TRACES 2008

Research Status and Priorities
Coral biology and Reproduction

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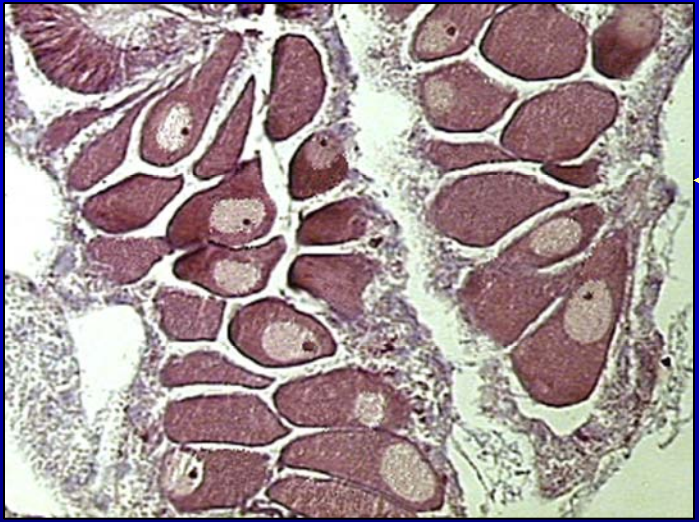
Status of deepwater coral biology research

Reproduction: Stony corals

Reproductive strategy and gametogenic cycles known for some species, including *Lophelia pertusa*

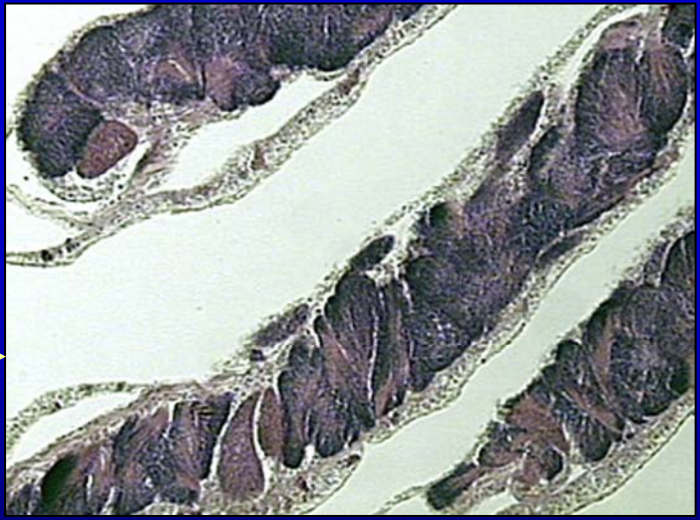
Structure forming species are gonochoristic broadcast spawners

Fecundity estimated for *O. varicosa* and *L. pertusa*



Female with mature eggs

Male with mature sperm

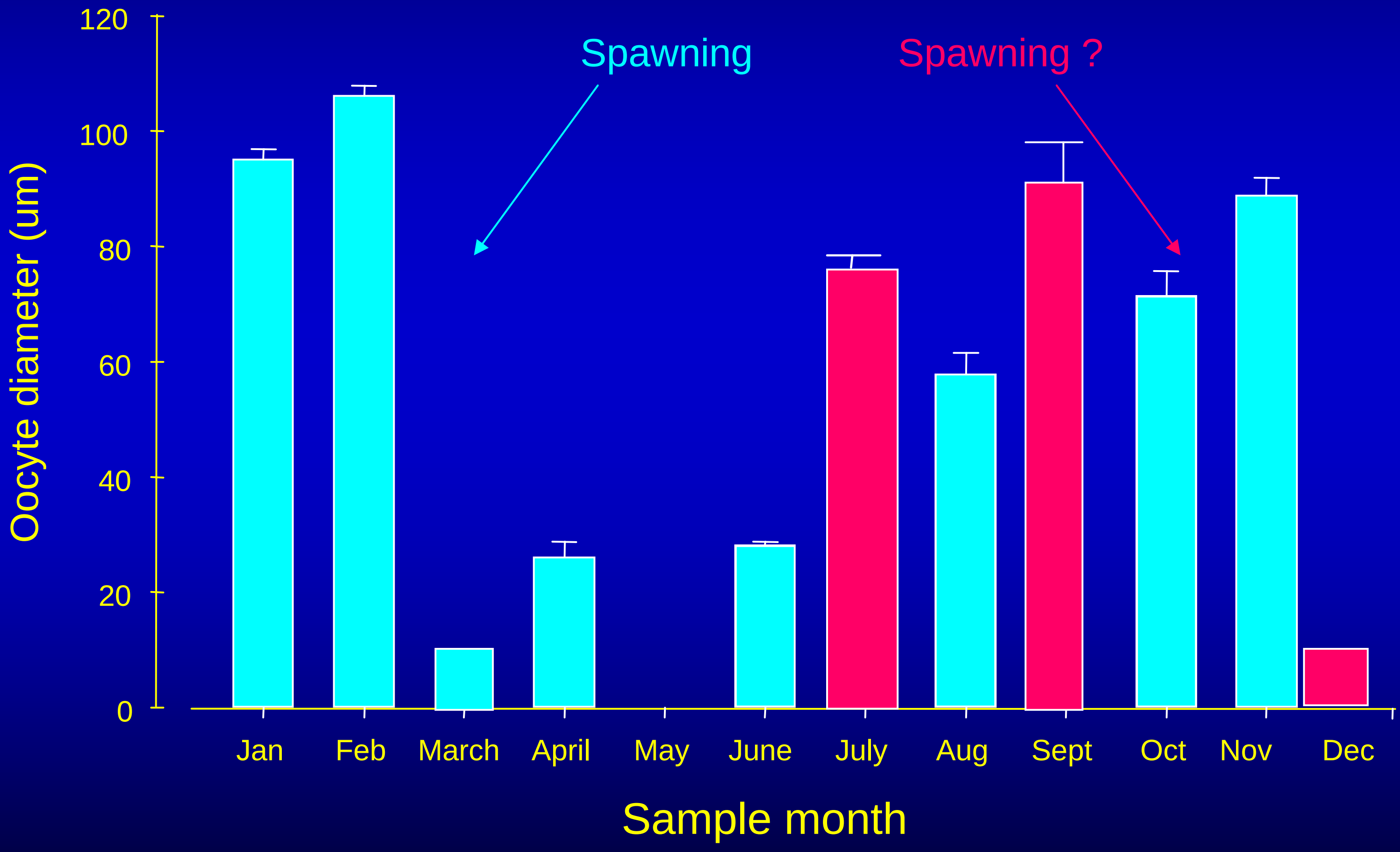


Embryogenesis and larval biology known only for *Oculina varicosa*

Larval settlement cues and recruitment rates unknown

Age at reproductive maturity unknown

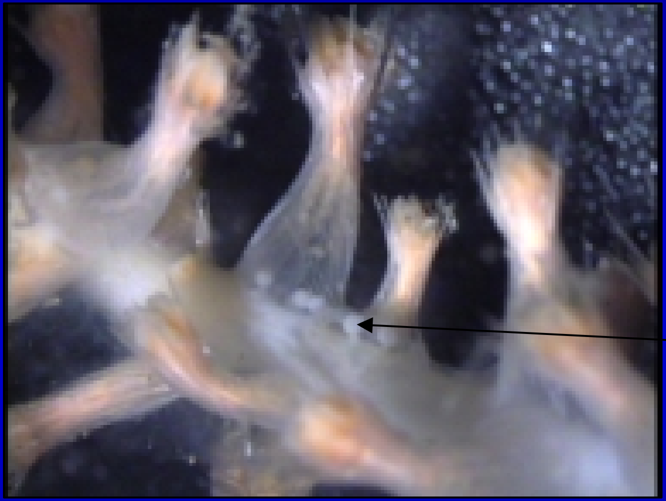
Comparison of the gametogenic cycles of *L. pertusa* from Norwegian Fjords and northern Gulf of Mexico



Octocorals

Reproductive strategy known for some species:
Broadcast spawning vs brooding is taxon specific

Oocytes in
gorgonian polyp



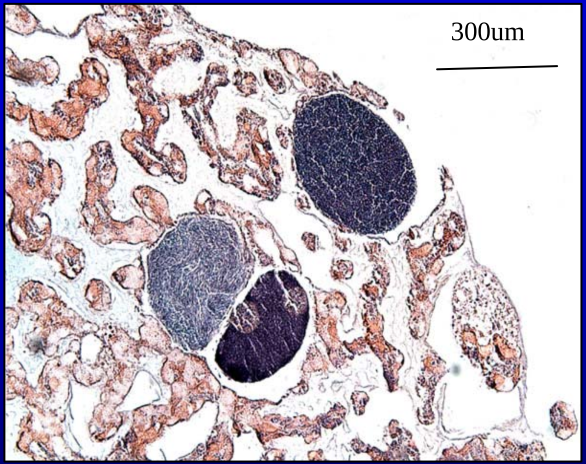
Deep sea Isidid with
oocytes visible along axis

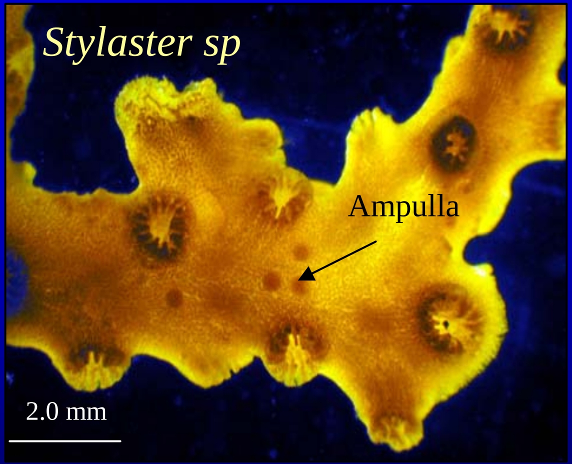
Embryogenesis and larval biology not known for most deepwater octocorals
Larval settlement cues and recruitment rates unknown
Age at reproductive maturity unknown

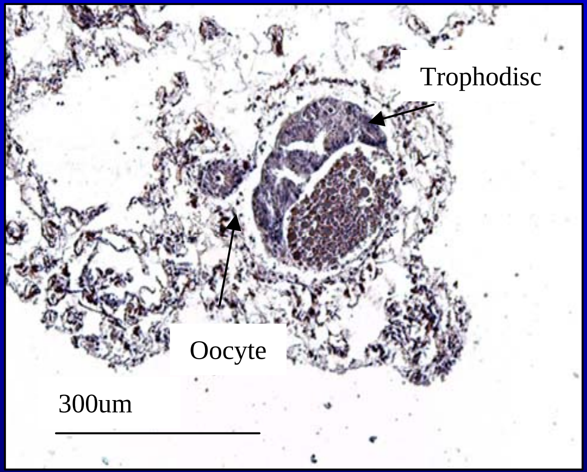
http://server.dmc.maine.edu/watlingsite/PAGES/repro.html

Hydrocorals

All species studied are gonochoristic brooders with most gonophores containing mature embryos or planulae.
Gametes within a single specimen were not highly synchronized
Females contained eggs as well as planulae, and males exhibited a range of gamete development.



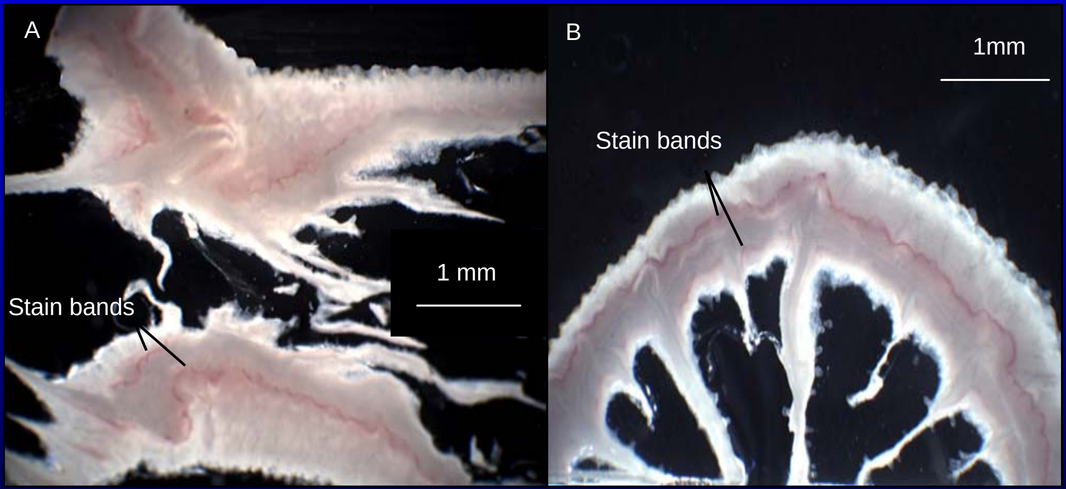




Larvae have short planktonic stage
Recruitment rates unknown

Growth of *Lophelia* transplants and *in situ* stained colonies

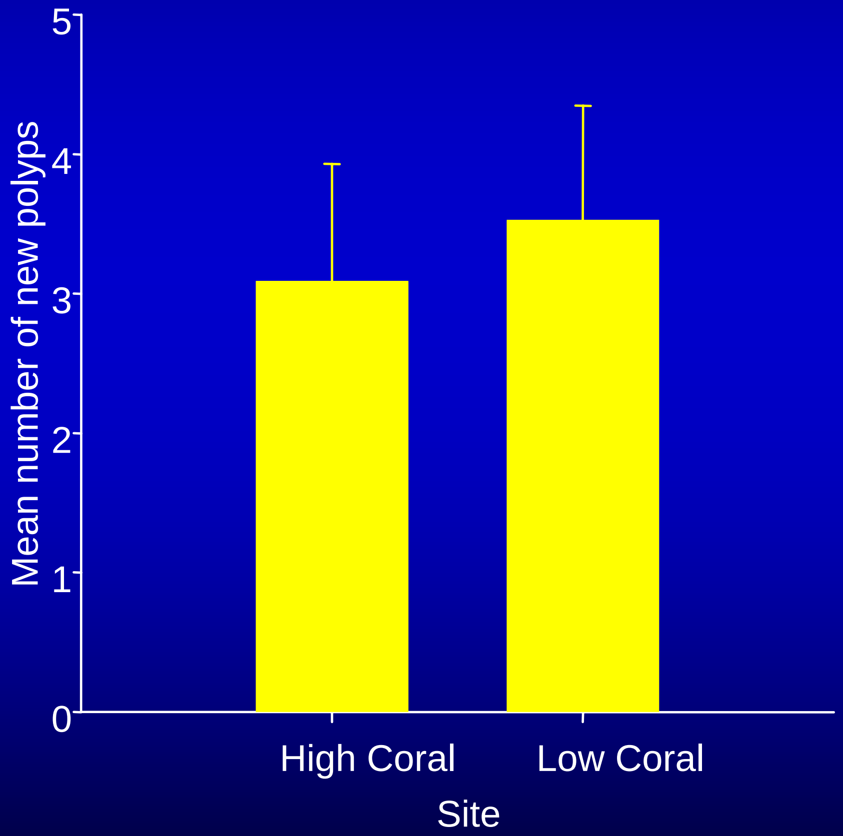
Colony stained *in situ*

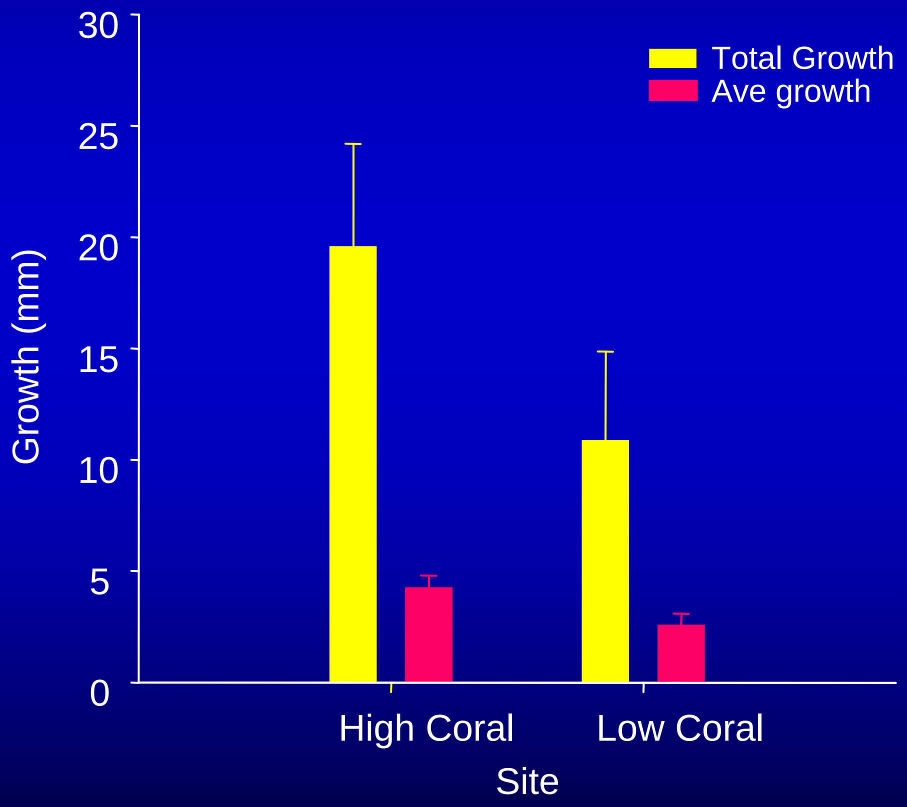


Lengthwise and transverse sections of stained transplant fragments showing two growth centers (stain bands) for each section

Examples of recovered fragments showing new polyps and growth lines

Lophelia transplants
growth and number of new polyps

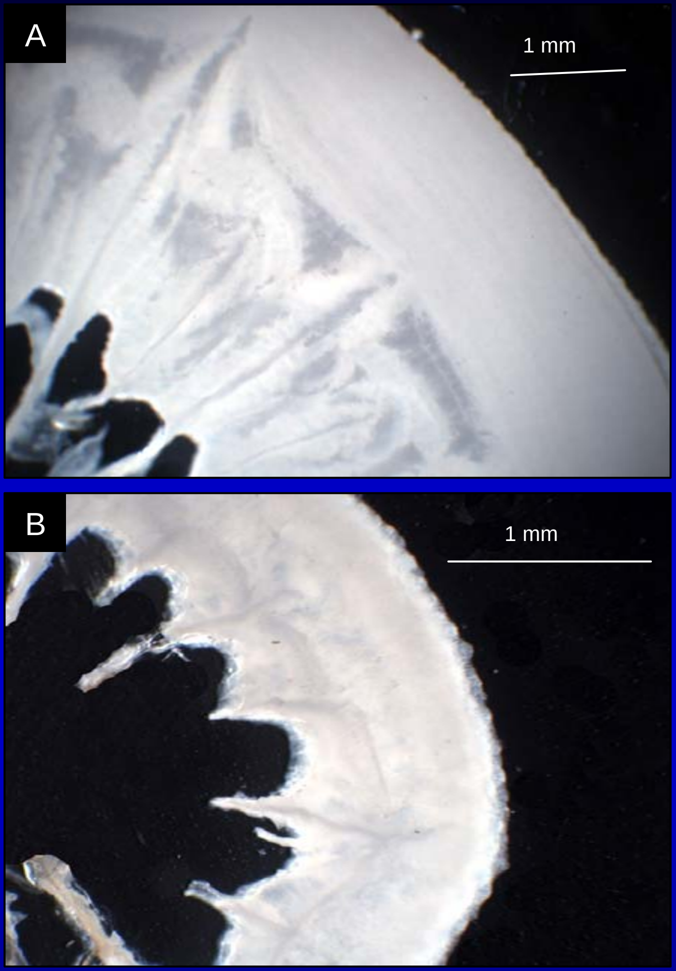




Documented deepwater coral growth rates

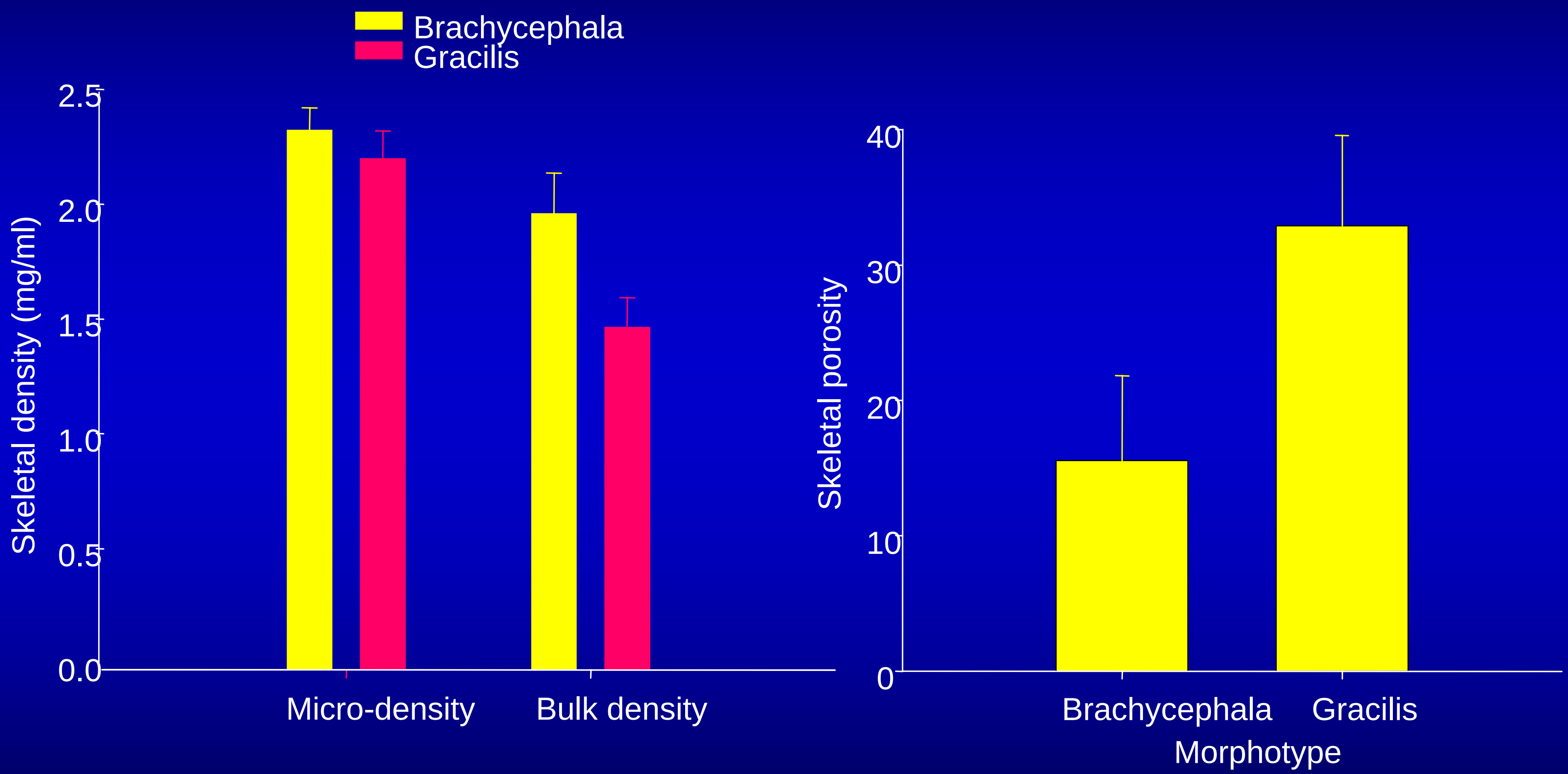
Lophelia pertusa	5-34mm yr-1 linear
Enallopsammia rostrata	5 mm yr-1 linear
Primnoa resedaeformis	1.5-17 mm yr-1 linear 0.04-0.18 m yr-1 radial
Corallium secundum	9.0 mm yr-1 linear 0.17 mmyr-1 radial
Antipathes sp	61.2-64.2 mm yr-1 linear < 0.13 mmy yr-1 radial
Gerardia sp	66.0 mm yr-1 linear 0.05 mm yr-1 radial

Skeletal density of *L. pertusa* morphotypes



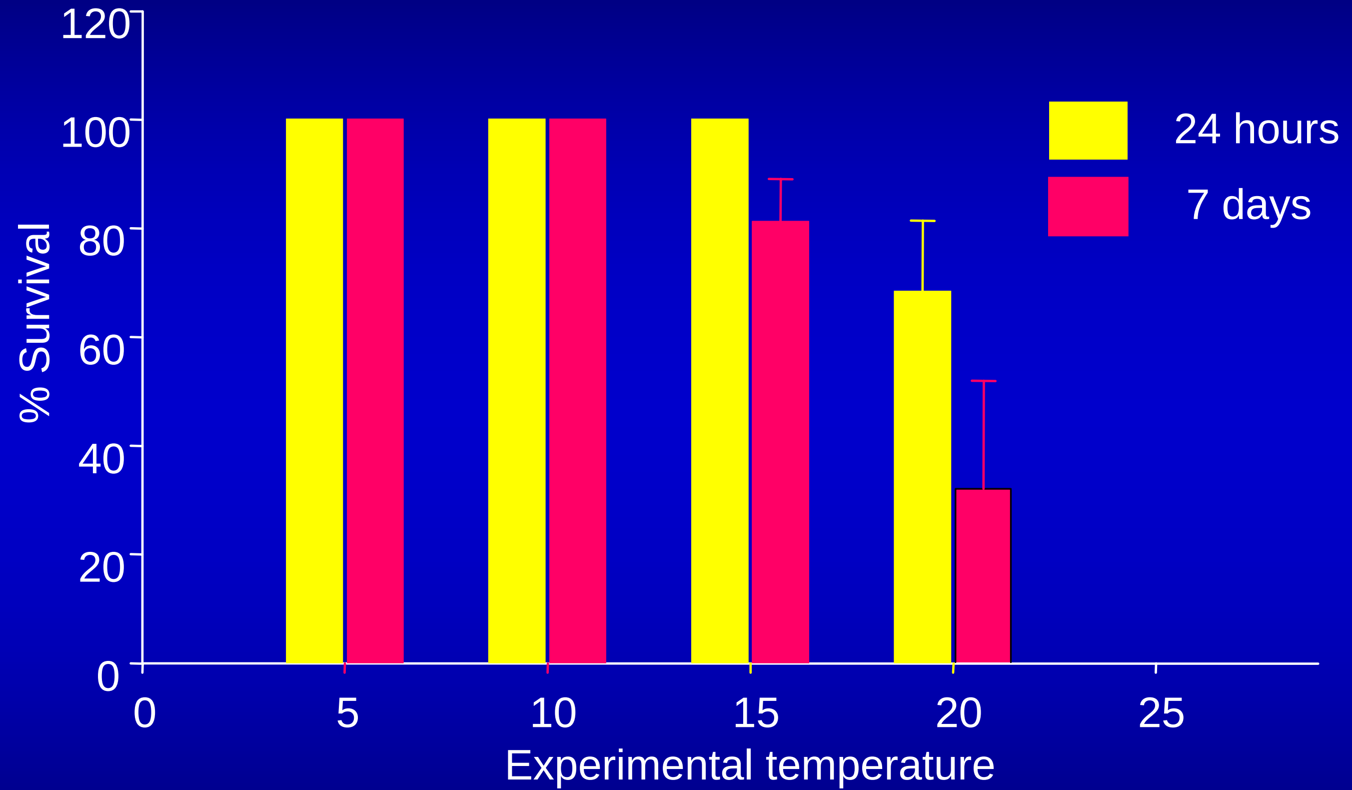
Resin-embedded sections (2mm thick) of
A) brachycephala and B) gracilis morphotypes showing the higher number and more closely spaced bands in the heavier morphotype

Skeletal density characteristics of different morphotypes of *L. pertusa*.



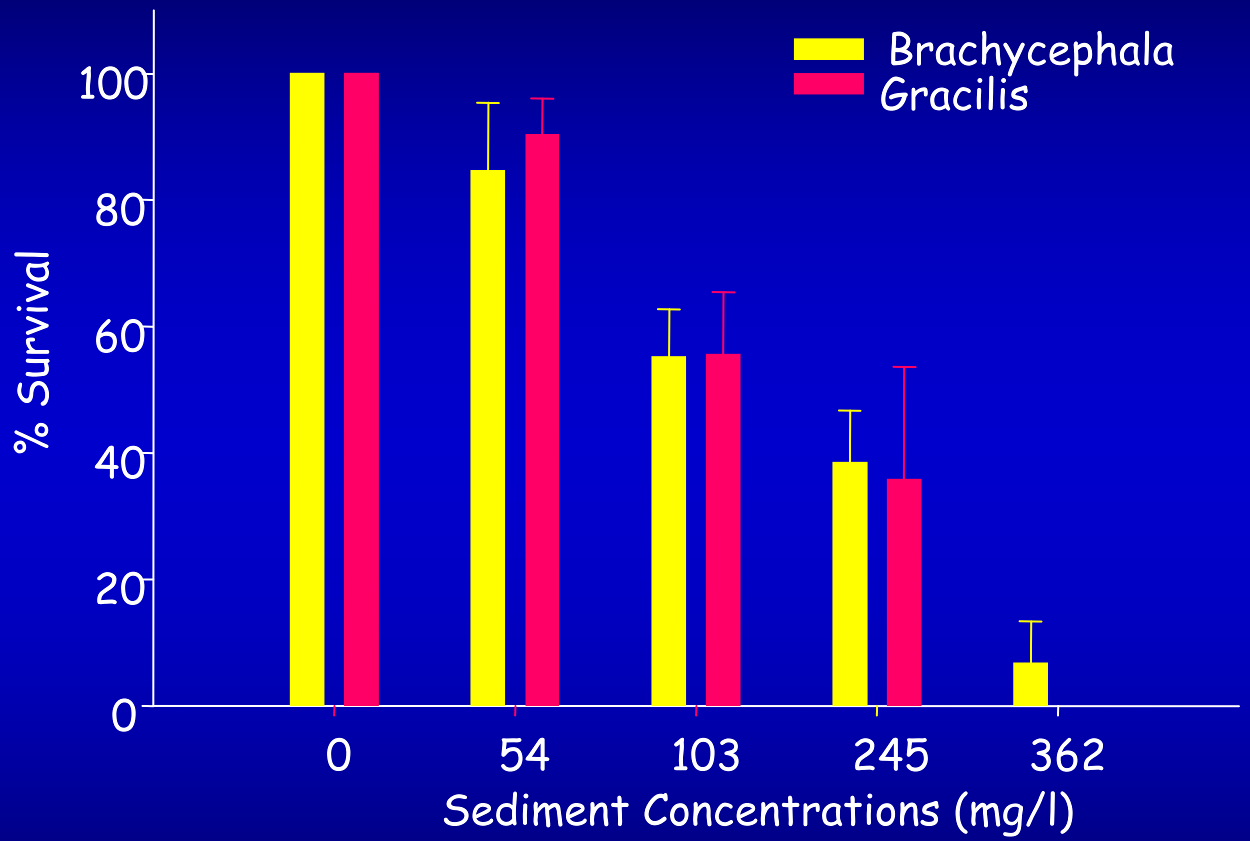
Micro-density represents the aragonite skeleton
Bulk density is total density, including pore spaces.
Porosity represents air spaces in the skeleton

Environmental tolerances:
Controlling factors in *Lophelia* distribution



Percent survival of *L. pertusa* exposed to different experimental temperatures for 24 hours and 7 days

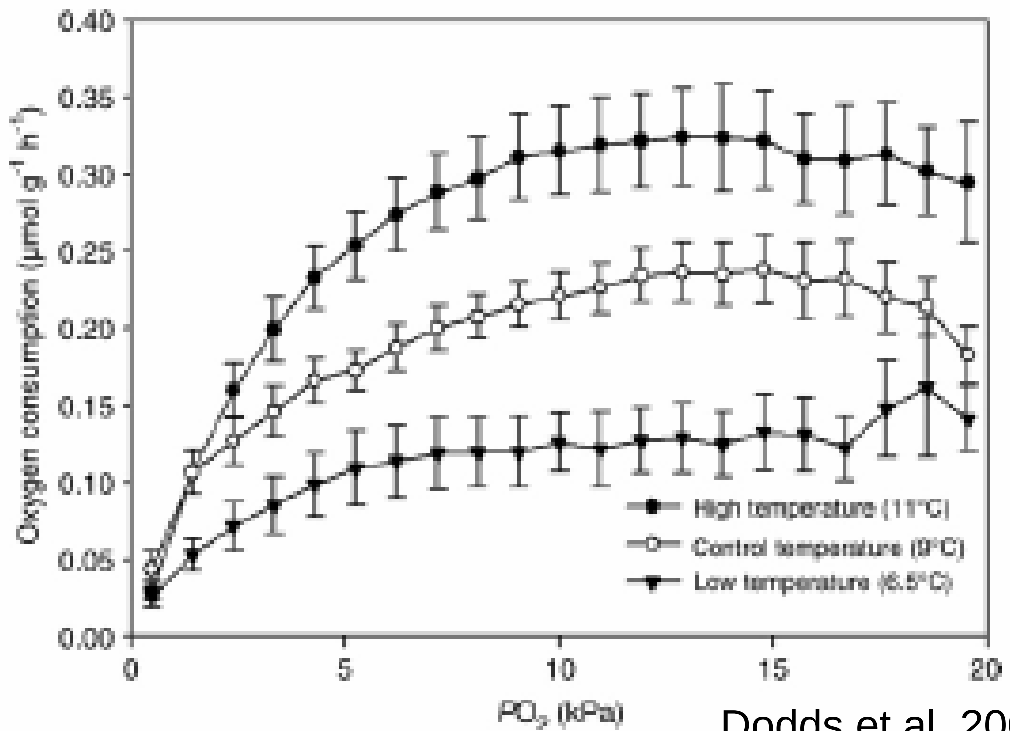
Sediment tolerance



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.

Respiration

L. pertusa can regulate respiration under moderate hypoxia
Lower limit for compensation is ~3.25 ml l-1 O_2
L. pertusa can regulate over wide range of [O_2]
Respiration is sensitive to small changes in temperature.



Dodds et al, 2007

Combination of O_2 and temperature may determine distribution of *L. pertusa*

Research priorities

Reproductive ecology of the structure-forming corals and recovery potential of damaged areas.

Energetics of structure-forming corals and effects of changing environmental conditions

Rate of skeletal growth, mound growth and causes of large scale mortality of structure-forming scleractinians

Reproductive ecology of the structure-forming corals and recovery potential of damaged areas.

Approach

Use a combination of histological techniques, genetics, live culture and hydrography, to identify dispersal patterns, recruitment potential and population structure

Scientific merit: High
Increase understanding of connectivity between different areas help identify sources and sinks of genetic recruits, establish vulnerability of the system to perturbation and probability of recovery from damage

Policy relevance: High
Knowledge of importance and/or vulnerability of different areas will help guide policy.

Feasibility: High
Much of this work is underway. Samples can be collected opportunistically. Corals can be maintained easily and current meters can be deployed for hydrographic data

Energetics of structure-forming corals and effects of changing environmental conditions

Approach

Includes effect of environmental parameters on survival, respiration, tissue lipid content, calcification etc using ex situ manipulative experiments and in situ sampling/observations.

Scientific merit: High
We currently have very little idea how natural or anthropogenically induced changes affect the survival and health of deepwater corals

Policy relevance: High
Understanding of the effects of change could guide policy decisions

Feasibility: Medium-high
Lophelia has been maintained in aquaria successfully for manipulative experiments and in situ observatories have been used in some locations.

Some species may not do well in aquaria

Rate of skeletal growth, mound growth and causes of large scale mortality of structure-forming scleractinians

Approach

Isotopic dating techniques and in situ observation of growth rates (incl. artificial structures), Coring and dating of *Lophelia* mounds, investigate biological and physical interactions on sedimentation of dead skeleton.

Use 'high resolution' isotopes to determine age of coral on dead mounds. Use paleo proxys in antipatharians and gorgonians to identify potential climate features that may have caused scleractinian mortality.

Scientific merit: High
It is important to know time scales of coral structure formation and causes of mass stony coral mortality observed in many locations

Policy relevance: Medium
Policy cannot influence processes if driving forces are natural

Feasibility: High
Would require some expensive coring and pioneering isotopic techniques, but with careful design and adequate samples it can be done