Aspects of the Biology and Ecology of *Lophelia pertusa* in the Northern Gulf of Mexico

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Objectives

- Assess the distribution and abundance of *L. pertusa* and other benthic cnidarians* at each study site.
- Identify biotic and non-biotic factors that may influence the distribution of *L. pertusa*.
- Investigate aspects of *L. pertusa* biology.

* Included gorgonians, black corals and soft corals

Studies Used to Address Objectives

Assess the distribution and abundance of *L. pertusa* and other benthic cnidarians at each study site

- Video transects to determine percent cover of *L. pertusa* and abundance of other benthic cnidarians.

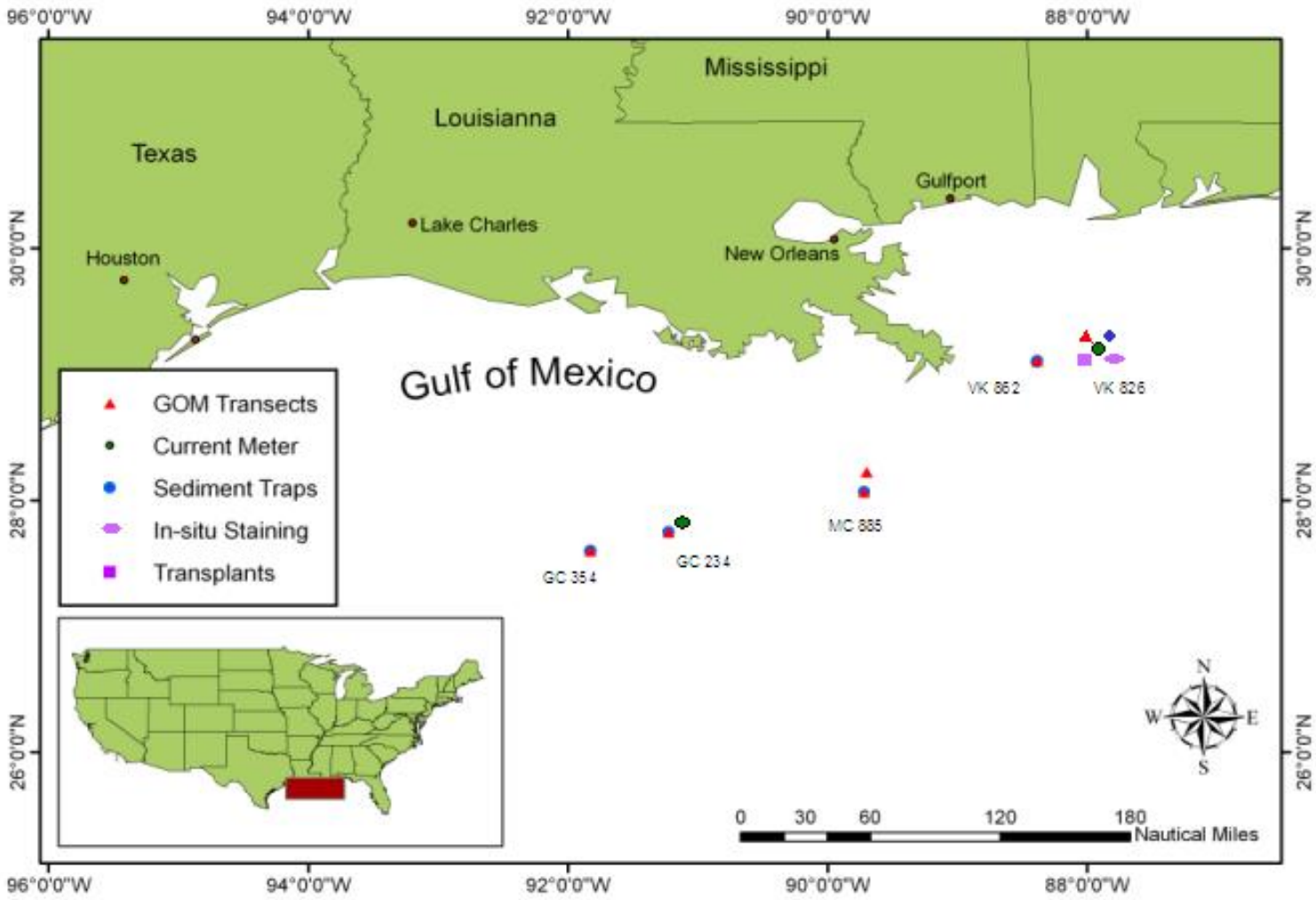
Identify biotic and non-biotic factors that may influence the distribution of *L. pertusa*

- Sediment flux and zooplankton availability
- *L. pertusa* reciprocal transplant study
- *L. pertusa in situ* growth
- Temperature tolerance of *L. pertusa*
- Sediment tolerance of *L. pertusa*
- Feeding experiments with *L. pertusa*

Describe reproductive biology of *L. pertusa*

- Gametogenesis in *L. pertusa*

Study Sites

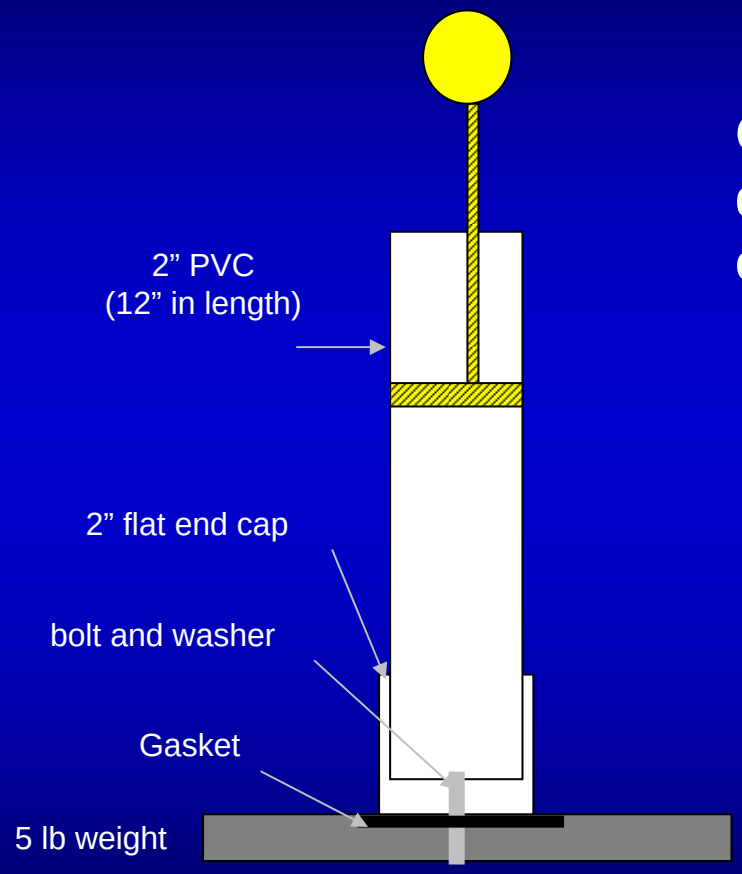

96°0'0"W
94°0'0"W
92°0'0"W
90°0'0"W
88°0'0"W
30°0'0"N
28°0'0"N
26°0'0"N
Mississippi
Louisianna
Texas
Gulfport
Lake Charles
Houston
New Orleans
Gulf of Mexico
VK 862
VK 826
MC 885
GC 234
GC 354
GOM Transects
Current Meter
Sediment Traps
In-situ Staining
Transplants
N
W
E
S
0
30
60
120
180
Nautical Miles

Methods

Video transects

- Multiple parallel along-slope video transects, 100m in length, were taken at each site
- Parallel lasers (25cm apart) were used to maintain distance above the substrate
- Time, depth, temperature and salinity were recorded constantly
- Sequential images were extracted from the video footage and used to determine percent cover of *L. pertusa,* and abundance of other benthic cnidarians

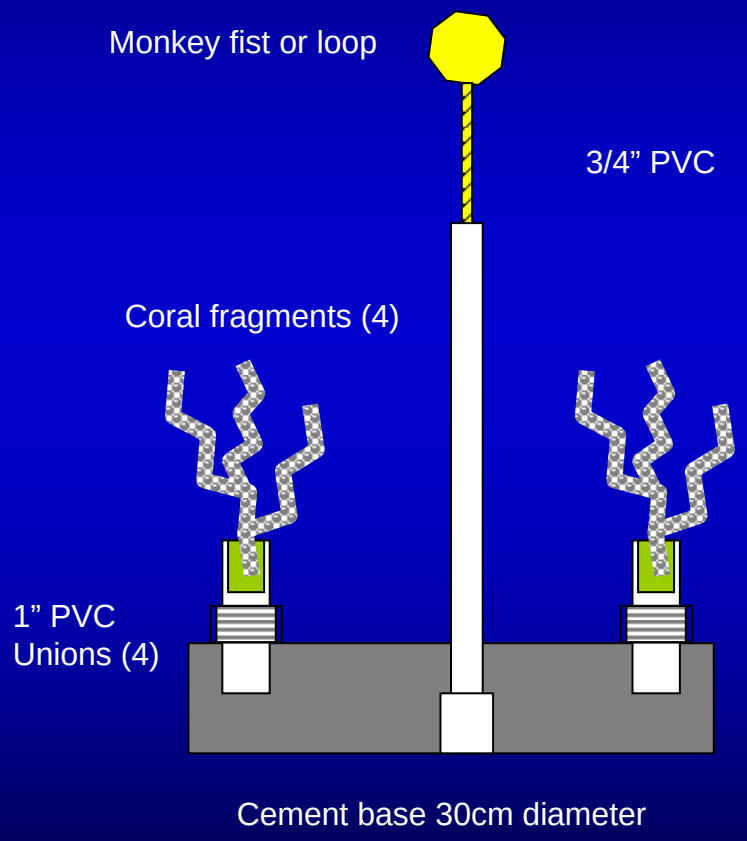
Sediment Flux and Zooplankton Availability



Comparison of sediment and zooplankton deposition between sites, and within high coral versus no coral areas at alpha sites

Site	Deployed	Recovered
VK826	6HC 6NC	5HC 3NC
GC234	3HC 3NC	3HC 3NC
GC354	3HC 3NC	3HC
VK862	6NC	3NC
MC885	3NC	

L. pertusa Reciprocal Transplant and *in situ* Growth

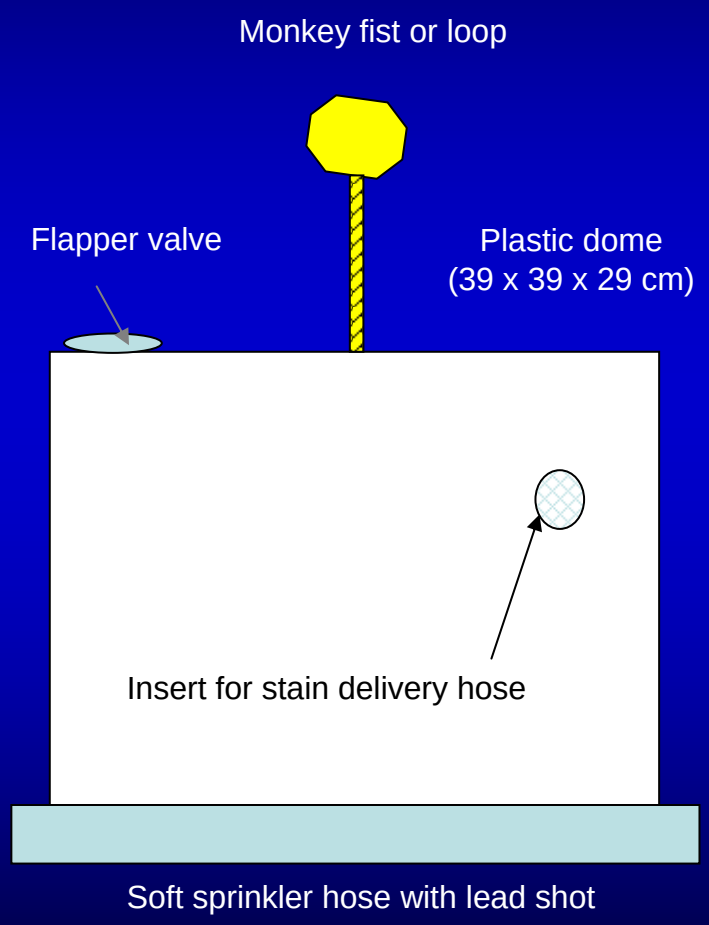


Objective:

Comparison of survival and growth of coral fragments transplanted into bare substrate areas at VK826. Control transplants were also placed within the high coral areas.

Four transplant discs, each with four coral fragments, stained with 10ppm alizarin for 48 hours were placed within a high coral area and another set on bare substrate in the same region.

L. pertusa in situ Growth

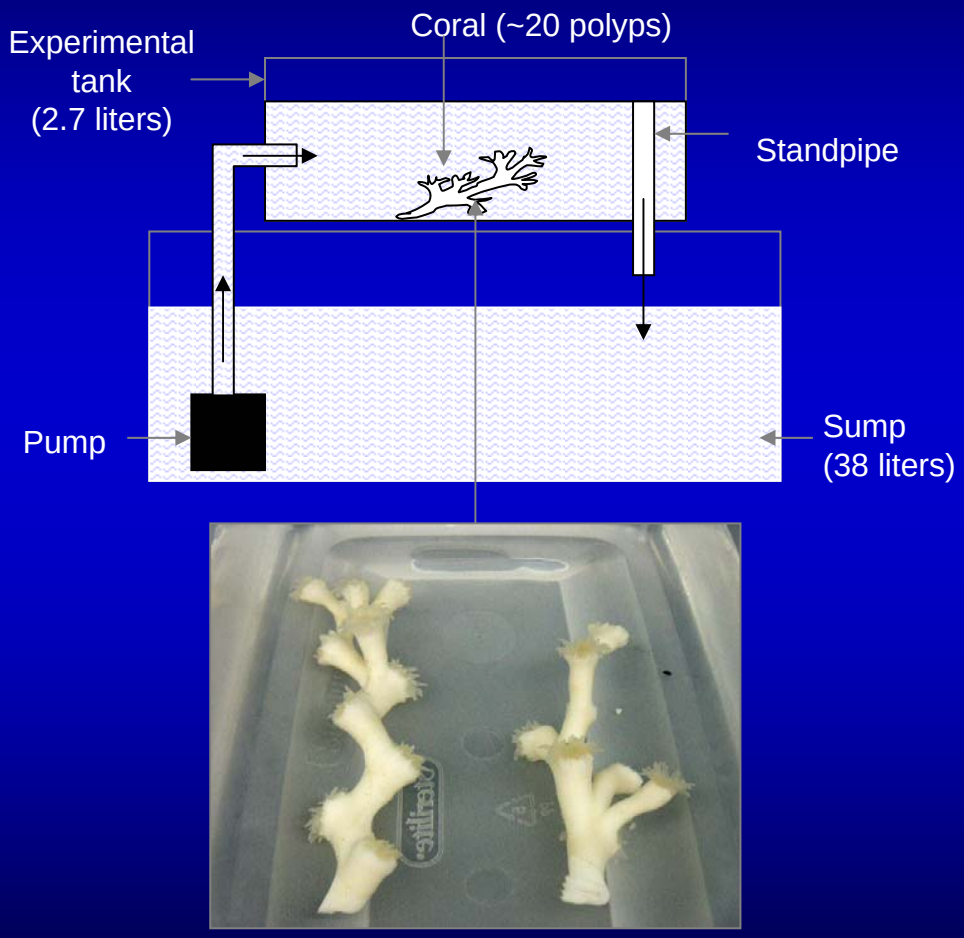


Objective:

Estimate *in situ* growth of small-coral colonies for comparison with the transplant growth rates.

Two small colonies at VK826 were stained for 48 hours *in situ* and collected during the following cruise in 2005.

Temperature Tolerance of *L. pertusa*

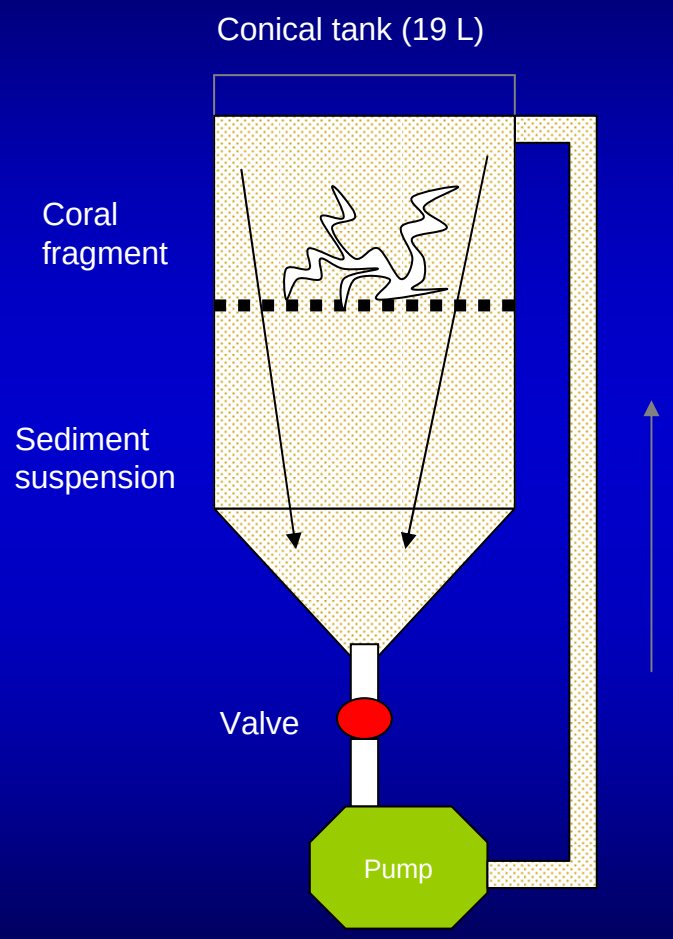


Objective:

Determine the upper limits of short term (24 hours) and long term (7 days) temperature tolerance of *L. pertusa.*

Treatment temperatures:
5°C, 10°C, 15°C, 20°C, 25°C

Sediment Tolerance of *L. pertusa*

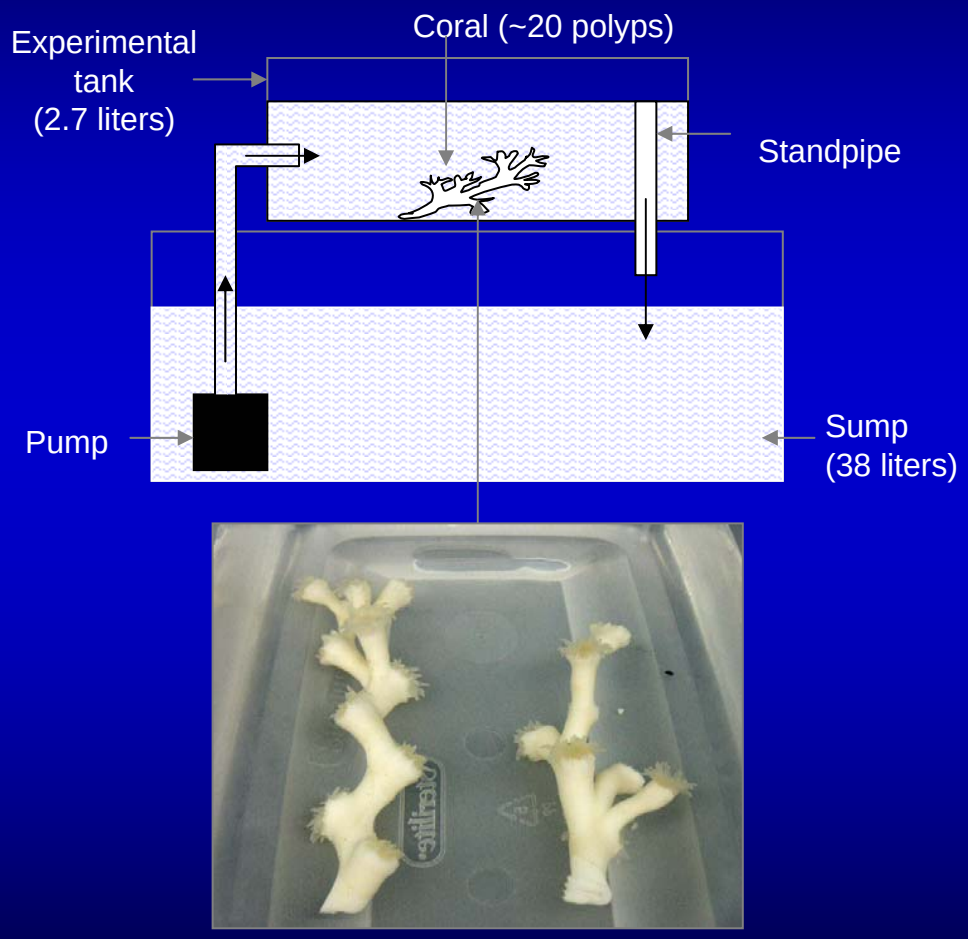


Objective:

Determine the upper limits of *L. pertusa* tolerance to suspended Gulf of Mexico sediments over a 14-day period.

Fragments were also completely buried for 1, 2, 4, 7 days and post-burial survival measured.

Feeding Experiments with *L. pertusa*



Objective:

Investigate the effect of different feeding rates on the survival, calcification rate, and lipid content of *L. pertusa* fragments .

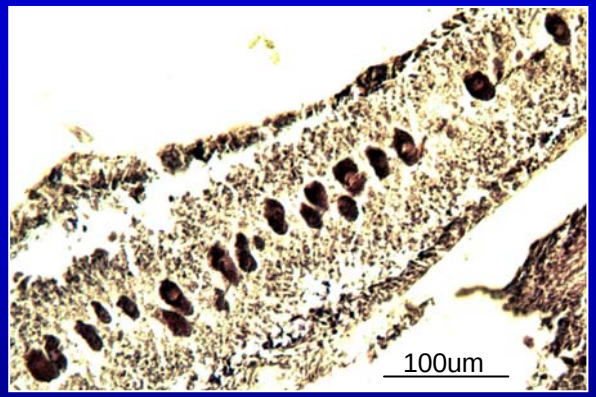
Treatments:

One food ration every 2, 4, 6, 8 days plus unfed treatment. Experiment lasted 30 days. Then fragments assessed for survival and sacrificed for lipid analysis and buoyant weight measurement.

L. pertusa Gametogenesis

Multiple small fragments from different colonies were sampled during both cruises and fixed in 5% Formalin. Samples were decalcified and processed using standard histological techniques. Oocyte diameter was measured for 100 oocytes per fragment

November



July

September

nucleolus

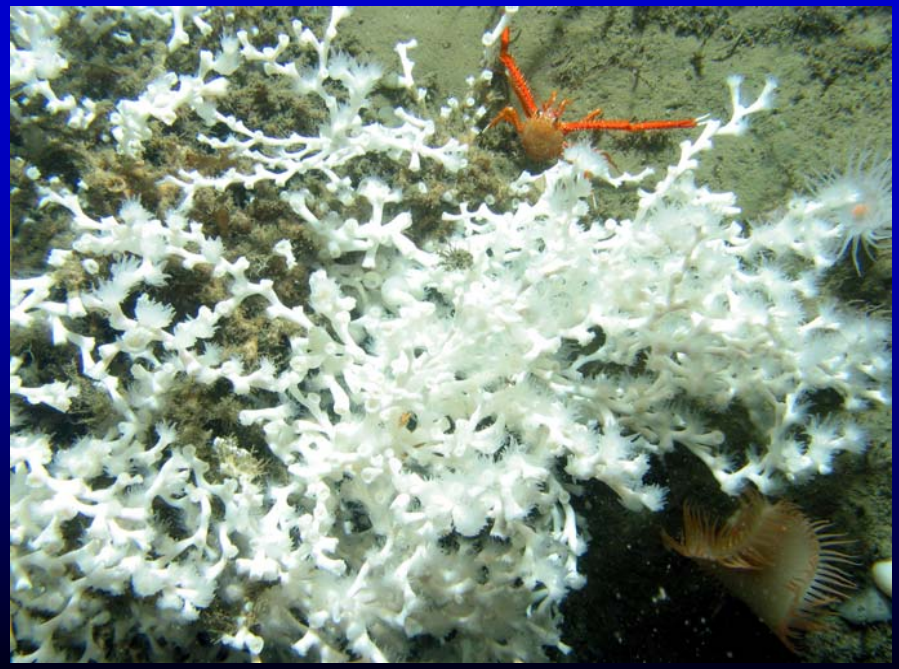
Results

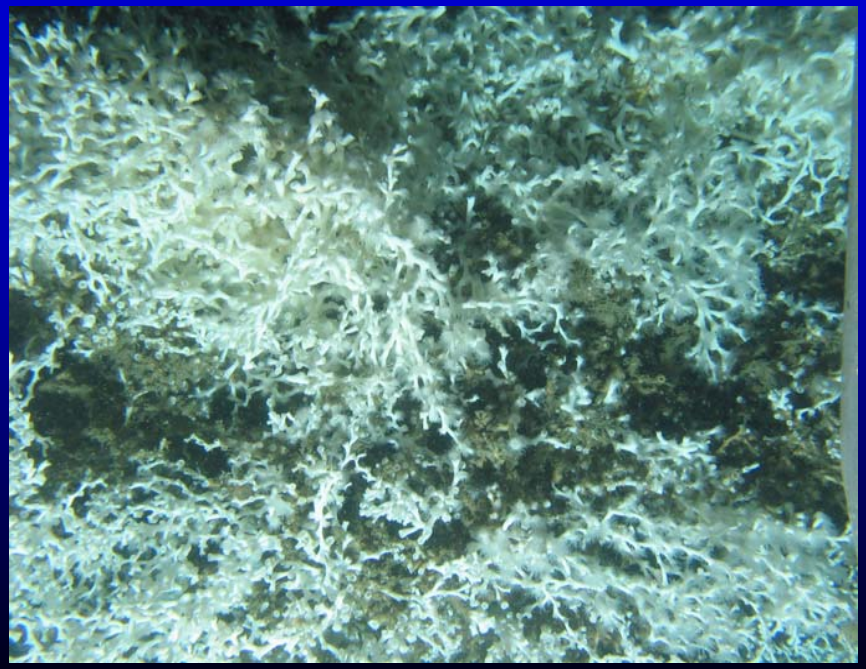
Description of Transects at ‘Alpha’ Sites

Site	Number of transects	Total Area (m^2)	Average depth (m) (SD)	Average temp (^oC) (SD)	% Live coral (SD)	% Dead coral (SD)
VK826	16	2900	465 (8.93)	8.8 (0.45)	13.3 (11.86)	21.8 (14.24)
GC234	3	1900	504 (3.5)	8.0 (0.23)	0.8 (0.84)	31.8 (25.17)
GC354	3	1830	525 (1.49)	8.0 (0.24)	1.9 (2.31)	50.0 (1.76)

18:50:35 09-12-05
DEPTH TEMP SALIN
1506FT 35.0

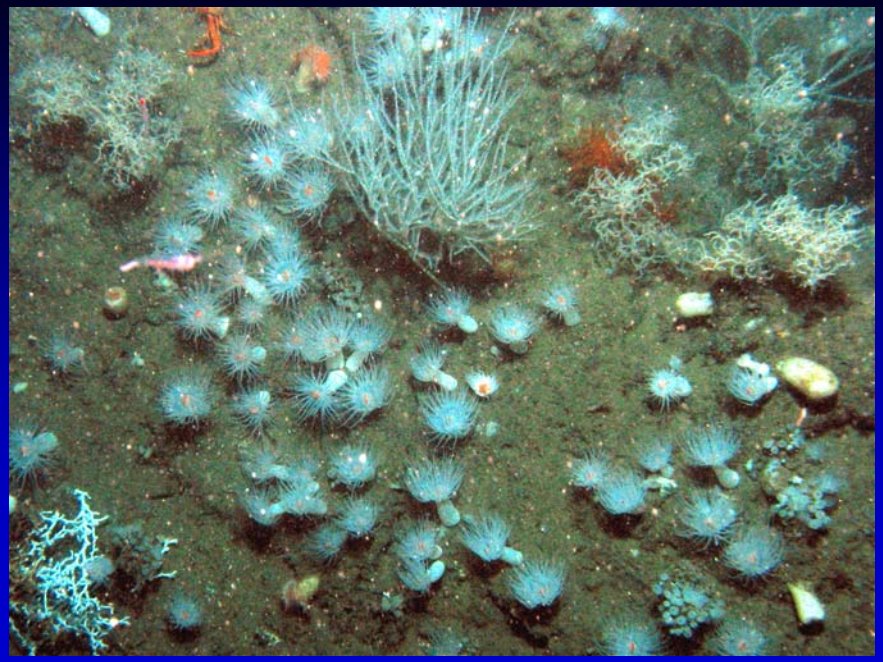
18:51:42 09-12-05
DEPTH TEMP SALIN
1503FT 08.6C 35.0

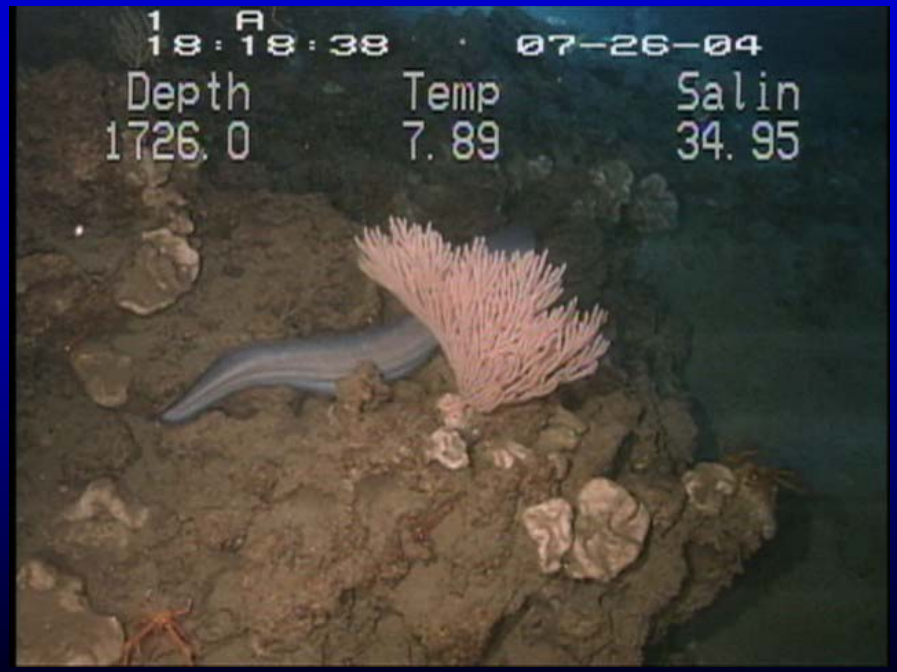




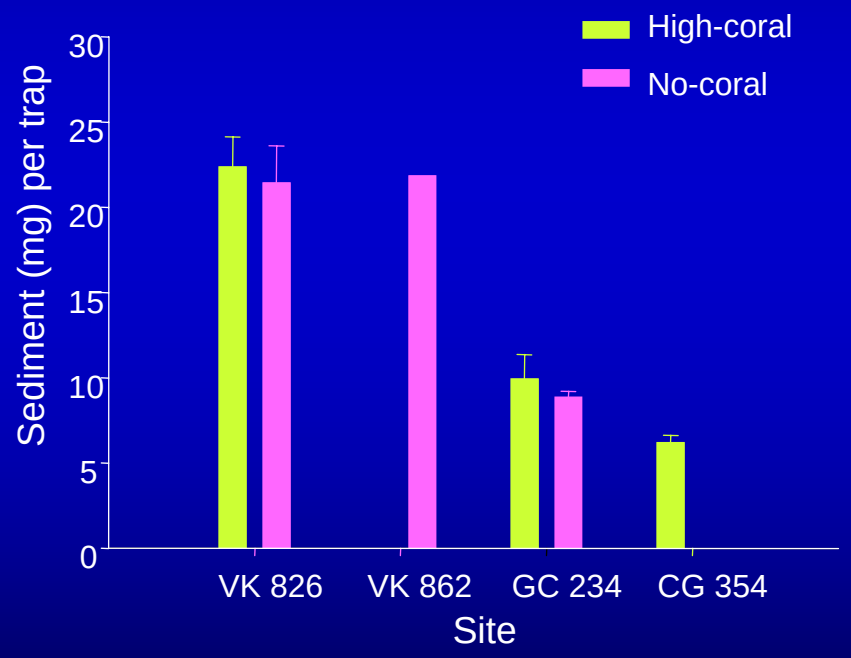
Description of Beta (β) Sites

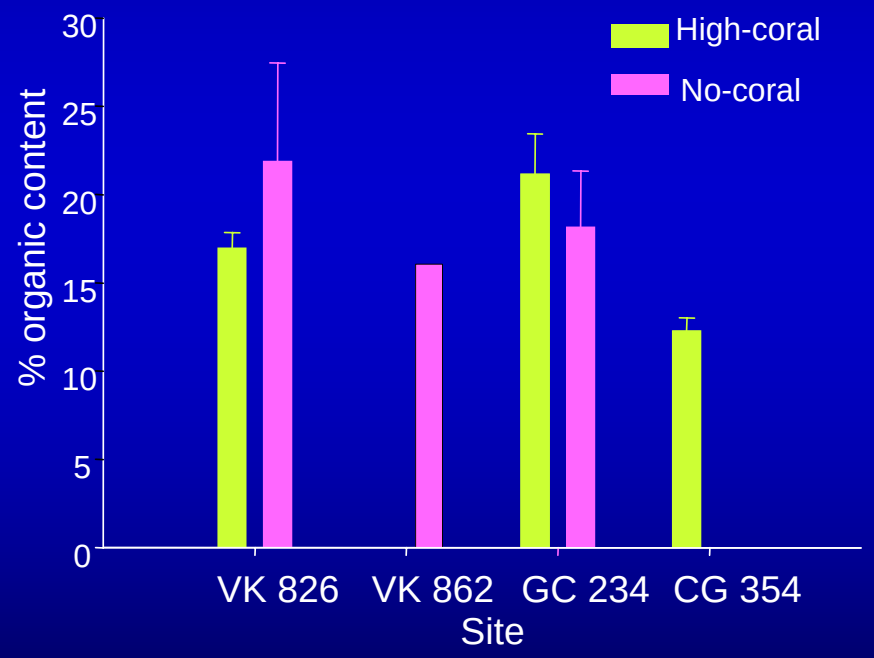
Site	Number of transects	Average depth (m)	Average temp (^{o}C)	Site comments
VK862	5	312	11.5	Highest anthozoan diversity of all sites. Isolated *L. pertusa* colonies. Dominated by unidentified anemones (up to 24 m^{-2})
MC885	4	632	7.3	Mostly soft sediment but with patches of large *Callogorgia americana delta.* Some seepage communities
GC184/185	0	540	8.0	Ridge feature with some dead *L. pertusa*. Large *C. americana delta.* Active seepage communities



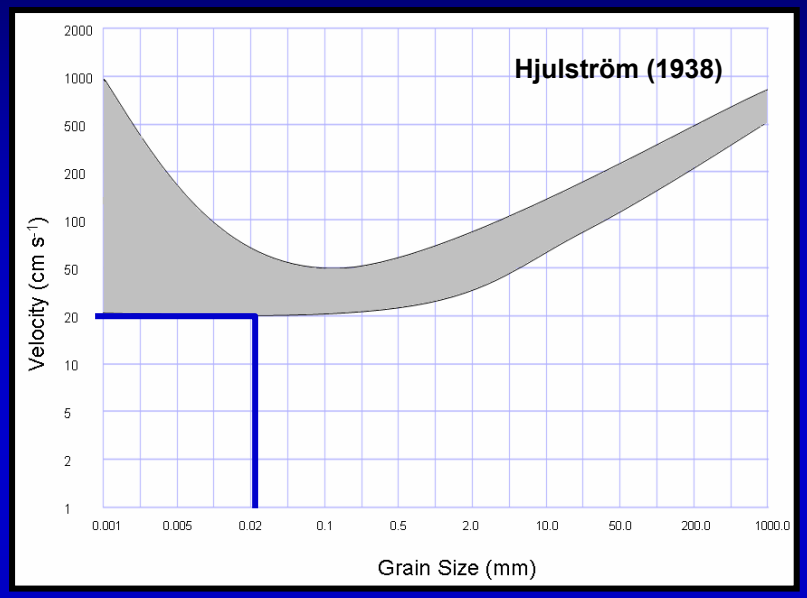

1 A
18:18:38 07-26-04
Depth
1726.0
Temp
7.89
Salin
34.95

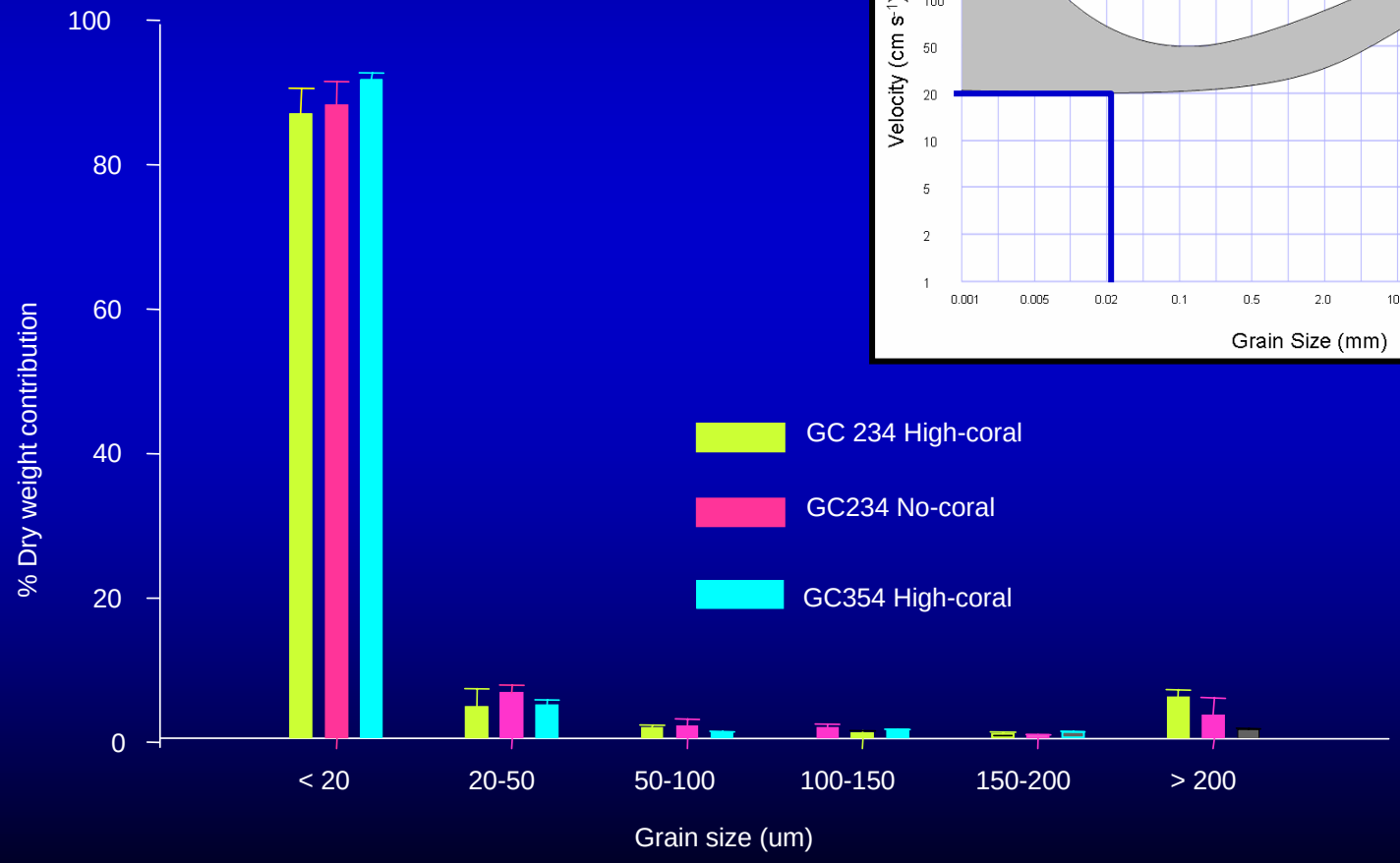
Sediment Deposition and Organic Content



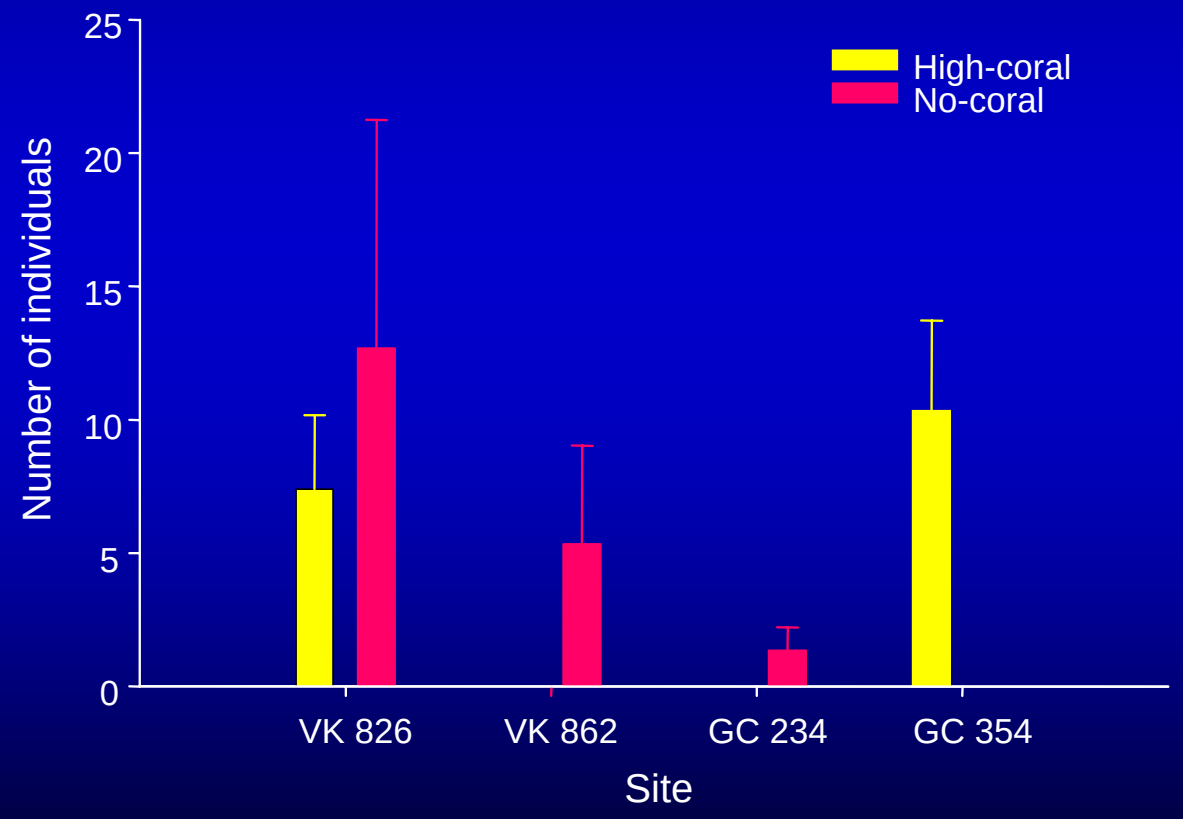


Sediment Grain Size Analysis

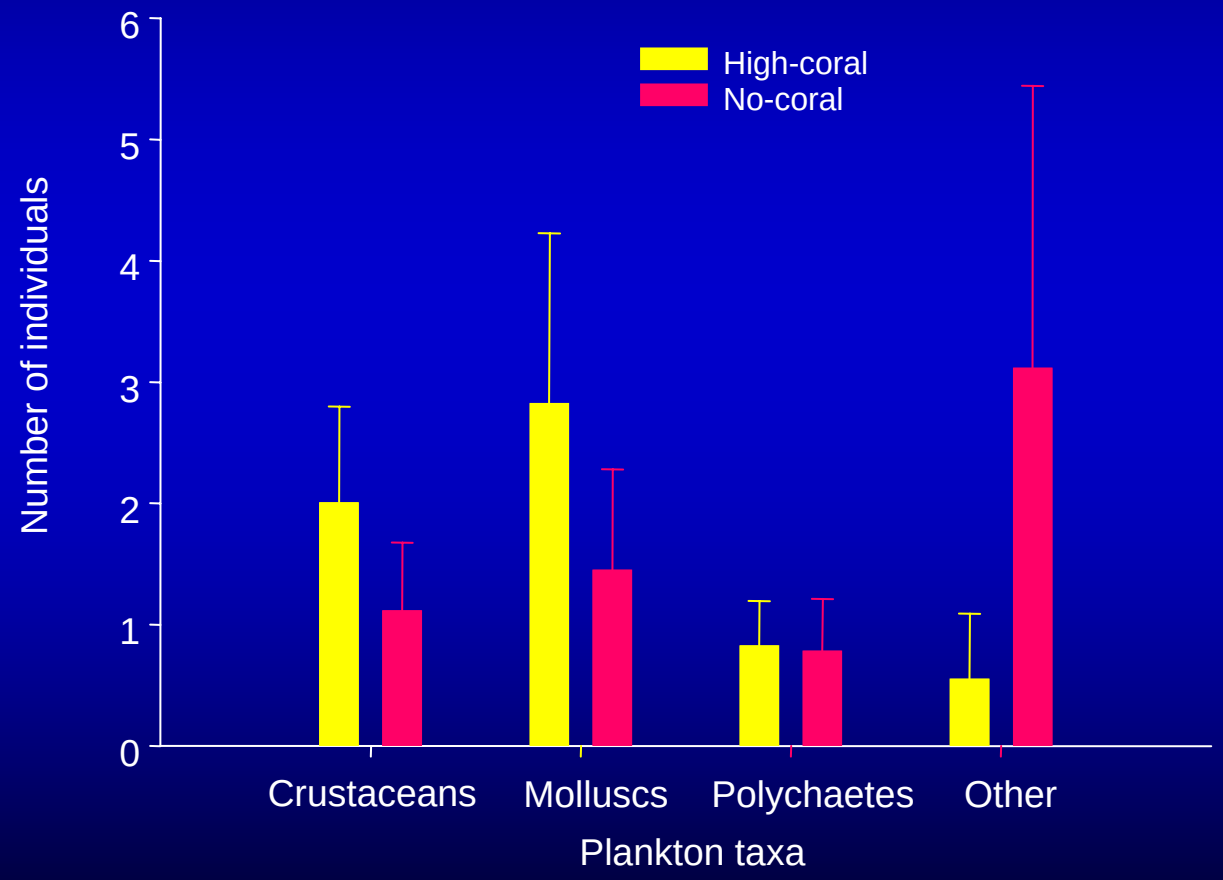




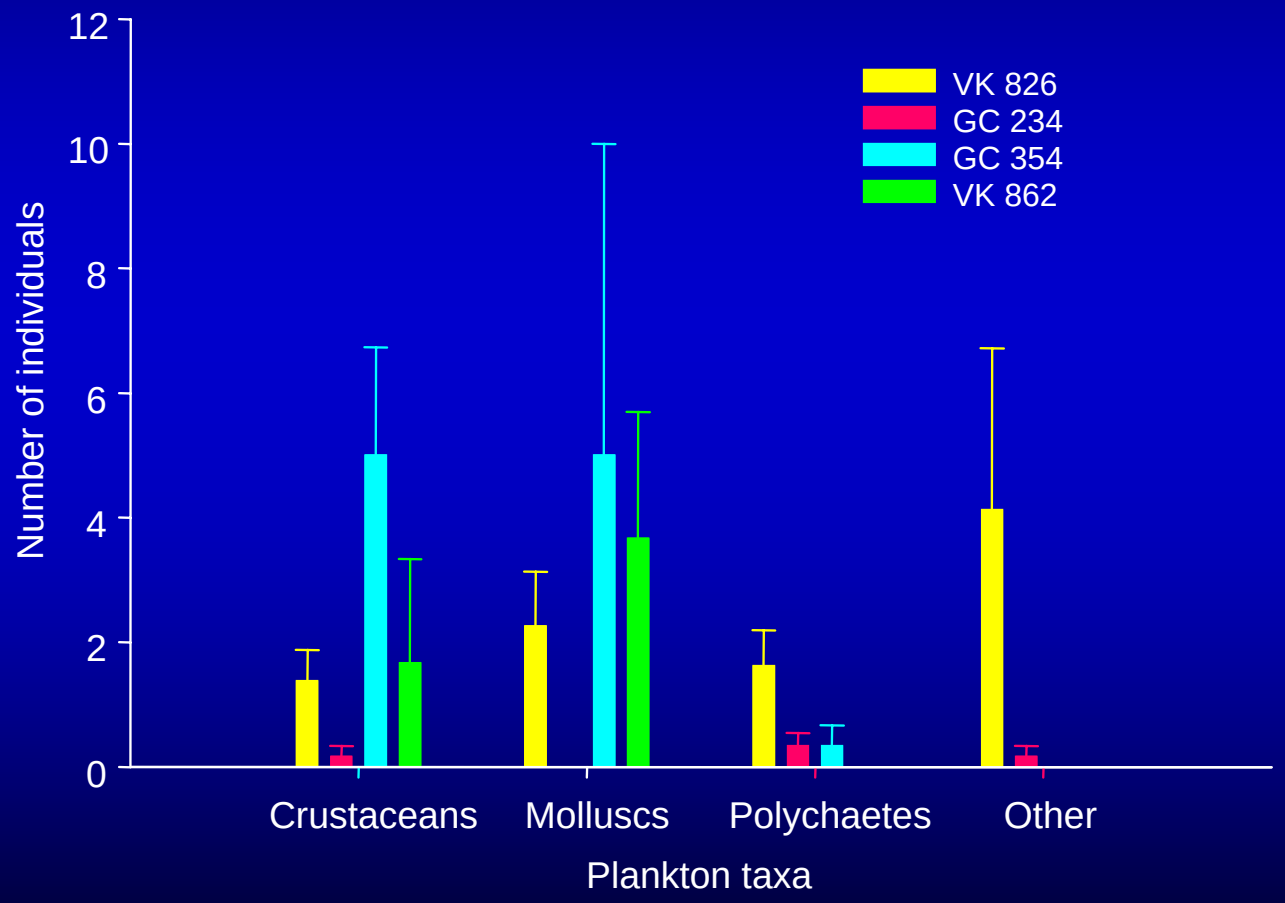
Zooplankton Abundance: High-Coral vs. No-Coral Areas



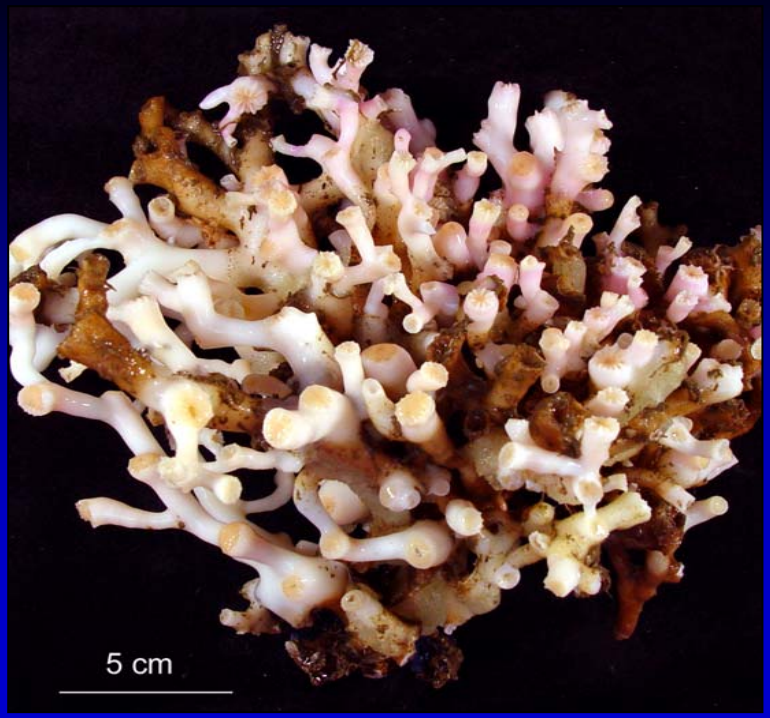
Zooplankton Taxa: High-Coral vs. No-Coral Areas

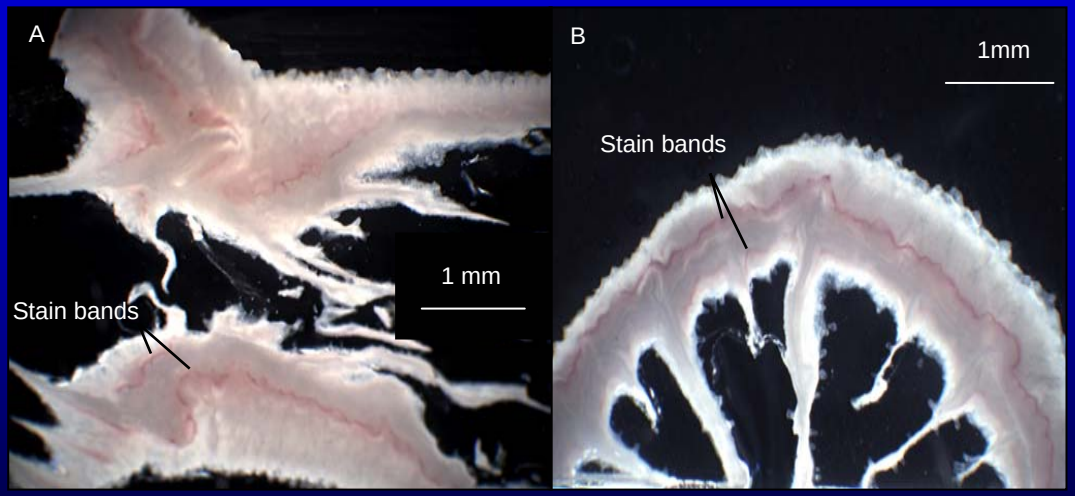


Zooplankton Abundance: Plankton Taxa at Each Site



Survival and Growth of *Lophelia* Transplants and *in situ* Stained Colonies

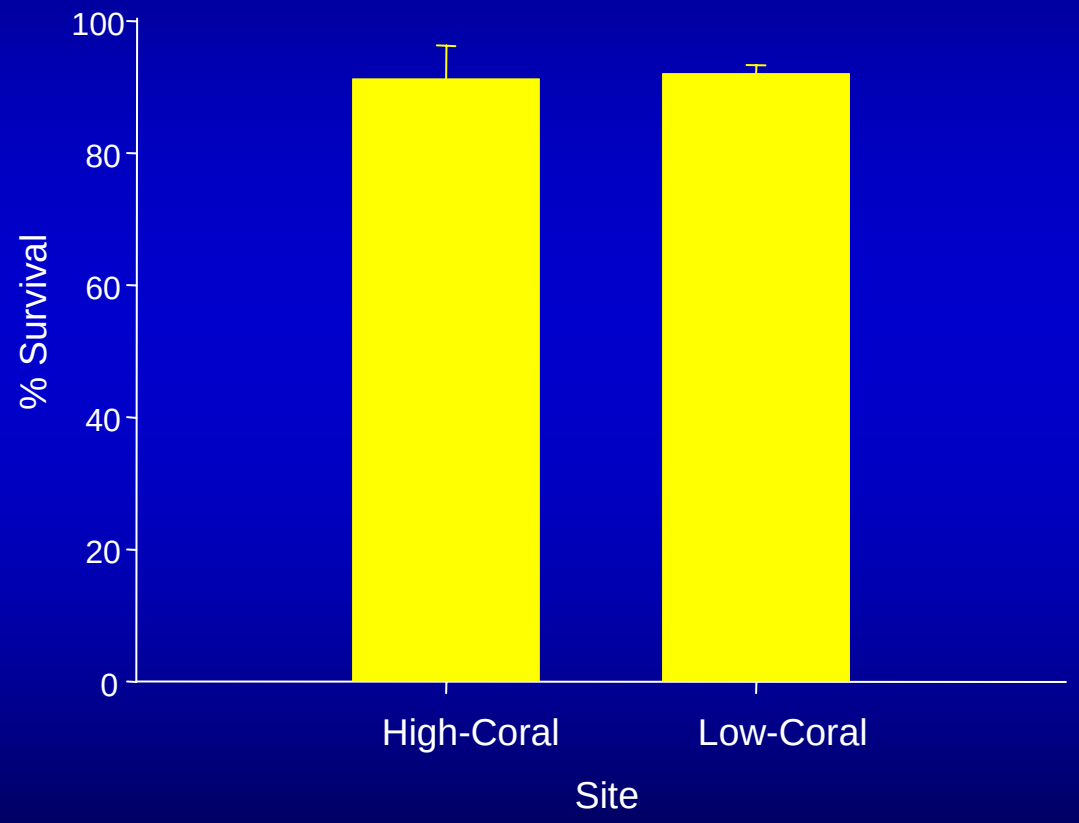




Lengthwise and transverse sections of stained transplant fragments showing two growth centers (stain bands) for each section

Examples of recovered fragments showing new polyps and growth lines

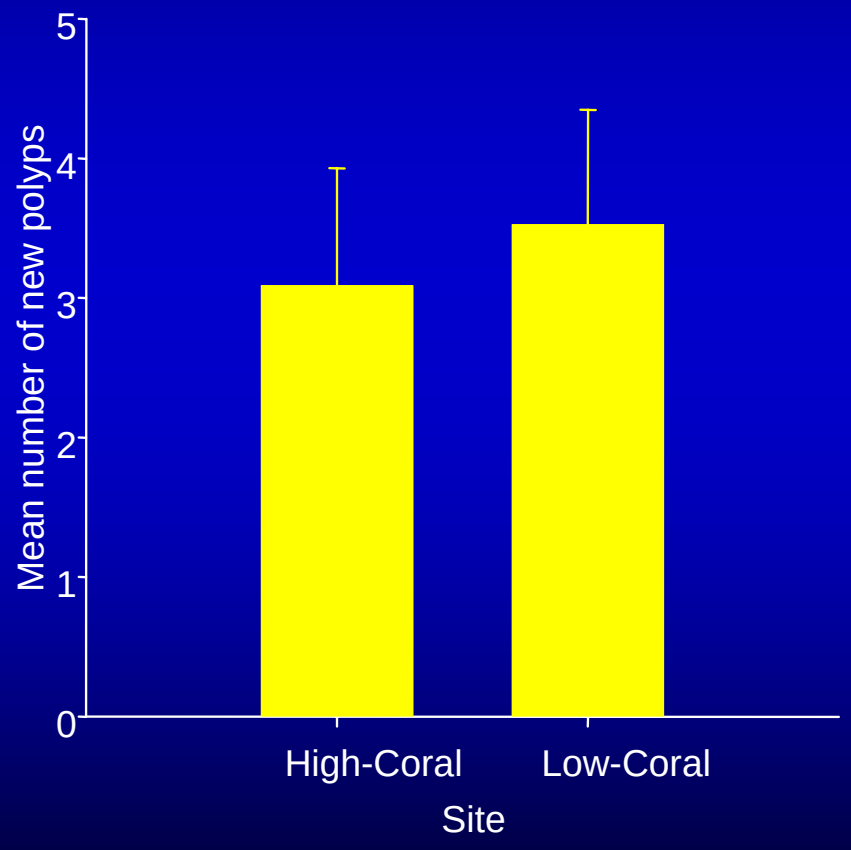
Survival of *Lophelia* Transplants

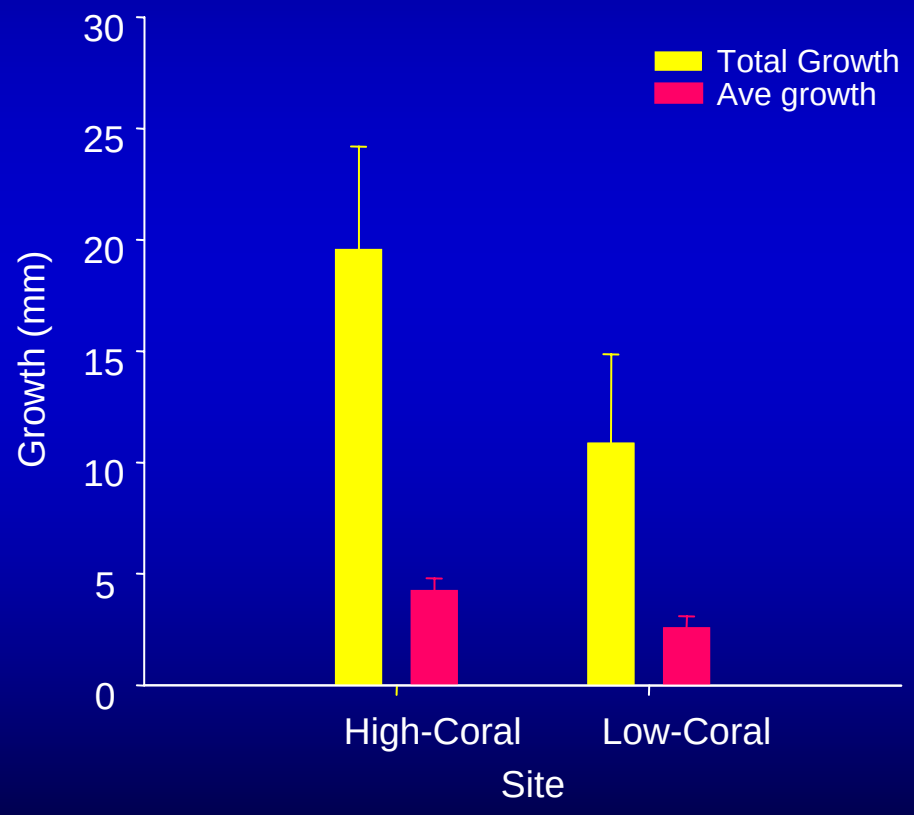


High-Coral n=4 transplant units (16 fragments)

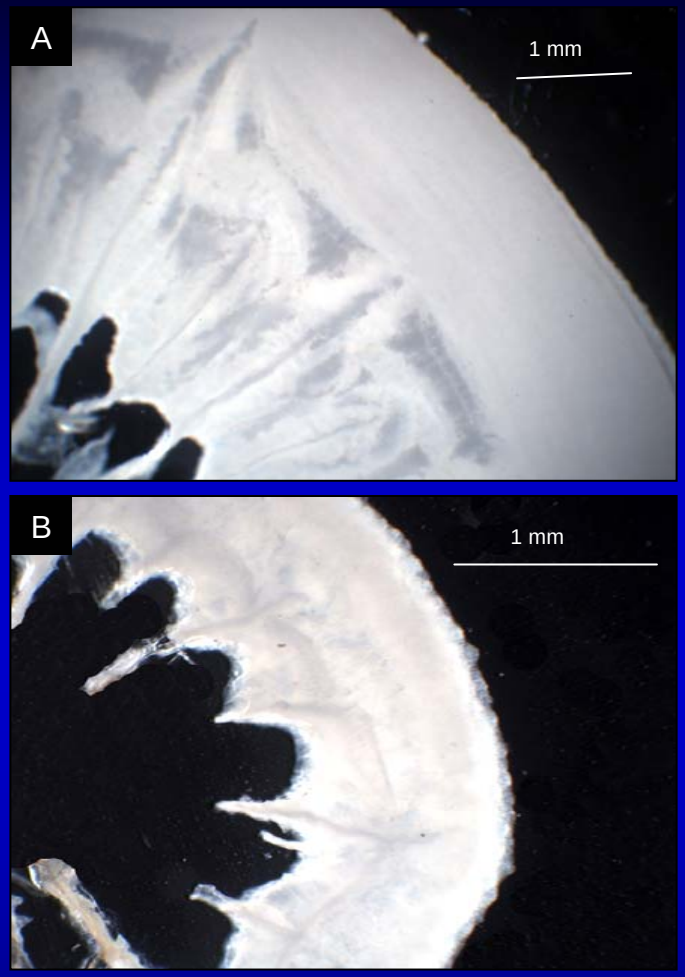
Low-Coral n=3 transplant units (12 fragments)

Lophelia Transplants Growth and Number of New Polyps



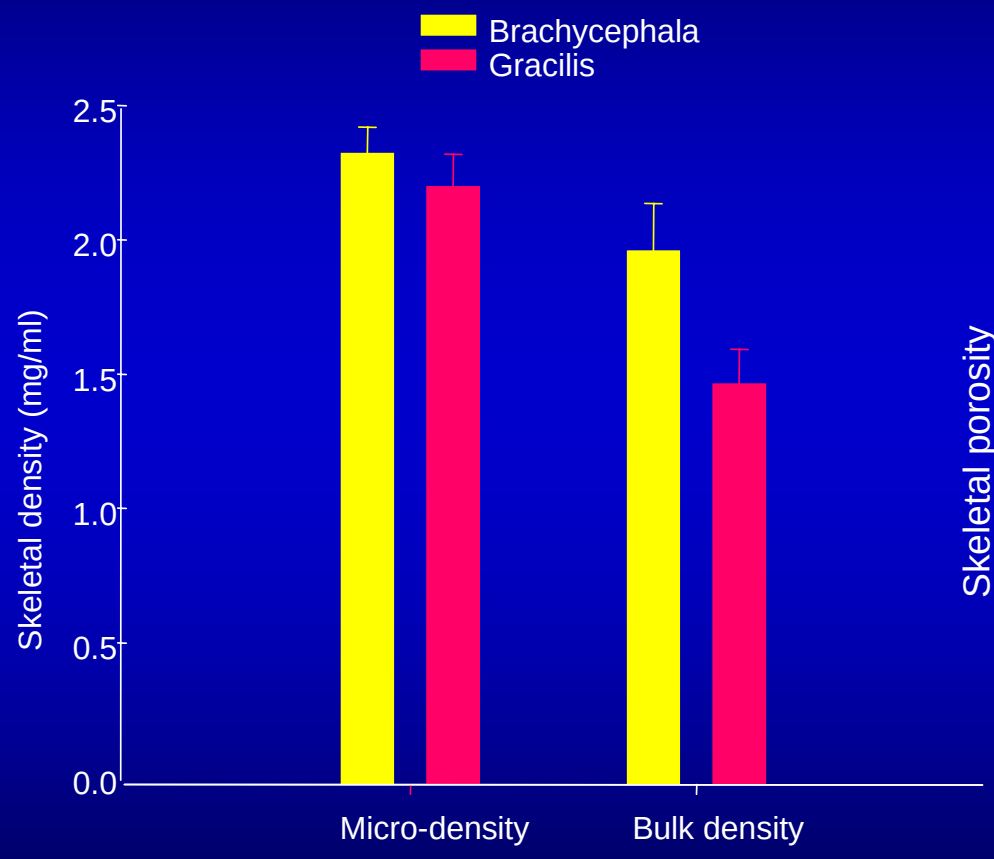


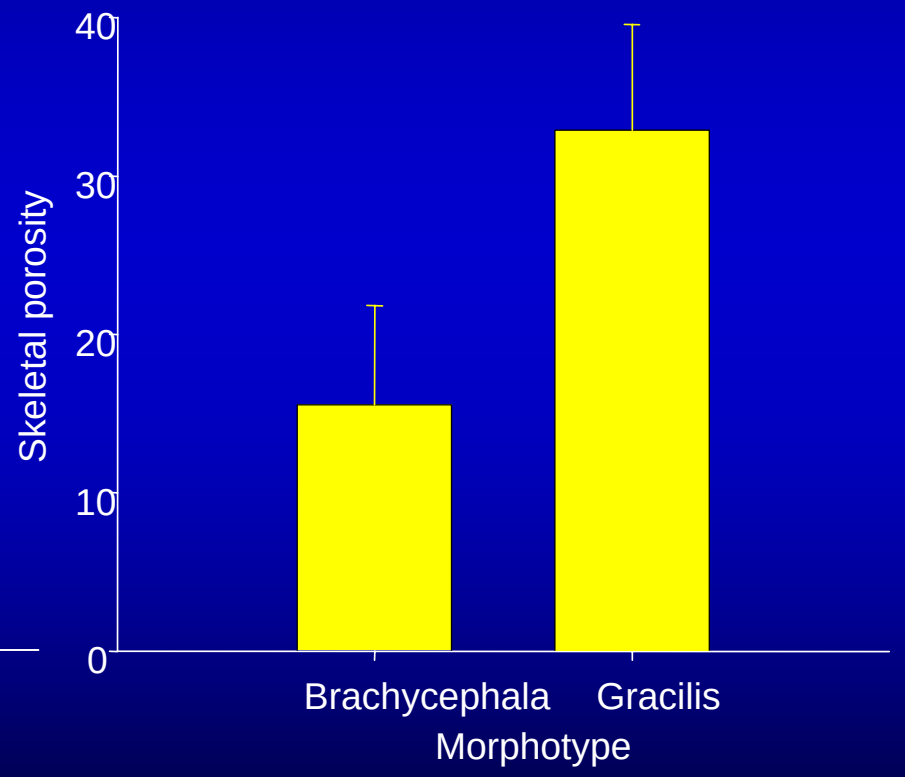
Skeletal Density of *L. pertusa* Morphotypes



Resin-embedded sections (2mm thick) of A) brachycephala and B) gracilis morphotypes showing the higher number and more closely spaced bands in the heavier morphotype.

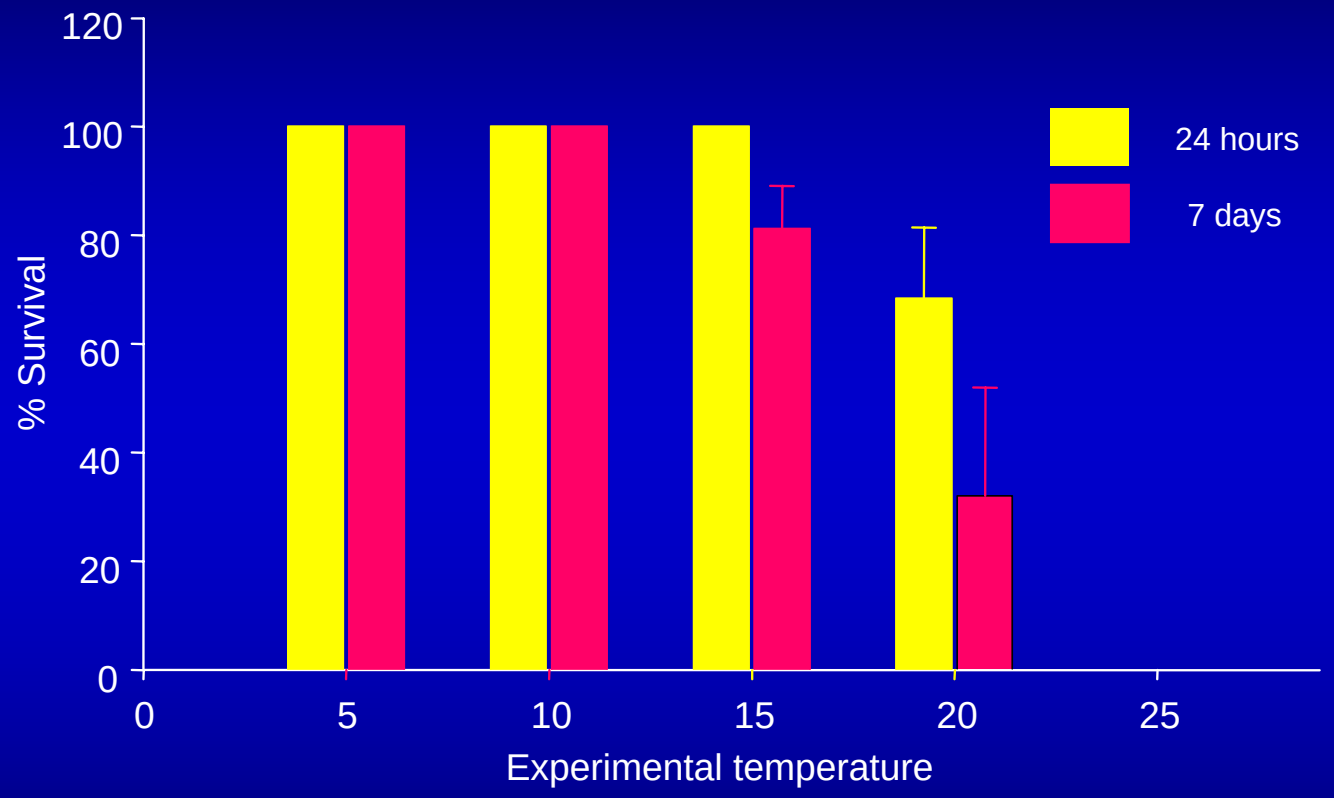
Skeletal Density Characteristics of Different Morphotypes of *L. pertusa*.





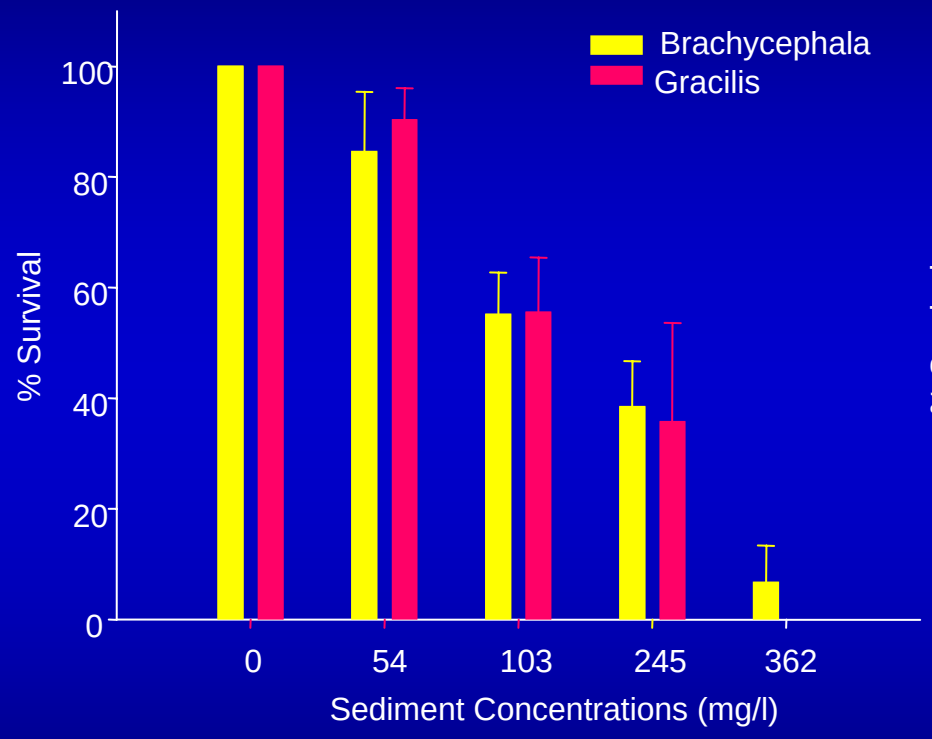
Micro-density represents the aragonite skeleton; bulk density is total skeletal Density, including the pore spaces in the matrix. Porosity represents air spaces in the skeleton.
Bars: averages of n=10 fragments of each morphotype

Temperature Tolerance

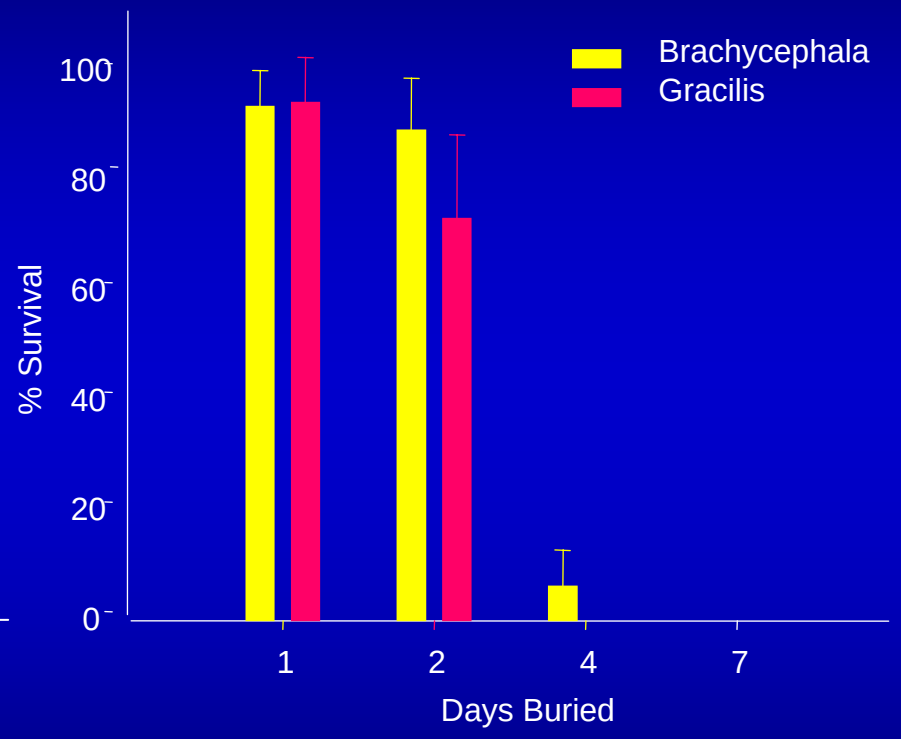


Percent survival of *L. pertusa* exposed to different experimental temperatures for 24 hours and 7 days.
(n =20 polyps per replicate, with 5 replicate tanks per treatment)

Sediment Tolerance of *Lophelia* Coral

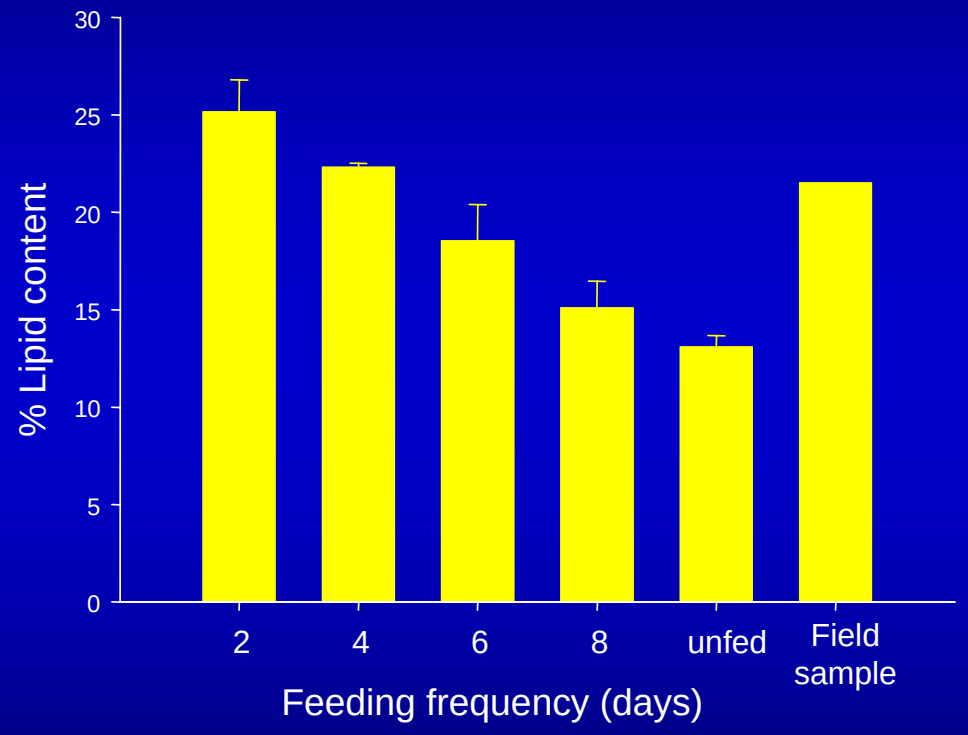


Mean % survival of two morphotypes of *L. pertusa* after exposure to a range of sediment suspensions for 14 days
Error bars: SE of n=3 trials.



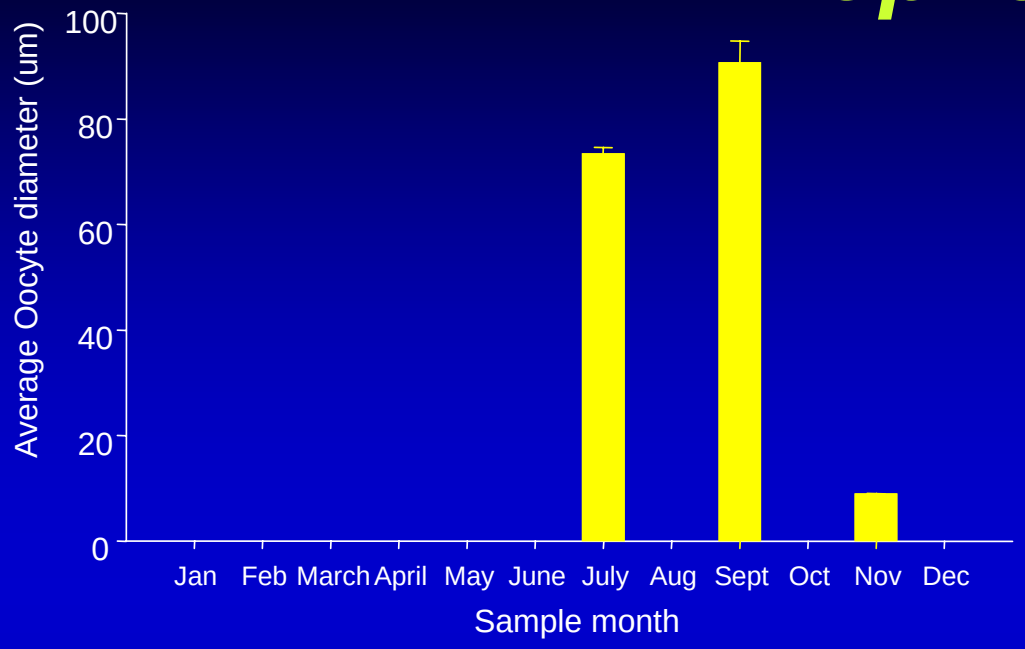
Mean % survival of two morphotypes of *L. pertusa* after burial for 1-7 days in Gulf of Mexico sediment.
Error bars: SE of n=3 trials

Feeding Experiments for *Lophelia* Coral

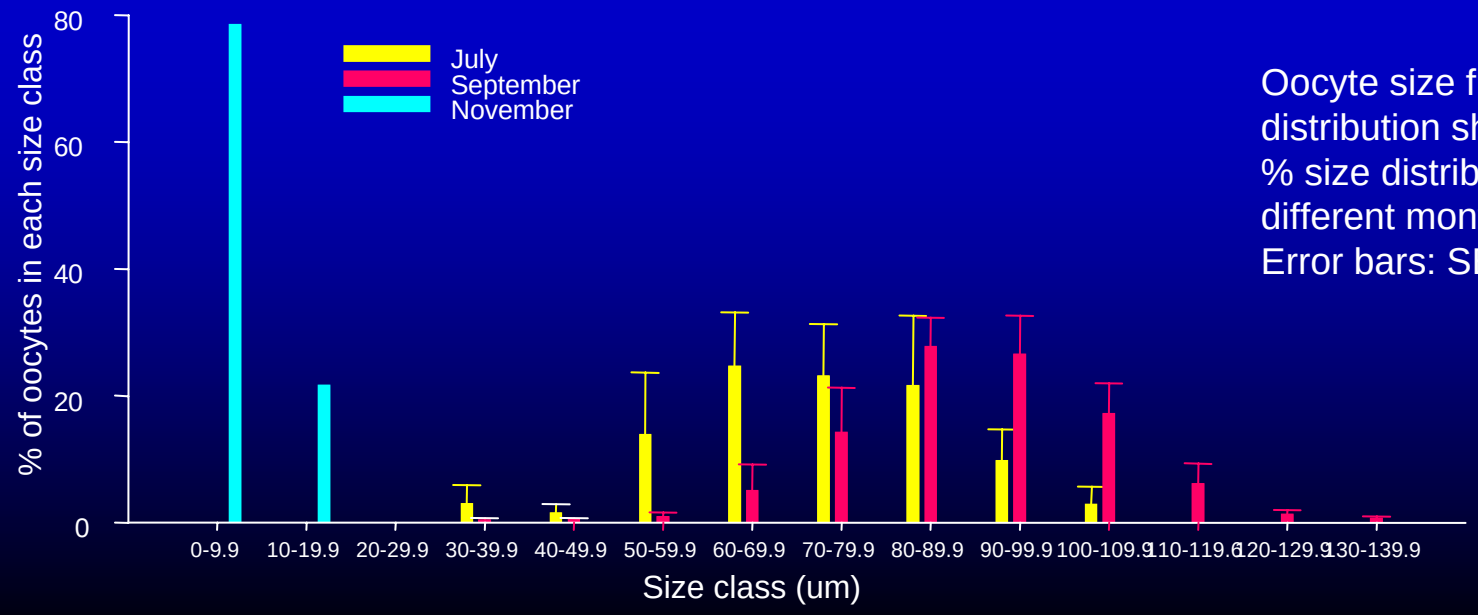


Percentage lipid content of *L. pertusa* fragments fed five different food rations over a one-month period. A field sample collected from VK826 in September 2005 was also included. Error bars: SE of n=2 trials

Lophelia Reproduction



Seasonal changes in *L. pertusa* oocyte diameter, indicating that spawning occurs in late September or October.
Error bars: SE of n=3-5



Oocyte size frequency distribution showing oocyte % size distribution from different months.
Error bars: SE of n =3-5

Summary

The benthic communities in the Viosca Knoll area are very different from the other study sites:

- VK862 had by far the most extensive and well-developed *L. pertusa* community, with a much more heavily calcified skeletal morphology than was found at other locations.
- The VK862 beta site also had a unique benthic community, dominated numerically by anemones, and with the highest anthozoan diversity than any of the other sites.
- The Green Canyon (alpha and beta) sites were similar in their geology and benthic community, with much less prevalent *L. pertusa* and patches of a large gorgonian, *Callogorgia americana delta* representing the dominant cnidarian species.
- The Mississippi Canyon beta site was primarily soft sediment, with no *L. pertusa* but extensive areas of large *C. americana delta*.

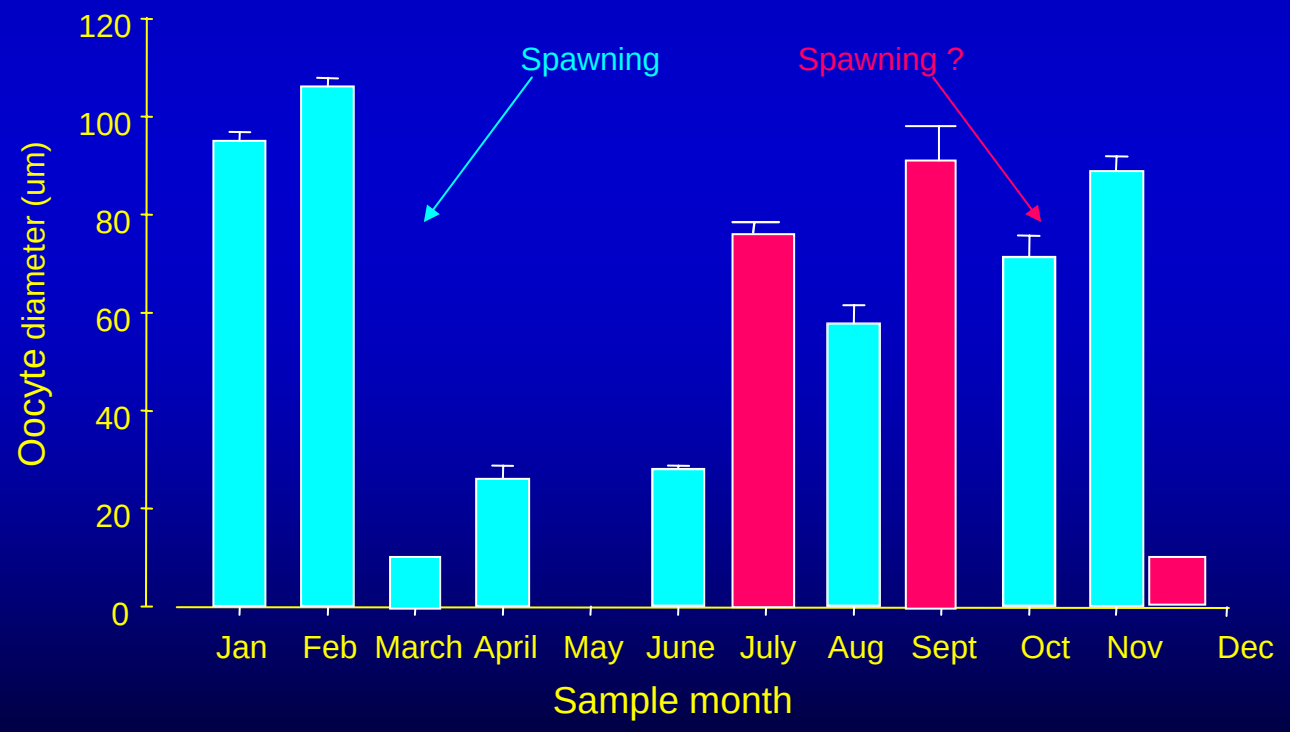
Explanation for the observed differences are still unclear:

- Measured abiotic (temperature, depth, salinity, sediment load) and biotic (plankton availability) components of the habitats did not satisfactorily explain the observed differences between sites.
- Transplant experiments show that colonies can survive in areas that do not have coral cover.
- Either benthic community is driven by some factor that was not measured, or by extreme environmental events such as benthic storms, high currents and sediment slumps.

Laboratory experiments were useful in defining the tolerance limits of *L. pertusa* to some of the environmental influences that potentially affect the distribution and extent of the coral community:

- The upper thermal limit of 10–15°C from laboratory experiments, concurs with the observed upper thermal limit for *L. pertusa* distribution *in situ*.
- Manipulative studies also showed that *L. pertusa* has a fairly high tolerance to sediment level and to low food supply.
- Such studies may be useful in the future to address questions that cannot readily be answered by *in situ* observations.

Comparison of the Gametogenic Cycles of *L. pertusa* from Norwegian Fjords and Northern Gulf of Mexico



Acknowledgments

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Harbor Branch Oceanographic Institution

Graduate students of the Oregon Institute of Marine
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