

Elwha Nearshore Update

A NEWSLETTER OF THE ELWHA NEARSHORE CONSORTIUM

October 2008

Welcome to the Fall 2008 *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 2007) 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 provides workgroup and newsletter coordination, and partners with the Lower Elwha Klallam Tribe, Clallam Marine Resources Committee (MRC), Olympic National Park, Peninsula College, Puget Sound Partnership, and others in promoting the work and communication of the Elwha nearshore consortium. For information on the Clallam MRC contact Doug Morrill, committee chair, dmorril@elwha.nsn.us, 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; 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 shaffjas@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>.

Table of Contents

Workgroup Announcements	2
Additional Coordination	2
Ongoing Management Issues	2
New and Ongoing Restoration Activities by Subject Category.....	4
Physical Processes.....	4
Habitat	6
Biological Communities.....	11
Fisheries	12
Workgroup Directory.....	13
Educational Entities	13
Additional Resources, Completed Studies, and Publications	14

Workgroup Announcements

THE 2009 ELWHA NEARSHORE CONSORTIUM (ENC) WORKSHOP CO-SPONSORED BY THE WDFW, CLALLAM COUNTY, PENINSULA COLLEGE AND LEKT. WILL BE 8 JANUARY 2009 IN PORT ANGELES AT THE PENINSULA COLLEGE. TECHNICAL PRESENTATIONS DURING THE DAY. IN THE EVENING WE'LL HAVE THE 'ELWHA CONVERSATIONS' PUBLIC MEETING. DETAILS FORTHCOMING, CONTACT ANNE SHAFFER, WDFW, SHAFFJAS@DFW.WA.GOV, WITH INPUT.

JEFF DUDA, USGS, IS CONVENING AN ELWHA RESTORATION SESSION AT THE UPCOMING PUGET SOUND GEORGIA BASIN CONFERENCE, 9-11 FEBRUARY 2009, IN SEATTLE. CONTACT JEFF (Jeff.Duda@usgs.gov) IF YOU'RE INTERESTED IN PARTICIPATING.

Additional Coordination

The Elwha Research Consortium (ERC). Dwight Barry, Professor, 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. **Contact:** Dwight Barry 360.417.6586/ dwrightb@pccadmin.ctc.edu.

Ongoing Nearshore Management/Restoration Issues

The key elements of the nearshore restoration strategy, including historic 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, and 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 (shaffjas@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 Clallam County continues to promote dialog with citizens and Place Road landowners on the west levee and has co-authored a SRFB proposal to provide fish passage thru the west levee in conjunction with the dike alteration that will be taking place with the upcoming dam removals.

Funding decision is due no later than January 2008. Current contact for this dialog is Cathy Lear, Clallam County, 360.417.2361/CLear@co.clallam.wa.us

The coordination between Elwha nearshore habitat management and restoration continues to need leadership. Top priority items include coordination between the city of Port Angeles (installing a new revetment along the Elwha bluffs); 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 contacts for this are Matt Beirne, Elwha Tribe (457.4012 x 12/ beirne@elwha.nsn.us); Jeffree Stewart, DoE, 360.407.6521/ jste461@ECY.WA.GOV; and John Cambalik, PSP, 360-582-9132/fax: 360-582-9132 jcambalik@psp.wa.gov.

The Port Angeles landfill closure . The City of Port Angeles was required to seal off the waterward, northern edge of the circa 1930 landfill, located along the formerly unarmored portion of the feeder bluff of the Elwha drift cell. An early proposal for placement of 10K tons of rock armoring on the beach was not allowed, and a compromise design was approved that required excavation 30 feet landward, removal of debris, insertion of sheet pile walls with rock toe protection, and placement of sand and cobble as beach enhancement over the toe protection. A road down Dry Creek ravine was used for hauling materials, that must be scaled back where it intruded near the mouth of the creek. Required monitoring of the beach enhancement will begin as of this winter. Maintenance activities for beach enhancement may be required, as determined by results of monitoring. Contact for this project is Jeffree Stewart, DoE, 360.407.6521/ jste461@ECY.WA.GOV.



Port Angeles land fill closure project July 2008.

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 baseline studies this past year focused on characterizing seasonal variations in sediment-transport dynamics and sediment sampling of the seabed to validate multibeam acoustic backscatter collected in 2007. Results show that the present Elwha River plume is thin, even at high discharge, is tidally driven and bidirectional, and has relatively low sediment concentration (<10 mg/L). Bed shear stresses can be high due to tidal currents around the delta front, and the combined wave-current stresses have winnowed fine-grained material leaving a gravel/cobble seabed. Sediment dispersal under present, restricted supply conditions is broad and most of the fine-grained sediment likely leaves the shallow delta surface.

Students from around the U.S. were involved in the baseline studies through a Research Apprenticeship taught at the Friday Harbor Laboratories, University of Washington (<http://depts.washington.edu/fhl/studentApprentice2008.html#spring3>). Throughout the spring quarter, undergraduate students developed and completed individual research projects that were incorporated into our baseline studies. These students were highly motivated and appreciated the research experience and field trips given by a number of scientists in the Nearshore Research Consortium.

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.

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 (beirne@elwha.nsn.us; lward@elwha.nsn.us) and Jim Johannessen, Coastal Geologic Services, Inc., Email: 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 1.38×10^7 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.

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;Tiffany Nabors, Western Washington Univsity; 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.

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

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.

Habitat

An Integrated Approach to Restoration of Anadromous Salmonids and Their Habitat in the Elwha River Following Dam Removal. (The LEKT-UI-CSC Project)

Contact: Chris Peery, University of Idaho Cooperative Fisheries Research Unit, Moscow, ID. 208.885.7223. cpeery@uidaho.edu

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

In this project the Washington Department of Fish and Wildlife Habitat Science program and Lower Elwha Klallam Tribe (with strong and much appreciated partnering support of Clallam County Marine Resources Committee, Peninsula College Fisheries and REU programs, Western Washington University Biology and Huxley programs, as well as collaboration with USGS, and NOAA) continues defining fish use within the central Strait nearshore, and in particular the Elwha nearshore. Our focus includes defining: a) Species populations, timing, and life history strategies of juvenile salmonids (including Puget Sound Chinook, Hood Canal Summer Chum, searun cutthroat, steelhead, and bull trout) within the central and western Strait, with an emphasis on Elwha nearshore, and; b) Nearshore habitat function for fish, including spawning forage fish. The study, funded in 2007, is based on the nearshore restoration strategy developed in 2004 (see Shaffer et al. 2004). In this work the nearshore from Pysht east to the tip of Dungeness Spit has been partitioned by geomorphic habitat type. Fish use is then documented at selected representative sites by beach seining, forage fish spawn surveys, and kelp snorkeling surveys. Since March 2007 we have worked with over 24 undergraduate students and conducted over 600 seines over 22 sites of central and western Strait lower rivers, shorelines, bluffs, and spits; repeatedly sampled five shoreline, bluff, and spit sites for surf smelt spawn, and; conducted snorkel surveys of six shoreline, spit, and bluff kelp beds a minimum of three times. Draft watershed reports are available on request. Highlights of findings to date include:

Salmonid use of nearshore. Fish use of the nearshore central and western Strait appears to vary with nearshore habitat type. Salmonid use varies by habitat type and geographic area. In particular

A. Fish use of the Elwha estuary From Shaffer, Beirne et al (in prep): The fish use of three main areas (east, west, and impounded west sections) of the Elwha estuary was assessed using standard seining techniques from March-September 2007. Species diversity, richness, and evenness were all highest in the connected section of the west estuary which constitutes only 20% of the total Elwha estuary. Further, over 60% of total fish, 90% of salmonids, and 94% of juvenile Chinook salmon were collected from connected west estuary. Species diversity and richness of the Elwha east estuary and impounded west estuary were very similar for months both were sampled. Juvenile salmon were the same size in the east and west connected estuary. We theorize that sediment processes closed off fish access the majority of the east estuary for most of the 2007 outmigration window. Migrating juvenile salmon are theorized to have responded to this closure by using the small proportion of west estuary left to them. These results indicate that: 1. Use of the Elwha estuary is complex and even fragments of connected estuary are critically important for migrating salmon; 2. Sediment processes in the Elwha estuary are dynamic, and; 3. Juvenile salmon appear to be able to respond to dynamic sediment environment. Projecting these conclusions to the upcoming dam removal project lead us to recommend that our top priority for nearshore restoration includes increasing habitat options available for juvenile salmon in the Elwha estuary. Modification of the west levee to provide, at a minimum, fish passage, and optimally to provide at least partial ecosystem recovery is a top priority for nearshore restoration in the central Strait of Juan de Fuca. More detailed monitoring of fish migration in the Elwha estuary, including radio tracking of fish to better define fish use of this complex and dynamic estuarine habitat is warranted and strongly recommended.

B. ESA listed Chinook use of the Elwha nearshore. From Shaffer, Crain et al (in prep): Fifty-eight juvenile Chinook salmon were collected from nearshore areas of the central and western Strait of Juan de Fuca, west of the Elwha River, between June and September 2007. Genetic analysis documented that 43% of these fish were Puget Sound Chinook salmon (Elwha/Dungeness reporting group), with 48% representing various Columbia River populations. The remaining 9% of the Chinook salmon observed were contributed by Washington Coastal and the Klamath Falls systems. These observations have important management implications as the National Marine Fisheries Service currently ends the Critical Habitat designation of nearshore habitat for the Puget Sound Chinook salmon population at the mouth of the Elwha River. It also supports long held belief that nearshore of the open coast of Washington is critical for salmon migration. Information supporting significant use of nearshore areas west of the Elwha River by listed Chinook salmon should result in revision of the Critical Habitat designation and boundary to accurately reflect the geographic area and nearshore habitats used by federally listed species.

Kelp bed function A total of 14 snorkeling surveys were conducted in the kelp beds within Elwha and comparative drift cells during the summer of 2007. Surf smelt, herring, and sand lance were the dominant species. Very few salmon were observed relative to snorkeling surveys conducted in some of the same areas in June-August 2001. Fish density was significantly higher in kelp beds than non-kelp habitat and significantly higher in kelp beds within the comparative drift cells than in the Elwha drift cell. Geomorphic habitat type was also a significant variable in fish use of overstory kelp beds: kelp beds at embayed sites had higher fish density than spits and bluff sites. Kelp density, and water depth are theorized to contribute to the observed different in function. The drop in densities of some species from 2001 sampling may be due to stock declines, or interannual variation. Additional work defining the structure and functional processes of kelp beds, as well as long term variability in fish use, is recommended.

Contact: Anne Shaffer, WDFW, 332 E. 5th Street, Port Angeles, WA. 98362
360.457.2634/417.3302fax shaffjas@dfw.wa.gov

Eelgrass Mapping Along the Elwha Nearshore The second round of eelgrass mapping will occur during spring/summer 2009. Area of emphasis will include Freshwater Bay, Port Angeles Harbor, and Dungeness Bay. The work is sponsored by the Clallam Marine Resources Committee with partnership from WDFW and the 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 associated 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 over the three-year period from Discovery Bay to Crescent Bay. 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 represent the majority of the salmonid catches early in the year (March-April) while Chinook catches generally peak in June/July. In 2008 we plan to begin sampling the invertebrate communities at specific sites for comparison with previously collected Chinook stomach samples.

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. lward@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 site 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 65th St., Seattle, WA, 98115. 206-526-6282 x 233, 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) 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, 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 being reviewed (internally) for publication in *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 August 2008 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 (Boscoe 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 transects using a GIS. We also used the Delft 3-D hydrodynamic model to identify slack (i.e., low currents) diving windows. Sampling will occur during 15 days spread over a 6-week period of August and September. The goal for each of the two diver teams is 3 dives per day, which should allow approximately 75-90 surveyed transects depending upon weather.

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), 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 is nearing completion of its third season of a three year estuary assessment project funded by the EPA. Estuarine sampling and collection activities during the 2007 field season

included vegetation sampling, water quality monitoring, sediment coring, sediment benthic grabs, insect fallout traps, beach seining, and stomach lavage of juvenile salmonids.

Fisheries assessment activities were developed with guidance from Jeff Cordell, University of Washington, and included bi-monthly seining within the estuary on the east side of the Elwha River mouth. Seining was conducted in five locations within the estuary. Due to the significant storms the previous winter, the estuarine complex on the east side of the river was severely constricted by a sediment berm. This appears to have resulted in a lesser abundance and diversity of fish caught during this season's seining activities relative to the 2006 season. Juvenile salmonids greater than approximately 60 mm were lavaged to extract stomach contents for diet analysis. Diet preference for juvenile salmonids will be compared to the macroinvertebrate community identified through sediment grabs and insect fallout traps. Periodically juvenile Chinook salmon were collected for the USGS otolith study led by Jeff Duda. WDFW and Peninsula College and the Clallam Marine Resources Committee partnered with the project by conducting seining on the west side of the river mouth. They documented very large numbers of juvenile salmonids in the western estuary (see synopsis above.)

Vegetation sampling was completed in August with the assistance of USGS staff (Pat Shafroth, Tracy Fuentes, and Vanessa Beauchamp) and Rebecca Paradis (REU student). Sampling was based on a modified-Whittaker method using nested plots.

Rob Young, University of North Carolina, and his field crew completed sediment coring in June. A subsample of cores will be radiocarbon dated and analyzed for carbon/ nitrogen/ sulfur. Benthic macroinvertebrates were collected by tribal staff in May, July, and September throughout the estuary complex (including the private isolated pond on the west side) using petite Ponar sediment grabs. Water quality data was collected throughout the estuary using a Hydrolab Datasonde 4a for temperature, dissolved oxygen, salinity, conductivity, pH, turbidity, and depth.

Contact: Matt Beirne, Lower Elwha Klallam Tribe, 51 Hatchery Road, Port Angeles, Washington. 360.457.4012 ext 12; 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) continues to implement the National Science Foundation's Research Experiences for Undergraduates funded program to establish an undergraduate student research program at PC, linking students with faculty and agency scientists. This grant funds 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.

This includes the possibilities for terrestrial, freshwater, and nearshore projects. For more information and full list of participants **Contact** Dr. Bill Eaton (PI), Peninsula College, 1502 East Lauridsen Blvd., Port Angeles, WA 98362, 360-417-6246, bille@pcadmin.ctc.edu.

Washington State University (WSU) Beachwatchers program continues in Clallam County. The second training session for citizen monitoring, which has included elements of the Elwha nearshore, will be completed in November 2007. Beachwatchers is an excellent resource for assistance in field monitoring. **Contact:** David Freed, WSU Beach Watchers, Clallam County 360-565-2619 DFreed@co.clallam.wa.us

Additional Resources, Completed Studies, and Publications

Peninsula College is sponsoring a newsletter of the Elwha Research Consortium entitled 'Upstream'. The newsletter, initiated in September 2006, can be found at [http://www.pc.ctc.edu/coe/new%20pdfs/UPSTREAM1\(1\)Sept06.pdf](http://www.pc.ctc.edu/coe/new%20pdfs/UPSTREAM1(1)Sept06.pdf). **Contact:** Dwight Barry 360.417.6586/dwightb@pcadmin.ctc.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.pc.ctc.edu/coe/publications.htm>. 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.

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, Point No Point Treaty Council, 7999 NE Salish Lane, Kingston, WA 98346, 360-297-6526, stodd@pnptc.org

Use of Estuarine and Nearshore Habitats by Anadromous Salmonids.

Contact: Chris Peery, University of Idaho Cooperative Fisheries Research Unit, Moscow, ID. 208.885.7223. cpeery@uidaho.edu Raymond Moses, Lower Elwha Klallam Tribe. 51 Hatchery Road, Port Angeles, WA 98363. 360.457.4012 ext. 26. rmoses@elwha.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