if the increase is related to climate change, but the river is likely adjusting to the new regime, which has implications for channel stability and potential for restoration work. For the three reaches, the lower most, Bridge Creek to Krumbo Lane, was channelized in the early 1900s and appears to be adjusting as evidenced by the formation of bars and meanders within the levees. The upper most reach, Page Dam to P-Ranch, was historically wider than downstream due to beaver activity and overbank flows. Streambed elevation lowered in the early 1900s, likely in response to channelization downstream, but appears to have adjusted based on the presence of pools, riffles, bars, and riparian vegetation. The middle reach, P-Ranch to Bridge Creek, has recently lost riffles and increased in overall water depth, likely due to placement of rock weirs. Localized erosion is associated with the weirs. These may be unintended consequences of the weirs. Among reaches, the middle reach has the lowest habitat quality rating for trout based on water depth and substrate characteristics.

Restoration scenarios fall on a continuum ranging from no action to complete restoration (i.e., attempting to fully return ecosystem to its pre-disturbance condition), with rehabilitation (improving attributes of the native ecosystem but not fully to pre-disturbance conditions) and mitigation (improving specific attributes while an altered system is acceptable). Approaches for the Blitzen River could include five restoration scenarios along the continuum, with varying inputs (e.g., physical change, costs, public opinion) and returns. Easy decisions would be those that produce large environmental improvements with small inputs, whereas difficult decisions

would be those that require high inputs to produce a significant environmental response. Examples of these scenarios are:
1. Restoration to attain pre-disturbance conditions: Activities—remove diversions, canals, and levees; reestablish natural processes; reconfigure channel and floodplain to recreate pre-disturbance conditions; Considerations—major engineering, loss of water management, reduced wetland habitat, hydrology may be changing.
2. Rehabilitation to return to some 20th century condition (e.g., 1970s): Activities—remove weirs and add gravel in P-Ranch to Bridge Creek reach; Considerations—template selected depends on objectives, range of costs and benefits.
3. Rehabilitation to target ecological objective: Activities—for instream habitat install structures, add gravel, riparian planting; for floodplain habitat maintain diversions, canals, and irrigated areas; Considerations—identify ecological/management priorities, limitations of approach, costs depend on scale and scope of objectives.
4. Mitigate to reduce undesirable conditions: Activities—riparian planting to address low riparian cover, apply bank stabilization techniques to reduce bank erosion; Considerations—require prioritization of needs, may have low aesthetic value, costs depend on scale and scope of problem.
5. No action: Activities—retain water management capabilities and assume river will adjust to conditions; Considerations—does status quo meet management objectives, will degradation continue, sustainability of current costs, stability of system.

Future work should address whether instream habitat can be improved without reducing ability to support migratory waterfowl, determining physical factors limiting redband trout, clarifying what is happening with changes in hydrology, and determining the sources and fluxes of sediment in the system.

2. Hydrology and water resource studies at Malheur NWR. (presented by Dan Craver)
Primary functions of Region 1 Water Resources Branch (WRB) are to: 1) Provide support in acquiring and maintaining water rights; 2) Address water resources threats and needs; 3) Maintain a monitoring network for water use and reporting at NWRs and Service hatcheries; and 4) Water data management; all within both R1 and R8. The WRB also is conducting the Water Resources Inventory (WRI), which will consist of a database (inventory) and report (assessment) for all NWRs. The WRI is being developed in context of climate change using the spatially explicit national framework. Three to five NWRs within each of the start-up Landscape Conservation Cooperatives (Great Northern, Pacific Islands, and California LCCs) are planned to be included in the WRI during FY2011.

For Malheur NWR, the WRB assists with the NWR's 122 existing water rights and new applications for winter rights. A water measurement plan was developed in 1996, supported by a monitoring network of 39 sites. A settlement agreement for the winter water right application stipulated development of a water quality report and instream flow study for redband trout in the Donner und Blitzen River. The water quality report was completed in 2006, and found that high water temperature and low dissolved oxygen were problems. Water bypass at dams, riparian restoration, and reactivation of floodplains are practices the NWR can implement to improve water quality. The instream flow study is being led by the Oregon Department of Fish and Wildlife using a 1D PHABSIM approach. Preliminary results are due this spring.

The WRB is currently assessing the ability to use satellite images and lake-level data to update lake-bed topography, identify low areas, and predict lake levels. This information may assist carp management (e.g., identify areas carp may aggregate) and predict when Malheur Lake may be at extremely low levels. Lake level and snow-water data at various times during the year are inputs to a model to predicting September 1 lake levels. For this year, lake levels are similar to those 1992, which was one of the lowest levels on record, snowpack in the Steens Mountains appears sufficient to keep lake levels at about last year's level.

Additional issues noted were the rationale for the approach selected for the instream flow study (lead agency choice) and offer by CRFPO to explore additional uses of data expected in the instream flow report.

3. Migratory behavior and passage of redband trout in the Donner und Blitzen River. (presented by Matt Anderson)

Oregon State University recently completed a study of redband trout migratory behavior in the Donner und Blitzen River and passage delays at diversions dams on Malheur NWR. Three reaches were identified on which to focus: lower river—Malheur Lake to Bridge Creek, middle river—Bridge Creek to Page Springs weir, and upper river—Page Springs weir upstream for the remainder of the mainstem Donner und Blitzen River. Temperature loggers were placed at various locations among the reaches and discharge recorded at Page Springs weir. Redband trout were collected in traps on the ladders at Sodhouse, Busse, and Page dams, and by angling in areas downstream of dams. After collecting biological information, individuals received either radio (96) or PIT (706) tags. To detect radio tags, mobile tracking was conducted at least weekly during spring and monthly during other seasons, and two stationary radio receivers were placed near tributaries in the upper river. To detect PIT tags, arrays were installed at Busse, Grain Camp, and Page dams that allowed detections of fish approaching the dams, entering ladders, and exiting ladders, and an additional array was installed at Cato Bridge (i.e., near the confluence of the Donner und Blitzen River with Malheur Lake).

Water temperature primarily increased from upstream to downstream, with values (7-day average daily maximum water temperature) exceeding the ultimate upper incipient lethal temperature (24.3°C) at a number of stations during summer. Redband trout were ages 1-5. Because fish matured at age 3, immature fish were migrating between spawning-rearing habitat in the upper reaches and the lower river. Based on PIT tag detections, migration rate was best described by fork length and discharge. Passage delay times were compared among the three dams, and also partitioned into time for finding-entering ladders and time for ascending ladders. Overall passage delay time differed among all dams, ranging from less than a day (Page Dam) to a number of weeks (Busse and Grain Camp dams). Fish took much longer to find-enter ladders as opposed to ascending ladders. Radio-tagged fish were detected upstream of Page Dam, a reach considered spawning habitat. Fish tagged in the lower river arrived upstream of Page Dam later than fish tagged in the middle river, and several fish tagged in the lower river were only detected in the middle river reach or below dams in the lower river reach. Conclusions concerning migratory behavior were that seasonal migrations were likely due to temperature, migrations included adult and subadult fish, individuals may make multiple migrations, and possible positive relation between lake level and trout use of the lake. Conclusions concerning

passage were that delay times were dam specific, delays at Busse and Grain Camp dams were biologically significant, delays were primarily caused by ladder attraction and entrance problems, and delays may affect migratory life history. Recommendations were that improvements to fish passage and screens are the top priority for redband trout, improving riparian vegetation starting upstream and moving down may expand summer thermal conditions, and new ladders should focus on improvements to attraction.

Additional issues noted were: Passage efficiency at the dams was low (~40%); Importance of area immediately downstream of Page Dam (all migratory fish use the area at some point); and Effects of habitat degradation coupled with impediments to connectivity have likely been the greatest factors affecting migratory redband trout.

4. Aquatic resource issues and applying sound science at Malheur NWR. (presented by Linda Beck)

Malheur NWR is using a collaborative process to develop its CCP, which will address several aquatic resource issues. Major aquatic issues include water delivery system and associated infrastructure; hydrology, habitat and vegetation management, and aquatic health. For water delivery system and infrastructure, substantial funds (over $3.2 million) have been dedicated to modify dams to improve fish passage and install screens at water diversions. For hydrology, Region 1 WRB is providing GIS support for inventory and mapping of infrastructure, exploring models to predict Malheur Lake levels, and funded the geomorphic assessment of the Donner und Blitzen River by Utah State University. For habitat and vegetation management, wetlands are managed on a rotational basis (i.e., maintained for 3-4 years and then drawn down in the spring) to encourage select vegetation types and also to eliminate carp. Green planting (i.e., cutting and removing vegetation wherein some is left in the fields) also is used to management vegetation. Aquatic health addresses several issues, including amphibians (e.g., recently found spotted frogs and the presence of invasive bullfrogs), freshwater mussels (presence of four native species), and invasive carp. For carp, control efforts have been sporadic opportunities using a variety of method (e.g., chemicals, water management, and screening). The NWR hosted the Invasive Carp Control Workshop in March, and formed three aquatic workgroups to help develop strategies addressing carp (Assessment, Control, and Partnerships/Funding). A list serve has been developed for carp, and everybody is welcome to sign up. For funding activities related to carp, five sources contributed during 2009-2010 and two grant applications are pending. At the workshop, application of a population dynamics model was discussed as a tool to assist in understanding how control actions may affect carp. Upcoming activities planned for this summer are carp sampling work using electrofishing and a fly fishing club, investigating overall fish assemblage, and invasive carp awareness day. Aquatic plan surveys also are planned.

Additional issues noted were: Existence of sampling protocols for frogs, mussels, etc.; Uses of the population dynamics model (contribute to an integrated carp management plan); and Obligations of water management (solely by the NWR, over time wetlands along the river are compensating for reduced functions of lake habitat for birds).

C. NWR Activities and Issues Concerning Aquatic Resources

The intent of this session was to allow an open discussion of new aquatic issues and needs, updates on identified needs, CCP schedules, plans, etc., by attending NWRs. Because the

ensuing discussion ended up being a continuation of aquatic management issues at Malheur NWR, the CRFPO requested that NWRs individually provide pertinent information subsequent to the meeting, which was incorporated into action items.

During the continued discussion of Malheur NWR, a comment was made that water management in the Donner und Blitzen River is an apparent conflict between birds and fish. Points made in response were that:

- The establishing legislation for Malheur NWR specifically addressed birds;
- Management considerations should not be limited to individual groups of animals but focus on the ecosystem; and
- Management issues should be framed as to what can be done for both the needs of birds and aquatics.

It was concluded that the Service should consider what tools are available and identify those needed to be developed in order to inform water management decisions about effects on both birds and fish. A water budget for Malheur NWR was identified as an essential tool needed to assist in the formulation and evaluation of possible management scenarios.

D. Conclusion

Of the five objectives established to address the workshop goal of providing a forum for effective information exchange and coordination among Service Programs, two (updating NWRs about CRFPO activities and aquatic issues at Malheur NWR) were explicitly addressed in workshop sessions and a third (develop action items) addressed in the following section of this document. The third workshop session (NWR activities and issues concerning aquatic resources) was intended to address the remaining two objectives (i.e., update CRFPO on NWR issues and explore possibilities for cooperative efforts). Because of the continuing discussion on Malheur NWR and time constraints at the workshop, these objectives were addressed through follow up after the workshop and incorporated into appropriate action items in this report.

III. Action Items

The following are action items resulting from the 2010 NWR-CRFPO Workshop. Some are activities for ongoing projects and assistance that the CRFPO has been engaged with NWRs during the past, as well as needs for which resources and plans have yet to be developed.

1. Malheur NWR and CRFPO work together to:
   - Identify and develop tools (e.g., water budget) needed for evaluating possible effects of various water management scenarios on multiple resources (e.g., birds, fish, other aquatic species, habitats, etc.).
   - Develop sampling protocols for fish, freshwater mussels, and other aquatic taxa.
   - Review pending instream flow study for the Donner und Blitzen water rights settlement agreement for additional analyses of anticipated datasets.

2. Pierce NWR keeps CRFPO informed of Lower Columbia River Fish Enhance Group proposals (e.g., investigations of ground water potential for salmon spawning channel development, fish passage options at water control structures) for CRFPO to provide technical assistance and advise Pierce NWR.

3. NWRs, CRFPO, and other Service programs work together to evaluate feasibility of conceptual habitat restoration actions at NWRs in the lower Columbia River considered by the U.S. Army Corps of Engineers and Bonneville Power Administration to benefit listed salmon and steelhead.

4. CRFPO to continue assessment of fish passage, fish community, and aquatic habitats at Julia Butler Hansen NWR to characterize post-construction conditions for evaluation of tide gate installations and modifications on the Mainland Unit.

5. CRFPO and Bandon Marsh NWR to continue assessment of physical and biological attributes of Bandon Marsh to characterize conditions for evaluation of the tidal marsh restoration project, post-construction period expected to begin in late summer-fall 2010.

5. Willapa NWR Complex and CRFPO work together on planning for potential habitat restoration of salt marsh habitats at Willapa NWR, stream habitats in Nelson and Risk creeks associated with Julia Butler Hansen NWR, and with assessment of conditions in small streams at Willapa NWR.

6. CRFPO to provide technical assistance to Tualatin NWR relative to salmonid use of off-channel area, potential fish entrapment in managed wetlands, wetland management-river temperature relations, and restoration of channelized streams, to the extent possible.

7. CRFPO to provide technical assistance to Ridgefield NWR relative to aquatic habitats and fish use of the Gee Creek watershed, conditions at Post Office Lake, and potential for improved connectivity between the Columbia River and Steigerwald Lake, to the extent possible.

8. CRFPO fisheries assistance for National Wildlife Refuges

- Continue providing assistance for CCP development, technical support, and general surveys to address aquatic resource issues to the greatest extent possible with existing resources.
- Continue to work with NWRs to develop FONS and other proposals for resources to address aquatic resource issues and needs.

9. CRFPO will organize the annual workshop for spring 2011.

IV. APPENDICES

APPENDIX A

NWR-FISHERIES WORKSHOP AGENDA
April 28, 2010
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, CRFPO, PFW, and other Service programs.

Objectives:
1. Update NWRs about results and activities by the CRFPO to address aquatic resource issues and needs.
2. Present aquatic resource issues and results of associated work at Malheur NWR.
3. Update CRFPO about aquatic resource issues, needs, and management planning at NWRs.
4. Explore additional possibilities for cooperative efforts among NWRs, CRFPO, PFW, and others.
5. Develop action items.

Geographic Scope: Columbia River basin below McNary Dam, Oregon waters excluding the Klamath River basin, small tributaries of Willapa NWR

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

1. CRFPO results and activities on aquatic resource issues and needs

10:05-10:35 Preliminary evidence that sculpin species native to the Pacific northwest do not serve as a host in the reproductive cycle of the western pearlshell mussel (Greg Silver)

10:35-11:05 Assessment of tidal inundation for a proposed dike removal project at Willapa NWR (Joe Skalicky)

11:05-11:35 Assessment of salmonid populations and passage at tide gates at Tenasillahe and Welch islands (Jeff Johnson)

11:35-12:00 Questions and discussion concerning morning presentations

12:00-1:00 Lunch

2. Aquatic resource issues and results of associated work at Malheur NWR

1:00-1:30 Geomorphic history and current channel condition of the Donner und Blitzen River, Malheur National Wildlife Refuge, Oregon (Nira Salant)

1:30-2:00 Hydrology and water resource studies at Malheur NWR (Dan Craver)

2:00-2:30 Migratory behavior and passage of redband trout in the Donner und Blitzen River (Matt Anderson)

2:30-3:00 Aquatic resource issues and applying sound science at Malheur NWR (Linda Beck)

3:00-3:15 Break

3. NWR Activities and Issues Concerning Aquatic Resources

3:15-4:15 Open discussion of new NWR issues and needs, updates on previous issues and needs, CCP schedules and progress, upcoming work, etc. at each NWR

4:15-4:30 Wrap-up

APPENDIX B

Attending 2010 Workshop

Matt Anderson	Mt. Hood National Forest
Linda Beck	Malheur NWR
Alex Chmielewski	Ridgefield NWR
Don Campton	RO Fisheries
Lynn Cornelius	Ridgefield NWR
Dan Craver	RO Water Resources
CalLee Davenport	OFWO
Joel David	Julia Butler Hansen NWR
Joe Engler	RO Refuges
Marie Fernandez	Willapa NWR
Lamont Glass	Umatilla NWR
Randy Hill	Ridgefield NWR
Kathy Hollar	RO Partners Program
Amy Horsteman	OFWO/CRFPO
Mike Hudson	CRFPO
Jeff Johnson	CRFPO
Rich Johnson	RO Fisheries
Jeff Jolley	CRFPO
Melissa Kennedy	CRFPO
Kevin Kilbride	RO Refuges
Marci Koski	CRFPO
Sam Lohr	CRFPO
Roy Lowe	Oregon Coast NWR Complex
Paul Meyers	Julia Butler Hansen NWR
Nira Salant	Utah State University/ICRRR
Howard Schaller	CRFPO
Pete Schmidt	Tualatin NWR
Dan Shively	RO Fisheries
Greg Silver	CRFPO
Joe Skalicky	CRFPO
Shawn Stephensen	Oregon Coast NWR Complex
Tim Whitesel	CRFPO

APPENDIX C

Workshop Presentations by Service Personnel

Presentation: Preliminary evidence that sculpin species native to the Pacific northwest do not serve as a host in the reproductive cycle of the western pearlshell mussel. Presented by Greg Silver (see Section II.A.1 for discussion).

Preliminary evidence that sculpin species native to the Pacific Northwest do not serve as a host in the reproductive cycle of the western pearlshell mussel (*Margaritifera falcata)*

Brian Adair, Gregory S. Silver, Timothy A. Whitesel and Kimberly Kittell
U.S. Fish and Wildlife Service
Columbia River Fisheries Program Office
Vancouver, Washington

Acknowledgements

•Willapa National Wildlife Refuge funded this study.

•Brian Adair – Portland State University, Pacific Northwest Native Freshwater Mussel Workgroup

•Marie Fernandez, David Hines, Brian Davis – USFWS

Overview

I. Background Information
   I. Western pearlshell mussel (WPM) biology, life history
   II. WPM at Willapa NWR

II. Sculpin host fish study
   I. Justification
   II. Methods
   III. Results

Background

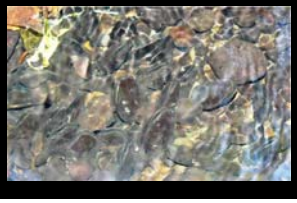
- Mussel populations are declining due to habitat alterations, water pollution, declines in host fish abundance and other anthropogenic factors
- The U.S. hosts the world's greatest diversity of freshwater mussels (~300 species)
- Few studies of freshwater mussels conducted in the Pacific Northwest
- Three genera west of Rocky Mountains (7 species)
  - Anondonta –The Floaters
  - Gonidea – Western ridged
  - Margaritifera –Western pearlshell

Western Pearlshell Distribution

- Most common freshwater mussel species in PNW
- Now extirpated in many large western rivers and coastal streams

Western Pearlshell Mussel

- Live in cold, clean streams and rivers
- Prefer stable substrates of sand, gravel and cobble
- Life span may exceed 100 years, average 60-70
- Reproduction occurs between May and early July
- Complex life history



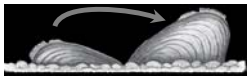
Life Cycle

3. Transport: Glochidia form a cyst around themselves and remain on a host for several weeks.

2. Spawning: Embryos develop into larvae called glochidia, which are released into the water and must encounter and attach to a host fish. Size of glochidia: 0.002 - 0.02 inches.

4. Settlement: Mussels release (excyst) from host fish and sink to the bottom. They burrow in the sediment and remain until mature. Newly settled juveniles are usually the same size as glochidia.

1. Breeding: Males release sperm into the water column. After being inhaled by females, sperm fertilizes eggs.



Host Fish

- Freshwater mussels may be host specific
- WPM host fish interaction not well-studied but is thought to include:
  - Salmonids
    - cutthroat trout
    - rainbow trout
    - Chinook salmon
    - coho salmon
    - sockeye salmon
    - brook trout
    - brown trout
  - Non-salmonids
    - speckled dace
    - Lahontan redside
    - Tahoe sucker
    - **sculpin?**

WPM @ WNWR

- WPM Reintroduction
  - September 2008, 100 WPM transferred from Bear R. to three creeks within Willapa NWR
  - Objective to restore self-sustaining mussel populations to areas previously occupied by WPM

WPM @ WNWR

- Self-sustaining populations must successfully reproduce
- Reproduction requires a viable host fish species to be present

- Salmonids not present in all refuge streams being considered for translocation
- Are other fish, including sculpin, viable host fish for WPM?

Study Proposal

- Investigate viability of sculpin as host for WPM
  - In Eastern U.S., sculpin can host mussel larvae
  - In PNW, sculpin known host fish for larvae of western floater *Anodonta kennerlyi*
  - Benthic, so likely associated with mussel beds
  - Generally widespread and abundant and can occur in streams where salmonids are absent
- Bear River selected as study area
  - Location of WNWR donor population
  - Known locations of mussel beds

Objectives

1) Determine whether sculpin in the Bear River were infested with mussel larvae

2) Determine whether infested sculpin were able to produce viable juvenile WPM

Study Design

Three Phase Project:

Phase I. Determining WPM gravidity
WPM in the Bear River monitored for signs of reproduction

Phase II. Sculpin collections
Observation of WPM reproductive activity initiated sculpin collections from the Bear River.

Phase III. Sculpin examinations: two-stage approach to address study objectives:

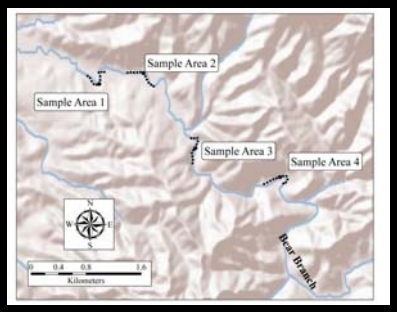
Objective 1. Detecting glochidia infestation

i. Sacrificed sculpin, provide preliminary indication of host fish viability

Objective 2. Assessing mussel transformation

i. Captively reared live sculpin, definitively establishes host fish relationship

Study Area



4 Sample Areas with high densities (beds) of WPM identified in previous surveys

Phase I. Determining WPM gravidity

- Surveys in Bear River beginning Mid-June 2008
  - >10 mussels examined at each visit
  - Pried open to look for signs of gravidity (inflated marsupial gills or glochidia)

- Results:

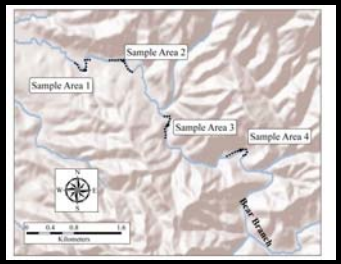
Date	# Observed	# Gravid	% Gravid	# Partially Inflated	% Partial
6/20/2008	30	1	3.3%	11	36.7%
7/15/2008	19	0	0.0%	2	10.5%

- Therefore, WPM spawning appeared to be occurring in Bear River

Phase II. Sculpin collections

- Sculpin collection occurred at 2 week intervals beginning on July 15
- 4 collection events
- Backpack electrofishing
- 20 sacrificed and preserved in situ in 100% ethanol
- 20 collected and held alive

Phase II. Sculpin collections (cont.)



- At each area, five 50 m reaches were sampled for sculpin
- 2 sculpin collected per 50 m reach (one sacrificed, one live)
- = 10 sculpin collected from each sample area

Phase III. Sculpin examinations

- Objective 1:
  - Detecting Infestation of Glochidia
    - Sculpin dissected to excise gills and fin tissues

- Tissues soaked in 0.05 molar KOH to make gill filaments and fin tissues translucent
- Examined tissues under magnification for encysted glochidia

Phase III. Sculpin examinations (cont.)

- Objective 2
  - Assessing Transformation of Glochidia
    - At the CRFPO lab, sculpin were held in plastic containers of aerated spring water
    - Sculpin were held at 10° C for 4-6 weeks
    - Fed frozen brine shrimp or meal worms every 2 days
    - Sculpin were isolated from the bottom of each container with mesh false bottoms (to prevent consumption of excysted juveniles)
    - Water was drained every 2 days and sieved
    - Contents of sieve were examined under a dissecting scope for juvenile mussels

Phase III. Results

Fate of collected sculpin

Collection Event	# Collected	# Sacrificed	# Mortality	Mortality (%)	Mean Time to Mortality (Days)
1	40	20	19	95%	2.3
2	44	20	18	75%	4.8
3	40	20	20	100%	4.6
4	40	20	14	70%	6.4
Total	**164**	**80**	**71**	**85%**	

- High sculpin mortality
  - Stress induced?

Phase III. Results

- **Objective 1**
  - Detecting Infestation of Glochidia

80 sacrificed sculpin
+71 captive rearing mortalities
151 total sculpin dissected and examined

0/151 infested with WPM glochidia (0%)

- **Objective 2**
  - Assessing Transformation
    - **No juvenile mussels were observed in filtrate**

Conclusions

- Lack of WPM glochidia infestation preliminary evidence sculpin are not a host fish for WPM
- Mussel relocation activities should be limited to streams where salmonids (or other tentative hosts) occur
- Future sculpin host studies might benefit from larger, higher density mussel beds and positive controls, ie., drift net sampling for glochidia or including salmonids
- WPM reproduction is protracted and varies annually, may have influence results
- Sculpin are easily stressed and difficult to rear captively!

Questions?

Presentation: Assessment of tidal inundation for a proposed dike removal project at Willapa NWR. Presented by Joe Skalicky (see Section II.A.2 for discussion).

Assessment of Tidal Inundation for a Proposed Dike Removal Project at Willapa NWR

April 28, 2010

Water Management and Evaluation Team
Columbia River Fisheries Program Office

Background:

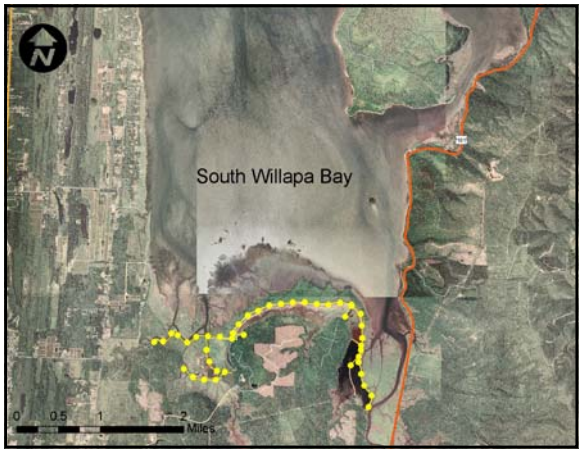
- Result of 2008 NWR-Fisheries Workshop!

Project Goals:

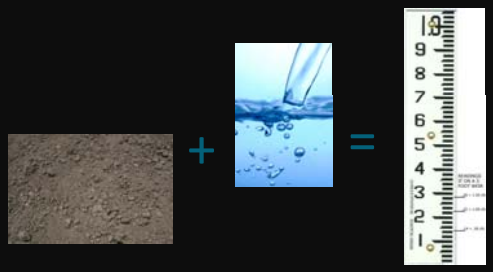
- Model a range of Tidal Inundations (pre-removal)
  - Assess existing terrain data and ID gaps
  - Acquire Gap Filler, aka Lidar
  - Construct new DEM for the AOI
  - Assess Tidal Extremes in S. Willapa Bay
  - Collect Tidal Data in S. Willapa Bay
  - Shoot a few ducks

Study Site:

Willapa National Wildlife Refuge

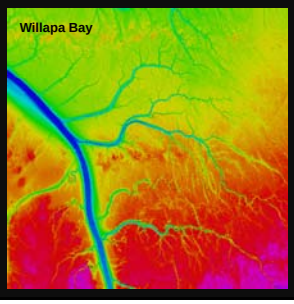


Assessment Recipe:



LIDAR
(Light Detection and Ranging)

Reflectance Imaging



Terrain Data Review

South Willapa Bay Lidar AOI

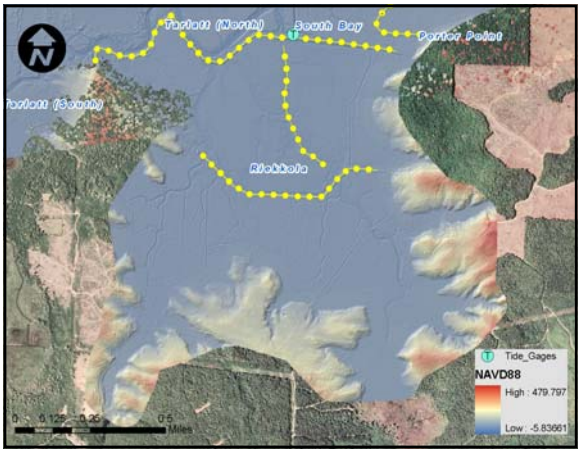
Coastal Lidar Data Collection Challenges

- Tides
- Rain
- Fog
- Wind
- Leaf-Off (winter)

- Window Alignment

Product

- Finally Shot May 27th 2009
- Coverage for 1534 acres (100 m buffer)
- On Low Tide, no fog, wind and rain!
- 2.7 cm Vertical Accuracy
- 1.5 points/m²
- 9.3 million total points



Tidal Assessment Issues

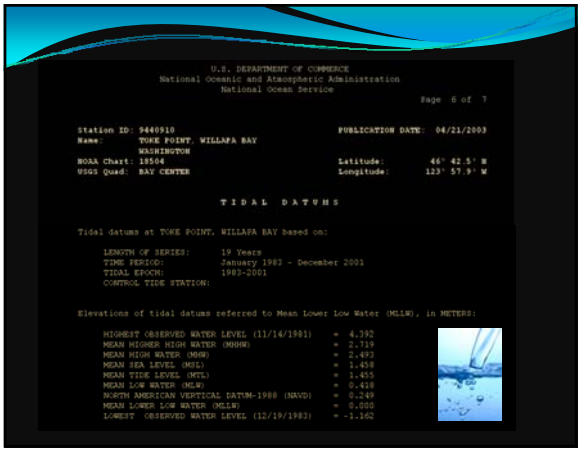
- Four Tidal Stations
  - Independent Tidal Datums
  - MLLW values are directly comparable
  - "Master" gage at the opposite end of the Bay
- No Existing Data for South Willapa Bay
- No Existing Tidal Models
- Storm Surges

Tidal Definitions

- **mean higher high water (MHHW)** — The average of the higher high water height of each tidal day observed over the National Tidal Datum Epoch.
- **mean high water (MHW)** — The average of all the high water heights observed over the National Tidal Datum Epoch.
- **mean lower low water (MLLW)** — The average of the lower low water height of each tidal day observed over the National Tidal Datum Epoch.
- **mean sea level (MSL)** — The arithmetic mean of hourly heights observed over the National Tidal Datum Epoch. Shorter series are specified in the name; e.g., monthly mean sea level and yearly mean sea level

MLLW Tidal Datum - Analysis

- UW Researches build DEM referenced to MLLW (Spartina)
- We Generated a difference DEM
- "Difference" applied to our NAVD88 Datum
- Result: MLLW DEM
  - Can now apply referenced tidal data!
  - Starting point



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service

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Station ID: 9440910
Name: TOKE POINT, WILLAPA BAY
WASHINGTON
NOAA Chart: 18504
USGS Quad: BAY CENTER
PUBLICATION DATE: 04/21/2003
Latitude: 46° 42.5' N
Longitude: 123° 57.9' W

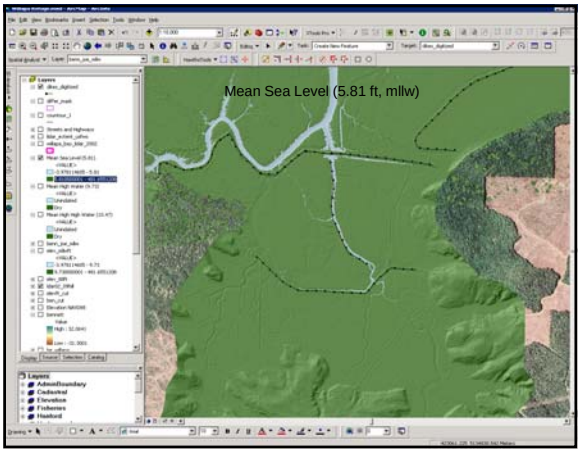
TIDAL DATUMS

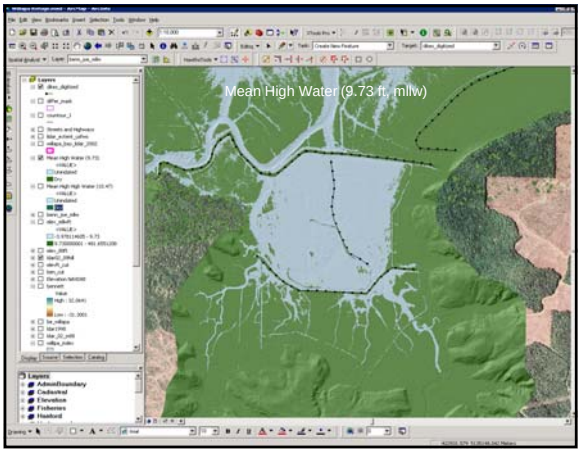
Tidal datums at TOKE POINT, WILLAPA BAY based on:

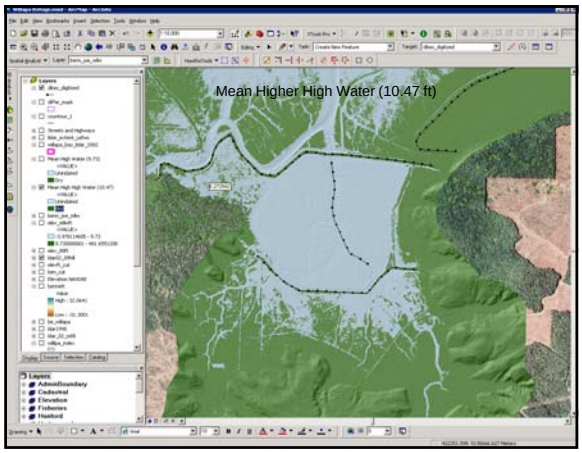
LENGTH OF SERIES: 19 Years
TIME PERIOD: January 1983 - December 2001
TIDAL EPOCH: 1983-2001
CONTROL TIDE STATION:

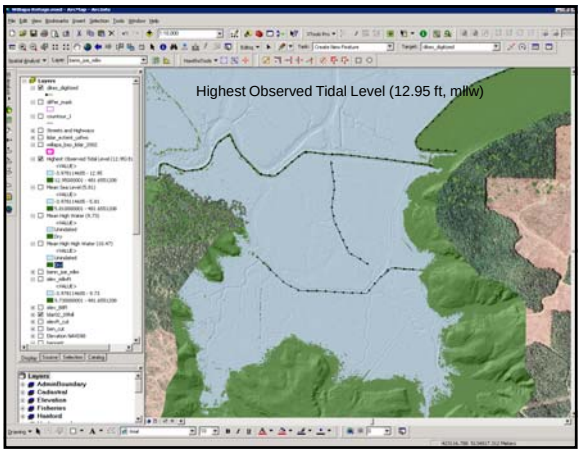
Elevations of tidal datums referred to Mean Lower Low Water (MLLW), in METERS:

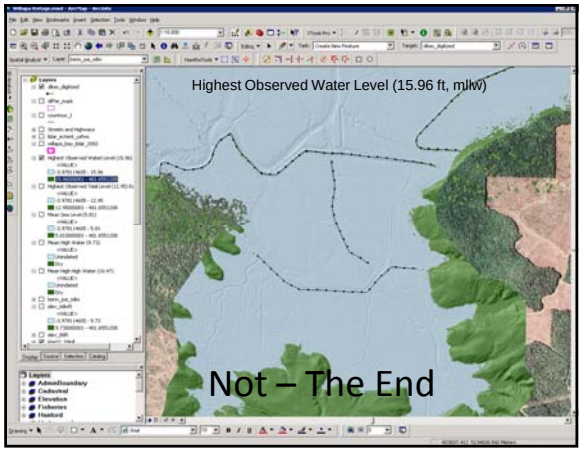
HIGHEST OBSERVED WATER LEVEL (11/14/1981)	= 4.392
MEAN HIGHER HIGH WATER (MHHW)	= 2.719
MEAN HIGH WATER (MHW)	= 2.493
MEAN SEA LEVEL (MSL)	= 1.458
MEAN TIDE LEVEL (MTL)	= 1.455
MEAN LOW WATER (MLW)	= 0.418
NORTH AMERICAN VERTICAL DATUM-1988 (NAVD)	= 0.249
MEAN LOWER LOW WATER (MLLW)	= 0.000
LOWEST OBSERVED WATER LEVEL (12/19/1983)	= -1.162





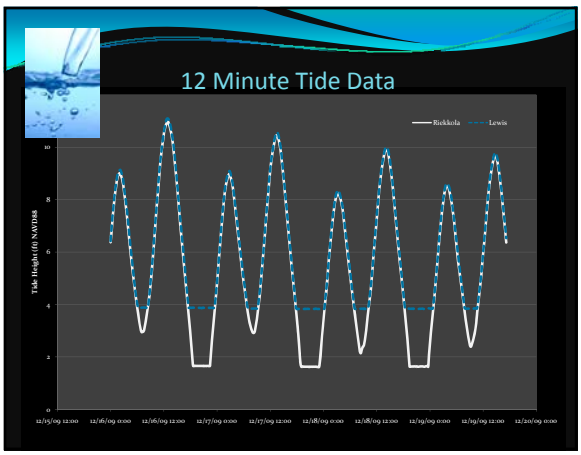

Mean Higher High Water (10.47 ft)


Highest Observed Tidal Level (12.95 ft, mllw)


Highest Observed Water Level (15.96 ft, mllw)
Not – The End


South Willapa Bay
Tide Gages
Tide Gages


Tide Gages


12 Minute Tide Data
Tide Height (ft) NAVD88

The End

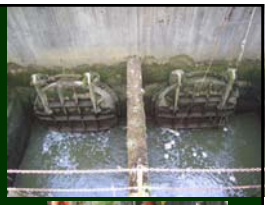
Presentation: Assessment of salmonid populations and passage at tide gates at Tenasillahe and Welch islands. Presented by Jeff Johnson (see Section II.A.3 for discussion).

Lower Columbia River Channel Improvement: Assessment of Salmonid Populations and Habitat on Tenasillahe and Welch Islands

Study goal: Evaluate the overall effectiveness of Tenasillahe island slough habitat restoration (tide gate retrofit)

- **Restoration (Tidegate/Inlet Improvements)**
- **92 acre restoration**

- Goal: Increase access/egress for ocean-type salmonids; improve access for adult salmonids; improve aquatic habitat
- Replace top-hinge steel tide gates with new “fish friendly” tide gates.
- Replace upper-slough culverts with bridges.
- Construction was conducted in summer 2007



Study goal: Evaluate the overall effectiveness of Tenasillahe island slough habitat restoration (tide gate retrofit)

Objectives

- Describe fish community in treatment and reference sloughs;
- Characterize aquatic habitats of treatment and reference sloughs (temperature and DO);
- Assess fish passage conditions;
- Measure juvenile salmonid growth rate and residence time in treatment sloughs.

Approach

Collect data from select sample reaches within treatment and reference sloughs

-measure habitat parameters

-collect fish

Collect tide gate operation/fish passage data at tide gates

-PIT tag technology

-collect fish at tide gates

-depth loggers (differential elevation)

Data collected 2 years pre- and 2 years post-construction

Fish community

- Systematic fish collection within sample reaches (seine and trap)

Number native species (total species)

	Welch	Tenasillahe
2006	9 (11)	3 (9)
2007	10 (12)	3 (8)
2008	8 (9)	5 (11)
2009	10 (11)	6 (16)

Fish community

- Systematic fish collection within sample reaches (seine and trap)

Salmon and Lamprey

Welch

	CK	CH	PCL	WBL
2006	204	2		3
2007	227	17	2	1
2008	175	23		
2009	124	10	2	

Tenasillahe

	CK	CH	PCL	WBL
2006				
2007				
2008	2			
2009	7			

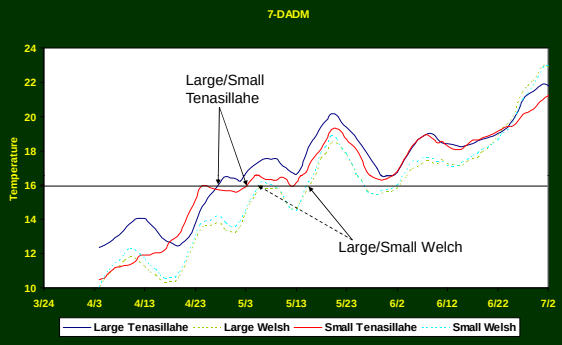
Characterize aquatic habitats

Temperature loggers installed near mouth of each slough

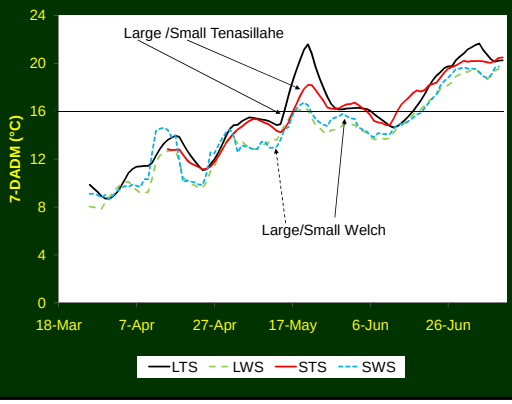
Recorded temperature each hour between March and June

Calculated a seven-day-average-daily-maximum (7-DADM)
-running average of max daily temperature

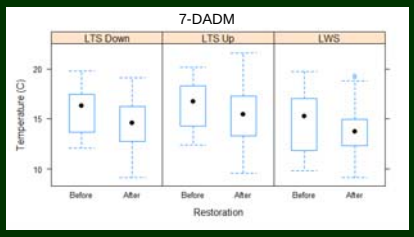
Water temp 2006



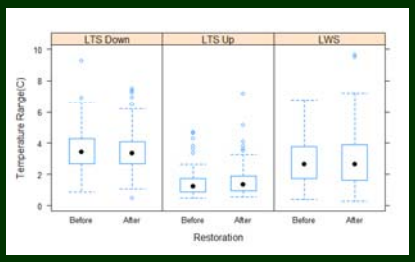
Water temp 2008



Habitat comparisons (Sara Ennis Masters Project PSU)



Habitat comparisons (Sara Ennis Masters Project PSU)



No significant effect of tide gate replacement on water temperature.

Assess fish passage conditions

Used combination of
- depth loggers,
- physical measurements
- PIT tagged fish

To determine tide gate function
- Number of openings
- duration of opening

Assess fish passage conditions

	% low tide *	Openings/day	Hours/day
2006	58%	1.1	3.8
2007	65%	1.2	3.6
2008	64%	1.3	4.4

* Percent of low tides that gate opened

Assess fish passage conditions: Trapping at tide gates

	2007	2008
3-spine Stickleback	77	2495
Bluegill	1	
Chinook Salmon	3	
Coho Salmon	2	
Common Carp	5	15
E. Banded Killifish		15
Largescale Sucker	70	15
N. Pike Minnow	6	11
Peamouth	652	342
Pumpkinseed		2
Sculpin	3	15
Shrimp		30
Unknown Sunfish		5
Yellow Perch		1
Yellow Bullhead		1
Grand Total	819	2947

Juvenile salmonid growth rate and residence

Released PIT tagged hatchery Chinook

-4 locations in Tenasillahe slough

-Operated antenna at tide gates

-Operated traps at tide gates

-Length and weight at release

Juvenile salmonid growth rate and residence

PIT Chinook detected leaving Tenasillahe Slough

	% detected	Median day
2006	74%	26
2007	68%	40
2008	66%	42
2009	53%	52

Juvenile salmonid growth rate and residence

PIT Chinook detected leaving Tenasillahe Slough

Release	Recapture	mm/day	g/day	Specific growth*
4/29	5/27	1.54	0.63	5.44
4/29	5/27	1.61	0.79	5.28
4/28	5/27	1.41	0.74	4.43
4/29	5/31	1.44	0.63	4.71
4/29	6/2	1.59	0.64	5.30
4/28	6/2	1.71	0.51	5.11
4/29	6/2	1.29	0.73	4.02
4/29	6/2	1.62	0.77	5.21
4/29	6/2	1.50	0.65	4.39
4/29	6/10	1.48	0.64	4.14

*percent body weight/day

Summary

- Fundamental difference in fish communities between island sloughs.
  - Higher proportion of non-natives in Tenasillahe Island Slough
- No significant effect of tide gate replacement on water temperature
  - Tenasillahe Slough is still more like “pond” than functioning tidal slough.
- New tide gates may stay open longer but fish access is still limited
  - New gates closed >19 hours per day
  - Fish need to swim against the water flow to access the slough
- Fewer salmon were detected leaving Tenasillahe Slough (PIT) after tide gate replacement.
  - Stayed longer after replacement
- Growth rate is high for salmonids released in Tenasillahe Slough.

Presentation: Hydrology and water resource studies at Malheur NWR. Presented by Dan Craver (see Section II.B.2 for discussion).

Malheur Lake Levels

Monitoring with Satellite Image Archives
(work in progress)

Prepared by Dan Craver, Water Resources Branch, Portland, OR – April 27, 2010

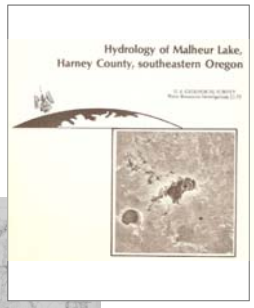
Questions

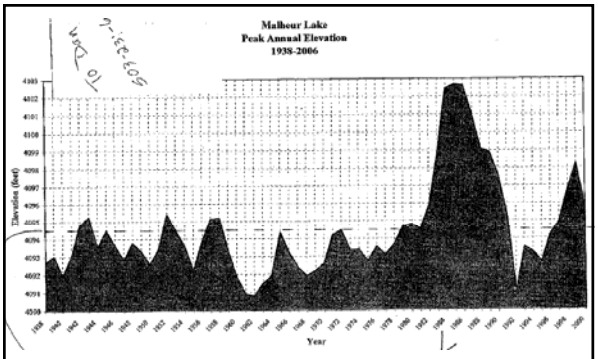
- Can contemporary satellite images and lake-level data be used to update the elevation contour map of the lake bottom, identify low spots, and predict levels in the coming season?
- Is this useful for carp management?

Past Studies

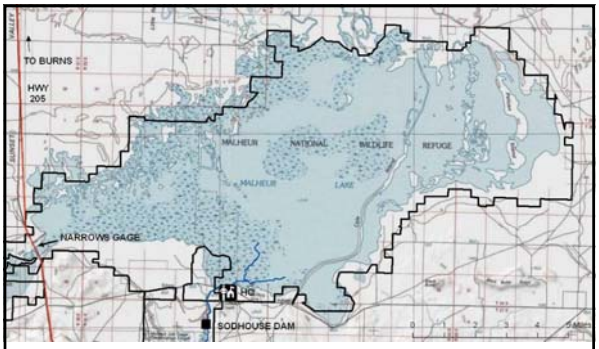
•1975 USGS Report

•1931 Contour Map

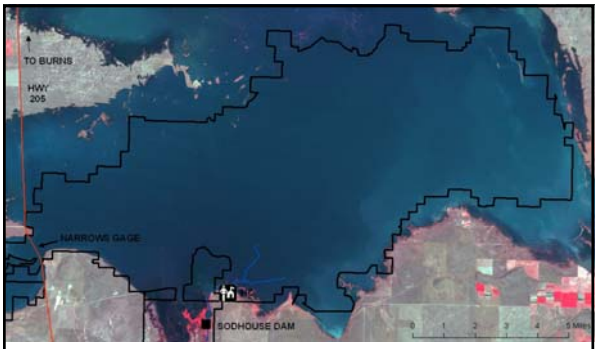




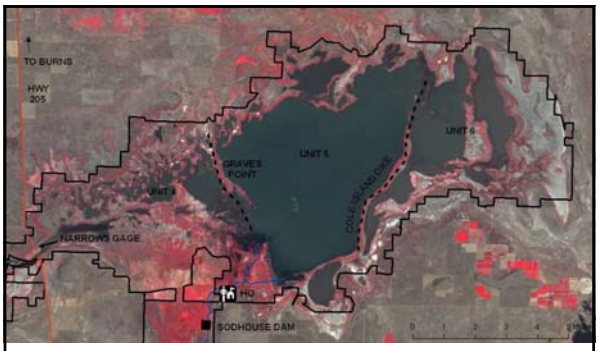
- Lake level period of record 1938 to present, measured at Narrows Bridge
- Note the 1984 flood and the 1992 drought
- Landsat Satellite Imagery period of record (reliably) 1984 to present
- Images every 2 weeks, available within days



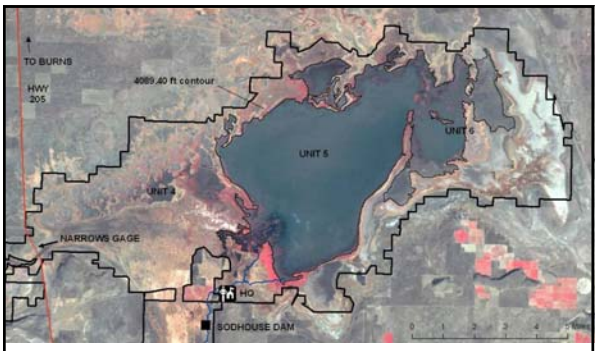
- USGS Topo Map



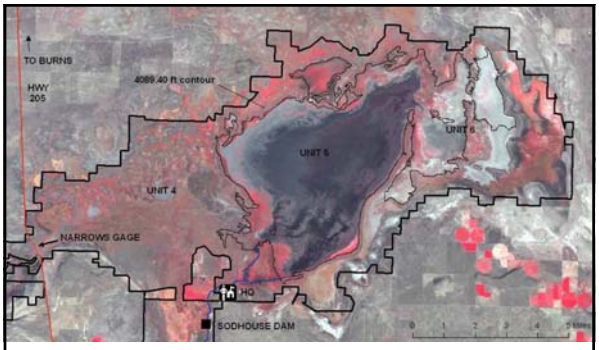
- June 28, 1984
- 4102.42 ft. elevation
- Image nearest to highest recorded lake-level (4102.68 on April 23, 1985)
- We have a collection of images and elevations as the lake receded



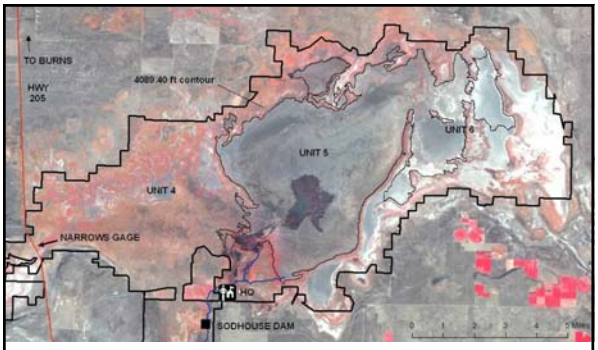
- April 11, 1994
- 4091.45 ft. elevation
- Elevation at which the water in the Lake appears to become disconnected from the water at the Narrows (location of the gage)
- Note dikes and units



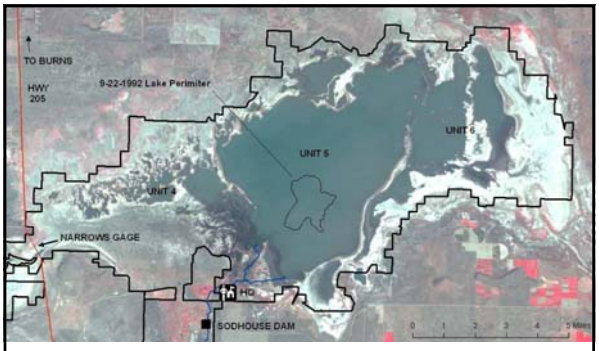
- October 11, 1994
- 4089.40 ft. elevation
- Image nearest to lowest lake-level recorded at the Narrows
- Unit 4 floods at 4092 ft., Unit 6 at 4091 ft. (Duebbert 1969)



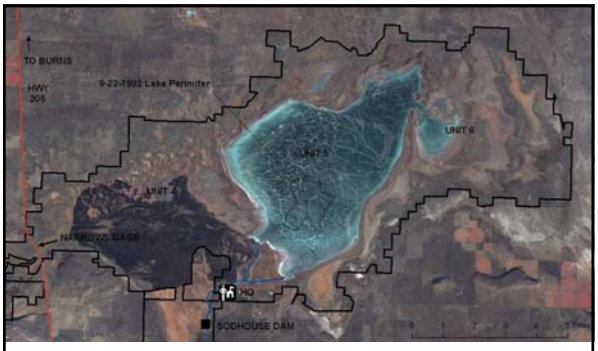
- September 23, 2004
- Unknown elevation
- Note color differentiation within the lake.
- Is this related to depth, turbidity, or vegetation? YES.
- Can this be used to infer water depths or carp habitat?



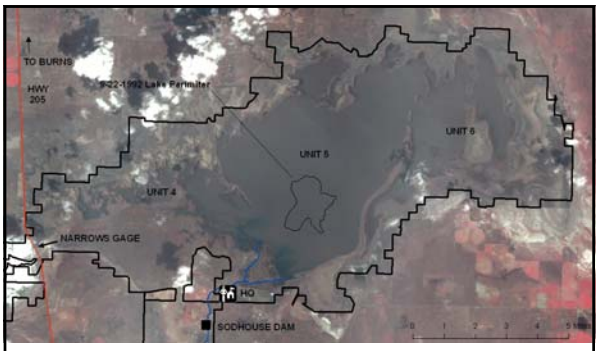
- September 22, 1992
- Unknown elevation. Approximately 1100 acres. (400 acres Ivey et al. 1998)
- Lowest known lake level to be captured by satellite or aerial imagery.
- Will the lake get this low again? What did it look like at the beginning of 1992?



- May 1, 1992
- 4090.35 ft. elevation
- Earliest cloud-free image of the lake in 1992
- Where are we at this year?



- December 10, 2009
- Unknown elevation
- Latest cloud-free image of the lake from last year



- April 17, 2010
- Unknown elevation
- After thawing, the lake level is higher than in December
- This is approximately the same starting lake level as in 1992
- How much water is going to come down the Blitzen River this year?

Fish Creek SNOTEL (Steens Mountain, Harney County)
First of Month SWE Measurements

	Jan	Feb	Mar	Apr	May	Jun
1992	10.7	10.9	15.0	13.6	0.7	0.0
2010	8.8	16.6	20.8	29.9		
Avg 30yr*	11.6	17.6	23.9	30.5	28.6	13.8

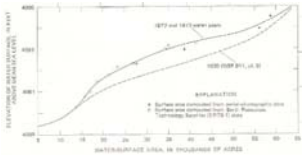
May 1, 1992

April 17, 2010

- While snow pack this year is below average, it is higher than 1992.
- Casual review of 30 years of SNOTEL and lake-level data shows there may be enough snow to maintain a lake-level similar to last year.
- Other factors to predicting lake-level include prior years snowpack, input from the Silvies River, weather (evapo-transpiration rates), and Refuge water management.

Model Assumptions

- Snowmelt is the greatest source to Blitzen
- Blitzen is most significant source to lake (Hubbard 1975)
- Area is related to elevation (Hubbard 1975)



- Narrows gage is good measure of lake-level
  (it really isn't (Hubbard 1975), but its all we got!)

Model Parameters

- Data sets:
  - Lake gage POR = 1938 to current
  - SNOTEL POR = 1939 to current
- Response:
  - September 1st lake-level
- Predictors:
  - April 15th SWE
  - Sum last 2 years SWE
  - May 1st lake-level
  - April 15th SWE X May 1st lake-level
  - Sum last 2 years SWE X May 1st lake-level

Model Results

Recommendations

- If an extremely low lake level is desirable, this may be our year of opportunity. Promote the possibility by maximizing diversion from the Blitzen River.
- Additional lake-level data will allow us to identify the elevation-area-volume relationship using remote methods and could be useful for many purposes.
- When the Lake falls below the level at which it is connected to the Narrows gage, find a method to measure the lake-level every 2 weeks (at least). Possibly by establishing a gage in the Lake or surveying with RTK GPS.

References

- Duebbert, H.F. 1969. The Ecology of Malheur Lake and Management Implications. U.S. Fish and Wildlife Service. Refuge Leaflet No. 412.
- Hubbard, L.L. 1975. Hydrology of Malheur Lake, Harney County, southeastern Oregon. U.S. Geological Survey. Water Resources Investigations 21-75.
- Ivey, G.L., J.E. Cornely, and B.D. Ehlers. 1998. Carp Impacts on Waterfowl at Malheur National Wildlife Refuge, Oregon. Transactions of the 63rd North American Wildlife and Natural Resources Conference.
- http://glovis.usgs.gov/
- http://www.wcc.nrcs.usda.gov/snow/

U.S. Fish and Wildlife Service Water Resources Branch, Portland, OR

Dan Craver | dan_craver@fws.gov | 503-231-2055

Pacific and Southern Pacific Region Water Resources Branch

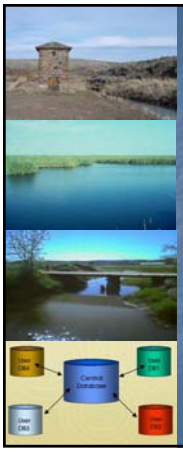
CRFPO Refuges-Fisheries Workshop
April 28, 2010
Vancouver, WA
Prepared by Daniel Craver

Outline

1. WRB Overview
2. Our work with Malheur NWR
3. Lake Level Monitoring Project

Who We Are

- ABA / Engineering, Portland
- 5.6 Hydrologists
- 1 each:
  - Program Analyst
  - Hydro Tech
  - Carto Tech
  - STEP (seasonal)
- "To secure, protect and enhance the water resources required for the Service to achieve its Mission."



What we do

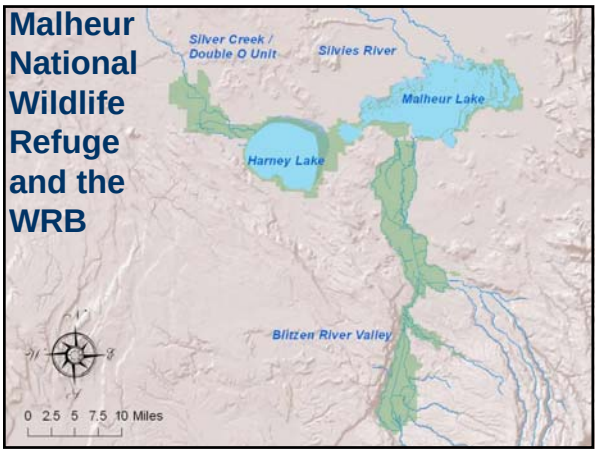
- **Water Rights:**
  Acquire, perfect, and protect through legal compliance and litigation support
- **Water Resources:**
  Address threats and needs, provide assistance to field and Directorate.
- **Water Measurement and Reporting:**
  Maintain R1/8 monitoring network and produce annual water use reports.
- **Water Data Management:**
  Build and maintain spatially enabled databases and information systems

Water Resources Inventory (and Assessment)

- Acronym Alert! – **WRI**
- NWRS Inventory and Monitoring (I&M)
- Refuge Quantity and Quality
- An Inventory – facts, data, maps, links to sources of information (database)
- An Assessment – analysis, professional judgment, threats, and needs (report)

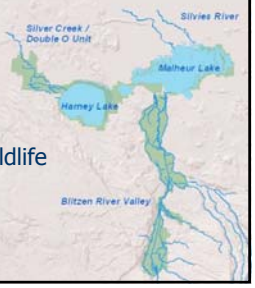
Water Resources Inventory (and Assessment)

- Key Features:
  - Spatially explicit
  - Climate change context
  - National framework
  - Station relevant
- Who?
  - Regional Office hydrologists in FY10
  - I&M staff, contractors, Refuges in FY11(?)
- Where?
  - Great Northern, Pacific Isl. and California LCCs
  - 3 to 5 Refuges



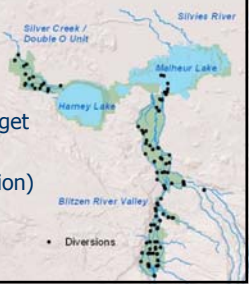
Malheur's Water Rights

- 122 total rights
  - ~49 Irrigation rights (1872 to 2002)
  - ~73 Storage rights
  - (50 Ponds Bill 1993)
- Interface
- New Applications:
  - Winter water right
  - (Permit 54164) 1999
- Transfer use: irrigation > wildlife
- Analysis / Litigation
- Monitoring / Reporting



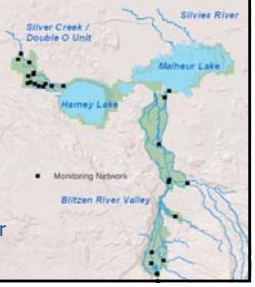
1996 Water Measuring Plan

- State reporting requirements (measure every POD)
- Parties involved:
  - WRB
  - Refuge
  - OWRD
  - Oregon Water Watch
- Simplified strategy = water budget
- Input – Output = $\Delta S/\Delta t$
- Net water use (not gross diversion)
- Established monitoring network



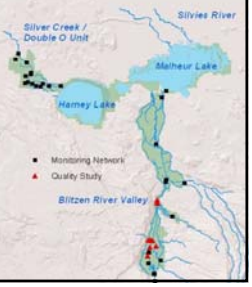
Monitoring Network

- Annual reporting, Refuge management
- 31 active, 9 discontinued
- Double O Unit
  - 14 Pond Staff Gages
  - ~1999
  - Monthly log books
- Blitzen Valley
  - 4 ponds
  - 11 Instream flow
  - Mid-90s
  - Stilling well ½ hourly
  - Wading measurements 4X/year
  - USGS, Historic Gages



2006 Water Quality Report

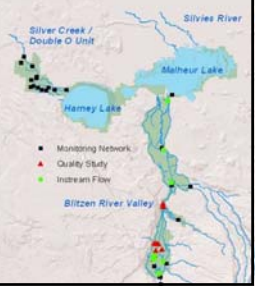
- Stipulation of winter water right, management concern for Redband trout
- Includes hydrology and water balance
- 2 year data collection 13temp + 6perm sites flow/quality
- Mass-balance model
- Critical issues:
  - High temperature
  - low DO
- Mass-balance model:
  - Return flow nutrients not the issue
- Temp modeling:
  - Hot before entering Refuge
- BMPs:
  - Enforce bypass at dams
  - Riparian restoration
  - Reactivate floodplains



Contact: Tim Mayer, tim_mayer@fws.gov

Blitzen Instream Flow Study

- Stipulation of winter water right agreement for minimum flow necessary (i.e. Redband trout)
- 2007 – Present
- ODFW Lead
  - 1D PHABSIM Model
- WRB Project Management
- WRB Data collection
  - Low, mid, high flows (USGS)
  - Habitat typing
  - 32 cross-sections at 8 reaches
  - 2 years
- Preliminary results this Spring
- Expand to summer flows



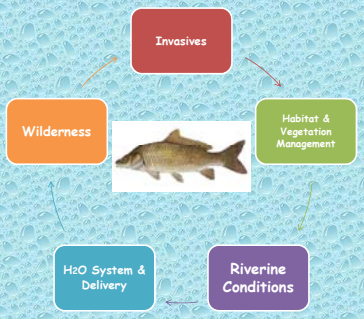
Questions thus far?

Presentation: Aquatic resource issues and applying sound science at Malheur NWR. Presented by Linda Beck (see Section II.B.4 for discussion).

Aquatic Resource Issues & Applying Sound Science at Malheur NWR

Linda Beck, Fish Biologist

CCP Driving Issue



Focal Aquatic Issues

1. Water System Infrastructure
2. Hydrology
3. Habitat and Vegetation
4. Health

Water System Infrastructure

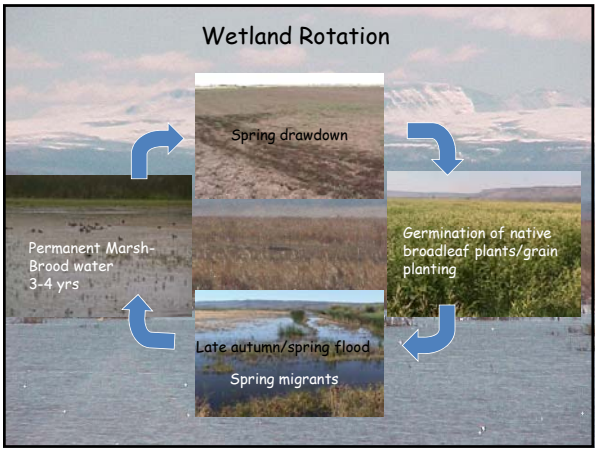
Hydrology

- Geomorphology of the Upper Blitzen River
- GIS mapping and modeling
- RO Water Resources
- Global Climate Change

Habitat & Vegetation



Wetland Rotation



Aquatic Health

- Global Climate Change
- Amphibians
- Mussels
- Species Assemblage Work
- Invasive Carp Control

Global Climate Change

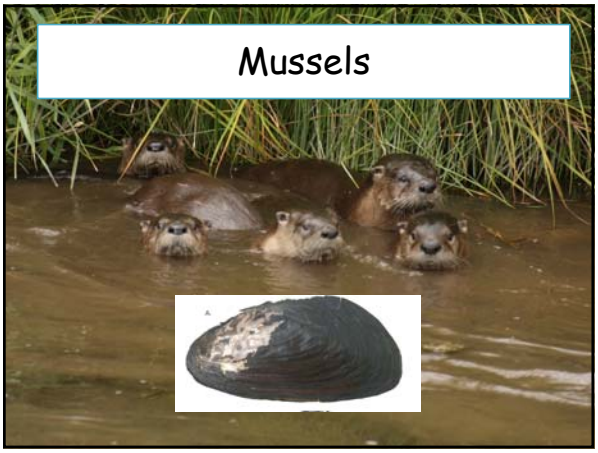


Amphibians





Mussels



Carp management in the past

Water management and hindering carp movement

Invasive Carp Control

Created a list serve:

https://www.fws.gov/lists/listinfo/malheurnwrcarpcoalition

Invasive Carp Control Workshop

Products: Aquatic Health Workgroups

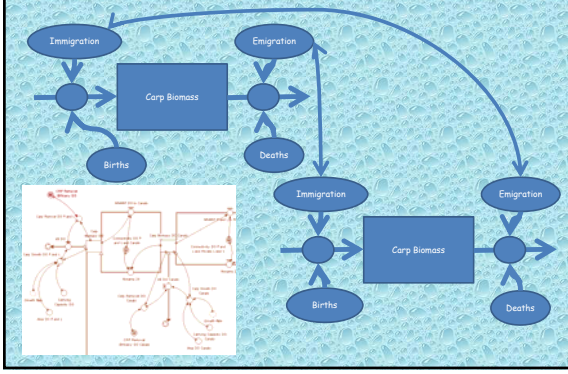
1. Assessment
2. Control
3. Partnership/Funding

Invasive Carp Control

Invasive Carp Control

- Grant Awarded 09-10
  - $12,000 – Attractants, repellants, exclusions & etc
  - $22,000 – Fish passage and screening
  - $10,200 – Screening
  - $6000 – Carp Workshop
  - $5000 – Malheur Wildlife Associates
- Grants Pending
  - $250,000 – Conservation Innovation USDA - NRCS
  - $200,000 – EPA Wetland Program Development
  - Maybe an island…

Large Scale Modeling



Upcoming Events

June - The week of the mussel
- Electrofishing on the Blitzen
- Research by Fly Rod

July- Assemblage Project

August 14 - Invasive Carp Awareness Day



- All activities focused on relating to CCP goals and objectives
- Aquatic Health pushed to forefront
- Huge momentum to do something with invasive carp and get Malheur Lake back
- Get involved!

Malheur Lake is the largest freshwater marsh in the western United States

Any Questions?

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

October 2012