

Elwha and Glines Canyon dam removals: nearshore restoration of the central Strait of Juan de Fuca

Anne Shaffer

Washington Department of
Fish and Wildlife



Cathy Lear, Clallam County

Doug Morrill, Matt Beirne, Elwha Tribe

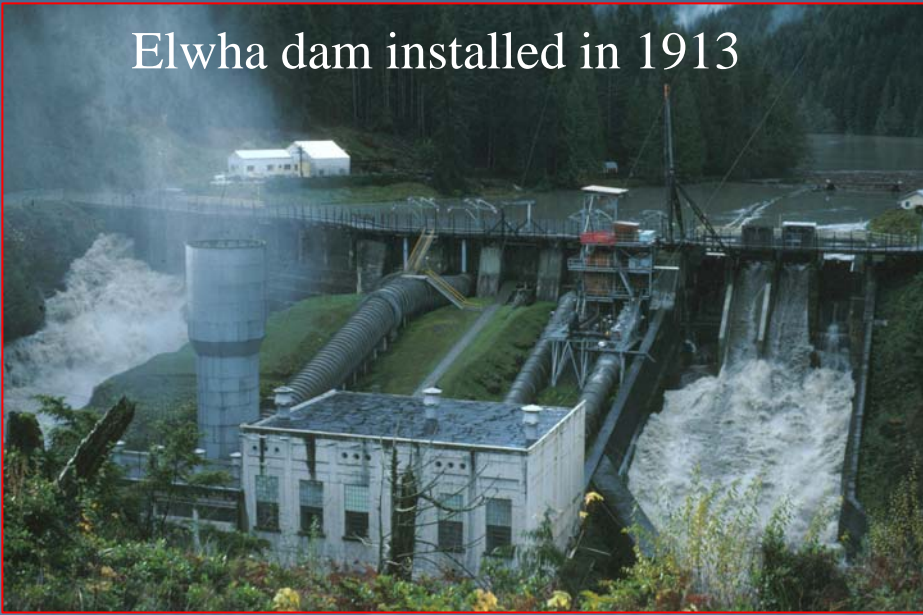
Pat Crain, Olympic National Park

Elwha watershed overview

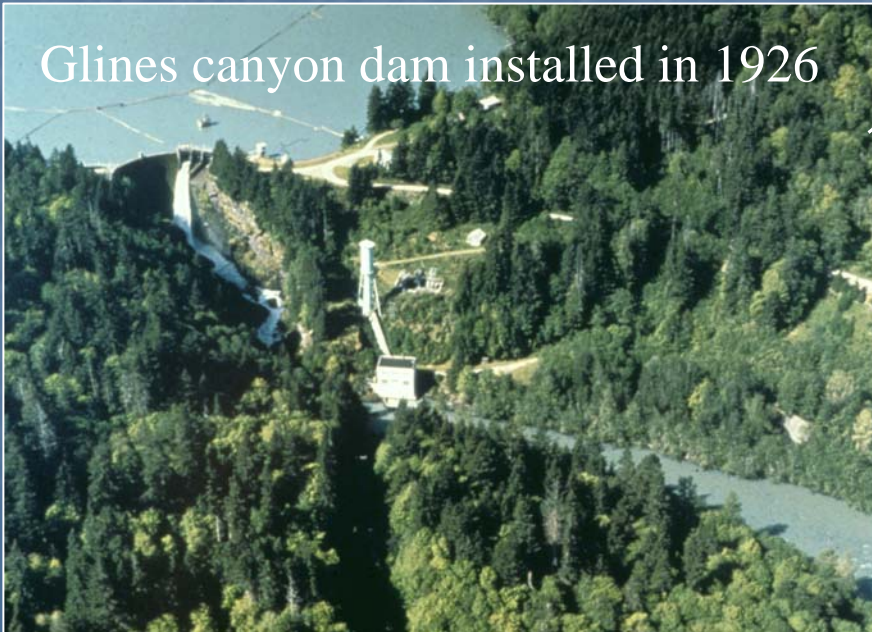
- 321 square miles, of which 267 mi² (83%) in Olympic National Park.
- Mean winter flows 2,000 cfs.
- Mean summer flows 600 cfs.
- Peak flood events 40,000 cfs.
- Base summer low flows 200 cfs.
- Annual precipitation in the basin 220 inches the upper reaches 56 inches at the river mouth.
- Bimodal flow pattern
Peak flows in November (rain on snow events) and June (snow melt)



Elwha dam installed in 1913



Glines canyon dam installed in 1926



Dam impacts Freshwater

- **Block** 93% of spawning and rearing habitat
- Trap sediment and woody debris critical for fish habitat
- **Raise** water temperature and increased incident of diseased/stressed fish
- **Inundate** culturally and biologically important freshwater habitat
- **Within** Olympic National Park, and so in conflict with federal Trust responsibility and park policy

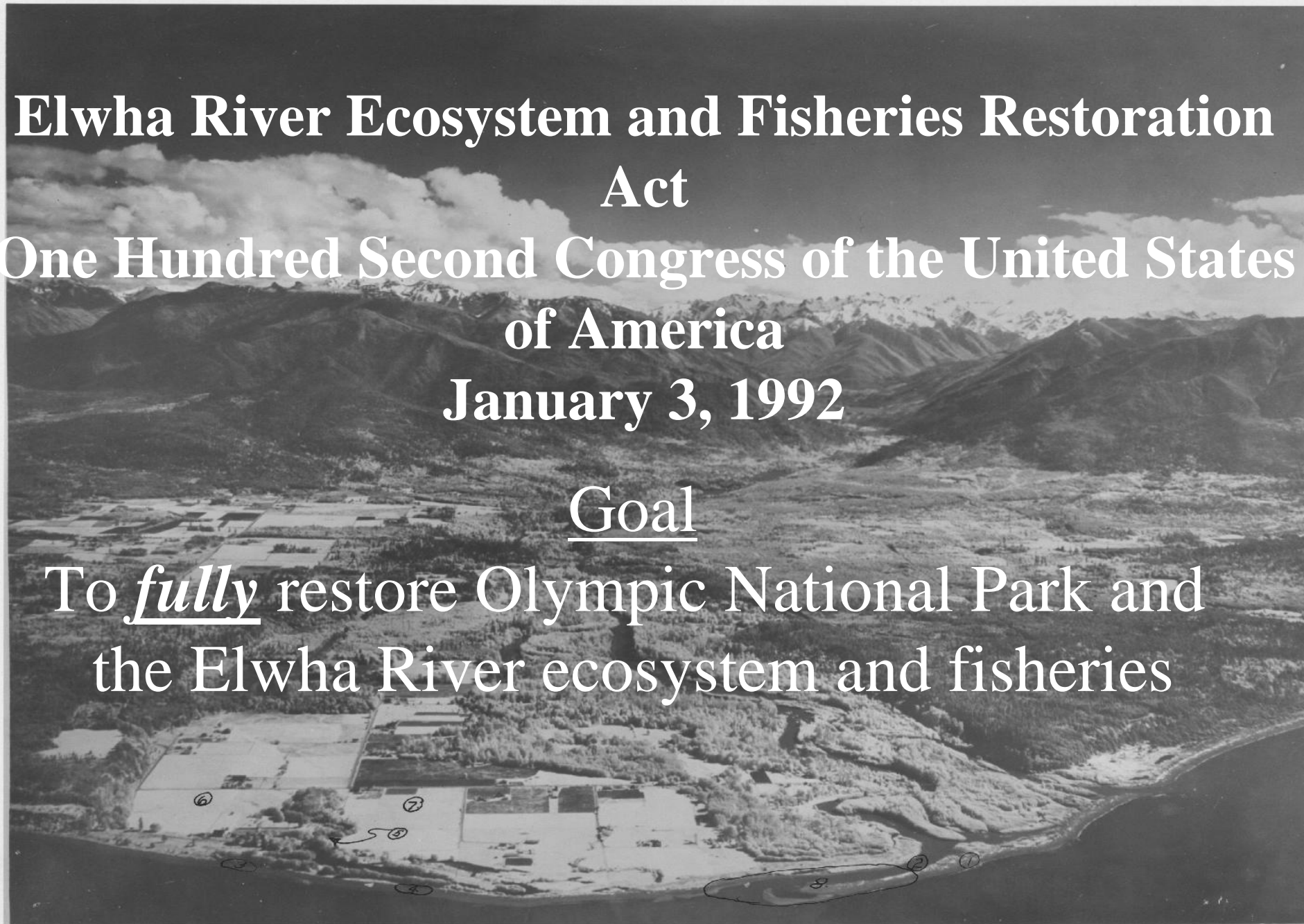
Elwha River Ecosystem and Fisheries Restoration Act

One Hundred Second Congress of the United States
of America

January 3, 1992

Goal

To fully restore Olympic National Park and
the Elwha River ecosystem and fisheries



Map by Randall McCoy, Elwha Tribe

VANCOUVER ISLAND,
BRITISH COLUMBIA



Shaffer, et al. 2006
WDFW



Elwha nearshore

Strait of Juan de Fuca is a unique feature of the Pacific Northwest

294 km long, 20-28 km wide, and 250 m deep at its entrance: includes a number of nearshore embayments

> 80% of the water from Puget Sound and Strait of Georgia flows through the Strait (Mackas and Harrison 1997)

High geographic, temporal (interannual and seasonal) variability in physical and biological processes that make up the Strait nearshore

Strait of Juan de Fuca

- Bathymetry 50-ft. interval
- > 200 ft. contours
- 200 ft. contour
- < 200 ft. contours
- Roads
- Primary road
- Secondary road
- Cities/Towns
- ☆ Capitol
- City
- Town

Overview of the central Strait

Shaffer, et al. 2006
WDFW



- High seasonal and geographic variability.
- The Strait is a wind and river-dominated system. Currents change dramatically within hours in response to both regional and larger scale oceanic winds. Water temperature and salinity largely defined by riverine flow.
- Sediment processes are the main nearshore forming process
 - Bluffs contribute majority of beach building material to nearshore, followed by major rivers.
 - Dominant limiting process for central Strait nearshore. Processes severely disrupted in the Elwha nearshore
- 66% of the tidelands of the Strait are publicly owned
- Less than 12% of upland adjacent to public beaches publicly owned

5 4'97

Zones of the Strait: Main Basin and Nearshore

- *Deep oceanic water*, strong wind and current mixing action, and seasonal strong contribution of riverine nutrients, make the water of the main basin well-mixed, cold, and oxygen and nutrient-rich throughout the year (Mackas and Harrison 1997).
- *Nearshore*: area of tidal influence, including trees along shoreline (riparian zone) to approximately 30m depth. May have limited circulation, be nutrient limited, and stratify.



Shaffer et al. 2006

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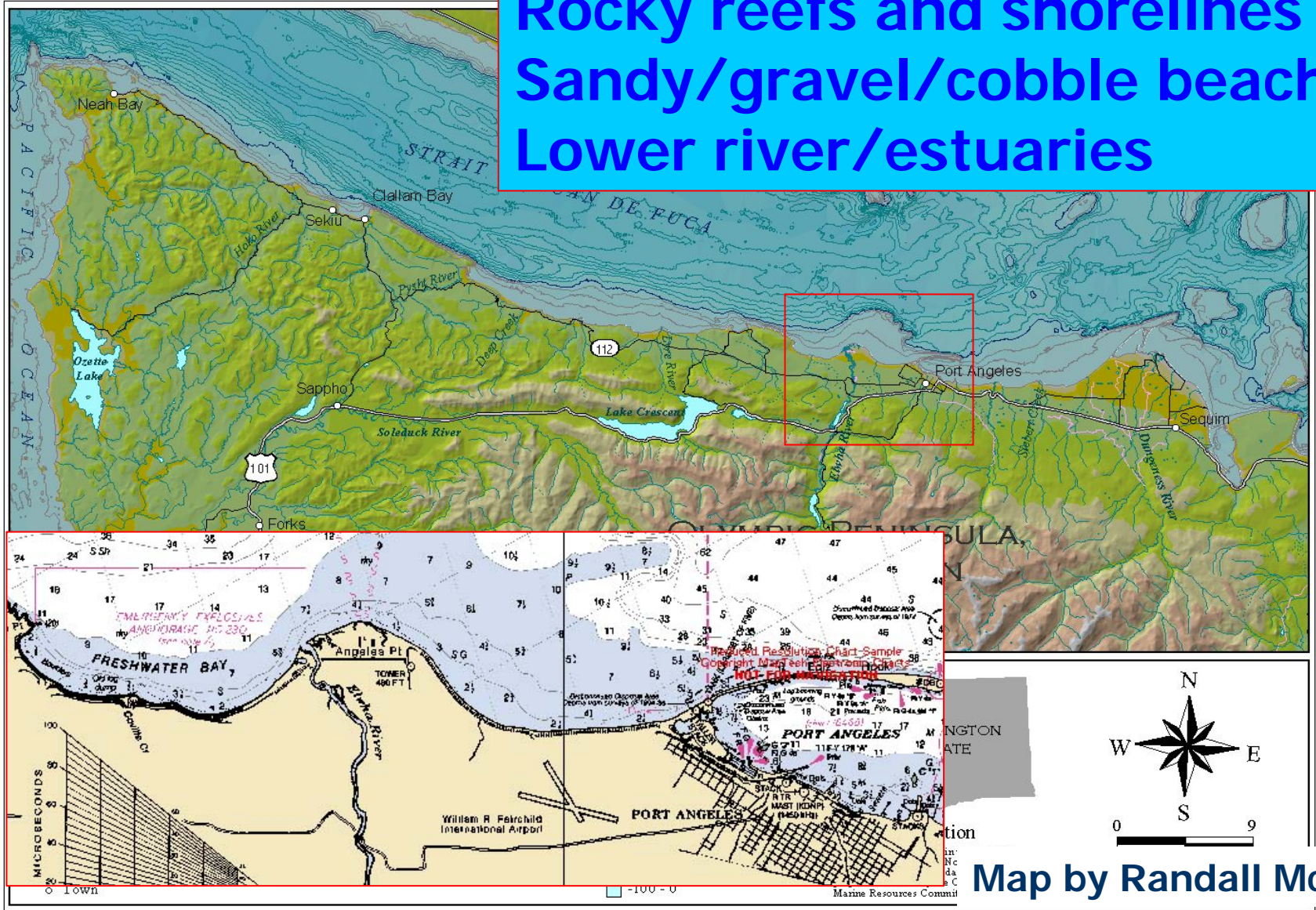
Elwha nearshore

Feeder bluffs

Rocky reefs and shorelines

Sandy/gravel/cobble beaches

Lower river/estuaries



Shaffer, et al. 2006
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Elwha rocky reefs and shorelines

- ┌ Kelp beds, drift algae, and rocky/ cobble shorelines with Laminarian cover.
- ┌ Kelp beds dominant-found along almost entire shoreline, extensive in Freshwater Bay.

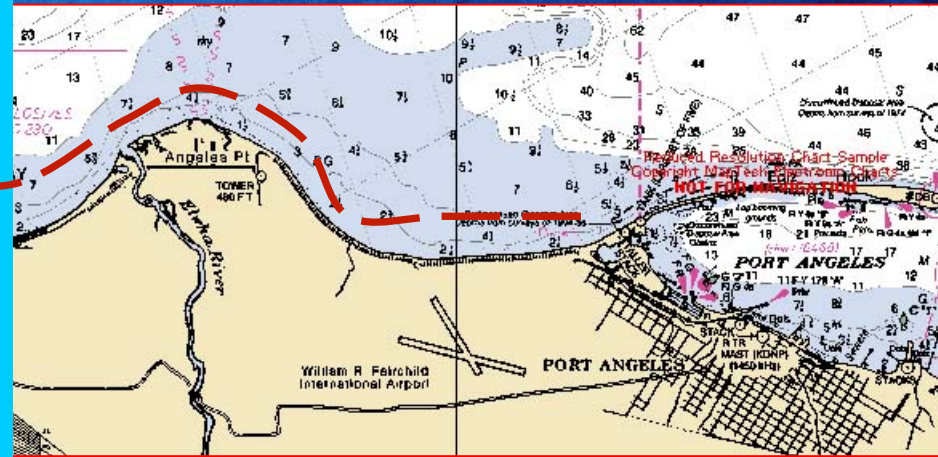


Photo by John Trone

Shaffer et al, 2006
WDFW



Elwha kelp and eelgrass beds used for migration and feeding salmon, forage fish, rockfish, etc...



Shaffer et al, 2006 WDFW

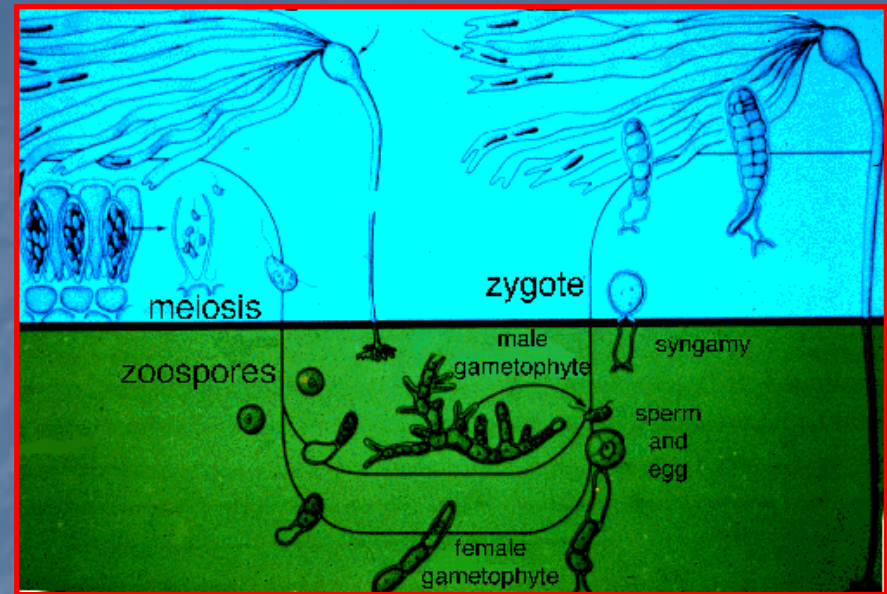


Haliotis kamtschatkana

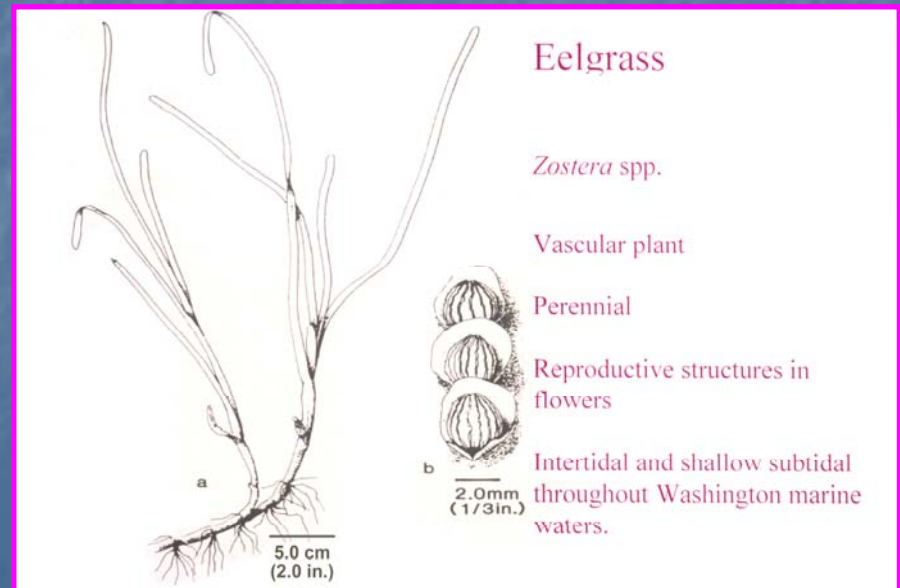
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Kelp and eelgrass beds-substrate matters

- Bull Kelp: Dominant overstory species
 - *Nereocystis luetkeana*
 - Annual species
 - Non-vascular
 - Needs cobble/rock substrate
 - All along our coast

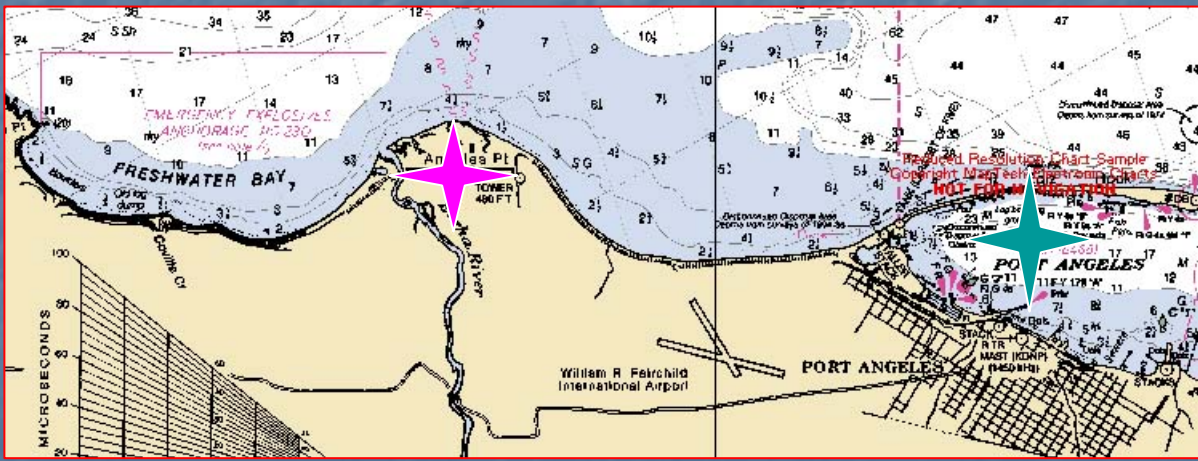
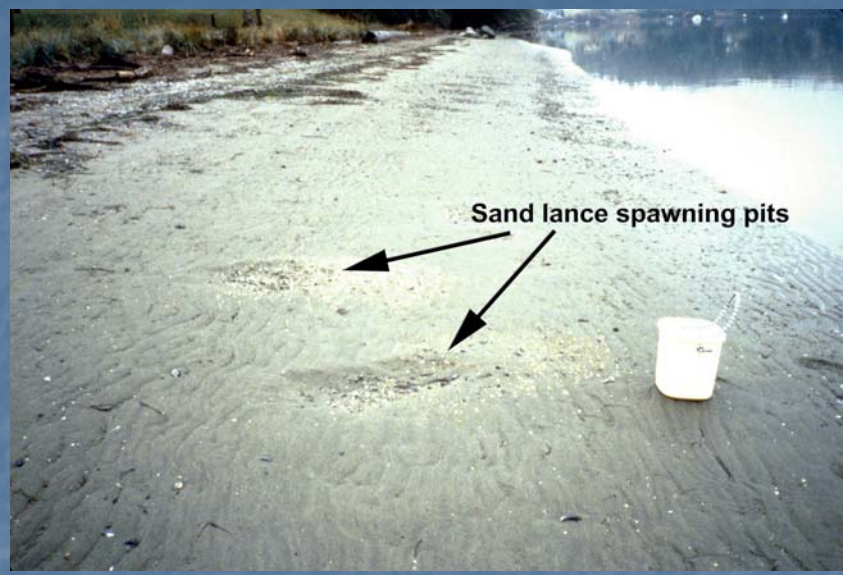
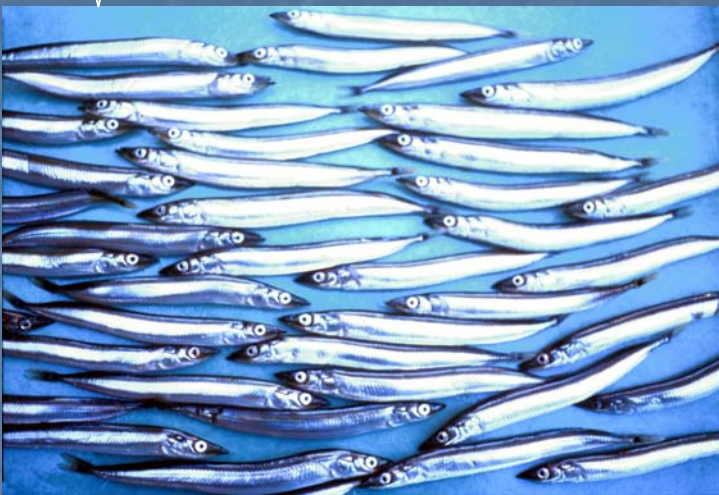


- Eelgrass:
 - *Zostera marina*
 - Perennial species
 - Vascular plant
 - Needs sand/gravel mix substrate



Elwha sandy beaches: who uses them...Forage fish and migrating salmon

★ Sand lance



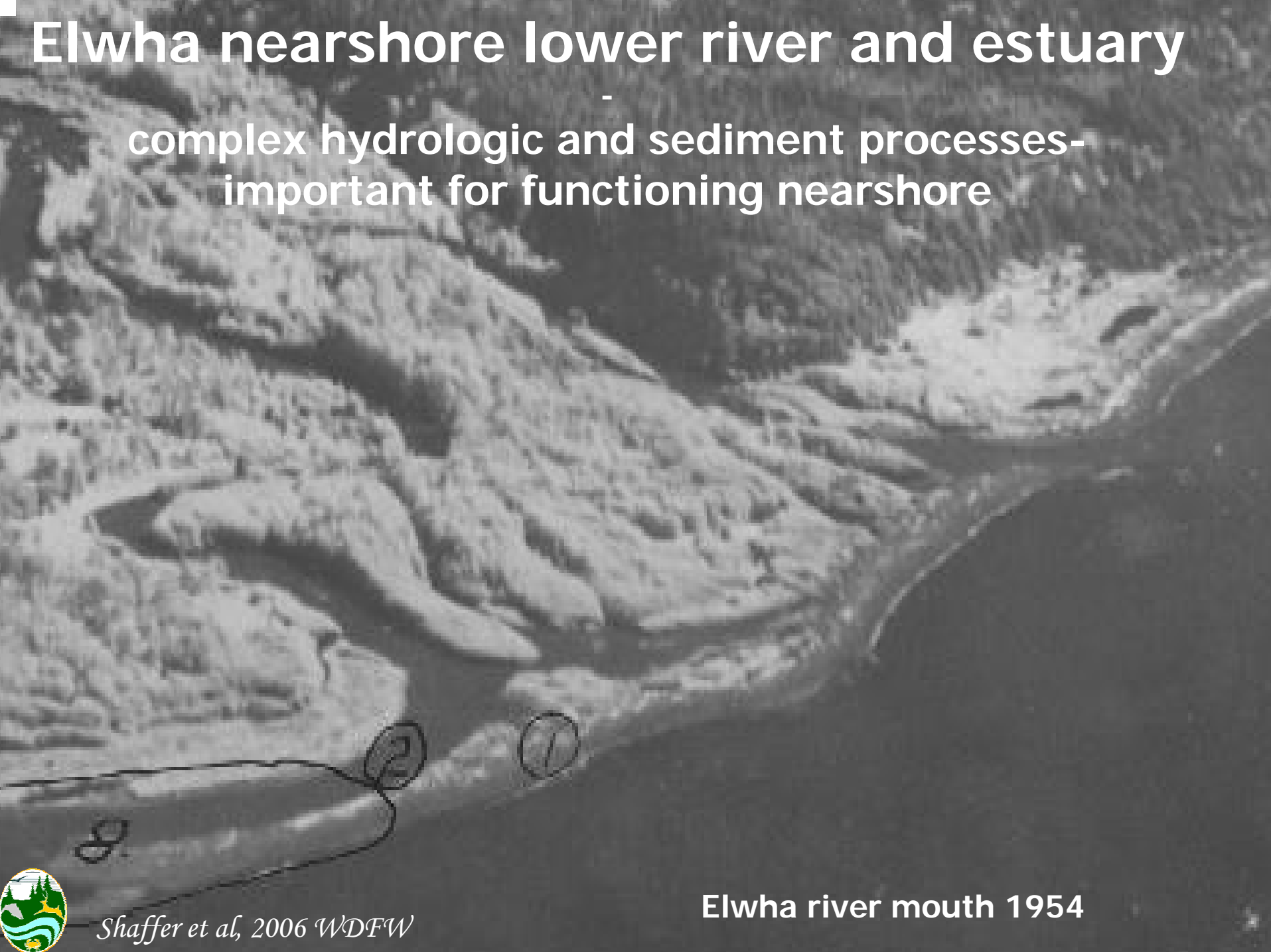
★ Eulachon



Shaffer et al, 2006
WDFW

Elwha nearshore lower river and estuary

complex hydrologic and sediment processes-
important for functioning nearshore



Lower rivers of the Elwha nearshore, who uses them...

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No fish



Juvenile salmonids
Heavily utilized by Chinook,
coho, chum, pink, cut throat, bull
trout

Anchovy, eulachon, surf perch

Etc...

Elwha river mouth 2005



Shaffer et al, 2006 WDFW

Elwha nearshore processes significantly impacted



Shaffer et al 2006
WDFW

1. Altering of rivers *
 - Damming
 - Modifying of shoreline ✦
2. Armoring of marine shorelines * ✦
3. Overwater structures ✦
4. Non-point pollution ✦
5. Point source/industrial pollution ✦
6. Oilspills ✦

* Significantly impact Elwha nearshore

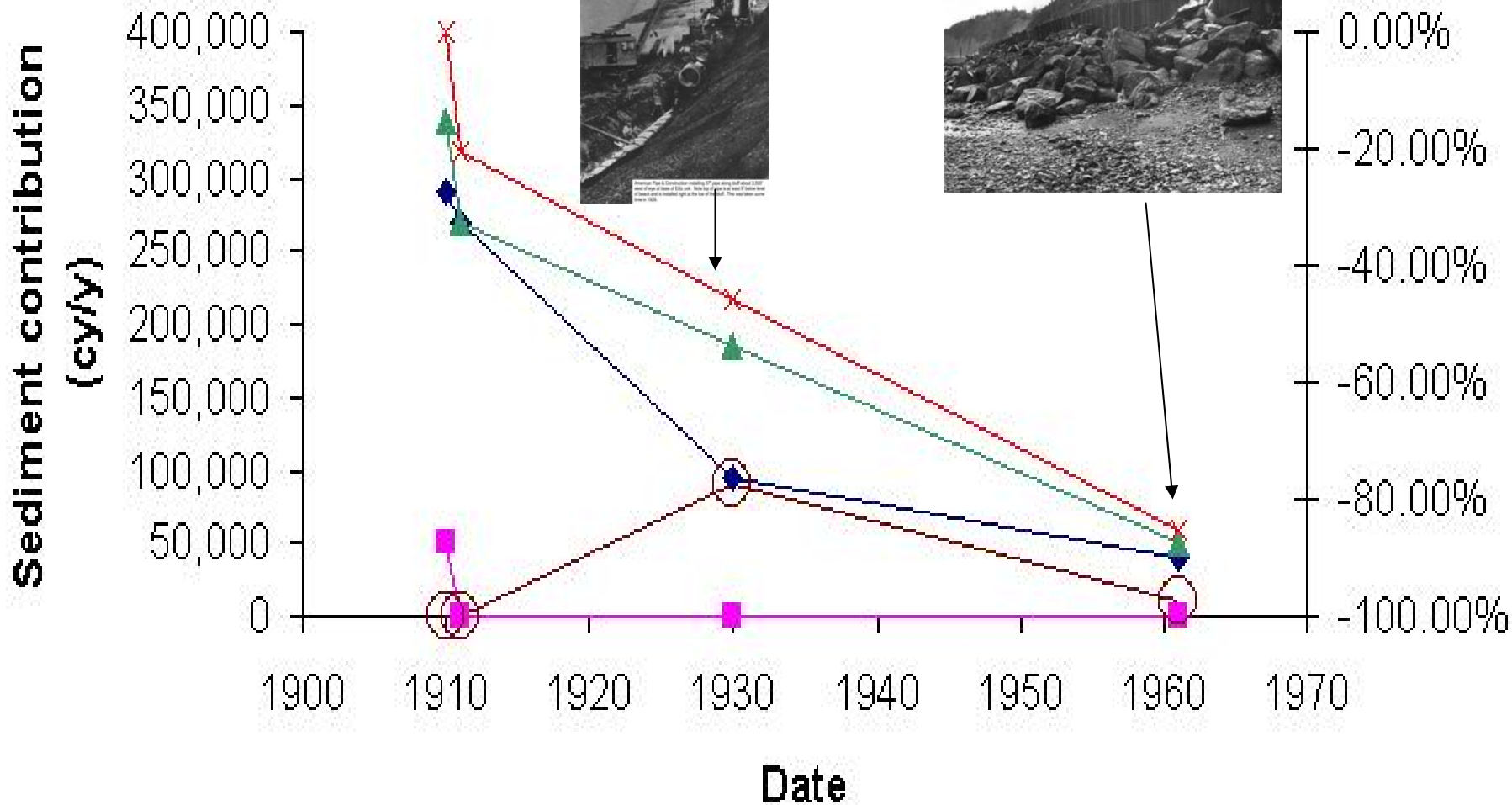
✦ Outside Olympic National Park



Littoral sediment contribution



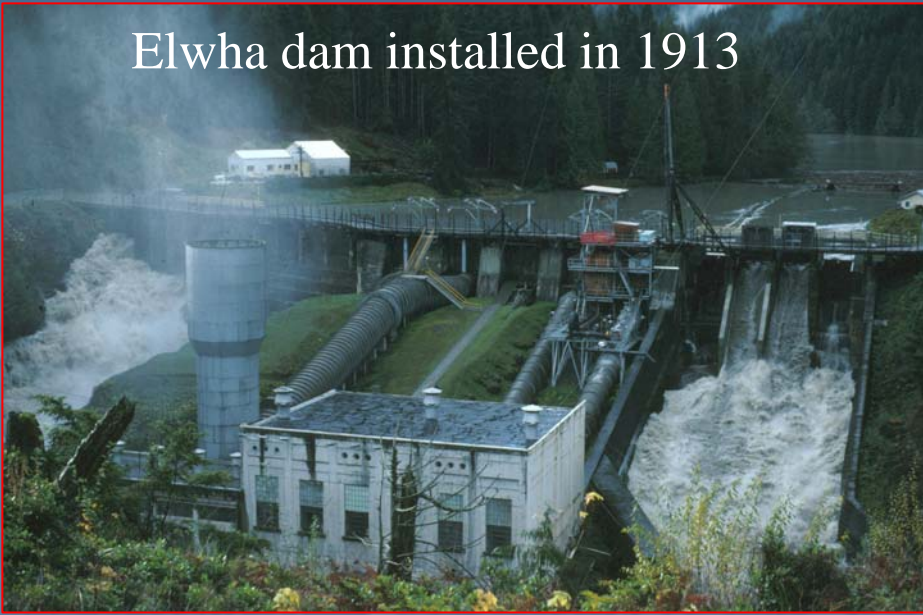
Shaffer, 2004
WDFW



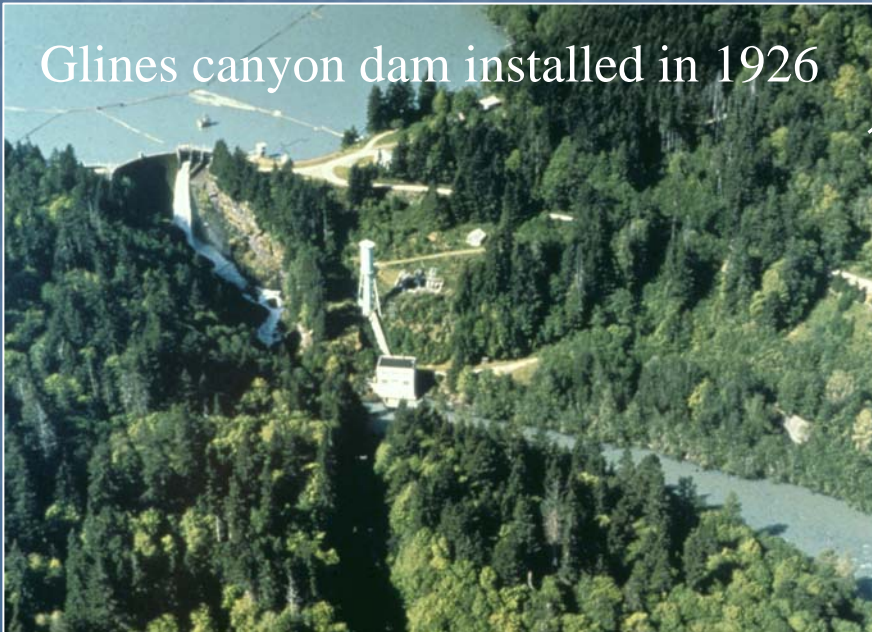
Photos provided by Dean Reed, Nippon

■ Elwha River ◆ Sea Bluffs ⊖ Eroding Beach ▲ Total × % change

Elwha dam installed in 1913



Glines canyon dam installed in 1926



Elwha shoreline alteration



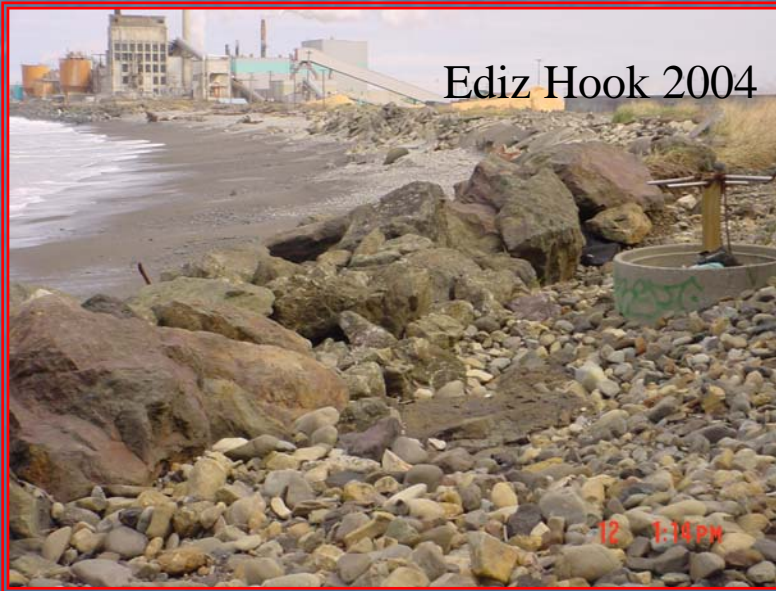
Ediz Hook 1884



Dungeness Spit 2004



Ediz Hook 2004



Dungeness Spit 2004



Shaffer, et al. 2006
WDFW



Lower river alterations

1964 construction of sugar dike by Clallam County



MOVING A RIVER — A bulldozer crosses the old channel after cutting through the last of gravel Thursday to allow the Elwha River to turn into a new channel at its mouth. A new bed for the river was dug after it had cut its way westward to a point where it endangered several residences at The Place near the confluence of the Elwha and the Strait of Juan de Fuca. The Strait is in top of picture. (Evening News Photo.) *May 15 - '64* (12)



1965



Shaffer, et al. 2006
WDFW

Restoration Future

- Elwha and Glines Canyon dams are slated to begin being removed in 2009.
 - Total sediment contribution to nearshore (including silt, sand, gravel, and cobble) from dam removal:
 - Initial sediment contribution 2-3 million cy of coarse (sand and gravel) and approximately 7-8 million cy of fine (silt and clay) material within 5 years of dam removal is predicted (Randle, pers comm).
- Post removal annual sediment contribution theorized to be 200,000 cy/year.



Restoration response of nearshore?

- Still being defined. Anticipate change in substrate and biological community in Freshwater Bay from kelp dominated to eelgrass dominated
- Sediment process only partially restored- feeder bluffs still armored-City of Port Angeles adding another 1000 feet of armoring
- Lower river still diked.
- Nearshore is outside of ONP's jurisdiction, and dominated by private property owners. Fate dictated by local citizens, city, county, state, federal, and Tribal management.



594011-1-2

Nearshore response to upcoming restoration event ?



Shaffer, et al. 2006
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Elwha nearshore workgroup

Formed in 2004 - a two day technical and public nearshore workshop (co-sponsored by Clallam MRC, WDFW, Elwha Tribe, ONP, Peninsula College, and PSAT)

Informal workgroup of scientists and managers dedicated to understanding and promoting restoration response. Coordinated by WDFW.

Approximately 30 members total, around a dozen actively involved in Elwha nearshore field work

Projects summarized in *Elwha nearshore update*-quarterly newsletter <http://www.clallammrc.org>.

Elwha nearshore consortium

<u>Name</u>	<u>Affiliation</u>	<u>Focus Area/Project Title</u>
<i>Anne Shaffer</i>	<i>Washington Department Fish Wildlife</i>	Nearshore coordination/Habitat function
<i>Joe Schmitt</i>	<i>Clallam Marine Resources Committee</i>	Nearshore coordination
<i>Cathy Lear</i>	<i>Clallam County</i>	Nearshore coordination/Habitat restoration
<i>Matt Beirne</i>	<i>Elwha Tribe</i>	Nearshore coordination/Habitat assessment
<i>Brian Winter</i>	<i>Olympic National Park</i>	Dam removal project manager
<i>Rob Elofson</i>	<i>Elwha Tribe</i>	Dam removal project manager
<i>David Freed</i>	<i>WSU Beachwatchers</i>	Education coordination
John Warrick	USGS	Nearshore habitat physical processes
Dave Parks	Washington Department Natural Resources	Nearshore habitat physical processes
Rob Young	University North Carolina	Estuary physical mapping
Nancy Wright	University of Idaho	Socio-economic/GIS
Brad Hanson	NOAA	Marine mammals
Kurt Fresh	NOAA	Fish use
Jim Norris	Menzies Project	Eelgrass mapping/habitat structure
Helen Berry	Washington Department Natural Resources	Nearshore habitat structure
Don Rothaus	Washington Department Fish Wildlife	Shellfish resources
Bob Sizemore	Washington Department Fish Wildlife	Shellfish resources
Jeffree Stewart	Washington Department of Ecology	Shoreline management
Steve Todd	PtNoPt Treaty Council	Historical habitat mapping
Ian Miller	Surfrider Foundation	Aerial photograph catalog

Overview of nearshore consortium work underway....



Incl. 2

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Shaffer, et al. 2006
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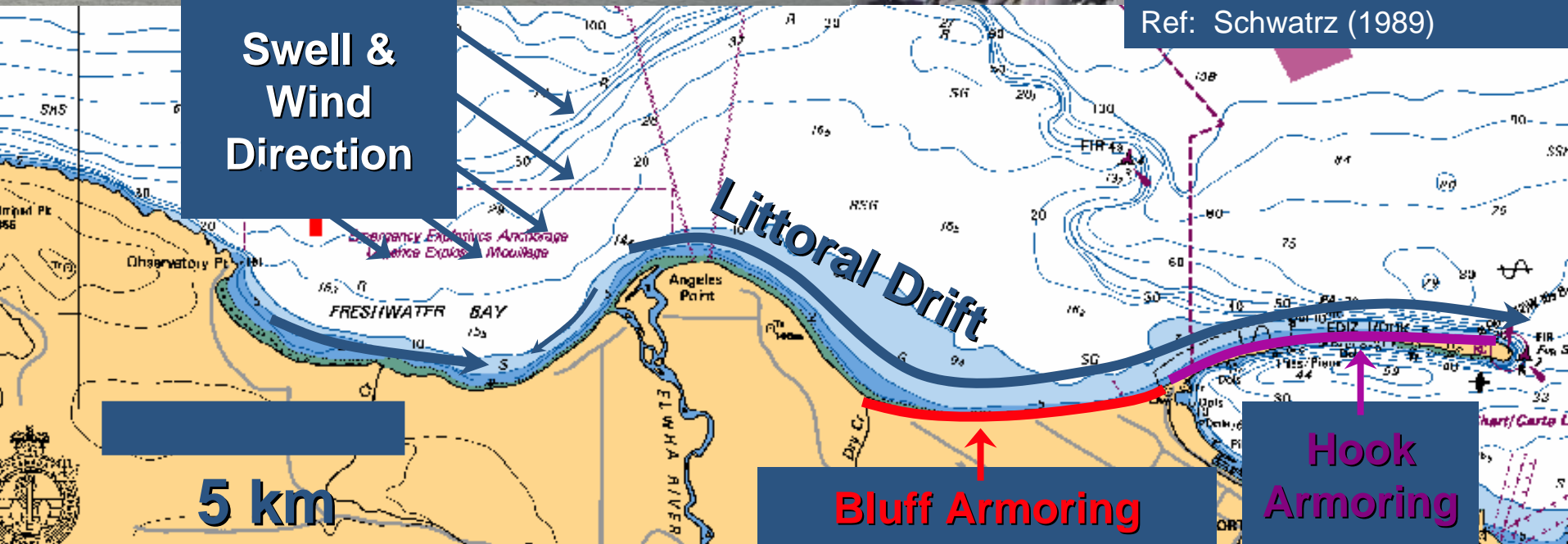


USGS Update Elwha Nearshore Consortium

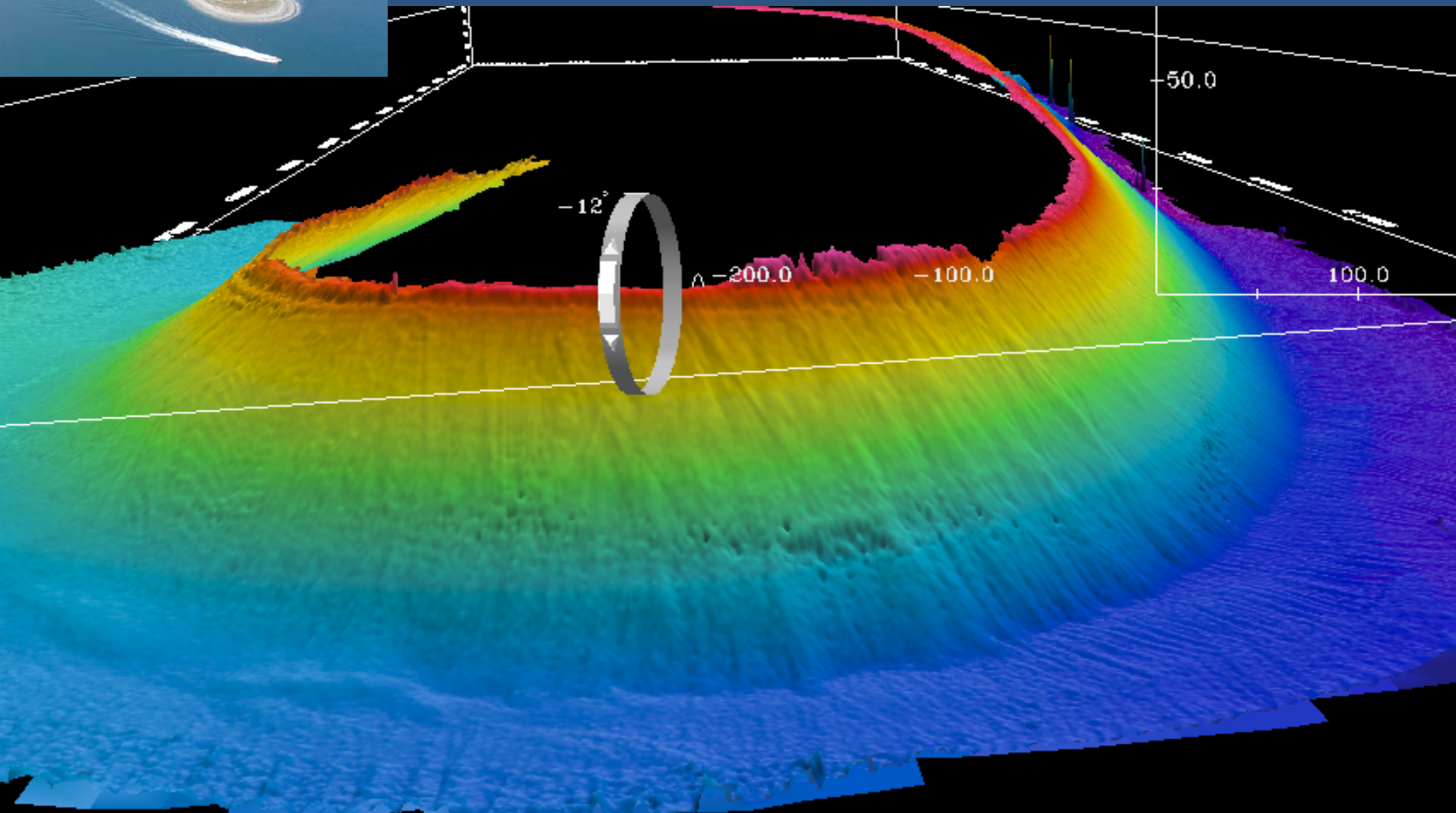
***Consortium Work Session
January 10, 2006***

***Jonathan Warrick
USGS Coastal and Marine Geology Program
Santa Cruz, CA***

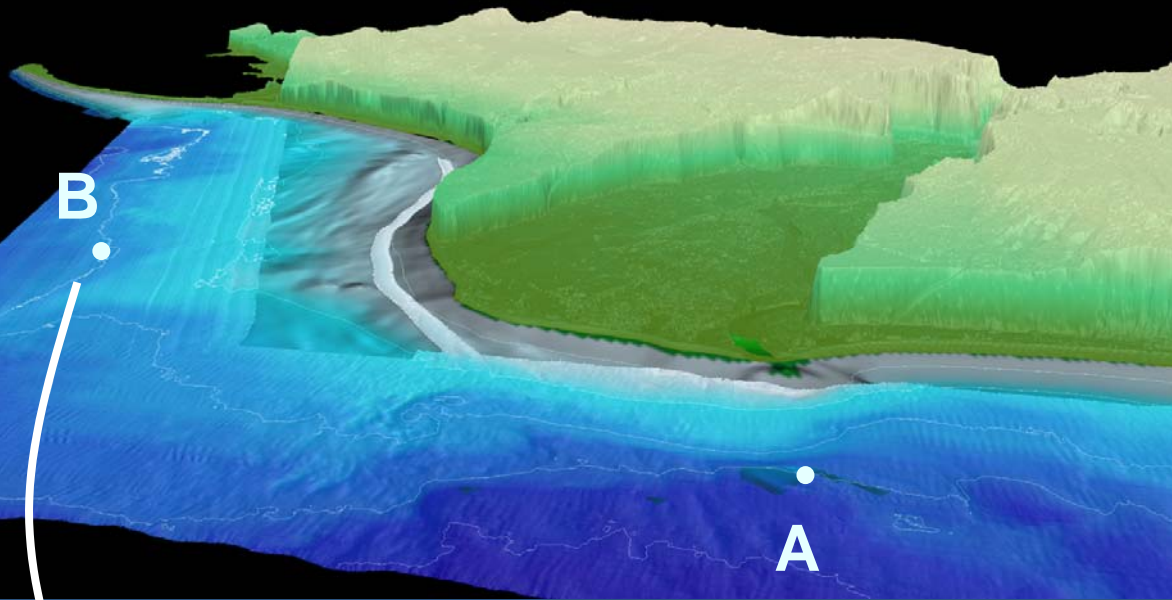
Elwha River Littoral Cell



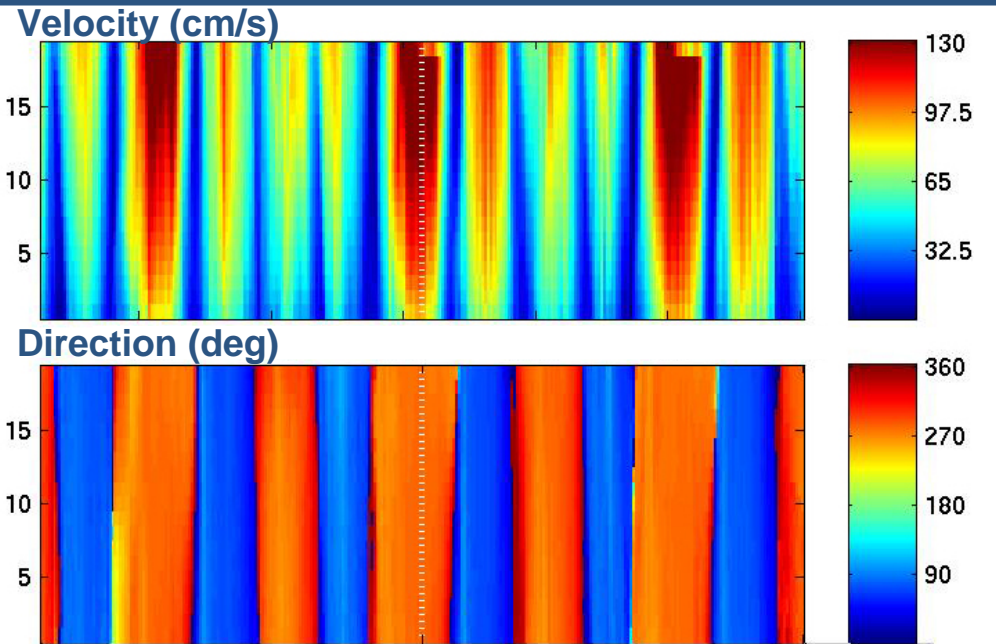
Ediz Hook Bathymetry



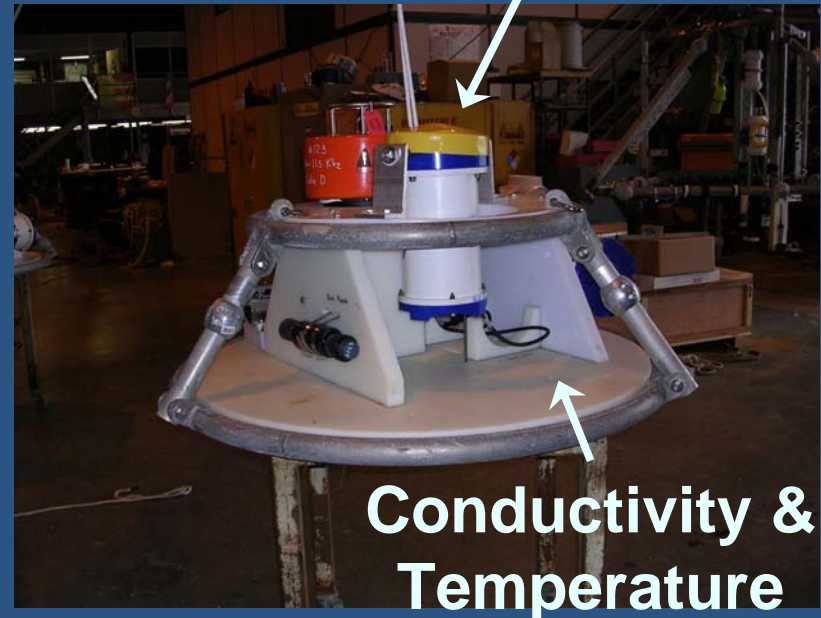
Process Monitoring (April-May 2006)



Current Speed & Direction:



**ADCP
(with waves)**



**Conductivity &
Temperature**

Landslide Hazard Zonation Lower Elwha Watershed and Nearshore

Define role of landslides to Elwha
nearshore physical processes

Dave Parks

Geologist

**Washington Department of Natural
Resources**



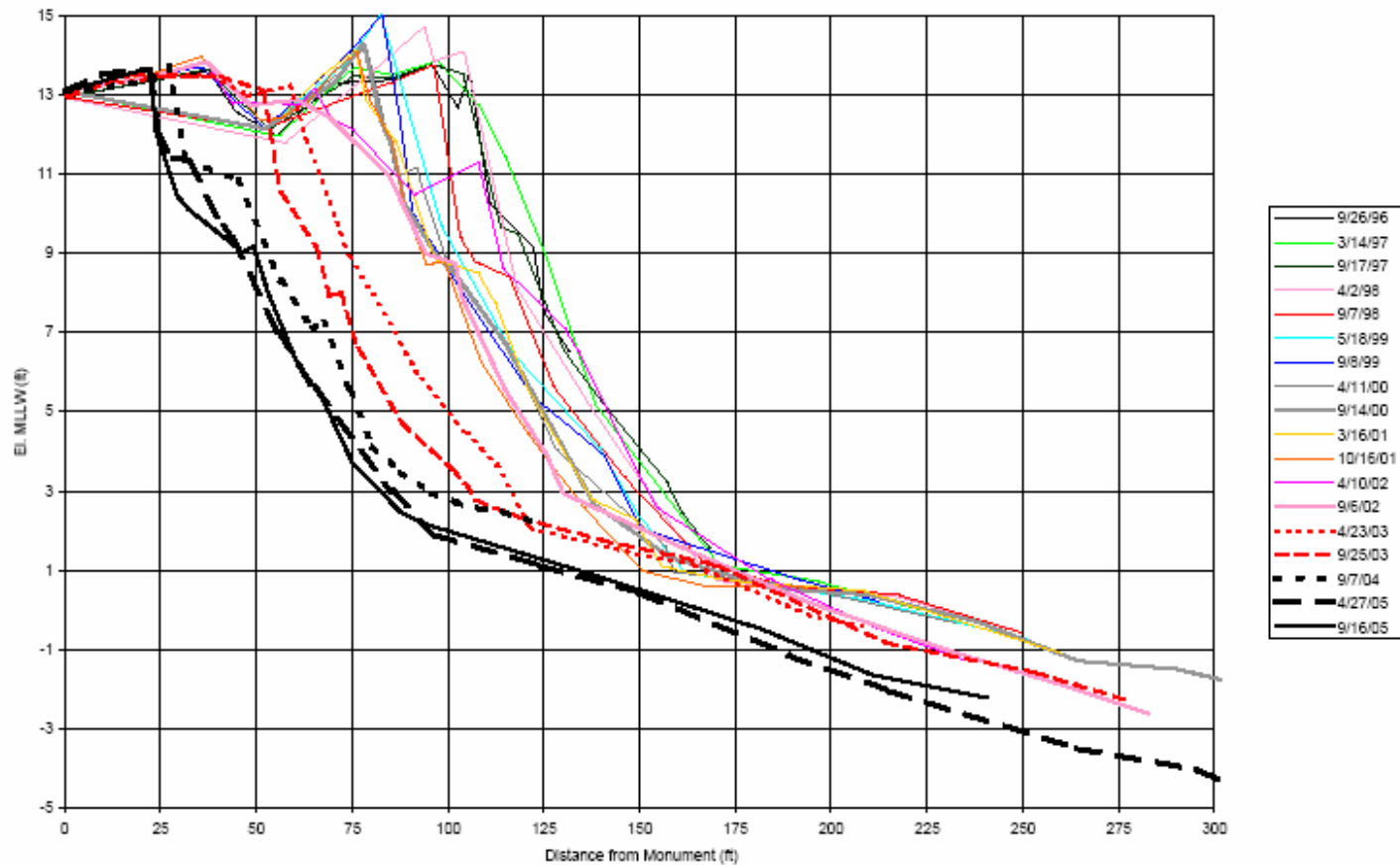


Beach Profile transects

Lower Elwha Klallam Tribe
Project

Wetland Assessment

Beach Profile Monitoring



Kurt Fresh, NOAA, Larry Ward, Matt Beirne, Lower Elwha Klallam Tribe, Anne Shaffer, WDFW

Pilot work fish use sampling Elwha nearshore

- Sampling Straits from Crescent Bay to Discovery Bay.
- Using townets and beach seines
- Major purpose is to figure out when (tidally) and where we can sample by gear type.
- Once get funding sample per nearshore restoration strategy

Eulachon in Elwha Estuary

Anne Shaffer* , Mike McHenry** , Dan Penttila* ,
*Washington Department of Fish and Wildlife
**Lower Elwha Klallam Tribe

Goal: Document current functional elements of estuary for Eulachon; define future restoration response to dam removals



Shaffer, et al. 2006

WDFW

Washington Department of Fish and Wildlife Elwha Nearshore Index Sites

*Don Rothaus, Bob Sizemore, Michael Ulrich,
Tina Blewett and Lisa Hillier*

Central Shellfish

Washington Department of Fish and Wildlife



GOALS

- Establish permanent and repeatable index sites to monitor physical and biological changes of Elwha dam removal to marine habitat
- Monitor areas relevant to sub-tidal shellfish resources in eastern Strait of Juan de Fuca

An aerial black and white photograph showing a wide river delta flowing into a large body of water. The delta is characterized by numerous channels and sandbars. The surrounding land is a mix of forested areas and open fields. The sky is overcast.

**Cathy Lear,
Biologist, Clallam County
West Levee Conservation Easement and Realignment Alternatives**

1940

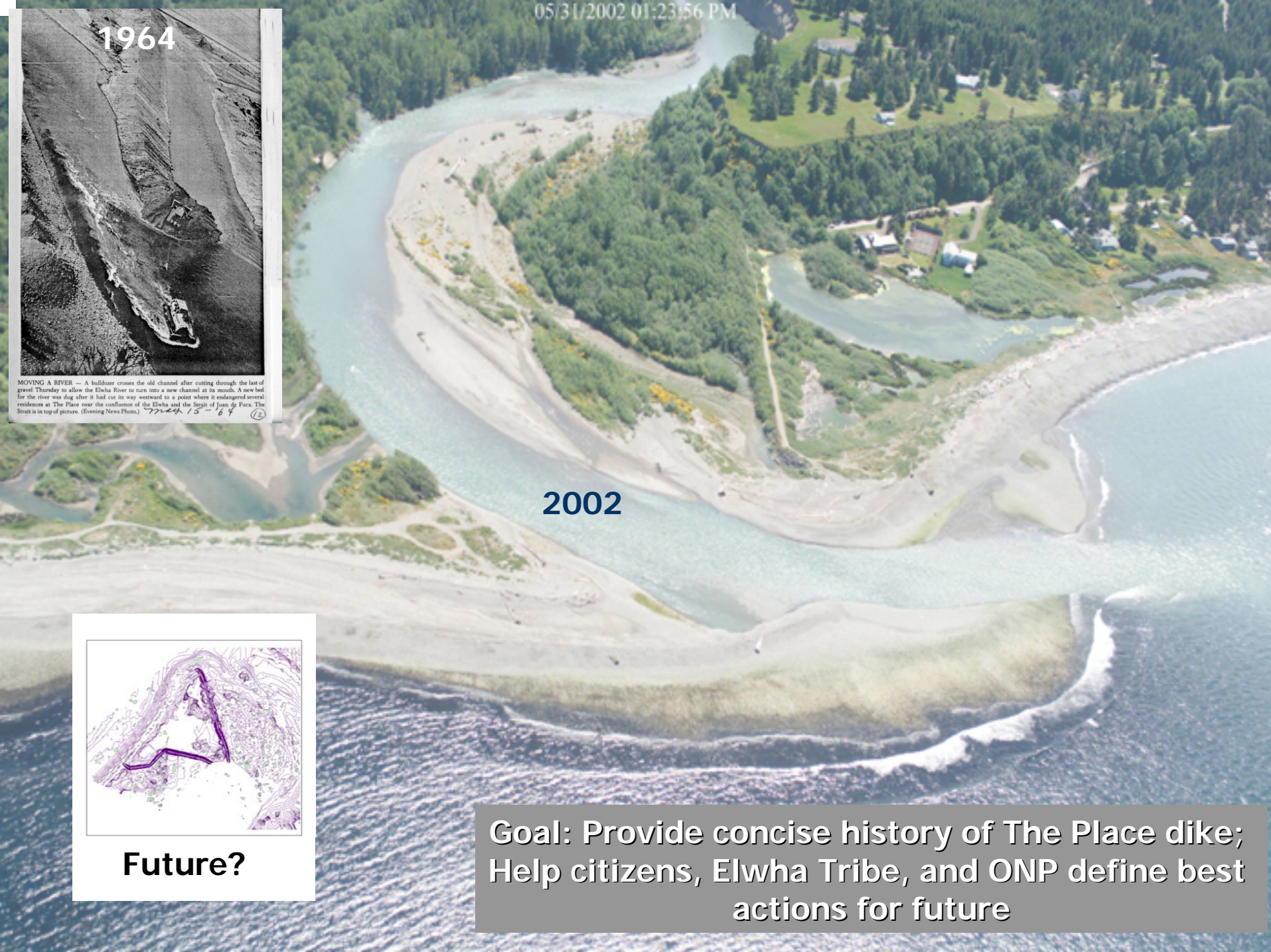
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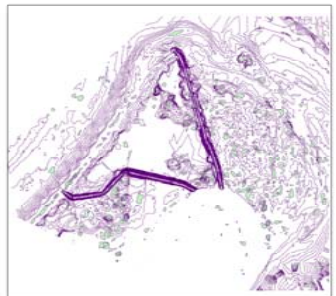
1964

MOVING A RIVER — A bulldozer crosses the old channel after cutting through the last of gravel Thursday to allow the Elwha River to turn into a new channel at its mouth. A new bed for the river was dug after it had cut its way westward to a point where it endangered several residences at The Place near the confluence of the Elwha and the Strait of Juan de Fuca. The Strait is in top of picture. (Evening News Photo.) 7/24/64 15-84 (2)

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2002



Future?

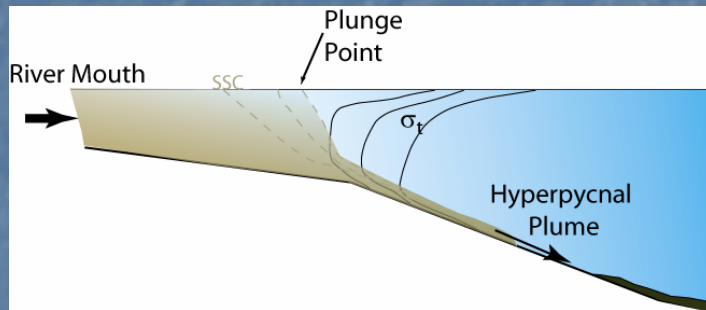
Goal: Provide concise history of The Place dike; Help citizens, Elwha Tribe, and ONP define best actions for future

Habitat modification due to sediment gravity-driven processes

- Elwha Dam removal baseline study

A. Ogston & C. Nittrouer
School of Oceanography
University of Washington

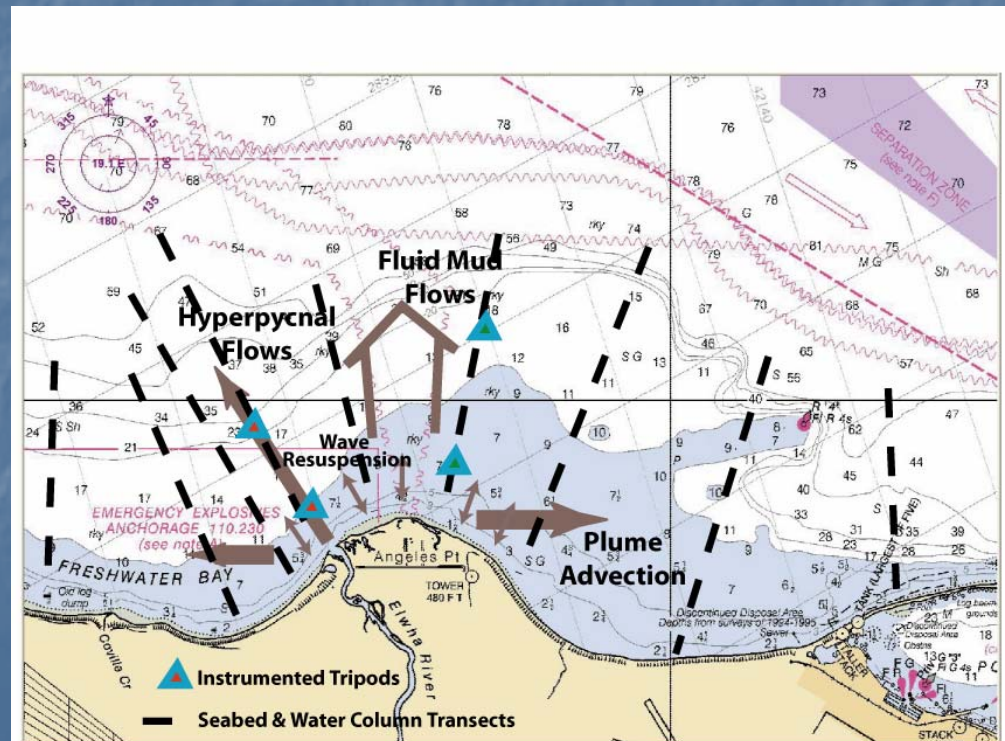
Hypothesis: high concentrations of suspended sediment discharged from the Elwha River, following dam removal, will be transported dominantly as gravity flows (fluid muds, hyperpycnal plumes), which will come to rest beyond the deltaic platform (i.e., in water depths >30 m). Sediment transported in gravity flows will form thick (>10 cm) seabed deposits directly downslope and in deeper water depths, and could produce erosive gullies on the delta front.



Objectives for this phase:

- 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 instruments should be deployed during dam removal to ensure the highest rate of return.

Potential Collaborators include:
USGS Coastal & Marine Geology
USGS WA Water Science Center
WDFW
Penninsula College



Elwha Project Cost Estimate

December 2005 *

Project category	Dollars (millions)	%
Acquisition	\$29.88	16
Planning/Design	13.49	7
Construct Water Quality Facilities	69.32	38
Dam Removal Activities	31.22	17
Ecosystem Restoration (fisheries, revegetation)	16.25	9
Other (flood, cultural, operations, etc.)	23.78	13
Total	\$183.95	100

* Brian Winter, Olympic National Park



Shaffer, et al. 2006
WDFW

Project funds allocated to the Elwha nearshore

\$180,000.00

0.10%



Elwha nearshore is a critical element to the upcoming dam removals that has gained less attention due to complex jurisdictions and physical and biological linkages. We need to promote every opportunity-there are many- of the upcoming nearshore restoration event. We have a long way to go and a very short time. But what a great journey.



Photo by Shirley Mitsawa



Shaffer, et al. 2006
WDFW