Evaluating the ecological performance of nearshore fish habitat enhancements at the Olympic Sculpture Park in Seattle, WA

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28 October 2010

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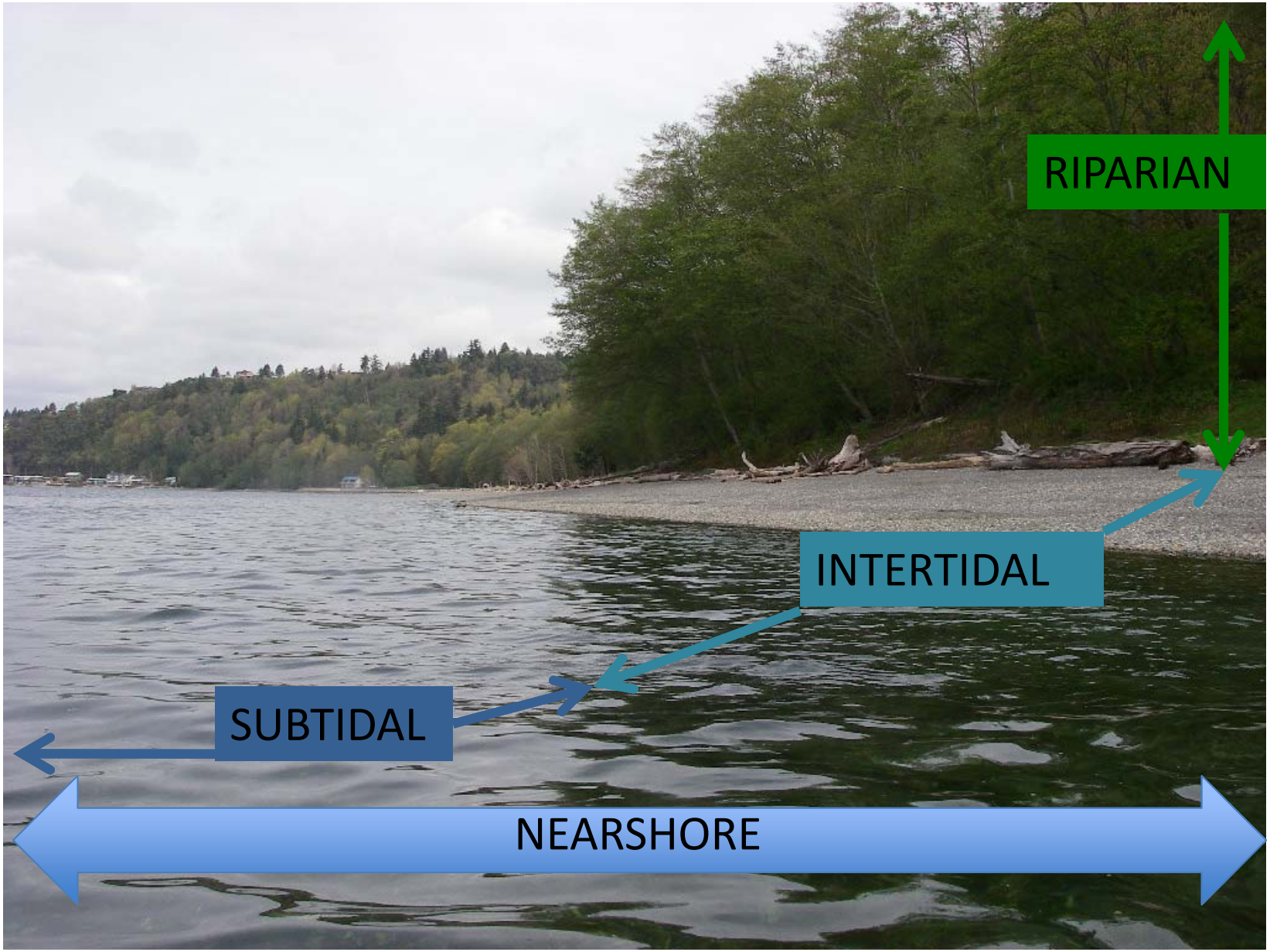
OUTLINE

1. Olympic Sculpture Park overview
2. Site comparisons: fish, invertebrates, physical characteristics
3. Behavior and movement of juvenile salmon
4. Synthesis

PUGET SOUND NEARSHORE



SHORELINE ARMORING

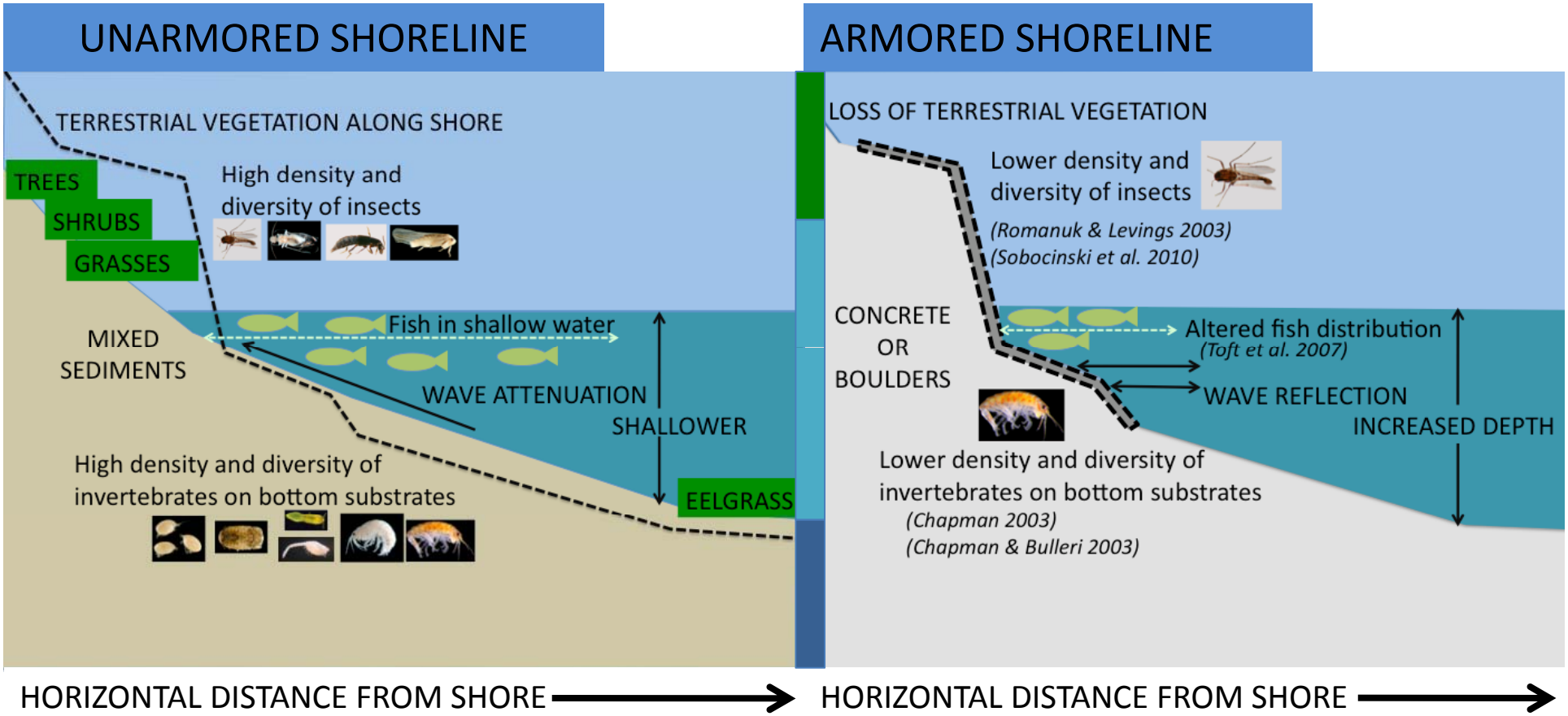
RIPRAP

SEAWALL

IMPERMEABLE SURFACE

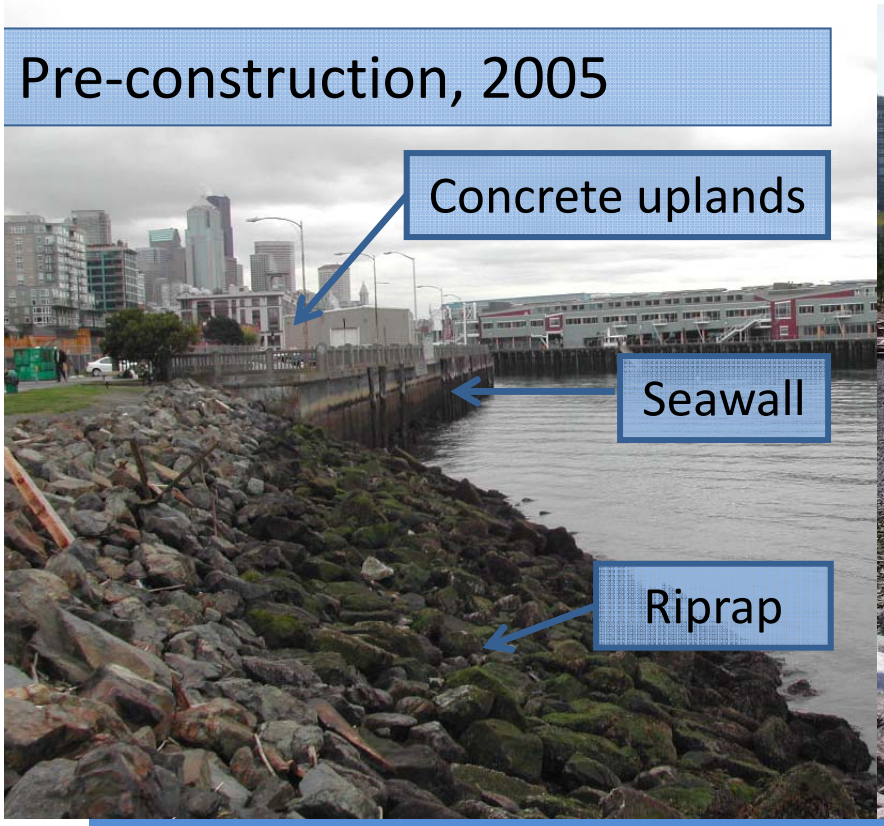
OVERWATER STRUCTURE

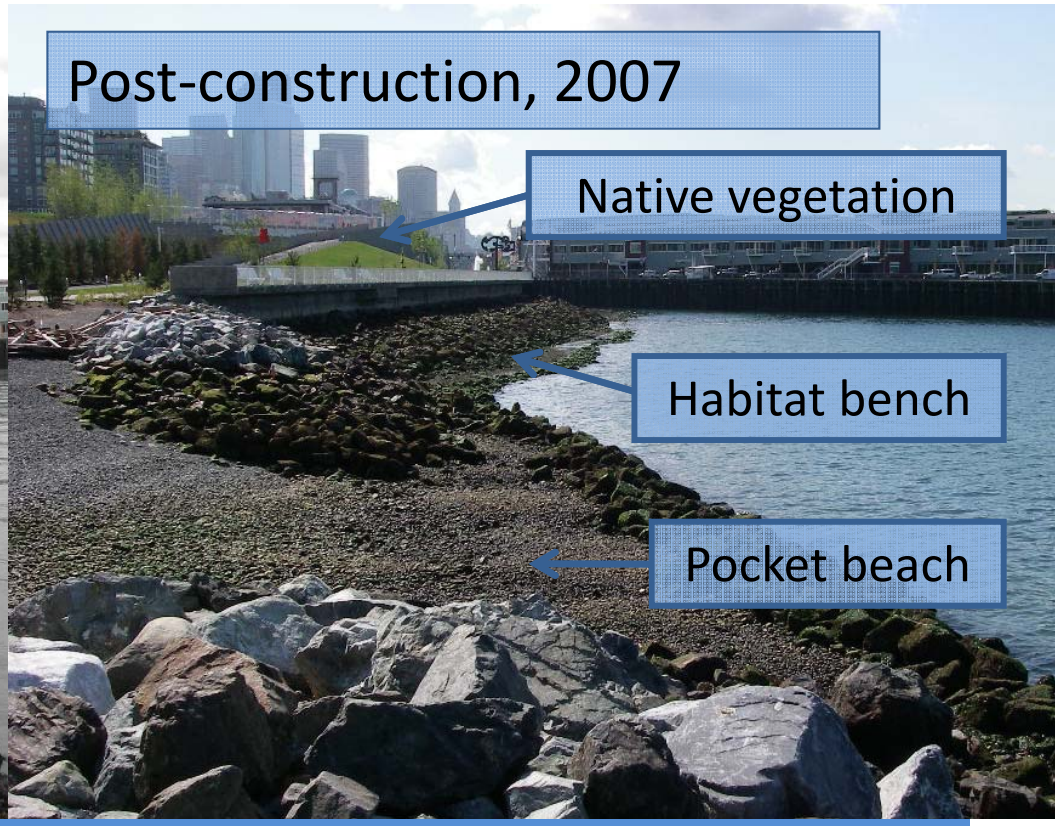
SHORELINE ARMORING



NET RESULT: LOSS OF HABITAT FOR NEARSHORE ORGANISMS

NEARSHORE FISH HABITAT ENHANCEMENTS: OLYMPIC SCULPTURE PARK (OSP)



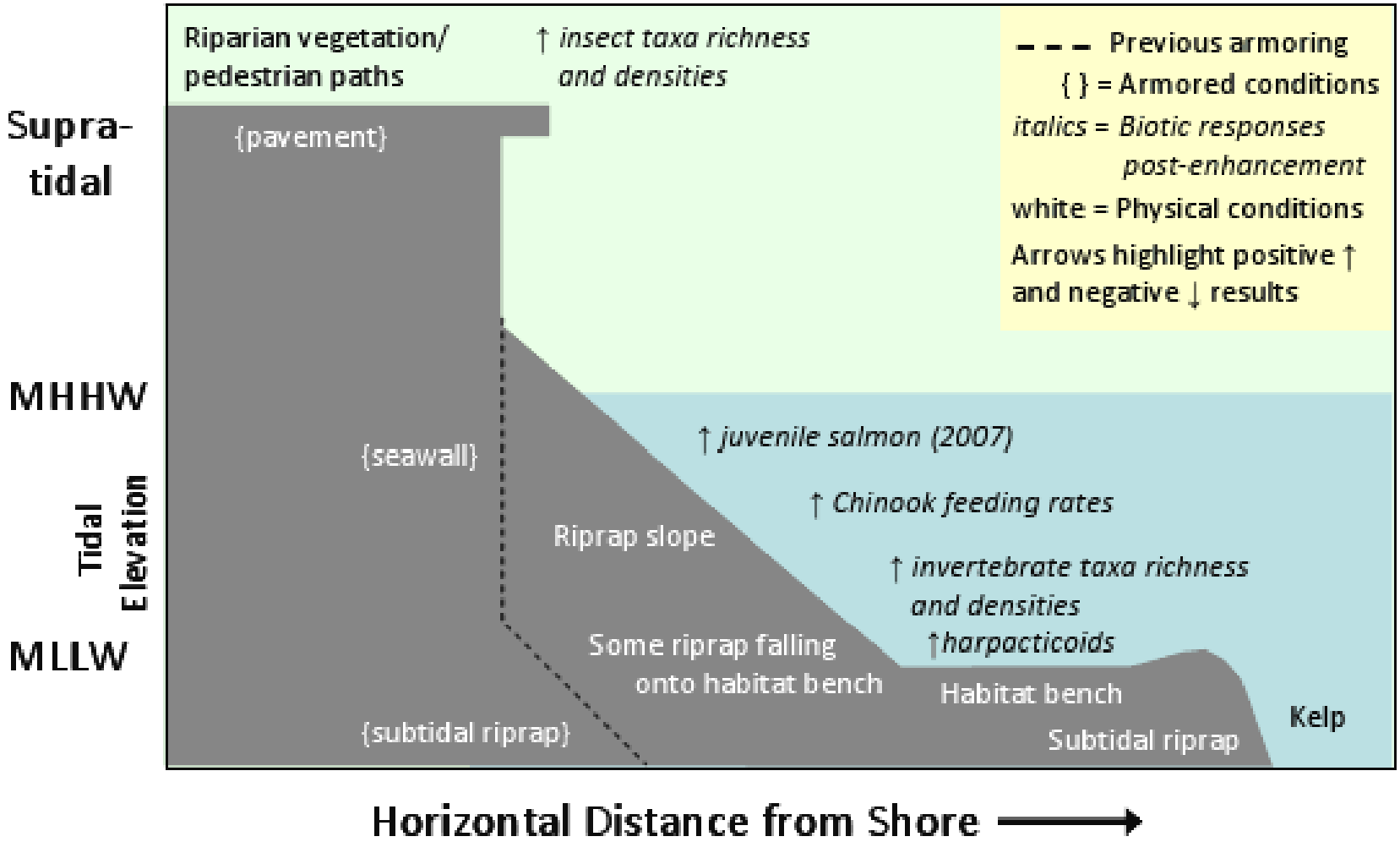


Specific environmental goals of OSP:

- Provide habitat for juvenile salmonids and other nearshore fish
- Restore connection between uplands and shore

NEARSHORE FISH HABITAT ENHANCEMENTS: OLYMPIC SCULPTURE PARK (OSP)

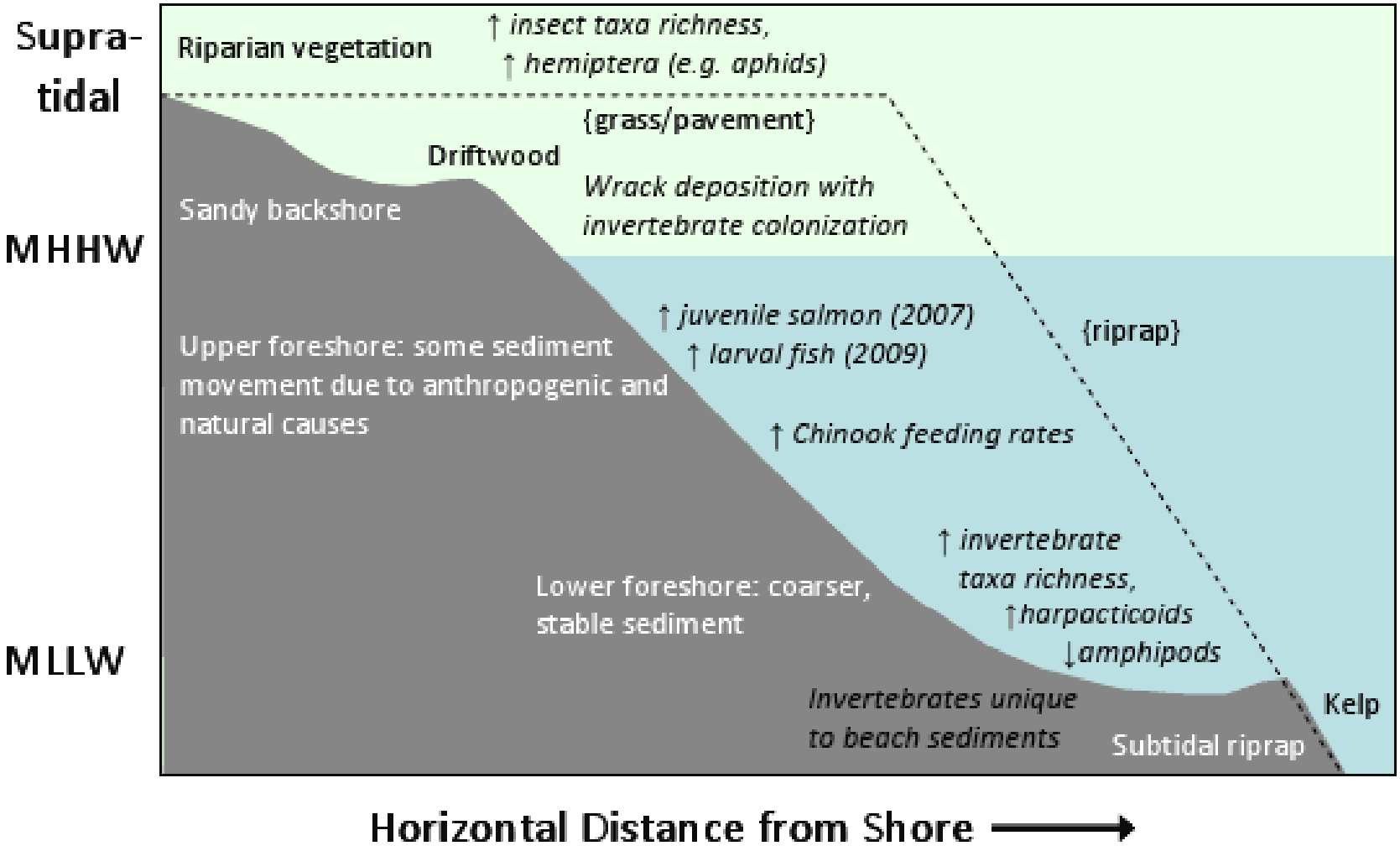
OSP Habitat Bench



Horizontal Distance from Shore →

NEARSHORE FISH HABITAT ENHANCEMENTS: OLYMPIC SCULPTURE PARK (OSP)

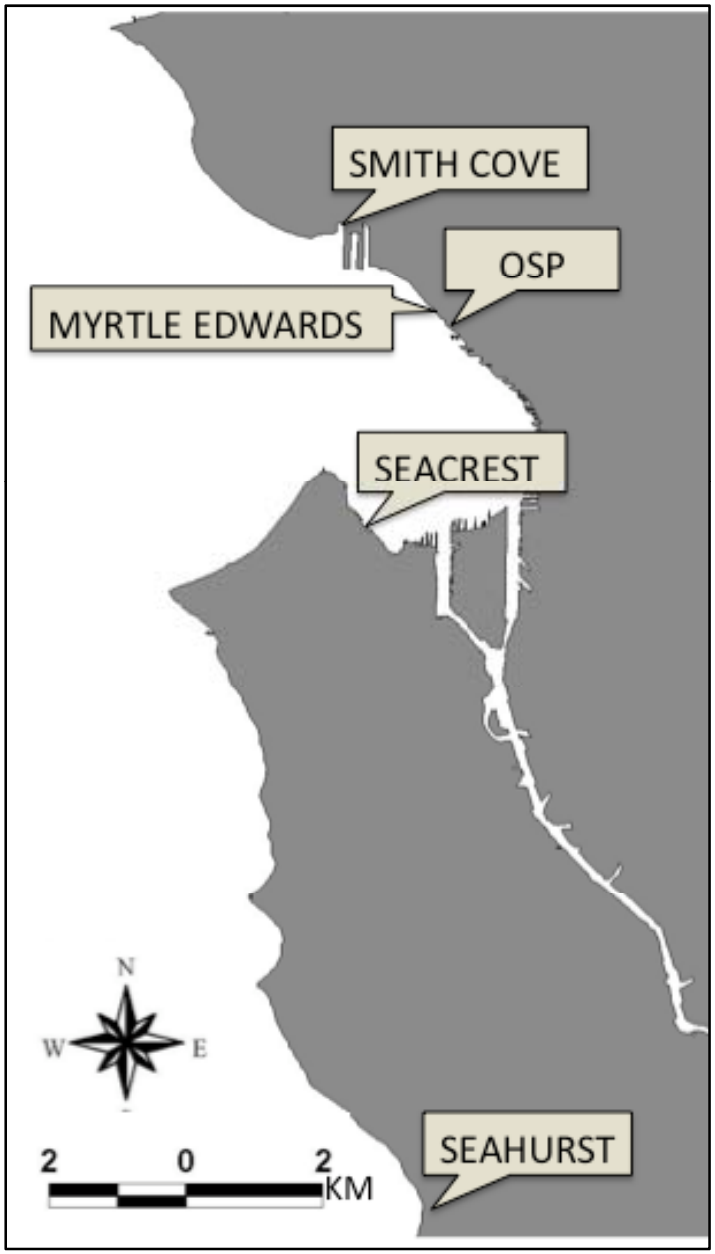
OSP Pocket Beach



SITE COMPARISONS – 2008

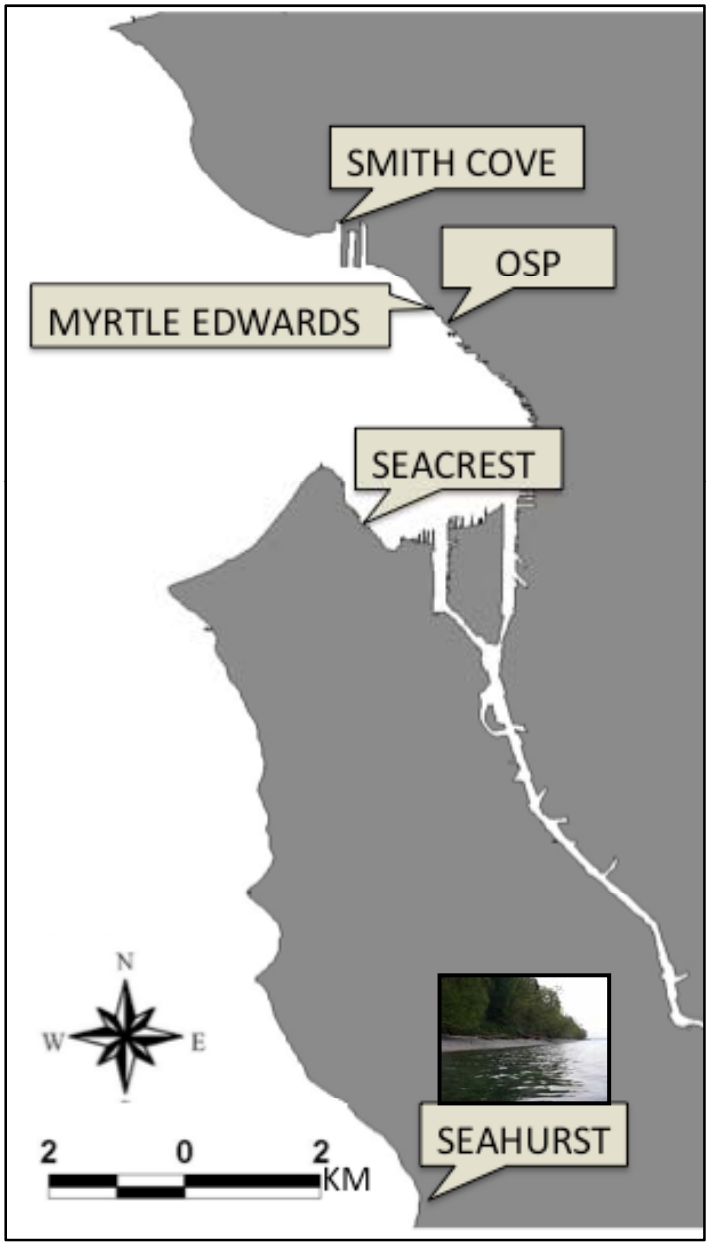
HOW DO OSP ENHANCEMENTS COMPARE WITH OTHER PUGET SOUND NEARSHORE ENVIRONMENTS?

STUDY SITES: 2008



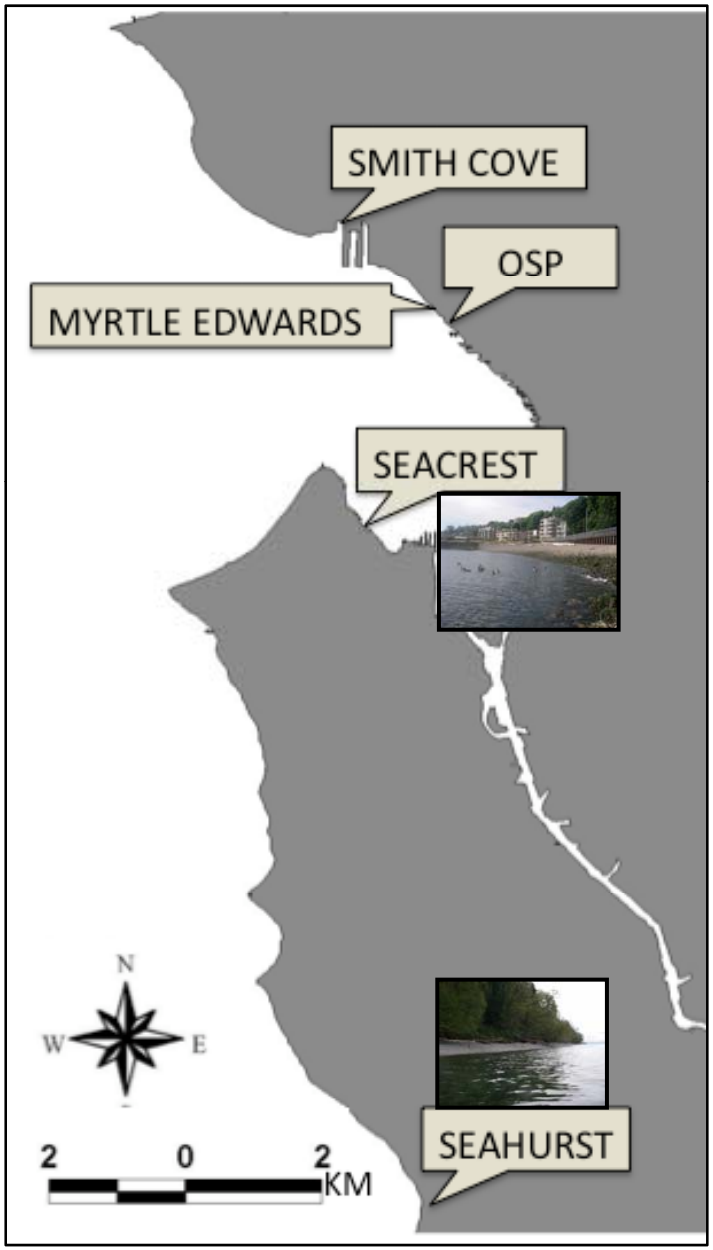
SEAHURST REFERENCE

STUDY SITES: 2008



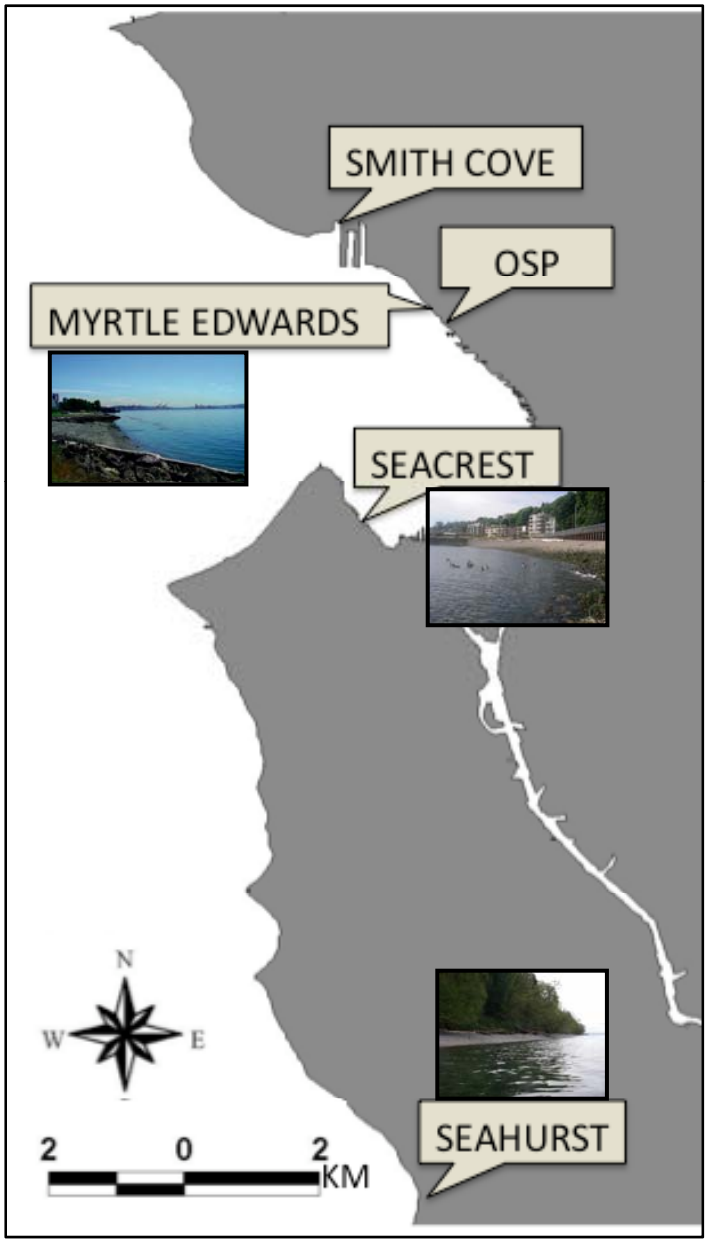
SEACREST

STUDY SITES: 2008



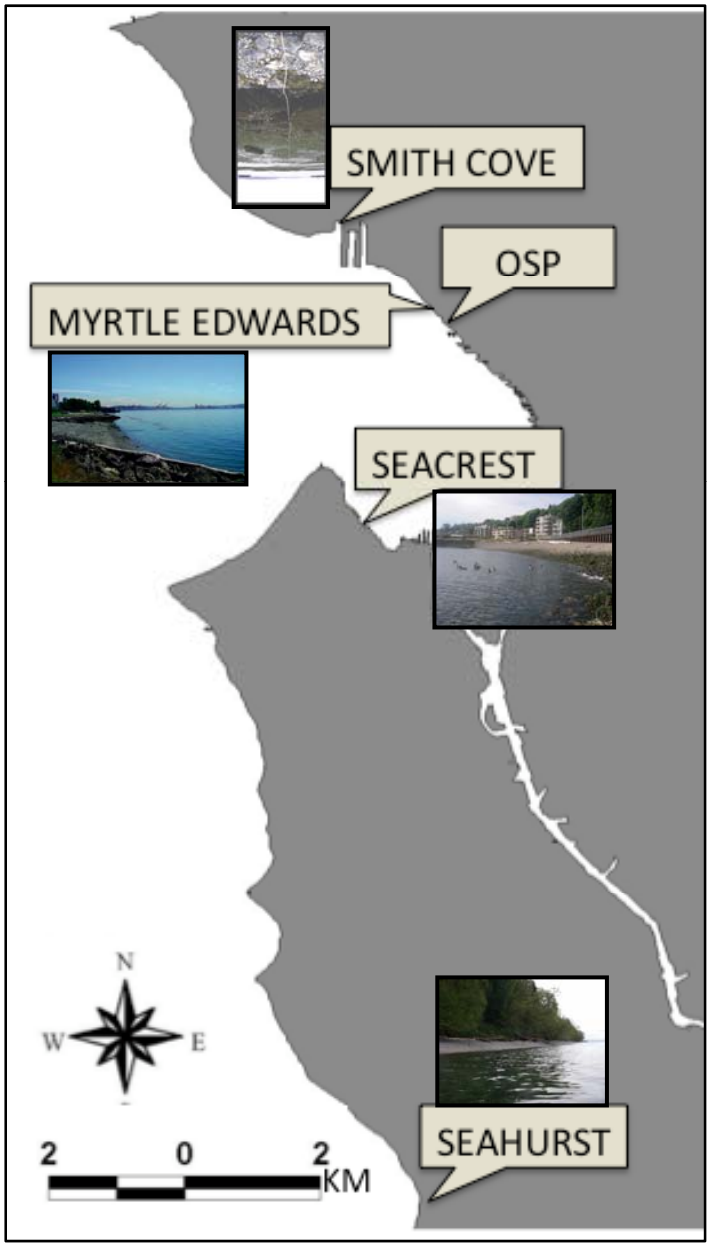
MYRTLE EDWARDS

STUDY SITES: 2008

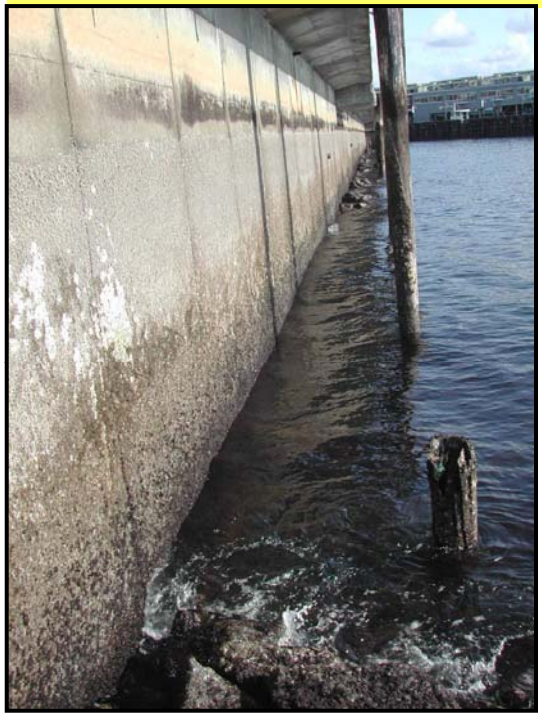


SMITH COVE

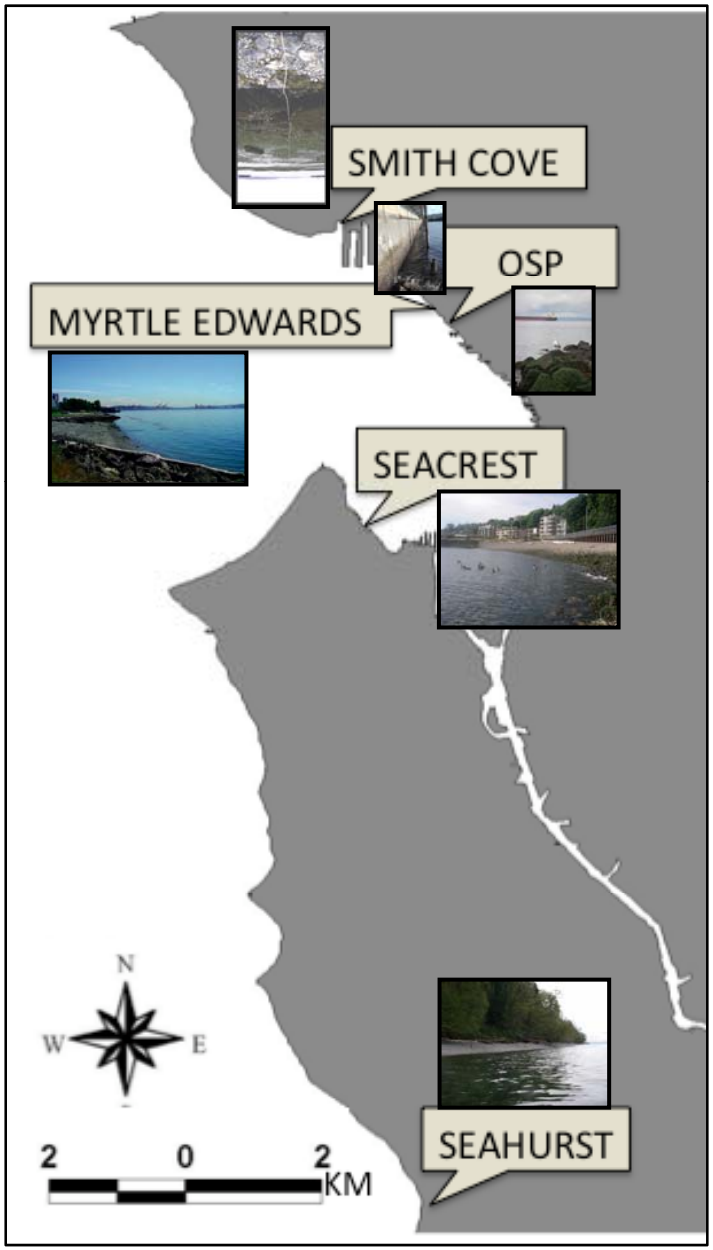
STUDY SITES: 2008



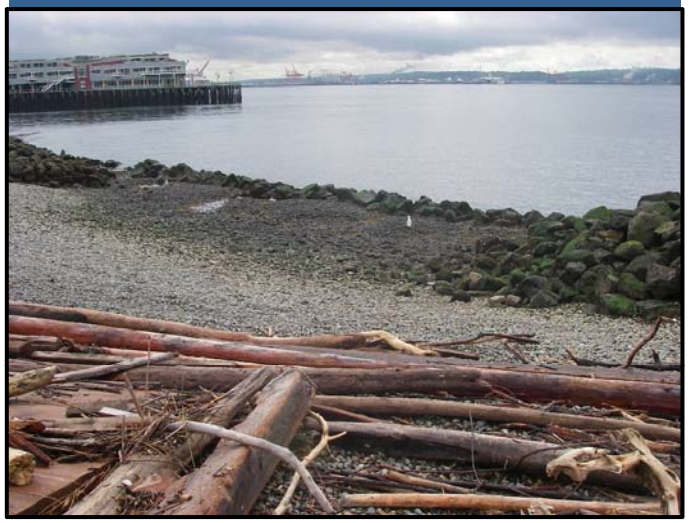
OSP SEAWALL AND RIPRAP



STUDY SITES: 2008



OSP ENHANCEMENTS

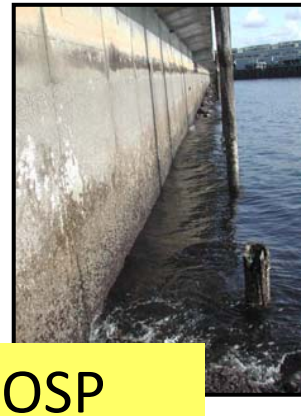


SITE COMPARISONS: SHORELINE ARMORING GRADIENT

SEAHURST REFERENCE

OSP POCKET BEACH & HABITAT BENCH

RIPRAP



OSP SEAWALL

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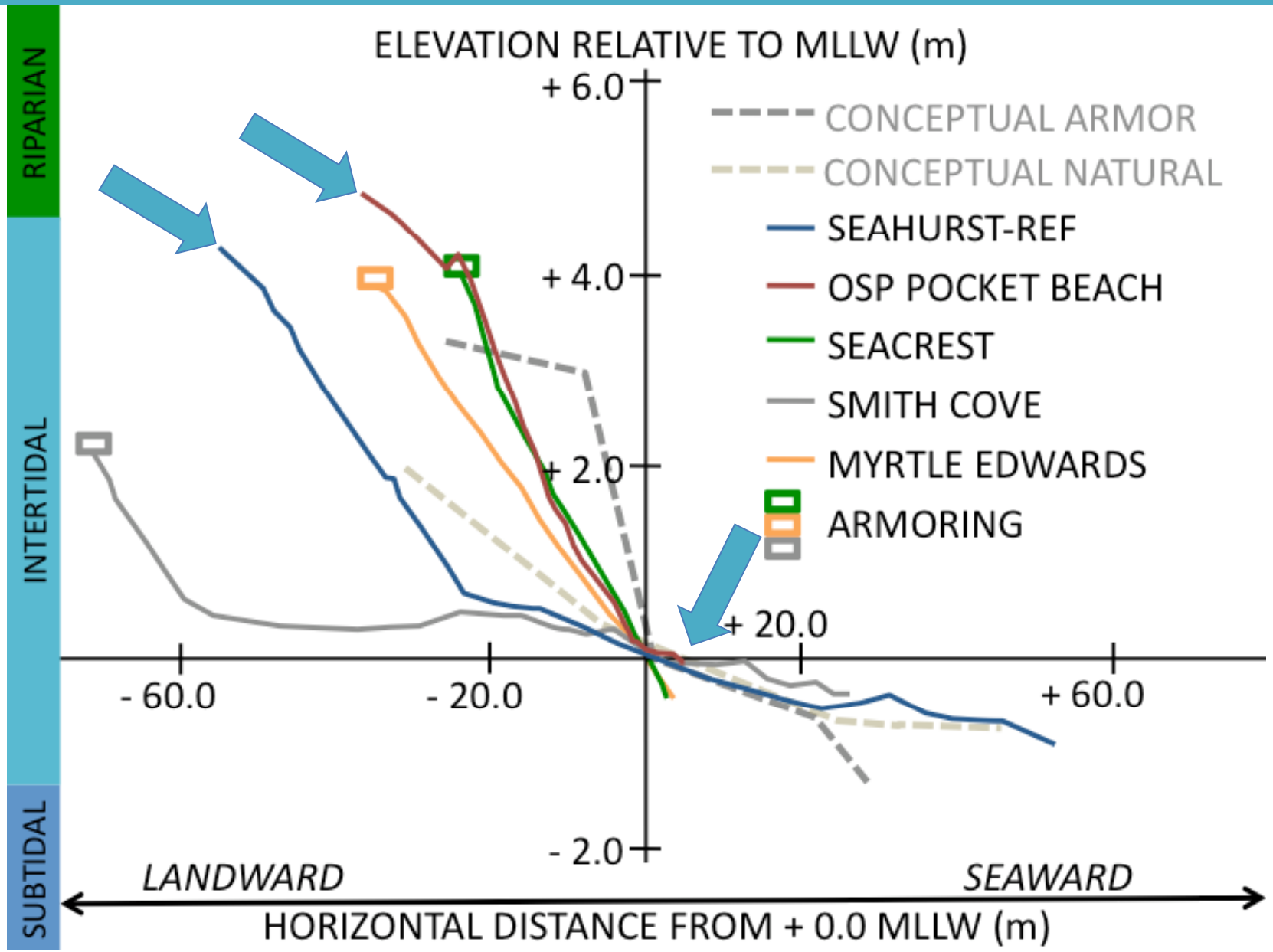
NATURAL *GRADIENT OF SHORELINE ARMORING* SEVERE

SEACREST, MYRTLE EDWARDS, SMITH COVE

BEACH PROFILES AND SEDIMENT GRAIN SIZE

- Purpose: *to characterize intertidal substrates and depth gradient of study sites*
- Winter and summer 2008
- Profiles of intertidal zone
- Sediment grain sizes and distribution

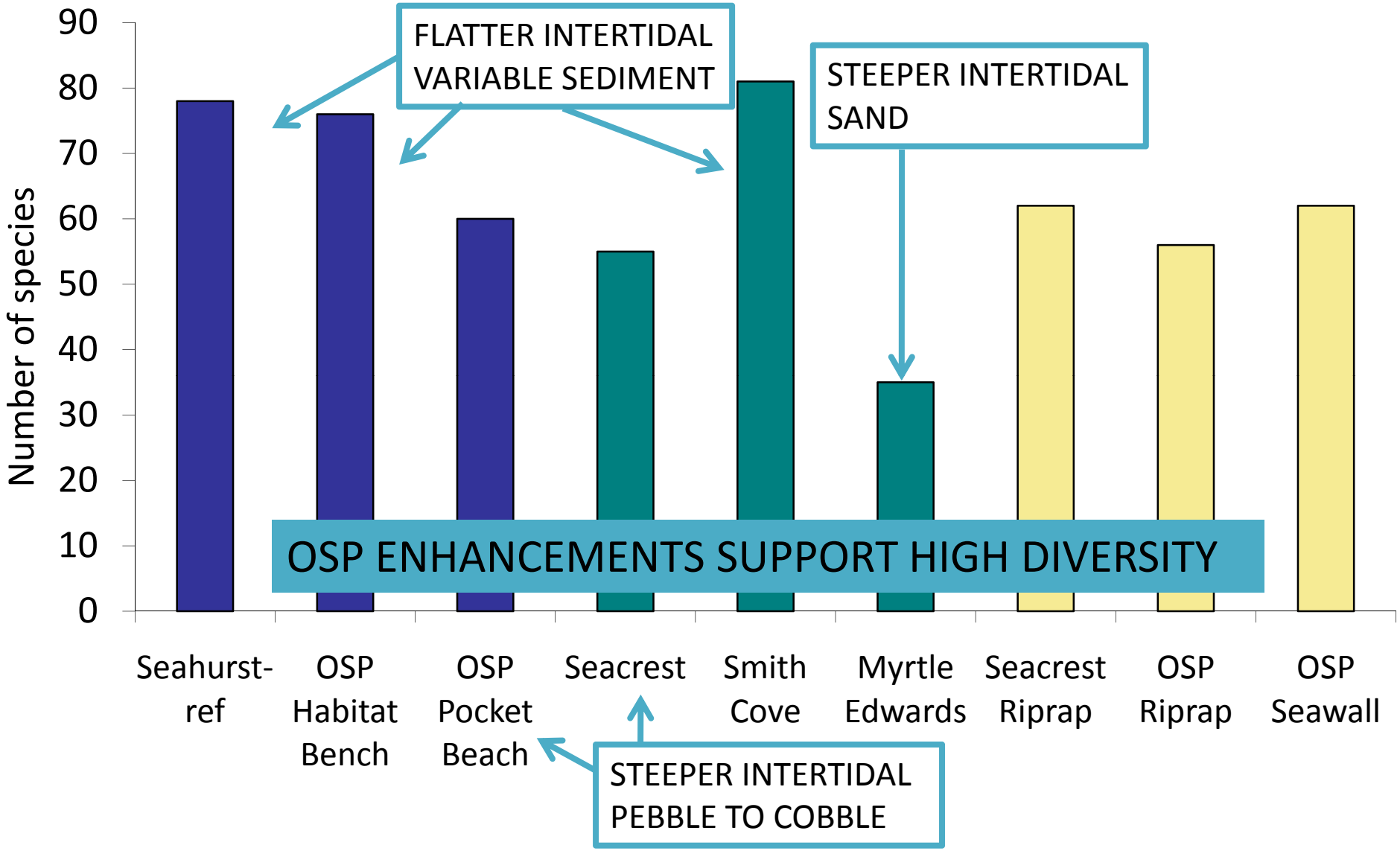
RESULTS: BEACH PROFILES AND SEDIMENT FEATURES



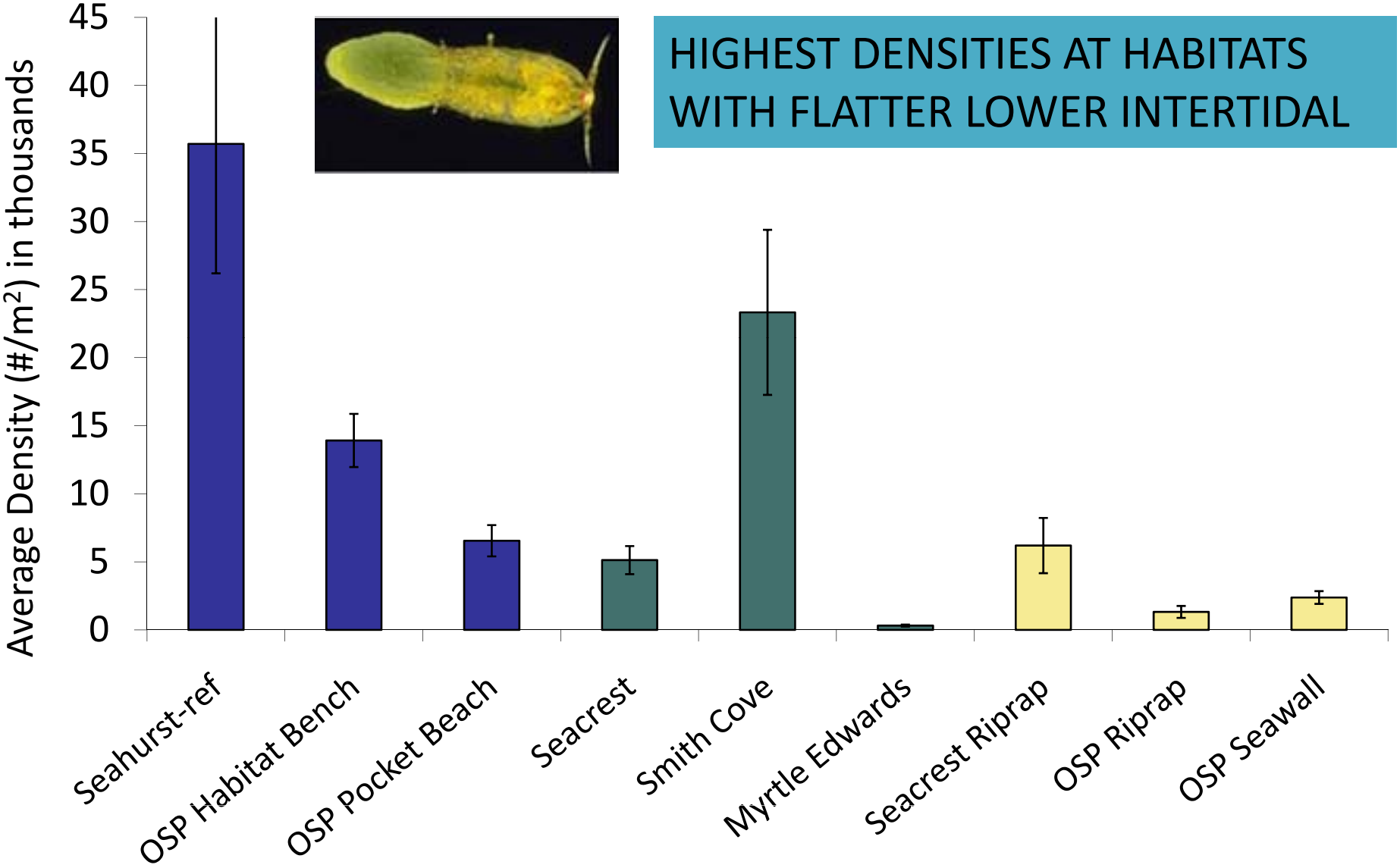
EPIBENTHIC INVERTEBRATE SAMPLING

- Purpose: *to compare production of salmon prey items*
- Organisms on the surface of intertidal sediments
- Sampled monthly April – July 2008
- Standardized by tidal elevation

EPIBENTHIC INVERTEBRATES: TAXA RICHNESS

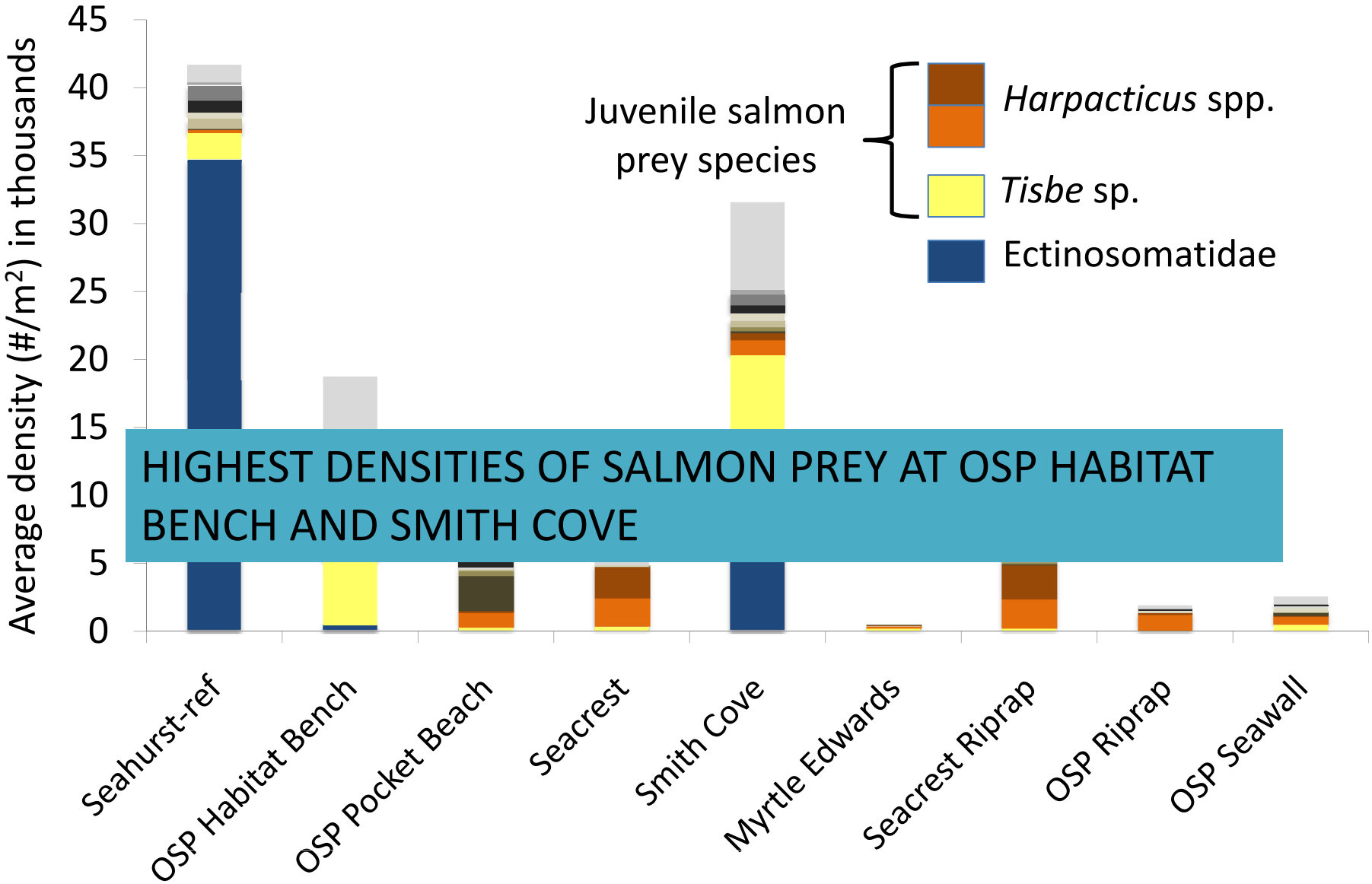


EPIBENTHIC INVERTEBRATES: HARPACTICOID COPEPODS



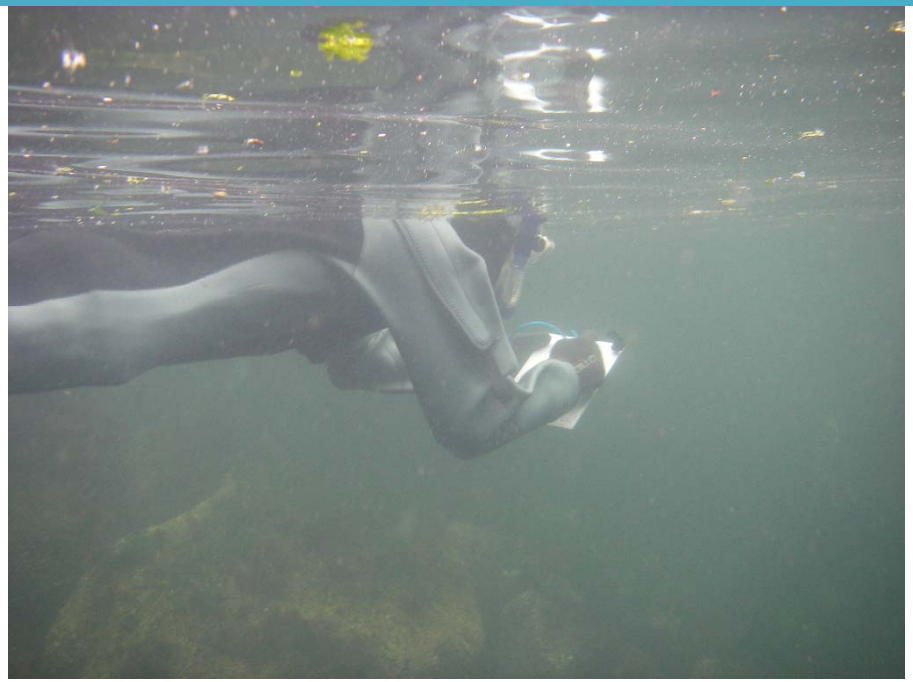
HIGHEST DENSITIES AT HABITATS WITH FLATTER LOWER INTERTIDAL

EPIBENTHIC INVERTEBRATES: SALMON PREY DENSITY



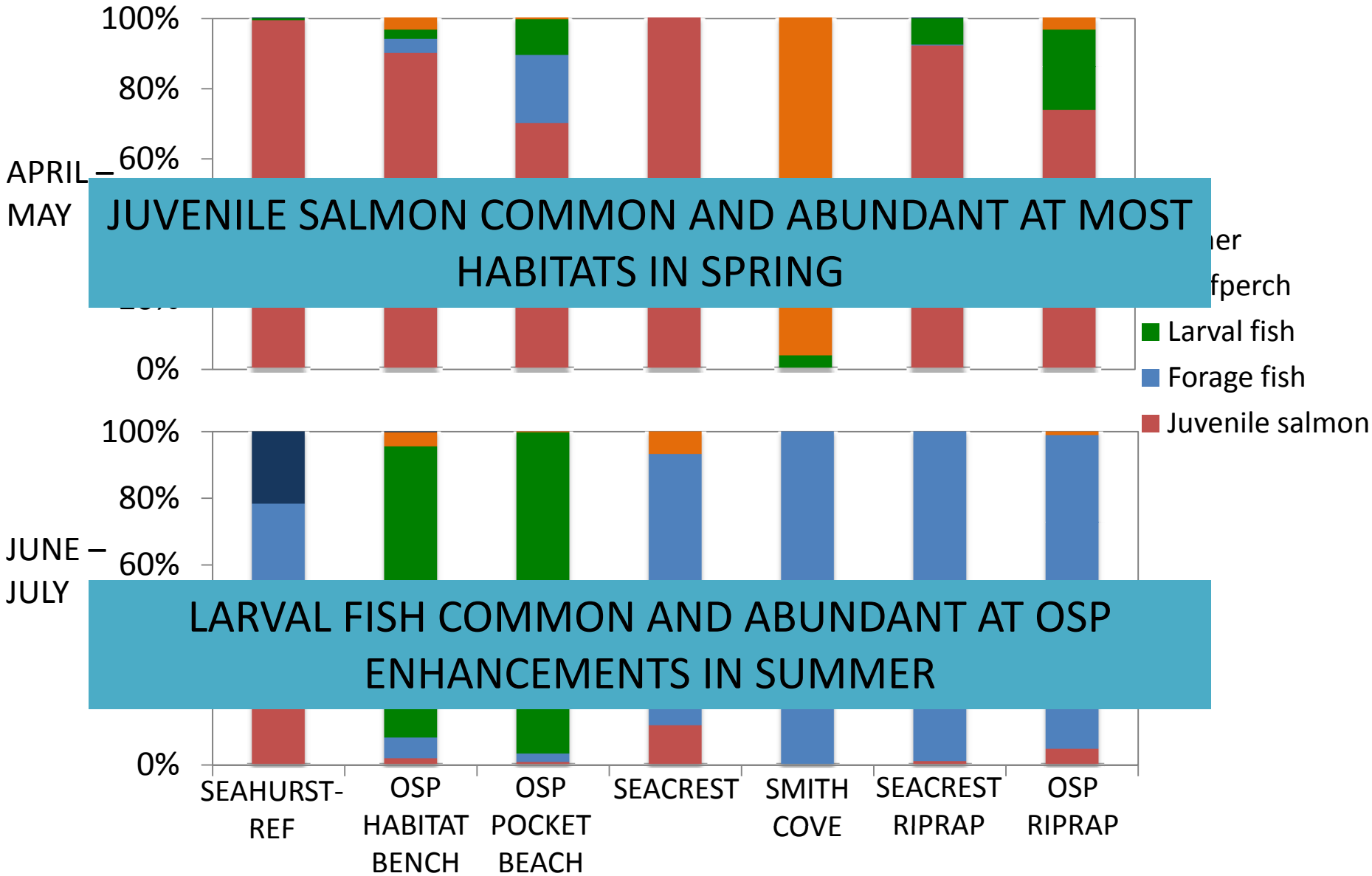
HIGHEST DENSITIES OF SALMON PREY AT OSP HABITAT BENCH AND SMITH COVE

SNORKEL SURVEYS

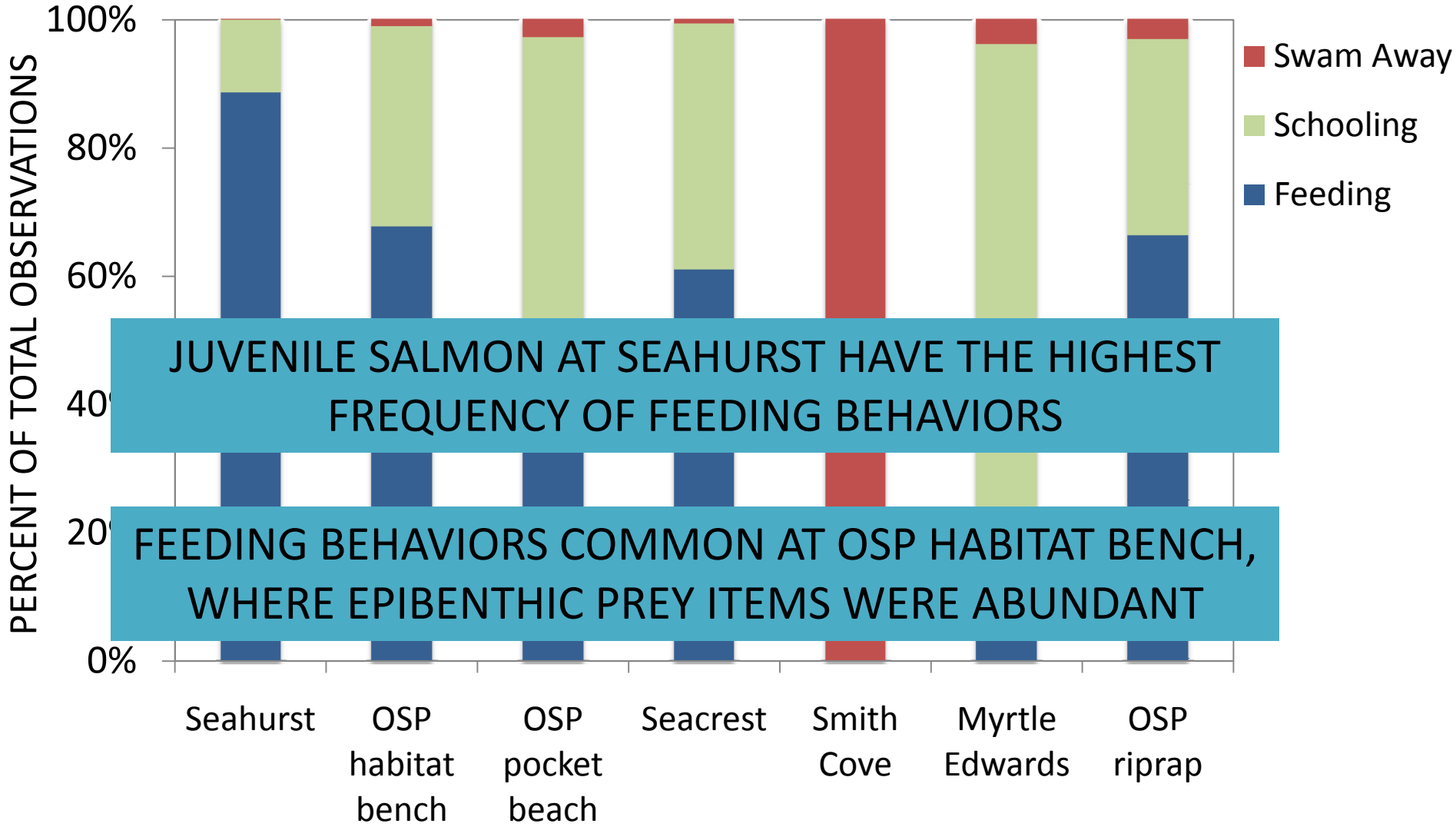


- Purpose: *to compare fish abundance, distribution and behavior*
- Weekly surveys April – July 2008
- Standardized by tidal elevation
- Species, school size, average length, water column position and behavior

SNORKEL SURVEYS: FISH COMPOSITION



SNORKEL SURVEYS: JUVENILE SALMON BEHAVIOR



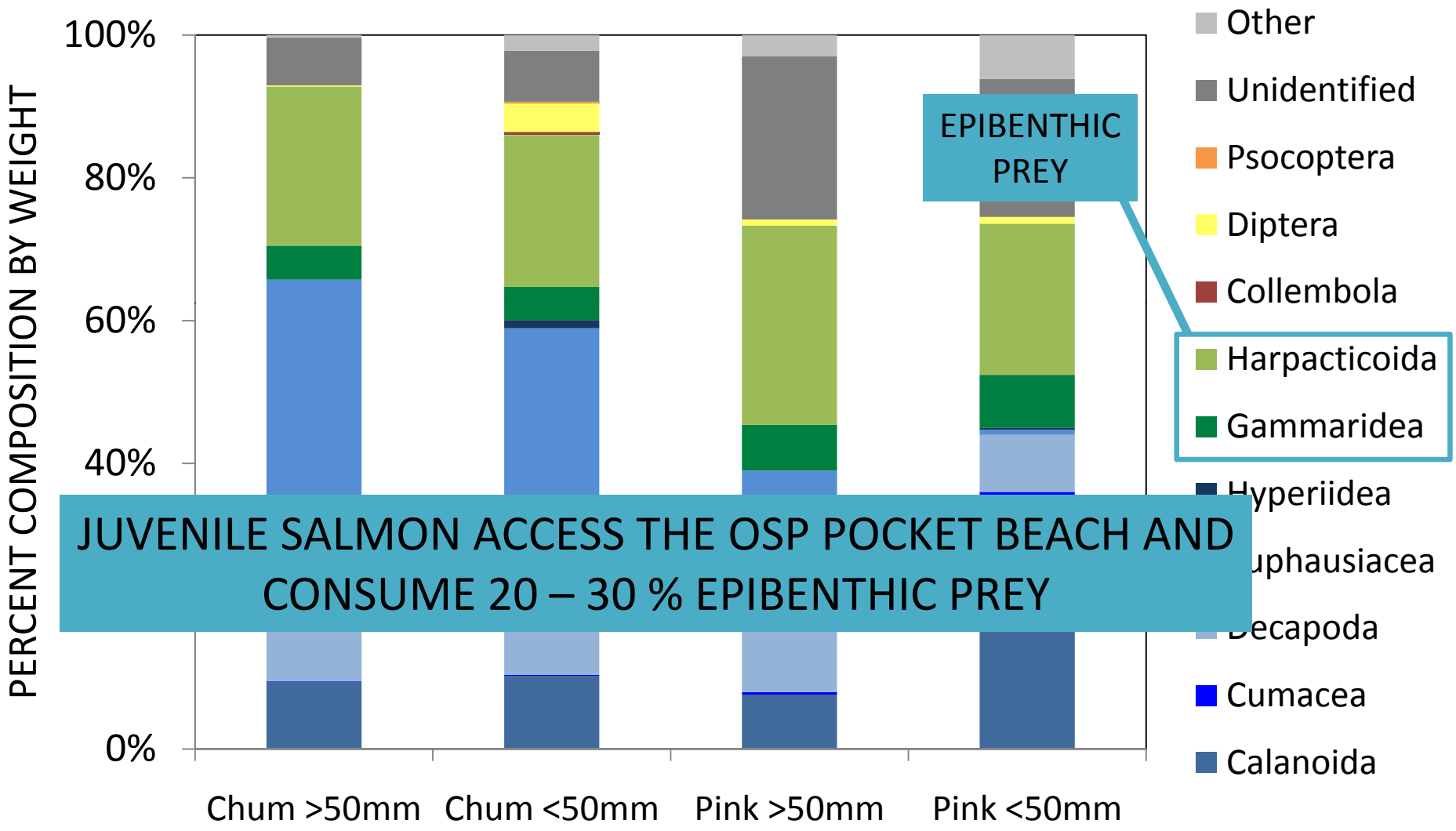
JUVENILE SALMON AT SEAHURST HAVE THE HIGHEST FREQUENCY OF FEEDING BEHAVIORS

FEEDING BEHAVIORS COMMON AT OSP HABITAT BENCH, WHERE EPIBENTHIC PREY ITEMS WERE ABUNDANT

ENCLOSURE NET AND JUVENILE SALMON DIETS

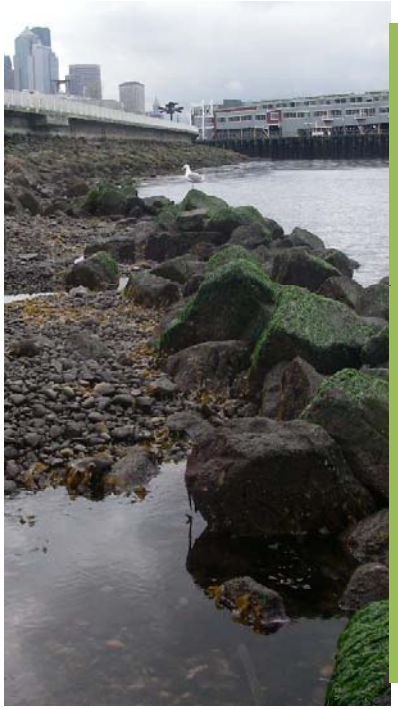
- Purpose: to *evaluate fish use and prey resources at OSP*
- OSP pocket beach only
- Monthly April – July 2008
- Net deployed across beach at high slack tide
- Fish enclosed for 3 – 4 hours
- Collect diet samples from juvenile salmon

ENCLOSURE NET AND JUVENILE SALMON DIETS



JUVENILE SALMON ACCESS THE OSP POCKET BEACH AND CONSUME 20 – 30 % EPIBENTHIC PREY

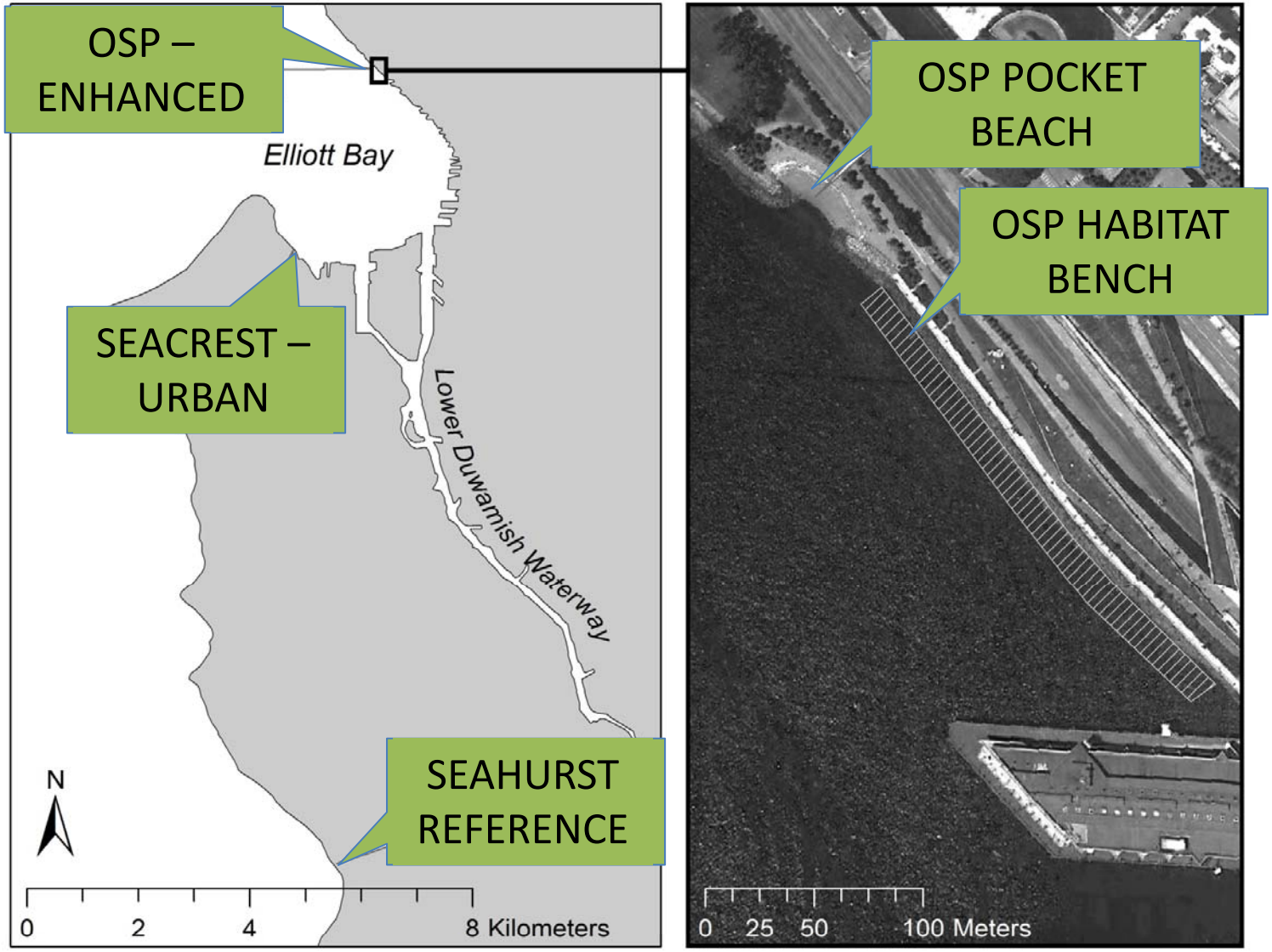
JUVENILE SALMON BEHAVIOR AND MOVEMENT – 2009



IN PUGET SOUND NEARSHORE ENVIRONMENTS

1. HOW FAST DO JUVENILE SALMON MOVE?
2. DOES BEHAVIOR AFFECT MOVEMENT RATES?
3. DOES SPEED OR COMPLEXITY OF MOVEMENT PATH RELATE TO SHORELINE ARMORING OR BEHAVIOR?

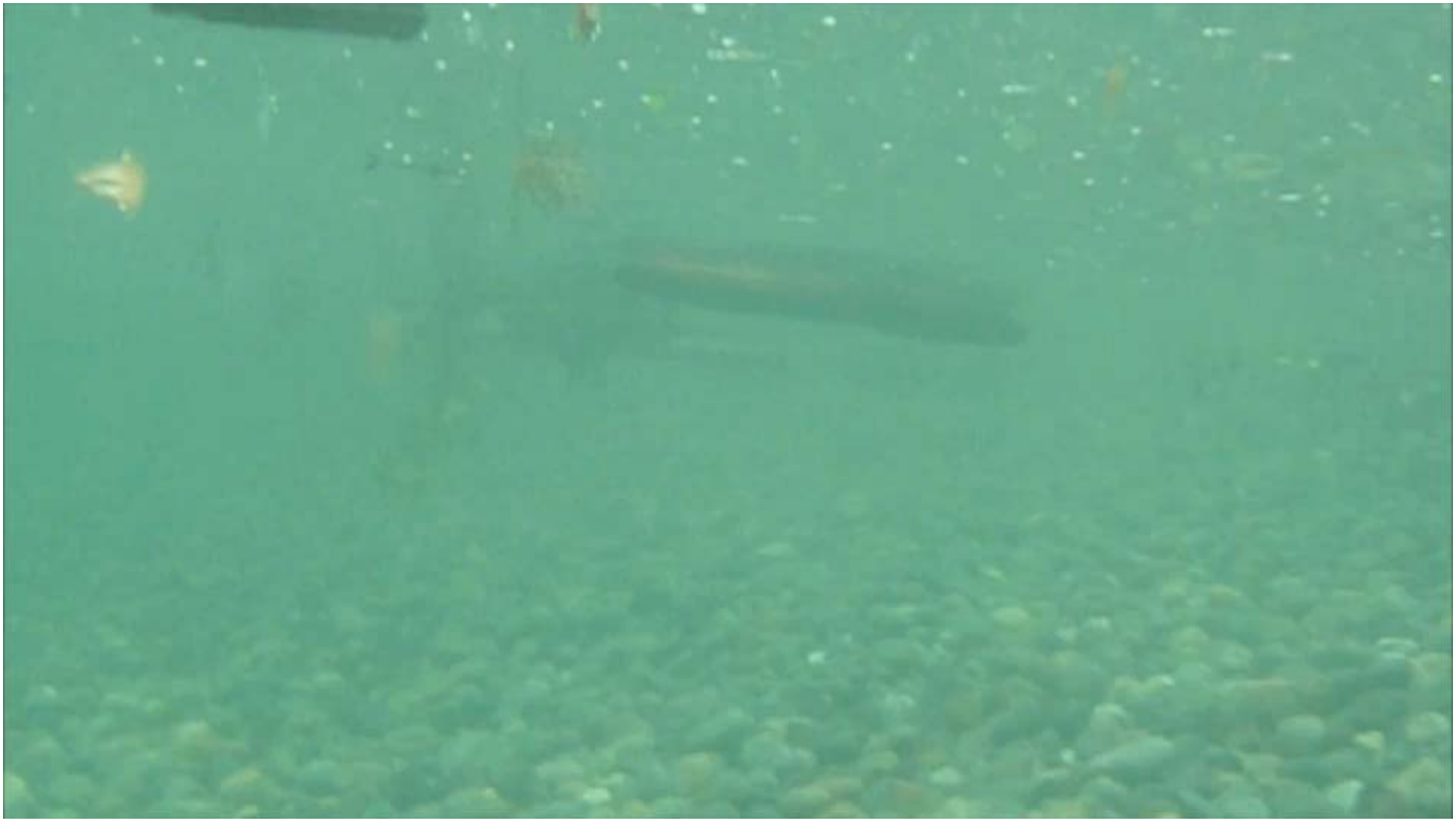
STUDY SITES


OSP – ENHANCED
Elliott Bay
SEACREST – URBAN
Lower Duwamish Waterway
SEAHURST REFERENCE
N
0
2
4
8 Kilometers
OSP POCKET BEACH
OSP HABITAT BENCH
0
25
50
100 Meters

BEHAVIOR CATEGORIES: SCHOOLING

BEHAVIOR CATEGORIES: SWIMMING AWAY

BEHAVIOR CATEGORIES: FEEDING

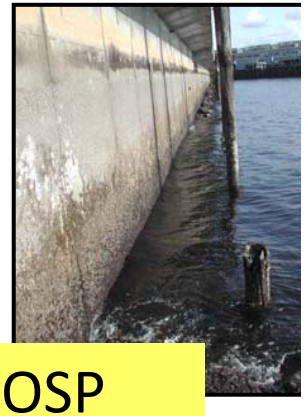


SYNTHESIS: ECOLOGICAL PERFORMANCE OF OSP

SEAHURST REFERENCE

OSP HABITAT BENCH

OSP POCKET BEACH



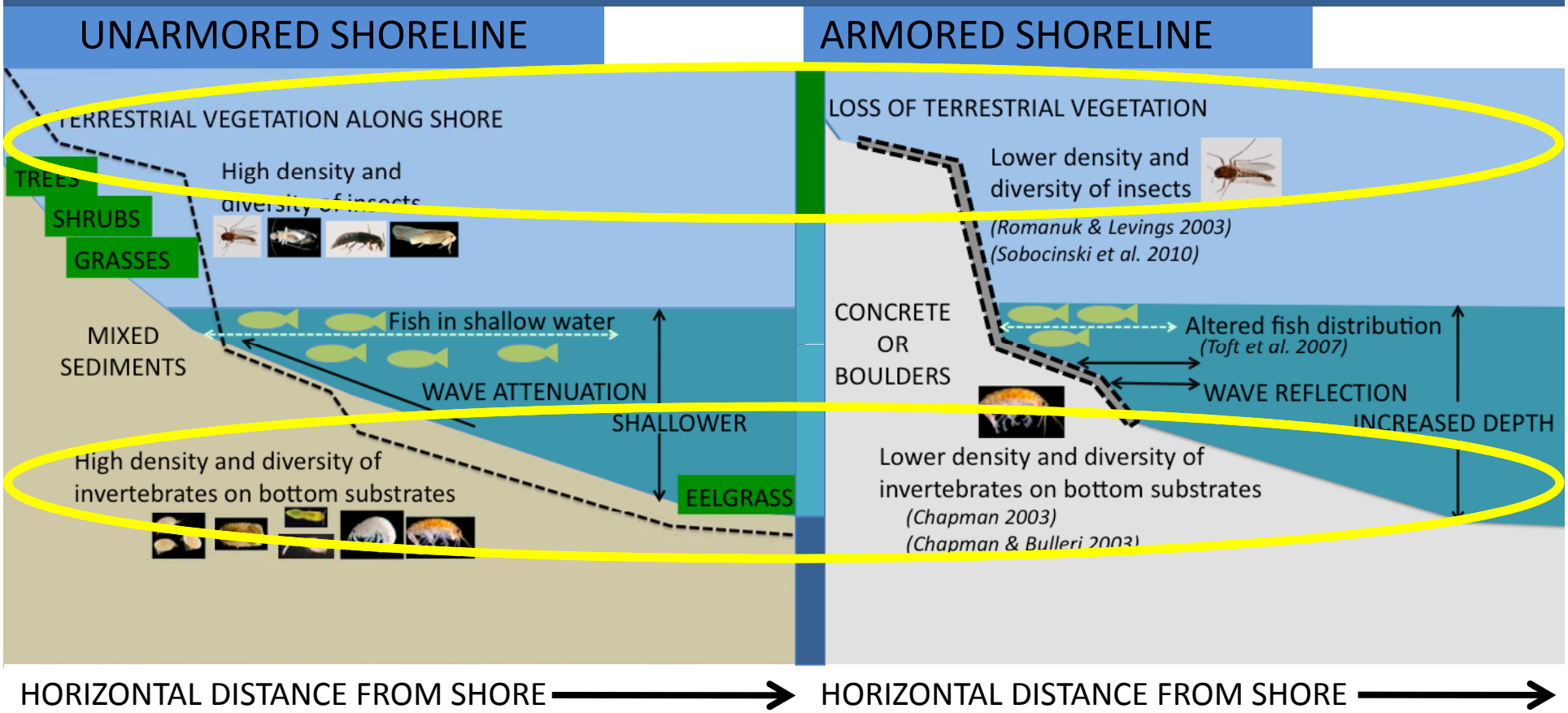
OSP SEAWALL

NATURAL — *GRADIENT OF SHORELINE ARMORING* — SEVERE

- ACCESSIBILITY
- PREY RESOURCES
- OBSERVED FEEDING

ENHANCED RELATIVE TO ARMORED SHORELINES

SYNTHESIS: RECOMMENDATIONS FOR SALMON HABITAT ENHANCEMENTS IN NEARSHORE ENVIRONMENTS



HORIZONTAL DISTANCE FROM SHORE → HORIZONTAL DISTANCE FROM SHORE →

1. RESTORE LOWER GRADIENT AND SEDIMENT DIVERSITY IN LOWER INTERTIDAL
2. RESTORE TERRESTRIAL CONNECTION TO UPPER INTERTIDAL

ACKNOWLEDGEMENTS

THESIS COMMITTEE AT UW, FOR INVALUABLE GUIDANCE AND CONSTRUCTIVE FEEDBACK:

SI SIMENSTAD

JASON TOFT

DAVE BEAUCHAMP

ANDREA OGSTON

WETLAND ECOSYSTEM TEAM, ESPECIALLY:

BETH ARMBRUST, CLAIRE LEVY, JASON TOFT – FOR GOING THE DISTANCE IN THE FIELD AND THE LAB

JEFF CORDELL – INVERTEBRATE ORACLE

MARY RAMIREZ – MOVEMENT ANALYSIS

FUNDING SOURCES:

Salmon Recovery Funding Board

GREEN / DUWAMISH AND CENTRAL PUGET SOUND WATERSHED

King Conservation District

Washington Department of FISH and WILDLIFE

PUGET SOUND NEARSHORE PARTNERSHIP

RESTORING OUR ECOSYSTEM HEALTH

QUESTIONS ? ?