Ecesis

California Society for Ecological Restoration Quarterly Newsletter *Summer Volume 25, Issue 2*

Benefits of Tidal and Estuary Restoration

Juvenile coho salmon captured on February 17, 2015. *Photo by Thomas B. Dunklin.*

The Salt River is a tidally influenced slough tributary to the Eel River estuary located in Humboldt County near Ferndale, California. An intensive multi-stakeholder planning process was started in 1990 with a Coastal Conservancy grant that initiated studies on sedimentation, hydrology, and aquatic and avian biology; the culmination of this process was a multi-phase plan to restore the hydraulic and ecological function of the Salt River. Seventeen fish species were captured during the fall and winter sampling (2014-2015) including the first documentation of longfin smelt in the Salt River. Sampling also confirmed overwintering use by coho salmon, with rapid growth and good condition factors. See article beginning page 2.

by Ross Taylor, SERCAL Board of Directors, Region 7

California has nearly 850 miles of coastline where land meets the Pacific Ocean; but when shorelines along bays, inlets and river mouths are accounted for, California has approximately 3,400 miles of tidally influenced shoreline. Since European colonization of the United States, extensive simplification and degradation of estuaries and tidally influenced shoreline has occurred. For example, in the San Francisco Bay more than 90% of the tidal wetlands and salt marshes were diked, drained and filled.

Estuaries and the lands surrounding them are places of transition from land to sea and from fresh to salt water. Although influenced by tides, estuaries are often protected from the full force of ocean waves, winds, and storms by such land forms as barrier islands or peninsulas. Estuarine environments are among the most productive on earth — supporting unique communities of plants and animals especially adapted for life at the margin of the sea.

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This issue was compiled by Region 7 Director Ross Taylor.

Ecesis is published quarterly by the California Society for Ecological Restoration, a nonprofit corporation, as a service to its members. Newsletter contributions of all types are welcome and may be submitted to any of the regional directors (see page 3). Articles should be sent as a word processing document and accompanying images sent as jpg or tif files.

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Longfin smelt captured on February 17, 2015. *Photo by Thomas B. Dunklin.*

Salt River Restoration in the Lower Eel River Watershed

by Ross Taylor, SERCAL Board of Directors, Region 7

The Eel River is the third largest watershed entirely within California and has a drainage area of approximately 3,700 square miles. The combination of the watershed's geology, location and precipitation has resulted in two notable factoids. First, the watershed has the highest sediment yield per unit area of any watershed in the continental United States — only the Mississippi River delivers more sediment to the sea than Eel River, but it also has a much larger drainage area. Second, the lower Eel River is adjacent to the Mendocino Triple Junction, the convergence of three tectonic plates, including the northern terminus of the San Andreas Fault. The Eel River supports runs of Chinook salmon, coho salmon, steelhead, green sturgeon and Pacific lamprey. Tributaries near the mouth of the Eel River support the southernmost populations of coastal cutthroat trout. Historically, the Eel River had an extensive tidal estuary with numerous side channels, oxbows, sloughs, and perennial and seasonal wetlands. Approximately 5,500 acres of the Eel River's wetlands were converted to agricultural lands as the lower Eel River was settled and populated in the late 1800s.

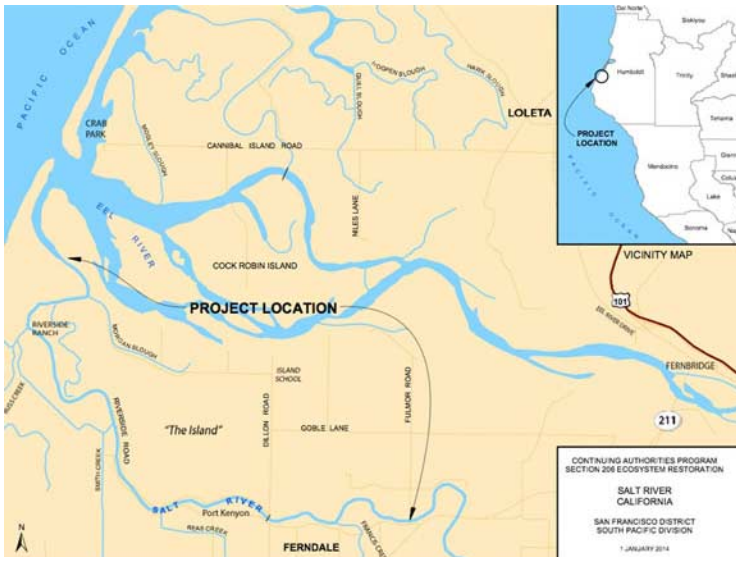

Figure 1. Salt River restoration project location for Phases 1-3.
Map by U.S. Army Corps of Engineers.

The Salt River is a tidally influenced slough tributary to the Eel River estuary located in Humboldt County near Ferndale, California (Figure 1). Salinity in the Salt River varies with the interactions of tides, Eel River flows, and freshwater inflows from its tributaries (Williams, Francis, and Reas creeks). In the mid-1800s, the Salt River channel was sufficiently deep to support ship traffic several miles upstream to Port Kenyon; however, increased sediment delivered from the upper watershed and reduced tidal prism to flush sediment resulted in an aggraded channel with significantly reduced widths and depths. The frequency of flooding in Ferndale and the surrounding farmland progressively increased as the Salt River filled with sediment over the past century, and efforts to alleviate flooding have become a persistent issue. An intensive multi-stakeholder planning process was started in 1990 with a Coastal Conservancy grant that initiated studies on sedimentation, hydrology, and aquatic and avian biology. Stakeholders have included Ferndale residents and dairy farmers, as well as city, county, state, federal, and tribal entities. The culmination of this process was a multi-phase plan to restore the hydraulic and ecological function of the Salt River.

Near the Salt River mouth, the 420-acre Riverside Ranch was purchased from an interested seller and the title is now held by the California Department of Fish and Wildlife (CDFW) (Figure 1). Phase 1 of the Salt River Restoration Program was focused on Riverside Ranch parcel. In 2013, the levee and tide gate at the Salt River's confluence with the Eel River were removed and upstream slough channels were excavated to meet the following objectives: (1) increase hydrologic function to the lower 2.5 miles of the Salt River; (2) provide access for re-colonization of the lower Salt River by native fish species; and (3) improve habitat for waterfowl and other avian species. The interchange of flow between the Eel River estuary and the lower Salt River was

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The Benefits of Tidal and Estuary Restoration *continued from page 1*

Estuaries are also important habitats for juvenile salmon and steelhead as they transition from freshwater into the marine environment. In some larger watersheds, a single species of salmonid may express varying strategies of estuarine use, from relatively quick movement through the system to spending several months foraging and putting-on additional growth before entering the ocean. Conversely, many marine organisms — including many commercially important species of fish — depend on estuaries at some point during early life-stage development. Because they are biologically productive, estuaries also provide ideal areas for migratory birds to rest and re-fuel during their long journeys.

Estuaries provide humans with a suite of resources, benefits, and services. They provide places for recreational activities, scientific study, and aesthetic enjoyment. Estuaries have important commercial value and their resources provide economic benefits for tourism, fisheries, and recreational activities. The protected coastal waters of estuaries also support important public infrastructure, serving as harbors and ports vital for shipping and transportation.

Estuaries also perform other valuable services. Water draining from uplands carries sediments, nutrients, and other pollutants to estuaries. As the water flows through wetlands such as swamps and salt marshes, much of the sediments and pollutants are filtered out. This filtration process creates cleaner and clearer water, which benefits both people and marine life. Wetland plants and soils also act as natural buffers between the land and ocean, absorbing flood waters and dissipating storm surges. This protects upland habitat as well as valuable real estate from storm and flood damage. Salt marsh grasses and other estuarine plants also help prevent erosion and stabilize shorelines.

Although tidal and estuary restoration projects are occurring throughout California, this issue of Ecesis is focused on several restoration efforts located in Humboldt County. Two projects are located in the Humboldt Bay watershed, on Salmon Creek (South Bay) and McDaniel Slough (North Bay). The third project is an ongoing, multiphase program to restore the tidal function of the Salt River located in the lower Eel River watershed near Ferndale.

Missed the news at the conference?

Susan Clark Coy, our fearless Admin Director for Life (or so we thought), is riding off into the sunset for her well-deserved and (we hope) highly enjoyable retirement.

Yikes! What's going to happen now?

Well, for starters, the admin office is moving to the far east side of California's desertlands, otherwise known as Tucson, Arizona, where long-time Publications Director and SERCAL Enthusiast Julie St. John will be assisting the Board in its continuing efforts to bring you great conference and networking/training opportunities.

See you soon!

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Salt River Restoration in the Lower Eel River Watershed

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restored in October of 2013 following completion of Phase 1 excavation and other construction activities (Figure 2). The purchase of the Riverside Ranch allowed the re-opening of two main sloughs and numerous secondary channels. Phase 2 was completed during the summer and fall of 2014, with another 1.8 miles of Salt River channel restored up to the Dillon Road Bridge. Phases 3 and 4 will eventually reconnect Francis and Williams creeks to the Salt River channel, for a total of seven miles of restored channel.

During the spring and summer of 2014, fish sampling was conducted in the lower Salt River by CDFW, the Humboldt County Resource Conservation District, and Humboldt State University to monitor the presence and distribution of fish within the recently restored main channel and sloughs located on the Riverside Ranch. This sampling captured fish with seine nets and minnow traps at 11 established sites distributed throughout the main channel and slough networks. All of the spring and summer sampling was conducted at low tide when water was concentrated in the channels. These initial sampling efforts documented numerous fish species utilizing the newly accessible habitat, including ESA-listed species such as coho salmon, tidewater goby and Chinook salmon.

The next phase of Salt River fish sampling occurred during the fall and winter of 2014-2015 and NOAA Fisheries requested that both low and high tide sampling were conducted. Ross Taylor and Associates (RTA) started this sampling effort in November of 2014 and sampled monthly through March of 2015. RTA conducted low tide sampling at the 11 sites established by CDFW, using methods consistent with those utilized by CDFW. RTA was also tasked with developing a high tide sampling protocol for the project. At high tide, increased water depths and channel widths in the Salt River's main channel dictated using different sampling gear than wading with the 30 foot seine net. A kayak was used to set a 100-foot long seine net that was six feet tall and had ¼-inch mesh. Seventeen fish species were captured during the fall and winter sampling, including the first documentation of longfin smelt (see photo, page 2) in the Salt River. The fall and winter sampling also confirmed overwintering use by coho salmon (see photo, page 1), with rapid growth and good condition factors. Fish sampling will continue in 2015 and 2016, extending farther upstream as subsequent Phases of the restoration project are completed.

Figure 2. Aerial view of the Riverside Ranch, immediately after completion of the Phase 1 excavation and construction, South Slough is in the foreground.

Avian surveys have documented more than 100 species utilizing the restored habitat on the Riverside Ranch. The species diversity is greatest during the winter months when migratory birds are present, including cackling geese, Canadian geese, and 12 species of dabbling and diving ducks. The sloughs, side channels, and tidally flooded flats provide ample habitat for wading species. Resident raptors include northern harrier, white tailed kite, red tailed hawk, merlin and American kestrel.

While the relatively immediate use of the restored estuary and wetland habitats by fish and avian species is encouraging, the long-term functionality of the restored Salt River channel to effectively transport sediment and reduce chronic flooding has yet to be determined. The channel's low gradient, the watershed's high sediment load, and the backwatering effect of high tides and periodic elevated Eel River flows are all factors being considered during project design as the program enters into its final phases.

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Salmon Creek Estuary Restoration and Monitoring Results

by Laura Bridy, Pacific Coast Fish, Wildlife and Wetlands Restoration Association, with contributions from Michael Love and Associates and California Department of Fish and Wildlife

A collaborative effort to restore the Salmon Creek Estuary at Humboldt Bay National Wildlife Refuge, south of Eureka, California, has come a long way and led to interesting results. This article describes the process of recreating a diversity of estuarine habitats within an altered landscape, some results of biological and water quality monitoring, and drought-related observations.

Over a century ago, the complex network of tidal channels and marshes of Humboldt Bay was diked and drained for cattle grazing. Meandering streams were consolidated, straightened, and greatly reduced while marshlands were drained. Salmon Creek, the largest tributary to Humboldt Bay, was ditched and the channel isolated from tidal influence of the bay using tide gates. In following years the drained marsh plains subsided and the coho salmon runs plummeted. Today, about 90% of Humboldt Bay's historic salt marsh and estuarine habitat has been lost.

Research and monitoring in Humboldt Bay and elsewhere has increasingly demonstrated the importance of tidal estuaries and connected low gradient freshwater wetlands, side channels, and other slow-water areas in the life history of coho salmon and other sensitive fish species such as tidewater goby, steelhead and coastal cutthroat trout.

Salmon Creek Estuary was incorporated into Humboldt Bay National Wildlife Refuge in the 1980s. In 2001, restoration planning began for Salmon Creek Estuary on the Refuge. The goals were to improve the structure, function, and diversity of the degraded estuary while working within the physical constraints and multi-species management objectives of the Refuge. These goals were pursued through a collaborative effort in multiple phases.

Phase I

As part of the first phase of restoration, the antiquated tide gate system in lower Salmon Creek was modernized in an effort to improve estuary habitat and fish passage. For example, an additional connection between Humboldt Bay's Hookton Slough and Salmon Creek was restored with the construction of a major new tide gate in an existing levee. Also, several small outmoded tide gates were replaced. The new adjustable tide gates are designed with larger openings to increase flow capacity, decrease water speed, and allow for unimpeded fish passage. They also are designed to greatly increase tidal circulation into and out of the estuary, which is a key to improving habitat by improving water quality (increasing oxygen content) and flushing sediment. Increased sediment transport to the ocean is expected to restore channel capacity — by widening and deepening channels — and decrease flooding upstream. Water circulation improvement is designed to allow additional seasonal rearing of salmonids in the lower 8,500 foot reach of Salmon Creek. Also, the muted tide cycle helps enlarge the size of this vital South Humboldt Bay estuary. The upper boundary of tidal influence moved upstream into the Refuge and increased the acreage of tidal wetlands by another 13 acres. Construction and installation of the new tide gates was performed by Nehalem Marine. Pacific Coast Fish, Wildlife and Wetlands Restoration Association (PCFWWRA) provided much of the project management and grant administration. Funding for this phase was provided by California Department of Fish and Wildlife's (CDFW) Fisheries Restoration Grant Program and California Coastal Salmon Recovery Program, US Fish and Wildlife Service (USFWS) Coastal Program, Humboldt Bay National Wildlife Refuge and California Coastal Conservancy.

Phases II & III

The second and third phases, from 2010-2013, restored 29.79 acres of estuarine habitat, including:

- Approximately 10,500 feet of meandering estuarine channel and six tidally influenced off-channel and side-channel ponds were constructed in order to restore habitat in an area that was historically ditched and drained for agriculture. Most of

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A construction sequence showing a section of field being restored to estuarine channel.

Salmon Creek Estuary Restoration and Monitoring Results *continued*

these are in the upper reach of tidal influence and include a stable channel form, complexity, sinuosity, and efficient routing of sediment and flood waters. An extra upstream pond was added to Phase III because biological monitoring showed that coho salmon preferred the ponds furthest upstream with the lowest salinities.

- Nearly 15.5 acres of subsided lands were raised to tidal salt marsh elevation with spoils generated from channel and pond excavation.
- Sixty-one large wood structures were installed in the channel and ponds to provide channel structure and fish habitat diversity.
- A fish passage structure was constructed in the Refuge's passive water delivery system to reduce existing stranding potential and allow access to suitable habitat in the northern part of the Refuge during higher water events.
- Riparian vegetation was planted near the newly constructed channels and ponds as appropriate.

Funding and staff expertise was provided by the USFWS Coastal Program. Substantial grant funding was also provided by CDFW's Fisheries Restoration Grant Program, National Fish and Wildlife Foundation, and Ducks Unlimited through a North American Wetland Conservation Act grant. Contributions of equipment and operators from the USFWS Maintenance Action Program reduced the amount of grant funding needed. Project Partners also included: PCFWWRA, Michael Love and Associates, Trinity Associates Environmental Planning, Pacific Watershed Associates, Humboldt Fish Action Council, California Conservation Corps, Restoration Forestry, Wallace Structures, SHN Consulting Engineers & Geologists Inc., Wayne Bare Trucking, Frank Zabel Trucking, Wendt Construction, California Redwood Company, and planting volunteers.

Monitoring/Results

In 2005, CDFW began sampling the stream-estuary ecotone of Salmon Creek to document its use by juvenile salmonids and to assess estuarine habitat restoration. The monitoring has consisted of bi-weekly fish and water quality sampling. CDFW captures fish using seine nets and minnow traps baited with frozen salmon roe. They also operate PIT tag antenna stations to remotely detect PIT-tagged salmonids moving in and out of ponds. Water quality monitoring has involved collecting water temperature, salinity, and dissolved oxygen data throughout the water column with a hand-held Yellow Springs Instruments Professional Plus meter at standard locations in the main Salmon Creek channel and off-channel ponds.

CDFW's monitoring has found that during the late summer and early fall the Salmon Creek stream-estuary ecotone has high water temperatures and salinity and relatively low dissolved oxygen making it unsuitable for juvenile salmonids. Then, in average or wetter rainfall years, increased stream flows flush saltwater from the stream-estuary ecotone during the winter and spring and create more preferred freshwater habitat for juvenile salmonids. When flows begin to drop in the spring and brackish water begins to move into the stream-estuary ecotone, there is usually a surface freshwater layer providing habitat for juvenile salmonids.

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Salmon Creek Estuary Restoration *continued*

Eventually stream flows drop to low levels by late spring resulting in brackish water conditions throughout the stream-estuary ecotone. Virtually all rearing juvenile salmonids leave the stream-estuary ecotone by June.

According to CDFW's report in 2013, based on data from Salmon Creek and other Humboldt Bay tributaries through 2012, mean growth rates of juvenile salmonids in the ecotone were typically 0.15 to 0.25 mm/day which was higher than growth rates observed by other projects in stream habitat upstream of the ecotone. Juvenile salmonids sought out freshwater rather than brackish water habitat while rearing in the ecotone. Juvenile salmonids, especially coho salmon, utilized newly constructed off-channel ponds as soon as they were completed and fall and winter rains increased stream flows and converted the ponds to primarily freshwater habitat. CDFW concluded that the stream-estuary ecotone provides productive rearing habitat for juvenile salmonids, especially over-winter habitat for juvenile coho salmon.

Aerial photo after Phases I-III were completed. The new meandering channels and ponds are in the foreground and center, salt marsh in the background. Humboldt Bay and the Pacific Ocean are in the very back. *Courtesy Dave Kenworthy, 2014.*

During the recent drought, monitoring results changed, and the typical estuary ecotone dynamic described above altered. More juvenile coho were captured in 2011/2012 than in subsequent drought years. For much of 2014, the ongoing drought resulted in unsuitable water quality for juvenile salmonids in the Salmon Creek ponds. During 2014, water temperature and salinity were higher than previous years, especially during the spring to early summer rearing period. Also, dissolved oxygen was generally lower in 2014 than previous years. These conditions were likely caused by the drought resulting in lower stream flows entering the Salmon Creek stream-estuary ecotone that allowed saltwater to intrude into Salmon Creek at higher concentrations and for longer periods of time. For example, in 2012, the last average rainfall year, freshwater conditions persisted throughout the water column through May, and surface freshwater was still present in June, but in 2014 the water column was stratified by April and brackish water was present throughout the water column by May. By August 2014 CDFW detected hyper-saline conditions of 38 ppt throughout the water column of Salmon Creek. This was the highest salinity reading detected since CDFW began sampling in 2005. Even after rainfall started in November, a layer of brackish water with low dissolved oxygen remained along the bottom of the ponds until at least mid-December.

CDFW captured and detected substantially less juvenile coho salmon in the Salmon Creek stream-estuary ecotone in 2014 compared to 2012, when habitat conditions were most favorable to support them (15 captured or detected by PIT tag in 2014 versus 170 in 2012). From July to December 2014, no salmonids were captured. But on the bright side, the restoration project appears to be benefiting federally listed as endangered tidewater goby and a variety of other coastal creatures which thrive in brackish conditions. From July to December 2014, 1,618 tidewater goby as well as top smelt, surf smelt, shiner surfperch, threespine stickleback, bay pipefish, Pacific staghorn sculpin, prickly sculpin, unidentified juvenile sculpin, plainfin midshipman, starry flounder, juvenile Dungeness crab, and yellow shore crab were detected in the Salmon Creek Estuary project area.

Many other case studies discuss the effect of the drought on stream flows and water temperature but this study is one of the few to document the effect of the drought in stream-estuary ecotone habitat, primarily in the form of higher concentrations of water salinity and the increased duration of brackish water in the stream-estuary ecotone. The monitoring has emphasized the importance of restoring a variety of habitats and allowing species to move in space and time to find their niche, as conditions change. This project emphasizes that a multi-species approach in restoration is important, as well as long-term monitoring program.

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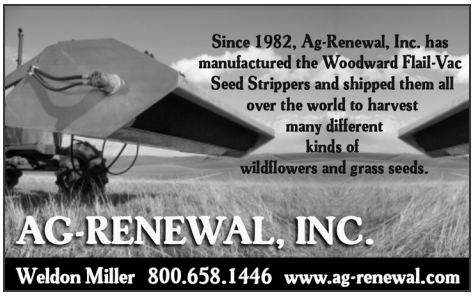

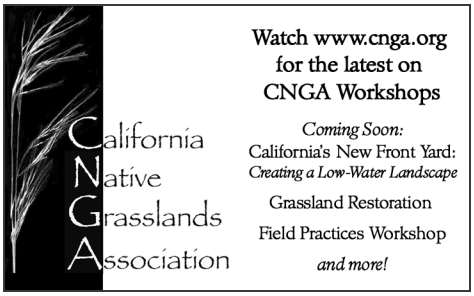

McDaniel Slough Tidal Restoration in Janes Creek Watershed, Humboldt Bay, CA

by Julie Neander, Environmental Programs Manager for the City of Arcata

The City of Arcata's environmental restoration projects began in the early 1980s with the creation of the Arcata Marsh and Wildlife Sanctuary. The original 75 acres of the Arcata Marsh and Wildlife Sanctuary, including 30 acres of freshwater wetlands, was completed in 1981. Since that time, the City has actively worked to enhance wetland and creek habitats within city limits.

In the 1990s, the City of Arcata partnered with the California Department of Fish and Wildlife (CDFW) and the State Coastal Conservancy to plan to restore and enhance nearly 300 acres of coastal and riparian wetland habitats on the northern portion of Humboldt Bay. Humboldt Bay is second only to San Francisco Bay in terms of the numbers and diversity of migratory water birds that winter along California's coastal Pacific Flyway. The McDaniel Slough project is significant — the site is not constrained by the railroad or Highway 101 which dikes off most of the Bay's former tidelands — because it provides one of the best opportunities on Humboldt Bay to restore coastal landscape processes of former tidelands on the Bay and the McDaniel Slough estuary. In 2013, more than fifteen years later, the City and CDFW along with numerous funders celebrated the completion of the McDaniel Slough Restoration and Enhancement Project.

The goal of Arcata's restoration program is to modify disturbed ecosystems so that they more closely resemble a desired condition — usually one that is matched to a reference condition or by retrospective work looking at old historic maps and photos. Key to the success of habitat restoration efforts in Arcata is having a wealth of local expertise to draw upon as well as involvement of the citizenry. Participation in restoration projects helps bring the community together and create a social identity, sense of place and local pride in their community. Funding from the Coastal Conservancy, CDFW, Natural Resources Conservation Service, US Fish and Wildlife Service, Caltrans, Wildlife Conservation Board and many local non-profits and businesses made the McDaniel Slough project possible.

McDaniel Slough project objectives included (1) maximize restoration of a large area of tidal marsh habitat dominated by native vegetation; (2) provide unimpeded access for anadromous fish migration between Humboldt Bay, McDaniel Slough and Janes Creek; (3) create a tidal channel system that maximized estuarine fisheries habitat in large, high-order, sub-tidal channels; (4) provide connectivity of habitats using "eco-levees" to create a gradation between the salt marsh/mudflat habitats and uplands; (5) provide connectivity with existing habitats which also include palustrine freshwater, riparian, and brackish wetlands at the Arcata Marsh and Wildlife Sanctuary and CDFW's Mad River Slough Wildlife Area; (6) alleviate rural and urban flooding due to tide gate restrictions and chronic channel aggradation; and (7) provide opportunities for public access, recreation and education.

Implementation of the McDaniel Slough project created a self-sustaining estuarine tidal marsh system through restoration of natural geomorphic and biologic processes. The project removed tide gates on McDaniel slough to provide access for anadromous fish between Humboldt Bay and Janes Creek. Design features included salt marsh, mudflat, tidal channels, brackish and freshwater habitats and uplands. Excavation to create or enhance brackish and freshwater habitats provided the fill for the levees that were constructed to protect adjacent non-project lands.

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Left Summer 2011 CDFW freshwater and brackish wetland & and levee construction. *Photo courtesy M. VanHattem (CDFW).*
Right McDaniel Slough post-breach on December 1, 2013 showing tidal action. *Photo by Dave Kenworthy.*

McDaniel Slough Tidal Restoration

continued

Trails were constructed on the City-owned levees providing opportunities for public access, education, and recreation.

Levee design included "eco-levees" with ten-to-one slopes on the bayward side to create a transition from low marsh to high salt marsh and upland habitat. Levee elevations of +9.0 feet NGVD accounted for sea-level rise and protection against the 100-year extreme tide. Heavy equipment (scrapers, excavators, backhoes) excavated and loaded material for levee construction and to build up the marsh plain. Excavation of tidal channels created or enhanced permanent and seasonal freshwater and brackish wetland habitats. The seasonal and brackish wetlands were excavated 12 to 18 inches to create optimal elevations for colonization by high salt marsh vegetation including rarer species such as Humboldt Bay owl's clover and Point Reyes bird's beak.

Tidewater goby enhancements included US Fish and Wildlife Service designs for restored tidal channels. Drainage swales and tide gates were used to provide connectivity through seasonal fresh and brackish habitats to tidal areas. A water control structure between the seasonal fresh and brackish wetlands west of the levees insured freshwater wetlands could dry out during the summer season to prevent cattail growth and discourage mosquito breeding.

When levee construction, channel enhancement, and culvert and tide gates work was completed in September of 2013, a full breach of McDaniel Slough occurred at low tide. The breach was done over a series of low tides excavating as much material as possible the first day while leaving enough to prevent overtopping by the intervening high tides. After three days of incremental excavation, the tide gates and culverts were removed and — for the first time in decades — McDaniel Slough flowed unimpeded to Humboldt Bay. Prior to the breach, monthly fish and water quality sampling was conducted to try to determine what resident/anadromous juvenile salmonids and other fish species utilized the estuary and lower watershed for rearing. Monitoring included water quality to make sure it was adequate to support juvenile salmonids. Pre-breach results showed

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McDaniel Slough, low tide, post-breach in May of 2014.
Photo by Dave Kenworthy.

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McDaniel Slough Tidal Restoration *continued*

poorer water quality and no fish utilization in the lower reaches of McDaniel slough. In the freshwater reaches of Janes Creek/McDaniel Slough, water quality was good with documented use by coastal cutthroat trout. Post-breach water quality improved throughout the system and monthly monitoring documented utilization by juvenile coho salmon, tidewater goby, Pacific staghorn sculpin, surf smelt, prickly sculpin and other marine species. Bird utilization of the area has also been monitored since 2009 with an increase in the number of species using to the area. CDFW's 2015 monitoring found 35 species and total numbers of over 8,000 birds utilizing the restored area.

The success of the ecosystem approach in restoring and enhancing Arcata's aquatic resources depends upon the community's interest and involvement as well as a degree of ecological awareness and understanding by the citizenry and elected officials. Even if not fully successful from an ecological perspective, the process of attempting to reverse past environmental impacts will have a lasting and profound impact on the people who choose to be involved and make the effort. For the McDaniel Slough project, the social dimensions of restoration are an important component to the overall project.

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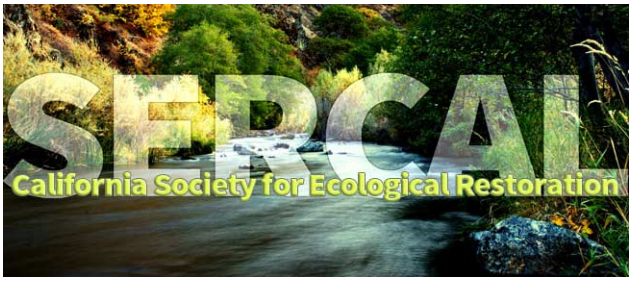

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