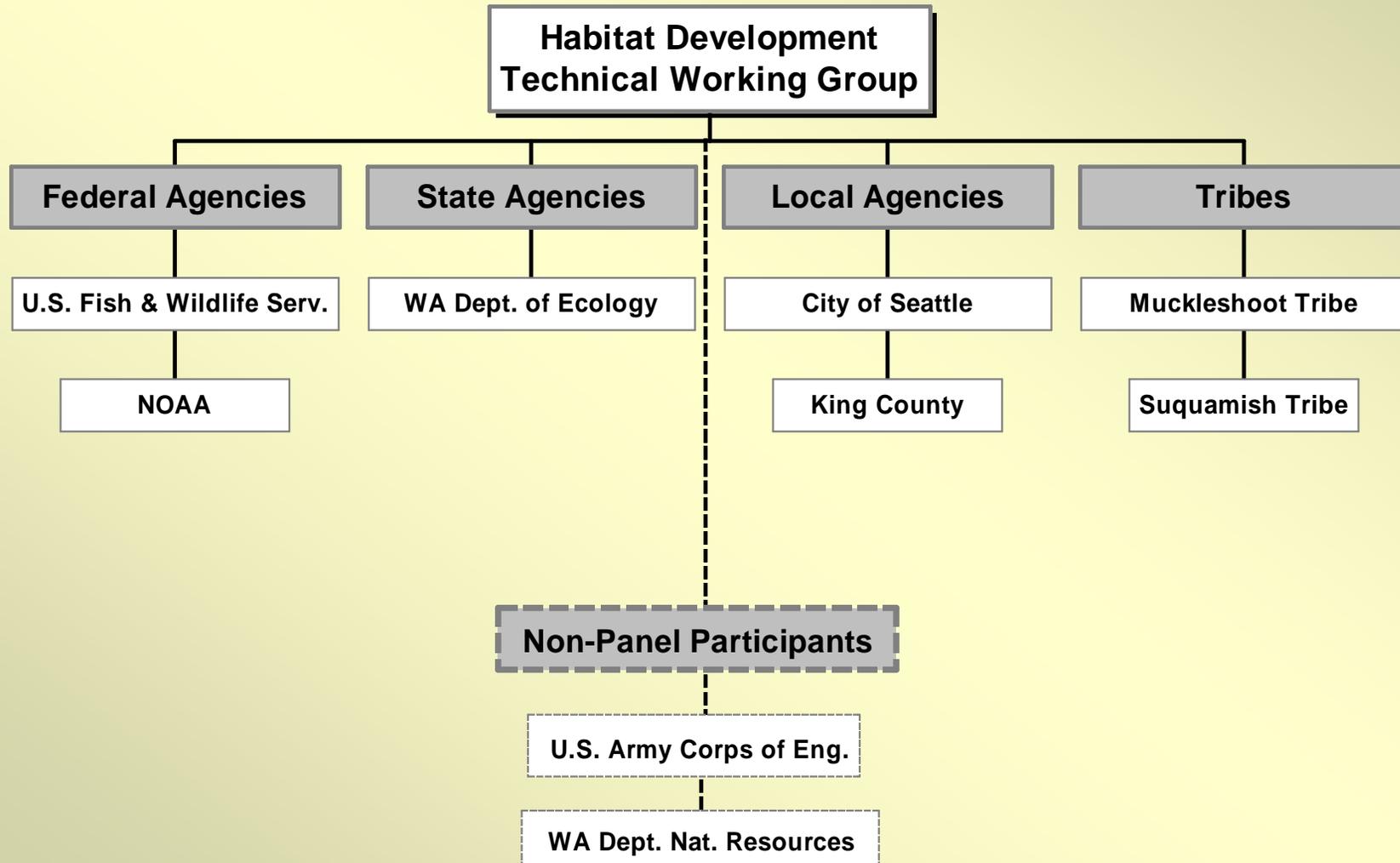


# **Elliott Bay Substrate Enhancement Project**



# Elliott Bay/Duwamish Restoration Program





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# Project Goals

- Increase substrate diversity
- Provide habitat for juvenile rockfish & salmonid prey
- Assess utility of oyster shell to increase habitat for juvenile Dungeness crab
- Increase amount of protective cover for organisms & surface for macroalgae

# Materials

- **Cobble**  
15 yd<sup>3</sup> at 3 plots
- **Pea gravel**  
5 yd<sup>3</sup> at 1 plot
- **Quarry spall**  
15 yd<sup>3</sup> at 3 plots
- **Oyster shell**  
5 yd<sup>3</sup> at 1 plot

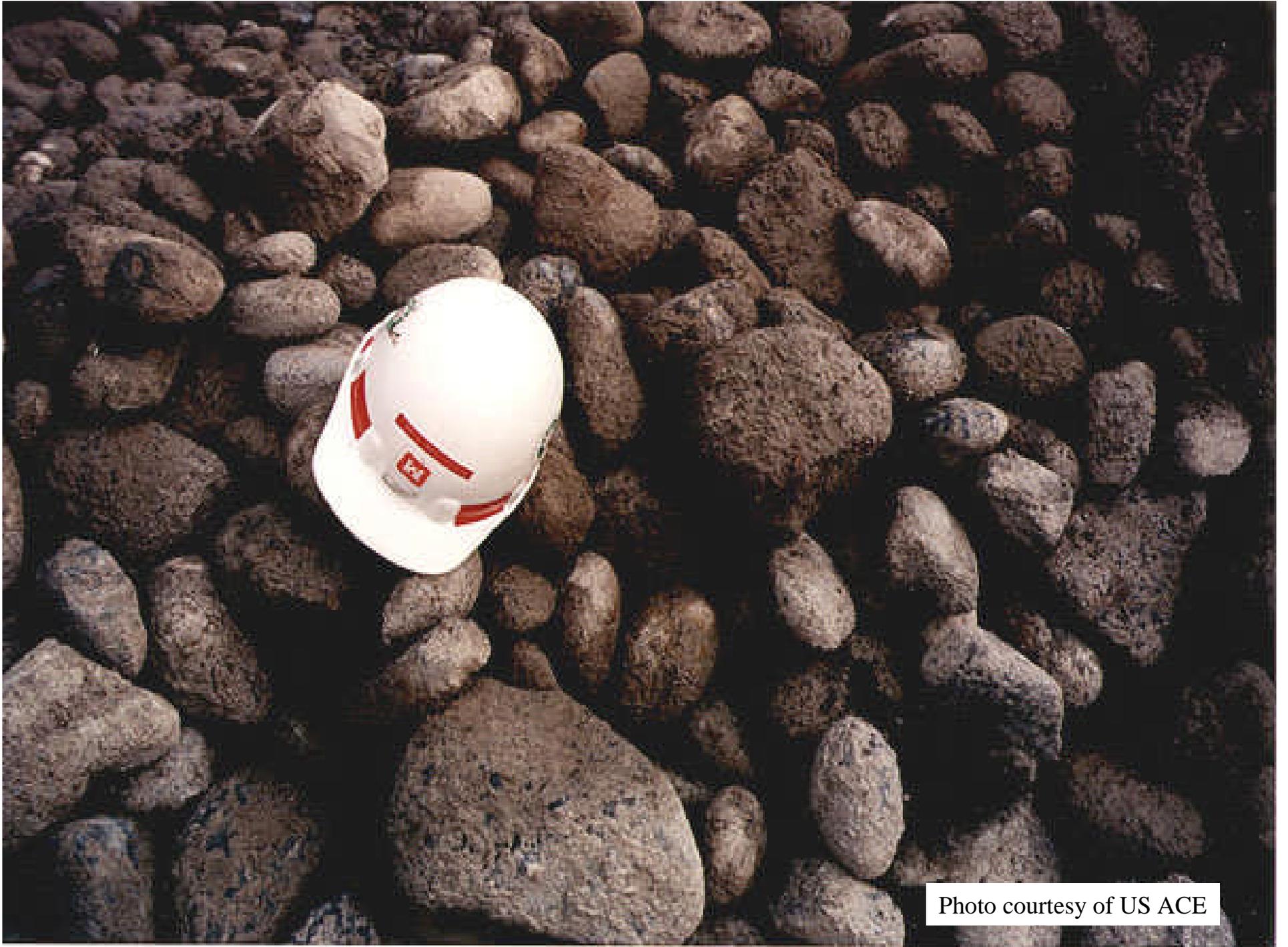


Photo courtesy of US ACE



Photo courtesy of US ACE



Photo courtesy of US ACE



Photo courtesy of US ACE

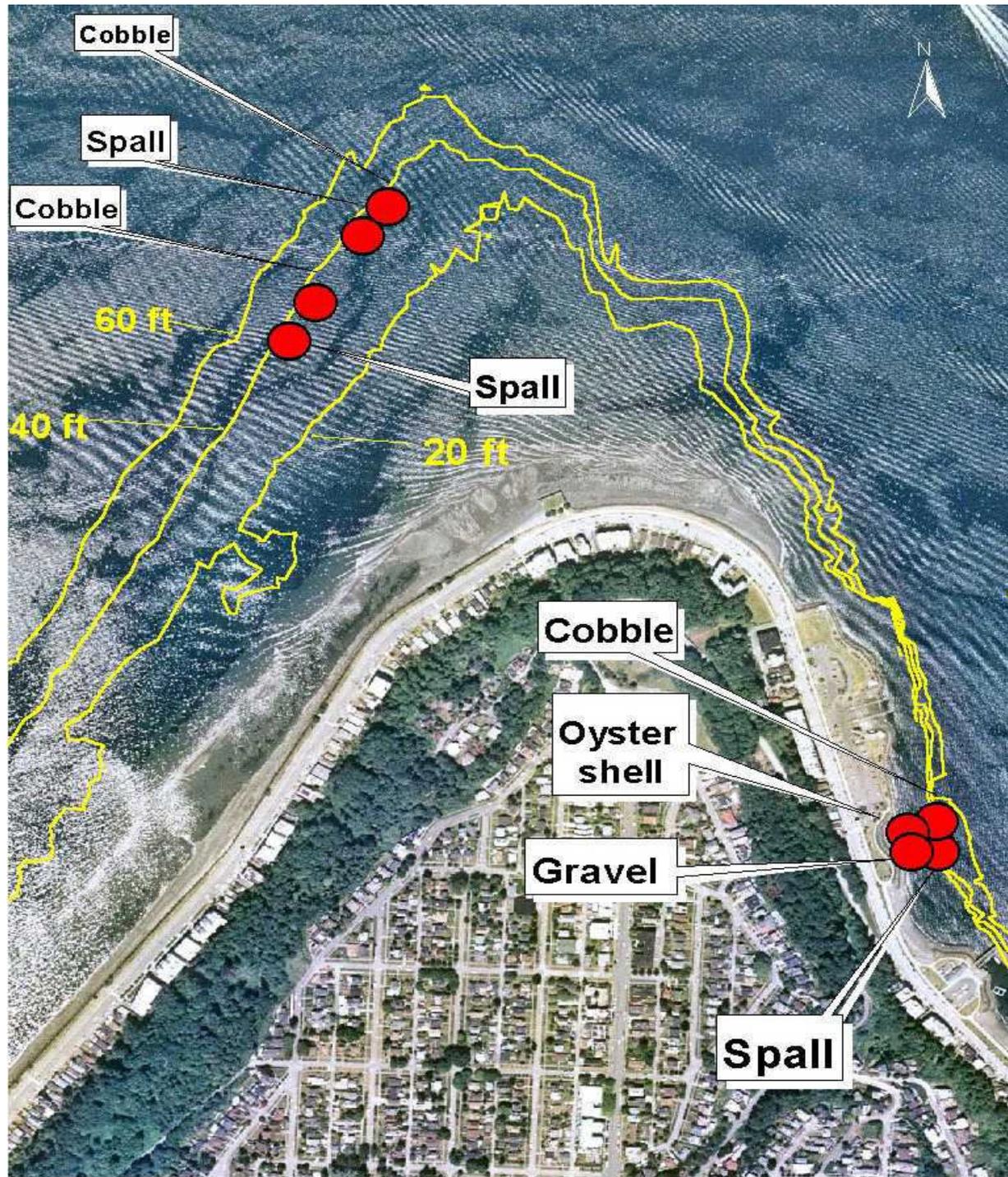




Photo courtesy of US ACE

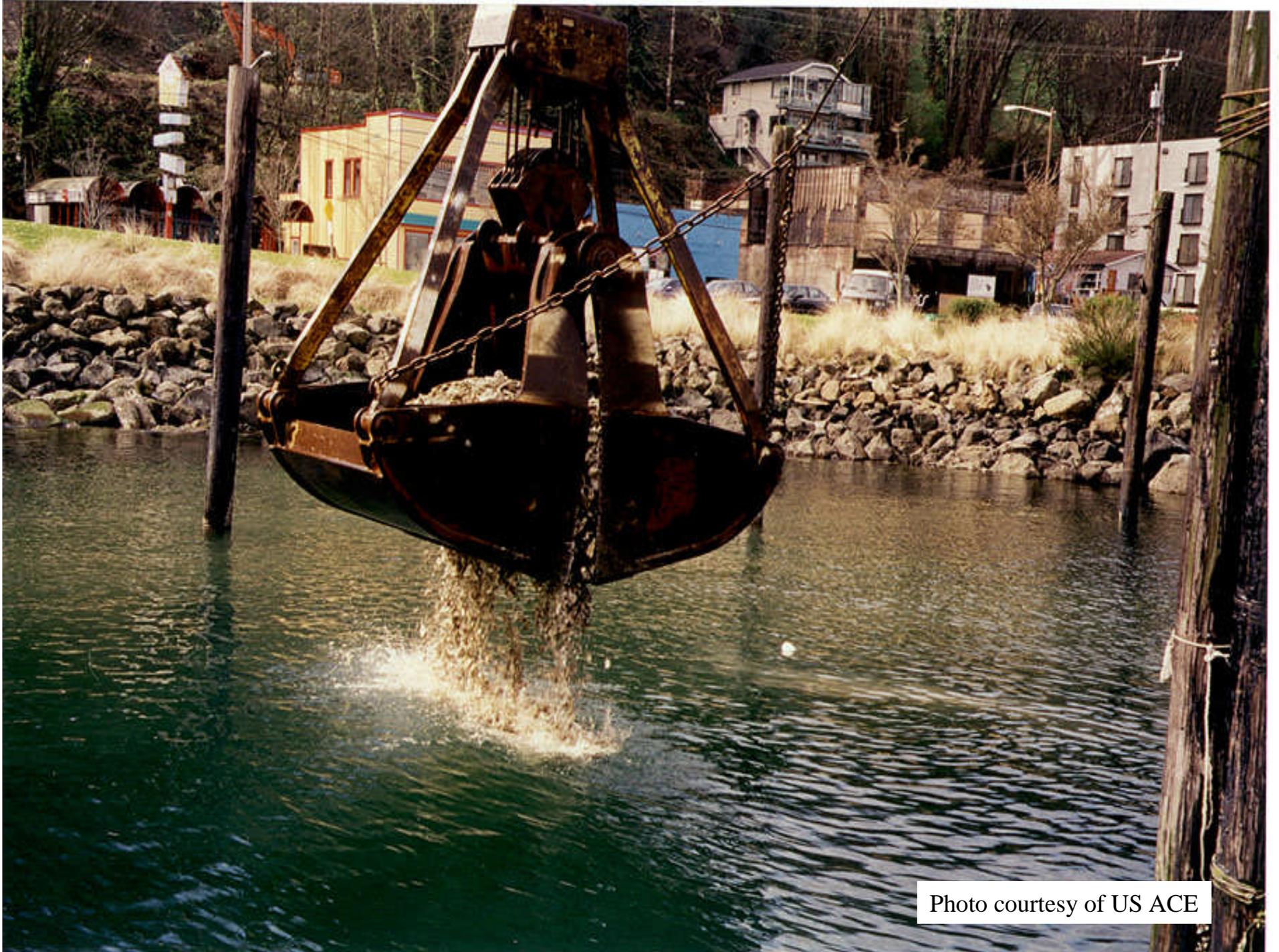
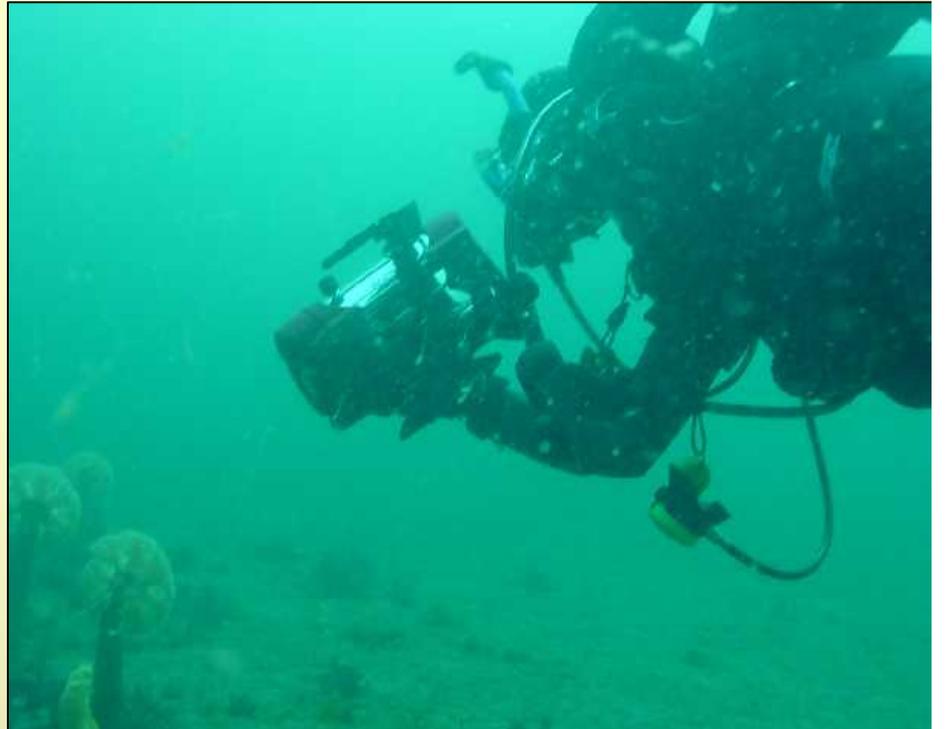


Photo courtesy of US ACE

# Monitoring Approach

- **Underwater video**  
4 times first year/2 times for 5 years
- **Juvenile Dungeness crab survey**  
10 samples once in summer
- **Epibenthic sampling**  
5 samples 1 month & 1 year post placement



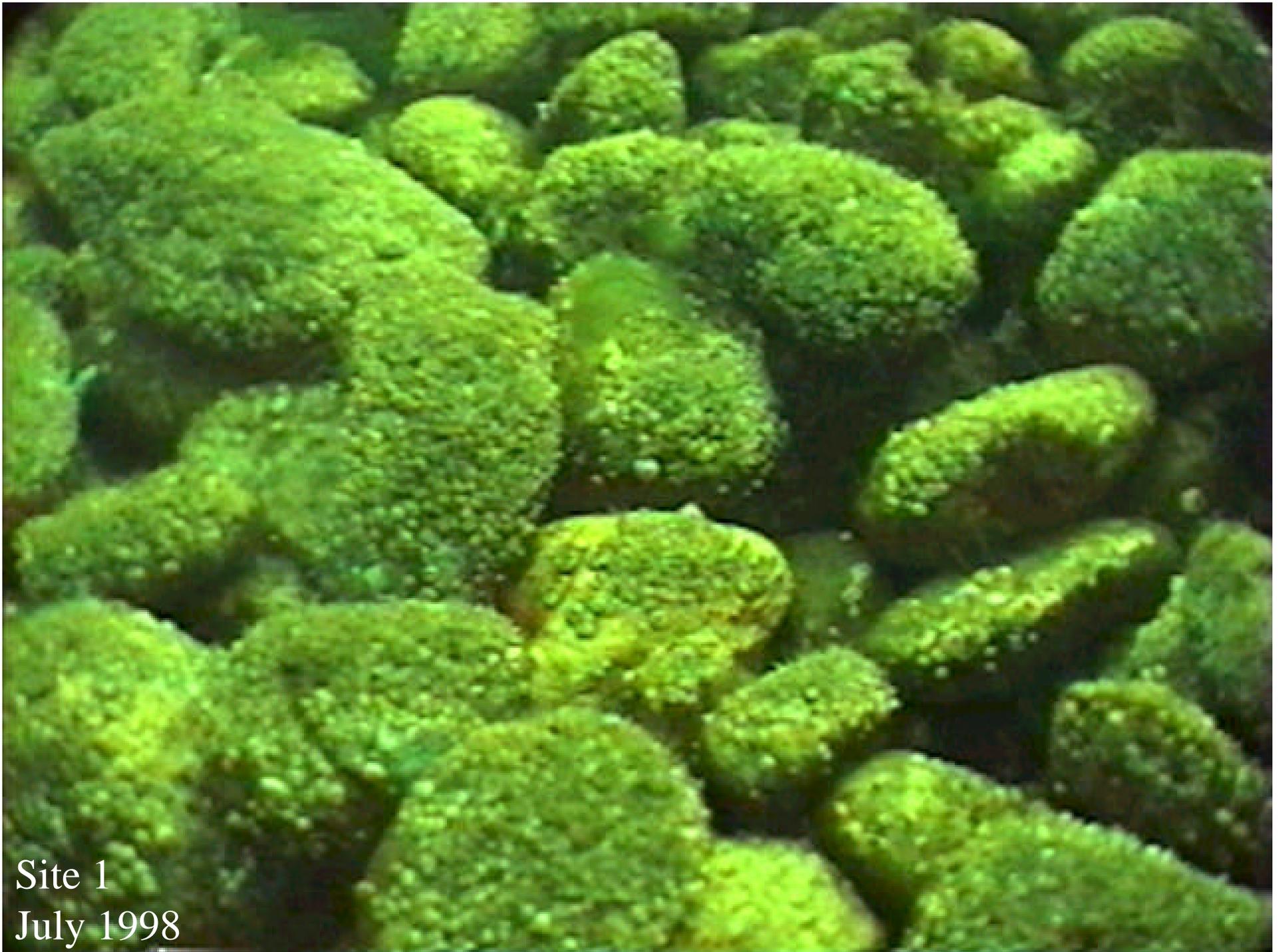


# Underwater Video Results

- Cobble and quarry spall show significant macroalgae growth
- Videos show various fish species in/around the substrates
- Videos show macroinvertebrates (anemones, nudibranchs, shrimp, sea stars) using the substrates



Site 1  
August 1999



Site 1  
July 1998



Site 1  
July 1998



Site 1  
August 1999

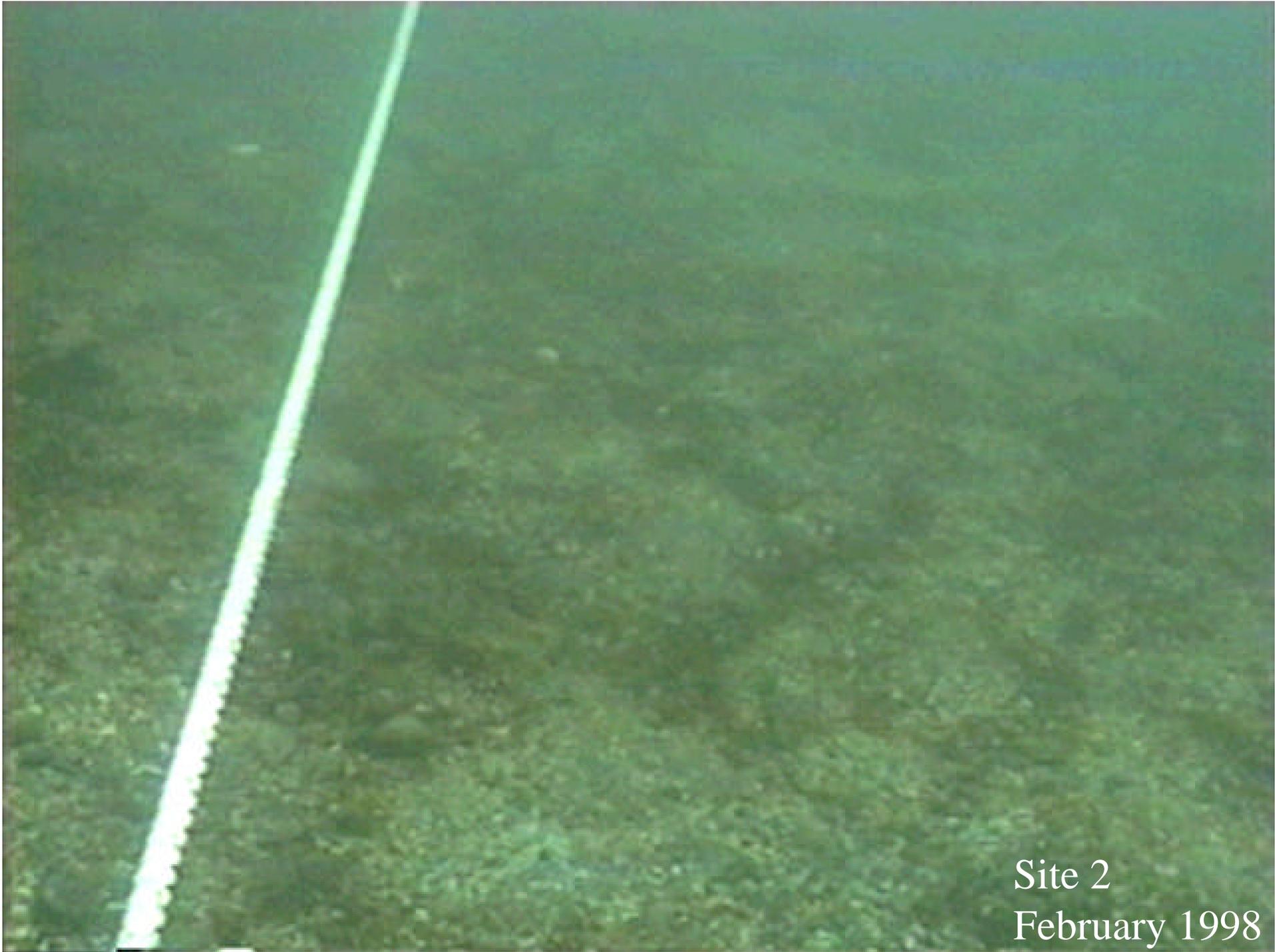


**Site 1: Aug 2000**





September 2002



Site 2  
February 1998



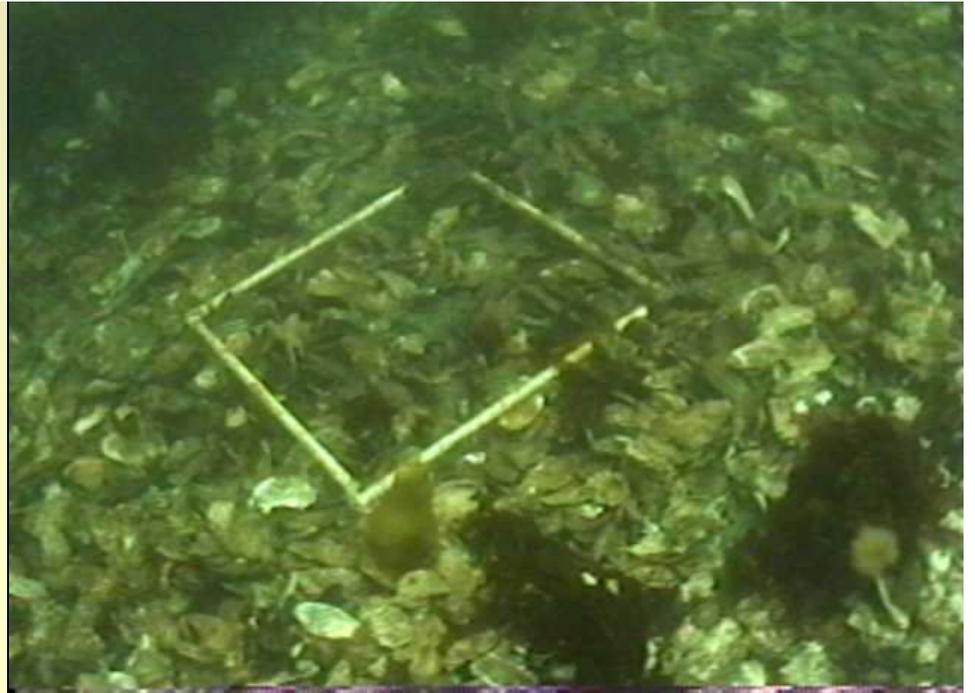
Site 2  
July 1998



Site 2  
July 1998



Site 2  
July 1998

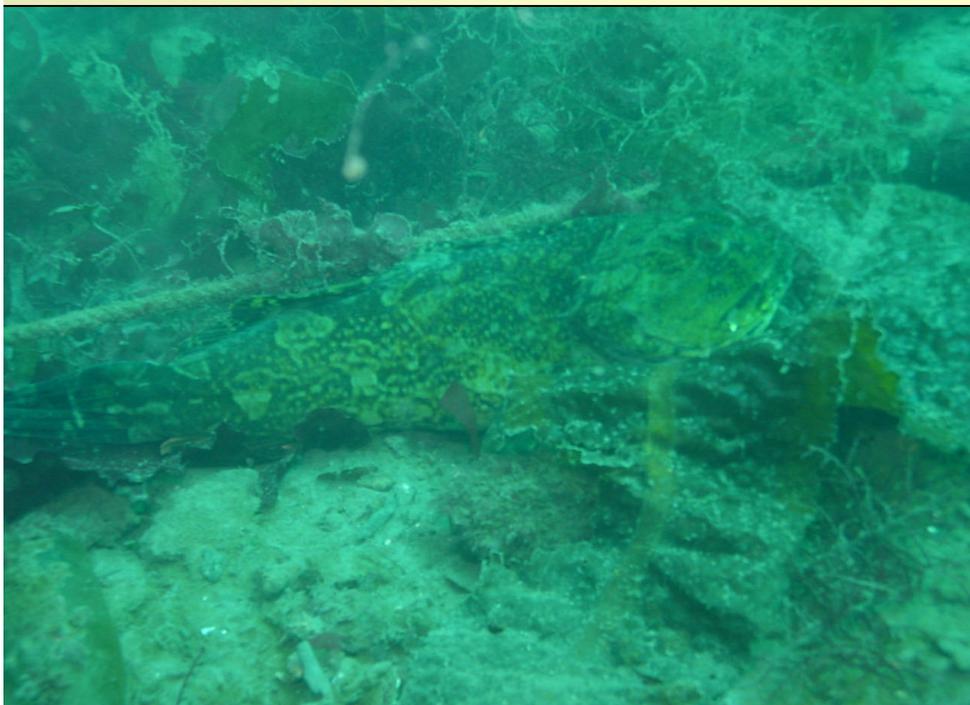
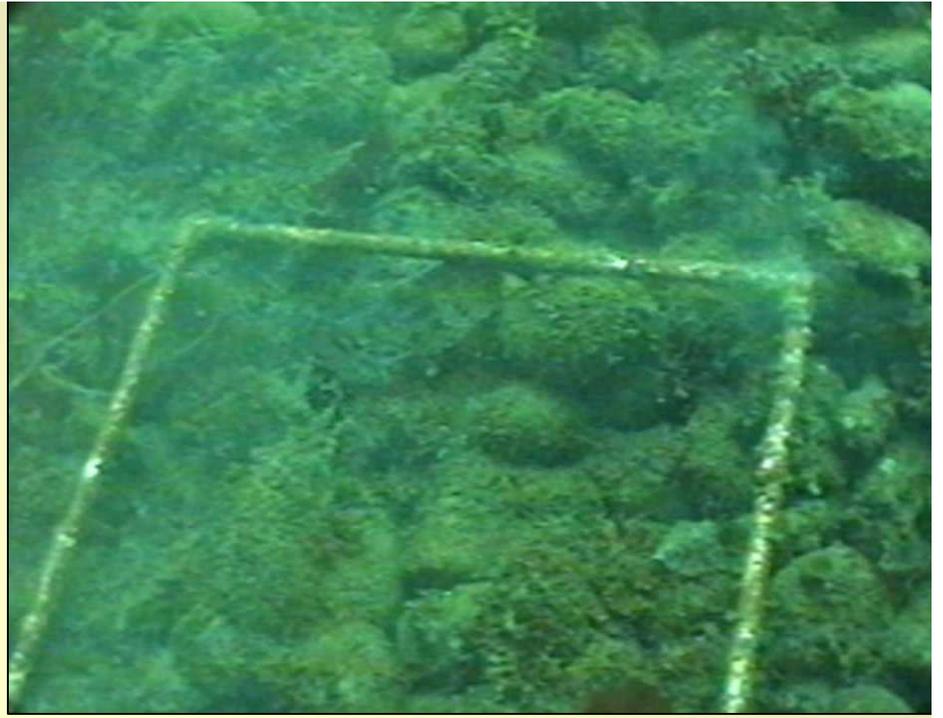


**Site 2: April 2000**





Site 2: April 2001



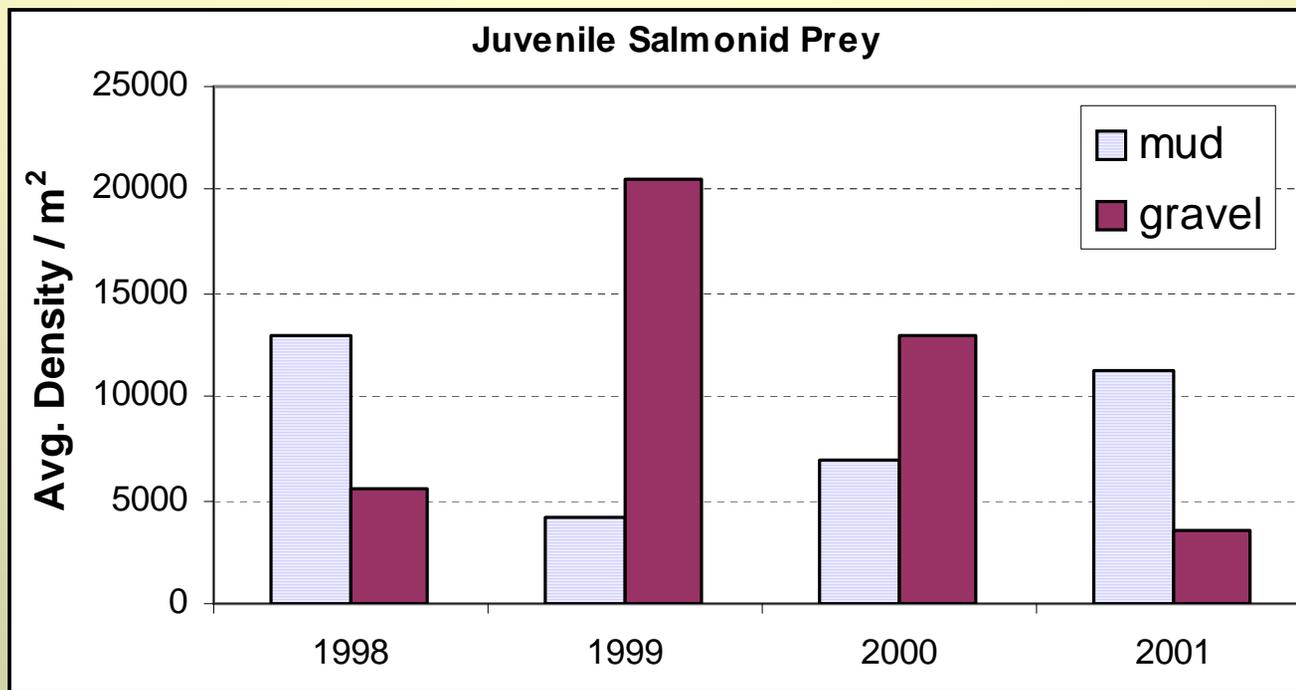
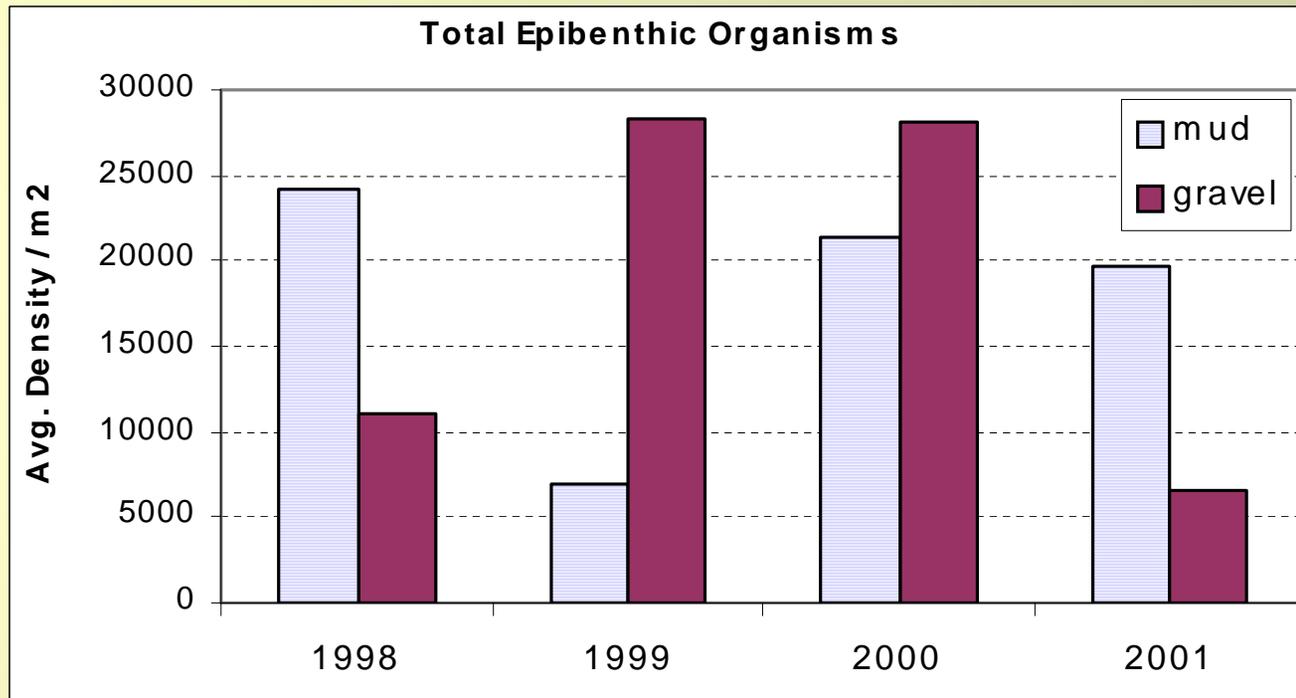


# Dungeness Crab Survey Results

- No juvenile Dungeness crabs were found in the oyster shell plot
- Low densities were found in the eelgrass control plot
- Other crab species and invertebrates were found in the oyster shell plot

# Epibenthic Survey Results

- Juvenile salmonid prey had higher #'s in gravel (not statistically significant)
- Epibenthic fauna did not show a significant difference between gravel & control plots
- Lack of significant difference likely due to small sample size & high variance





*Cumella*



*Corophium*



*Harpacticus sp.*



*Harpacticus sp.*

# Findings To Date

- The materials are effective for creating substrate diversity & complex habitat
- Inconclusive if pea gravel increased juvenile salmonid prey; pea gravel plot appears to be eroding
- Oyster shell may be more effective in shallow waters for attracting juvenile Dungeness crabs; shell is effective for attracting other crab species
- The cobble and quarry spall plots are effective for providing algae attachment sites and protective cover for rockfish/other fish

# Aknowledgements

- Margaret Duncan—The Suquamish Tribe
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