

Elwha Nearshore Update

AN ANNUAL NEWSLETTER OF THE ELWHA NEARSHORE CONSORTIUM
SUMMER 2011

We've had a number of updates to our Fall 2010 newsletter. Additions include a draft final proceedings from our February 2011 Elwha Nearshore Consortium 7th annual workshop, edited by Tara Morrow, WWU; the addition of Samantha Rich's work on large woody debris (LWD) in the Elwha nearshore (Ms. Rich is a graduate student with University of Illinois that many of you met at the February workshop), and the additions of Mark Titus, and Cecilia Fie, film makers now focusing on the Elwha project, including the nearshore.

Also of note: there will be a weeklong festival the week of 12-17 September 2011 to celebrate that project kickoff. Highlights include a two day science conference on 15-16 September. Available details and contact information for these updates-and more- are found at <http://celebrateelwha.com/> and included in the body of this update. Exciting times....

Welcome to the Summer 2011 *Elwha Nearshore Update* newsletter which summarizes current activities focusing on the Elwha nearshore. It is sponsored by the Elwha Nearshore Consortium, an informal workgroup formed in spring 2004 that is dedicated to understanding and promoting the nearshore restoration associated with the upcoming Elwha dam removals. The newsletter provides updates on various activities since the last edition (October 2010) and catalogs ongoing projects. Previous editions of the newsletter and proceedings from our original spring 2004 nearshore workshop can be found on the Clallam Marine Resources Committee website, <http://www.clallammrc.org>.

The Coastal Watershed Institute (CWI), provides workgroup and newsletter coordination, and partners with the Lower Elwha Klallam Tribe (LEKT), Clallam Marine Resources Committee (MRC), Olympic National Park (ONP), Peninsula College (PC), and others in promoting the work and communication of the Elwha Nearshore Consortium. Information on the Coastal Watershed Institute can be found at www.coastalwatershedinstitute.org. For details on the Clallam MRC contact Andrew Shogren, committee chair, ashogren65@yahoo.com, and Cathy Lear, Clallam County, Clear@co.clallam.wa.us/ 417. 2423. For information on the Elwha Tribe, contact Matt Beirne, 360.457.4012 x12; matt.beirne@elwha.nsn.us. For information on Elwha Nearshore Consortium, or questions or comments about the newsletter, contact Anne Shaffer, Coastal Watershed Institute, anne.shaffer@coastalwatershedinstitute.org. Information on the Elwha dam removals can be found at the Elwha webpage <http://www.nps.gov/oly/elwha/home.html>.

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Workgroup Announcements

The Elwha dam removal project officially kicks off on 17 September 2011. The Olympic National Park, Lower Elwha Klallam Tribe, and partners are sponsoring a weeklong festival the week of 12 September 2011, including a two day science conference on 15-16 September 2011. The two day science event will include a key note and panel discussions as well as a technical presentations and an evening event. The Clallam Marine Resources Committee (MRC) has dedicated student funds for conference proceedings. For science conference details and to register see <http://elwharesearchconsortium.wildapricot.org> . Details will also be posted by email to the Elwha Nearshore Consortium (ENC) as they are available.

The last 2011 Elwha Nearshore Consortium workshop, co-sponsored by the Coastal Watershed Institute, Olympic Peninsula Surfrider Foundation, Clallam County MRC, Peninsula College, and Lower Elwha Klallam Tribe, was held in Port Angeles at the Peninsula College 14 February 2011. It was one day venue with technical presentations during the day and the 'Elwha Conversations' public evening meeting, on the history of the Elwha nearshore (both Tribal and Non-Tribal) by Jacilee Wray, Olympic National Park, and Jamie Valadez, Lower Elwha Klallam Tribe. Proceedings of the workshop, edited by Tara Morrow, are available on the Coastal Watershed (www.coastalwatershedinstitute.org), Peninsula College (www.elwhainfo.org) and WWU Huxley Program for the Environment web pages. Contact Anne Shaffer, CWI, anne.shaffer@coastalwatershedinstitute.org, for additional details.

Dam Removal Project Update

Significant milestones continue to be reached as we count down the months to the largest dam removal in U.S. history. The dam removal contract was awarded in August to Barnard Construction of Bozeman, Montana for a total of \$26.9 million and removal of the Elwha and Glines Canyon dams will begin in September 2011.

Earlier this year, two water treatment facilities were completed and will protect the City of Port Angeles' municipal and industrial water supplies before, during and after removal of the two dams. The Port Angeles Water Treatment Plant, designed to treat up to 10.6 million gallons daily, began providing clean water to Port Angeles residents in February 2010. The Elwha Water Facilities protect the City's industrial water supply, the Washington Department of Fish and Wildlife's fish rearing channel and the Lower Elwha Klallam Tribe's fish hatchery and was completed ten months ahead of schedule in April 2010.

The \$16.9 million replacement hatchery facility on the Lower Elwha Klallam reservation is complete. The hatchery will help maintain existing stocks of Elwha River fish during the dam removal phase.

Modifications to the levee on the west side of the river (Place Road dike) were completed in summer 2010; work is underway now on the levee on the east side to protect landowners and the Lower Elwha Klallam Tribe reservation from flood impacts.

Over the summer, contractors replaced a fish-blocking culvert on Griff Creek with a much-larger bottomless arch culvert, which will allow fish access to the cold, clear waters of Griff Creek during and after dam removal.

A sediment erosion project on the Lake Mills delta was completed in October 2010. Contractors cleared a number of alder trees and excavated an 1100-foot long pilot channel through the center of the delta. This work will maximize the river's capability to naturally erode large amounts of delta sediment as dam removal begins.

Other work includes plant propagation at the park's native plant center, construction of engineered log jams in the lower river by tribal habitat restoration crews, and restoration of disturbed areas along the lower river by tribal revegetation crews. Park and tribal staff are working together and with many other area partners to provide current information and promote regional and national awareness of this landmark restoration project.

Contacts: Barb Maynes, Olympic National Park, barb_maynes@nps.gov; 360-565-3005, Dave Reynolds, Olympic National Park, david_m_reynolds@nps.gov; 360-565-2985

Additional Coordination

The Elwha Research Consortium (ERC). Dwight Barry, Peninsula College, is coordinating the ERC, founded in 2005. Western Washington University's Huxley College of the Environment and its partner institution Peninsula College continue to provide invaluable research support and education opportunities initiated thru the awarded \$500,000 National Science Foundation's Research Coordination Networks grant. While funding for the ERC has concluded, this initiative established the Elwha Research and Education Consortium to serve a vital function to encourage and facilitate the development of more research and educational opportunities associated with the Elwha River Restoration Project. **Contact:** Dwight Barry 360.417.6586/Dwight.Barry@wwu.edu or visit the website at www.elwhainfo.org

Ongoing Nearshore Management/Restoration Issues

Elwha Nearshore Restoration. The next steps and key elements of the nearshore restoration strategy, including historical habitat, current sediment processes, and current habitat form and function, are coming together. Our next step is to combine these elements to predict future habitat conditions and, our ultimate goal, define additional 'value added' restoration priorities in the Elwha nearshore. This modeling effort has not yet been funded. Potential partners on this work, which is a top priority, include the Corps of Engineers, CWI, BoR, ONP, USGS, WDFW, Clallam County, and the Elwha Tribe. The priority work is time sensitive and depends on full and open collaboration by federal, state, academic, and tribal partners. Contact Anne Shaffer (anne.shaffer@coastalwatershedinstitute.org) if you are interested in a copy of the strategy and how you can help realize this very important component of our nearshore restoration work.

Elwha Nearshore Ongoing Federal Management The Corps received funding to perform nourishment to Ediz Hook in FY11. The preliminary plan is to nourish a 2000 foot reach adjacent to the Nippon Paper Industries Mill and a 3000 ft reach downdrift located near the middle trunk of the Hook. Environmental coordination with the resource agencies will begin in the next few months. The 1976 USACE report for Ediz Hook is posted at the ftp site

<ftp://ftp.usace.army.mil/pub/nws/EdizHook/>. The CoE will work on getting all of the Corps reports regarding Ediz Hook more accessible to the Elwha Nearshore group. Also, the CoE have recently submitted a proposal with the Corps Regional Sediment Management Program for funding to install a Coastal Data Information Program (CDIP) buoy. This has been a long standing top priority of the Elwha Nearshore Consortium. Unfortunately it was not funded. **Contact:** Dave Michalsen, Seattle District, Corps of Engineers, David.R.Michalsen@usace.army.mil.

The City of Port Angeles installed a revetment along the Elwha Bluffs in 2007 and has been coordinating with WDFW on status and changes of the beach profile, and amassing materials for beach nourishment. Recent erosion around the revetment is a concern for natural resource managers, environmental groups, and local citizens, who have requested a meeting with regulatory agencies to discuss the status of the revetment and future actions there.

The City of Port Angeles is well into the 3 year process of updating their Shoreline Master Program in accord with State Guidelines at WAC 173-26. The SMP update is the correct time for any interested citizens to express their concerns and suggestions for how the City's shoreline areas will be managed over the coming years. Public visioning events and surveys have found a continued interest being expressed for removal of the seawall and contaminated materials. Also suggestions for removal and relocation of the waterline along the base of the bluff to the Nippon Mill. It is understood there are significant ecological as well as economic implications to such measures being implemented. The removal of the waterline, in particular, could have profound effects on nearshore ecological functions, and should be carefully investigated from various perspectives prior to proceeding. Contact: Jeffree Stewart, DoE, 360.407.6521/jste461@ECY.WA.GOV.

Place road dike modification The Park service raised the existing Place Road dike/west levee 1-3 feet within the existing footprint, per the Corps of engineers plans and specifications. This work included hydroseeding with fertilizer. Contact: Brian Winter, ONP. 360.565.1373; brian_winter@nps.gov

Elwha nearshore action plan. The Coastal Watershed Institute and North Olympic Land Trust are partnered on a proposal to develop and implement the Elwha Nearshore Action Plan, which includes defining, prioritizing, and implementing nearshore restoration actions for each of the four Elwha nearshore landforms (embayed shoreline, lower river, feeder bluff, and spit). For information contact Anne Shaffer, CWI, anne.shaffer@coastalwatershedinstitute.org, and Michele d'Hemecourt, michele@northolympiclandtrust.org

New and Ongoing Restoration Activities by Subject Category

within Elwha nearshore, as provided by project primary investigators. For ongoing projects with no update the project title and contact information are provided (see earlier newsletters for project details).

Physical Processes

Habitat modification due to marine sediment dispersal – Elwha dam removal studies.

Data from our baseline studies funded by Washington State Sea Grant and the National Science Foundation were under analysis over the past year, and planning is starting for activities during the dam-removal period. The objectives for the baseline study were to: 1) characterize the seabed and water column in the present river condition, 2) estimate the impacts of high discharge events on the delta after dam removal, and 3) determine when and where instrumentation should be deployed during the dam removal condition to ensure the highest rate of return from our sampling. We have secured NSF funding for the dam-removal period to study hyperpycnal plumes emanating from the Elwha River, and will be collaborating with other studies in the nearshore, particularly with the USGS Nearshore Habitats efforts.

The fate of sediment transported from rivers to the marine environment is linked to physical processes including, river discharge, storms and tides. Our studies show that the present Elwha River plume is thin (even at high discharge) and has relatively low suspended sediment concentration (<10 mg/L). The small amount of fine-grained sediment that does reach the nearshore is directed by tidal currents, and the combination of plume dynamics and strong bed stresses ensure that the fine-grained sediment is ultimately broadly dispersed. Under conditions of higher sediment supply, we expect transport dynamics to differ during transport events and are planning an experimental design to capture those dynamics.

We will again try to offer the Elwha delta Research Apprenticeship at the Friday Harbor Laboratories, University of Washington (<http://depts.washington.edu/fhl/>) in Spring 2012 depending on the funding situation. In this apprenticeship, undergraduate students develop and complete individual research projects that will be incorporated into our Elwha delta studies. If you have an interested student, please have them contact us for more details.

Contact: Andrea Ogston and Chuck Nittrouer, School of Oceanography, University of Washington, Box 357940, Seattle, WA 98115. Ph. 206-543-0768. Email: ogston@ocean.washington.edu.

Elwha-Dungeness Drift Cell Feeder Bluff Sediment Budget Assessment This project characterizes spatial differences in feeder bluff particle size distributions and historic sediment supply from coastal bluffs and measures seasonal changes in beach particle size distribution and topographic profiles to estimate changes in beach sediment storage in both the impacted (Elwha) and un-impacted (Dungeness) drift cells. Beaches in the Elwha and Dungeness drift cell provide a variety of important functions including spawning habitat for forage fish, critical prey species for a variety of marine organisms including salmonids (Shaffer et. Al 2008, Parks et. Al 2010). Feeder bluffs are coastal escarpments subject to mass wasting and erosion and are a critical source of sediment supplying beaches eroded by waves and tides (Finlayson 2006, Johannessen and MacLennan 2007, Shipman 2008, Keuler, 1988). Rates of littoral sediment transport in the Strait of Juan de Fuca are some of the largest measured in Puget Sound (Ecker et al. 1979, Galster 1989, Schwartz 1989, Wallace 1988, Finlayson 2006, Warrick et. Al 2009) due to long fetch distances and oblique wave approach angles.

Construction of sheet-pile and rock armoring of the industrial water pipeline between Dry Creek and Ediz Hook along with construction of the two Elwha River dams has limited sediment supply to Elwha beaches from the river and feeder bluffs and has resulted in significant coarsening of the beach, limiting the availability of suitable forage fish spawning habitat, eroding Ediz Hook, and causing significant shoreline retreat (Galster 1989, Galster and Schwartz 1989, Warrick et al. 2009, Parks et al. 2010 in review).

The pending removal of two dams on the Elwha River is anticipated to result in a partial restoration of sediment supply to the Elwha drift cell with anticipated replenishing of the beaches between the Elwha River and the tip of Ediz Hook (Shaffer et. Al 2008). However, no restoration of the sediment supply from feeder bluffs in the Elwha drift cell is currently planned, limiting the long-term supply of sediments to beaches in the Elwha nearshore.

To date, no comparative studies of the rates of sediment supply to the nearshore from bluff erosion in the Elwha or Dungeness drift-cells have been completed nor any evaluation of the variability of bluff particle-size distributions on grain-size composition of adjacent beaches. In this project we characterize spatial differences in bluff particle size distributions and historic sediment supply from coastal bluffs and measure seasonal changes in beach particle size distribution and topographic profiles to estimate changes in beach sediment storage in both the impacted (Elwha) and un-impacted (Dungeness) drift cells.

These efforts will allow development of a sediment budget for Elwha and Dungeness beaches which will provide critical information for future restoration and land-use planning decisions on the role of sediment supply from feeder bluffs and relative influence of these sediments on beach particle size distributions.

To estimate long-term rates of sediment supply from feeder bluffs, historic mass wasting on bluffs will be inventoried and measured between 1963 and 2009, using methods developed by Hapke (2004) using orthorectified aerial photographs and ARC-GIS. Bluff stratigraphy and particle size distributions will be mapped and characterized using a combination of photographic and sieve techniques. Sites will be chosen based on lithologic differences between drift cells (e.g. glacial till, glacial drift, glaciomarine drift, diamicton etc.). Changes in seasonal volumes of sediments stored on beaches will be measured using standard topographic surveying methods (theodolite) with fixed and monumented transects of beach profiles from bluff toes water ward to the low tide terrace. Sites will be located within major lithologic units and will be measured once every three months.

Elwha Sites

West of Elwha (Freshwater Bay)

East of Angeles Point (tie in with existing Lower Elwha Transects)

East of Dry Creek

Base of Ediz Hook

Dungeness Sites

East of Morse Creek

East of Siebert Creek

East of McDonald Creek

Base of Dungeness Spit

Finally, changes in seasonal particle size distributions (coarsening or fining) will be measured by sub-sampling digital photographs of beach sediments along topographic transects deployed in Task 2. Topographic profile surfaces will be photographed once every three months.

Additional sieving of sediment grab samples from the back beach (toe of bluff), beach face, and on the low tide terrace will be conducted.

Contact: Dave Parks, Washington Department of Natural Resources 311 McCarver Street Port Angeles WA 98362 , 360-417-1405 ext. 225 david.parks@dnr.wa.gov

Elwha Sediment Management and Monitoring Plan

Contact: Tim Randle, Sedimentation and River Hydraulics Group (D-8540) U.S. Bureau of Reclamation Technical Service Center, P.O. Box 25007 Denver, CO 80225-0007; 303-445-2557/TRANDLE@do.usbr.gov.

Beach Profile Monitoring of the Elwha River Delta Coast

Contact: Matt Beirne and Larry Ward, Lower Elwha Klallam Tribe, 51 Hatchery Road, Port Angeles, Washington. 360.457.4012 ext 12 and 17 (matt.beirne@elwha.nsn.us; larry.ward@elwha.nsn.us) and Jim Johannessen, Coastal Geologic Services, Inc., Email: coastalgeo@comcast.net, Phone: 360-647-1845

Effects of Elwha Dam Removal on Nearshore Habitats (not updated from 2009)

This is a U.S. Geological Survey (USGS) research project with four primary tasks: (1) document the effects of dam removal on the nearshore sediment budget, (2) characterize the changes experienced in offshore substrate and habitats due to increased sedimentation after dam removal, (3) understand the physical processes (waves, currents and sediment transport) of the river mouth region, and (4) develop a process-based numerical model for nearshore sediment transport of Elwha River sediment. Progress on the first three tasks is described under the USGS CHIPS portion of the Habitats section of this newsletter. In the past year, significant progress has been made on the 4th task. USGS developed a process-based hydrodynamic and sediment transport model for the Elwha River delta region within the Strait of Juan de Fuca. The model is driven with water levels and waves at the entrance to the Straits. Model calibration and validation are being performed on water levels and tidal currents, and on wave heights, periods, and directions using data collected at two sites off the delta during 2005 and 2006. Preliminary model results show a complex pattern of strong tidal currents across the delta capable of transporting fine sediment on both flood and ebb tides. In addition, strong residual currents exist over the delta, along with eddies that form on either side of the river mouth. The model is operated in both 2D and 3D, when necessary to simulate the sediment transport associated with fine-grained dispersal in the river plume. Strong tidal currents are shown to dominate the dispersal of sediment transported in the Elwha River plume. The model set-up, calibration, and some preliminary results are discussed in a recent publication of Gelfenbaum et al. (2009). USGS will continue to develop, test, and operate the numerical model of flow and sediment transport to improve the understanding of transport processes around the Elwha River delta. The model will be used to predict short and long term sediment accumulation after the dams on the river are removed.

Contact: Guy Gelfenbaum, USGS, 345 Middlefield Rd., MS999, Menlo Park, CA 94025, ggelfenbaum@usgs.gov; or Jon Warrick, USGS, 400 Natural Bridges Drive, Santa Cruz, CA 95060, jwarrick@usgs.gov.

Monitoring sediment and channel topography in the lower Elwha River: Field surveys and remote sensing are used to monitor sediment grain-size characteristics and channel geometry on the lower Elwha River, in order to establish baseline data for a representative period of time before dam removal begins. We plan to survey transects in selected areas of the river repeatedly at biannual intervals to establish the range of topographic and grain-size variability caused by the seasonal hydrograph fluctuations in the dammed system, so that these can eventually be compared with changes to be evaluated at the same locations after dam removal once the system begins to respond to reservoir-sediment influx. Aerial photographic analysis of channel movement is discussed in the following report: Draut, A.E., Logan, J.B., McCoy, R.E., McHenry, M., and Warrick, J.A., 2008, Channel evolution on the lower Elwha River, Washington, 1939-

2006: U.S. Geological Survey Scientific Investigations Report 2008-5127,
<http://pubs.usgs.gov/sir/2008/5127/>.

Biannual field surveys of channel topography and subaerial sediment grain size have been under way since September 2006, with the fifth survey just completed in early September this year. Results so far have shown that the lowermost study reach on the Elwha River, 0.5 km upstream of the river mouth, has undergone substantial channel change over the 2006-2007 and 2007-2008 winter flood seasons, with little change over the spring snowmelt flood seasons in between. Since September 2006, more than 15 meters of eastward channel migration (retreat of the right bank) has occurred. The channel thalweg has shallowed by about a meter since the fall of 2006, and areas on the left bank (point bar) have accreted and eroded with each flood season, losing and gaining up to 1.5 m of bed elevation locally. This reach of the river has undergone more rapid channel movement during our study interval than two other reaches upstream that are closer to Elwha Dam; we attribute the greater mobility of the channel in its lowermost reach to greater availability of fine sediment compared with reaches closer to the dam

Contact Amy Draut, Coastal and Marine Geology Program, USGS, Pacific Science Center, 400 Natural Bridges Drive, Santa Cruz, CA 95060 USA. 831-427-4733/ adraut@usgs.gov; webpage: http://walrus.wr.usgs.gov/infobank/programs/html/staff2html/staff/Amy_Draut.html

Habitat

Eelgrass/Understory Macrovegetation Mapping Along the Elwha Nearshore The Clallam Marine Resources Committee is studying population and distribution trends of eelgrass over time. In late summer of 2010 the MRC broadened its mapping of eelgrass to include fish use of eelgrass and other subtidal vegetated habitats in the Elwha River drift cell and comparative locations in the Dungeness drift cell and Crescent Bay and utilized standard Department of Natural Resources Submerged Vegetation Monitoring Project methods to estimate aerial extent, mean maximum depth, and patchiness index of vegetated habitats. This survey period also included concurrent sampling of fish abundance using hydroacoustics and frame-trawl sampling. Results from this study will be available April 1, 2011, and data will be provided to the general public, elected officials, and land managers. The work is led by Jim Norris, Marine Resource Consultants, sponsored by the Clallam MRC with partnership from CWI and the USFWS National Coastal Maritime Refuge. **Contact:** Cathy Lear, Clallam County, Port Angeles Washington 360.417.2361/ Clear@co.clallam.wa.us, and Jim Norris, Marine Resource Consultants, 360.385.2845/jnorriss@olympus.net.

Nearshore Central Strait of Juan de Fuca: an ecosystem assessment of salmonid use and priority restoration actions Long term monitoring of the Elwha and comparative estuary continue. The original two plus year assessment, which built on over a decade of WDFW lead fish assessment in the nearshore central and western Strait, was completed in June 2009. The work was very successful, and provided a number of important recommendations for habitat restoration. Key results include the determination that the Elwha drift cell is functioning at a lower level ecologically for fish than comparative areas; Ecological function of the Elwha estuary appears heavily partitioned, with the majority of fish use occurring within the sliver of west estuary between the river and Place Road dike; the documentation of surf smelt spawn along the shoreline of Freshwater Bay, and along the feeder bluffs of Dungeness drift cell. The project provided intern experience for over 50 WWU and Peninsula College students. Partners on the project included LEKT, WDFW, Clallam County, and USGS. Results can be found in a series of

reports published at the Center for Excellence website:
<http://www.pc.ctc.edu/coe/publications.htm>.

Significant downturns in state funding have suspended the majority of agency work on the Elwha nearshore project. The Elwha nearshore fish use assessment has transferred to the Coastal Watershed Institute and long term monitoring continues. We also continue to pursue external funding to implement restoration priorities, which include: habitat preservation thru property acquisition; habitat restoration for the lower river and bluffs of the Elwha drift cell, and next step assessment priorities to continue long term nearshore monitoring, and modeling of sediment and fish use to develop real time adaptive management tools needed to for short term post dam removal habitat function. Annual reports are available. **Contact:** Anne Shaffer, Coastal Watershed Institute, Port Angeles, Washington 360.461.0799;
anne.shaffer@coastalwatershedinstitute.org.

Assessment of the nearshore benthic invertebrate communities in the Elwha and Dungeness Drift Cells, Central Strait of Juan de Fuca, Washington State. The benthic community assessment will be performed in conjunction with the Elwha-Dungeness Drift Cell Feeder Bluff Sediment Project conducted by David Parks (Washington Department of Natural Resources). The feeder bluff sediment project will characterize the spatial differences in bluff particle size distributions and historic sediment supply from coastal bluffs to estimate changes in beach sediment storage in both the impacted (Elwha) and un-impacted (Dungeness) drift cells. The data will be used as baseline information in anticipation of the dam removals and the large influx of gravel, sand and silt into the Elwha River and nearshore marine environment of the Strait of Juan de Fuca.

The study of the benthic invertebrates in the Elwha and the Dungeness drift cells will be conducted to define the current nearshore communities at six sites within the drift cells. At similar geomorphic habitat types the benthic communities at the Elwha sites will be compared to the Dungeness sites to identify differences, if any, between the impacted Elwha cells and the un-impacted Dungeness cells. The benthic communities will be evaluated at the following sites within the drift cells:

Elwha Sites

Freshwater Bay (2 sites; east and west side of bay)
Elwha Bluff east of Dry Creek
Base of Ediz Hook

Dungeness Sites

East of Morse Creek
Base of Dungeness Spit

At each location benthic community samples will be collected at two tidal elevations (MLLW and MTL) and at the wrack line. The benthic invertebrates will be identified to lowest practical taxonomical level. To the extent possible, the current benthic community data will be compared to historical benthic community data from the Marine Ecosystems Analysis (MESA) Program to evaluate any changes in the benthic community over time. Potential enhancement of the benthic habitats including restoration efforts will be evaluated during the study as the effects of the dam removals to the benthic invertebrate habitats occur.

The first sampling event was conducted July 10 through 15, 2010 and the sampling is currently planned as a biannual effort. Based on potential future funding and student involvement, the sampling effort may increase including additional sites, the number of samples collected at each site, and the number of sampling events per year.

The study is current conducted in partnership with Jeff Cordell at the University of Washington
Contact: Helle B. Andersen at the Coastal Watershed Institute, 360.808.4984 or
helle.andersen@coastalwatershedinstitute.org

Role of dams on Large Woody Debris (LWD) in temperate rainforest nearshore habitat. Large Woody Debris (LWD) is an important component of the marine ecosystem. It is a base component of critical habitats for numerous fish species including endangered salmon and forage fish including smelt and sand lance. The master's project I am working on includes studying the role of LWD deposition on riparian and nearshore ecosystems. This includes researching historical distribution, comparing undisturbed watersheds, establishing benchmarks for what restoration should look like, and predictions for the Elwha's future state.

Contact: Samantha Rich, Graduate student, Natural Resources and Environmental Science University of Illinois, Urbana-Champaign, 206.660.7655, rich6@illinois.edu

Nearshore Fish Communities in the Eastern and Central Strait of Juan de Fuca (not updated from 2009). Beginning in 2005, staff from the Lower Elwha Klallam Tribe, NOAA's Northwest Fisheries Science Center, and the Jamestown S'Klallam Tribe have been collecting data on the nearshore fish communities of the eastern and central Strait of Juan de Fuca. Our goal is to use these communities and their associate habitats as indicators of change influenced by sediment introduction after the dams have been removed. More than 200 beach seine hauls have been made at 37 sites between 2006 and 2008 from Discovery Bay to Crescent Bay. Sampling is conducted between March and September. Overall 48 species of fish have been identified including four species of Pacific salmon as well as steelhead and cutthroat trout. Forage fish, including surf smelt, Pacific herring, and sand lance, appear to dominate the nearshore community of the region and represent nearly 60% of the total catch. In addition to the high abundance of forage fish, numerous life stages of each species are commonly encountered at multiple sites throughout the season. Pink and chum salmon represented the majority of the salmonid catches early in the year (March-April) while Chinook catches generally peak in June/July. In 2009, monthly beach seine samples were not collected. In July, a survey of intertidal habitat conditions a potentially altered areas and reference areas was conducted to establish baseline conditions prior to dam removal. In addition, epibenthic zooplankton samples as well as diet samples of selected species were collected at a number of sites. In 2010, the collection of intertidal habitat, invertebrate, and fish diet data will be expanded; in addition, monthly collections of nearshore fish will be resumed in 2010. Kurt/Anna please update this
Contact: Kurt Fresh, NOAA Fisheries. Northwest Fisheries Science Center, 2725 Montlake Blvd. East, Seattle, WA 98112-2097. 206.860.6793. kurt.fresh@noaa.gov and Larry Ward, Lower Elwha Klallam Tribe, 51 Hatchery Road, Port Angeles, WA 98363. 360.457.4012 ext.17. larry.ward@elwha.nsn.us

Elwha Nearshore Habitat Monitoring (not updated from 2009). In 2005 the WDFW Shellfish Dive Team and the Jamestown S'Klallam Dive Team established two permanent study sites (one treatment and one control) as baseline data sets for pre and post dam removal comparisons. These two study sites focused on rocky habitat and used important shellfish species (red and green sea urchins, sea cucumbers, abalone and rock scallops) as targets for evaluating impacts of dam removal. Additional presence/absence data on other key vertebrate, invertebrate

and algal species was obtained. Habitat mapping at each site was completed using diver observations and video documentation. The video data will also be used to create baseline photo mosaic images of the habitat for pre and post dam removal comparisons.

In late September of 2006 the WDFW Dive Team and Jamestown S'Klallam divers established an additional permanent study site on rocky habitat within Freshwater Bay and resurveyed the previously established study sites. The group resurveyed the rocky habitat study sites again in September of 2007.

WDFW and Jamestown S'Klallam divers established a permanent study site on soft bottom habitat directly off the mouth of the Elwha in 2006. This study sites focuses on geoducks and horse clam densities to evaluate impacts of dam removal on these important shellfish species. In 2008 WDFW hopes to augment the permanent soft bottom site by 12rndeb12 dredging random one-meter samples from near this location. This data will be used to determine infaunal species composition before and after dam removal.

Because of the scope and scale of this study, collaboration and support from other interested parties will be needed in order to expand this project beyond its current level. **Contact:** WDFW: Don Rothaus, at 425-379-2315; Tribes: Doug Morrill, Lower Elwha Klallam Tribe, at 360-457-4012 ext. 18; or Kelly Toy, Jamestown S'Klallam Tribe, at 360-681-4641

Consequences of the Elwha River dam removal on nearshore habitats and ecosystems-USGS Coastal Habitats in Puget Sound (CHIPS) Program (not updated from 2009).

Contact: Jeff Duda, Western Fisheries Research Center, 6505 NE 65th St., Seattle, WA, 98115. 206-526-6282 x 233, Jeff_Duda@usgs.gov. Jeff et al. please update these entries

The CHIPS program is a USGS initiative to provide interdisciplinary research and collaboration to coordinate, integrate, and link USGS studies with Puget Sound Nearshore Ecosystem Restoration Project (PSNERP) and Puget Sound Partnership (PSP) goals and objectives. Current studies have three themes: the effect of urbanization on nearshore ecosystems; restoration of large river deltas, and recovery of nearshore ecosystems. The Elwha River restoration task, intended to provide scientific assessment of nearshore restoration through dam removal, consists of hydrologists, oceanographers, fluvial and coastal geomorphologists, fisheries biologists, and ecologists working together to characterize the existing conditions of the Elwha River estuary and nearshore ecosystems. Below are brief descriptions of some of the work that is being conducted.

Beach Characterization. The erosion of beach habitat in the Elwha River delta is driven in part by the interception of river born sediments that are trapped behind two dams upriver. Two beach surveys were conducted in FY08 to provide high-resolution topography, bathymetry and sediment grain-size data. These surveys continue the semi-annual mapping that began in September, 2004 that is being used to characterize beach geomorphology and change. Data collected in FY08 reveal that the beach shore-face continues to erode, especially along the beach east of the river mouth. Little erosion or accretion has occurred along the lower portion of the beach profiles, suggesting that the low-tide terrace is relatively stable compared to the upper beach shore-face. These results and others from the nearshore geomorphology research have been summarized in a manuscript that is published in the journal *Geomorphology*. The raw topographic data were presented in USGS Data-Series Report 288 (2008). Additional work is being conducted to explore differences in rates of sediment transport along segments of the delta that receive different oceanographic forcings.

Benthic Habitat Mapping. Characterization and mapping of nearshore substrate and habitat offshore of the Elwha River mouth were provided in two publications in FY08. These publications present data and interpretation of habitat types and provide critical information for future investigations of habitat change-detection in the short- and long-term following dam removal. The raw sonar and video data and their classification into habitat types are provided in USGS Data Series 320 (2008; available online at <http://pubs.usgs.gov/ds/320>). A synthesis of these data, including a comparison of mapped substrate types with long-term kelp distribution and abundance maps, were published in the special issue of the journal *Northwest Science*, “Dam Removal and Ecosystem Restoration in the Elwha River Watershed, Washington State.” Map products are being used by CHIPS scientists to select sampling sites for scuba dive surveys (see below) intended to document biological communities of the Elwha River nearshore east and west of the river’s mouth.

Chinook Habitat Utilization. As juvenile Chinook salmon migrate from freshwater rearing areas, they undergo the physiological, behavioral, and life history changes necessary for transition to life in the ocean. Estuaries are recognized as an important part of this migration. It is hypothesized that salmon utilize estuarine habitats because they: a) provide a higher growth potential; b) represent a transition to saltwater conditions; and c) provide an increased ability to avoid predators. All of these factors may play a role in higher survival during the subsequent marine life history phase. However, a great deal of inherent variability is associated with estuaries, especially in regards to their size, their physical processes, and their complexity. We sampled the microstructure of juvenile Chinook salmon otoliths to infer daily rates of growth-in-habitat. Our preliminary results for wild Chinook salmon revealed two distinct otolith microstructure patterns – Freshwater Growth and Estuary/Nearshore Growth. Unlike other river systems with larger and more complex estuaries, where different growth trajectories exhibit finer grained habitat specific patterns, the Elwha River has a relatively small estuary with presumably limited productivity gradients. Adult sampling to date (~15 samples) suggests that juvenile growth patterns should be discernible and that most adults (92%) were 4 years old. The first brood year where we have collected juvenile otolith samples will return as 4 year olds in 2010.

Nutrients. We have collected 14 monthly water samples from 7 locations in the lower Elwha River, estuary complex, and nearshore over a 16-month time-span to estimate spatial and temporal patterns in nutrient concentrations. Preliminary results showed seasonal patterns of nutrients consistent with other rivers in Puget Sound, and that the nearshore and estuary were out-of-phase in total N and total P measurements. By and large, the lower Elwha River and estuary complex has relatively low levels of nutrients, a result that is consistent with other studies that have been conducted throughout the Elwha River. In September, 2007 in vivo deployment of nutrient diffusing substrates deployed at 4 locations within the Elwha River estuary complex showed distinct lentic and lotic patterns, and different patterns of nutrient limitation. In the estuary, nitrogen limitation was suggested, but in Boscoe Creek (which drains into the estuary complex) N/P co-limitation was apparent, a result consistent with similar studies occurring in lower Elwha River side channels sites (Sarah Morley, NOAA Fisheries research project in progress). Our characterization of spatial and temporal trends in nutrient concentration will be presented in a USGS Scientific Investigations Report intended to summarize the USGS and the Lower Elwha Klallam Tribe assessments and ecological studies of the the Elwha River estuary.

Freshwater Plume. The dispersal of sediment from the Elwha River to the Strait of Juan de Fuca following dam removal will depend on the waves and currents that move this material. The initial dispersal of sediment will likely be tied to the freshwater movement from the river mouth. To better understand the nature and movement of this freshwater and sediment “plume”, a five-day Elwha Plume Study was completed during the high snowmelt discharge in June 2007. During this

study, the freshwater discharged from the Elwha River could be clearly identified as a thin, buoyant layer along the ocean surface. Movement of the plume was related to coastal currents, as the plume was dominantly directed toward the east in response to tidal currents. Data and results of this study are being compiled within a USGS Open-File Report.

Estuary Vegetation Mapping. Characterization of the biological communities of the Elwha River estuary, which has not received recent study, is of interest to the Lower Elwha Klallam Tribe, who received a grant from the EPA develop an estuarine characterization and management plan. Beginning in FY07, we have assisted the Lower Elwha Klallam Tribe with their efforts to characterize and delineate the vegetation communities of the Elwha River estuary. In spring and summer 2007, we designed a vegetation sampling plan in cooperation with the tribe. In August 2007, we identified different vegetation patches in the study area and established a total of 21 vegetation plots within six major vegetation types. We identified most taxa to species and estimated the percent cover of all vascular plants within nested plots ranging in size from 100 cm² to 100 m². The plot design and data collection generally follows the Carolina Vegetation Survey, an approach that is being used elsewhere in the Elwha River watershed. Plot sampling occurred in August 2007 and preliminary data summaries were presented at the 5th Annual Elwha Research Consortium meeting. In May 2008, surveys were initiated to determine the surface elevation of the plots. These surveys will be completed in September 2009 when additional studies of woody vegetation in the forested plots (5-7 of the 21 plots) will be performed. A final data analysis and write-up will be included in a USGS Scientific Investigations Report characterizing the ecology of the Elwha River estuary.

Surface Water/Ground Water Measurement in the Elwha River Estuary. Channel-bed elevations may significantly increase following dam removal, due to the release of large volumes of sediments that are currently stored behind the dams. This could raise ground-water levels throughout the alluvial aquifer, and possibly change the hydrodynamics of the estuary complex, which is an important nursery habitat for several species, including endangered salmonids. In September 2007 we conducted a series of synoptic discharge measurements of the river below the dams under steady, low-flow conditions. This “seepage run” found hyporheic exchanges exceeding 10% of the total flow in some locations, but an overall neutral gain/loss of water in the lower river was observed. We also monitored ground water wells adjacent to the river and in the floodplain, which allowed us to document the rapid response of groundwater levels during a major flooding event on December 3rd. The rapid response observed indicated that the alluvial sediments are highly transmissive. On September 1-2, we deployed a approximately 600 m of fiber-optic distributed temperature probe in the eastern estuary wetland complex, which allowed us to examine fine scale temperature differences of this area, with a goal of inferring areas of ground water influence.

Two CTD instruments were deployed in the estuary complex during the summer of 2008 (June – present) to collect temperature and conductivity measurements of the two Elwha estuary beach lakes. A third mini-CTD was installed within a piezometer in the estuary to record groundwater and salinity levels in the sediments. Of particular interest is the role of tidal stage on the elevation, temperature, and salinity of the estuary complex and how this relates to ground water/surface water interactions. These data have been coupled with paired measurements of the surface water inflow to the estuary (Bosco Creek) and the outflow from the estuary to the river mouth. An acoustic Doppler device was installed in the outflow, allowing us to determine the net water flux through the system and estimate the tidal prism or total volume of water exchanged through typical summer tidal cycles. These data will be supplemented with fine scale synoptic

temperature measurements throughout the estuary obtained with the fiber-optic distributed temperature sensing system.

Finally, in cooperation with the USGS CHIPS Urbanization Task, we will be surveying the Strait of Juan de Fuca near the Elwha River mouth (Freshwater Bay to Ediz Hook) using a boat mounted streaming electro-resistivity method to locate areas of submarine groundwater discharge to the nearshore environment. These measurements will provide an important baseline of this physical process that is thought to be important for the maintenance of nearshore vegetation communities, such as eelgrass meadows. It will also allow us to estimate the extent that groundwater loss from the Elwha River estuary affects the overall water flux.

Scuba Dive Surveys of Biological Communities of the Elwha River Estuary. Development of baseline conditions in multiple physical, biological, and chemical constituents of the Elwha River nearshore prior to dam removal has been the primary mission of the CHIPS Elwha Task. Characterizing habitat-specific biological communities and associations using previously developed benthic substrate maps (described above) highlights the interdisciplinary nature of the CHIPS program, while providing important baseline information prior to dam removal. Planning throughout the fall and winter (2007-2008) included meetings with subtidal community experts, delineation of study boundaries in the Elwha delta region and control areas to the east and west, and evaluating different sampling strategies. Once a specific strategy was identified for sampling communities based upon a modification of PISCO methodologies (see www.piscoweb.org for details), we used a stratified random approach to select sites using a GIS. We also used the Delft3D hydrodynamic model to identify slack (i.e., low currents) diving windows. Sampling in 2008 and 2009 occurred during 15 days spread over a 6-week period of August and September. Forty-five sites were surveyed in 2008 and 43 in 2009. Each of two diver teams surveyed >1 transect per site, for a total of 98 transects surveyed in 2008 and 86 in 2009.

We based our stratification on characteristics that should drive ecological differentiation and provide a gradient of response following dam removal. Strata were based upon distance from mouth (seven wedge shaped bands running perpendicular to shore, including 2 controls outside of the Elwha nearshore at Green Point [east] and Low Point [west]), depth (3-6 m, 9-12 m, 15-18), substrate (hard/mixed/soft substrate classification based upon USGS Data Series Report 320). In areas that were not surveyed by Cochrane et al (2008), such as the control sites to the east and west of the Elwha, we stratified based upon kelp data from WA Department of Natural Resources (3 categories of kelp presence based upon 15 years of annual survey data – no kelp, kelp in 1-8 years, or kelp in 9-15 years). On each 30 m x 2 m transect, divers will identify and count fish species, species of brown macroalgae, and invertebrate taxa > 3 cm.

Biological Communities

Beached Bird Surveys of the Elwha Nearshore. The Coastal Observation and Seabird Survey Team (COASST) joins the Elwha nearshore monitoring effort this fall, adding two new beaches and supplementing four historical sites in the Strait of Juan de Fuca area. COASST is a citizen science program run out of the University of Washington that recruits and trains local citizens to monitor beaches on a monthly basis. Standardized surveys of particular beaches, with identified start and stop points, return information on all beach-cast carcasses on a monthly basis. These baselines have already been used in greater Puget Sound as baselines against which both catastrophic (e.g., gillnet bycatch mortality) and chronic (e.g., decreasing use of the Sound as a wintering area) forcing can be assessed. We currently monitor Freshwater Bay shorelines. MRC

funding has allowed us to add Crescent Bay Beach which is a comparative area for dam removal. This will help us to capture any changes as a function of sedimentation following dam removal.

In order to gear up, COASST partnered with the Olympic Coast National Marine Sanctuary to conduct the first of several expected local trainings at the Landing Mall in Port Angeles on October 9. The upshot was nine new COASSTers, bringing the survey site total to 36 along the Strait from Neah Bay to Port Townsend. Stay tuned for more information on findings as the baseline becomes established. For more information on COASST, please visit the website www.coasst.org, email at info@coasst.org or call the COASST office at 206-221-6893.

Macroalgae Blooms in Impounded Elwha West Estuary. Macroalgae blooms of the impounded estuary west of the Place Road dike have been a concern for private property owners. Recent attempts to partially restore hydrologic connection to the river were not successful, so researchers are now shifting focus to understanding what is causing the increasing blooms of *Ulva intestinalis*. Tim Nelson, Phycologist with Seattle Pacific University, sampled the west estuary algae on 12 October 2010 and had marine botany undergraduate students do preliminary CN analysis on the ulvoid tissue. The quick-and-dirty answer is that these algae are definitely nitrogen limited. They're down at around 1% tissue N on average, with many samples below 1%. For comparison, we estimate that algae in the Straits would be 4-6% N. The literature suggests N limitation below about 2% for sure, and possible limitation between 2 and 4%.

Next steps will be to repeat the sampling, identify sources of nitrogen, and possibly find funds for additional nutrient analysis to decipher the relative contribution of nitrate, nitrite, ammonium, etc. We also are brainstorming sources for nutrients and ideas for limiting N input to the extent possible including limiting fertilization (hydro seeding on the revised dike this year may have played a role in this year's bloom), plant N-demanding vegetation around the margins (and don't fertilize it much), remove plants that have N-fixing bacteria associated with them (e.g., legumes) near the area, etc.

Contact: Tim Nelson, Chair and Professor of Biology, Dept. of Biology, Suite 205, Seattle Pacific University, 3307 3rd Avenue West, Seattle, WA 98119-1950, Telephone: 1-206-281-3640, FAX: 1-206-281-2882, e-mail: tnelson@spu.edu, URL: <http://myhome.spu.edu/tnelson>

Fisheries

Shellfish Harvest Activities Associated with Elwha Dam Removals (ongoing management topics).

Contact: WDFW: Michael Ulrich, WDFW, at 360-902-2737; Tribes: Doug Morrill, Lower Elwha Klallam Tribe, at 360-457-4012 ext. 18; or Kelly Toy, Jamestown S'Klallam Tribe, at 360-681-4641

Workgroup Directory

Workgroup participants actively working in nearshore. *Italic* are nearshore workgroup coordinators/key contacts

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John Williams	Stillhope Productions	jw@StillHopeProductions.com
Jacilee Wray	ONP	Jacilee_wray@nps.gov
Rob Young	Western Carolina University	ryoung@wcvax1.wcu.edu

Educational Entities

A number of educational entities have received funding for Elwha proposals (not specific to nearshore). They include:

Peninsula College (PC) was not refunded in 2009 for Elwha-related research under the National Science Foundation's Research Experiences for Undergraduates program which established an undergraduate student research program at PC, linking students with faculty and agency scientists. In previous years this grant funded PC and Western Washington University Huxley College of the Environment students to conduct research projects associated with the Elwha River Basin ecosystems before and after removal of the dam and provided extensive experience with terrestrial, freshwater, and nearshore projects. Graduates of the program that participated in the nearshore projects have secured permanent positions with the Navy, and project/seasonal professional field positions with USGS, WDFW, ONP, and the Lower Elwha Klallam Tribe. Unfortunately NSF funding for the Elwha REU program ended September 2009. The project was highly successful, and should be refunded. Peninsula College intends to submit a new REU request in 2010 and invites interested parties to contact Dwight Barry (dbarry@pencol.edu). For more information and full list of participants **Contact** Dr. Hague, (PI), Peninsula College, \, 360-417-6246, bhauge@pencol.edu

Project documentaries

The Elwha Project: Observations of a River and it's People. Contact: Rob Casey, Photographer, 206.297.9547; rob@robcasey.net; www.robcasey.net;

Return of the River. Contact: John Gussman, Doubleclick Productions 360.808.6406; jgussman@dcproductions.com; www.elwhafilm.com

Guardians of Nature: Elwha River Restoration Project. Contact: Cecile Favier Director, Tel : +33 (0) 1 75 43 70 28; cilfavie@free.fr; www.cecilefavier.jimdo.com

Return to Elwha. Contact: Jason Jaacks. Cordillera Productions, 303.513.4652 cordilleraproductions@gmail.com; www.returntoelwha.com/

Into the Breach: The Return of the Wild Elwha. Contact: Mark Titus, Director, (206)794-2411; mark@augustisland.com; www.augustisland.com

Elwha Nearshore Short Films. Contact: John F. Williams Still Hope Productions, Inc : (360) 598.4152; jw@StillHopeProductions.com; www.StillHopeProductions.com

Additional Resources, Completed Studies, and Publications

The Elwha Watershed Information Resource integrates ecological and socioeconomic information that describes the physical environment, biological and human communities, and

management issues in the Elwha Watershed. It is designed to increase communication among stakeholders, provide education, and facilitate access to data related to the Elwha Watershed. Visit us at <http://www.elwhainfo.org/>; **Contact:** Dwight Barry [360.417.6586/](tel:360.417.6586) Dwight.Barry@wwu.edu.

The last 2011 Elwha Nearshore Consortium (ENC) workshop, co-sponsored by the Coastal Watershed Institute, Olympic Peninsula Surfrider Foundation, Clallam County MRC, Peninsula College, and Lower Elwha Klallam Tribe, was held in Port Angeles at the Peninsula College 14 February 2011. It was one day venue with technical presentations during the day and the 'Elwha Conversations' public evening meeting, on the history of the Elwha nearshore (both Tribal and Non-Tribal) by Jacilee Wray, Olympic National Park, and Jamie Valadez, Lower Elwha Klallam Tribe. Proceedings of the workshop, edited by Tara Morrow, are available on the Coastal Watershed (www.coastalwatershedinstitute.org), Peninsula College (www.elwhainfo.org) and WWU Huxley Program for the Environment web pages. Contact Anne Shaffer, CWI, anne.shaffer@coastalwatershedinstitute.org, for additional details.

A collection of research paper as a Special Issue of the journal Northwest Science was published in 2008. The volume, "Dam Removal and Ecosystem Restoration in the Elwha River Watershed, Washington State" contains 18 papers by university, state, federal, and tribal scientists on various topics associated with studies occurring in the watershed prior to dam removal. Copies of the papers are available for downloading as PDF files from the Peninsula College Center of Excellence website, located at <http://www.elwhainfo.org/research-and-science/elwha-research-consortium/erc-publications>. Funding for the Special Issue was provided by the National Science Foundation through a grant supporting the Elwha Research Consortium and by the National Park Foundation. Inquiries regarding the Special Issue can be directed to Jeff Duda.

Beach morphology and change along the mixed grain-size delta of the dammed Elwha River, Washington 2009. Warrick, J.A., George, D.A., Gelfenbaum, G., Ruggiero, P., Kaminsky, G. M., and M. Beirne,. *Geomorphology*, 33 pages. doi:10.1016/j.geomorph.2009.04.012.

Modeling sediment transport and delta morphology on the dammed Elwha River, Washington State, USA 2009 Gelfenbaum, G., Stevens, A., Elias, E., and Warrick, J., *Proceedings of Coastal Dynamics 2009: Impacts of Human Activities on Dynamic Coastal Processes*: Edited by Masaru Mizuguchi and Shinji Sato. Tokyo, Japan.

Fish habitat use response to anthropogenic induced changes of physical processes in the Elwha estuary, Washington, USA. 2009. Shaffer, J.A., M. Beirne, T. Ritchie, R. Paradis, D. Barry, and P. Crain. *Hydrobiologia* 636:179-190

Channel evolution on the lower Elwha River, Washington, 1939-2006: 2008. Draut, A.E., Logan, J.B., McCoy, R.E., McHenry, M., and Warrick, J.A., U.S. Geological Survey Scientific Investigations Report 2008-5127, <http://pubs.usgs.gov/sir/2008/5127/>

Historical Changes to Estuaries, Spits, and Associated Tidal Wetland Habitats in the Hood Canal and Strait of Juan de Fuca Regions of Washington State. The Final Report of this study is available for download at http://pnptc.org/Historical_Nearshore.html.

Contact: Steve Todd, Suquamish Tribe, stodd@Suquamish.nsn.us

Eelgrass Mapping Along The Elwha Nearshore. 2007. Norris, J. I, Fraser, A. Shaffer, and C. Lear. In Proceedings, Puget Sound Georgia Basin. Puget Sound Action Team, Olympia, Washington. Reprints available on request.

Observations of Eulachon, Thaleichthys pacificus, in the Elwha River. Olympic Peninsula Washington. 2007. Shaffer, J.A, D. Penttila, M. McHenry and D. Vilella.2007. Northwest Science.81(1):76-81

Relating Forage-Fish use With Spatial and Temporal Variability of Particle-Size Distributions of Mixed Grain-Size Beaches in the Elwha and Dungeness Drift Cells , Central Strait of Juan de Fuca, Washington State. In revision. The removal of two dams on the Elwha River of Washington State is expected to release 1.38×10^7 m³ of gravel, sand and silt into the Elwha River and nearshore marine environment of the Strait of Juan de Fuca. Waves and tides are expected to distribute these sediments widely upon beaches within the Elwha littoral cell with implications for fish use including forage fish surf smelt (*Hypomesus pretiosus*) and sand lance (*Ammodytes hexapterus*). Forage fish spawning surveys (Moulton and Penttila, 2000), consisting of beach foreshore surface photographs and bulk sediment samples allow correlation between sediment particle-size distributions and forage-fish egg frequencies. Seasonal and spatial variability of mean grain-sizes of mixed sand-gravel beaches is characterized with traditional sieve (Church et al. 1987) and photographic methods (Adams, 1979). Sample sites are categorized by geomorphic setting (e.g. embayments, bluffs, and spits) and sampling frequency reflects expected annual seasonal variation in sediment transport processes . These results will be used to compare forage fish habitat form and function response to future sediment inputs from dam removals. The work completed and final report is currently in peer review for publication. **Contact:** Dave Parks Washington Department of Natural Resources, 311 McCarver, Port Angeles, WA 98362.: 360-4457.2570 ext. 225/fax: 360-452-4922/ dave.parks@wadnr.gov, Dave Parks, DNR; and Jon Warrick USGS, jwarrick@usgs.gov.

Comprehensive Assessment of the Wetland Complex at the Mouth of the Elwha River. The Tribe completed a three year Elwha River estuary assessment project that was funded by the EPA. Estuarine sampling and collection activities included vegetation sampling, water quality monitoring, sediment coring, sediment benthic grabs, insect fallout traps, beach seining, and stomach lavage of juvenile salmonids. Project partners included USGS, WDFW, and Peninsula College. Results of this research will be reported in an upcoming USGS technical report likely to be published in 2010. **Contact:** Matt Beirne, Lower Elwha Klallam Tribe, 51 Hatchery Road, Port Angeles, Washington. 360.457.4012 ext 12; matt.beirne@elwha.nsn.us.