



STRUCTURE AND FUNCTIONAL CHARACTERISTICS OF SEAMOUNTS ECOSYSTEMS



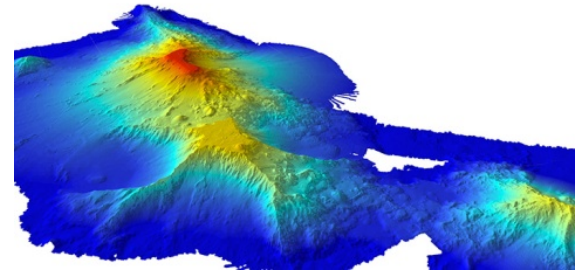
TINA MOLODTSOVA

P.P. SHIRSHOV INSTITUTE OF OCEANOLOGY RAS

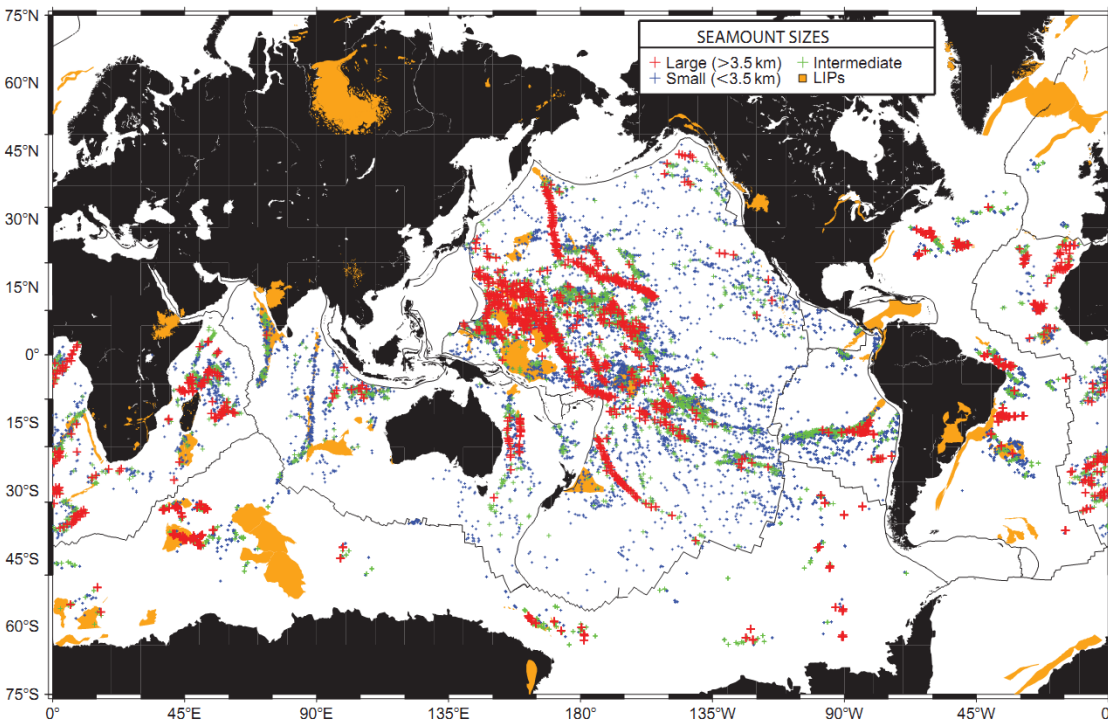


Presentation outline

- General characteristics of seamounts
- Communities distribution at seamounts
- Factors influencing community structure
- Hydrological patterns and productivity
- Communities of seamounts. Benthic-pelagic coupling and trophic structure
- Benthic assemblages of seamounts
- Age and longevity
- Gaps and concerns



Seamount characteristics

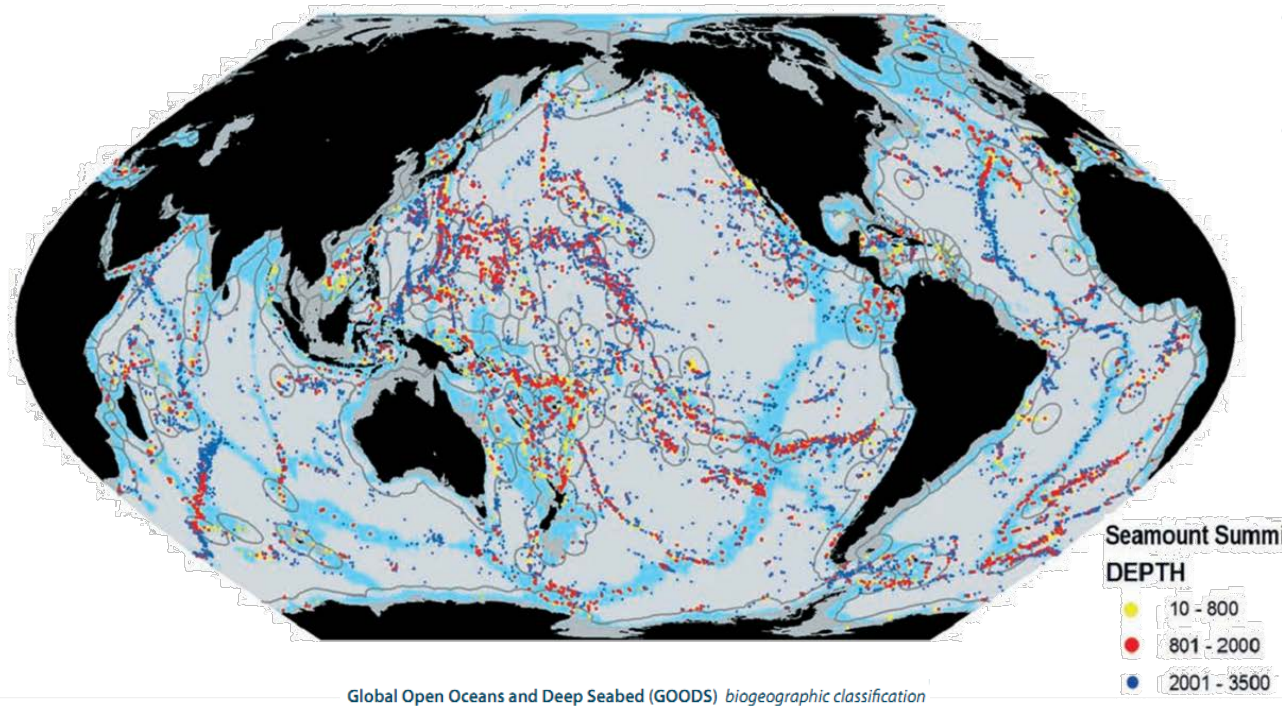


Seamounts: Ecology, Fisheries & Conservation

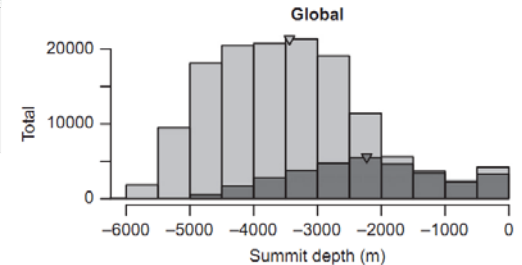
- undersea features with elevation >1000 m above the seafloor
- mostly volcanic in origin
 - island arc seamounts
 - mid-ocean ridge seamounts
 - intraplate seamounts
- Based on 30-arc bathymetry 33452 seamounts
- habitat area ~ 17.2 million km²

Seamount characteristics

- Shallow , medium and deep seamounts
- Mean depth distribution for summits ~2229 m

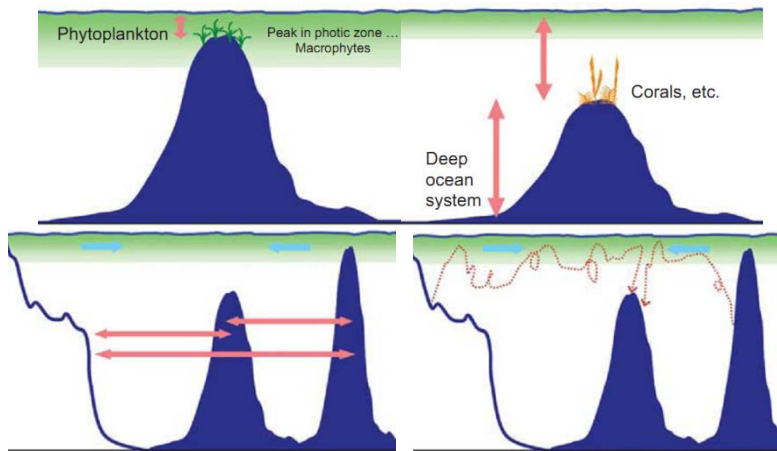
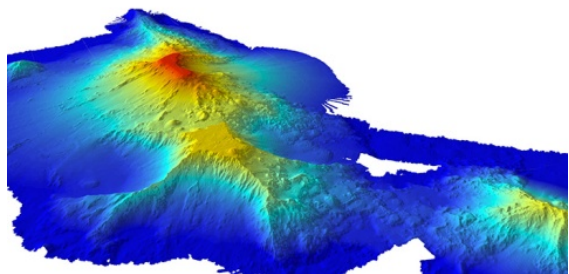


the depth of the summit relative to the sea surface

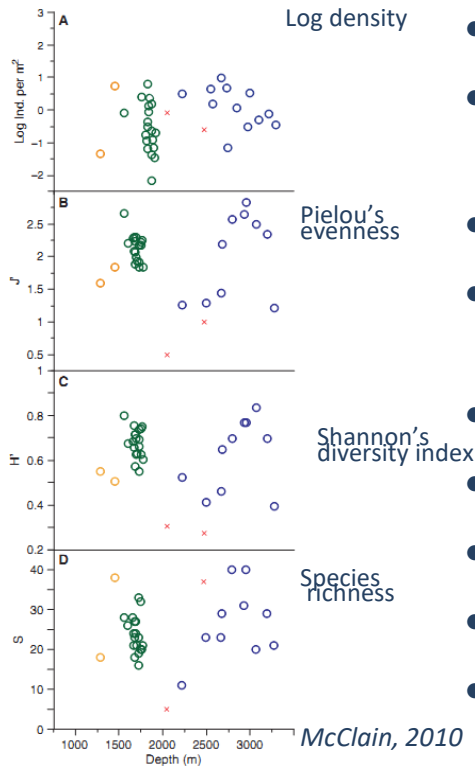


C. Yesson et al. / Deep-Sea Research I 58 (2011) 442–453

Factors influencing community structure

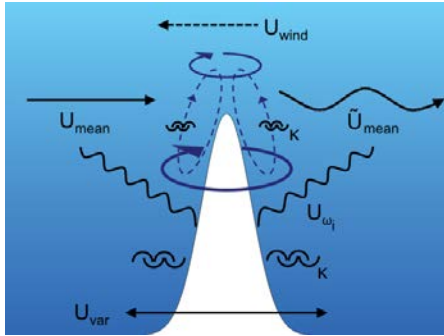


Davidson Seamount

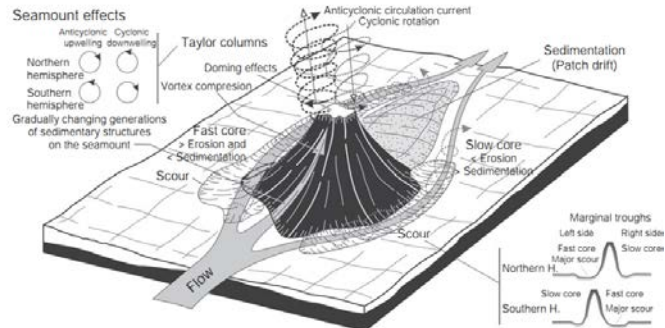


- Geomorphology
- Depth
- Distance from the mainland
- Origin
- Geologic history (sea level change, secondary volcanism)
- Salinity
- Latitude/longitude
- Complex hydrology
- Substratum composition
- Sedimentation patterns

Hydrological patterns



Flow patterns at isolated seamount (NH)
W. Lavelle, C. Mohn, 2010

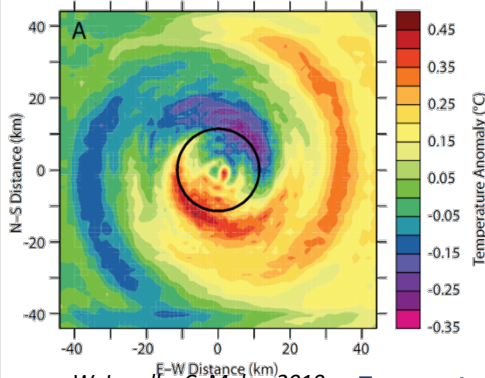


F.J. Hernández-Molina et al.

- influence local and global oceanic hydrological patterns:

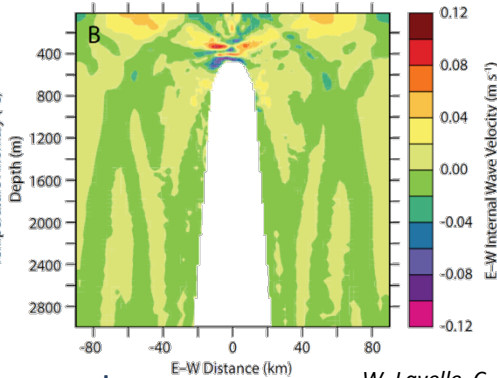
- turbulence
- upwelling
- downwelling
- tidal flows
- Taylor columns
- internal waves
- trapped waves

- in turn influence geomorphology and sedimentation patterns



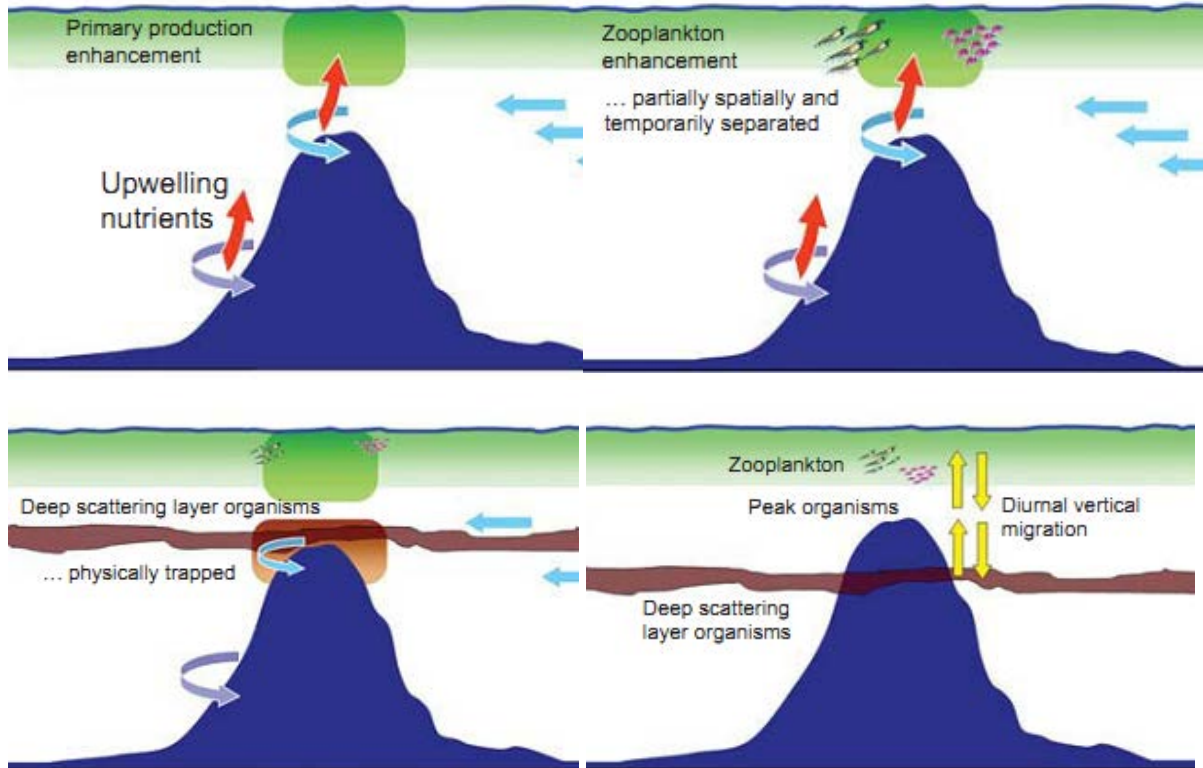
W. Lavelle, C. Mohn, 2010

Temperature anomaly



W. Lavelle, C. Mohn, 2010

Hydrological patterns



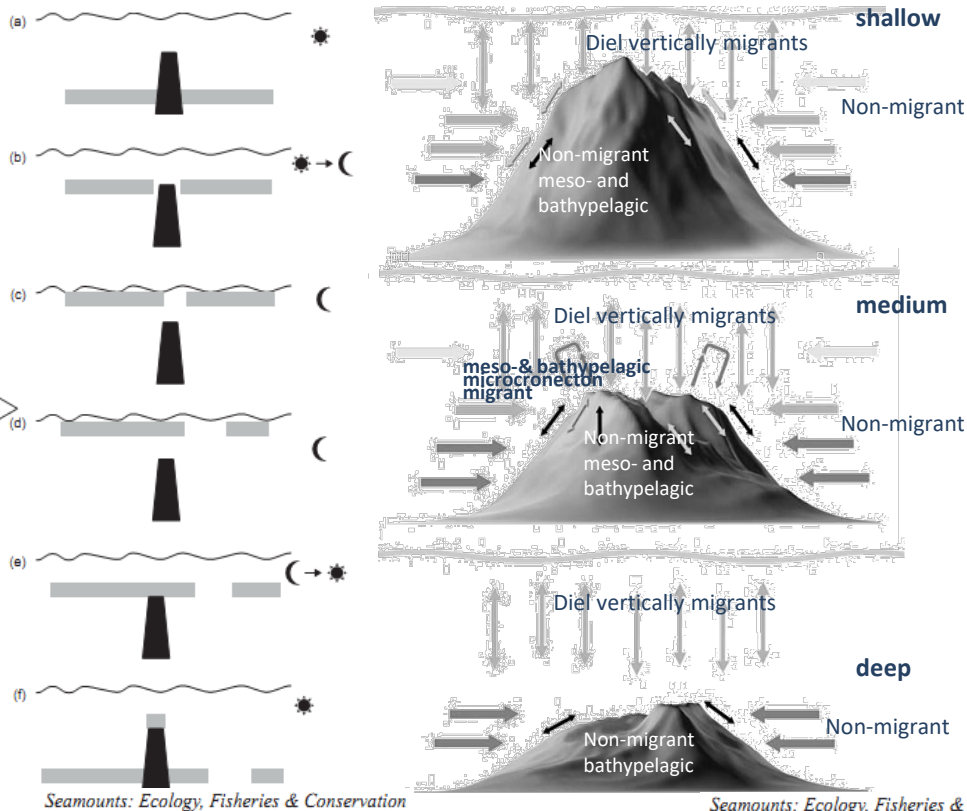
Tony J. Pitcher and Cathy Bulman *Seamounts: Ecology, Fisheries & Conservation*

Hydrological patterns can

- Enhance productivity (productive seamounts <1500 m)
- Play an important role in benthic coupling-pelagic coupling (trapping of DSL)

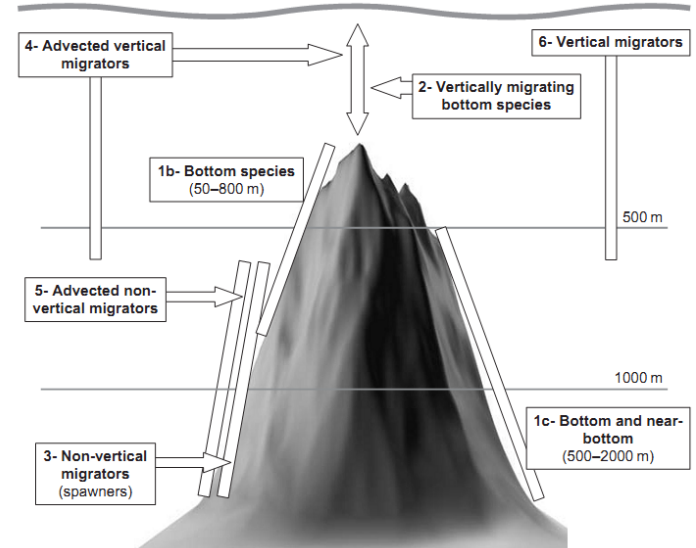
Hydrological patterns

Bottom trapping of vertically migrating zooplankton Interaction between different guilds of deep-sea fish



- DSL trapping affects pelagic and benthic communities

squids

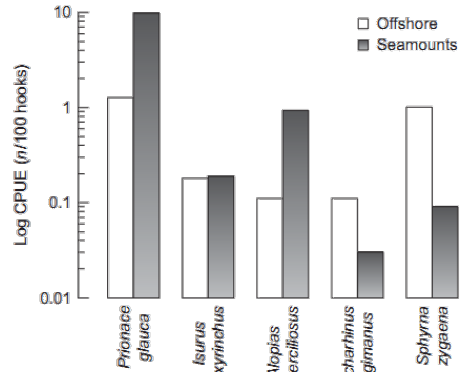


Seamounts: Ecology, Fisheries & Conservation

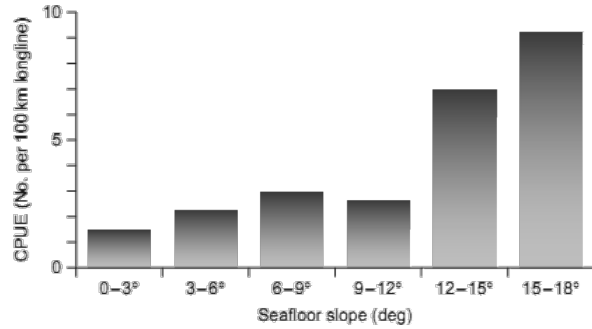
Seamounts: Ecology, Fisheries & Conservation

Hydrological patterns

sharks



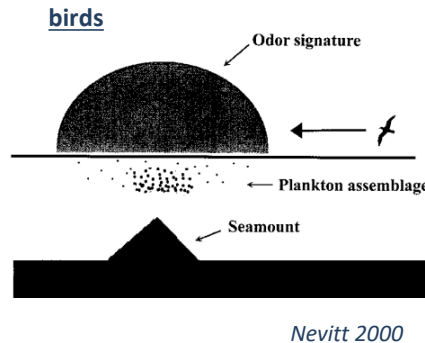
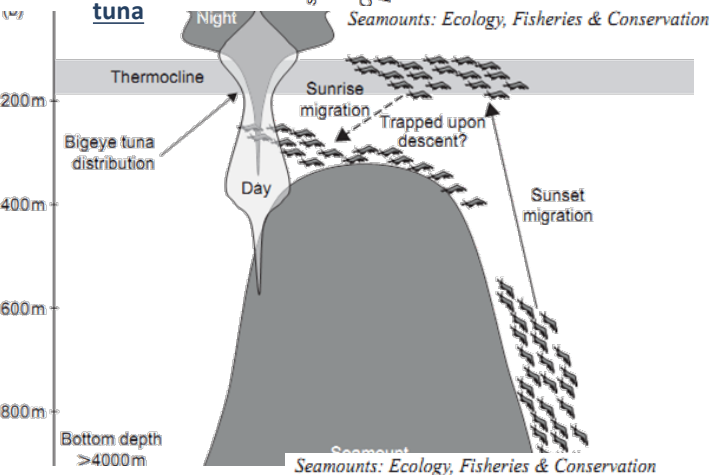
loggerheads



- Attract to seamounts
- highly migratory species
- birds and mammals

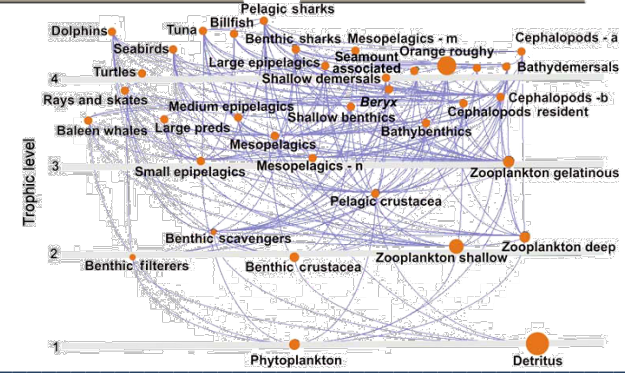
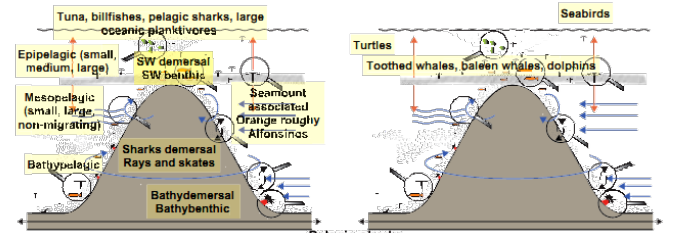
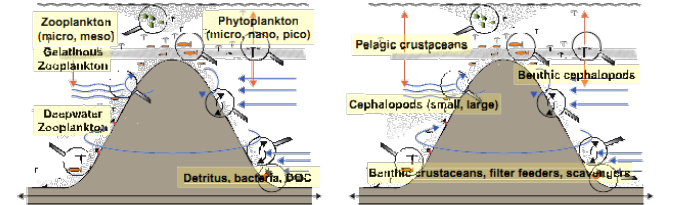
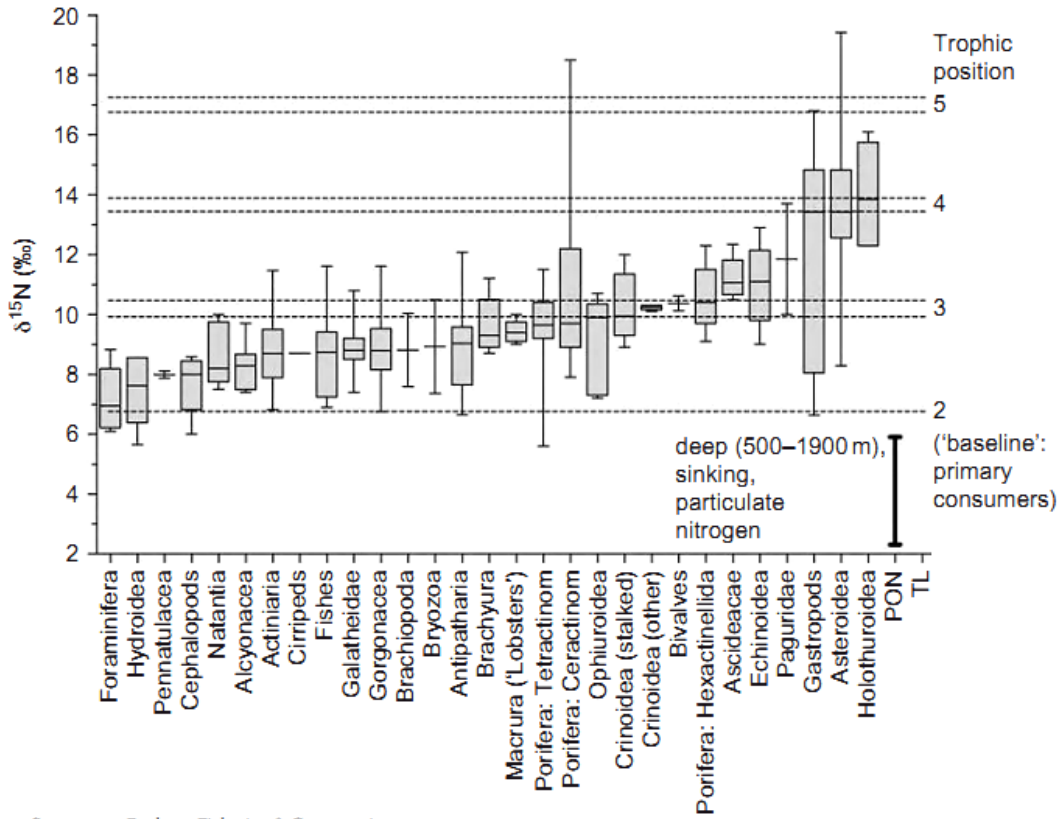
mammals

Species	Geographic region/ seamount	Strength of evidence	Source
Baird's beaked whale	North Pacific	Qualitative observation	Ohsumi (1983), Balcomb (1989), Reeves and Mitchell (1993)
Dall's porpoise	California Current System/Cordell Bank	Quantitative investigation of environment correlates	Yen <i>et al.</i> (2004), Tynan <i>et al.</i> (2005)
Humpback whale	California Current System/Hecate Bank	Quantitative investigation of environment correlates	Tynan <i>et al.</i> (2005)
Short-finned pilot whale	California Current System	Quantitative investigation of environment correlates	Hui (1985)
Common dolphins	California Current System	Quantitative investigation of environment correlates	Hui (1985)
Spinner dolphins	Hawaii	Indirect evidence based on feeding and diurnal tracking of mesopelagic boundary layer	Benoit-Bird and Au (2003)
Southern elephant seals (juveniles)	South Pacific/ De Gerlache Seamounts	Qualitative observation based on tagging data	Bornemann <i>et al.</i> (2000)
Crabeater seals	Antarctic waters near Queen Maud Land	Qualitative observation based on tagging data	Nordoy <i>et al.</i> (1995)



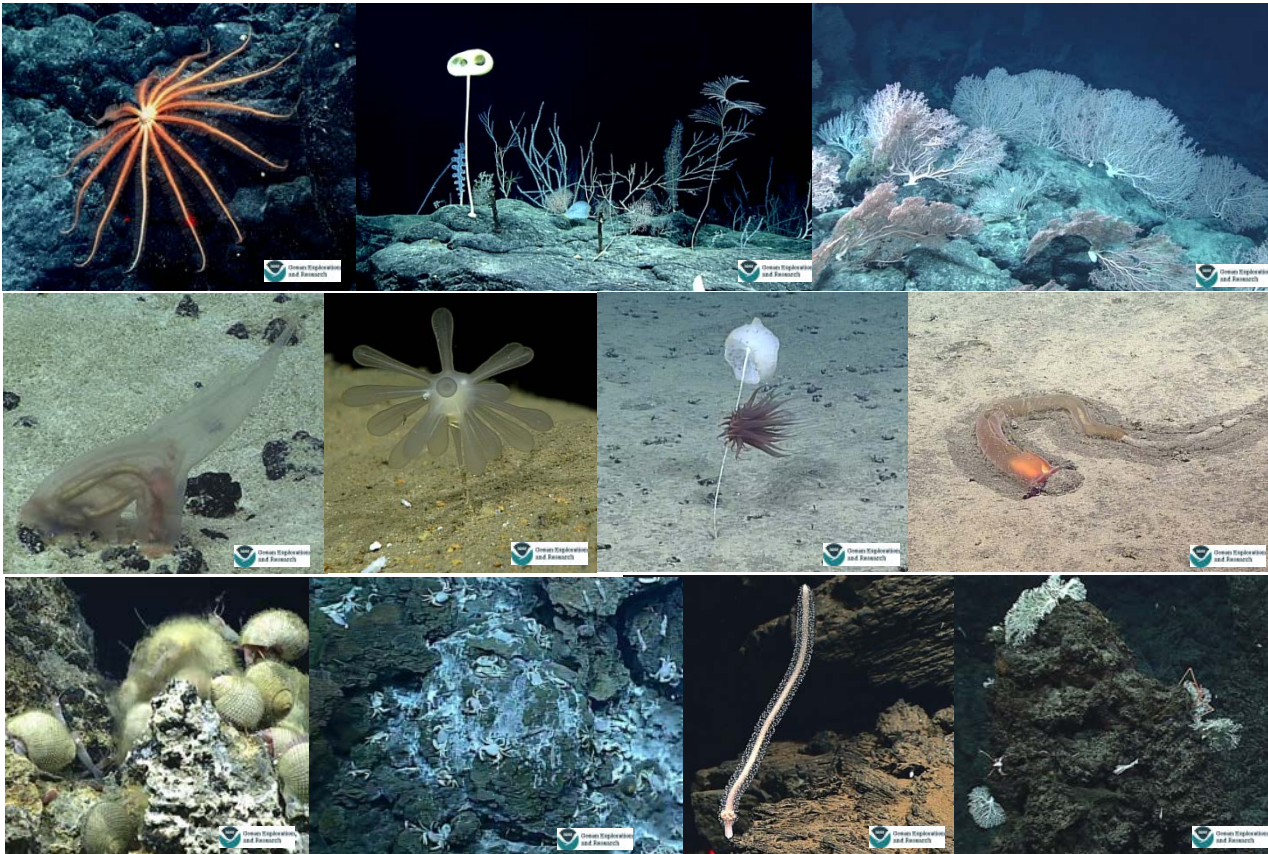
Seamounts: Ecology, Fisheries & Conservation

Trophic structure

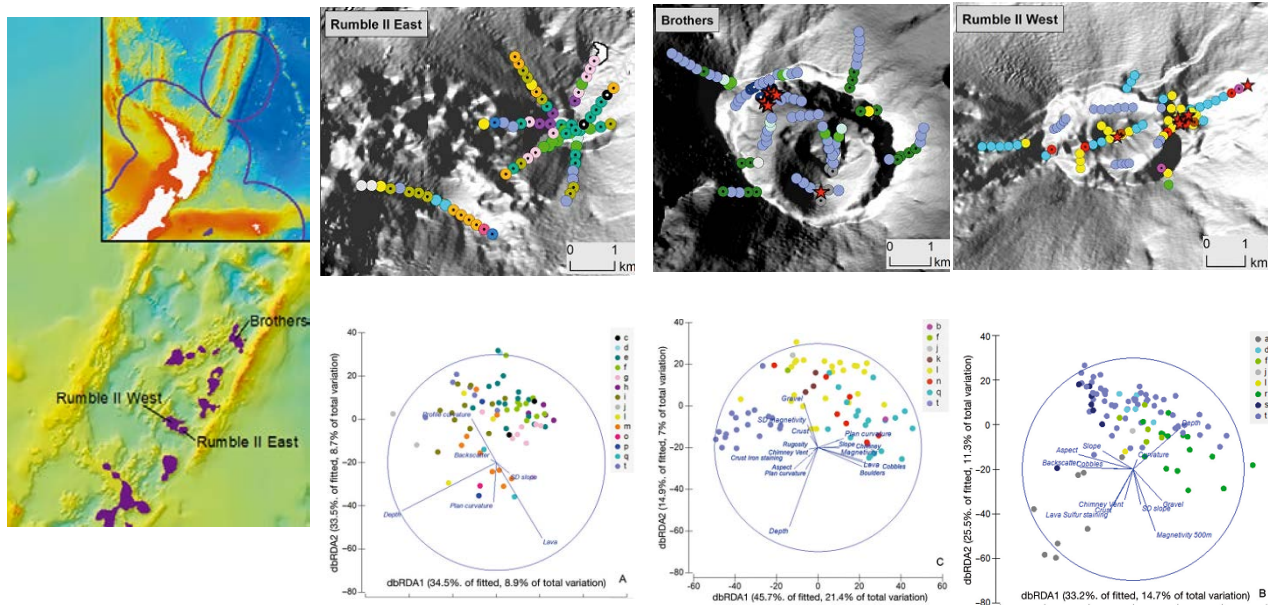


Benthic assemblages

- Hard substrate communities
- Soft sediment communities
 - top of guyots
 - soft-sediment pockets
- Chemosynthetic ecosystems
 - vents
 - peripheral zone



Benthic community structure



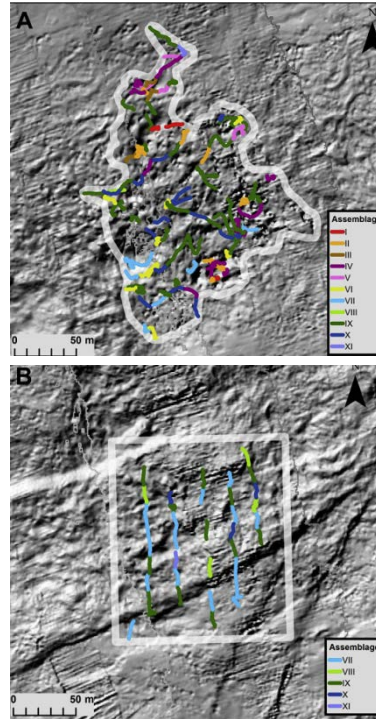
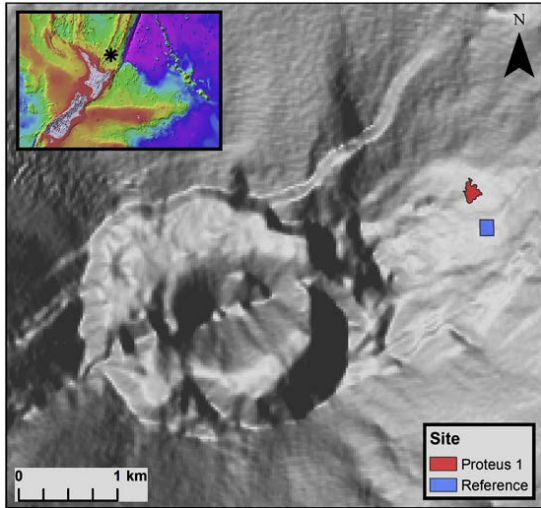
Between seamounts

- Based on video profiling of three NZ seamounts (51 transects)
- 20 assemblages (14, 8, 8), including 13 unique
- only 3 assemblages present in all 3 seamount studied
- 4 assemblages in any 2 of 3 seamount studied

Boschen et al.: Megabenthos of three New Zealand seamounts

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t
RUMBLE II E			x	x	x	x	x	x	x	x		x	x		x	x	x			x
BROTHERS	x			x		x				x	x							x	x	x
RUMBLE II W	x					x				x	x	x		x			x			x

Benthic community structure



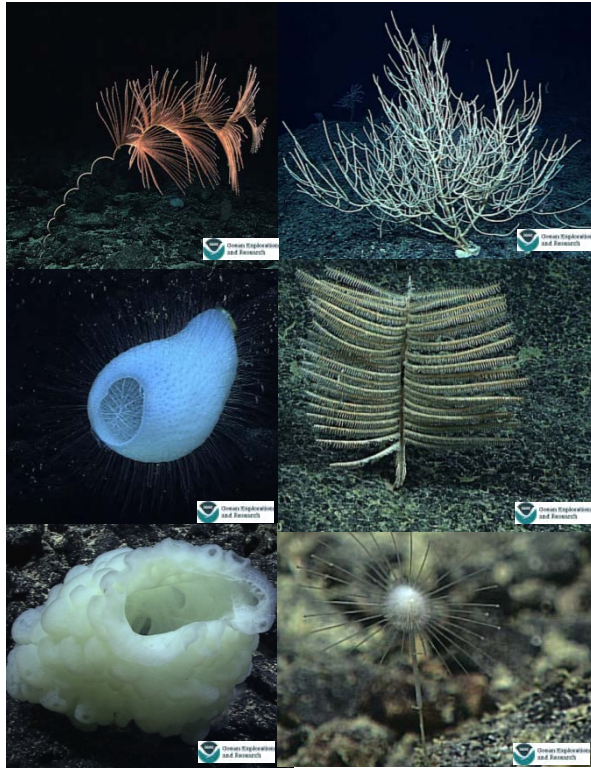
Within seamount

- Two sites studies (Proteus 1 and reference site)
- 42 putative taxa from 152 transects
- 11 assemblages
- 6 assemblages unique for Proteus 1; five for both sites; no unique assemblages for the reference site

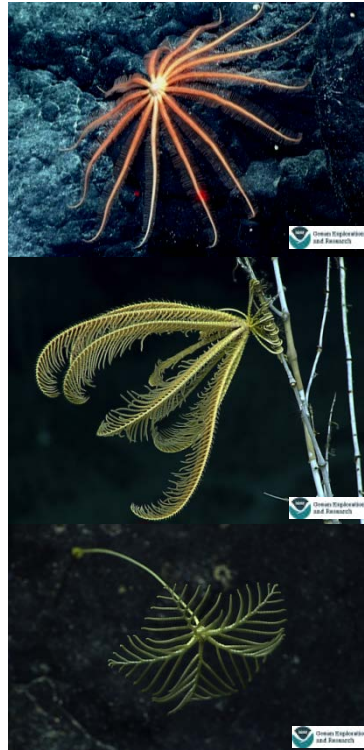
Boschen et al.: Megabenthos of three New Zealand seamounts

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
PROTEUS I	X	X	X	X	X	X	X	X	X	X	X
REFERENCE							X	X	X	X	X

Benthic assemblages

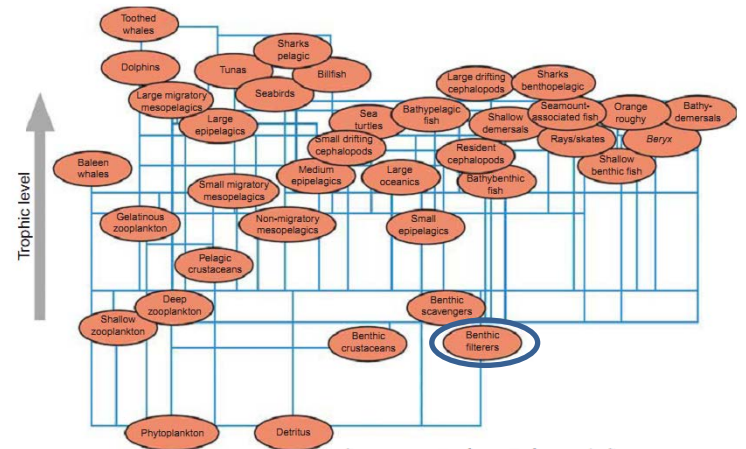


Nevitt 2000



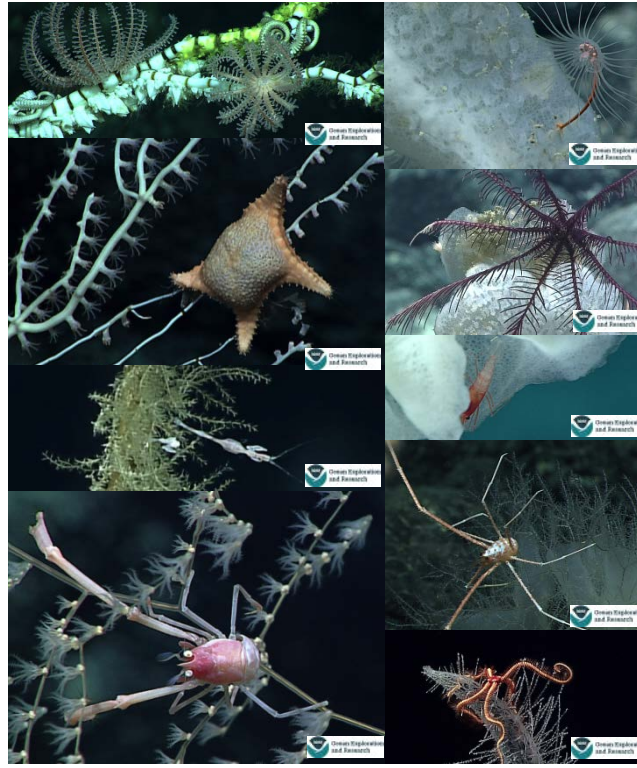
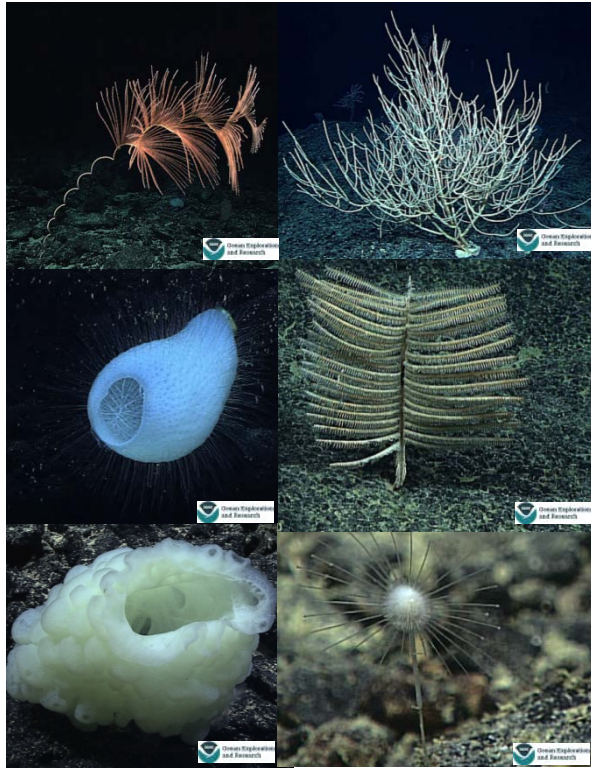
Filter feeders

- Important component of ecosystems
- Play an important role in benthic coupling-pelagic coupling



Seamounts: Ecology, Fisheries & Conservation

Benthic assemblages



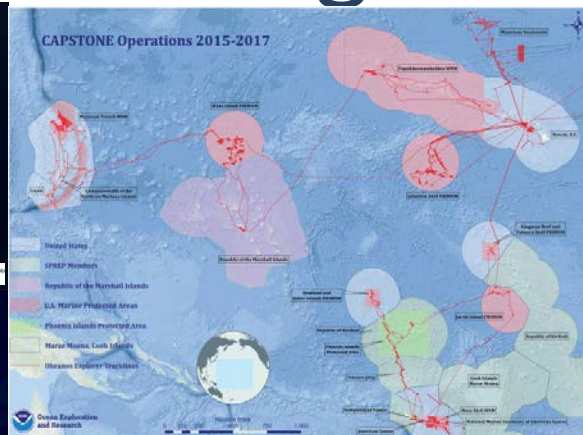
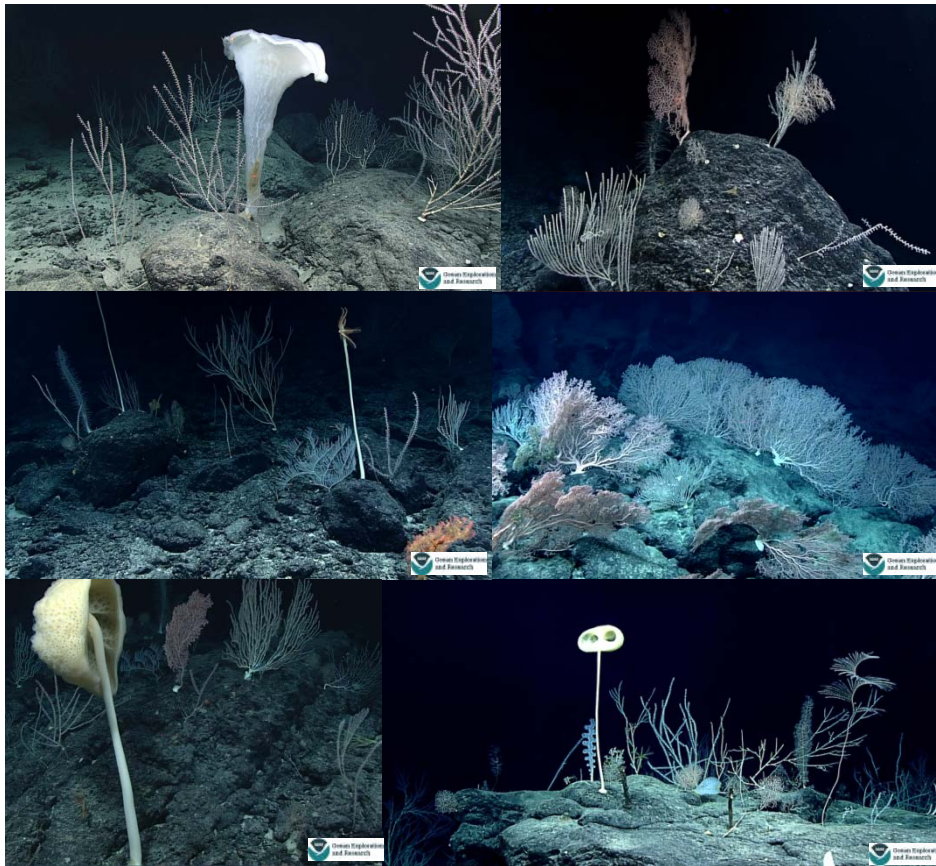
Filter feeders

- Important component of ecosystems
- Play an important role in benthic coupling-pelagic coupling

Sponge and corals

- Habitat-forming organisms enhancing biodiversity
- Host reach associated fauna
- May play a crucial role as a refuge, feeding ground and nursery for fish and invertebrates

Benthic assemblages



CAPSTONE at a Glance

-  over 635,000 km² of seafloor mapped
-  333 primary biological & 278 geological samples collected
-  187 ROV dives at a depth range of 250 - 6,000 meters
-  over 260 participating scientists, students, and managers
-  8.4 million live video views via YouTube and over 8 million additional live video views via other outlets such as Facebook

Known High Density Mn-Crust Communities By the End of CAPSTONE

Region	Location	Known Prior to CAPSTONE	Found During CAPSTONE	Total
Central Pacific	PMNM	3	7	28
	PRIMNM-Johnston	0	5	
	MHI	0	2	
	Musicians	0	11	
South Pacific	Am Samoa	0	3	11
	PRIMNM-Howland&Baker	0	1	
	PRIMNM-Jarvis	0	1	
	PRIMNM-Palmya&Kingman	0	0	
West Pacific	PIPA	0	5	7
	Marianas	0	3	
	PRIMNM-Wake	0	4	
Total		3	43	46

Seamount sponges and corals

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SENCKENBERG

OCEANARIUM



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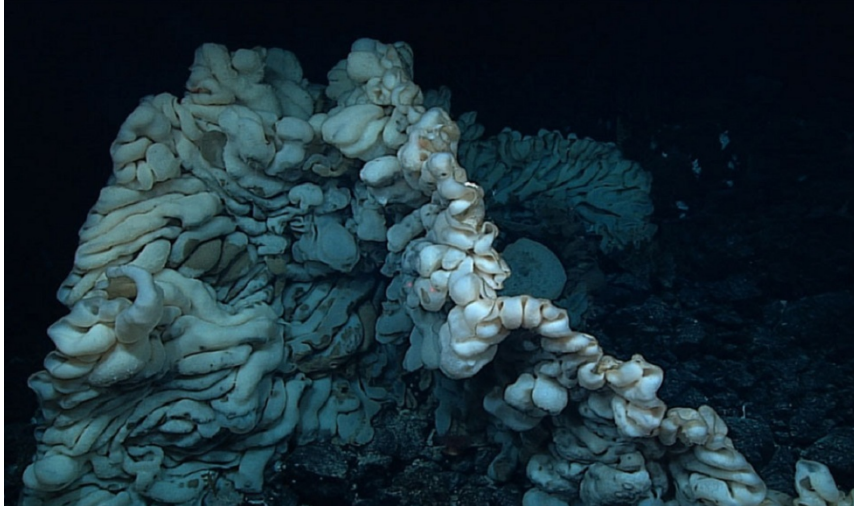
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The largest sponge in the world?

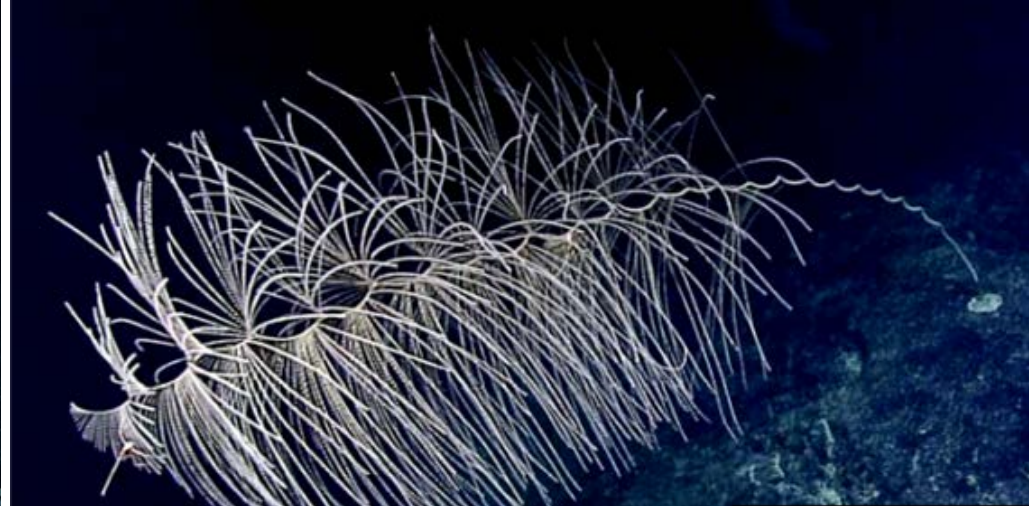
Daniel Wagner¹ · Christopher D. Kelley²



Rossellidae (Lanuginellinae) 3.5 x 2.0 x. 1.5 m
(Hawaii, Papahānaumokuākea MNM)

The World's largest known Gorgonian

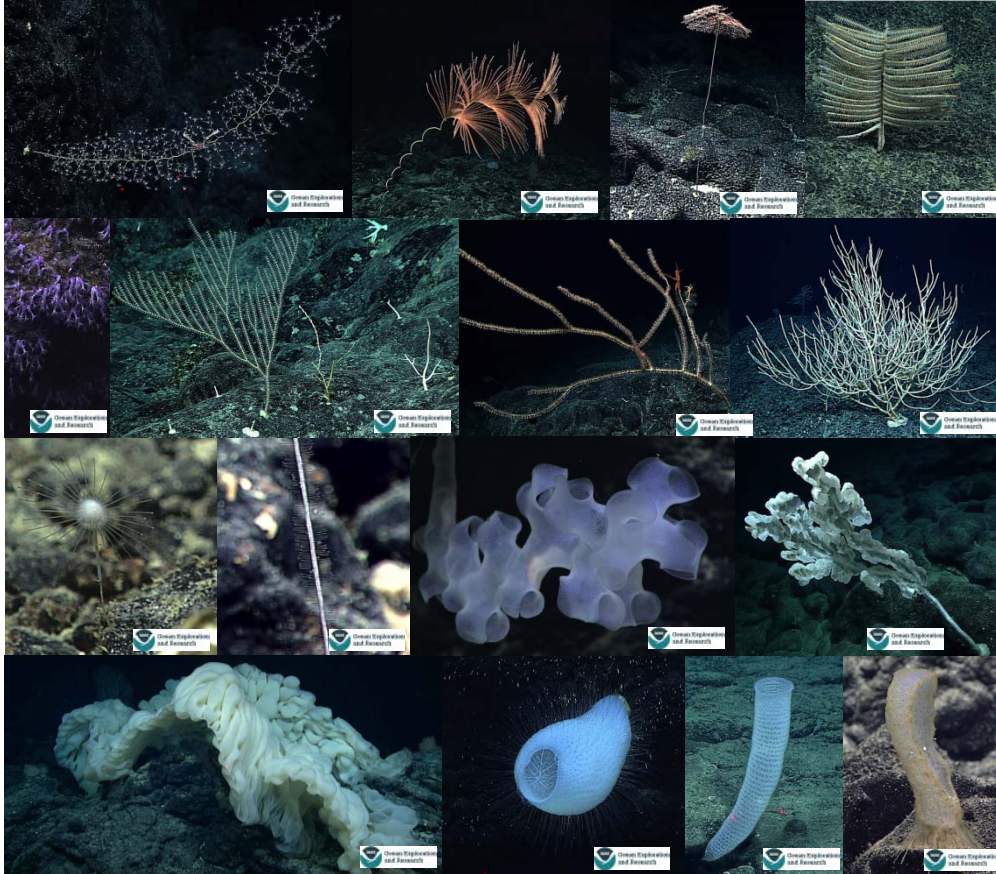
LES WATLING¹, SONIA ROWLEY^{1,2} & JOHN GUINOTTE³



Iridogorgia magnispiralis 5.7 m tall
(Hawaii, Twin Banks)

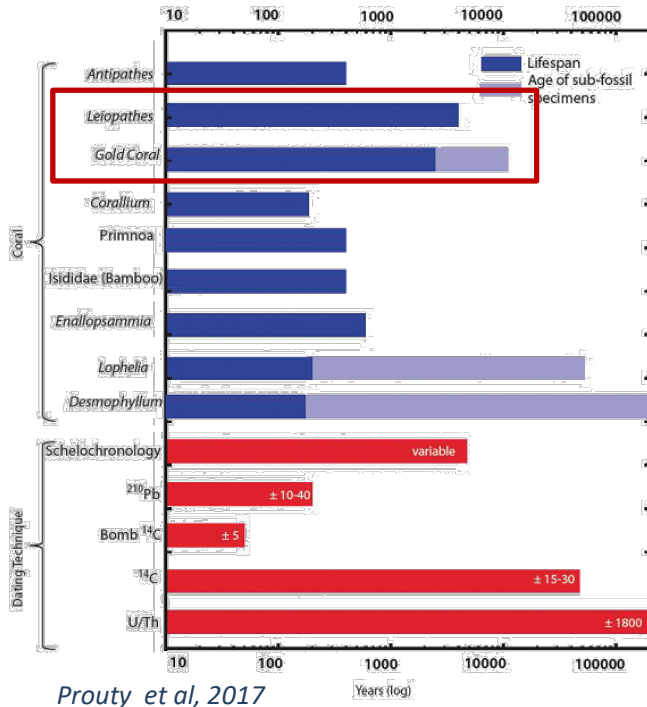
Seamount sponges and corals

- Characteristic seamount taxa present
- Patchy distribution.
- Density increases at the ridges and crests. Highly affected by hydrology

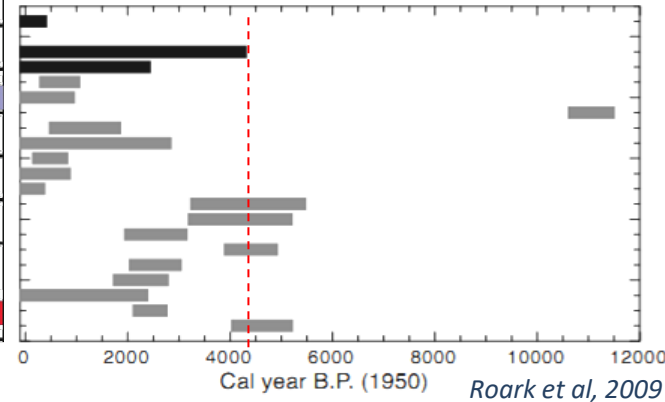


Seamount sponges and corals

Maximum lifespan of several key deep-sea corals



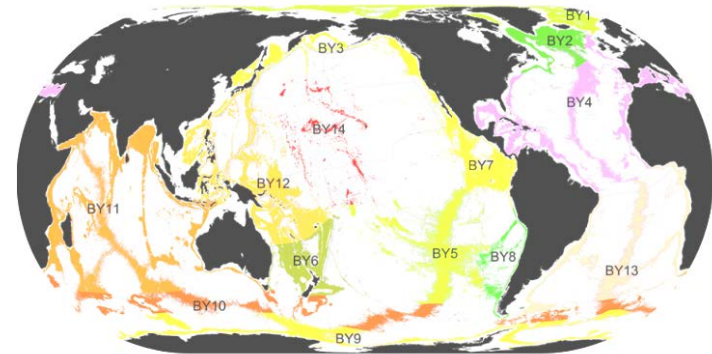
Life spans of *Gerardia* sp. and *Leiopathes* during the Holocene.



- Characteristic seamount taxa present
- Patchy distribution.
- Density increases at the ridges and crests. Highly affected by hydrology
- Predominantly long-living and slowly growing
- Estimations of recovery rates: decades and hundreds of years
- Vulnerable to any anthropogenic impact

Gaps and concerns

- Predictive models of distribution and biogeography are based on abiotic factors
- Limited sampling
 - number of seamounts sampled
 - depth range covered
 - size classes included (<10 cm is usually neglected)
- Lack/ incomparability of sufficient taxonomical expertise
- Limited data on individual taxa
 - life cycles,
 - larval dispersal,
 - connectivity,
 - gene flow



L. Watling et al./Progress in Oceanography 111 (2013) 91–112

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T. Morato (IMAR)



Hawai'i Undersea
Research Laboratory



Ocean Exploration
and Research

Okeanos Explorer