

# Elwha Nearshore Update

*A NEWSLETTER OF THE ELWHA NEARSHORE CONSORTIUM*

October 2009

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Welcome to the Fall 2009 *Elwha Nearshore Update* newsletter which summarizes current activities focusing on the Elwha nearshore. It is sponsored by the Elwha nearshore workgroup, an informal consortium 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 2008) 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 Washington Department of Fish and Wildlife (WDFW) 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), Puget Sound Partnership (PSP), and others in promoting the work and communication of the Elwha nearshore consortium. For information on the Clallam MRC contact Doug Morrill, committee chair, [doug.morril@elwha.nsn.us](mailto:doug.morril@elwha.nsn.us), and Cathy Lear, Clallam County, [CLear@co.clallam.wa.us](mailto: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](mailto:matt.beirne@elwha.nsn.us). For information on Elwha nearshore consortium, or questions or comments about the newsletter, contact Anne Shaffer, Washington Department of Fish and Wildlife at [anne.shaffer@dfw.wa.gov](mailto:anne.shaffer@dfw.wa.gov) 360.457.2634. Information on the Elwha dam removals can be found at the Elwha webpage <http://www.nps.gov/olym/elwha/home.html>.

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# Workgroup Announcements

THE 2010 ELWHA NEARSHORE CONSORTIUM (ENC) WORKSHOP, CO-SPONSORED BY THE WDFW, CLALLAM COUNTY, PENINSULA COLLEGE, AND LOWER ELWHA KLALLAM TRIBE IS PROPOSED TO BE HELD IN PORT ANGELES AT THE PENINSULA COLLEGE 25-26 JANUARY 2010. IT WILL BE A TWO DAY VENUE WITH TECHNICAL PRESENTATIONS DURING THE DAY. IN THE EVENING WE'LL HAVE THE 'ELWHA CONVERSATIONS' PUBLIC MEETING. DETAILS FORTHCOMING, CONTACT ANNE SHAFFER, WDFW, AND DWIGHT BARRY, PENINSULA COLLEGE, WITH INPUT.

## Dam Removal Project Update

Removal of the Elwha and Glines Canyon dams is scheduled to begin in 2011, following construction of associated mitigation facilities. The Port Angeles Water Treatment Plant, Elwha Water Treatment Plant, and Elwha Surface Water Intake will all be completed by the end of this year. Currently under construction is mitigation for the Elwha Heights Water Association (a water pipeline connecting residents to the Dry Creek Water Association), temporary rearing facilities for Chinook salmon on Morse Creek, and a new greenhouse facility to raise plants for the revegetation program. Construction of a new fish hatchery on the Lower Elwha Klallam Tribe's reservation will begin in November. Modification of the levee on the west side of the river mouth and the set back levee on the reservation will begin next year. Other measures in the final planning stages include a bottomless culvert for Griff Creek within the Park, a wastewater collection system for the reservation, and a pipeline outfall extension for the Nippon Paper Industries Mill at the base of Ediz Hook. Contact: Brian Winter, Olympic National Park, [Brian\\_winter@nps.gov](mailto:Brian_winter@nps.gov); (360) 565-1323.

## Additional Coordination

*The Elwha Research Consortium (ERC)*. Dwight Barry, Peninsula College, is coordinating the ERC, founded in 2005 when Western Washington University's Huxley College of the Environment and its partner institution Peninsula College continue to provide invaluable research support and education opportunities through the awarded \$500,000 by the National Science Foundation's Research Coordination Networks grant program. This initiative establishes 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. The ERC is intending to hold it's annual meeting in conjunction with the Society for Ecological Restoration and The Wildlife Society conference in February in Marysville, WA. **Contact:** Dwight Barry 360.417.6586/ [dbarry@pencol.edu](mailto:dbarry@pencol.edu) or visit the website at [www.elwhainfo.org](http://www.elwhainfo.org)

# Ongoing Nearshore Management/Restoration Issues

The 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, Battelle, USGS, WDFW, Clallam County, UI, 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@dfw.wa.gov](mailto:anne.shaffer@dfw.wa.gov)) 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.

**The Place Road Levee Fish Passage Feasibility Study.** Clallam County conducted a geomorphic investigation in to the feasibility of providing fish passage through the Place Road levee from the slough in to the impounded portion of the estuary.

The study looked at the following questions:

1. What is the morphology of the west estuary slough? How long will the slough likely be functional?
2. How much overwash occurs from the Strait of Juan de Fuca into Dudley pond?
3. Would a canal, or other proposed fish passage solutions, affect any overwash?
4. Would a truncated levee provide the needed flood protection to Place Road landowners?

The study concluded that the slough, formed in the 1980's, is "transient in nature" and may last for some time or be lost in the next flood event. Overwash has occurred but "has had little impact on the amount of sediment in the pond or the overall pond shape. The primary drivers of overwash into the pond are wind waves and ocean swell from the Strait of Juan de Fuca and overwash will not be impacted by a more variable water level within the pond." The study states that the proposed fish passage solutions would not affect any overwash.

Flooding of one residence in particular could be an outcome of truncating the levee. The residence is located at an elevation very close to the water level in the pond.

The study also concluded that the dynamic nature of the area and the input of sediment when the dams are removed "will undoubtedly cause profound change to the estuary. Sedimentation will likely begin to reform large spits and bars prograding offshore and to the east, perhaps vaguely resembling those found in pre-dam conditions (Schwartz and Johannessen 1997). This suggests the available estuary habitat could increase substantially in the coming decades regardless of other anthropogenic changes made prior to dam removal."taking place with the upcoming dam removals. Current contact for this dialog is Cathy Lear, Clallam County, [360.417.2361](tel:360.417.2361)/[CLear@co.clallam.wa.us](mailto:CLear@co.clallam.wa.us)

**The City of Port Angeles has 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. The City has been coordinating with WDFW on status and changes of the beach profile in front of the landfill retaining wall, and amassing materials for beach nourishment. On 9/22/09, a site visit was conducted with Chris Waldbillig (WDFW), Hugh Shipman and Jeffree Stewart (Ecology) and Terri Partch, (PA Public Works engineer). The beach profile has been rising and falling, with much of the toe armor rocks being exposed. At higher tide levels, there is very little evidence of physical debris from the landfill on the cobble beach. According to the City, debris can still be found at low tides. There was discussion about the appropriate size and volume of materials to be placed. Its expected beach nourishment will be added during the coming month (October 09).

The beach profile has been rising and falling, with some of the toe armor rocks being exposed on occasion. At higher tide levels, there is very little evidence of physical debris from the landfill on the cobble beach. According to the City, debris can still be found at low tides. There was discussion about the appropriate size and volume of materials to be placed. Its expected beach nourishment will be added during the coming month (October 09).

The Dry Creek Coalition has conducted some testing which reportedly found high levels of metals in certain areas; Ecology Toxics Control has been notified, and this will reportedly need further investigation. Contact: Jeffree Stewart, DoE, 360.407.6521/ [jste461@ECY.WA.GOV](mailto:jste461@ECY.WA.GOV).

The coordination between Elwha nearshore habitat management and restoration continues to need leadership. Top priority items include coordination between the City of Port Angeles (see above), Nippon Paper (who has a five-year maintenance program for applying additional armoring to the existing armoring along 9000 feet of shoreline along the Elwha bluffs), and CoE (that has a half dozen or so authorities for ecosystem assistance for drift cell maintenance and restoration). Current Elwha nearshore workgroup contact ; John Cambalik, PSP, 360-582-9132/fax: 360-582-9132 [jcambalik@psp.wa.gov](mailto:jcambalik@psp.wa.gov).

## 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 baseline study.**

Baseline studies funded by Washington State Sea Grant and the National Science Foundation were continued over the past year. The objectives for the baseline study are 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.

The fate of sediment transported from rivers to the marine environment is linked to physical processes including, river discharge, storms and tides. To best predict sediment dispersal after the Elwha dam removal we have focused our baseline studies three time periods: a) spring snow melt, b) autumn/winter storms, and c) low discharge. From 2007-2008 we completed sediment transport observations during the spring snow melt (June) and low-flow seasons (August and March). Results show that the present Elwha River plume is thin (even at high discharge), is tidally driven and bidirectional, and has relatively low suspended sediment concentration (<10 mg/L). The past year we have focused on the autumn/winter storm period. A bottom tripod, which measures near-bed currents, sediment in suspension and captures video of the sea floor and water column, was deployed from November 2008-January 2009. Results show that storm waves and strong tides (spring tides) are capable of resuspending the small amount of fine-grained sediment that is presently delivered to the delta top, and transport it to the east.

Please let your interested students know that we will again be teaching an Elwha delta Research Apprenticeship at the Friday Harbor Laboratories, University of Washington (<http://depts.washington.edu/fhl/studentApprentice2010.html#spring2>). Undergraduate students develop and complete individual research projects that will be incorporated into our baseline Elwha delta studies.

**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](mailto:ogston@ocean.washington.edu).

#### **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](mailto:beirne@elwha.nsn.us); [larry.ward@elwha.nsn.us](mailto:larry.ward@elwha.nsn.us)) and Jim Johannessen, Coastal Geologic Services, Inc., Email: [coastalgeo@comcast.net](mailto:coastalgeo@comcast.net), Phone: 360-647-1845

#### **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.**

The removal of two dams on the Elwha River of Washington State is expected to release  $1.38 \times 10^7$  m<sup>3</sup> 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. Sample workup was completed in winter 2008, data analysis will be completed by October 2009, and results presented at upcoming CERF conference.

**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](mailto:dave.parks@wadnr.gov), Dave Parks, DNR; and Jon Warrick USGS.

***Effects of Elwha Dam Removal on Nearshore Habitats*** 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 4<sup>th</sup> 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](mailto:ggelfenbaum@usgs.gov); or Jon Warrick, USGS, 400 Natural Bridges Drive, Santa Cruz, CA 95060, [jwarrick@usgs.gov](mailto: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](mailto:adraut@usgs.gov); webpage: [http://walrus.wr.usgs.gov/infobank/programs/html/staff2html/staff/Amy\\_Draut.html](http://walrus.wr.usgs.gov/infobank/programs/html/staff2html/staff/Amy_Draut.html)

### **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](mailto:TRANDLE@do.usbr.gov).

## *Habitat*

### **Nearshore Central Strait of Juan de Fuca: an ecosystem assessment of salmonid use and priority restoration actions**

This 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 with Clallam County, Peninsula College, LEKT, ONP, NOAA partnerships, provided intern experience for over 40 WWU and Peninsula College students. Results can be found in a series of reports published at the Center for Excellence website: <http://www.pc.ctc.edu/coe/publications.htm>. Findings within in the Elwha estuary have been accepted for publication in *Hydrobiologia*. The publication, in press, is entitled; Shaffer, J.A., M. Beirne, T. Ritchie, R. Paradis, D. Barry, and P. Crain. In press. Fish habitat use response to anthropogenic induced changes of physical processes in the Elwha estuary, Washington, USA.

Significant downturns in state funding have suspended the majority of agency work on the Elwha project. External funding is being pursued 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 predict post dam removal habitat function.

**Contact:** Anne Shaffer, WDFW, 332 E. 5<sup>th</sup> Street, Port Angeles, WA. 98362  
360.457.2634/417.3302fax [anne.shaffer@dfw.wa.gov](mailto:anne.shaffer@dfw.wa.gov)

**Eelgrass Mapping Along the Elwha Nearshore** The second round of eelgrass mapping was conducted during spring/summer 2009. Area of emphasis were Freshwater Bay, Port Angeles Harbor, and Dungeness Bay. The work is sponsored by the Clallam Marine Resources Committee with partnership from WDFW and the USFWS National Coastal Maritime Refuge.

**Contact:** Cathy Lear, Clallam County, Port Angeles Washington 360.417.2361.

### **Nearshore Fish Communities in the Eastern and Central Strait of Juan de Fuca**

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.

**Contact:** Kurt Fresh, NOAA Fisheries. Northwest Fisheries Science Center, 2725 Montlake Blvd. East, Seattle, WA 98112-2097. 206.860.6793. [kurt.fresh@noaa.gov](mailto: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](mailto:larry.ward@elwha.nsn.us)

***Elwha Nearshore Habitat Monitoring.*** 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 venturi 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.***

**Contact:** Jeff Duda, Western Fisheries Research Center, 6505 NE 65<sup>th</sup> St., Seattle, WA, 98115. 206-526-6282 x 233, [Jeff\\_Duda@usgs.gov](mailto:Jeff_Duda@usgs.gov).

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 (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 cm<sup>2</sup> to 100 m<sup>2</sup>. 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 5<sup>th</sup> 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 3<sup>rd</sup>. 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](http://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

### 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](mailto:beirne@elwha.nsn.us).

## 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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## Educational Entities

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

Peninsula College (PC) were 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. 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 dams. The 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, 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](mailto:dbarry@pencol.edu)). For

more information and full list of participants **Contact** Dr. Hague, (PI), Peninsula College, \, 360-417-6246, bhauge@pencol.edu

Washington State University (WSU) Beachwatchers program continues in Clallam County.  
**Contact:** David Freed, WSU Beach Watchers, Clallam County 360-565-2619  
DFreed@co.clallam.wa.us

## Additional Resources, Completed Studies, and Publications

The Elwha Research Consortium 'Upstream' newsletter has been discontinued; instead, news updates are provided in the "News" tab of the Elwha Watershed Information Resource, online at [www.elwhainfo.org](http://www.elwhainfo.org) **Contact:** Dwight Barry [360.417.6586/dbarry@pencol.edu](mailto:360.417.6586/dbarry@pencol.edu).

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/>

As the removal of the Elwha River dams approaches, a new collection of research papers has been published as a Special Issue of the journal Northwest Science. 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. In press.*** Shaffer, J.A., M. Beirne, T. Ritchie, R. Paradis, D. Barry, and P. Crain. *Hydrobiologia*

***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](http://pnptc.org/Historical_Nearshore.html).

***Contact:*** Steve Todd, Point No Point Treaty Council, 7999 NE Salish Lane, Kingston, WA 98346, 360-297-6526, [stodd@pnptc.org](mailto:stodd@pnptc.org)

***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