

# Groundfish, Deep-water Corals, and Sponges: Examining Diel Patterns of Fish-Habitat Associations on Heceta Bank, Oregon



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# Importance of Deep-water Corals and Sponges

- Enhance structural complexity and of biodiversity
- Under what conditions do close associations occur?
  - Strong: Southeastern US (Ross & Quattrini, 2007), Aleutians (Stone et al., 2006)
  - Weak: Gulf of Maine (Auster, 2005), southern California (Tissot et al., 2005)



# Diel Changes in Habitat Use

- Many deepwater demersal fishes exhibit diel changes in habitat use
- Likely varies by species, possibly with life history stage
- Majority of *in situ* surveys conducted during the day



Hart T., J. Clemons, W. Wakefield and S. Heppell. 2010. Day and night abundance, distribution, and activity patterns of demersal fishes on Heceta Bank, Oregon. Fishery Bulletin 108:466-477

Conducted day/night comparison of habitat-specific abundance and activity for 31 fish taxa

**Findings:**

Most taxa showed only slight diel differences in abundance

Handful of taxa abundances differed by several orders of magnitude

Distinct diel changes in taxa aggregating around habitat features (boulders, rock ridge)

Dominant Day

Unidentified juvenile rockfish



Puget Sound rockfish



pygmy rockfish



Dominant Night

sharpchin rockfish



yellowtail rockfish

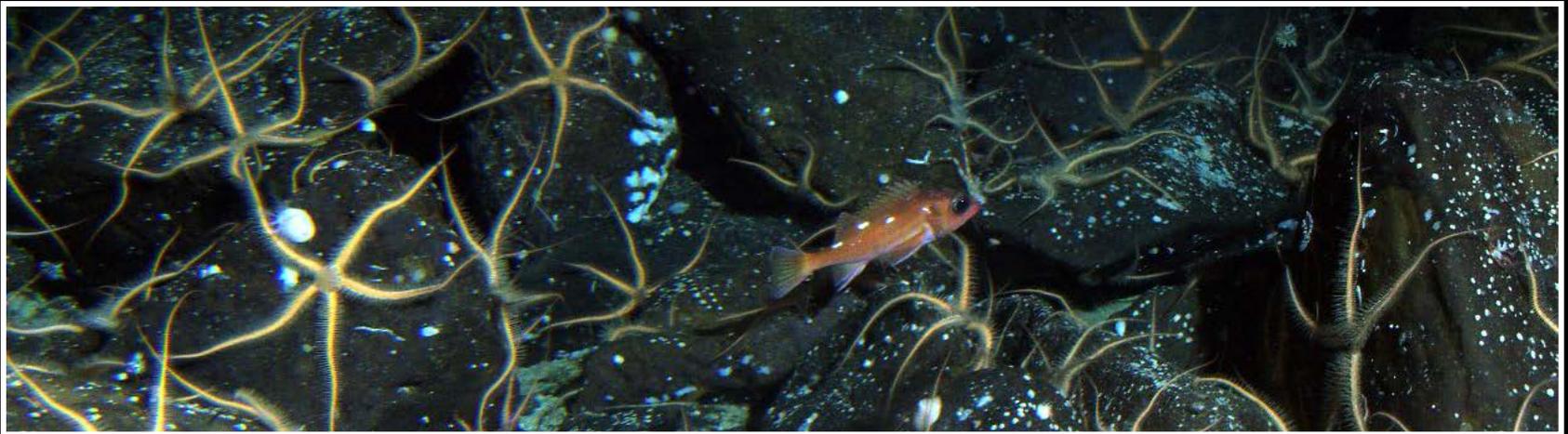


greenstriped rockfish



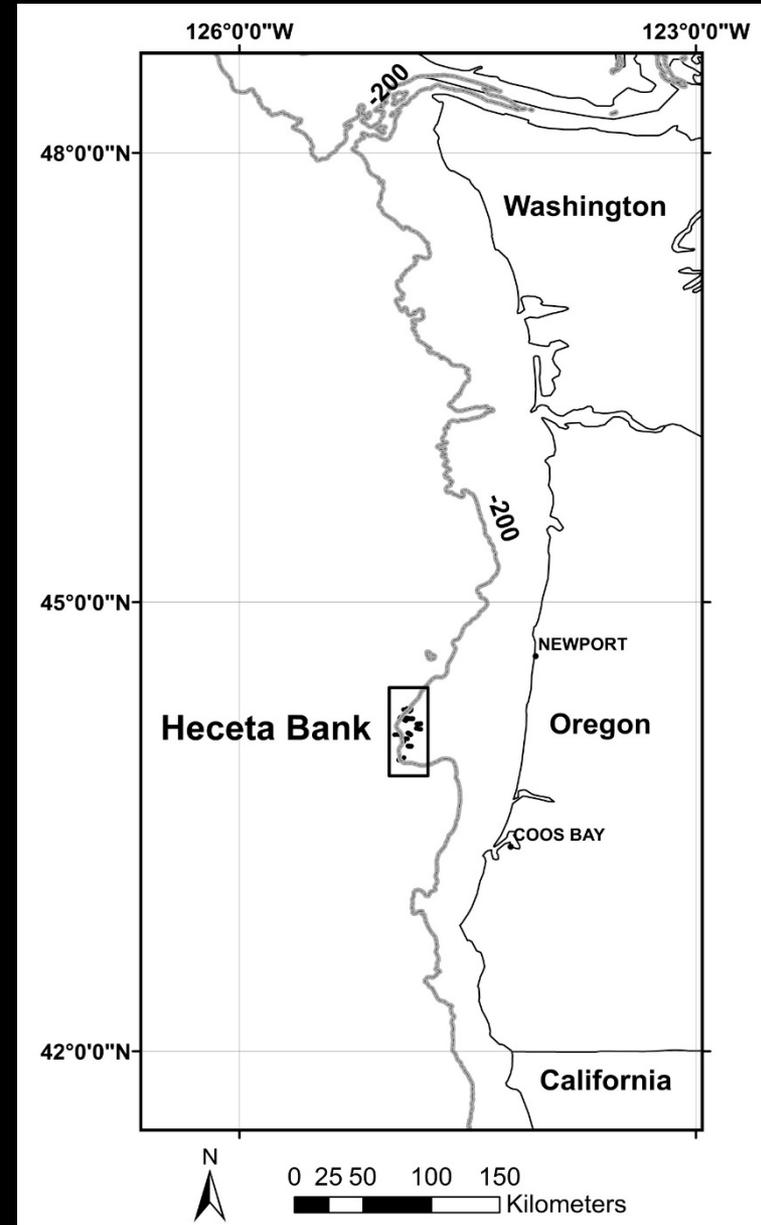
# Research Questions

1. Do corals and sponges provide structure for fishes?
2. How do these associations change over the diel period?



# Heceta Bank, Oregon

- Edge of continental shelf, 80-600 m
- Contains diverse habitats
- Vicinity of Heceta Bank important area for commercial fishing
- 25+ years of study

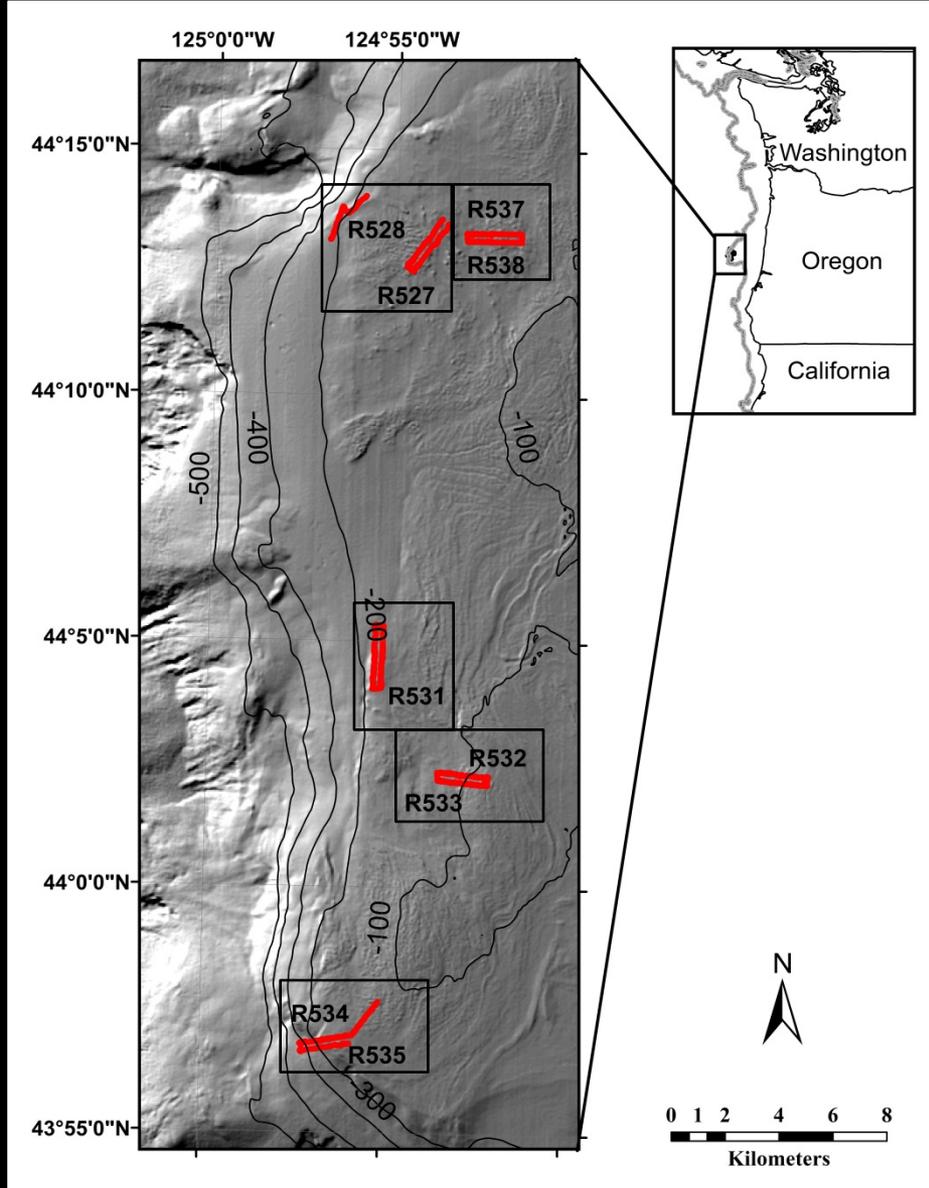


# Heceta Bank, Oregon

- 2000 ROPOS Survey



- 9 paired day/night dives
- Video survey: 3-chip camera
- 2-m wide belt transect
- Depths 71-341 m



# Laboratory Analysis

>45 hours video

## Habitats:

- Used binary habitat code system (R, F, B, C, P, G, S, M)  
First letter: Primary substrate > 50% fov  
Second letter: Secondary substrate > 20% fov  
(after Stein et al., 1992)
- Creates contiguous habitat “patches”
- Cluster analysis: (Euclidean distance, group average)  
26 combinations reduced to 11 habitats, similarity >80%

## Sunrise and Sunset Times:

Time derived using U.S. Naval Observatory website.

## Structure forming invertebrates:

- All sponges and corals (>10 cm) were identified, enumerated, and sizes estimates were taken

## Identified fish and categorized associations with SFI:



- **Proximity:** none, <1m, <1 fish body length, physical contact
- **Fish behavior:** swimming, hovering, or resting

(after Stone, 2005)

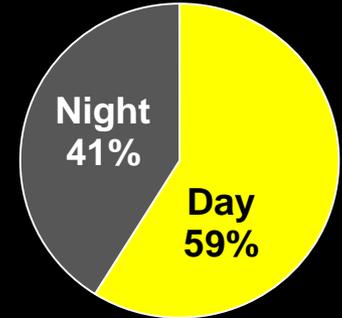
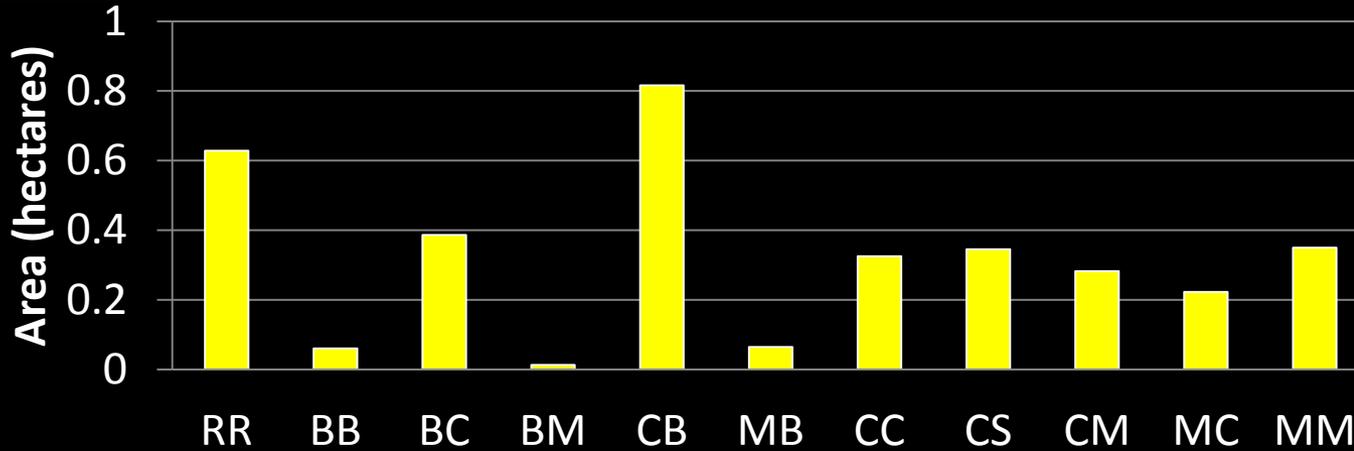
# Habitat Composition

## Bottom Time



Day

Total area = 3.5 ha

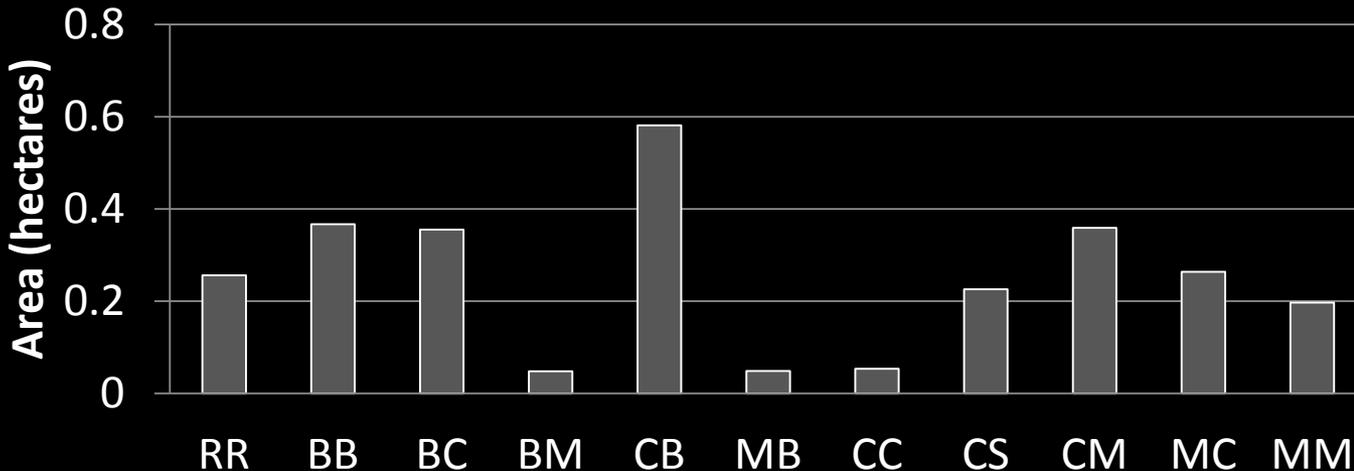


≈ 40 km surveyed

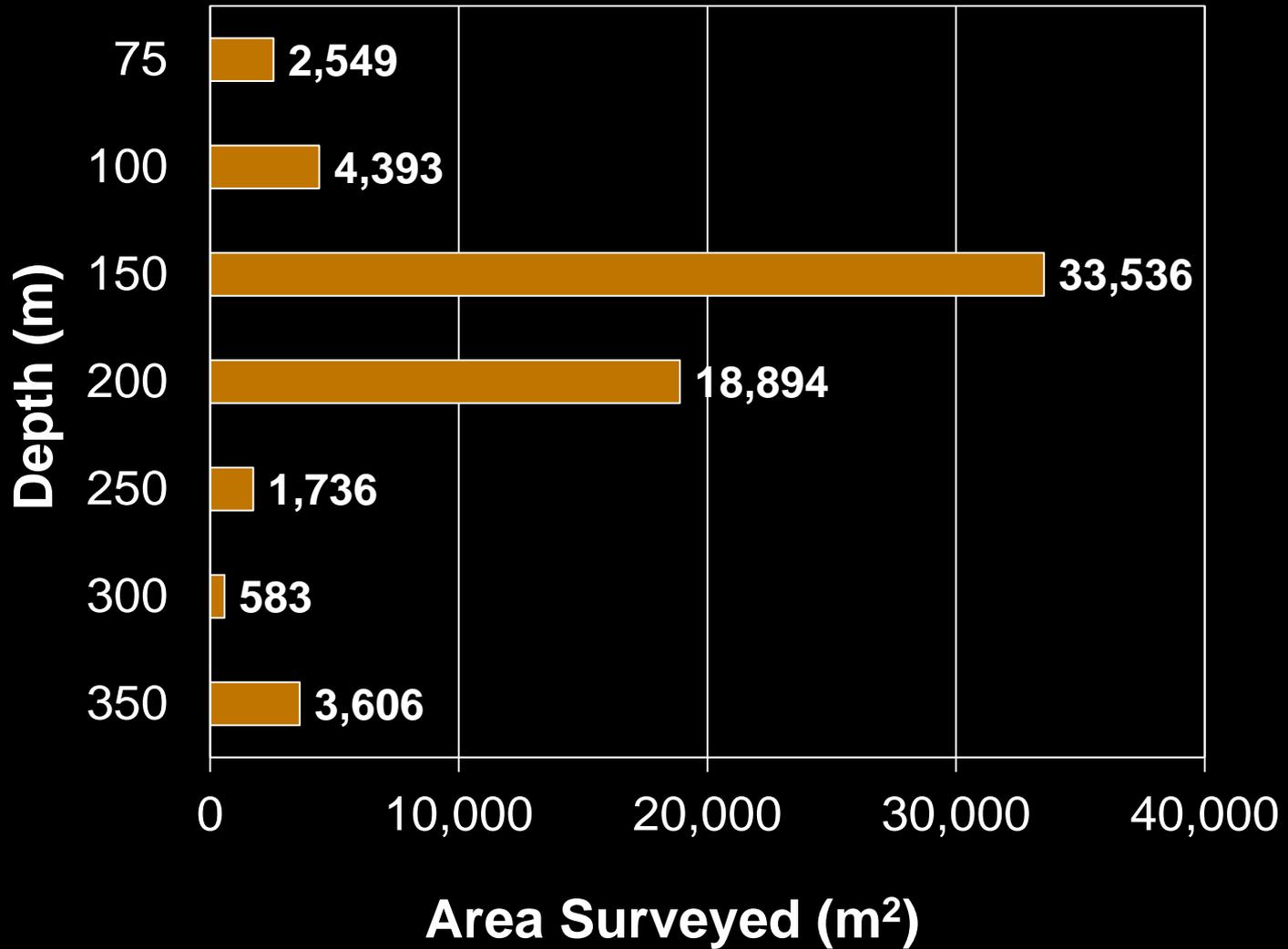


Night

Total area = 2.8 ha



# Area Surveyed by Depth



# Most Abundant Fishes on Heceta Bank

**Total Number of Fishes: 27,880    Number of Taxa: 52**



**Day    n=16,557**

Common name	Scientific name	Count	Cum. %
juvenile rockfish	<i>Sebastes spp.</i>	3,583	22%
Puget Sound rockfish	<i>Sebastes emphaeus</i>	3,581	43%
pygmy/Puget Sound	<i>Sebastes spp.</i>	2,358	58%
pygmy rockfish	<i>Sebastes wilsoni</i>	2,213	71%
sharpchin rockfish	<i>Sebastes zacentrus</i>	1,196	78%
rockfish, unidentified	<i>Sebastes spp.</i>	965	84%
Other		1,389	



**Night    n=11,323**

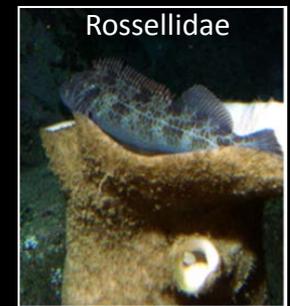
Common name	Scientific name	Count	Cum. %
sharpchin rockfish	<i>Sebastes zacentrus</i>	7,734	68%
rockfish, unidentified	<i>Sebastes spp.</i>	1,091	78%
yellowtail rockfish	<i>Sebastes flavidus</i>	363	81%
Dover sole	<i>Microstomus pacificus</i>	316	84%
rosethorn rockfish	<i>Sebastes helvomaculatus</i>	294	87%
greenstriped rockfish	<i>Sebastes elongatus</i>	257	89%
Other		1,268	



# Most Abundant Coral and Sponges

1,729 corals and sponges from 15 taxa, comprising 9 families

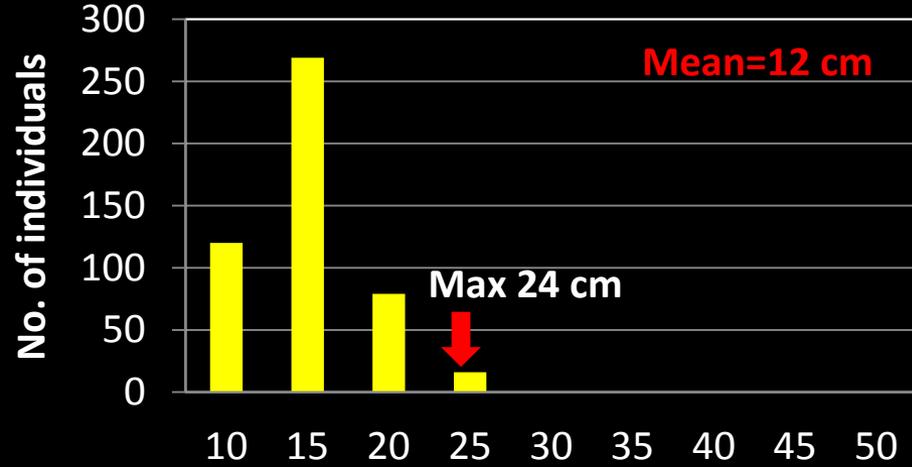
<b>Porifera</b> n=1,683	<i>n</i>
Porifera, unidentified (8% total)	131
<b>Demospongiae</b> (33% total)	
<i>Poecillastra</i> sp.	453
Demosponge, unidentified	106
<i>Mycale (Mycale) loveni</i>	17
<b>Hexactinellida</b> (57% total)	
<i>Heterochone calyx</i>	473
Rossellidae (barrel sponges)	479
<b>Cnidaria</b> n=46 (3% total)	
Plexaurid corals	43
<i>Calcigorgia beringi</i>	2
<i>Paragorgia</i> sp.	1



# Coral and Sponge Size Distributions

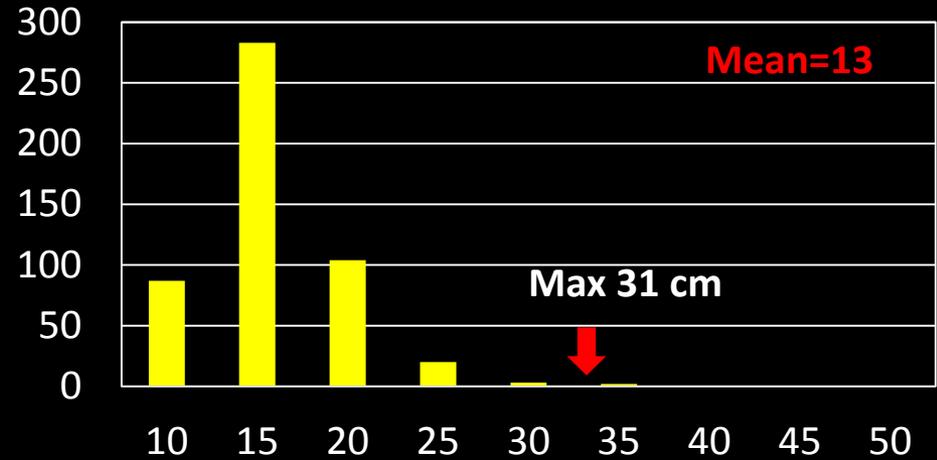
*Pocillostra sp.*

n=453



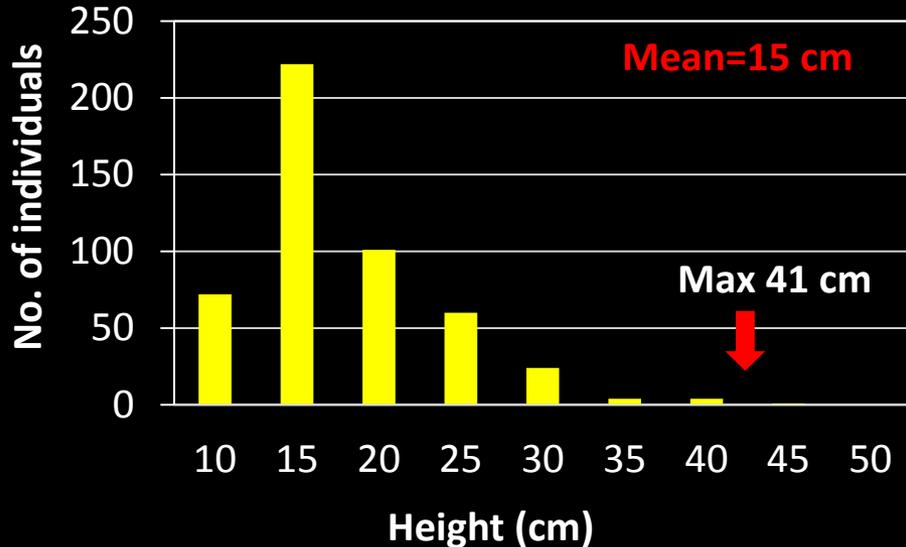
*Heterochone calyx*

n=473



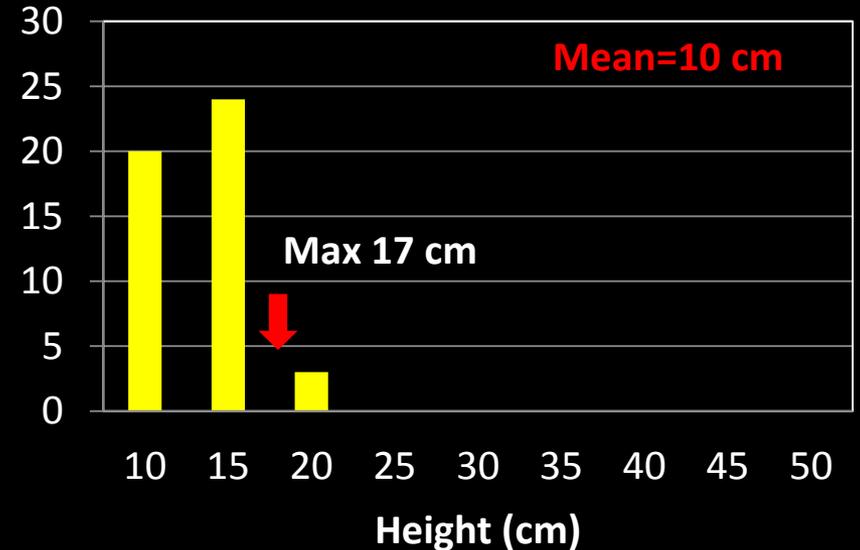
Rossellidae

n=479



Plexaurid Corals

n=43



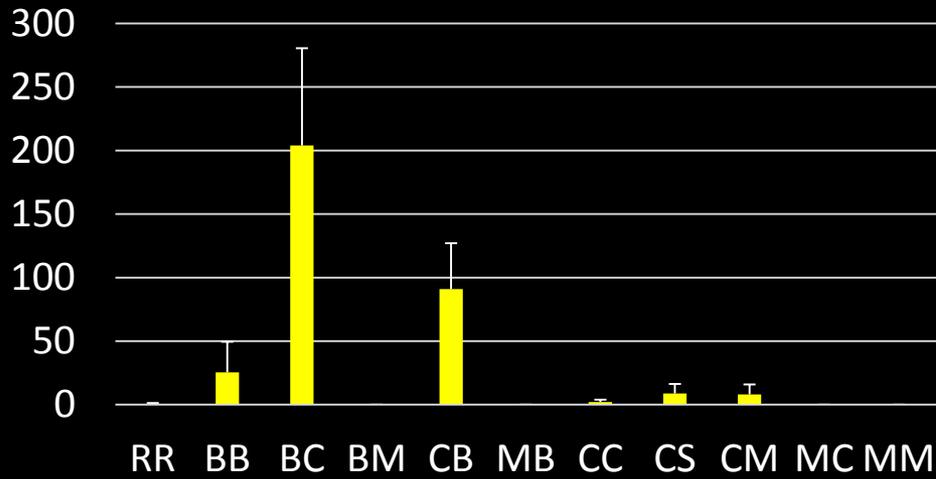
# Densities of Common Sponge and Corals

<u>Taxa</u>	<u>n</u>	<u>(no./hectare)</u>	<u>S.E.</u>
<b>Porifera</b>			
Porifera, unidentified	131	54	11
<b>Demospongiae</b>			
<i>Poecillastra</i> sp.	453	80	20
Demosponge, unidentified	106	49	9
<b>Hexactinellida</b>			
<i>Heterochone calyx</i>	473	97	18
Rossellidae	479	179	21
<b>Cnidaria</b>			
Plexaurid corals	43	22	9
<b>Total Corals &amp; Sponges</b>	<b>1,729</b>	<b>494</b>	<b>39</b>

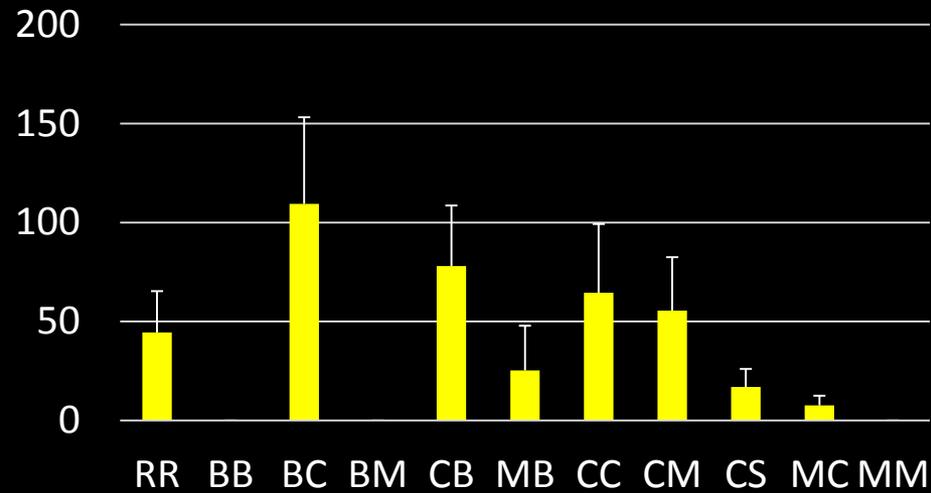


# Coral and Sponge Densities by Habitat

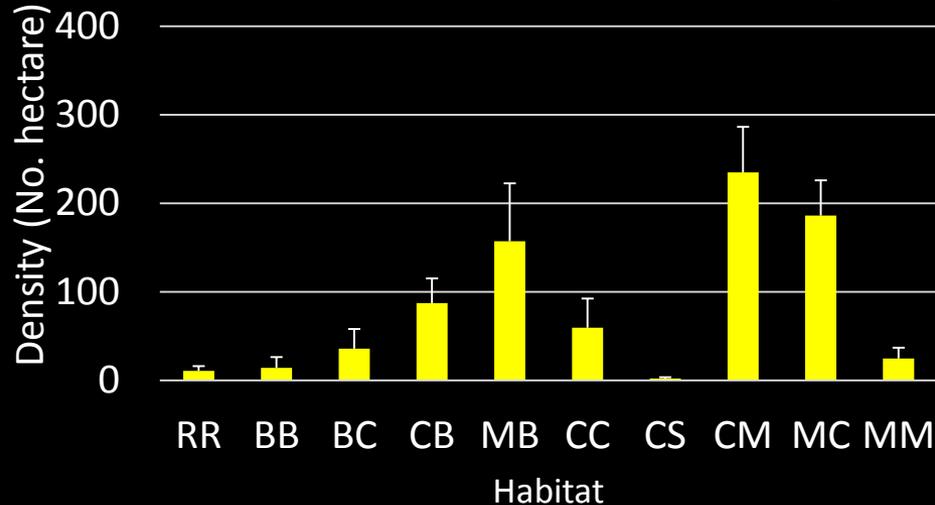
*Poecillastra* sp.  $n=453$



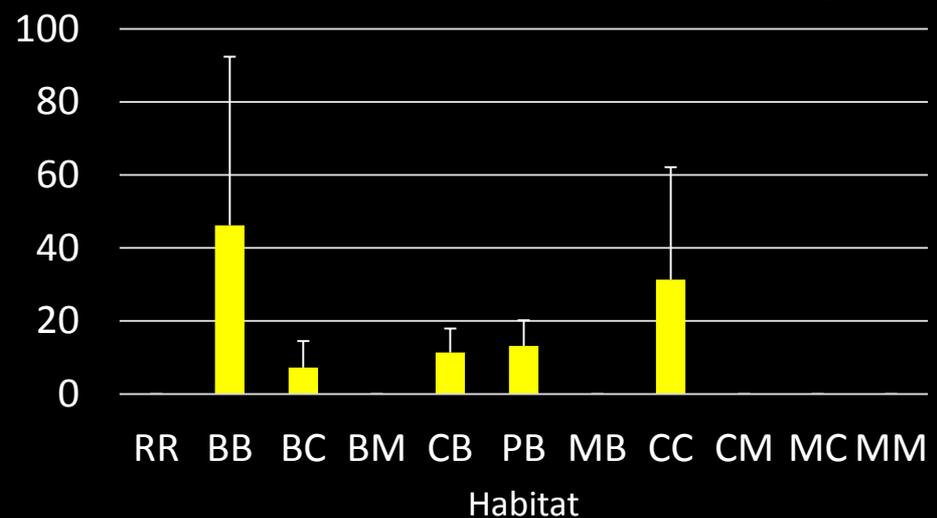
*Heterochone caylx*  $n=473$

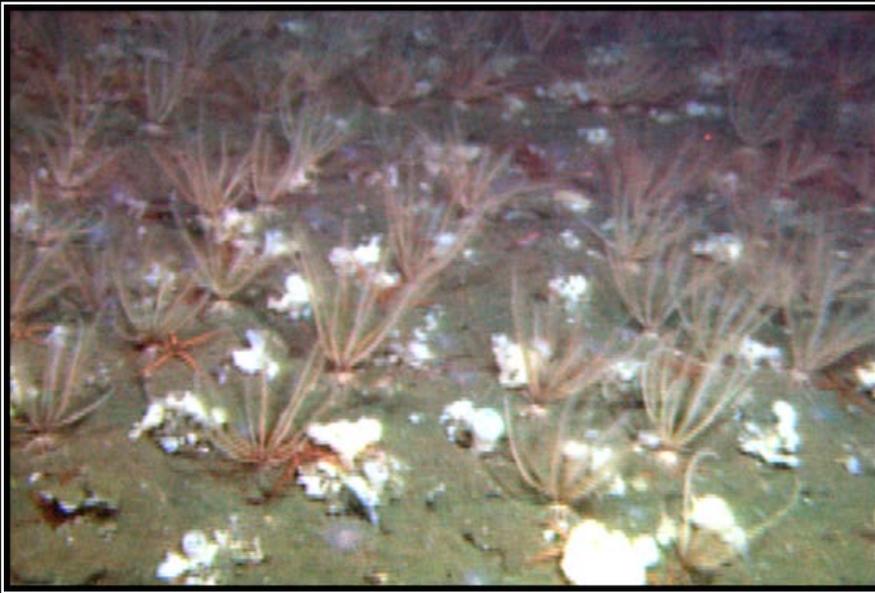


Rossellidae  $n=479$



Plexurid Corals  $n=43$





**Large sponges rare on bedrock habitats (RR, FC), although small sponges common**

### Possible Causes:

- **Environmental: soft mudstone substrate & strong currents?**
- **Legacy of historic fishing or disturbance?**
- **Episodic recruitment event?**

# Fish Associations with Corals and Sponges

## Fishes Perspective



**Day** n=16,557

# fish associated  
coral

# fish assoc.  
sponge

% assoc.  
with coral

% assoc.  
with sponge

### Common name

juvenile rockfish	3	250	<1%	7%
rockfish, unidentified	0	244	0%	25%
sharpchin rockfish	0	172	0%	14%
pygmy rockfish	0	171	0%	8%
rosethorn rockfish	4	134	<1%	16%
other	2	202	<1%	3%
<b>Total</b>	<b>9</b>	<b>1,181</b>	<b>&lt;1%</b>	<b>7%</b>



**Night** n=11,323

sharpchin rockfish	36	1,437	<1%	19%
rockfish, unidentified	1	242	<1%	22%
rosethorn rockfish	3	65	1%	22%
greenstriped rockfish	0	13	0%	5%
yellowtail rockfish	0	13	0%	4%
other	11	57	1%	4%
<b>Total</b>	<b>47</b>	<b>1,878</b>	<b>&lt;1%</b>	<b>16%</b>

# Fish Associations with Common Sponge and Corals

## Fishes Perspective

Taxa	Time	n	% fishes < 1 m	% fishes <1 body length
<i>Poecillastra</i> sp.	Day	476	3%	0.1%
	Night	587	5%	0.6%
Rosselidae	Day	251	1%	0.1%
	Night	561	4%	0.7%
<i>Heterochone calyx</i>	Day	303	2%	0.1%
	Night	530	4%	0.5%
Plexurid corals	Day	7	<1%	<0.0%
	Night	47	<1%	<0.0%



# Common Sponge and Corals with Associated Fish

## Coral and Sponge perspective

Taxa	n	<1 m	<1 body length	Contact
<b>Sponges</b>				
<i>Poecillastra</i> sp.	453	215%	17%	3%
Rosselidae	479	145%	19%	5%
<i>Heterochone calyx</i>	473	158%	15%	4%
<b>Corals</b>				
Plexauridae	43	116%	9%	0%
<b>Total</b>	<b>1,729</b>	<b>157%</b>	<b>16%</b>	<b>4%</b>

# Day / Night Associations

## Coral and Sponge perspective

<u>Taxa</u>	<u>Time</u>	<u>n</u>	<u>&lt;1 m</u>	<u>&lt;1 body length</u>	<u>Contact</u>
<i>Poecillastra</i> sp.	Day	260	175%	6%	2%
	Night	193	167%	80%	4%
Rosselidae	Day	265	86%	6%	2%
	Night	213	218%	36%	9%
<i>Heterochone calyx</i>	Day	244	118%	5%	1%
	Night	229	200%	24%	7%
Total	Day	987	112%	6%	2%
	Night	742	264%	29%	6%



# Day / Night Behavioral Differences

## Coral and Sponge perspective

Taxa	Time	n	<u>&lt;1 m</u>			<u>&lt;1 body length</u>			<u>Physical</u>
			Swim	Hover	Rest.	Swim	Hover	Rest.	Contact
<i>Poecillastra</i> sp.	Day	260	45%	73%	58%	0%	1%	5%	2%
	Night	193	19%	17%	232%	3%	1%	30%	4%
Rosselidae spp.	Day	265	16%	29%	41%	1%	0%	6%	2%
	Night	213	8%	1%	209%	1%	0%	35%	9%
<i>Heterochone calyx</i>	Day	244	26%	34%	57%	0%	1%	4%	1%
	Night	229	21%	7%	172%	1%	0%	23%	7%
<b>Total</b>	Day	987	26%	41%	45%	1%	1%	5%	2%
	Night	742	18%	8%	192%	2%	0%	27%	6%

# Invertebrate Perspective on Day / Night Associations

## Sharpchin rockfish



	Total # fish associated	Total # fish on survey
Day	172	627
Night	1,473	1,759

Taxa	Time	<1 m	<1 body length	Contact
Poecillastra sp.	Day	22%	2%	1%
	Night	179%	21%	3%
Rosselidae	Day	6%	1%	1%
	Night	115%	19%	5%
Heterochone calyx	Day	27%	2%	0%
	Night	161%	16%	4%
Total	Day	15%	2%	1%
	Night	130%	15%	4%

# Species Specific Perspective on Day / Night Associations



## *Heterochone caylx* & Rosethorn rockfish

Time	n	<1 m	<1 body length	physical contact
Day	303	11%	1%	0%
Night	530	5%	1%	0%



## Rosselidae & Rockfish, unidentified

Time	n	<1m	<1 body length	physical contact
Day	251	17%	4%	0%
Night	561	22%	4%	1%

# Summary

## 1. Are large invertebrates habitat for fishes?

- Co-occur in same physical habitats
- Low amount of physical contact
- High level of associations <1m

## 2. When are invertebrates important?

- Most fish showed no diel variation in habitat associations
- A few invertebrates showed significant diel differences in number of fishes associated with them
- Day / Night differences largely due to change in fish behavior (e.g. swimming/hovering vs. resting)



Location	Fish Density (no./m <sup>2</sup> )	Coral/Sponge Density (no./m <sup>2</sup> )	% Fish Associated
Alaska (Stone, 2006)	0.2 - 0.3	1-3 (C)	84-99% (C)
(Stone, 2014)	0.06	1.2 (C) & 0.38 (S)	63% (C) & 69% (S)
OCNMS (Wrubel., 2013)	0.06	0.17 (C&S)	18% (C&S)
Heceta Bank	Day 0.5	0.001 (C) & 0.03 (S)	Day 0.1% (C) 7.1% (S)
	Night 0.6		Night 0.4% (C) 16.6%(S)
Southern California	0.5	0.07 (C)	0.30% (C)

## This study is only a snapshot in time

Many other factors may influence fish habitat associations:

- **Predator/prey relationships**
- **Fish life history stage**
- **Size, shape, and density of corals, sponges, or other structure**
- **Fish densities (functional role of corals to fish populations)**





## Conclusions

- Deep-waters corals were rare, but sponges abundant
- Most corals & sponges were small, but most fish associated with larger taxa (*Rossellidae* & *Heterochone calyx*)
- Most fish showed no diel variation in habitat associations
- A few fishes (sharpchin rockfish) showed differences in day/night associations
- Day/night differences largely due to changes in fish behavior (e.g. swimming/hovering vs. resting)

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