Habitat connectivity controls species richness, similarity and rates of community development

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Restoration Center

Dispersal, Recruitment and Habitat Invasibility in Shallow Epifaunal Benthic Communities of Southern New England

1. *Assembly Processes and Controls of Invasive Species Dominance in Non-Native and Resident Communities*
2. *Effects of temperature on niche overlap and timing of recruitment in a benthic marine community*
3. *A phenological mid-domain analysis of non-native and resident species recruitment richness*
4. *Habitat connectivity controls species richness, similarity and rates of community development: a marine metacommunity model system*
5. *The material properties of* Didemnum vexillum *and prediction of tendril fragmentation*

*The **SYSTEM:***
Shallow Epifaunal Benthic Communities of Southern New England

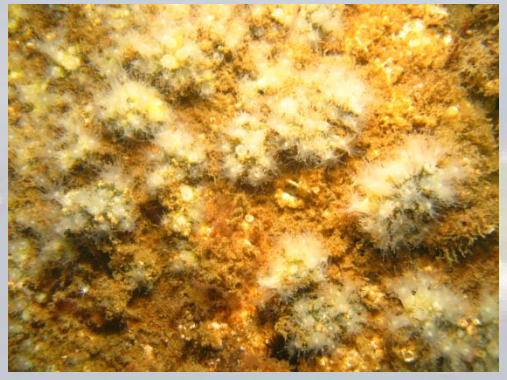
• >50 sessile animal species from the phyla **Porifera, Bryozoa, Entoprocta, Cnidaria, Annelida, Mollusca, Arthropoda and Chordata**

•Ascidians and bryozoa - dominant constituents of these communities

•**no one** species that will *completely* dominate if left unchecked

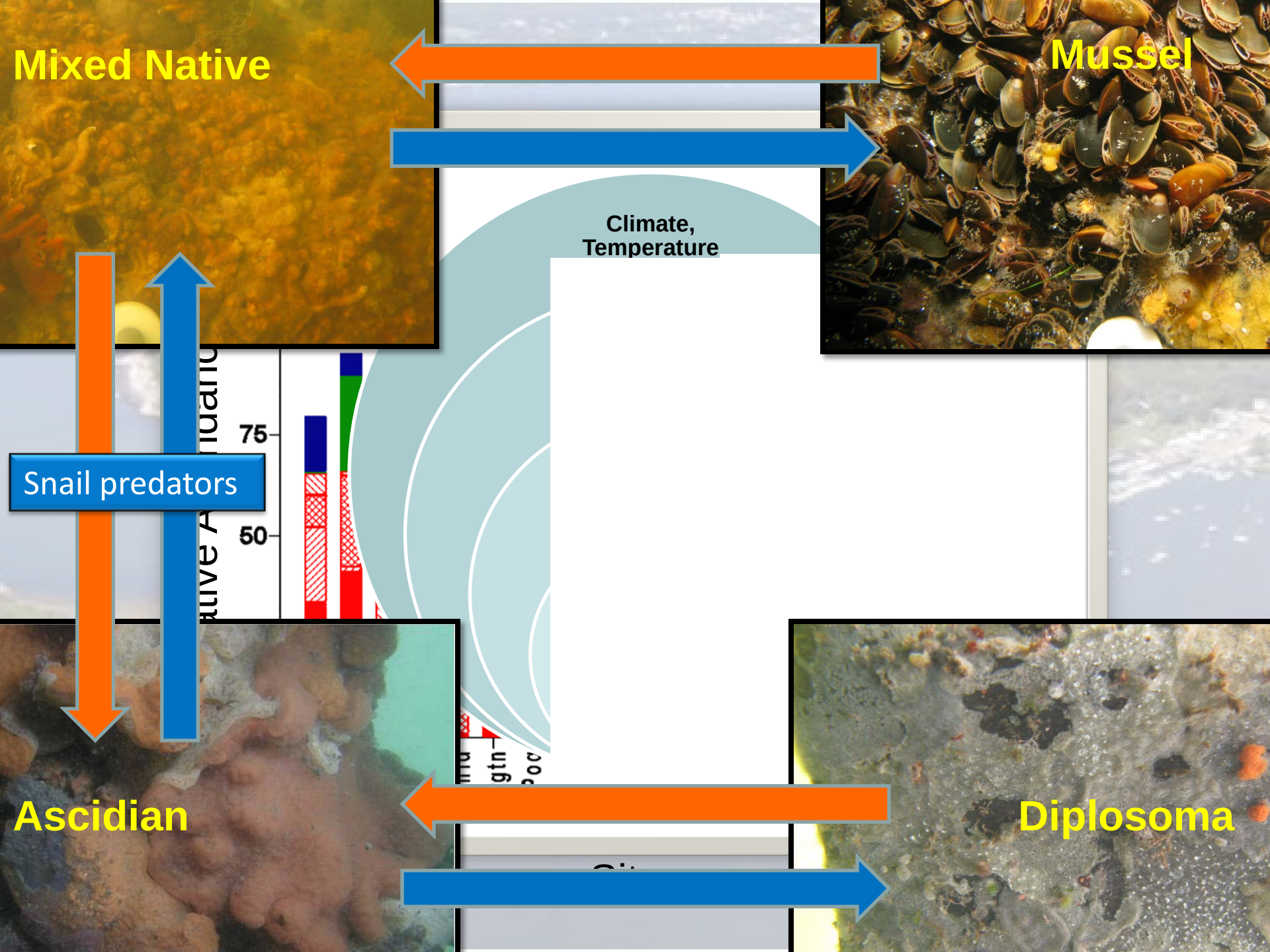
•Many species have short dispersal distances (<10m)

•Others (e.g., barnacles and mussels) have large dispersal distances (> 10km)

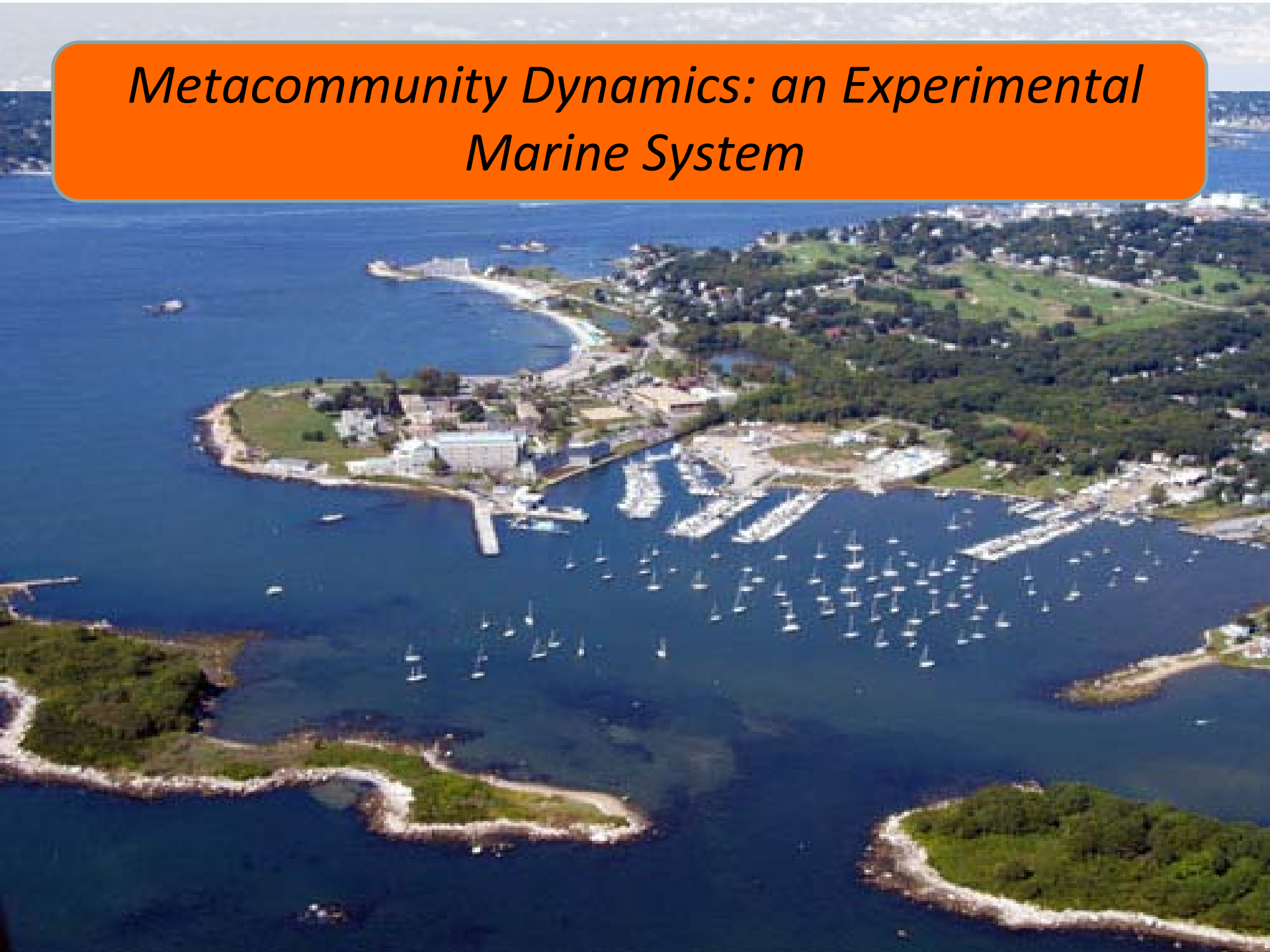


*The **SYSTEM:***
Shallow Epifaunal Benthic Communities of Southern New England

- Short dispersal distances and abundant recruitment back into the local habitat promotes the stability of local populations
- Assembly history is important in shaping the community - Priority may be of particular importance
- Since the 1970's the southern New England hard-substrate epifaunal community has seen the introduction of at least 8 species of ascidians
- temperature is considered to contribute extensively to the development of communities


Mixed Native
Mussel
Climate,
Temperature
Snail predators
Ascidian
Diplosoma

Metacommunity Dynamics: an Experimental Marine System



Why is understanding connectivity important?

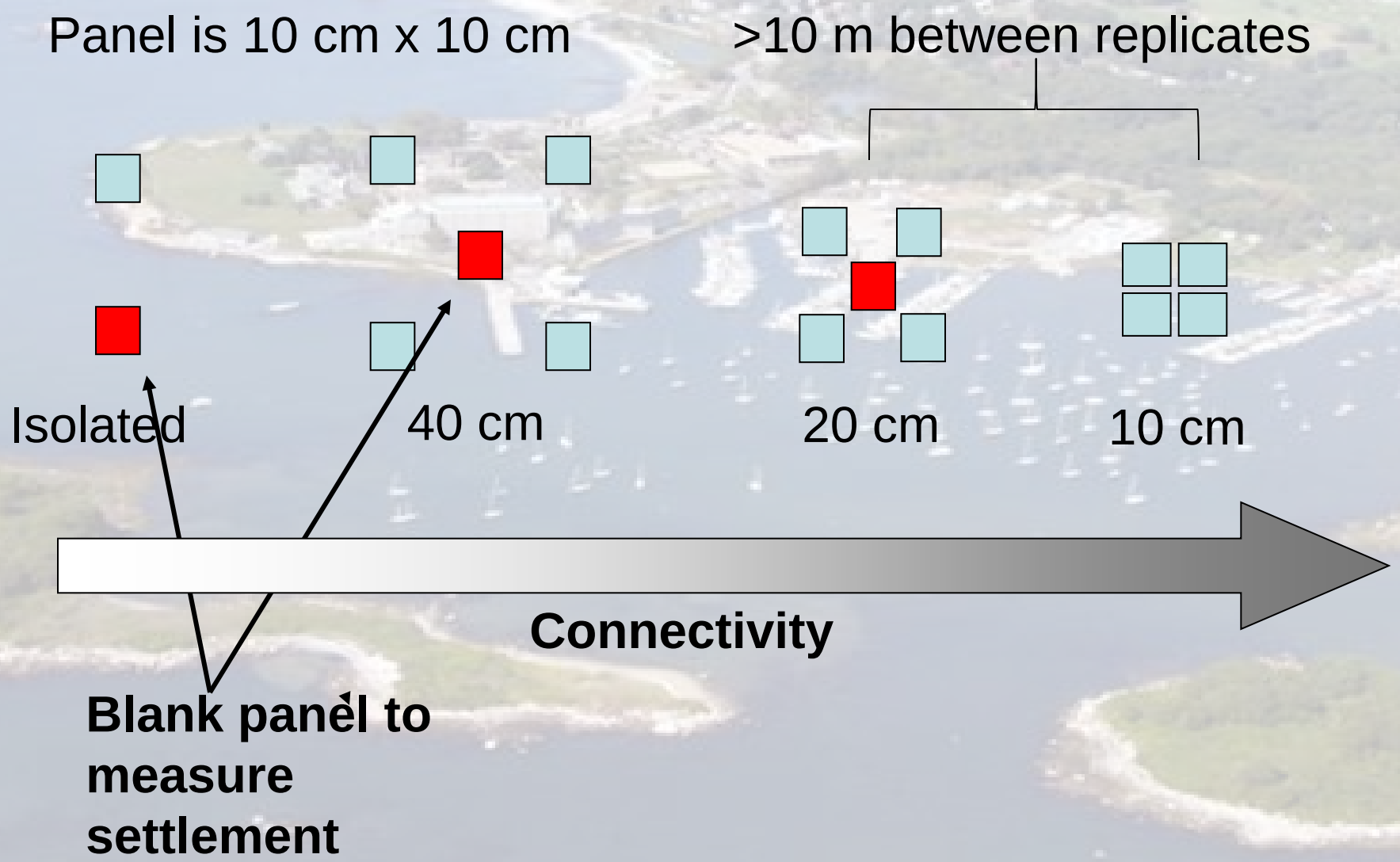
1. *Help with MPA design*
2. *Increase understanding of habitat fragmentation*
3. *Increase understanding of habitat creation*
4. *Understand rates of resilience/restoration*
5. *Improved understanding of species invasions*

Metacommunity Dynamics: an Experimental Marine System

- Does community connectivity affect species composition, abundance and richness?

- Does distance affect connectivity of fouling communities at small scales (meters)?

Assumption: distance affects larval connectivity

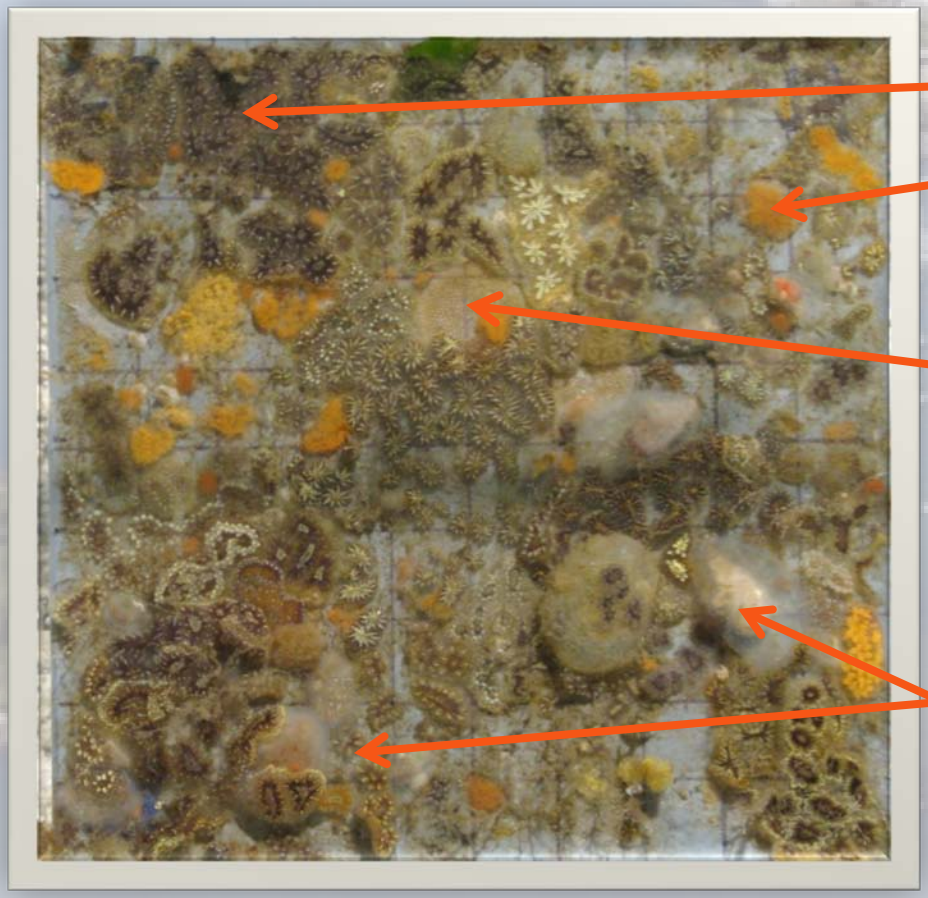


Metacommunity Dynamics: an Experimental Marine System

- Methods
  - Develop and deploy metacommunities
  - Examine distance-settlement relationships
  - Photographic and statistical analysis to examine composition

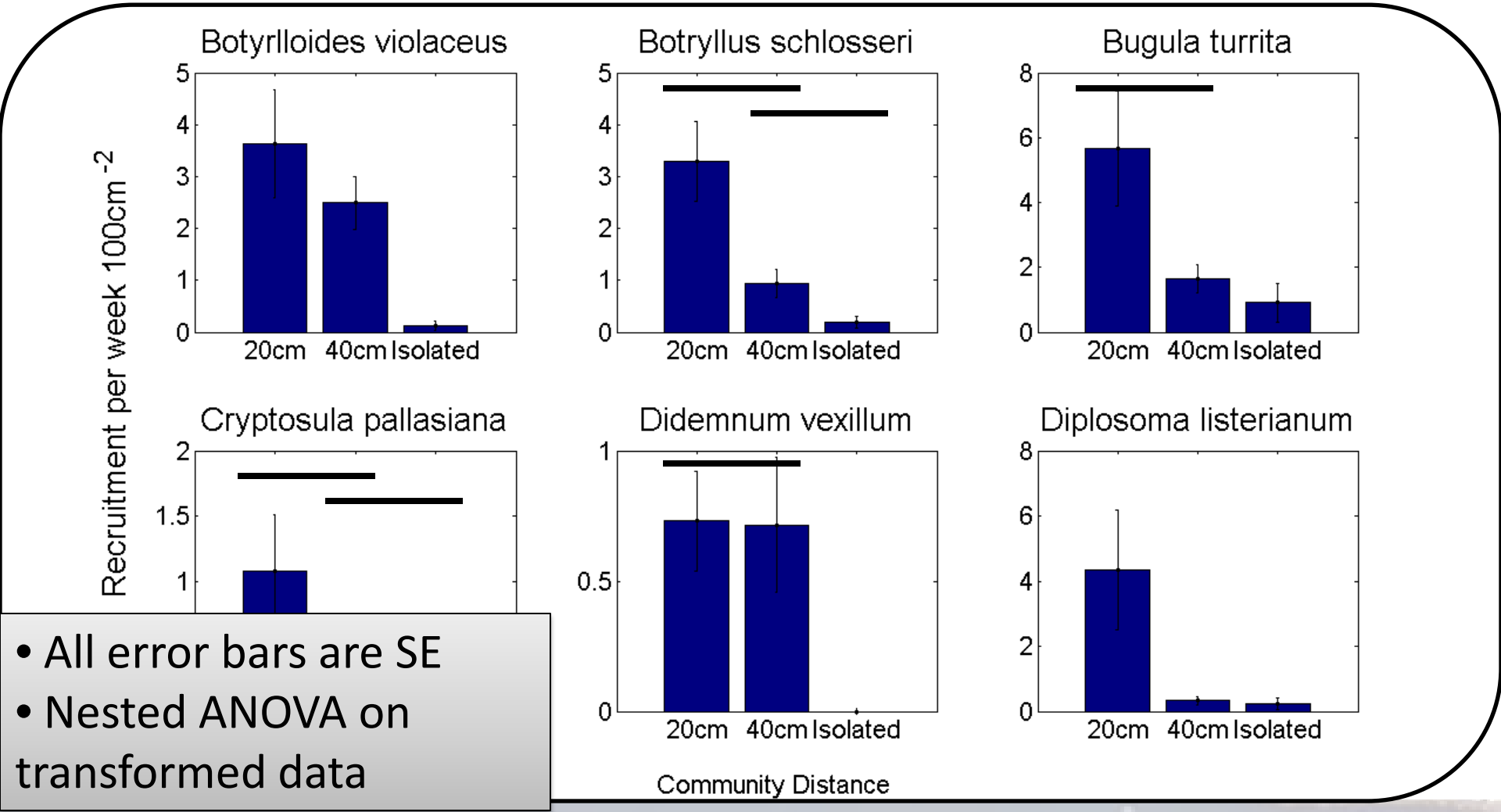
Species composition

Initial condition



- **Colonial Tunicates**
  - Botryllus schloseri
  - Botrylliodes violaceus
- **Colonial Bryozoan**
  - Cryptosula pallasiana
  - Bugula turrita
- **Solitary Ascidians**
  - Mogula manhattenensis
  - Ascidiella aspersa

- Dispersal distance affects connectivity of fouling communities at small scales (meters)



- All error bars are SE
- Nested ANOVA on transformed data

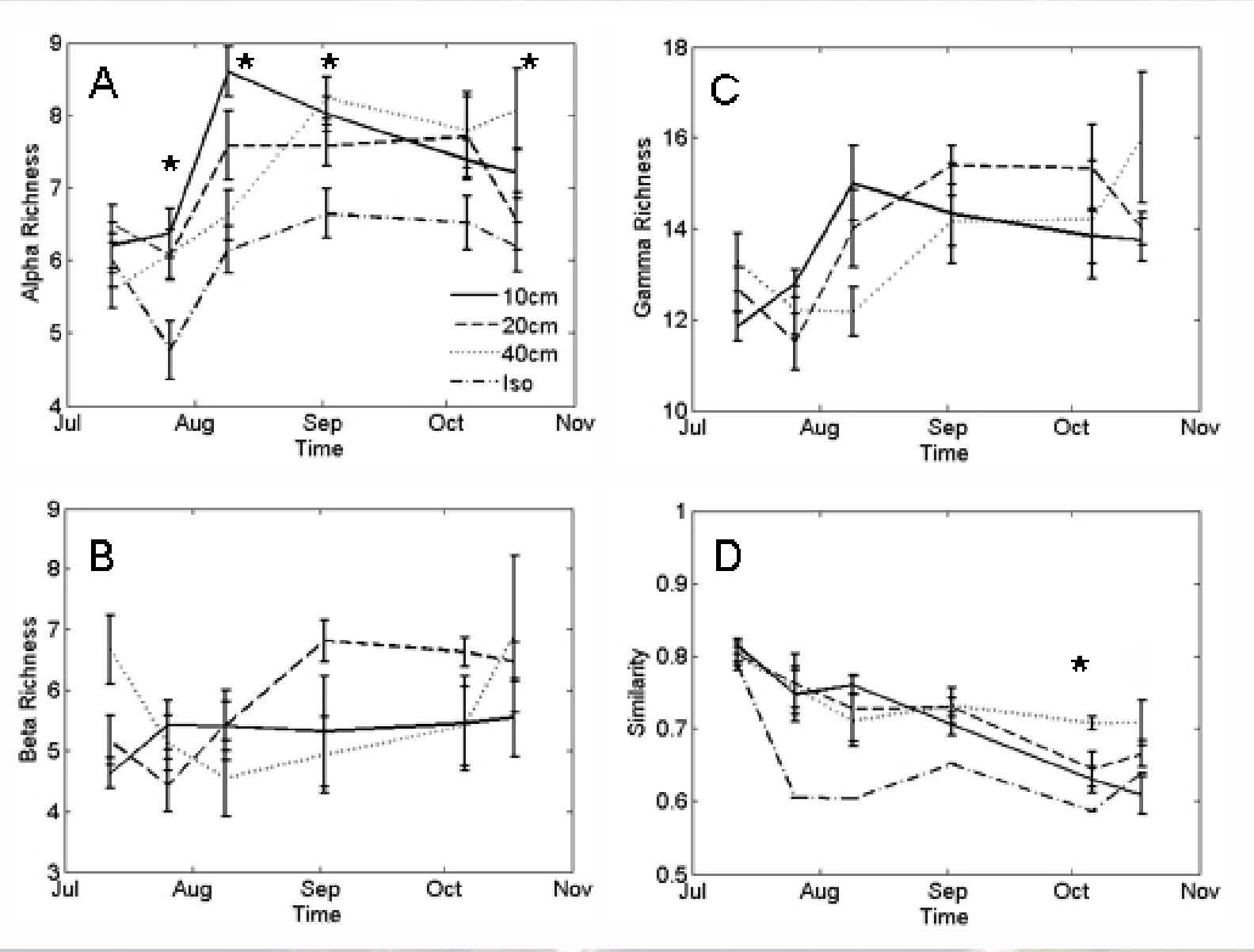
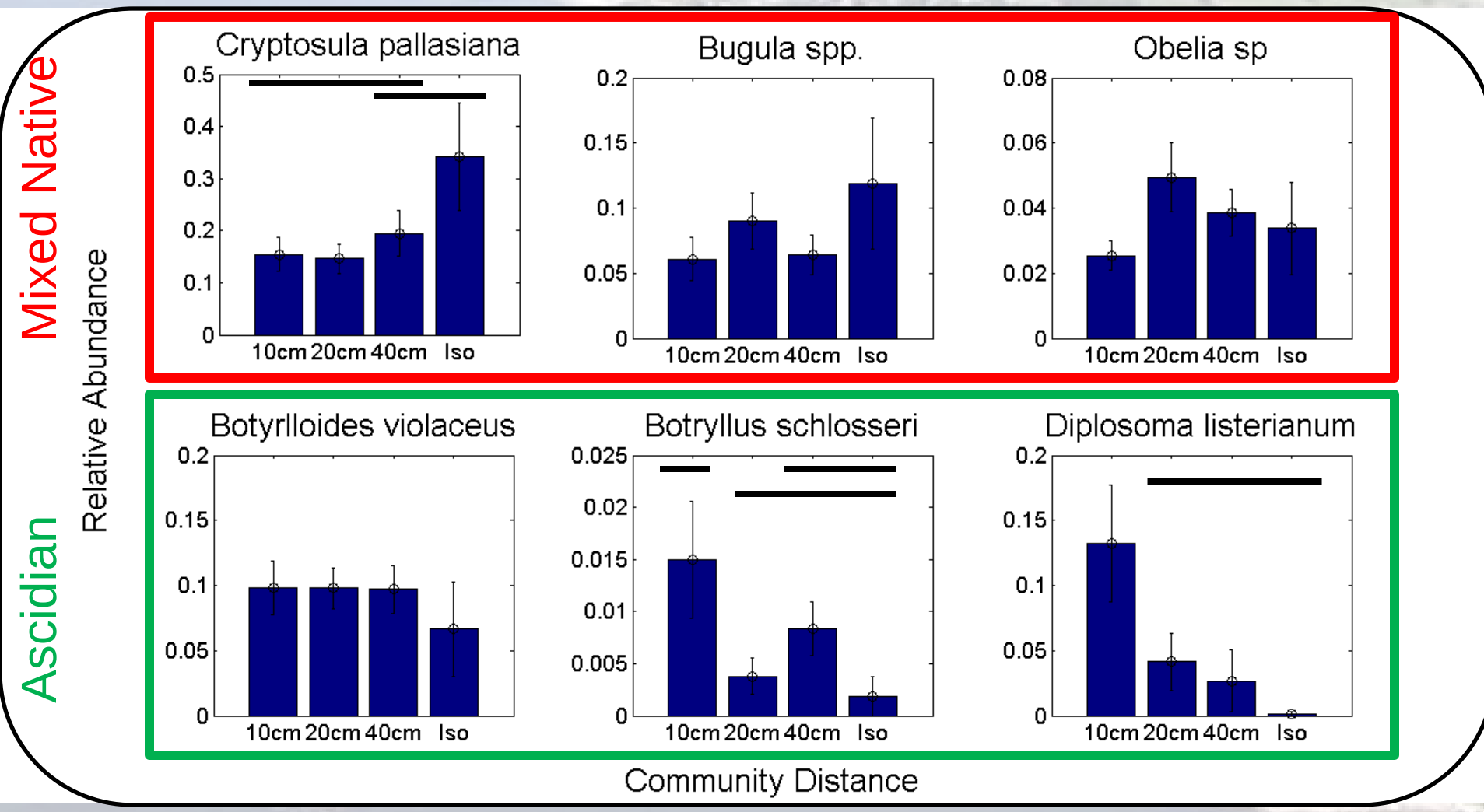
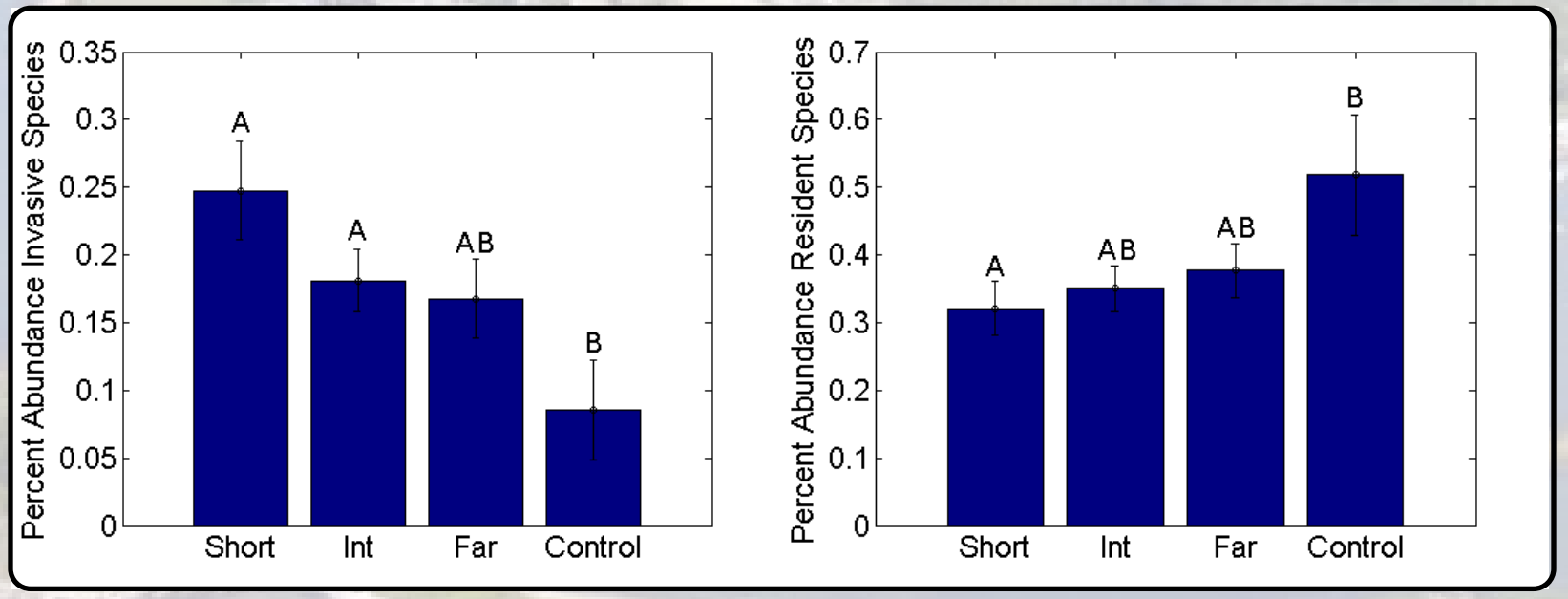


Figure 2. The effects of community distance (10 cm, 20 cm, 40 cm and isolated) on A) alpha, B) beta, C) gamma, and D) Bray-Curtis similarity. Asterix (*) indicates significant differences within a time period (ANOVA and multiple comparisons with Bonferroni correction). See Table 3 for multiple comparisons within a time step. Error bars are 1 SE.

- Community connectivity affects species abundances



- Community connectivity affects composition of resident and invasive species -- WHY?



Conclusions

Snail predator

Higher connectivity

- Changes is connectivity can influence state transitions or community resistance

Conclusions

- distance affects patterns of local species richness, and community similarity
- distance influenced the rate of change of alpha diversity over time. Species richness dynamics on highly connected panels preceded those on other panel groups
- patterns of local species richness at the end of the experiment were similar to other experiments that found the highest levels of species richness at intermediate dispersal levels and are consistent with theoretical predictions
- habitat connectivity may work in conjunction with predatory snails to shape species richness patterns in subtidal epifaunal assemblages, by limiting dominant competitors via top down control and dispersal limitation
- invasive species may have some advantage when dispersal distances are low and connectivity is high

Conclusions

- Potentially useful system for examining theoretical predications, complexity can be added
- Helpful in scaling theoretical predictions to real world application
- Provide insight into ecosystem processes

Thank you

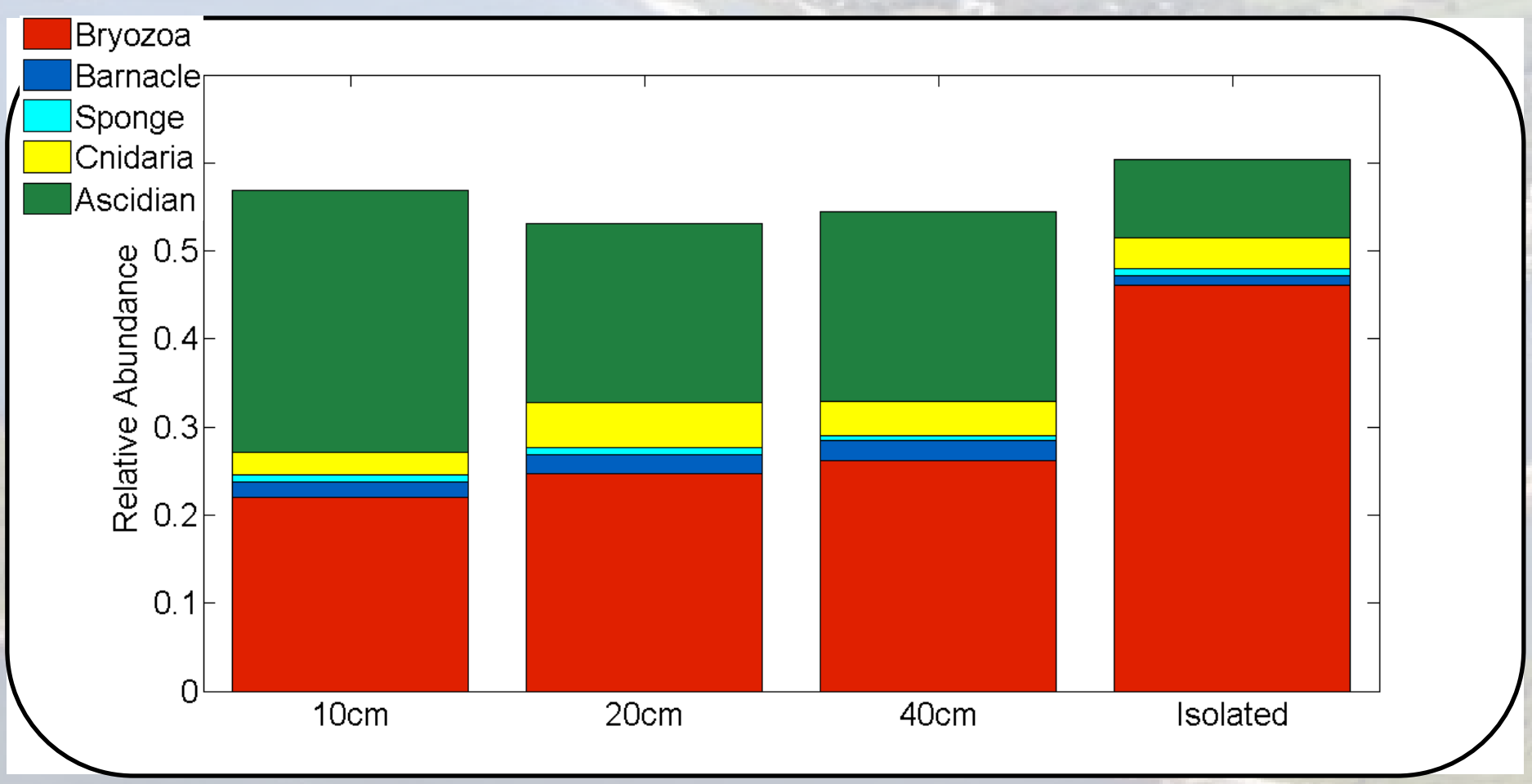
Acknowledgments

•Funding support was provided by UCONN Marine Sciences and Ecology and Evolutionary Biology Departments and

• EPA-STAR

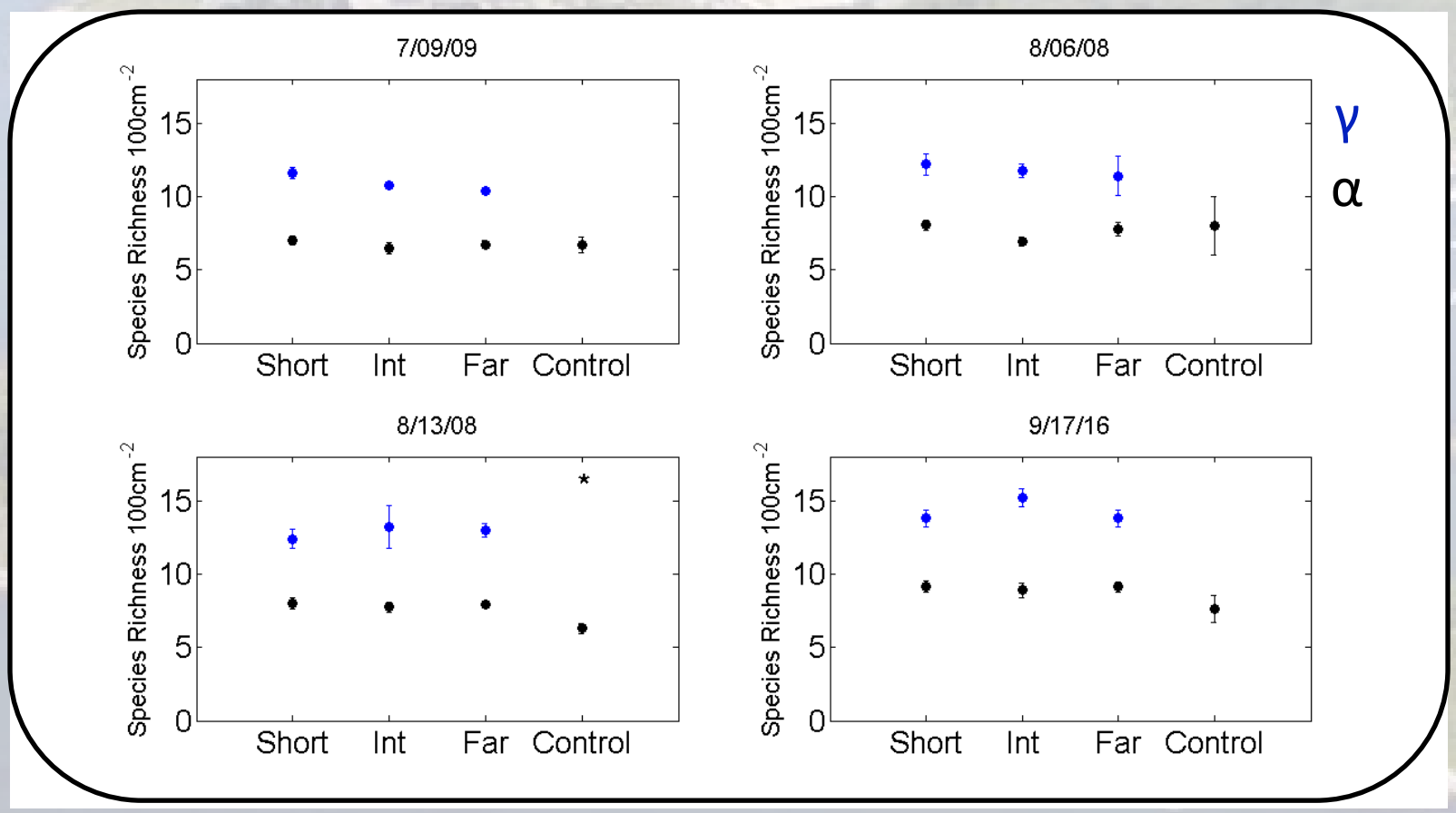
•Lots of divers!

- Hypothesis 2 – Community connectivity affects community composition



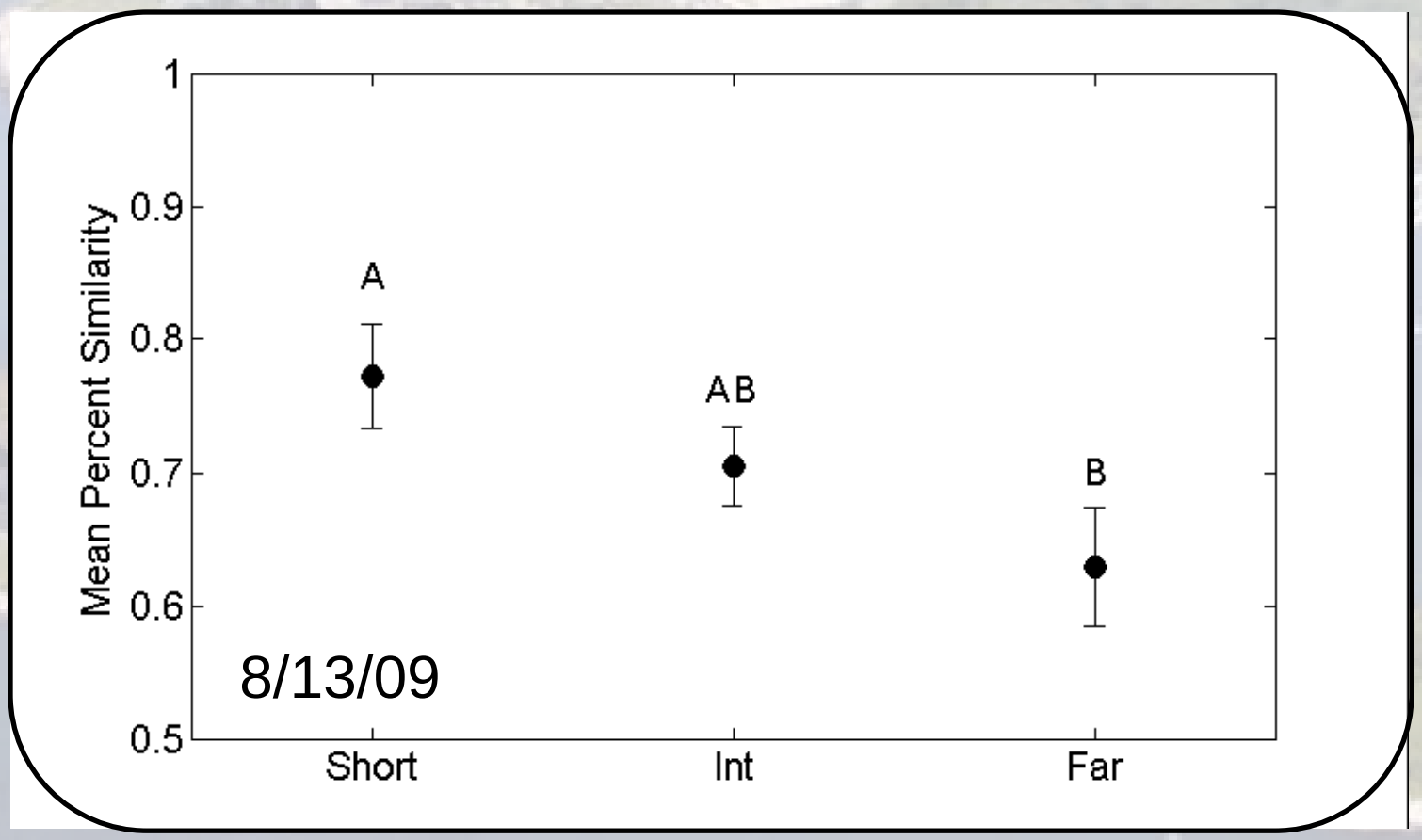
Metacommunity Dynamics: an Experimental Marine System

- Hypothesis 2 – Community connectivity affects species richness



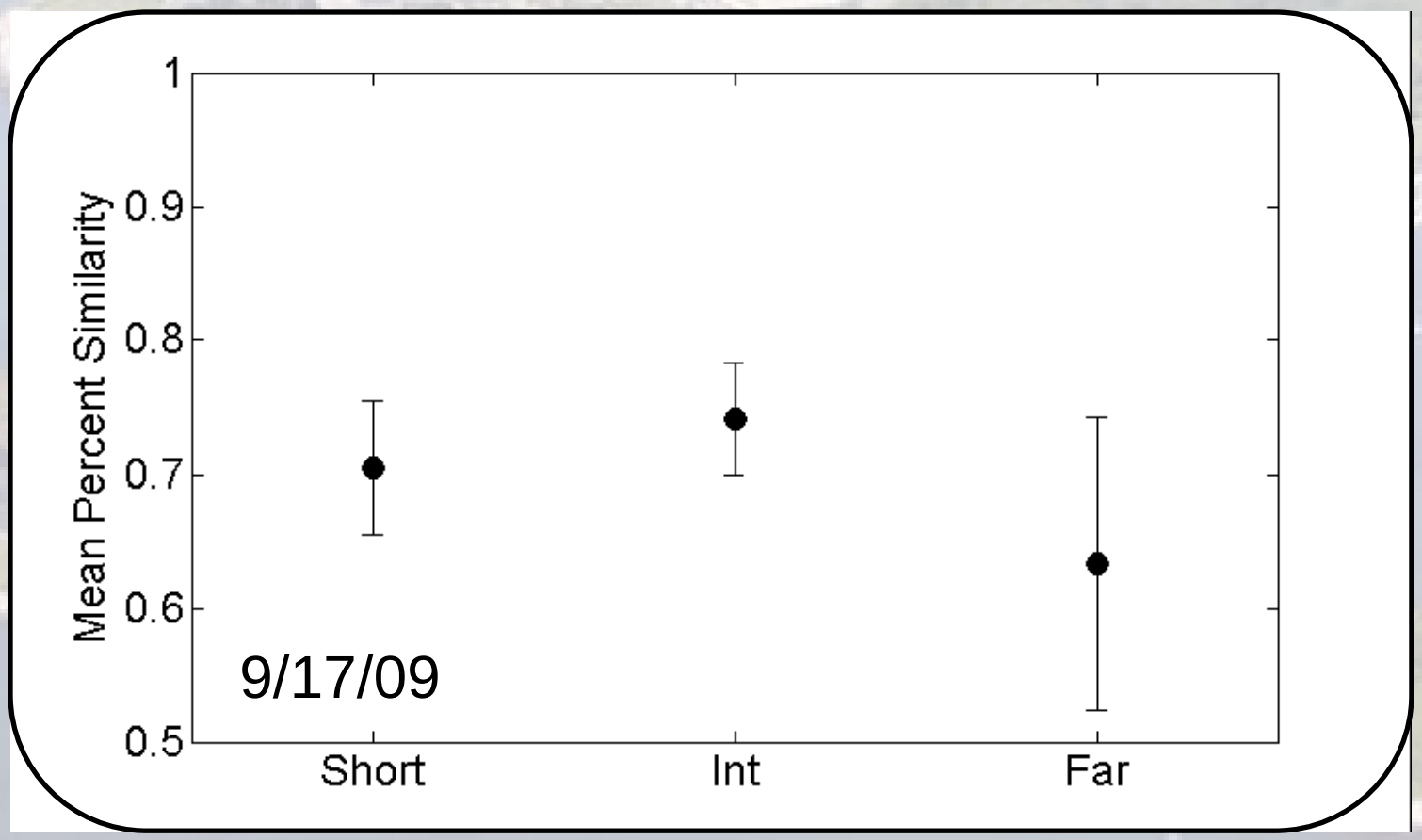
Metacommunity Dynamics: an Experimental Marine System

- Hypothesis 3 – Community connectivity affects community composition



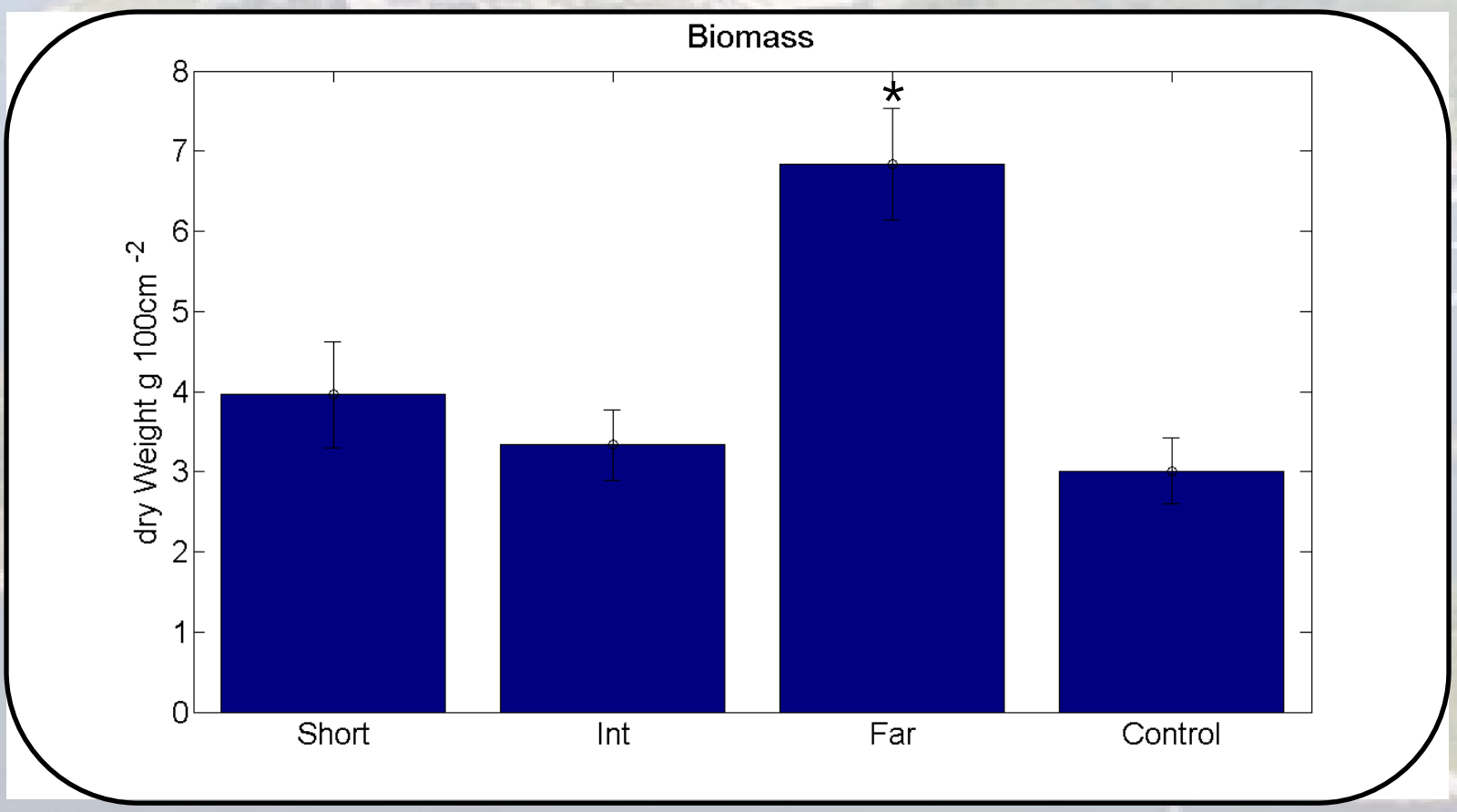
Metacommunity Dynamics: an Experimental Marine System

- Hypothesis 3 – Community connectivity affects community composition



Metacommunity Dynamics: an Experimental Marine System

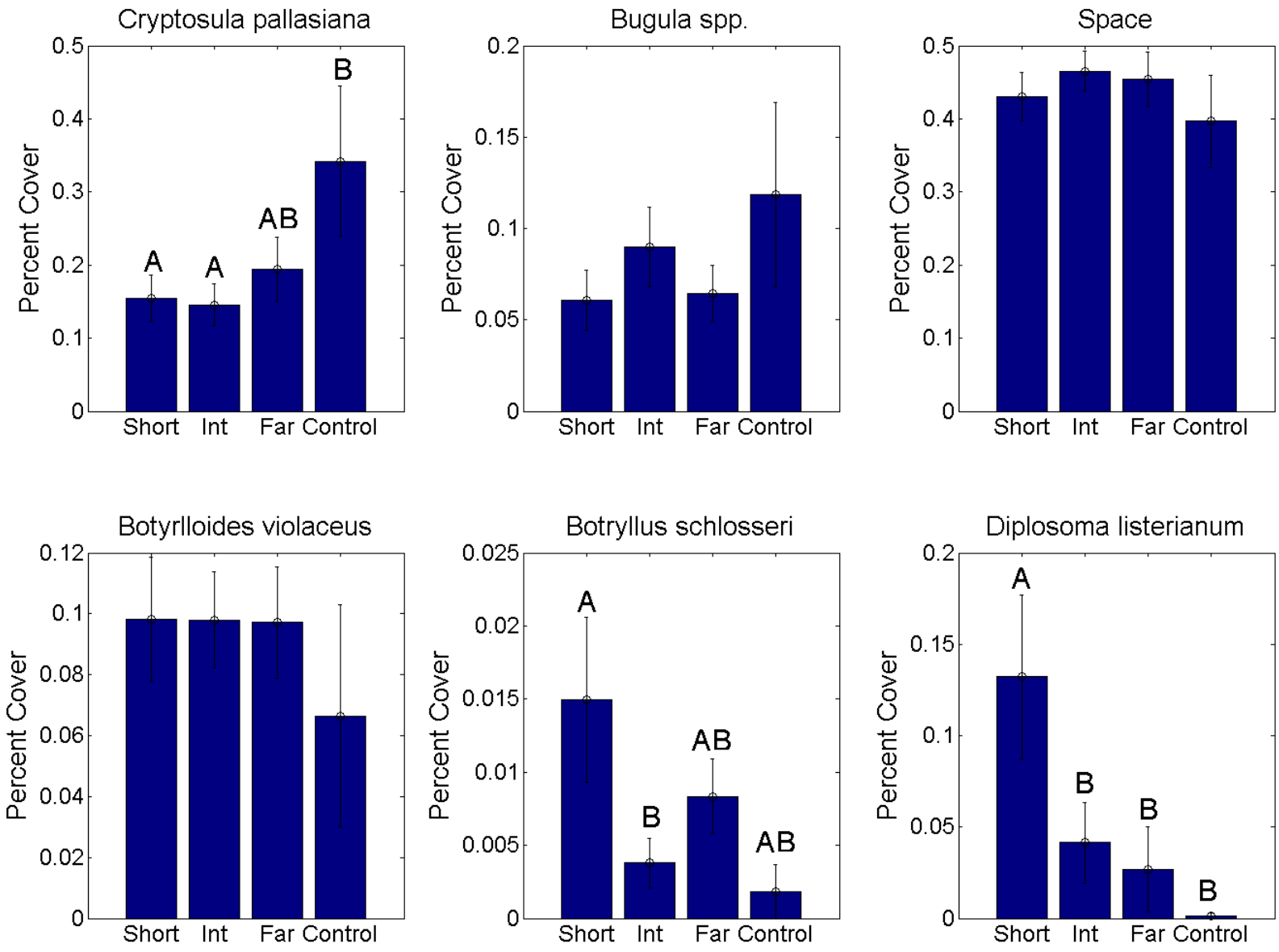
- Hypothesis 3 – Community connectivity affects community productivity

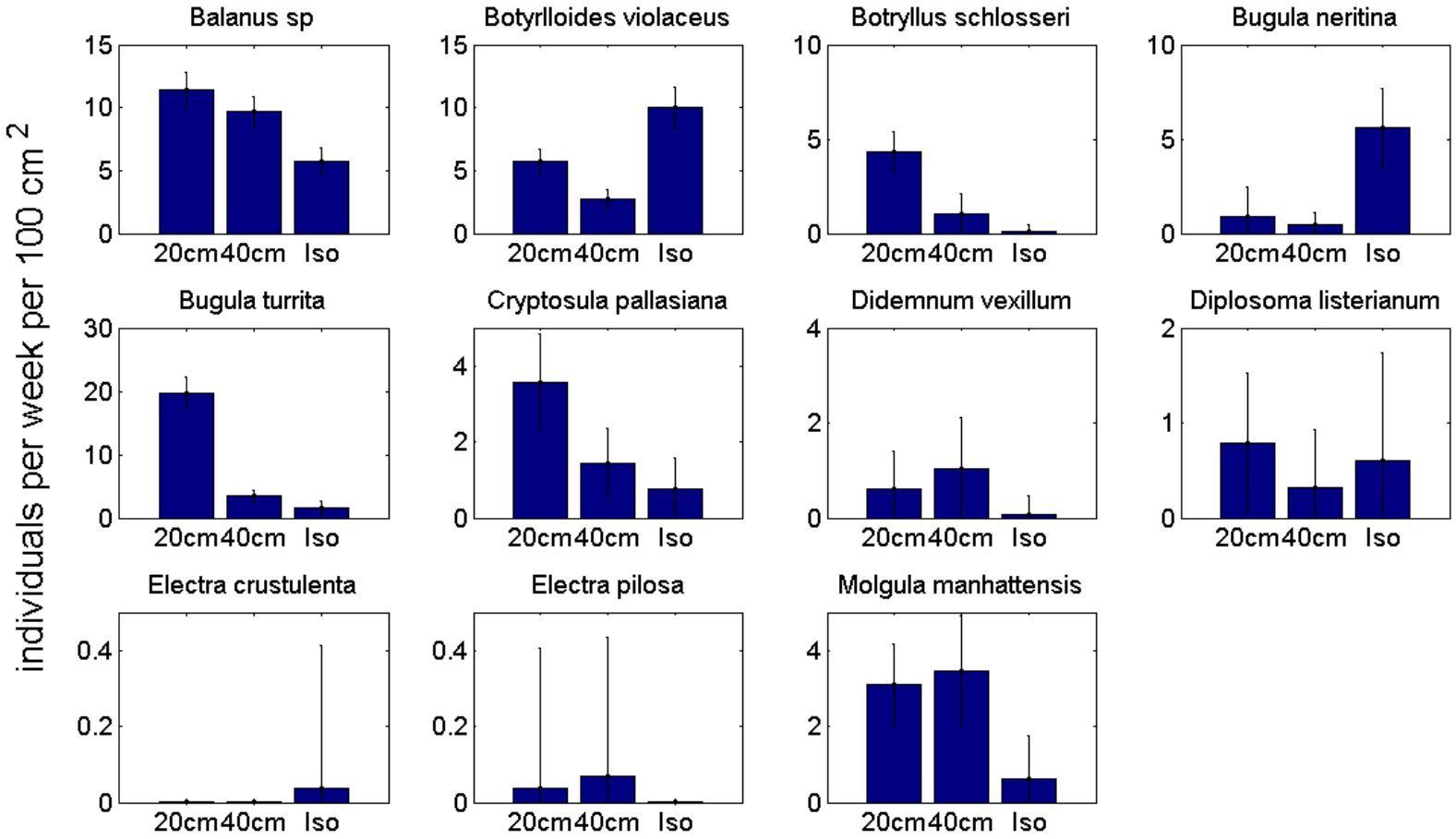


Conclusions

- Presence of predator snail favors MIXED NATIVE

- Results suggest that higher habitat connectivity may favor an ASCIDIAN over MIXED NATIVE community


Cryptosula pallasiana
Percent Cover
0.5
0.4
0.3
0.2
0.1
0
A
A
AB
B
Short
Int
Far
Control
Bugula spp.
Percent Cover
0.2
0.15
0.1
0.05
0
Short
Int
Far
Control
Space
Percent Cover
0.5
0.4
0.3
0.2
0.1
0
Short
Int
Far
Control
Botyrlloides violaceus
Percent Cover
0.12
0.1
0.08
0.06
0.04
0.02
0
Short
Int
Far
Control
Botryllus schlosseri
Percent Cover
0.025
0.02
0.015
0.01
0.005
0
A
B
AB
AB
Short
Int
Far
Control
Diplosoma listerianum
Percent Cover
0.2
0.15
0.1
0.05
0
A
B
B
B
Short
Int
Far
Control


individuals per week per 100 cm 2
Balanus sp
Botyrlloides violaceus
Botryllus schlosseri
Bugula neritina
Bugula turrita
Cryptosula pallasiana
Didemnum vexillum
Diplosoma listerianum
Electra crustulenta
Electra pilosa
Molgula manhattensis
20cm
40cm
Iso