Potential Ecological effects of Living Shorelines

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Eroding Shorelines

One third of all Chesapeake Bay shorelines are (naturally?) actively eroding.

- 1300 of 4360 miles in MD
- Rates up to several feet per year

Hardening of Shorelines

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One third of all Chesapeake Bay shorelines are (naturally?) actively eroding.

We’re hardening our shorelines to protect against erosion
- But armor doesn’t always work
- We hypothesize that armor has fewer ecologic benefits

The First Living Shorelines

- 1972 – Ed Garbisch, Environmental Concern

Control of upland bank erosion through tidal marsh construction on restored shores: Application in the Maryland portion of Chesapeake Bay
EW Garbisch and JL Garbisch. 1994. Environmental Management18

Hambleton Island restoration: Environmental Concern's first wetland creation project.
EW Garbisch. 2005. Ecological Engineering 24

History of “Living Shorelines”

- 1980s — “Living shorelines” term coined in Maryland
- 2003 — North Carolina passes Living Shoreline Law (HB 1028)
- early 2000s — Delaware puts “no bulkhead” policy in place

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● 2008	Maryland passes Living Shoreline Protection Act

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- 2008 — CBT and NOAA start work to quantify ecological impacts of LS
- 2009 — CICEET funds NC work on engineered shorelines
- 2010 — SERC and 16 other Pis are awarded NOAA grant
- 2010 — CBT, KCF and NOAA fund VIMS to evaluate engineering value

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- 2009 CICEET funds NC work on engineered shorelines
- 2010 NOAA funds Smithsonian work on shoreline value
- 2010 CBT, KCF, NOAA fund VIMS to evaluate engineering value
- 2010 President Obama’s Ches. Bay Exec Order includes LS goal
- 2010 Rhode Island and NJ begin living shoreline effort
- 2013 Second Chesapeake Living Shoreline Summit
- 2013-4 Bay Program Expert Panel to grant NPS credit for LS projects

Priorities – 2006 Chesapeake LS Summit

Chesapeake Living Shoreline Summit and Follow-Up Recommendations

1) Increase research on design, ecological impact, and sea level rise
2) Produce design criteria
3) Create (and use) regional management plans
4) Investigate social marketing
5) Promote local government planning
6) Create financial incentives

Existing Research

- Research on armor versus natural habitat
  - Campbell Foundation and Trust funded VIMS work
  - Trust and NOAA studies
  - NOAA-funded SERC work 2010-2015
  - Work from Europe on seawalls and rocky shores

- Research on conversion of armor to living shoreline

Ecological: Armor vs. Natural Marsh

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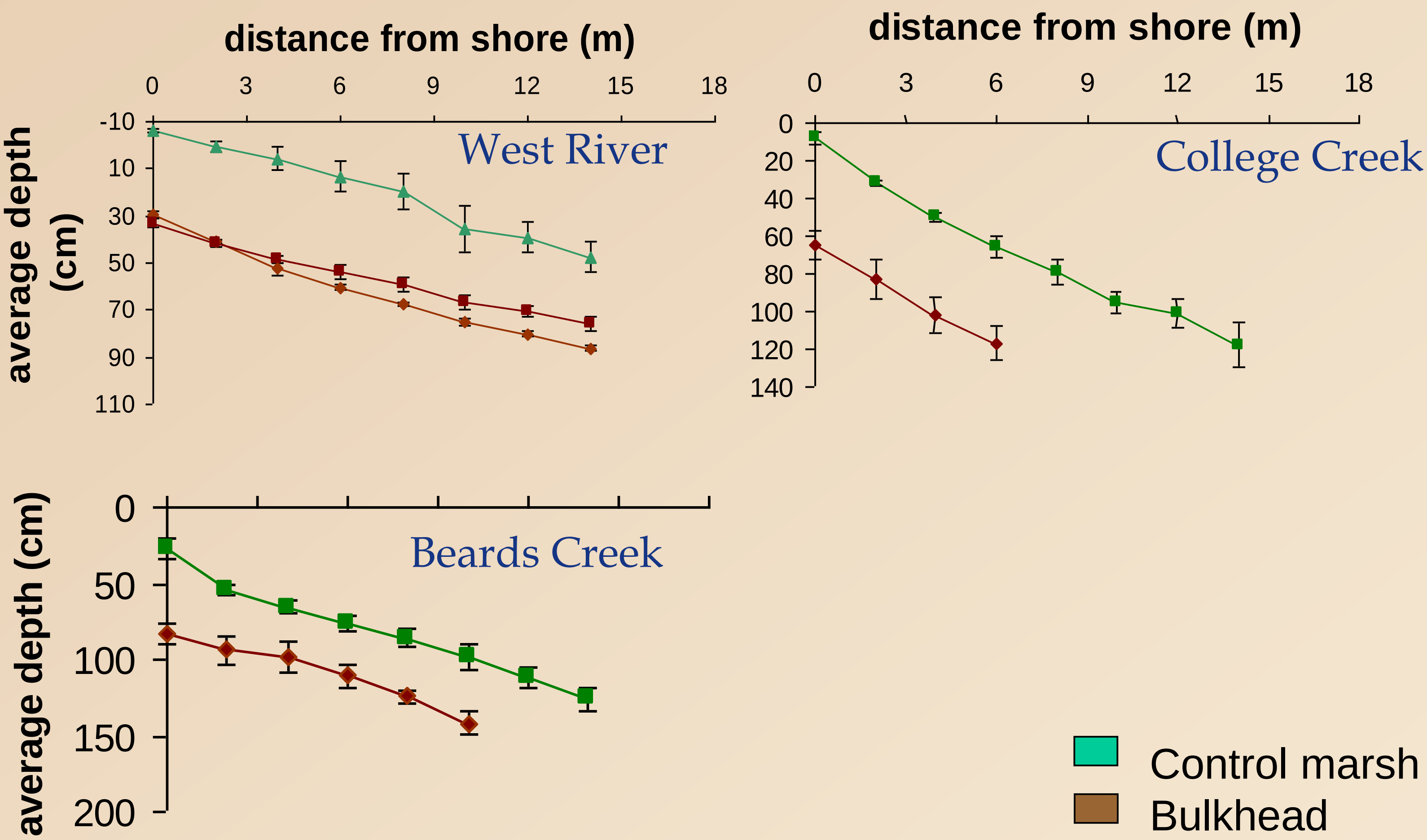
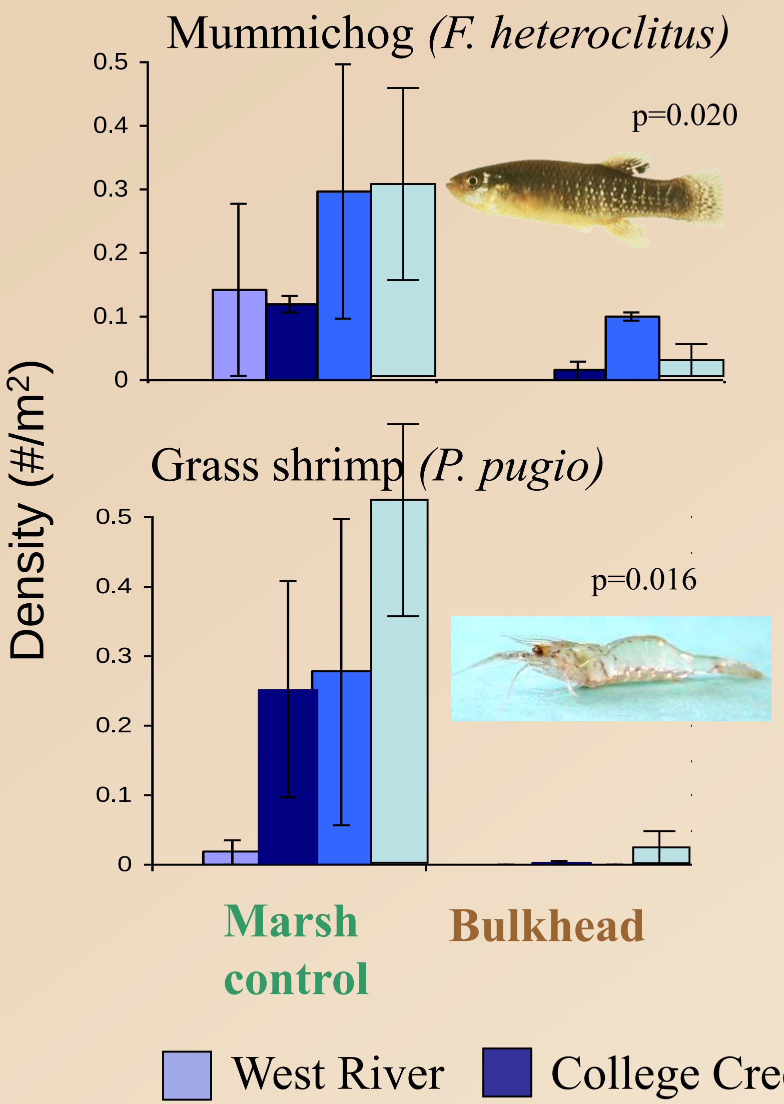
Bulkhead sites – Deeper than fringe marshes by 35cm; No habitat < 30 cm



Ecological: Armor vs. Natural Marsh

Most species more abundant in marsh than armor



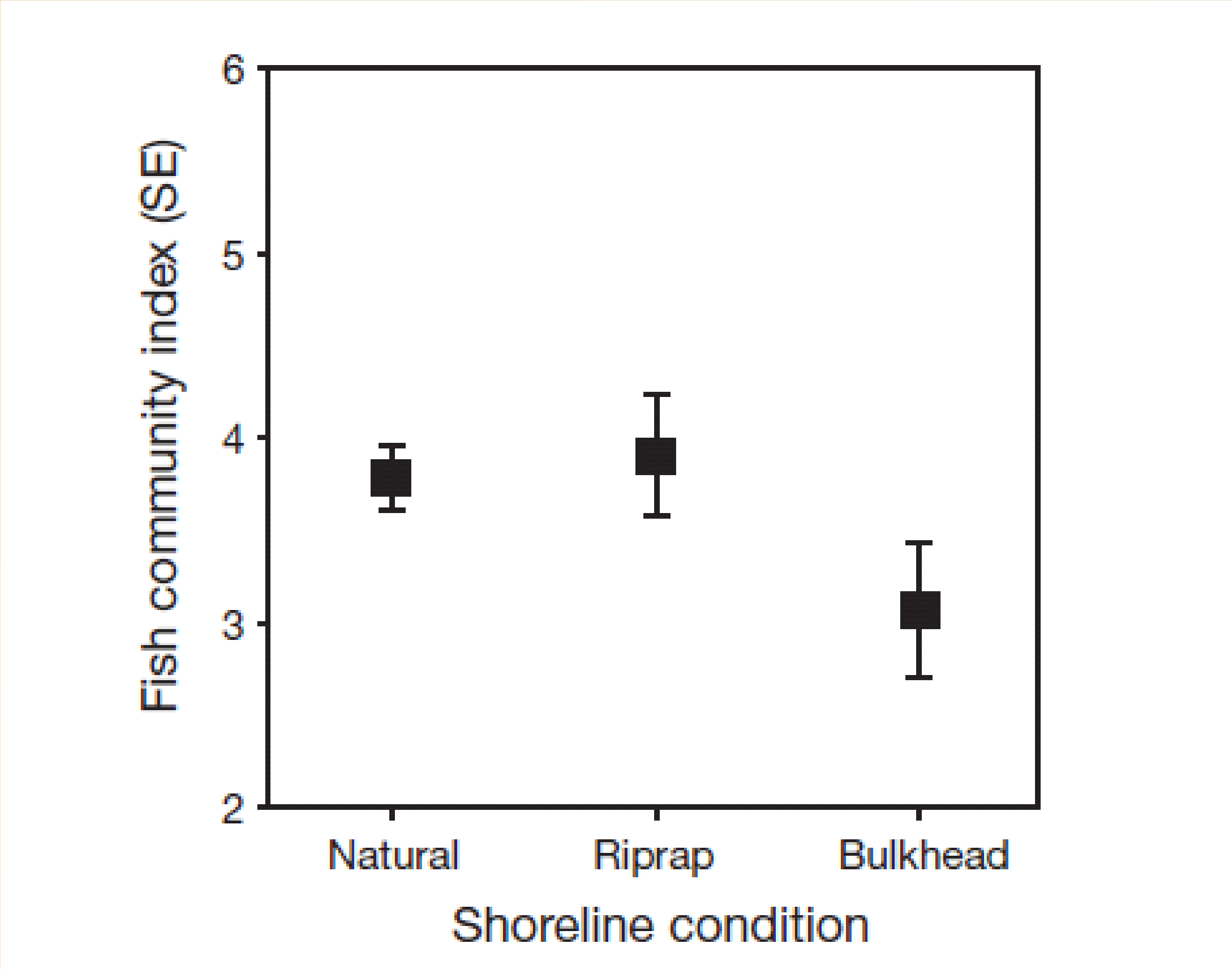
Chain pickerel

Stickleback

Spot

Ecological: Armor vs. Natural Marsh

Bulkhead lower values of diversity, density (Bilkovic and Roggero 2008)



Ecological: Armor vs. Natural Marsh

Seawalls - lower values of spp richness (Brauns et al. 2005; German lakes)

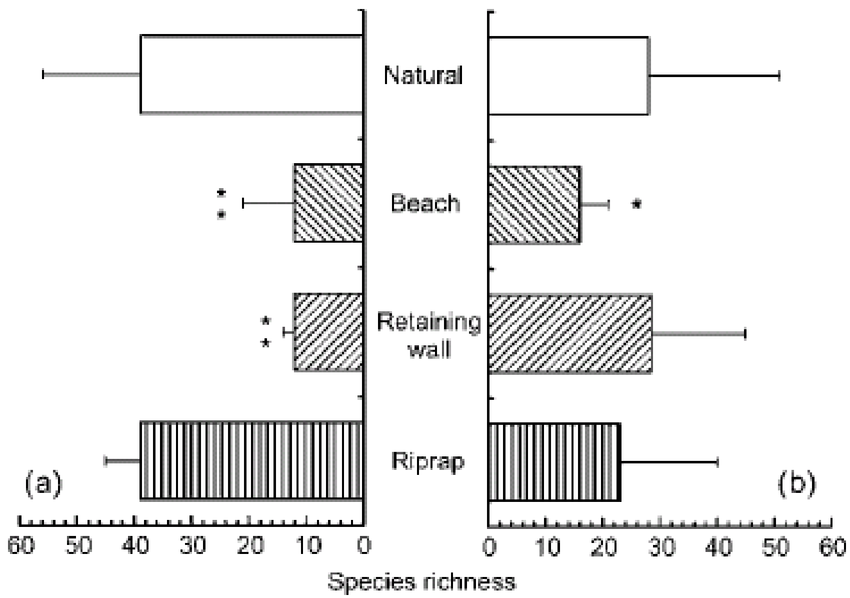
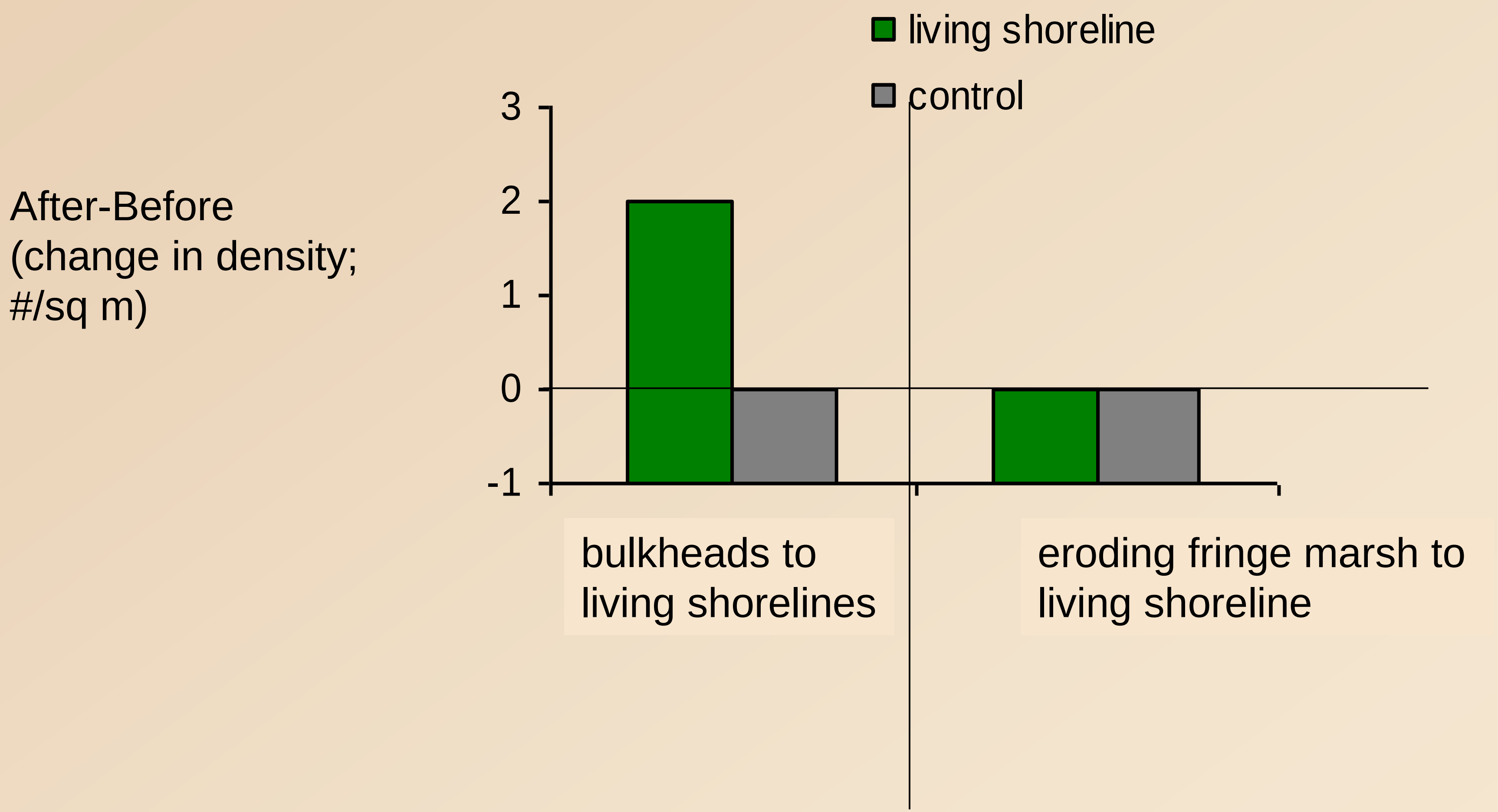


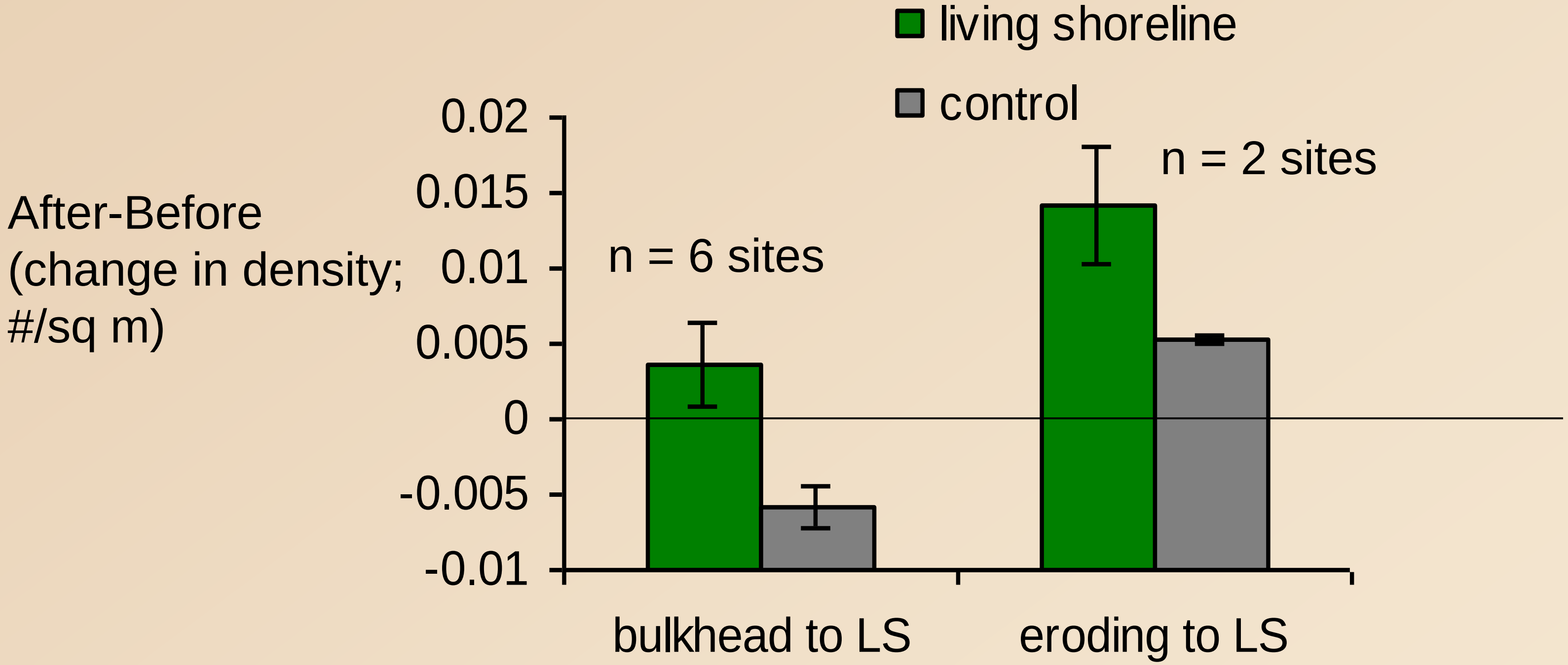
Fig. 2. Median species richness (+ max) of natural and developed shorelines (beach, retaining wall, riprap) within the (a) eulittoral and (b) infralittoral zones. Significant differences (Mann–Whitney *U*-test) between natural and each type of developed shorelines are indicated by asterisks (**$P < 0{\cdot}01$, *$P < 0{\cdot}05$).

Less research exists on armor versus living shorelines

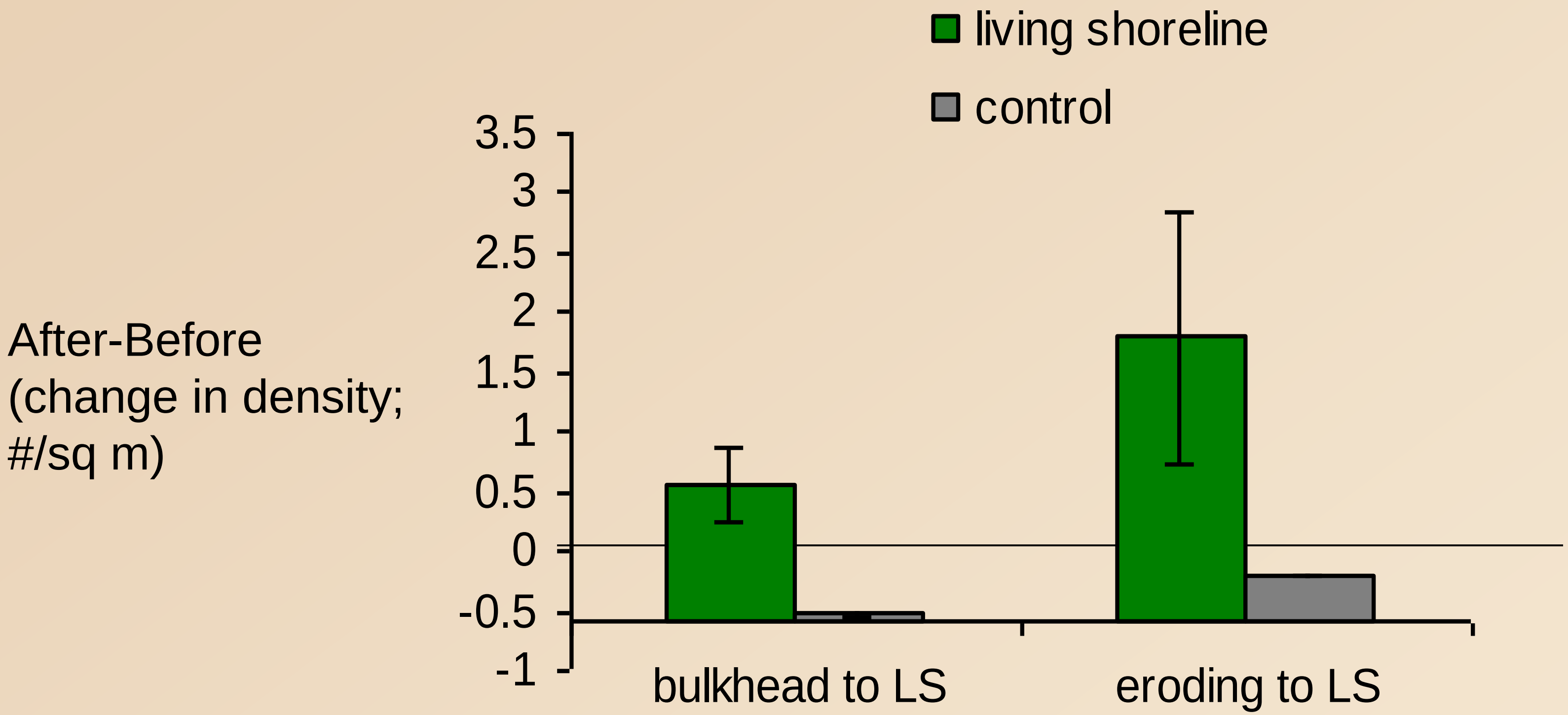
Ecological : Change in Spp. Diversity and Density hypothesized to be higher at LS sites than control sites



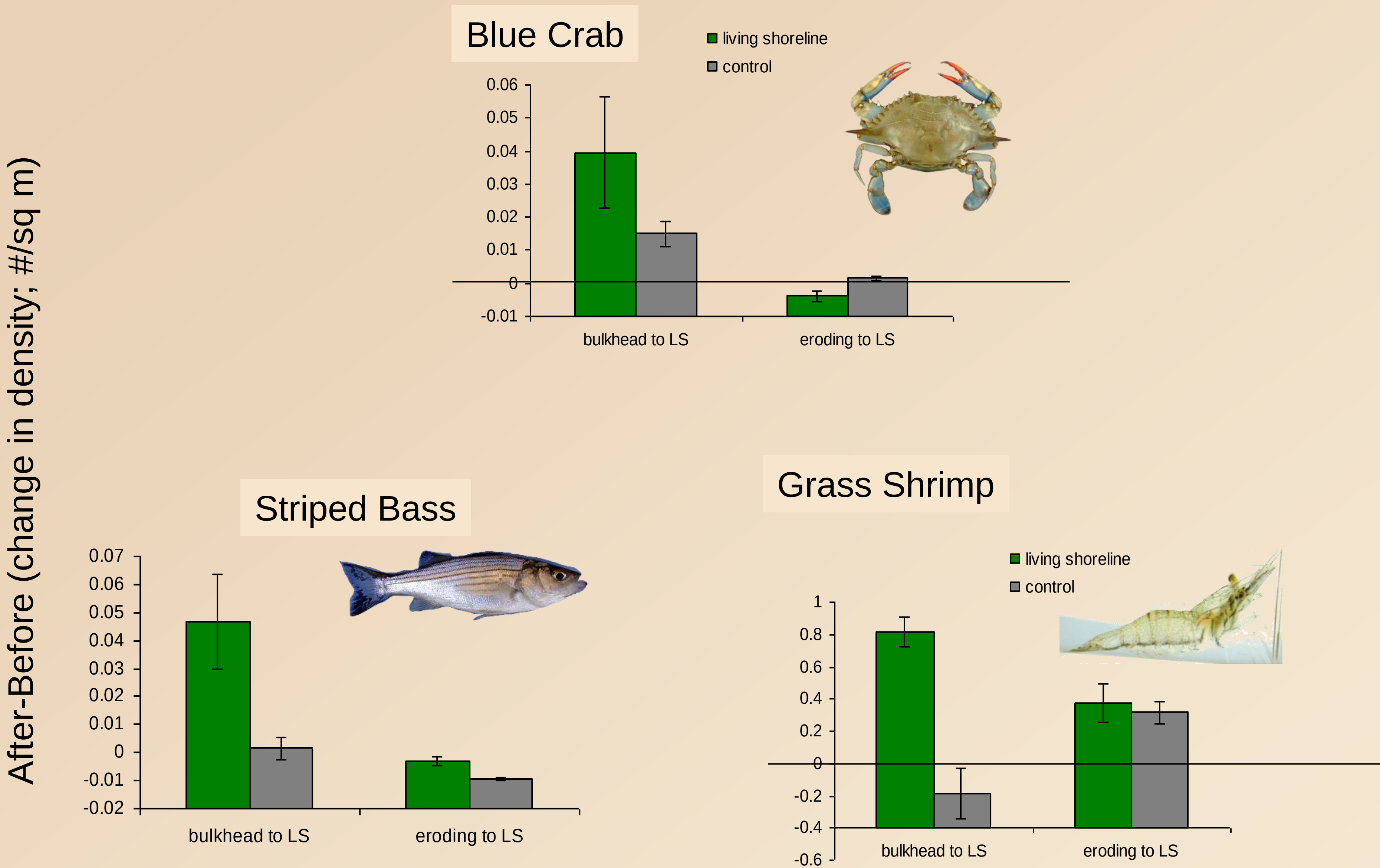
Nekton: species diversity increased



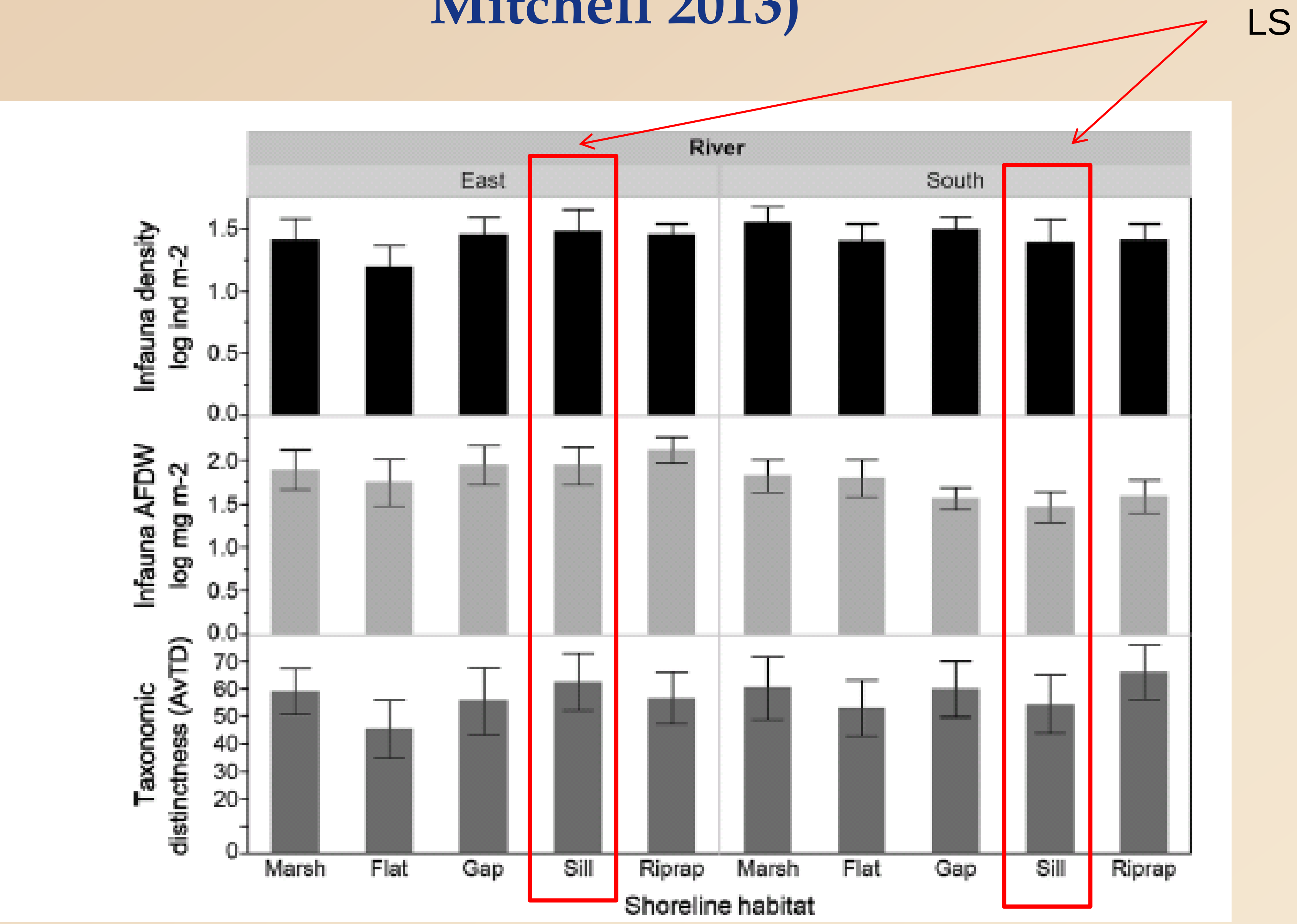
Nekton: density of individuals increased



Ecological: several nekton species increased at LS; none decreased



Ecological: LS similar infauna and plant density to other shoreline types (Bilkovic and Mitchell 2013)



Physical/Erosion: Sill/Living shoreline sites have higher accretion than natural sites (Currin et al., 2010; NC)

LS

Marsh type	Marsh edge location	Net sediment accretion (mm y^{-1})	n
Natural	Lower	-6.92 A	4
Sill	Lower	5.36 B	4
Natural	Upper	1.18 A	4
Sill	Upper	4.73 B	4

Using “natural habitats” in armor in other systems (rocky intertidal): It’s not all about wetlands

(Bulleri and Chapman, 2010; Italy)

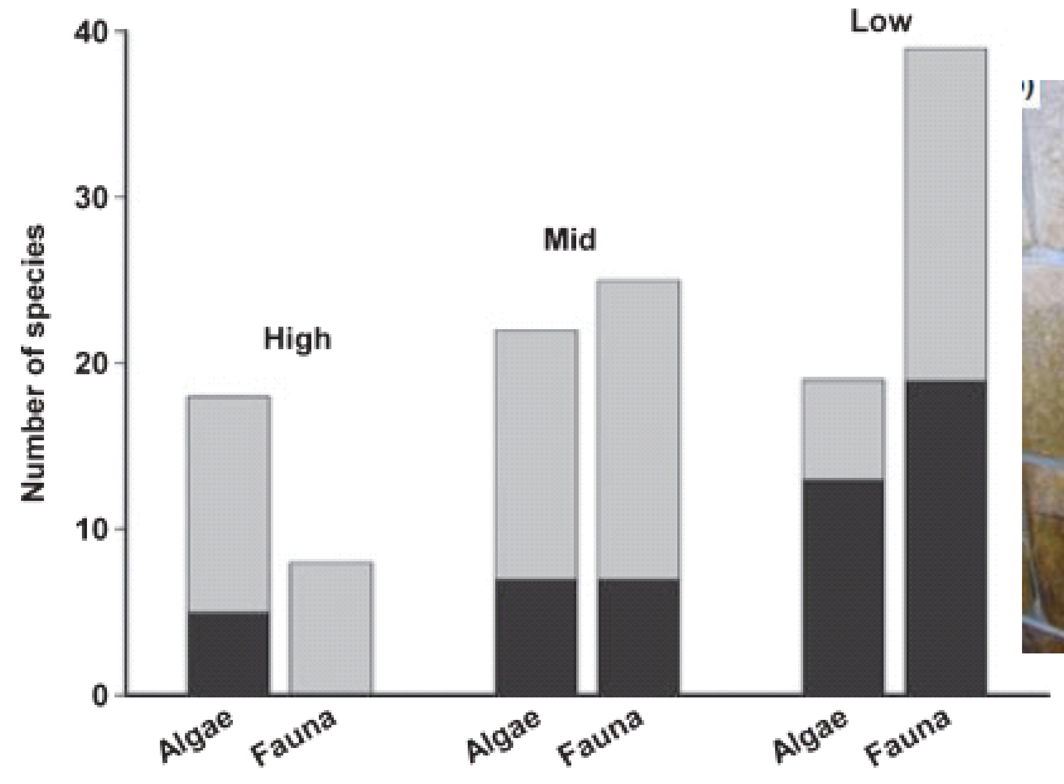
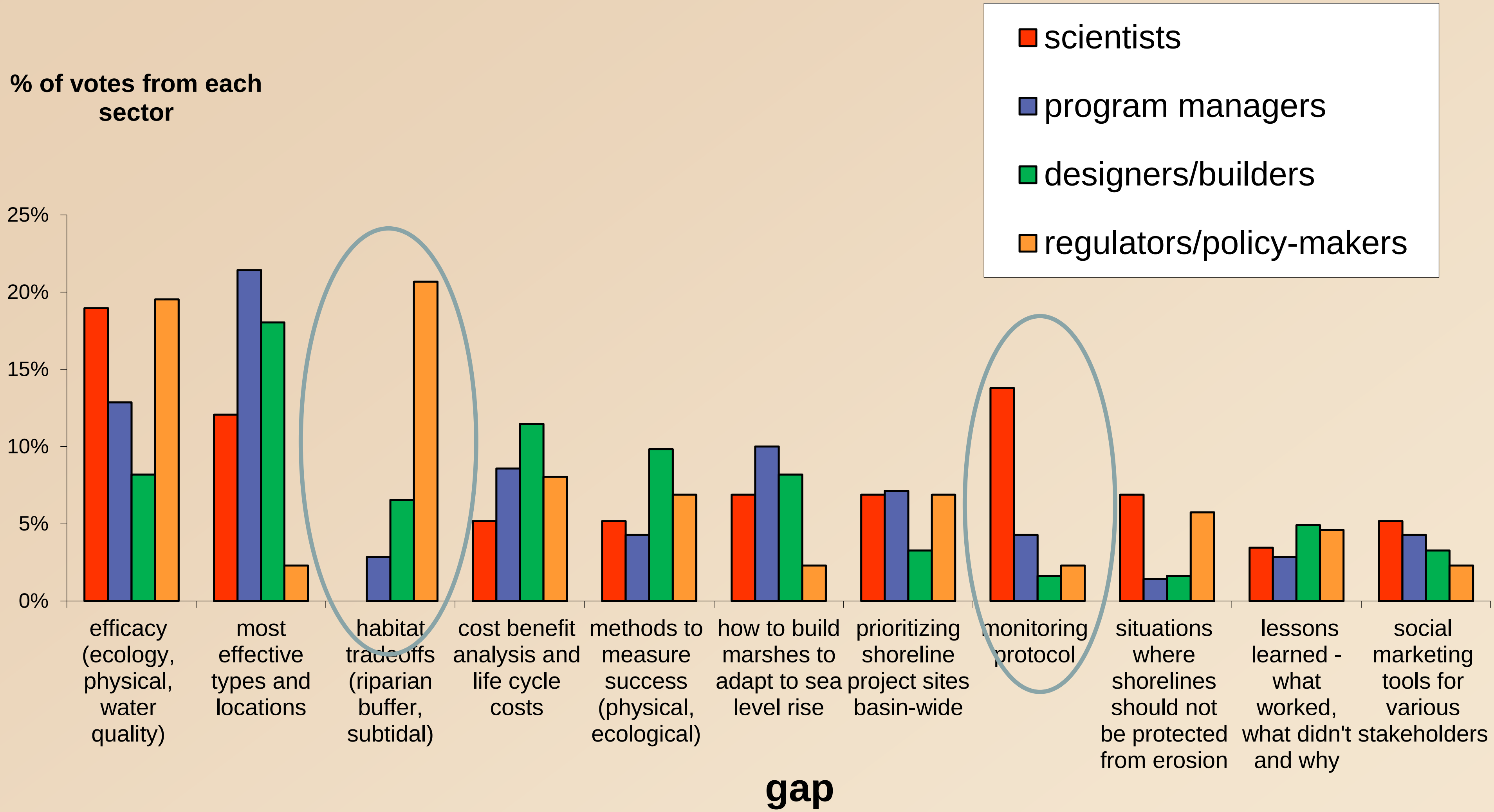


Fig. 2. The number of species of macro-algae and sessile animals living on the façade of the seawall (black bars) and the number of additional species found in the ‘rock-pools’ (clear bars) at three different shore levels (high, mid and low); data summed across all sites (see

Designing “rock pools’ into seawalls

Research Priorities – 2013 Chesapeake LS Summit



Top Research Priorities

For scientists

1. Efficacy of LS (WQ, hab, erosion)
2. Monitoring protocol development
3. Efficacy of types of LS and location
4. Adaptation to SL rise
5. Debate about where shorelines should not be protected from erosion

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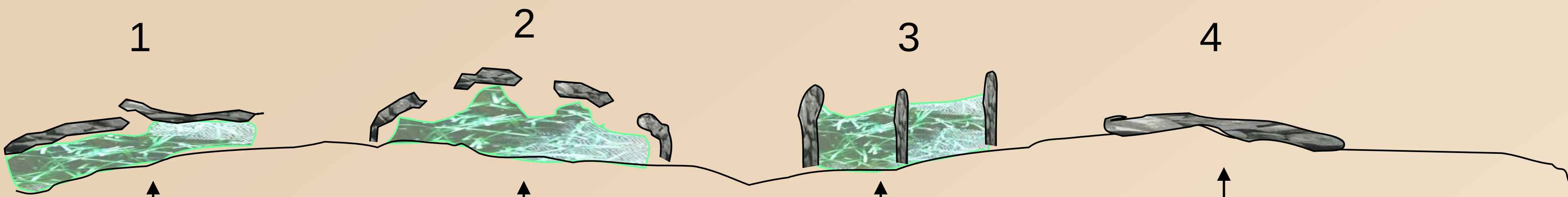
For regulators

1. Tradeoffs (subtidal, riparian buffer)
2. Efficacy of LS (WQ, habitat, erosion)
3. Cost benefit analysis and life cycle costs
4. How do we actually measure success
5. How do we prioritize LS sites basin-wide

Next Steps/Needs: Test Design Effectiveness for Erosion Protection and Habitat



1. LS #1
continuous sill
with windows

2. LS #2
segmented sill
(offshore breakwaters)

3. LS #3
groins

4. revetment

Future Research

- Optimum designs to maximize ecological function *and* erosion control function?