Biodiversity and biogeography of cold-water coral communities

TRACES workshop

Faro, April 2008

Pål Buhl-Mortensen

Institute of Marine Research, Norway

INSTITUTE OF MARINE RESEARCH
HAVFORSKNINGSINSTITUTTET

Some basic topics

- **Provide species inventories of species that use cold water corals as a habitat**
- **Describe the diversity and spatial distribution of associated invertebrates (understand the mechanisms)**
- **Interactions between species (ecology, behaviour, feeding, etc)**
- **Compare results from different sampling gears (improve techniques, ensure comparable results)**

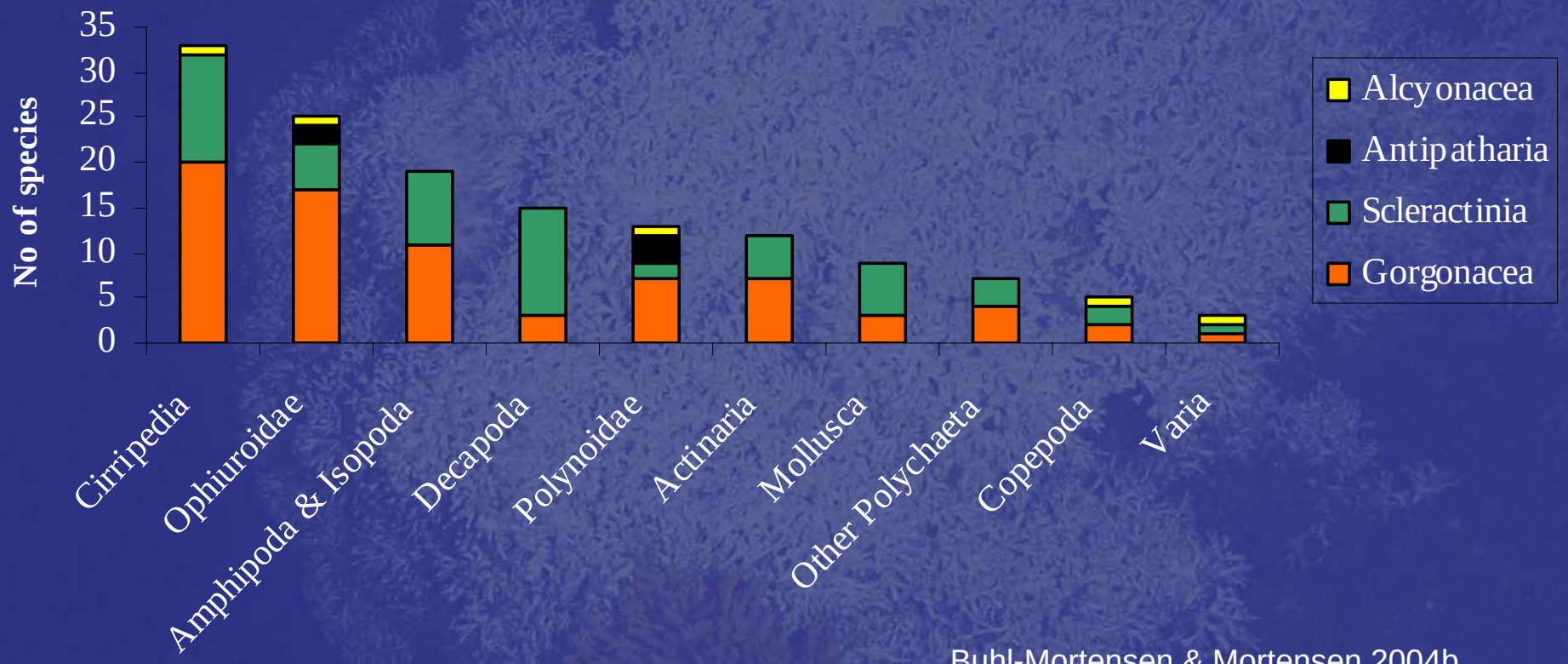
Sources to variation in the composition of associated fauna

- **Geographical variation**
  - ✓ Environment
  - ✓ Spreading centres
- **Temporal changes**
  - ✓ Reproductive success and larval supply
  - ✓ Evolutionary time
- **Habitat architecture/Host species**
  - ✓ Environment
  - ✓ Biological interactions
- **Age of substratum**
  - ✓ Succession

Symbiosis

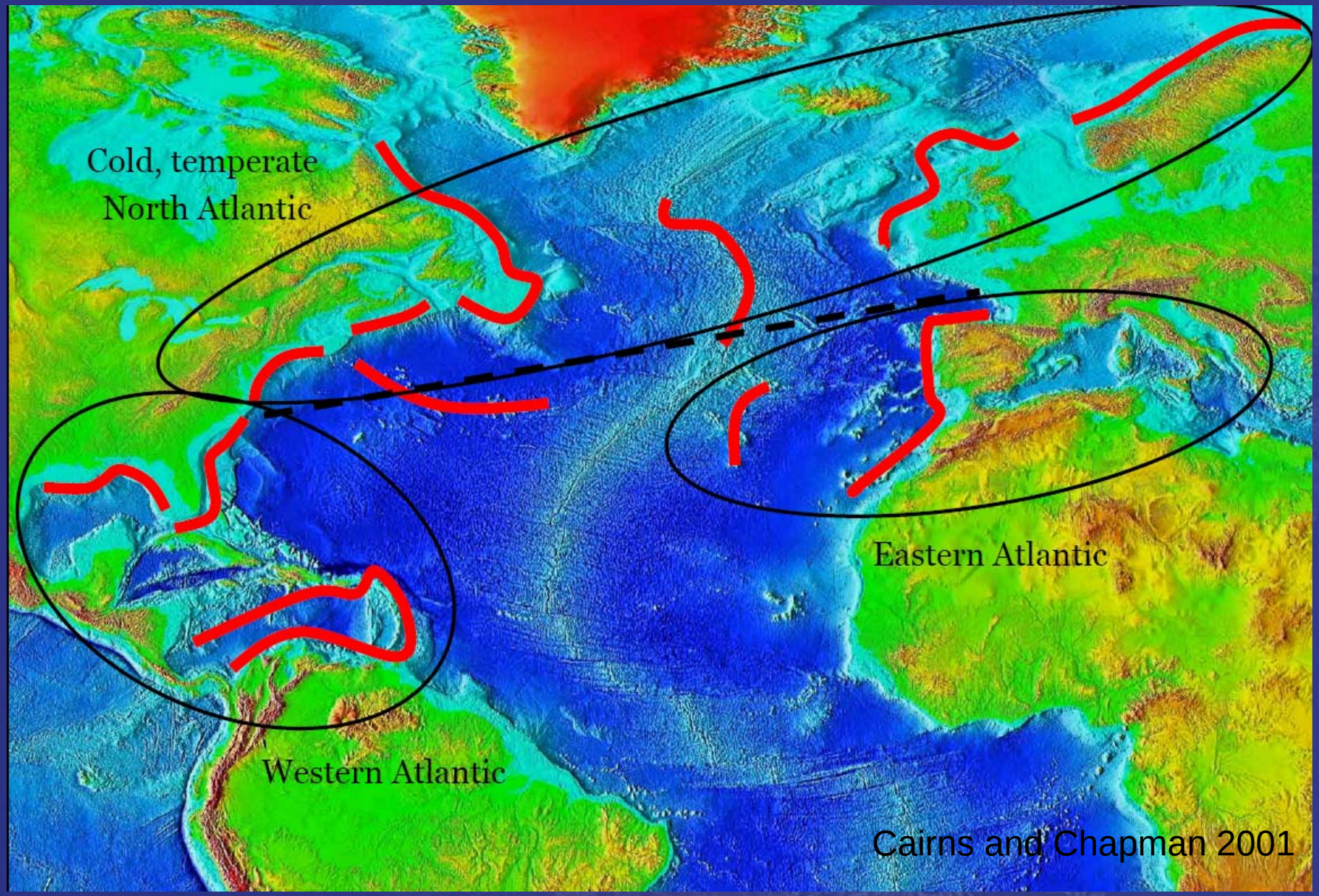
- Two species living together (de Bary 1879)
  - mutualism: both species benefit of the relationship
  - commensalism: the symbiont profit from staying with the host, but the host is unaffected
  - parasitism: the symbiont benefit, but the host suffer from its presence
- The relationship can be obligatory or facultative for one or both species

Taxonomic composition of symbionts in deep-water corals



Buhl-Mortensen & Mortensen 2004b.
– *Symbiosis* vol. 37: 155-168.

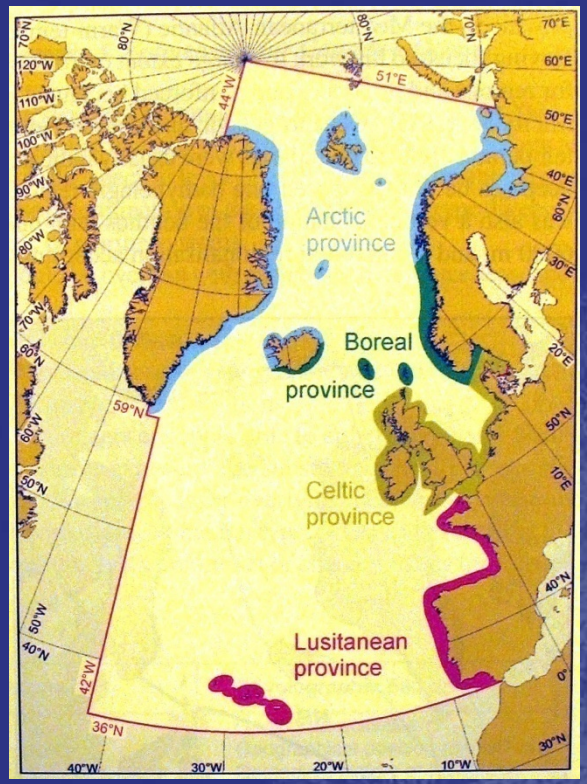
Biogeographic regions



Cairns and Chapman 2001

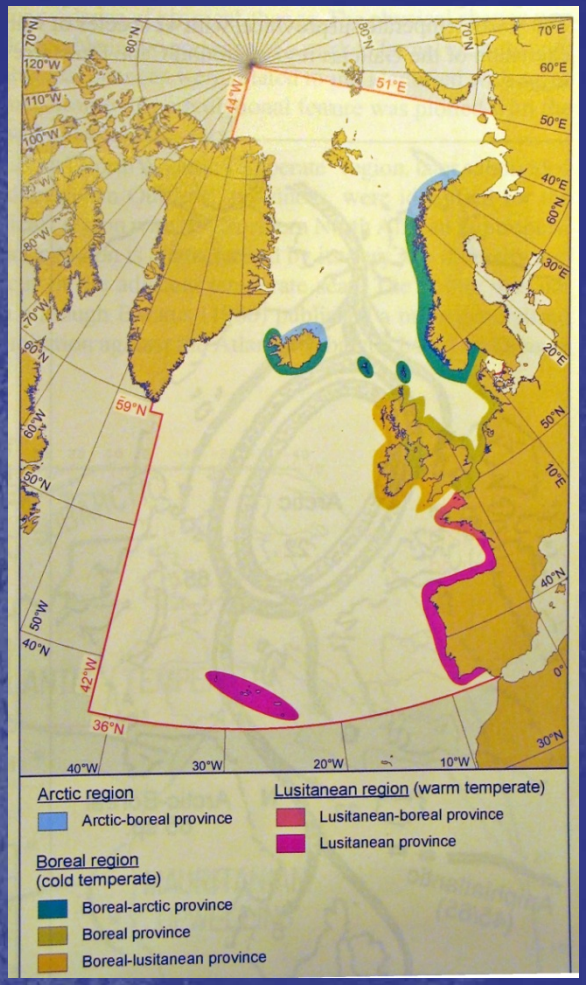
Major structure-forming deep coral species

Species	Norway	MAR	Canada	NEUS	SEUS	GoM
Octocorallia						
GORGONACEA						
Acanella arbuscula		X	X	?	?	X
Acanthogorgia armata			X	X		
Callogorgia americana delta						X
Keratoisis spp			X	?	X	X
Paragorgia arborea	X	X	X	X		
Paramuricea grandis				X		
Paramuricea placomus	X					
Primnoa resedaeformis	X	X	X	X		
Hexacorallia						
ANTIPATHARIA						
Bathypathes arctica		X	X			
Leiopathes glaberrima					X	X
Bathypathes alternata					X	
SCLERACTINIA						
Enallopsammia profunda					X	X
Lophelia pertusa	X	X	X	?	X	X
Madrepora oculata	X	X		?	X	X
Madracis myriaster					X	
Madrepora carolina						X
Oculina varicosa					X	
Solenosmilia variabilis		X				X



Forbes 1859

Briggs 1995

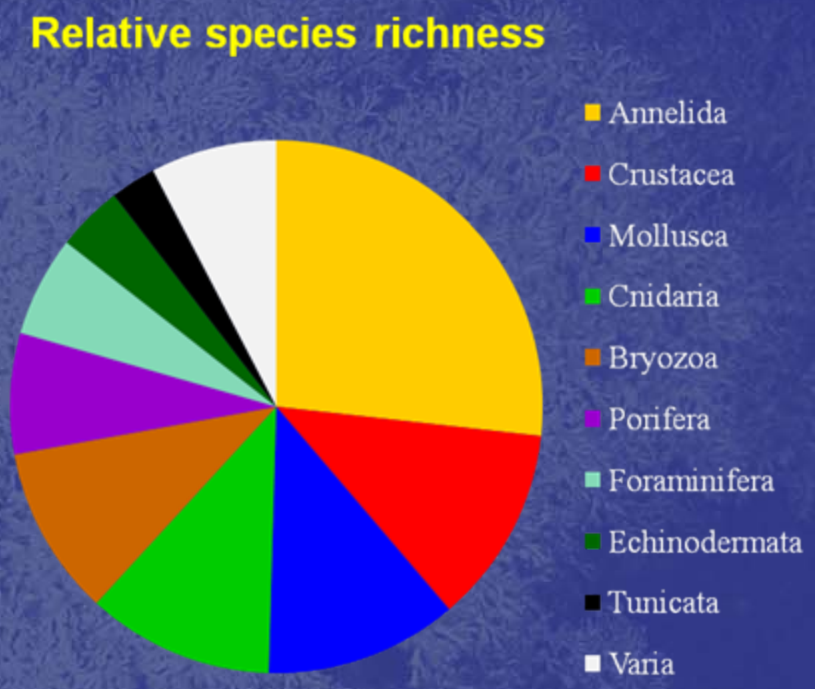


Hiscock 1998

Area these patterns reflected in the associated fauna of cold water corals?

Species richness *Lophelia* associates within taxonomic groups

Taxonomic groups	Reed et al 2006	Henry & Roberts 2007	Jensen & Frederiksen 1992	Mortensen & Fosså 2006
Annelida		81	151	44
Crustacea	4	75	32	54
Cnidaria	57	52	20	27
Mollusca	10	47	37	67
Bryozoa	1	17	72	52
Porifera	66	17	2	16
Foraminifera		7	15	41
Echinodermata	4	11	13	27
Tunicata			4	15
Varia		42	19	16
	142	349	365	359



Comparison hampered by different taxonomical resolution and focus

Microhabitats of *Lophelia pertusa*

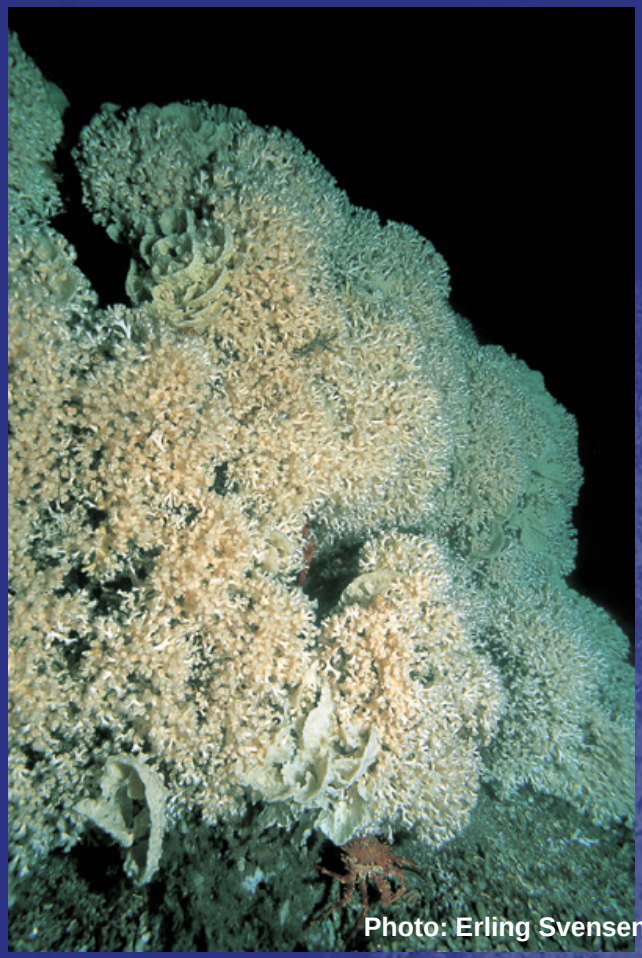
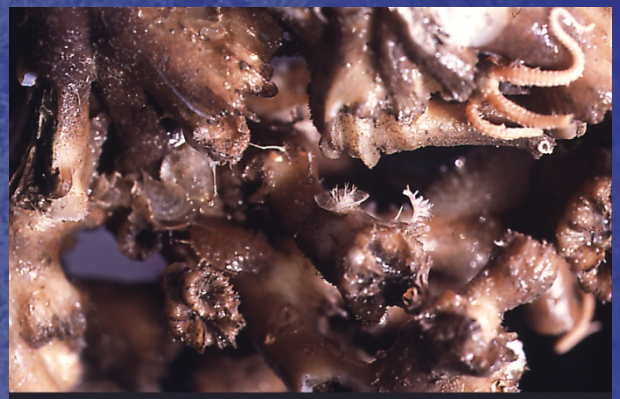
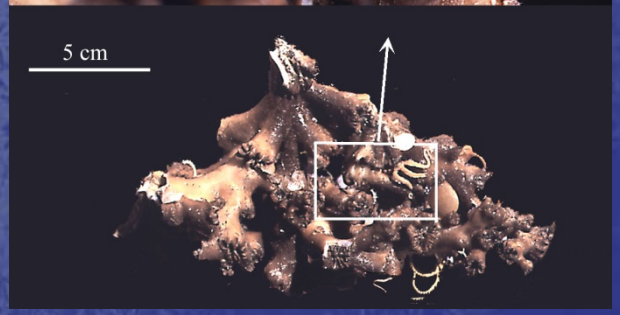


Photo: Erling Svensen

- surface of living corals (smooth tissue/mucus)
- surface of dead corals (hard/detritus laden)
- cavities inside dead skeleton
- free space between the coral branches





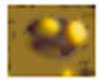
Similar microhabitats are found on bottoms without corals - the majority of species found with *Lophelia* are facultative

Vertical zonation of a *Lophelia*-reef


Living *Lophelia*

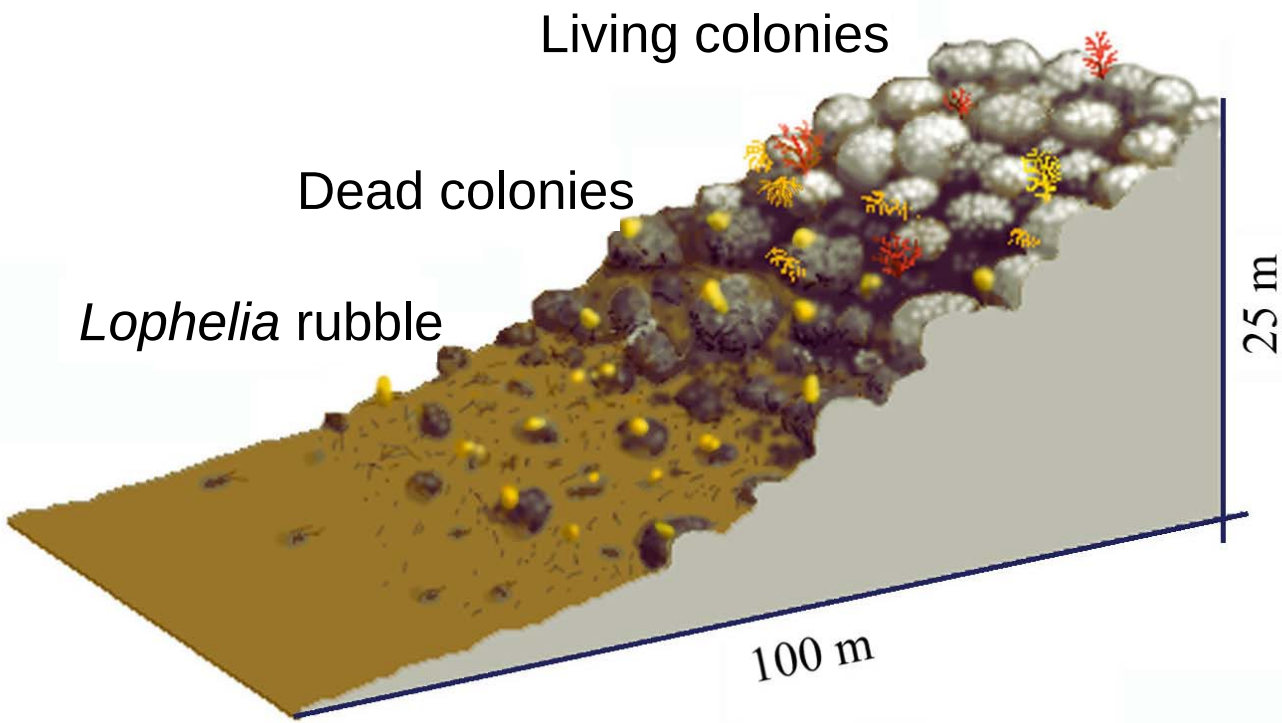

Dead *Lophelia*


Lophelia rubble

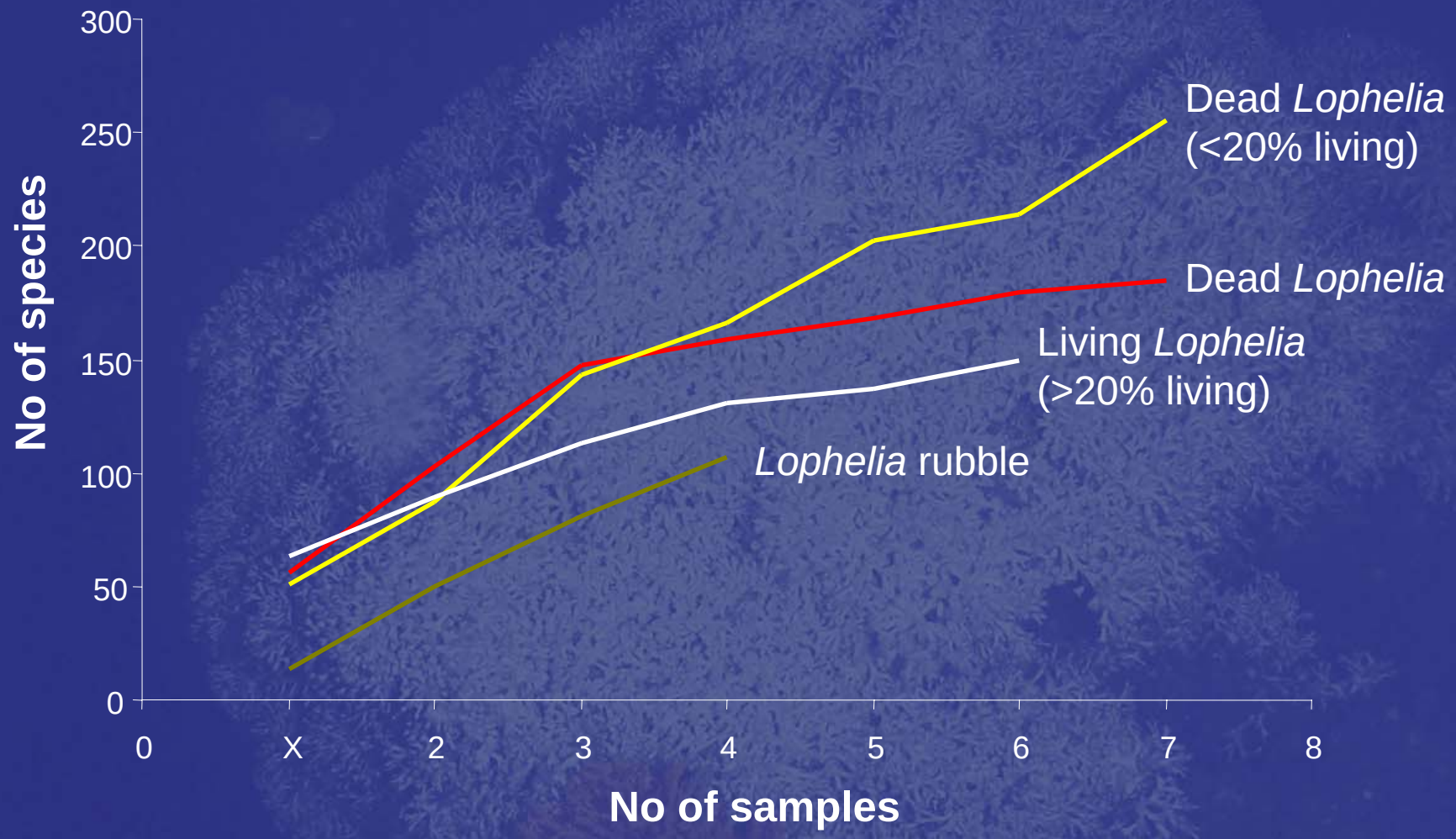

Sponges


Paragorgia arborea


Primnoa resedaeformis



Number of species in relation to number of samples and proportion live coral



(Mortensen & Fosså 2006)

Taxonomic composition

(Mortensen & Fosså 2006)

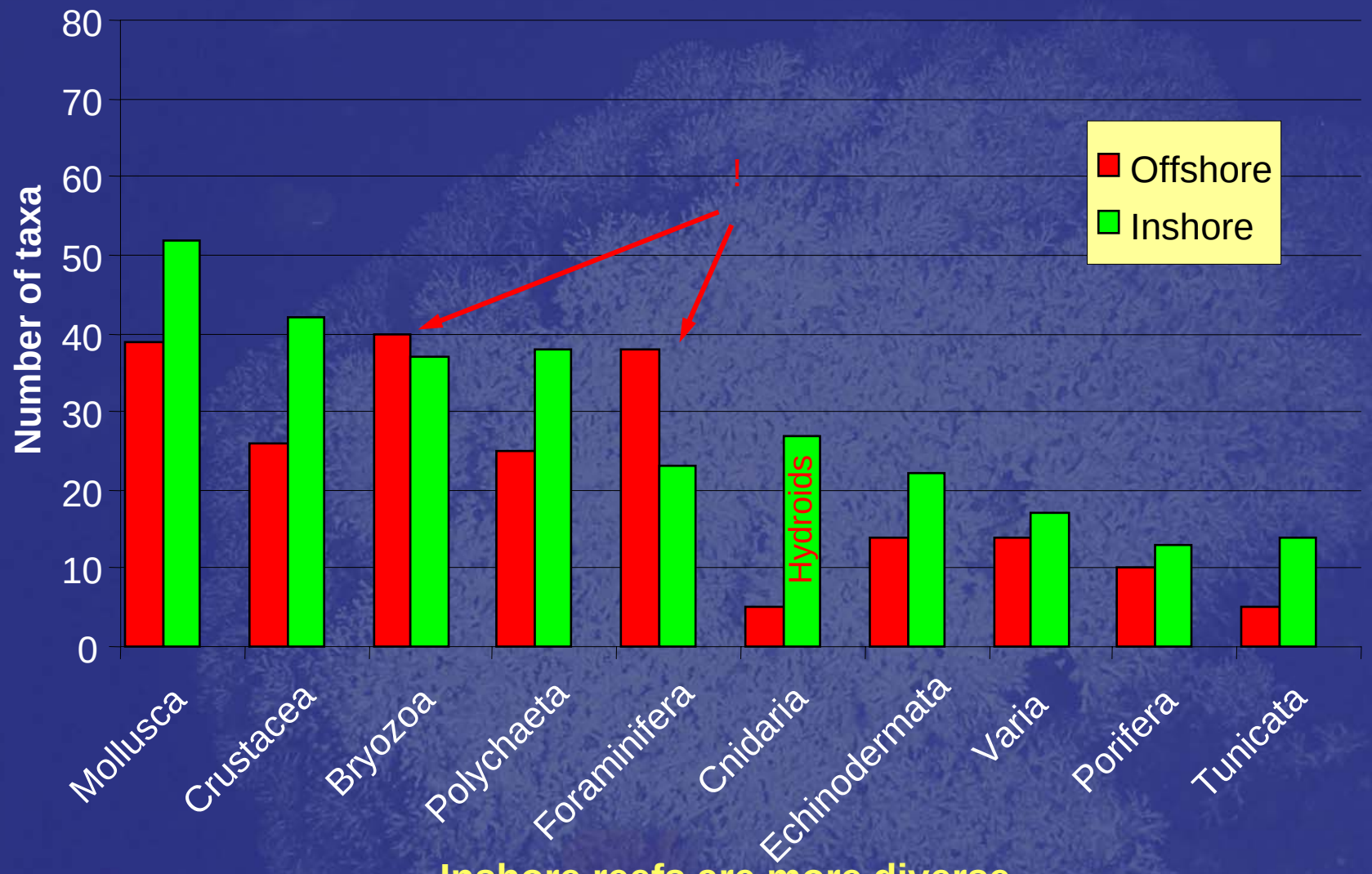
The four most species rich phyla:

- **Mollusca 71**
- **Crustacea 57 (many rare species)**
- **Bryozoa 52**
- **Polychaeta 45**

Examples of two specialised species inhabiting living coral:

Taxonomic composition

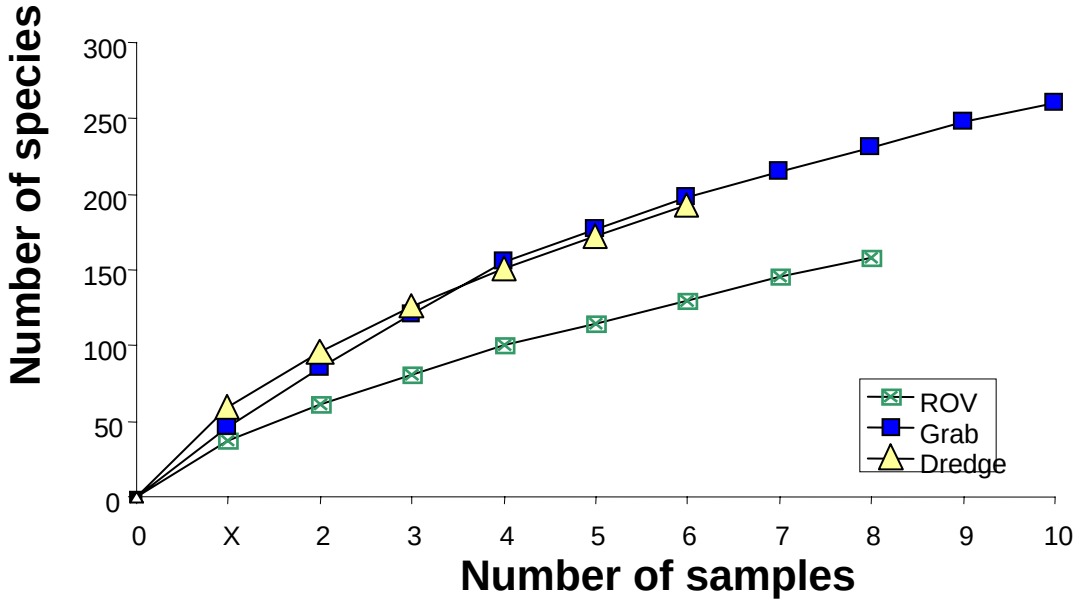
offshore vs. inshore reefs in Norway

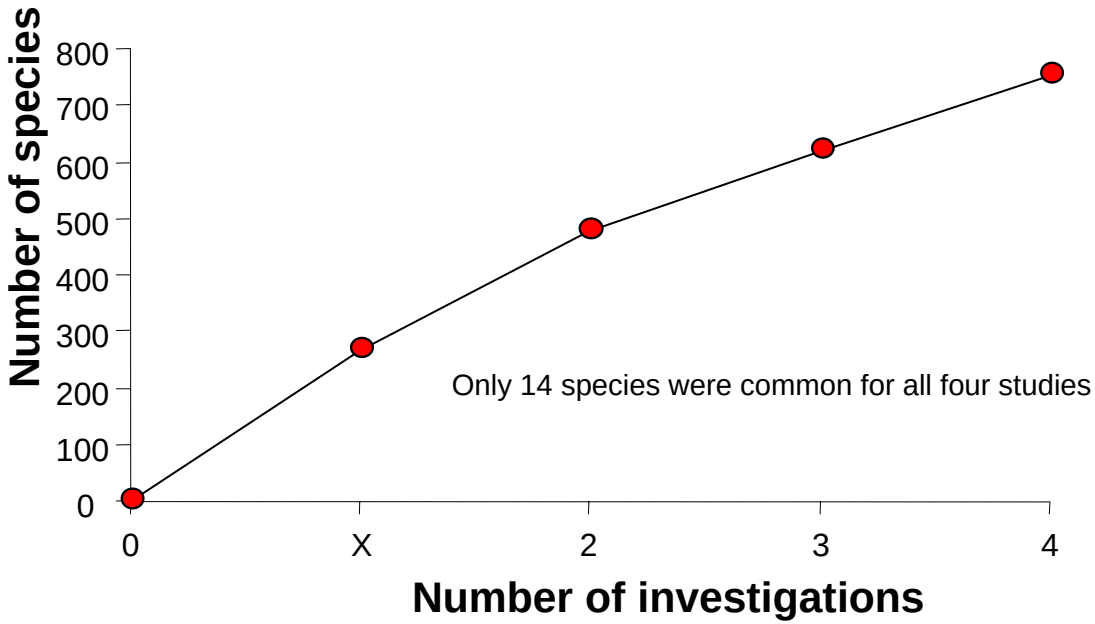


Inshore reefs are more diverse
(301 vs. 238 species)

(Mortensen & Fosså 2006)

Cumulative number of species





Based on:

Dons (1944);

Burdon-Jones & Tambs-Lyche (1960);

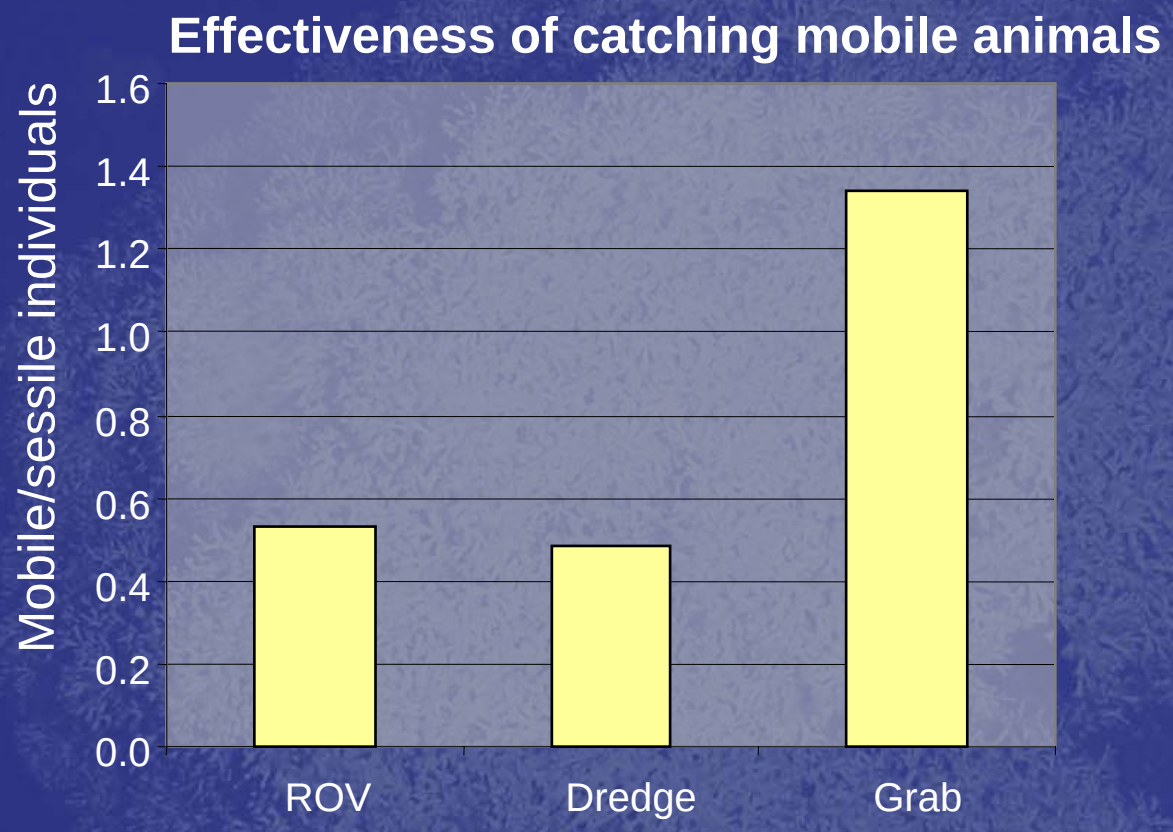
Jensen & Fredriksen (1992); Mortensen & Fosså (2006)

Biodiversity on *Lophelia* reefs

- **The associated fauna on *Lophelia*-reefs is rich in species and is dominated by sessile filter feeders**
- **No obligate relationships have been documented in the Northeast Atlantic (so far)**
- **Many species are rare in other habitats. *Lophelia*-reefs are an important habitat for many species**
- **Coastal reefs are more diverse that reefs on the continental shelf**
- **The composition of sampled species is to a large degree determined by the sampling method. Video-assisted grab is recommended**

Effects of sampling gear types

- Number of species and individuals per sample were highest for triangular dredge and lowest for ROV (- sample size)



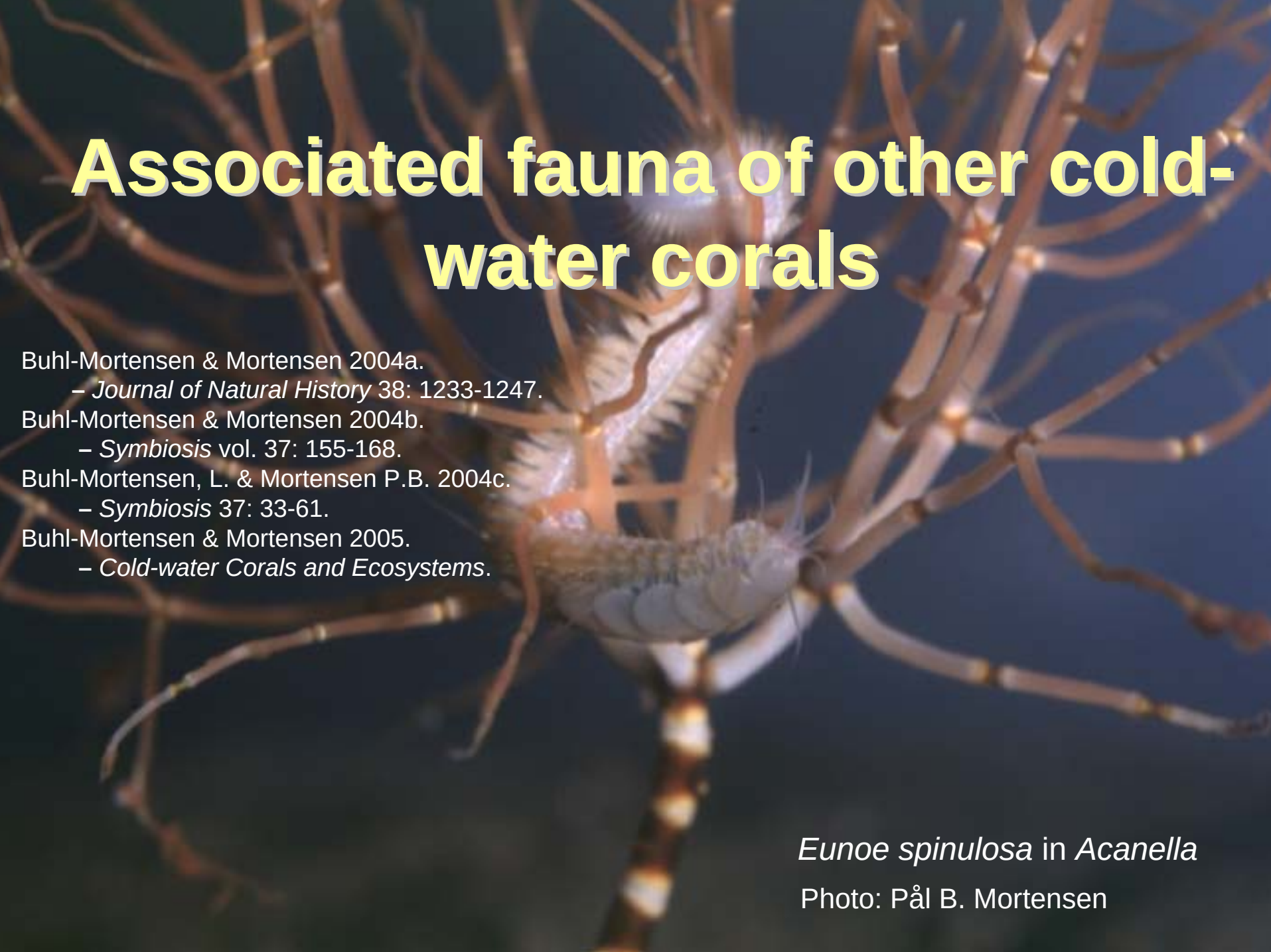
- A grab equipped with a video camera effectively samples the fauna (mobile animals are better represented) and damages less coral compared to a dredge

(Mortensen & Fosså 2006)


Sampling of associated fauna using a slurper
(ROPOS 2001)

Associated fauna of other cold-water corals

Buhl-Mortensen & Mortensen 2004a.
– *Journal of Natural History* 38: 1233-1247.
Buhl-Mortensen & Mortensen 2004b.
– *Symbiosis* vol. 37: 155-168.
Buhl-Mortensen, L. & Mortensen P.B. 2004c.
– *Symbiosis* 37: 33-61.
Buhl-Mortensen & Mortensen 2005.
– *Cold-water Corals and Ecosystems*.



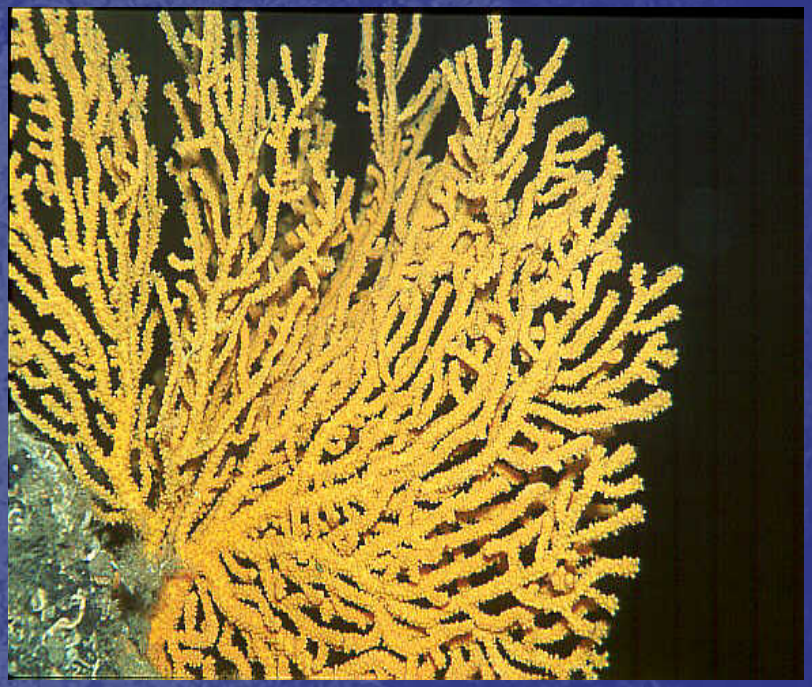
Eunoe spinulosa in *Acanella*

Photo: Pål B. Mortensen

Fauna on Paramuricea placomus

(from Strömgren 1970)

AMPHIPODA	
Stenopleustes nodifer	5180
Jassa spp.	340
Laetmatophilus armatus	15
Dulichia spp.	160
Phthisica marina	10
Caprella ciliata	50
Aeginella spinosa	20
ISOPODA	
Atacilla longicornis	684

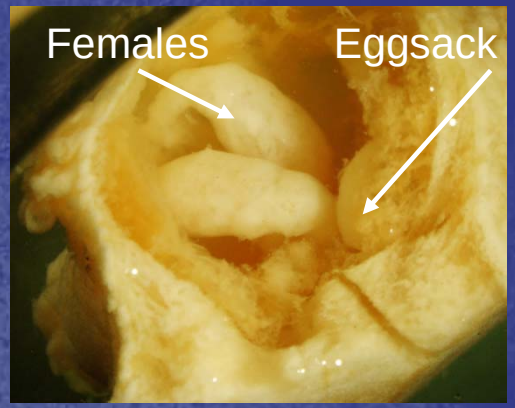


Paramuricea placomus
Photo: E. Svensen

Associated fauna of *Paragorgia arborea*

Gorgonocephalus lamarckii

Galls containing parasitic copepod



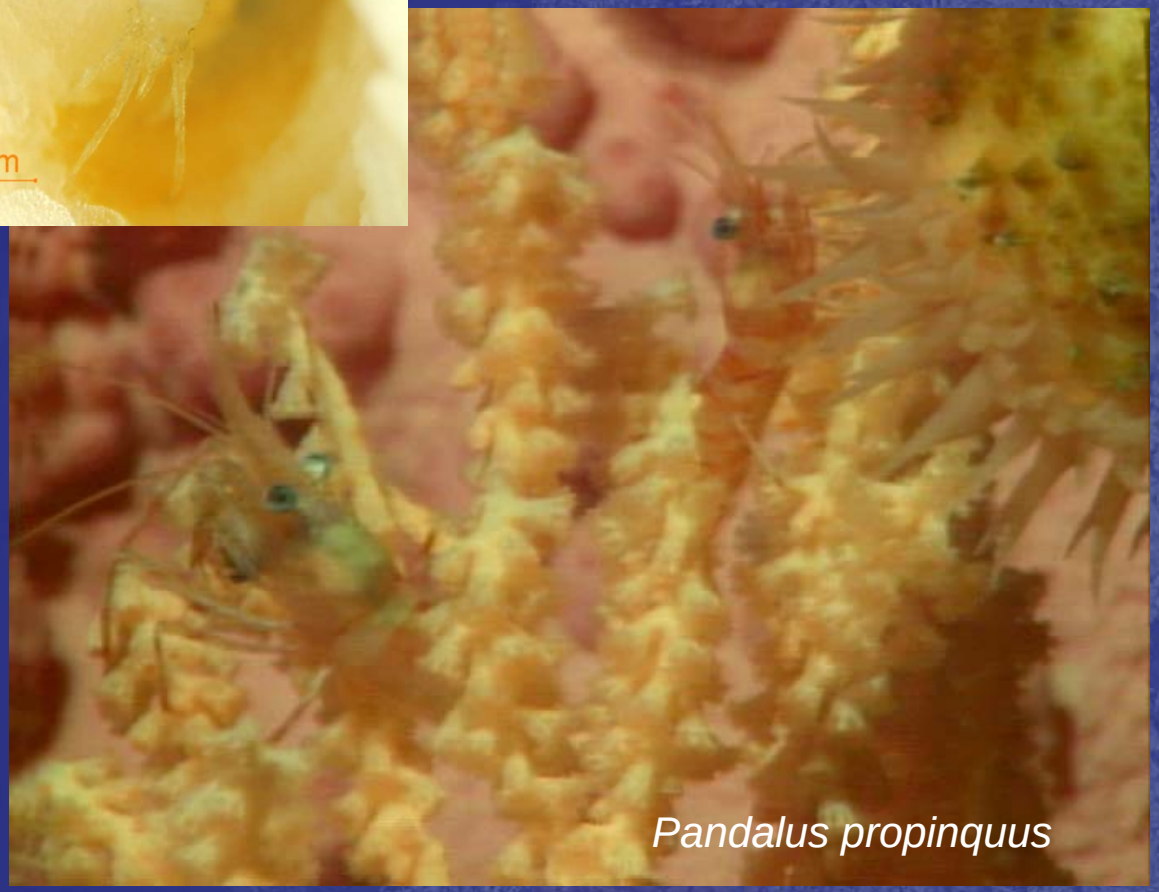
Gorgonophilus canadensis

Pandalus propinquus

Lichomolgid copepod

Photographs: Lene Buhl-Mortensen

Associated fauna of *Primnoa resedaeformis*

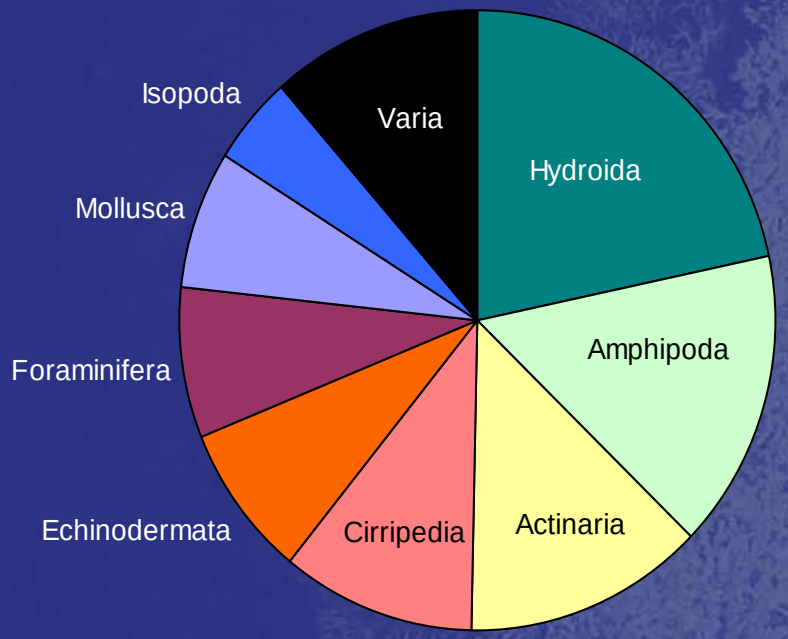


Enalcyonium cf. *olssoni*

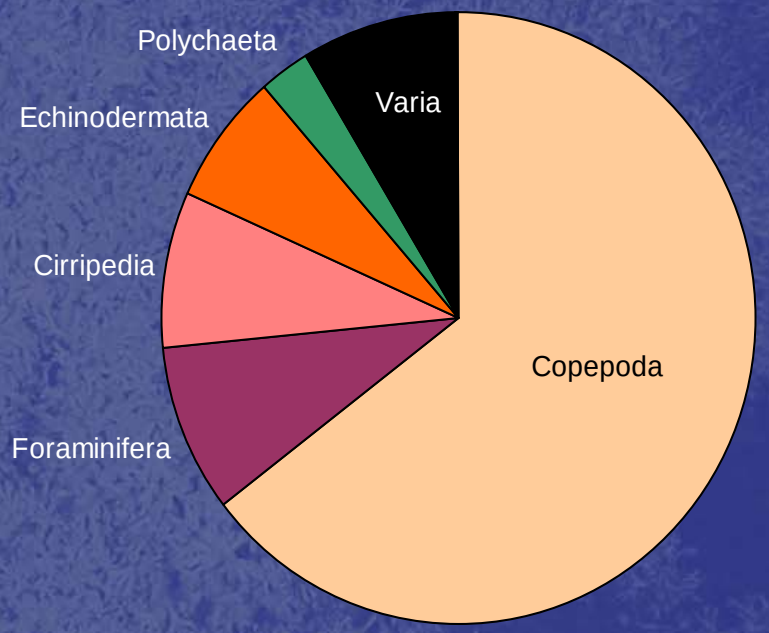
Photographs: Lene Buhl-Mortensen

Relative abundance of different taxonomic groups of associated fauna

(Buhl-Mortensen & Mortensen 2004a)



Primnoa



Paragorgia

Some research questions

- **Does the associated fauna of cold water coral reflect the general biogeographic patterns?**
- **Are there more examples of obligate relationships towards the equator?**
- **What can be done to provide comparable results?**

Compare what is comparable

- **Samples**
  - **Gear**
  - **Sample size and number**
  - **Habitat**
- **Representative coral habitats**
  - **For example: Norwegian offshore reefs are different from coastal reefs**
- **Taxonomic resolution**
- **Seasonal effects?**
- **How stable are the communities?**