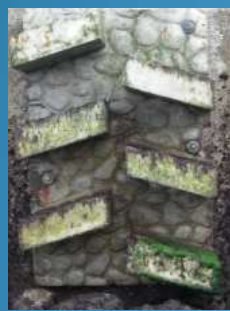


Habitat Enhancements in Seawalls – Seattle Seawall as a Case Study



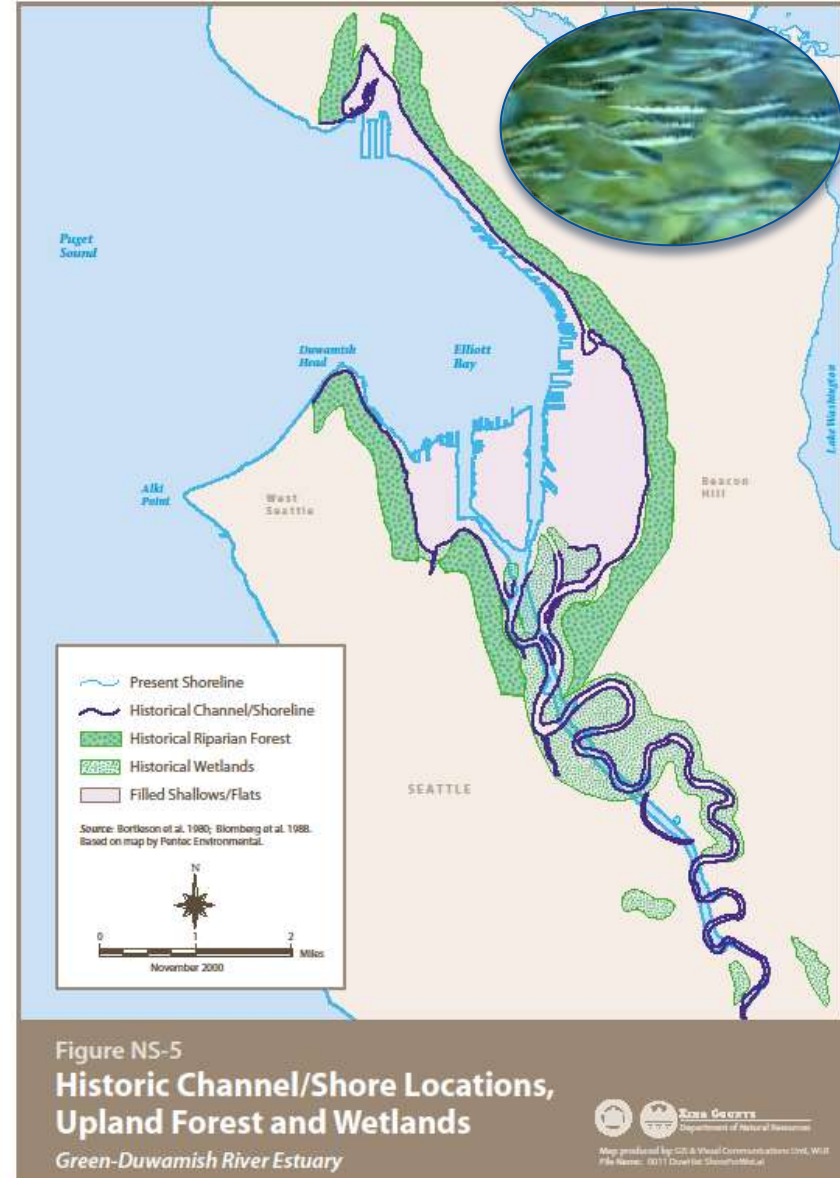
Seattle Seawall

- Seawall built in 1930's to create deep-water port.
- Intertidal zone transformed to vertical wall
- Few shallow areas remain
- Seawall in disrepair and needs major repairs and rebuild



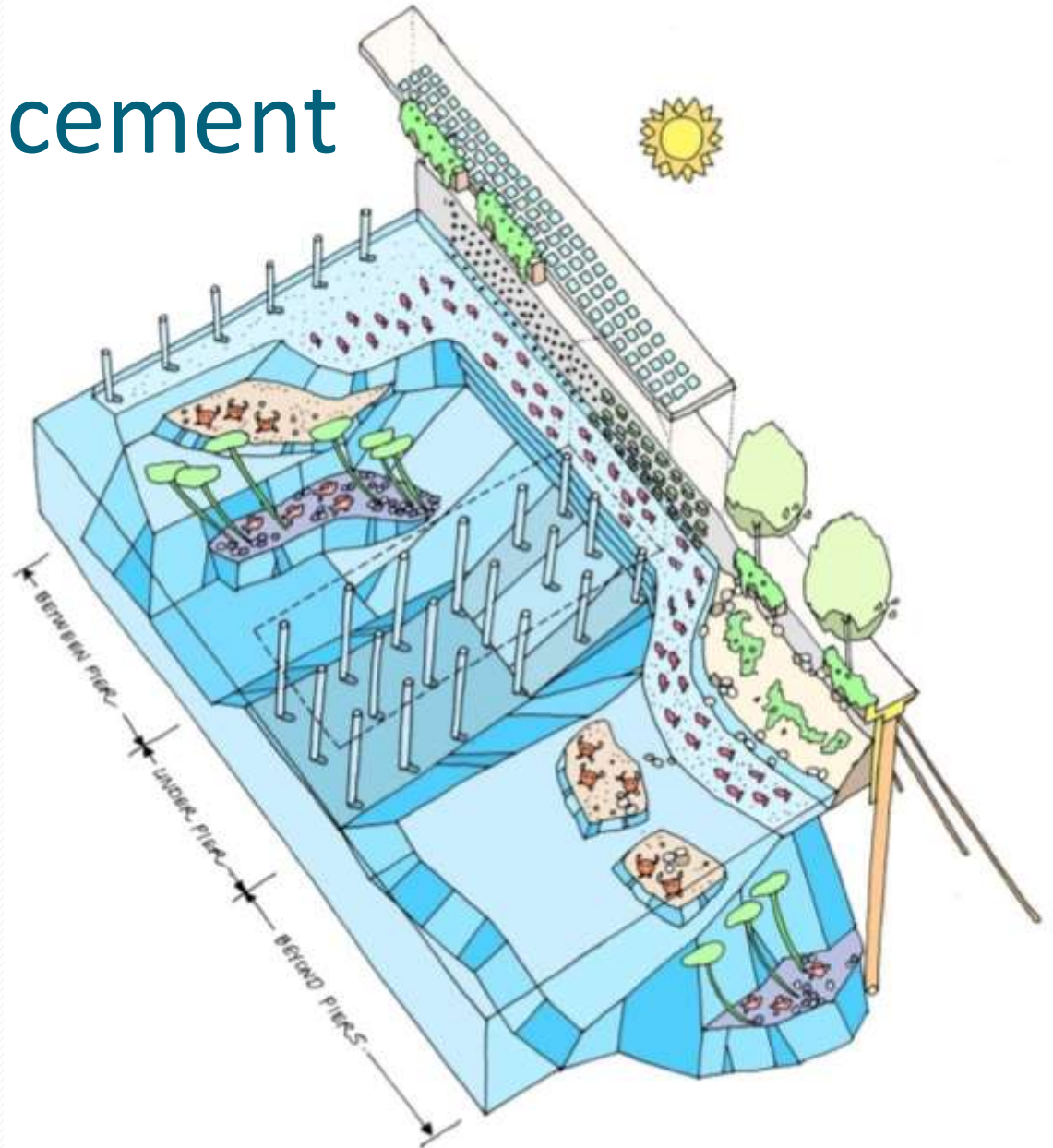
Shoreline Salmon

- Migratory corridor & rearing habitat for juvenile salmon
- Green River and Duwamish populations
 - 1999 ESA listing: Threatened Puget Sound Chinook
 - City of Seattle sponsored UW research found:
 - Juvenile salmon were abundant very close to the seawall
 - Their diets were linked to intertidal



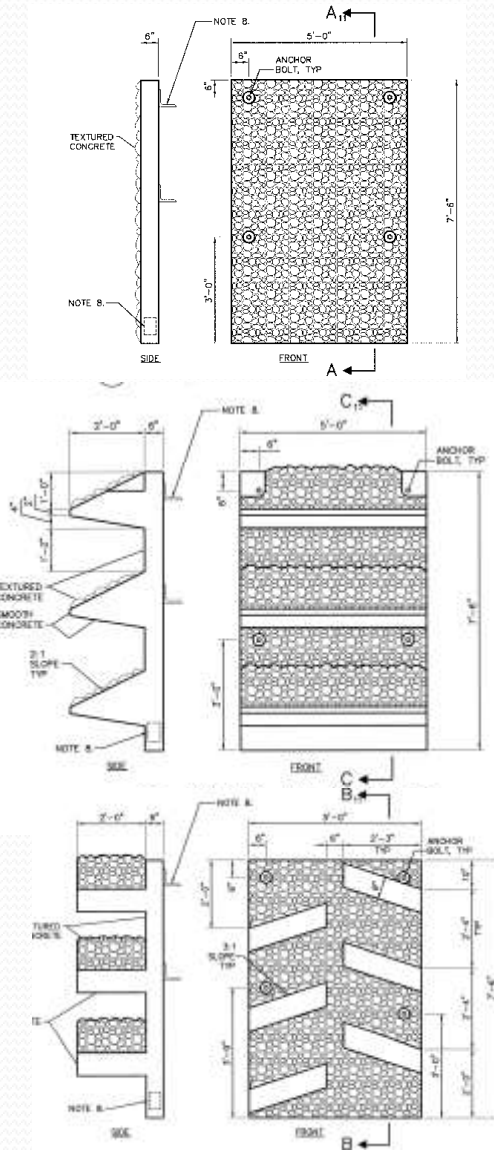
Habitat Enhancement

- New seawall
- Intertidal corridor
- Lighting
- Riparian vegetation
- **Textured wall**
- Substrate enhancement
- Cobble reefs



Habitat Enhancement Test Panels

- Design considerations
 - Vertical seawall
 - Cost effective over large area
- Engineered microhabitats
 - Slope/shade: fins and steps
 - Crevices: cobble surface
- Collaboration
 - City: Design, fabrication, installation
 - UW/Seagrant/KCD: biological monitoring



Fabrication & Installation



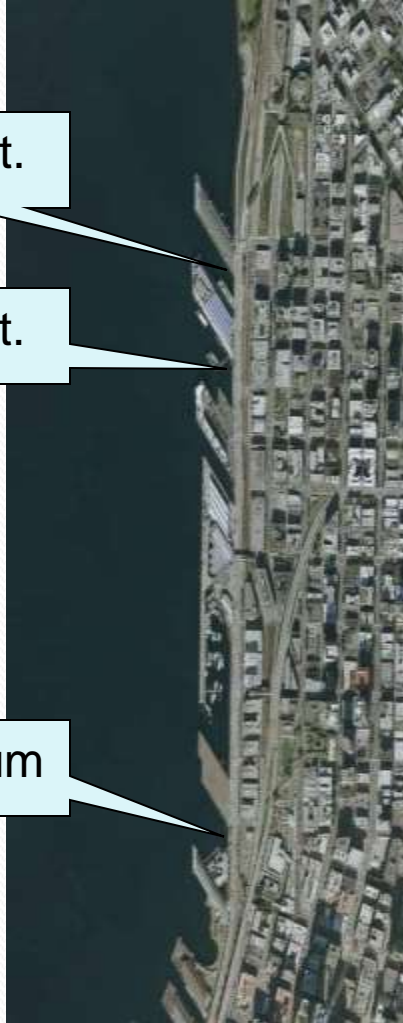
Overall study design

3 Sites

Clay St.

Vine St.

Aquarium



3 panel designs, each with 2 surface treatments;
plus Reference and Control

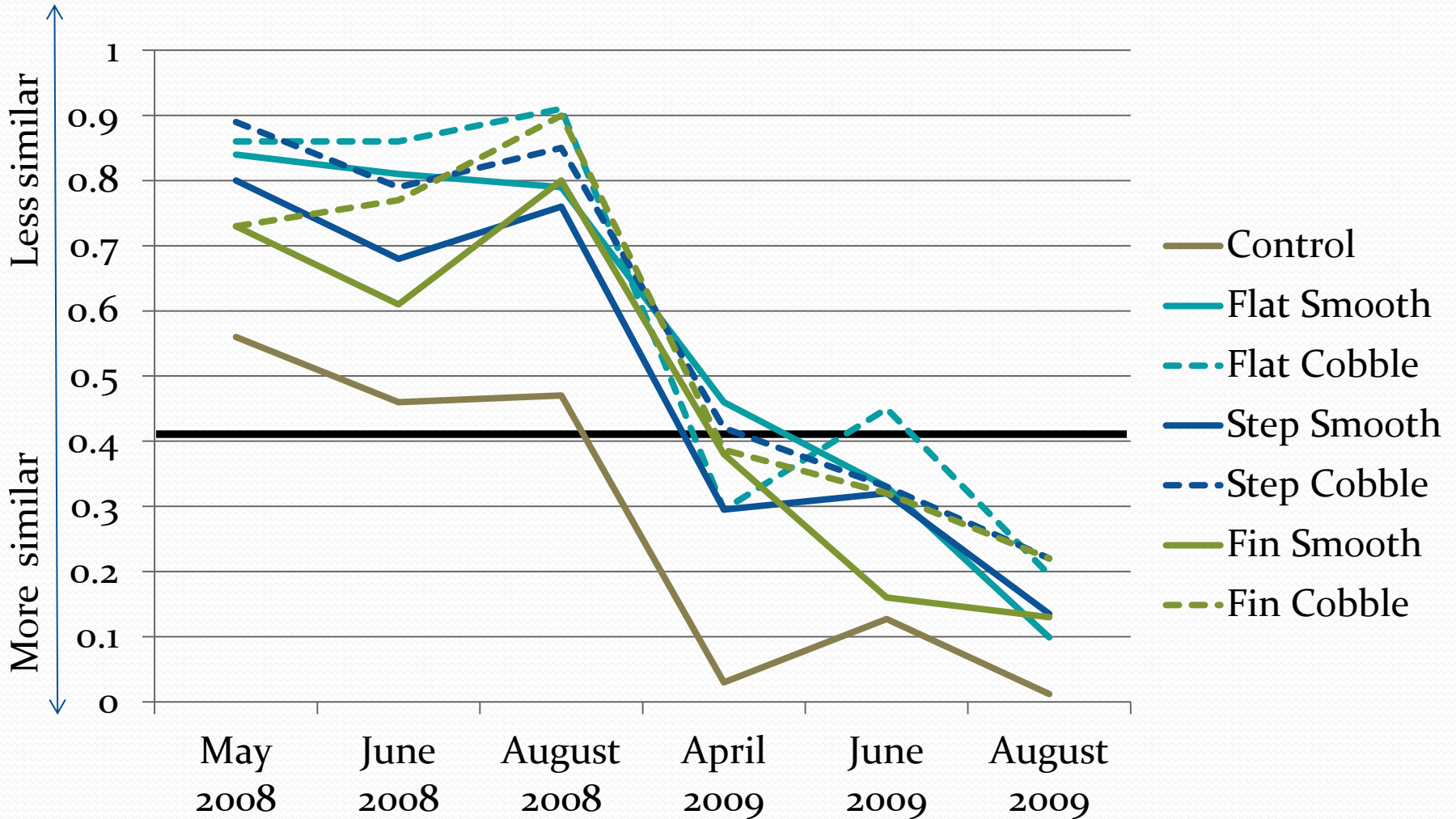


Sessile Organisms

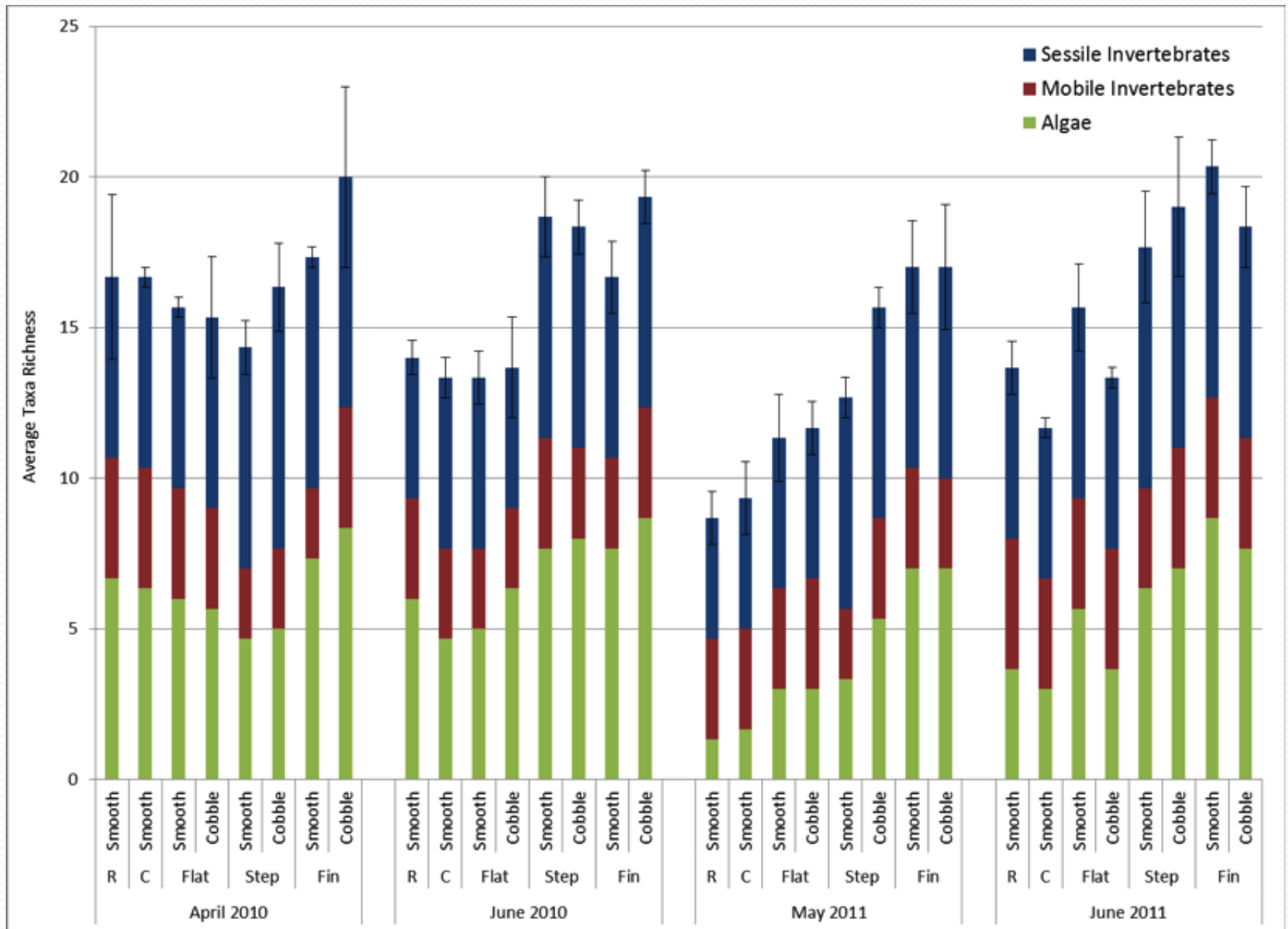


- Quadrats
 - Percent cover
 - Algae & Invertebrates
- Elevations (Ft., MLLW)
 - Upper (+5 to +7.5 ft)
 - Mid (+2.5 to +5 ft)
 - Lower (0 to + 2.5 ft)
- Replication
 - Site level (N=3)
 - Within panel (9)
- 2008—2011

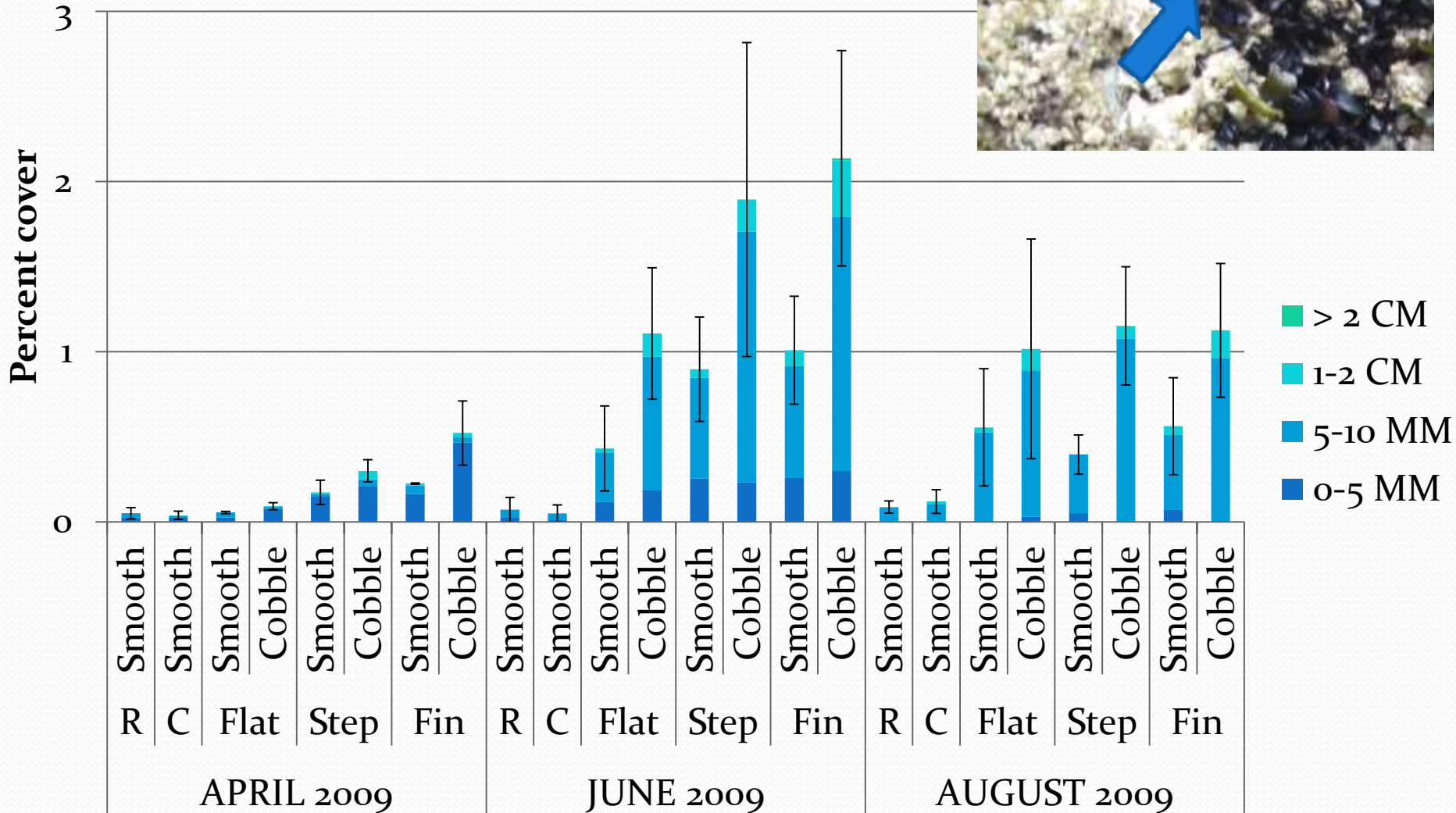
Community Composition (compared to reference)



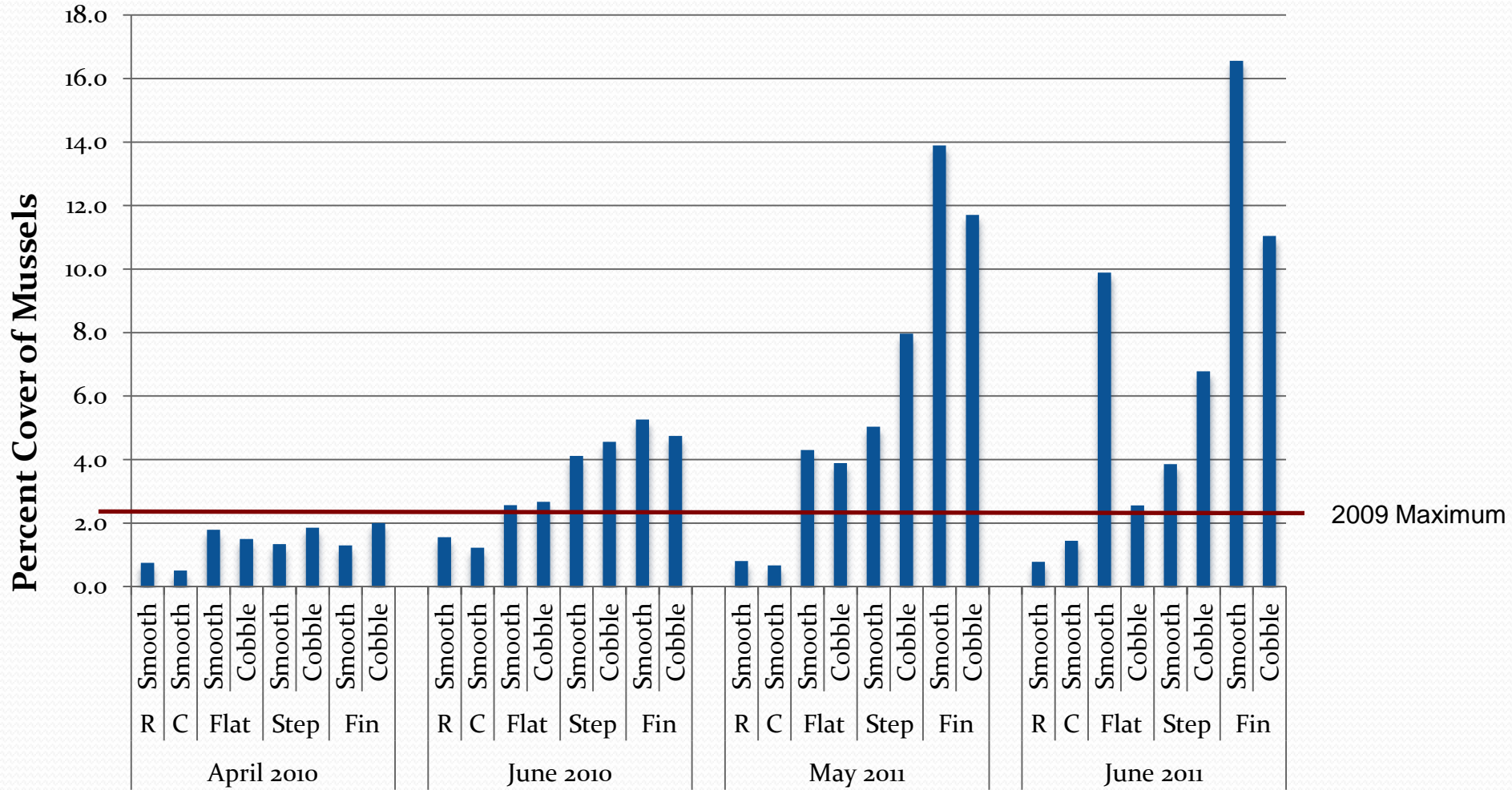
Taxa Richness



Mytilus (2009)

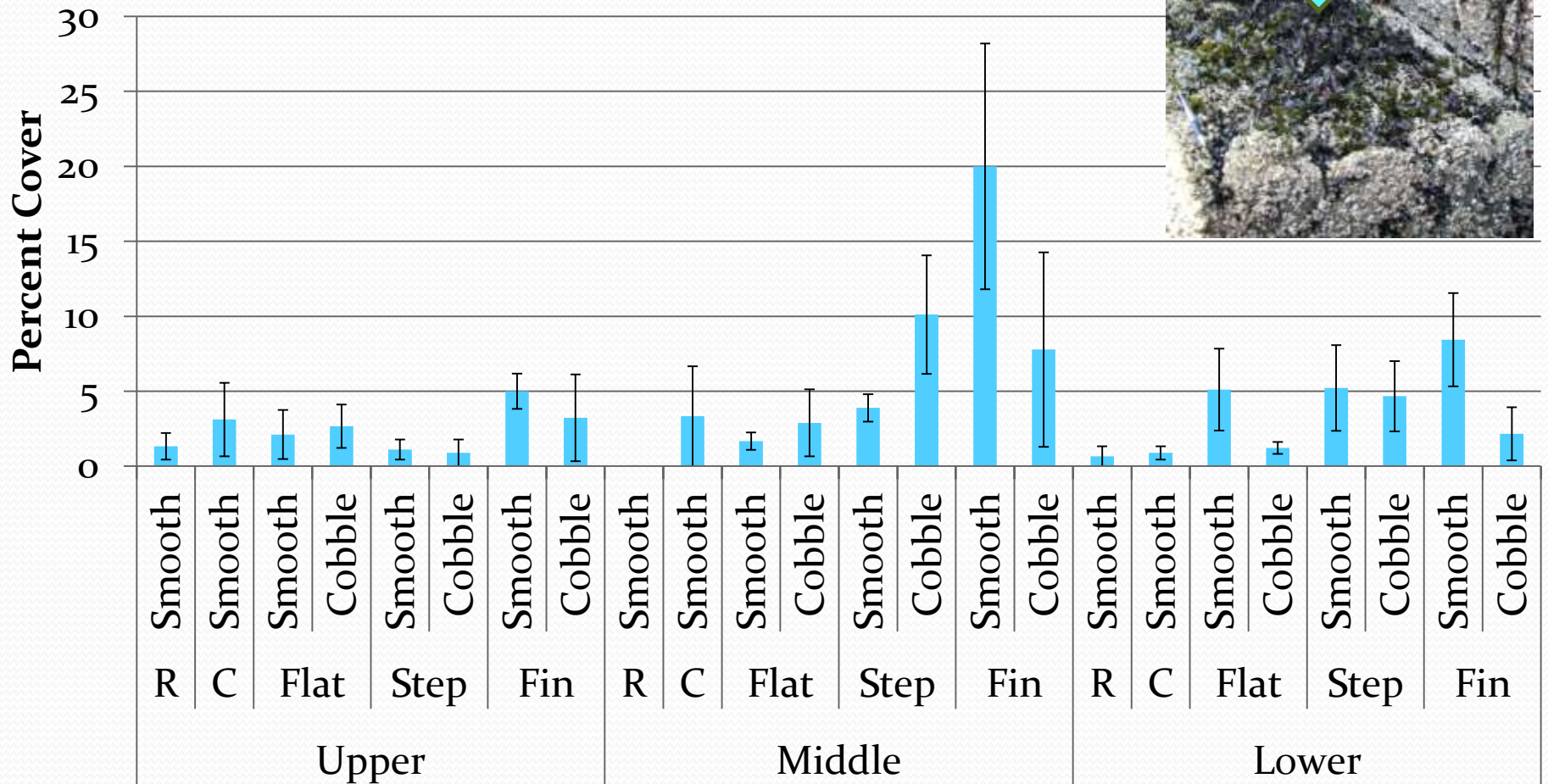


Mytilus (2010-11)

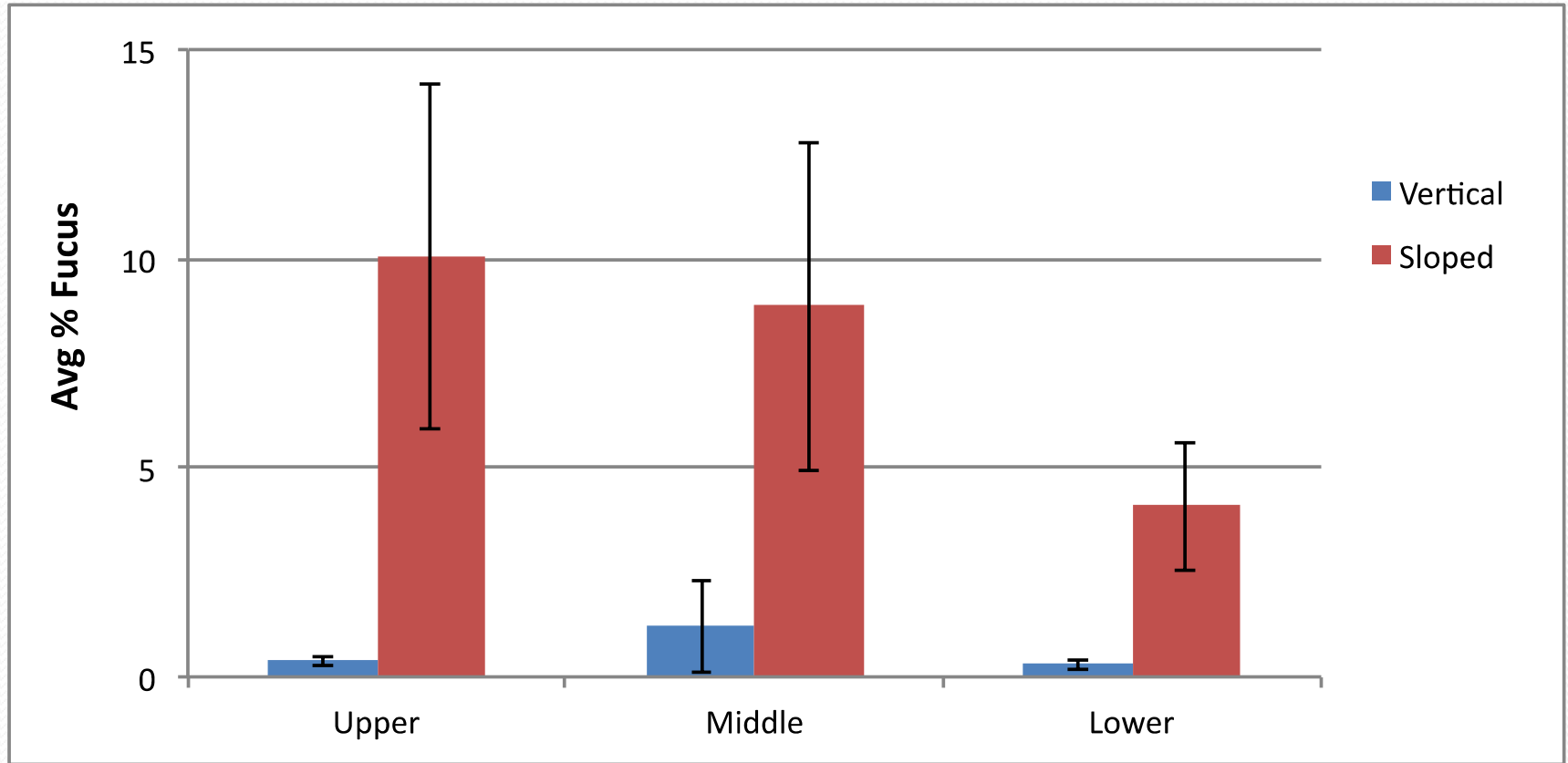


Fucus distichus

August 2009



Fucus 2010-2011



Epibenthic Organisms

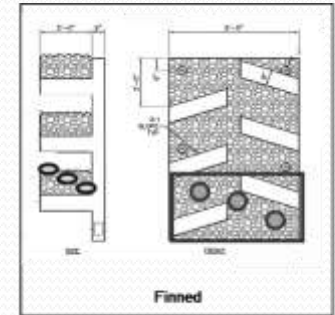


< 1 mm

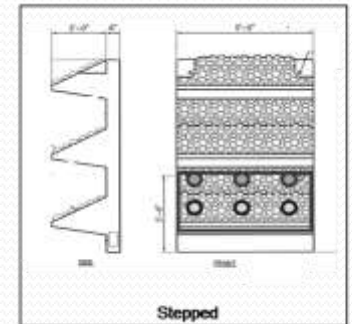


≤ 1mm

- Epibenthic Pump
 - 0-+3 feet MLLW
 - Composite samples
 - vertical
 - sloped
 - 2008—2011
 - April - July

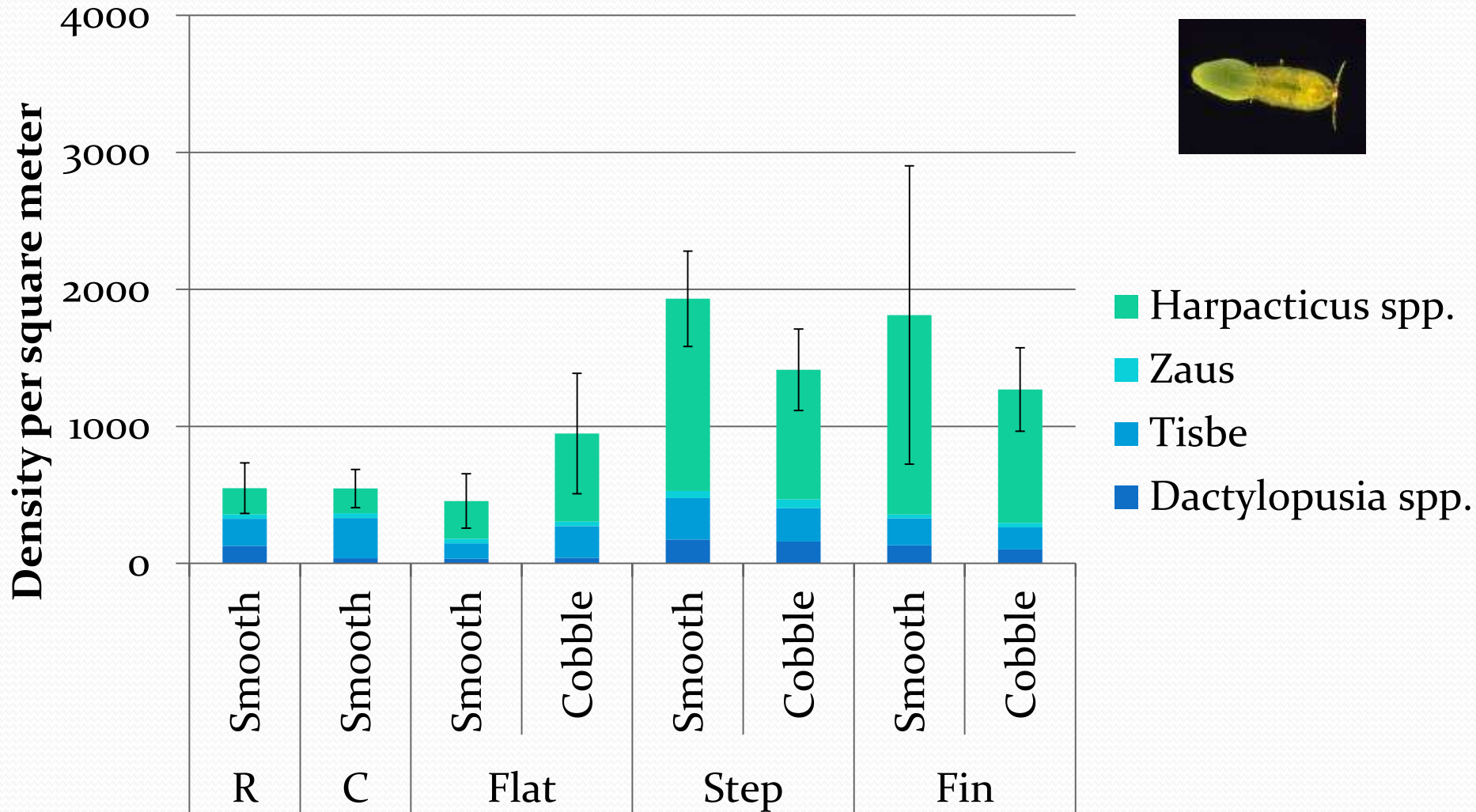


Individual composite samples for
○ Fin 1
○ Fin 2
● vertical surface



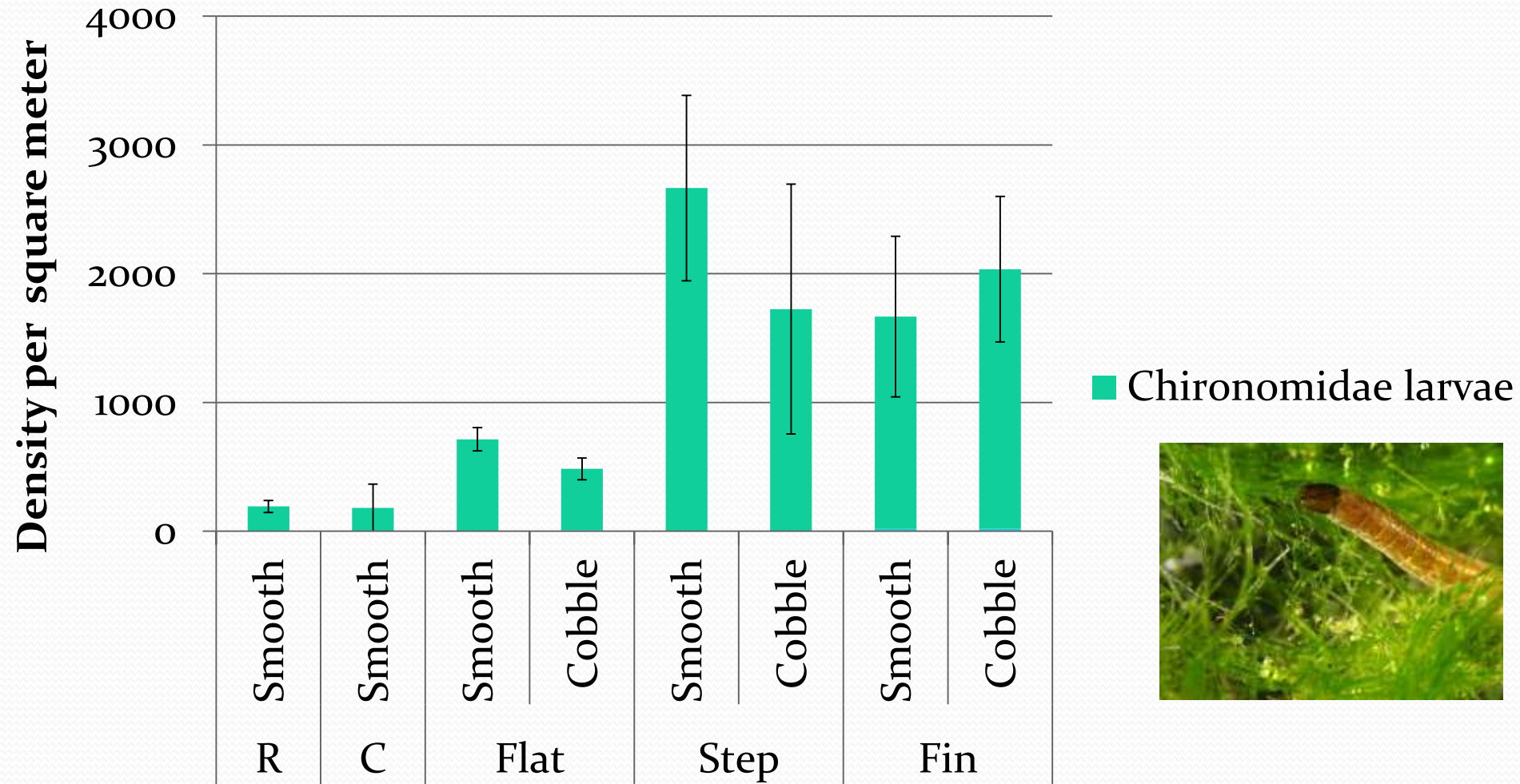
Individual composite samples for
○ step
● vertical surface

Juvenile Salmon prey densities: Harpacticoids



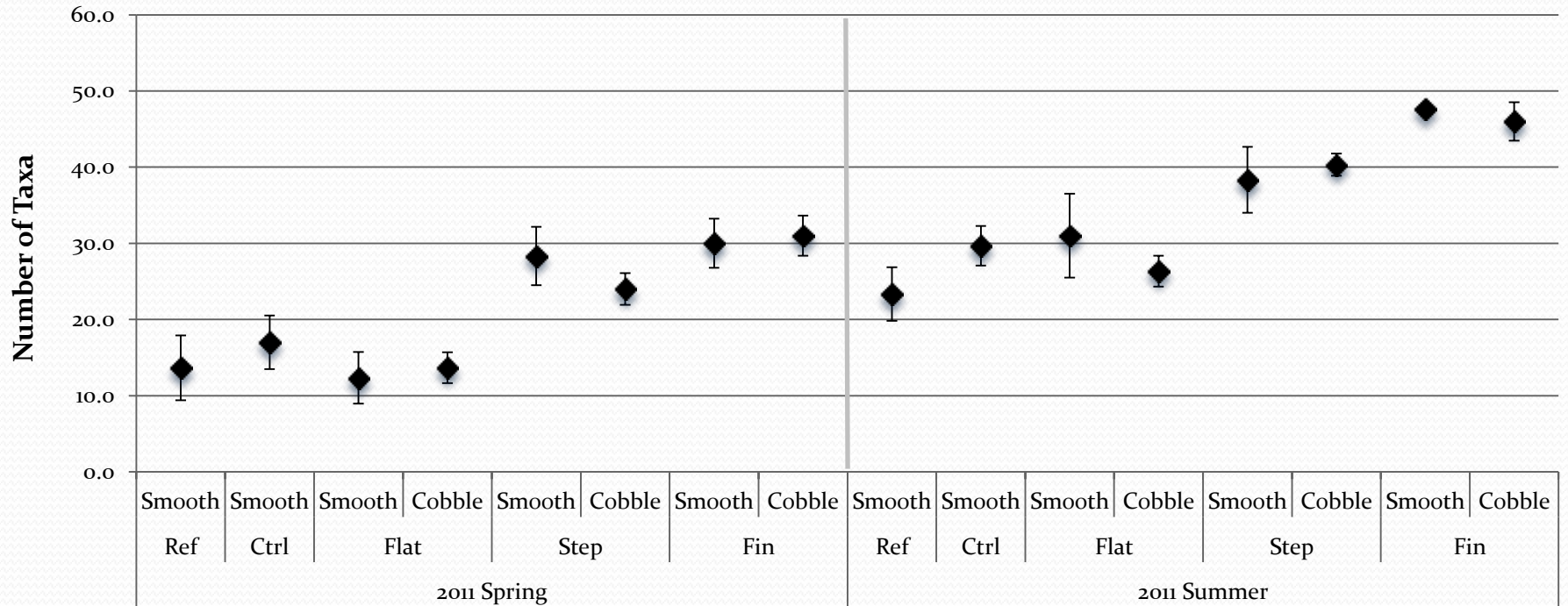
ANOVA: sampling event ($p < 0.01$) x panel type ($p < 0.01$)

Juvenile salmon prey densities: Insects



ANOVA: sampling event ($p < 0.01$) x panel type ($p < 0.01$)

Epibenthic organisms—taxa richness



Can habitat enhancements benefit juvenile salmon?



Conclusions

Can engineered microhabitats added to Seattle's seawall improve ecology of the intertidal zone?

Yes...

- Increased taxa richness
 - Epibenthic organisms (harpacticoid copepods)
 - Sessile Organisms
- Increased abundance of ecologically important species
 - *Fucus distichus* (slopes)
 - Mussels (crevices, fins, steps)
 - Juvenile salmon epibenthic prey species (fins, steps)

But...

- The context of the enhanced habitat needs to be considered