

# Linking substrate with biodiversity: how does the approach to substrate analysis influence our conclusions?

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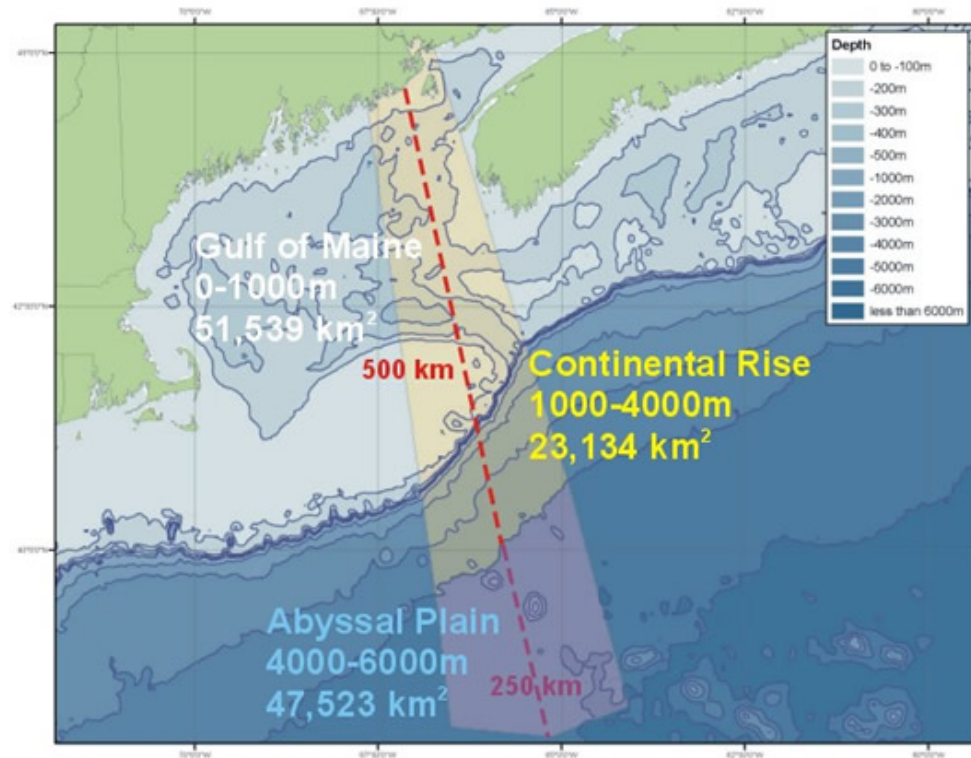
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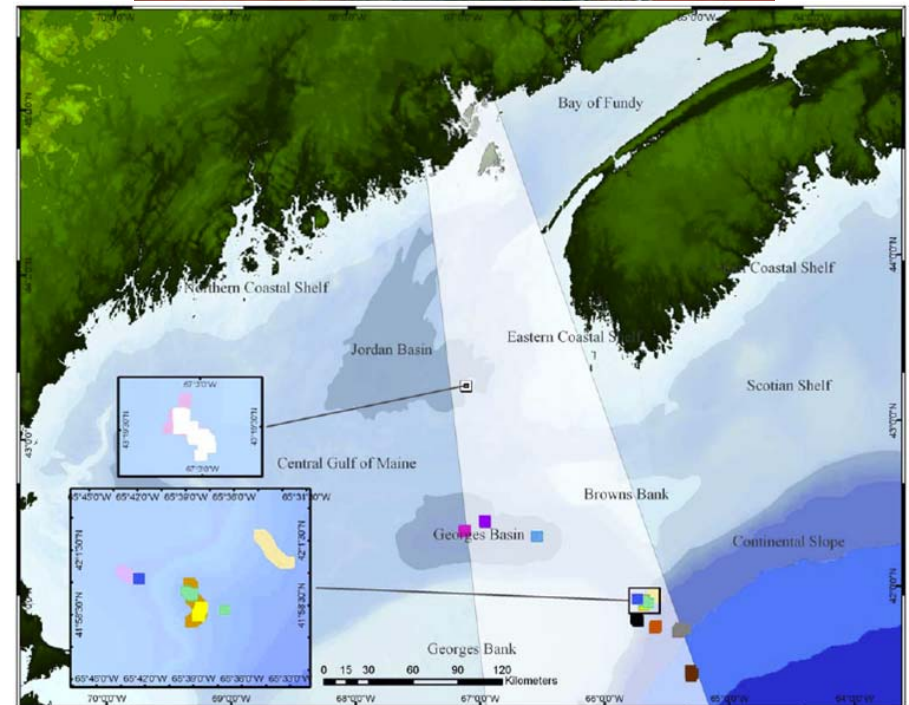
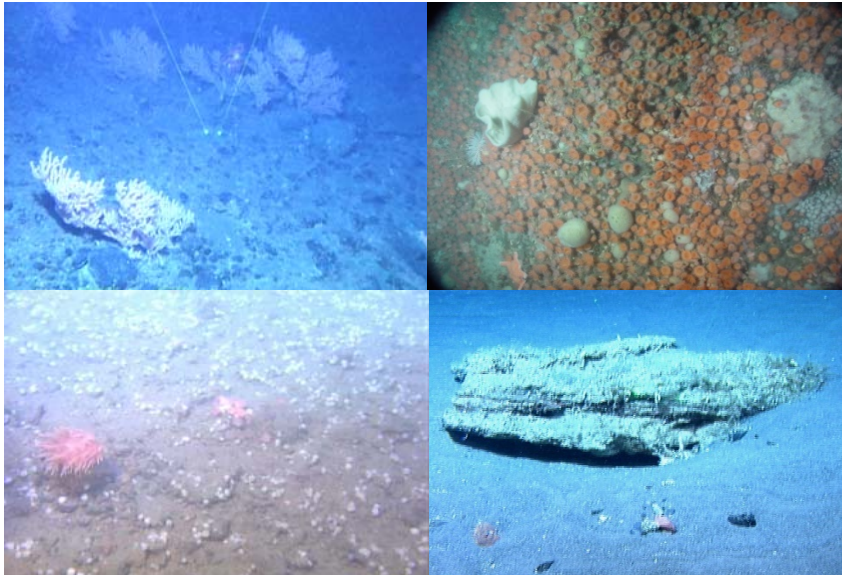
# Discovery Corridor Initiative

- International collaborative research
- Focus research to explore biodiversity
  - Census of marine life
  - Understand processes that contribute to biodiversity




# Primary Research Survey

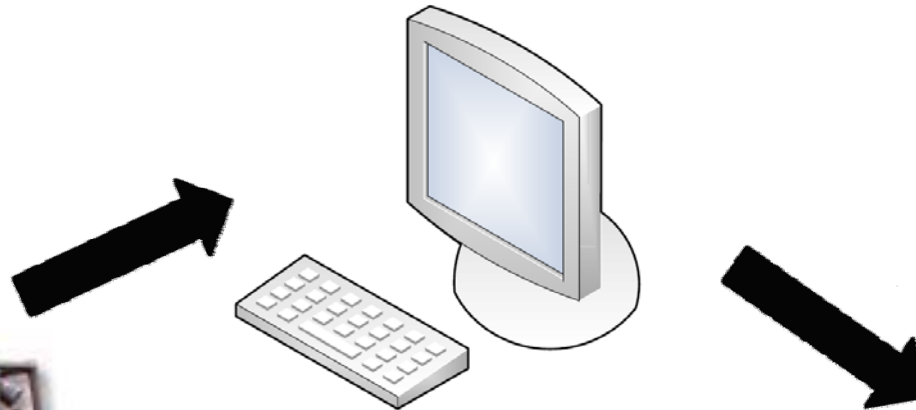
- July 2006
- 15 stations
- Video surveys using ROV ROPOS
- ~ 120 hrs seafloor video



# Processing Video

## Considerations

- Scientific objective: Link between substrate and biodiversity ?
- What habitat attributes to use ?
- Time 
- Cost \$



Event_Seq	Class_Seq	Mission_Year	JulianDay	Time_UTC	Species_Event	Anthropogenic	Event_Comment
1	256	2006	195	082453	paragorgia		
2	256						
3	258						
4	258						

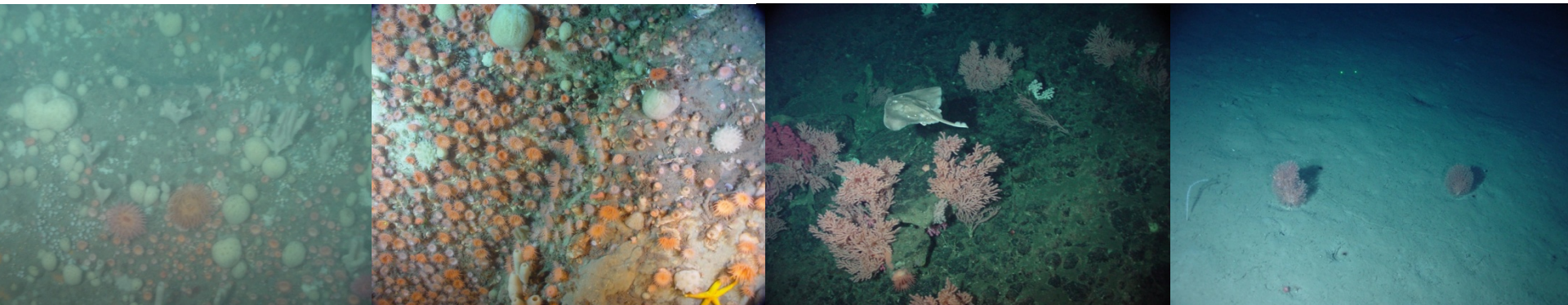
Chnl	Mission_Year	JulianDay	Time_UTC	Camera_Mode	View	Lat	Long	Depth	Seabed	Shoalness	Coastline	Prebble	Sand	Silt	Seabed_Roughness_Physical	Seabed_Roughness_Biogenic	Class	Comments
1	2006	194	020524	Transsect	Good	4157 8228 N	06538 1874 W	063		5	15	00			ripples	tube worms		
2	2006	194	020526	Transsect	Good	4157 8228 N	06538 1874 W	062		5	15	00			ripples	tube worms		
3	2006	194	020527	Transsect	Good	4157 8228 N	06538 1874 W	063		5	15	00			ripples	tube worms		
4	2006	194	020528	Transsect	Good	4157 8228 N	06538 1874 W	062		5	15	00			ripples	tube worms		
5	2006	194	020529	Transsect	Good	4157 8228 N	06538 1874 W	061		5	15	00			ripples	tube worms		
6	2006	194	020530	Transsect	Good	4157 8228 N	06538 1874 W	061		5	15	00			ripples	tube worms		
7	2006	194	020531	Transsect	Good	4157 8228 N	06538 1874 W	061		5	15	00			ripples	tube worms		
8	2006	194	020531	Transsect	Poor	4157 8228 N	06538 1874 W	049		5	15	00			ripples			
9	2006	194	020532	Transsect	Poor	4157 8228 N	06538 1874 W	049		5	15	00			ripples			
10	2006	194	020533	Transsect	Poor	4157 8228 N	06538 1874 W	048		5	15	00			ripples			

# Options for Analysis

- Technology available: Datalogging software: ClassAct Mapper v 3.2 (DFO)
- What level of substrate analysis required ?
  - Primary substrate (🕒 \$)
  - Primary, secondary substrate (🕒 🕒 \$\$)
  - % cover of all substrates visible (🕒 🕒 🕒 \$\$\$)
- *Will the resolution of the substrate analysis affect our interpretation of the results?*

# Methods

- Video processed with ClassAct Mapper
- Substrate size determined from scaling lasers (10 cm)
- % substrate recorded
  - Bedrock outcrop
  - Boulder
  - Cobble
  - Pebble
  - Sand
- Species abundance and composition (megafauna)



# Methods

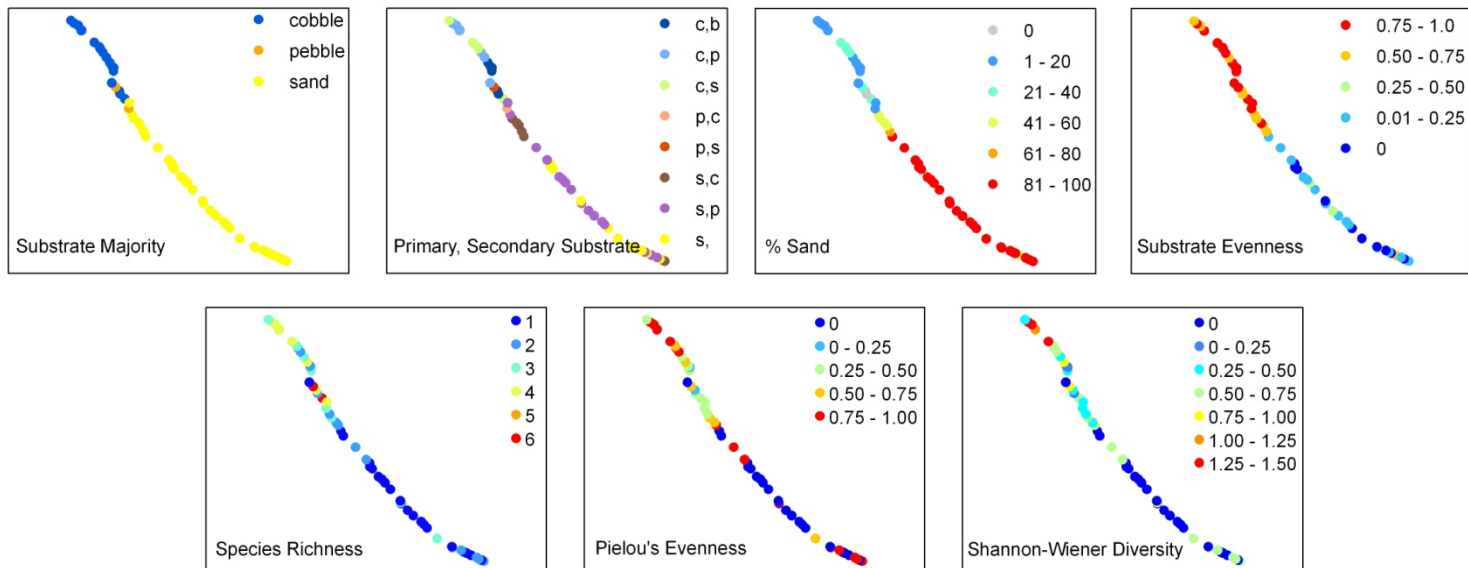
## Substrate measures

- Primary substrate
- Primary, secondary substrate
- % cover substrate
- Substrate Evenness

## Biodiversity measures

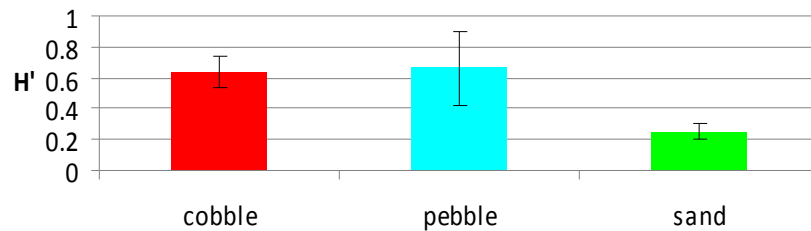
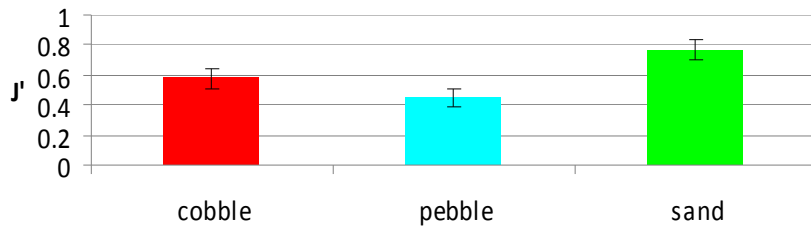
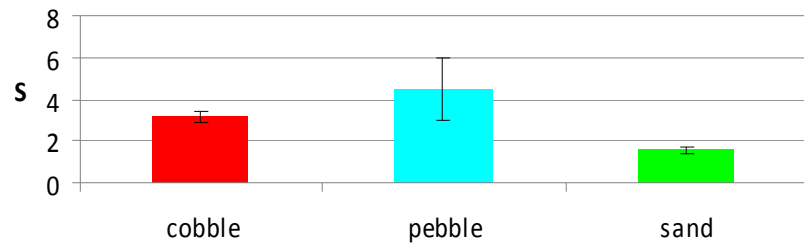
- Species Richness (S)
- Pielou's Evenness (J')
- Shannon-Wiener (H')

## Species composition

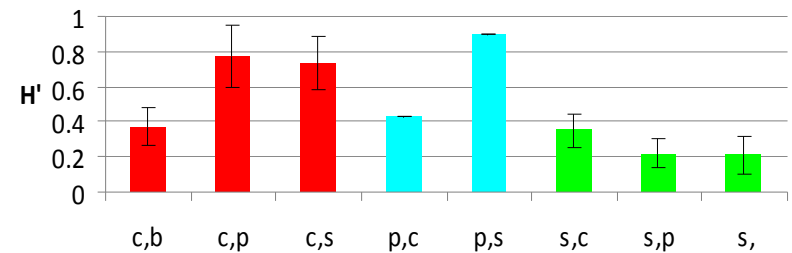
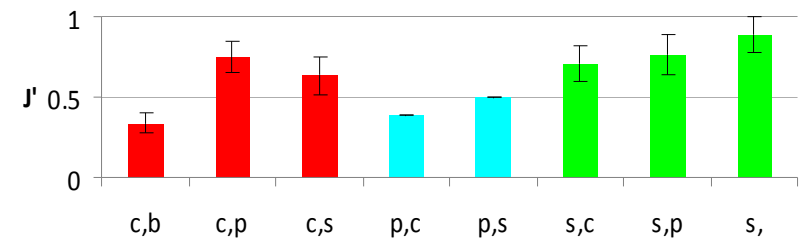
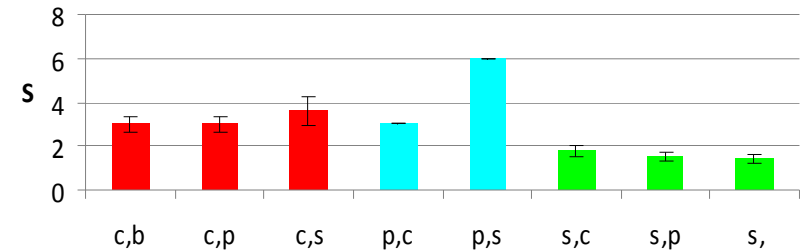


# Results: Biodiversity R982

## Primary Substrate



## Primary, Secondary Substrate



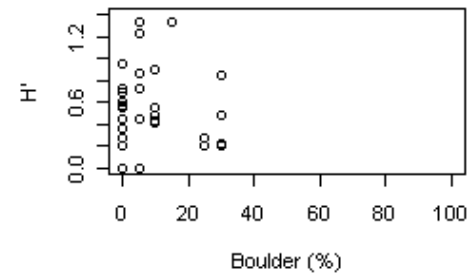
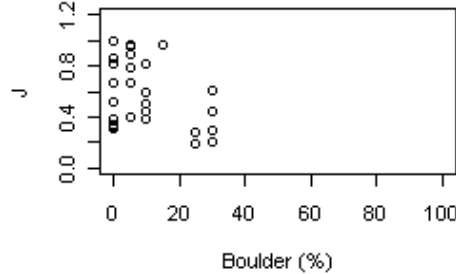
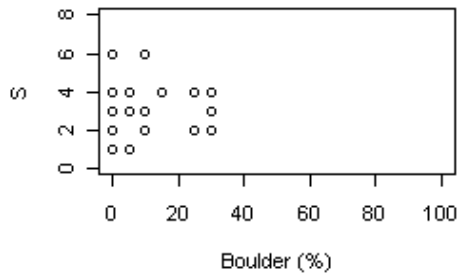
# % Substrate

$s$

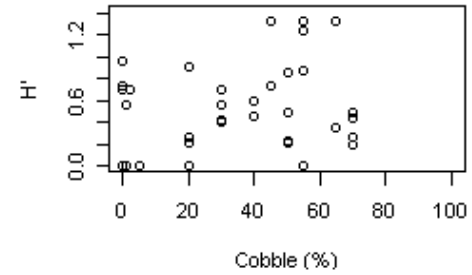
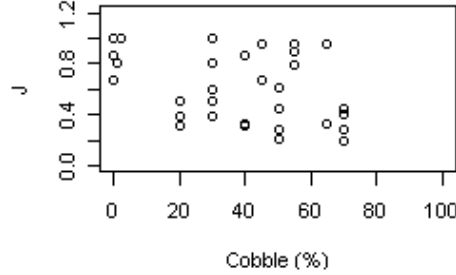
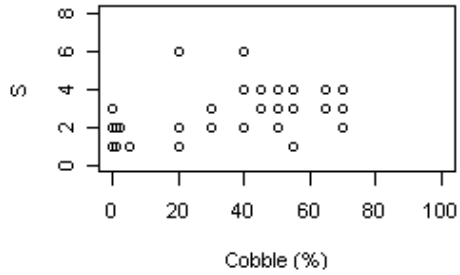
$J'$

$H'$

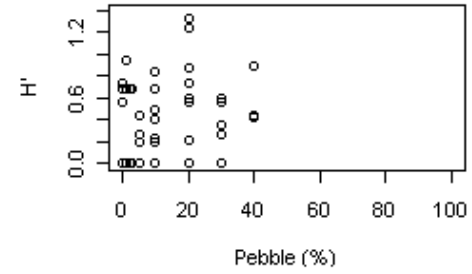
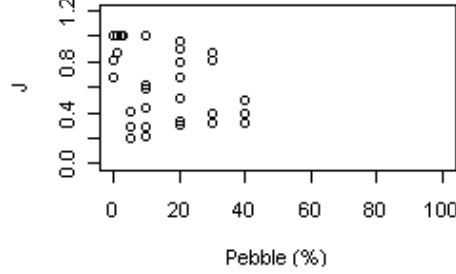
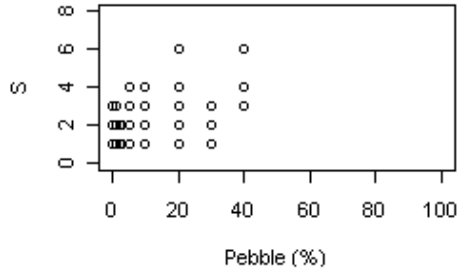
**Boulder**



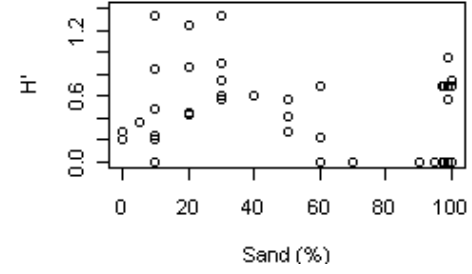
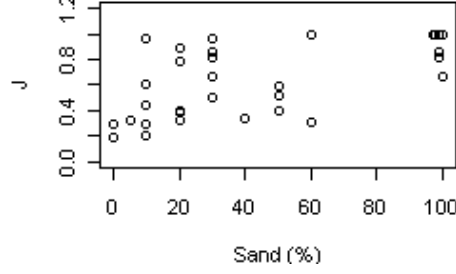
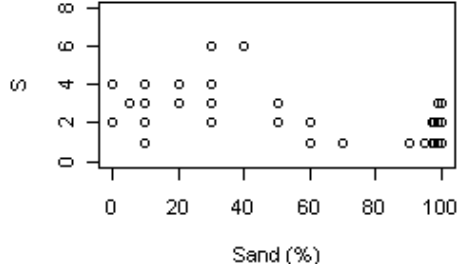
**Cobble**



**Pebble**

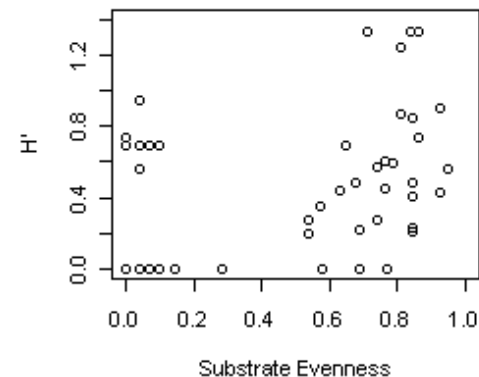
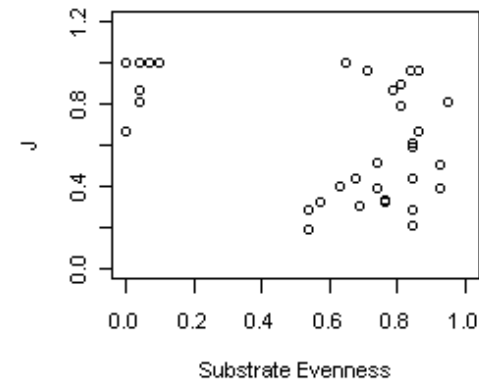
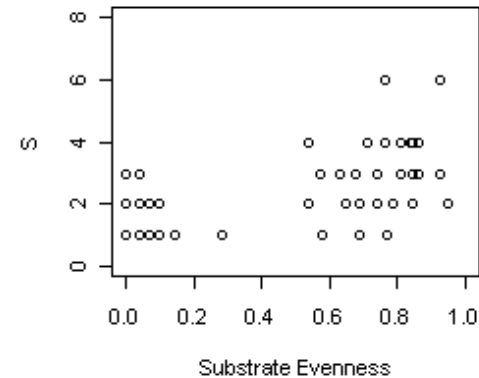


**Sand**



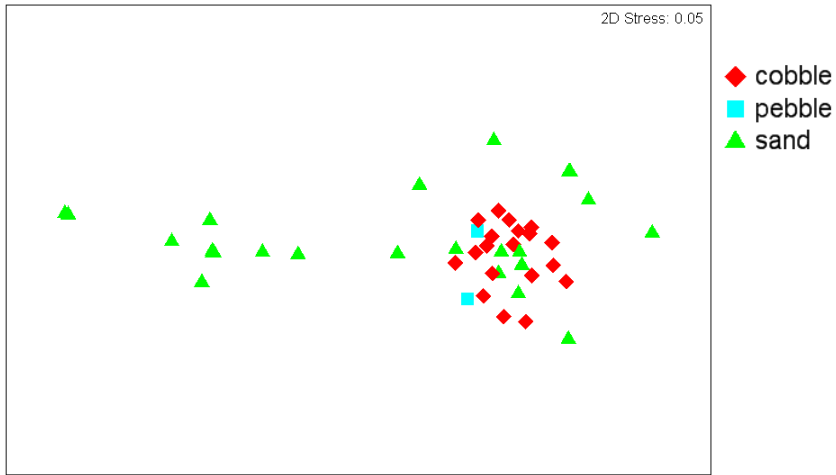
# Substrate Evenness

- Diversity index for substrate types
- Quantifies the representation of substrate categories within a sample
- Based on Pielou's Evenness Index

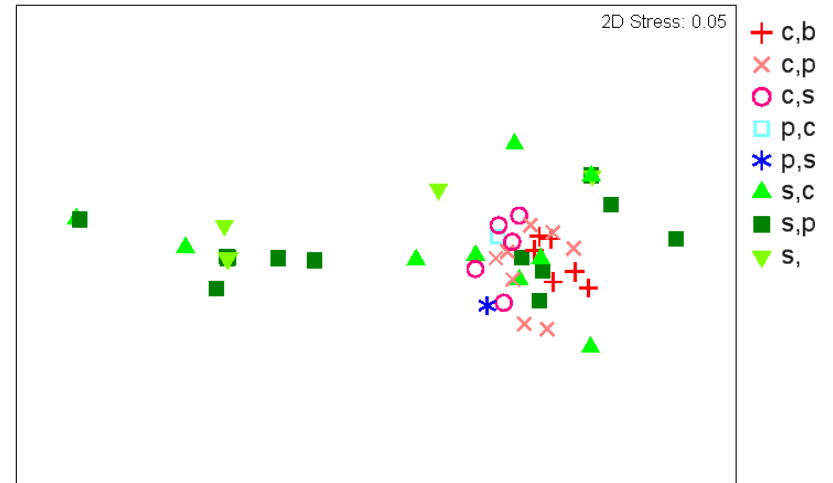


# Species Composition

## Primary Substrate



## Primary, Secondary Substrate



# Species Composition

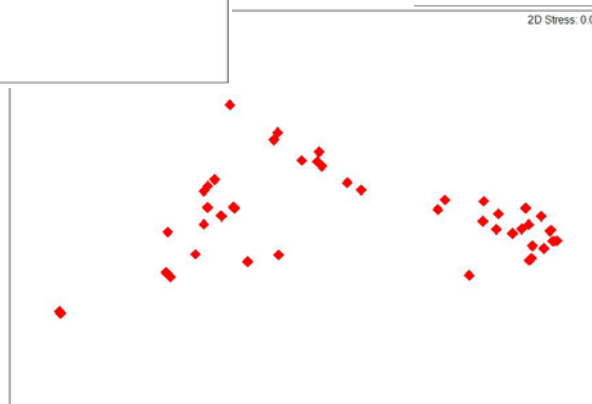
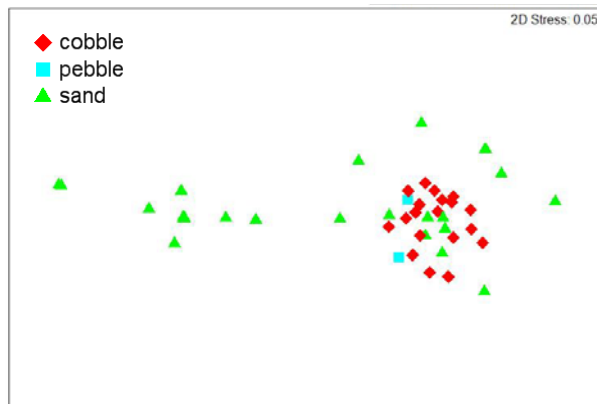
(BIO-ENV)

% Cover Substrate

- Cobble & Depth explain  
~ 50% of the spatial pattern

Substrate Evenness

- 4<sup>th</sup> best environmental variable to explain spatial diversity pattern
- After cobble, depth, and pebble



## Summary: Univariate measures of Biodiversity

Transect	Primary	Primary, Secondary	% Cover	Substrate Evenness
R982	Cobble (+) Pebble (+)	Cobble (+) Pebble (+)	Sand (-)	+
R978	Sand (-)	Cobble (+)	Sand (-) Cobble (+)	0
R976	Cobble (+)	Cobble (+) Pebble (+)	Cobble (+) Pebble (+) Boulder (+) Sand (-)	+
R974 NEC4	Bedrock (+) Boulder (+)	0	0	-
R974 NEC3	0	0	0	0

## Summary: Multivariate measures of biodiversity

Transect	Primary	Primary, Secondary	% Cover (top substrate metric)	Substrate Evenness (within top 3 envt metrics)
R982	Cobble Sand	100% Sand Cobble	Cobble	No
R978	0	Sand Cobble, > Sand	Cobble Sand	No
R976	Cobble/Pebble Sand	Cobble Sand	Pebble	Yes
R974 NEC4	0	0	Sand	No
R974 NEC3	0	0	Pebble	No

# Conclusions

- Biodiversity indices were higher on structured, hard substrate types (cobble, pebble)
- Highly resolved substrate measures allows construction of aggregate measures
- And for this analysis, primary substrate was sufficient to elucidate this pattern
- As signals of biota response to environment may be manifested at various spatial scales, acquiring highly resolved habitat attributes provides flexibility for analysis

# Acknowledgements

An underwater photograph of a seabed. The foreground is covered with numerous small, orange sea urchins. A larger, pinkish-orange sea urchin is prominent in the middle ground. To the right, a bright orange starfish is visible. The seabed is also scattered with various sized, light-colored rocks and shells. The background shows more of the seabed with some greenish-brown patches, possibly algae or other marine life.

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