Antarctic macrobenthic assemblages:

a survey of diversity, abundance and trophic structure

Courtney Zimmer and Laura Steinmann

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Patrick Reynolds, Advisor

Objectives

- Estimate diversity and abundance of benthic invertebrate species
- Identify and distinguish faunal distribution and trophic patterns
- Relate patterns to environmental parameters

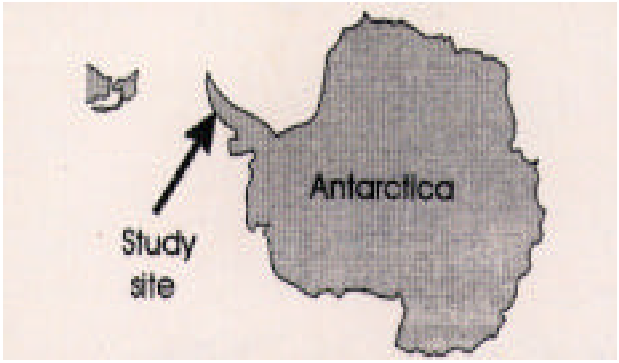
Samples

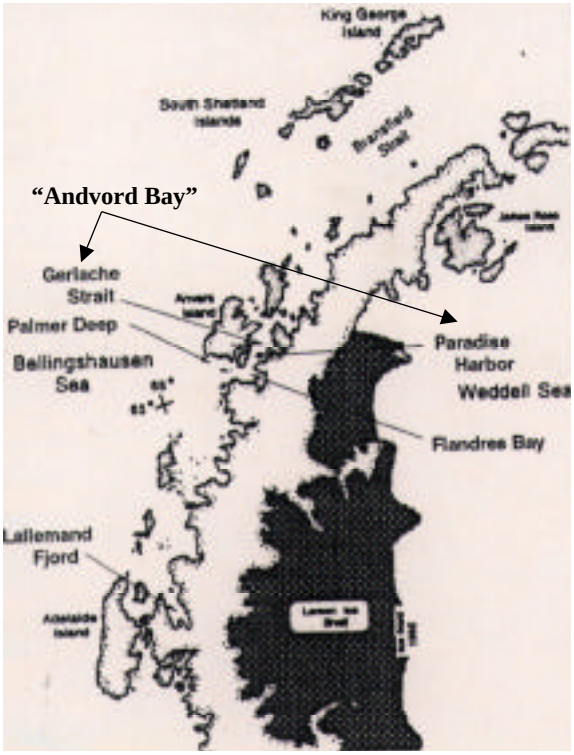
Collected on the NSF R/V Nathaniel B. Palmer, March 1999

Methods

- Sieve samples to 0.5 mm
- Fix samples in 10% formalin
- Remove formalin and preserve samples in 80% ethanol
- Use a dissecting scope to sort samples and identify invertebrates

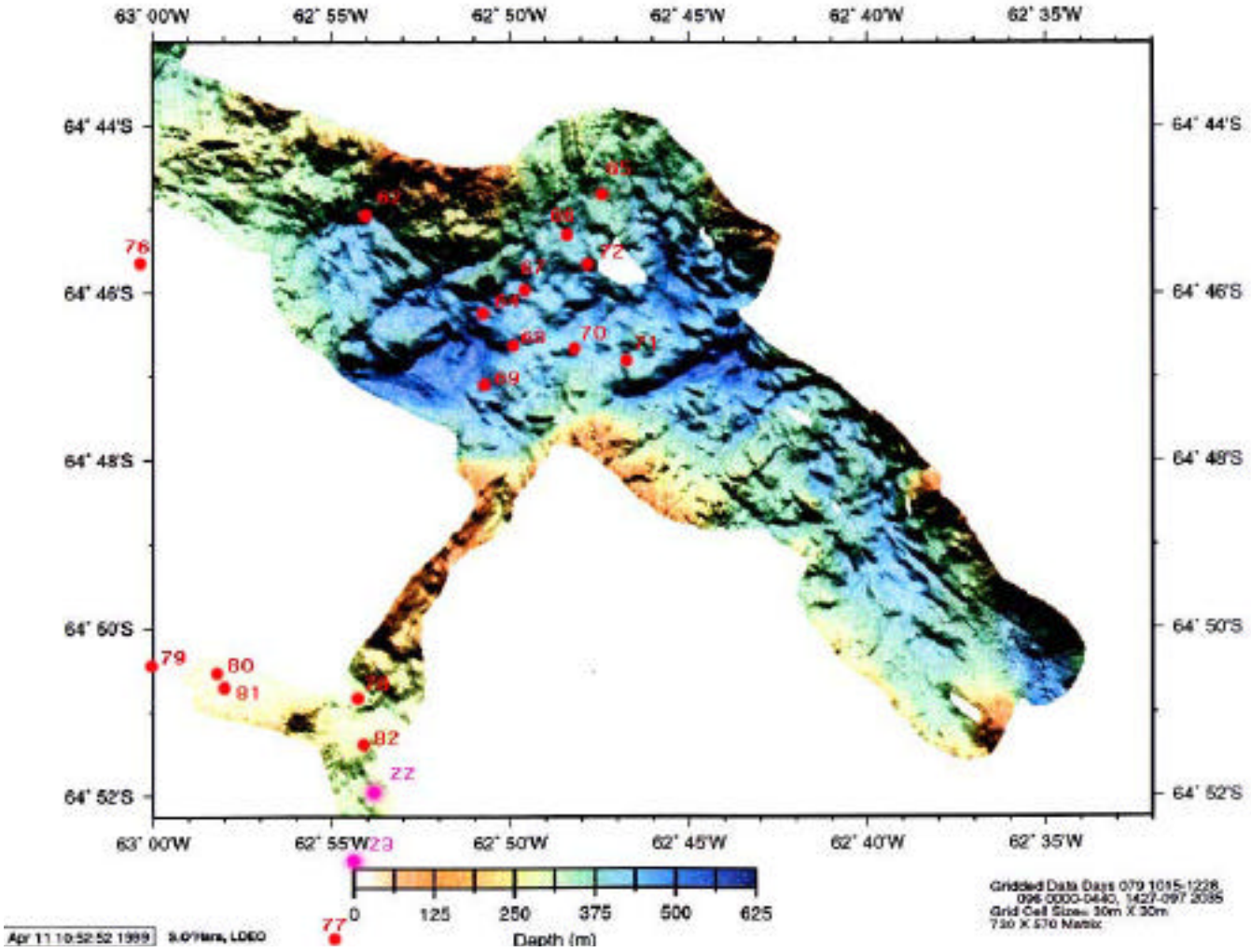
Study Sites


Antarctica
Study site


King George Island
South Shetland Islands
Bransfield Strait
"Andvord Bay"
Gerlache Strait
Palmer Deep
Bellingshausen Sea
Paradise Harbor
Weddell Sea
Flandres Bay
Lallemand Fjord

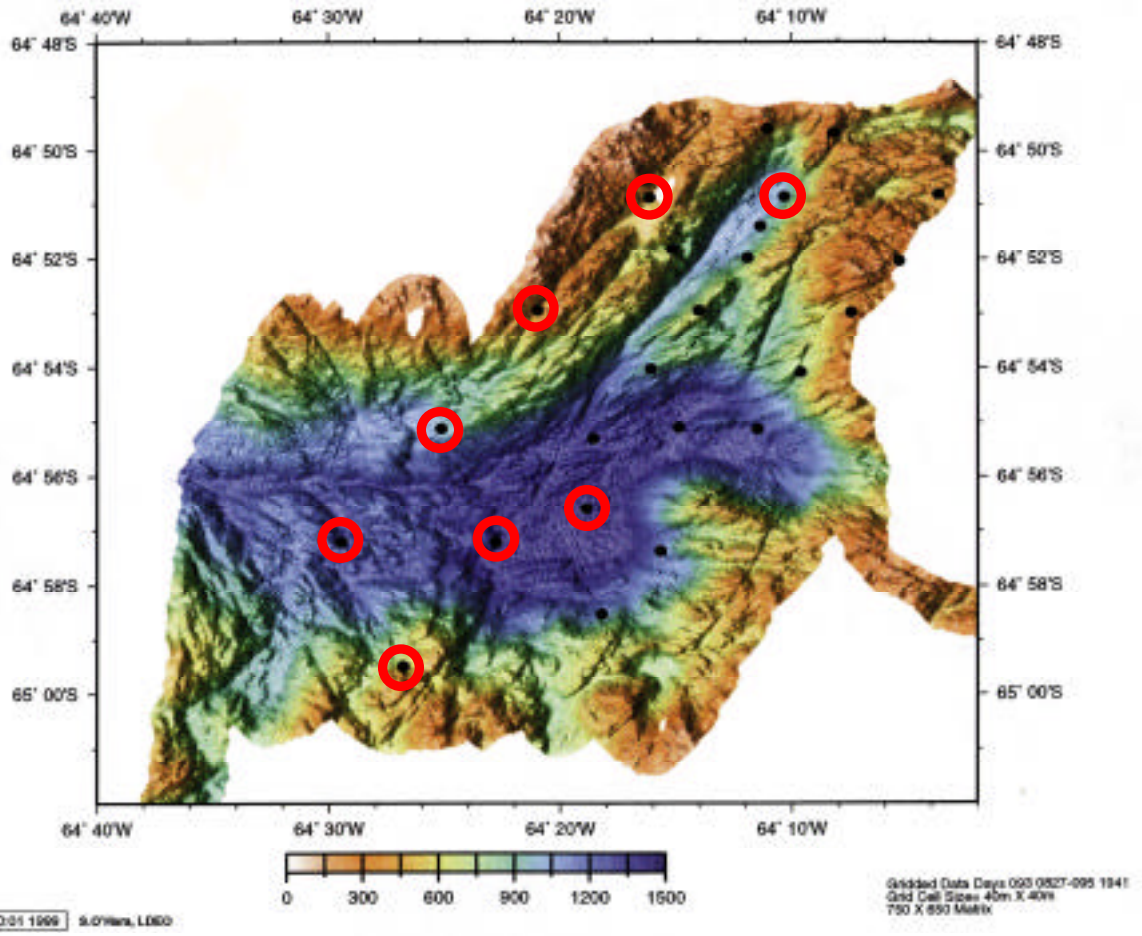
NBP9902 & NBP9903 SeaBeam Edited Data - Andvord Bay

Stations: red = 1998; pink = 1999



NBP9903 SeaBeam Edited Data - Palmer Deep

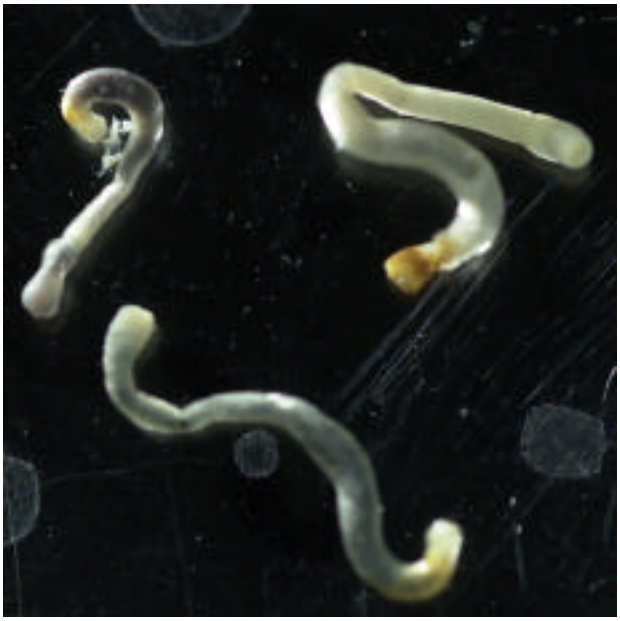
Stations: black only = 1998; red = 1999



Faunal data table

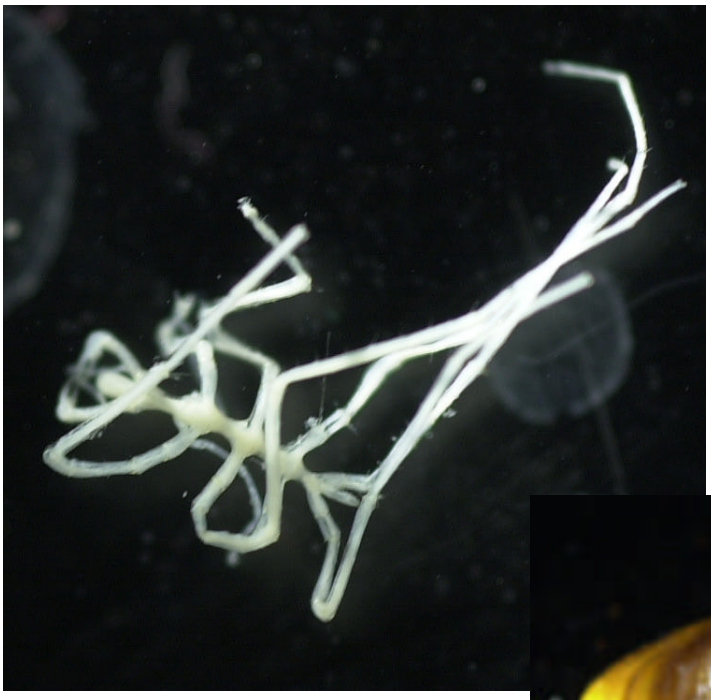
	grab 23	grab 22	grab 17	grab 16	grab 15	grab 14	grab 13	grab 11	grab 9	grab 8
maldanidae species 3	24	48								
bivalve species 1	16	7	29	2	3	4	3			5
sternaspidae					2	15	10		6	25
maldanidae species 1	29	19								3
lumbrineridae species 1	7	12				1	13	3		11
nematode						4	4			22
capitellidae species 2 (bb)					1	6	3	16		1
capitellidae species 1		7			3		15			1
bivalve species 2	21					1			1	
paraonidae (caterpillar worm	5	5			1		6			
owenidae	2						8			5
opheliidae	10	4							1	
orbinidae				3	3		4	1	2	
cirratulid (orbin but not)	3						2			8
terebellidae species 2		1	8	4						
terrebellidae species 1	3	4			1				5	
tanaid		12				1				
oligochaete		1				7			3	1
scalibregmidae	5	1				2			4	
nemertean				1		3	1	1	3	2
spionidae v7 (11)/ u1B/ uS/	1	2		1	3		1	1	1	1
amphipod sp 1	1	5								4
nephtyidae			2	1	2	4				
sipunculan	3	2			1					3
bivalve species 4	4	5								
pectinaridae	2	5								1
maldanidae species 2	1	1					1			3
solengastae						2				4
arebellidae		5				1				
v11 (14)/ v(1) (11) probably not an annelid						3		1		
anemone (burrowing)			2						1	
Echiuran					2		1			
lumbrineridae species 2							2			1
ophiuroidae						2	1			
ampharetidae		1								1
arenicolidae					2					
bivalve species 3	1									1
glyceridae	1						1			
amphipod sp 2										1
aphroditidae (sea mouse)						1				
chaetopteridae						1				
isopod						1				
pycnogonida								1		
sabellid							1			
sponge						1				
unknown J Sipunculan or Priapulan							1			
amphanomidae		1								
dorvolleidae		1								
lumbrineridae species 3		1								
trichobranchidae		1								
unknown polychaete	1									

Orbiniidae



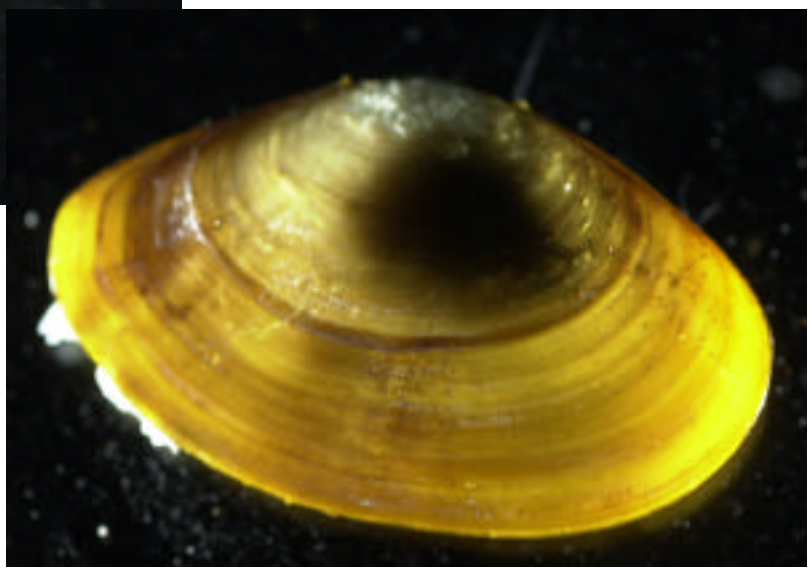
Caudofoveata

Pectinaridae



Pycnogonida

Ophiuroidea



Yoldia

Lumbrineridae

Paraonidae

Scalibregmidae

Diversity and Abundance

- Diversity measured using Shannon-Weiner index
  - Species richness
  - Species evenness
- High or low diversity in deep basins?
  - Traditionally, deep sea thought to have low diversity due to patchy food supplies, cold temperatures, and low light supplies (Rex, 1981)
  - Stability-Time (Sanders, 1968) and Habitat Heterogeneity (Gage, 1996) hypotheses predict high diversity due to long-term stability, creating a more heterogeneous environment and reduced competition

Summary data table

total # of individuals	149	140	104	78	60	41	27	24	24	12
total different groups	24	20	21	19	19	4	10	12	7	6
shannon-weiner diversity	2.4825687	2.41901285	2.39769863	0.85845743	1.63263093	2.43337408	1.19233481	2.5546984	2.49989277	2.0987668
depth	313	243	673	361	445	1430	1220	970	1040	1336
grab number	22	23	15	17	16	8	11	14	13	9
total # of individuals	149	104	140	78	60	24	27	24	12	41
total different groups	24	21	20	19	19	12	10	7	6	4
shannon-weiner diversity	2.4825687	2.39769863	2.41901285	0.85845743	1.63263093	2.5546984	1.19233481	2.49989277	2.0987668	2.43337408
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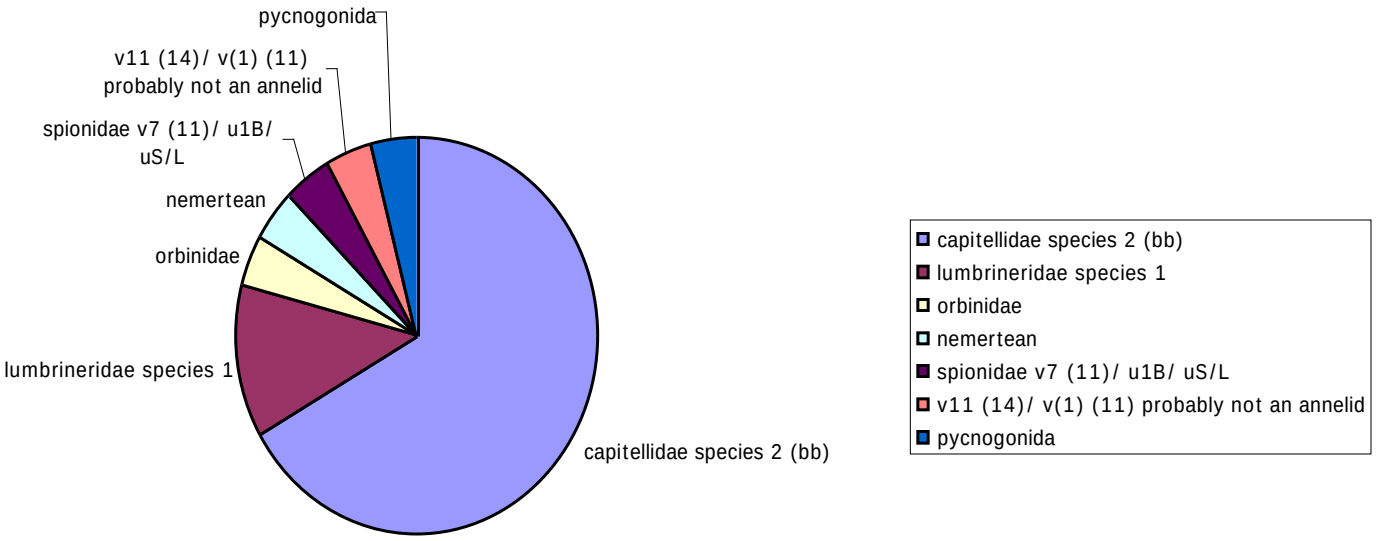
total different groups	12	7	24	4	20	21	6	19	10	19
shannon-weiner diversity	2.5546984	2.49989277	2.4825687	2.43337408	2.41901285	2.39769863	2.0987668	1.63263093	1.19233481	0.85845743
depth	970	1040	313	1430	243	673	1336	445	1220	361
grab number	14	13	22	8	23	15	9	16	11	17
total # of individuals	41	12	27	24	24	104	60	78	149	140
total different groups	4	6	10	7	12	21	19	19	24	20
shannon-weiner diversity	2.43337408	2.0987668	1.19233481	2.49989277	2.5546984	2.39769863	1.63263093	0.85845743	2.4825687	2.41901285
depth	1430	1336	1220	1040	970	673	445	361	313	243
grab number	8	9	11	13	14	15	16	17	22	23

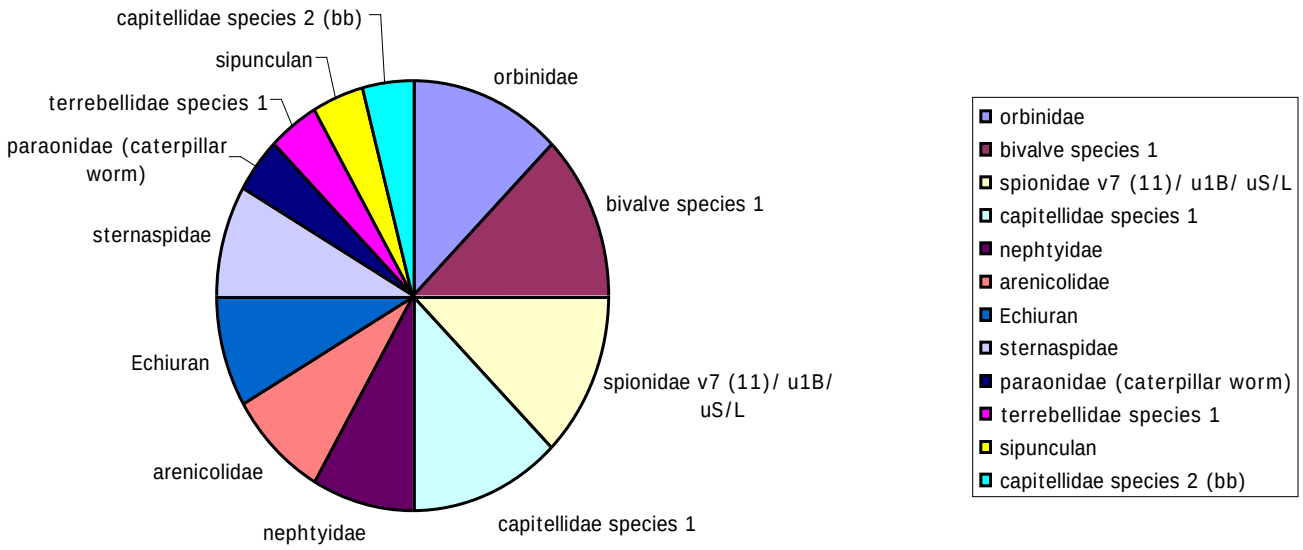
grab 11

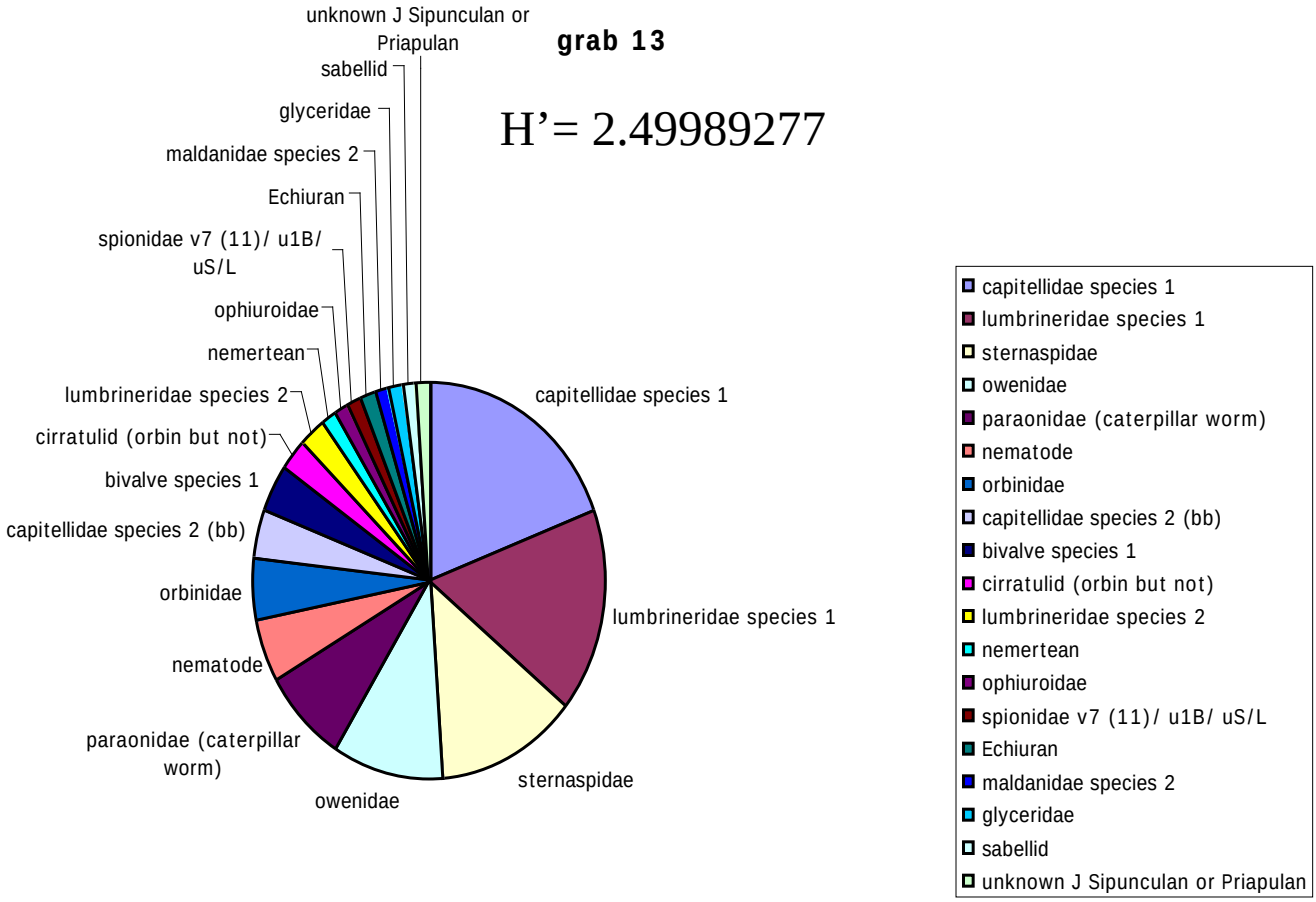
H'= 1.19233481



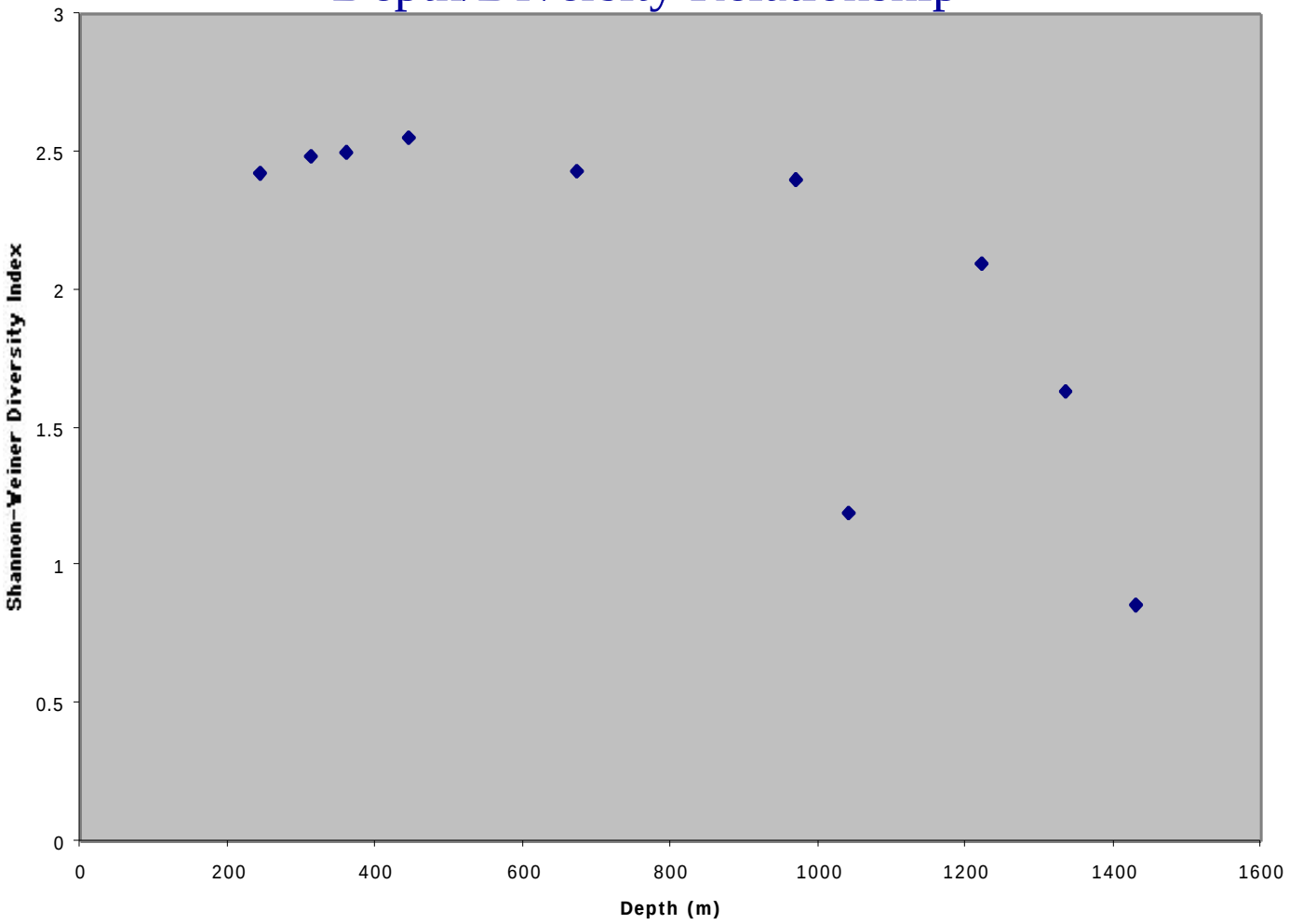
grab 15

H'= 2.39769863



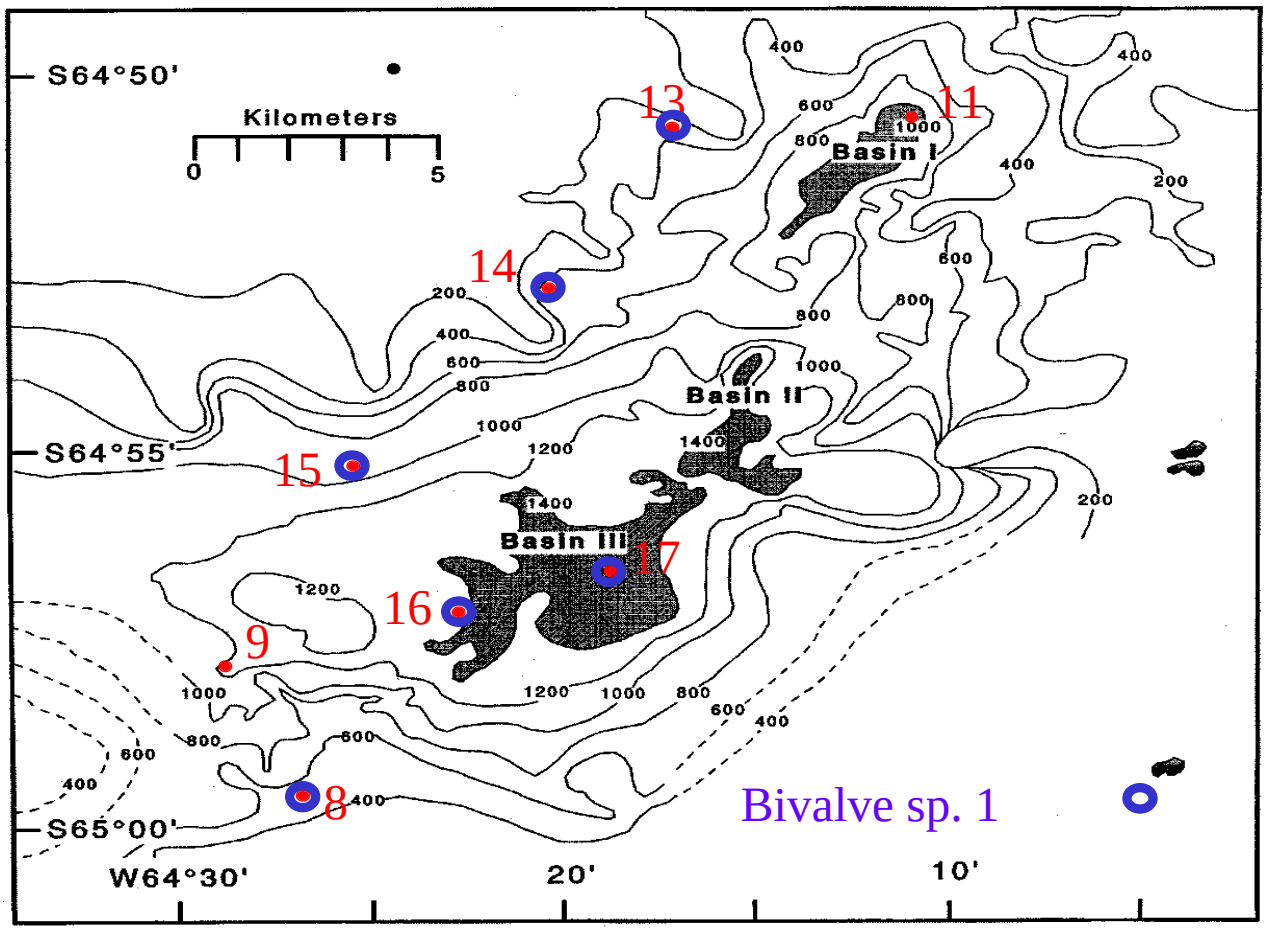

grab 13
H'= 2.49989277
unknown J Sipunculan or Priapulan
sabellid
glyceridae
maldanidae species 2
Echiuran
spionidae v7 (11)/ u1B/ uS/L
ophiuroidae
nemertean
lumbrineridae species 2
cirratulid (orbin but not)
bivalve species 1
capitellidae species 2 (bb)
orbinidae
nematode
paraonidae (caterpillar worm)
owenidae
sternaspidae
lumbrineridae species 1
capitellidae species 1
capitellidae species 1
lumbrineridae species 1
sternaspidae
owenidae
paraonidae (caterpillar worm)
nematode
orbinidae
capitellidae species 2 (bb)
bivalve species 1
cirratulid (orbin but not)
lumbrineridae species 2
nemertean
ophiuroidae
spionidae v7 (11)/ u1B/ uS/L
Echiuran
maldanidae species 2
glyceridae
sabellid
unknown J Sipunculan or Priapulan

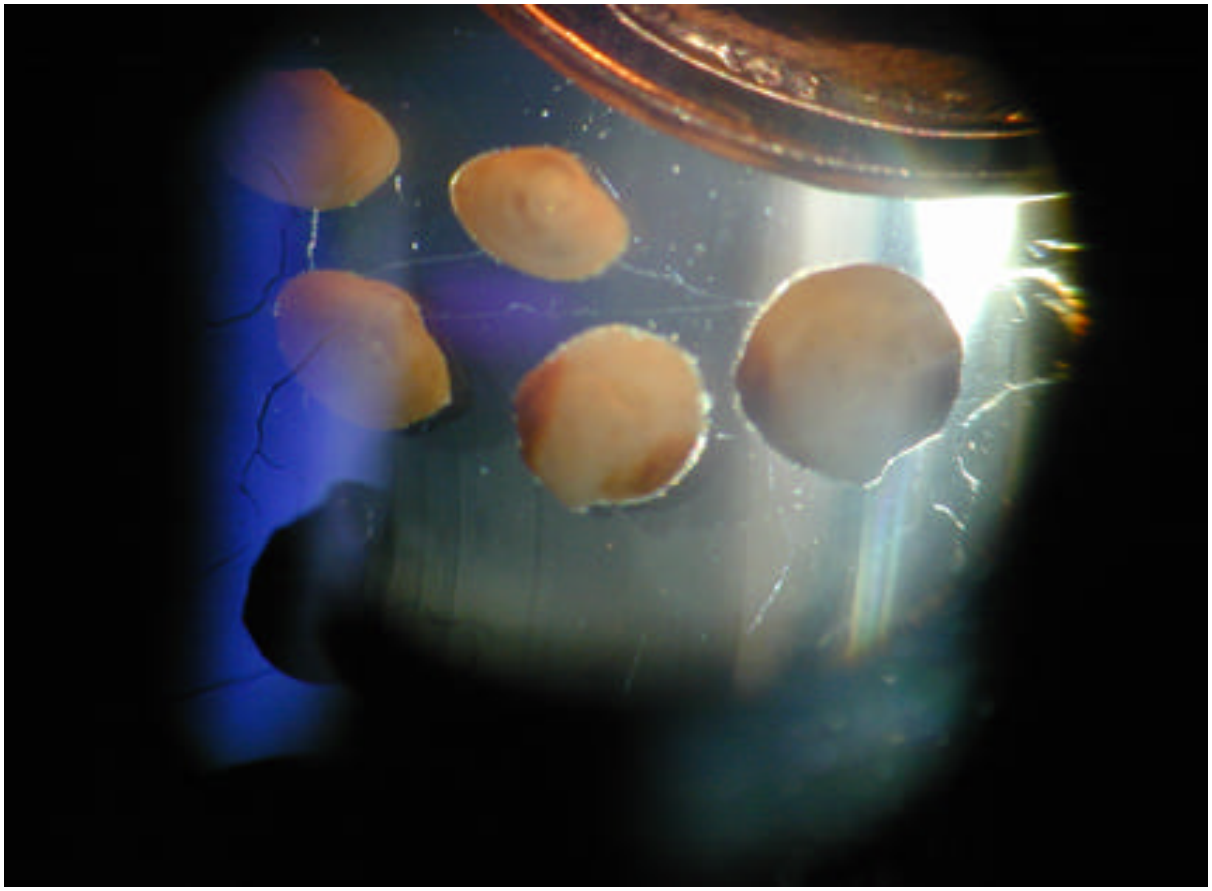
Depth/Diversity Relationship



General Species Patterns

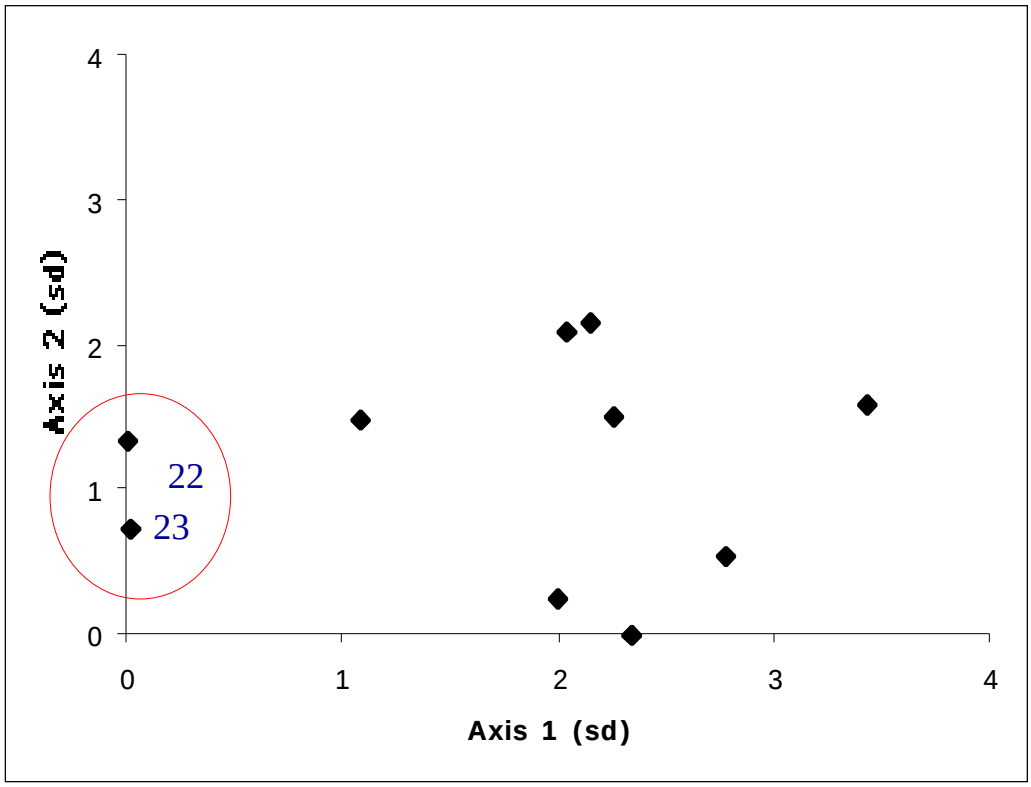
- Depth:
  - Wide range
    - Bivalve sp. 1 found at all depths
    - Spionidae < 1400m
    - Lumbrineridae < 900m
  - Limited range
    - Burrowing anenome >1200m
    - Maldanidae sp. 2 < 600m
    - Maldanidae sp. 1 < 300m

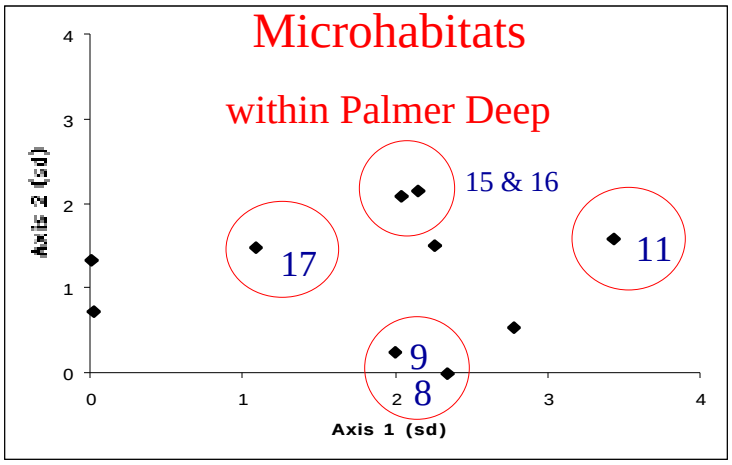

S64°50'
Kilometers
0
5
13
11
Basin I
14
Basin II
S64°55'
15
Basin III
17
16
9
8
Bivalve sp. 1
S65°00'
W64°30'
20'
10'

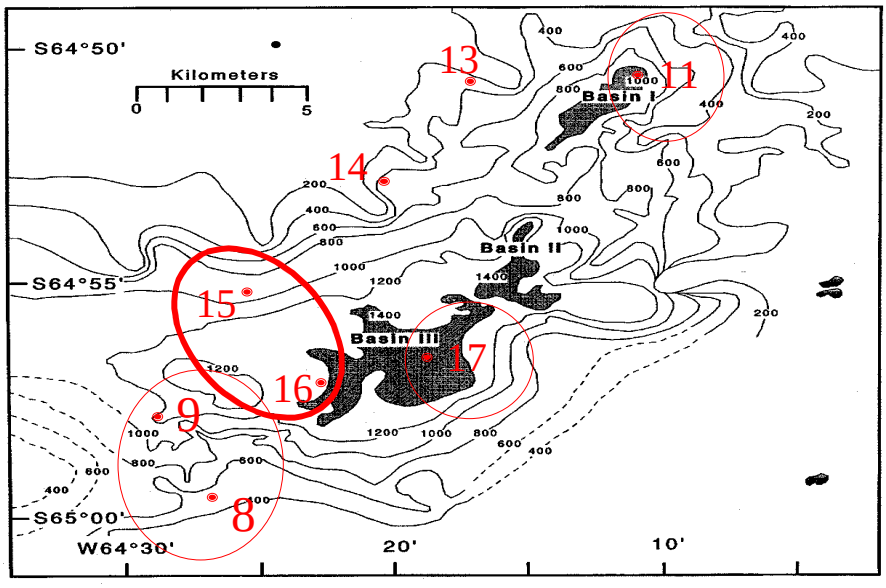


Bivalves (spp. 1 and 2)

Cluster Analysis




Microhabitats
within Palmer Deep
15 & 16
17
11
9
8
Axis 2 (sd)
Axis 1 (sd)
0
1
2
3
4


S64°50'
S64°55'
S65°00'
W64°30'
20'
10'
Kilometers
0
5
Basin I
Basin II
Basin III
13
11
14
15
16
17
9
8

Regional Differences

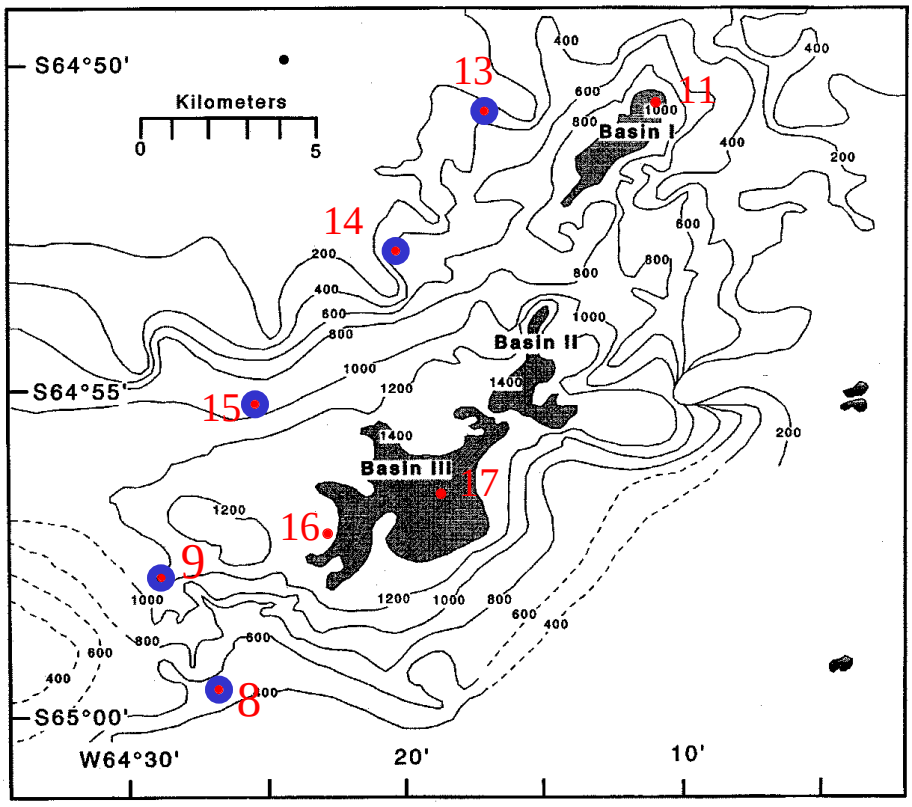
Palmer Deep

- Sternaspidae
- Orbiniidae
- Nephtyidae
- Arenicolidae
- Lumbrineridae sp. 2
- Burrowing anemone
- Echiurans
- Ophiuroids
- Solenogastre
- Nematodes
- Nemerteans

Andvord Bay

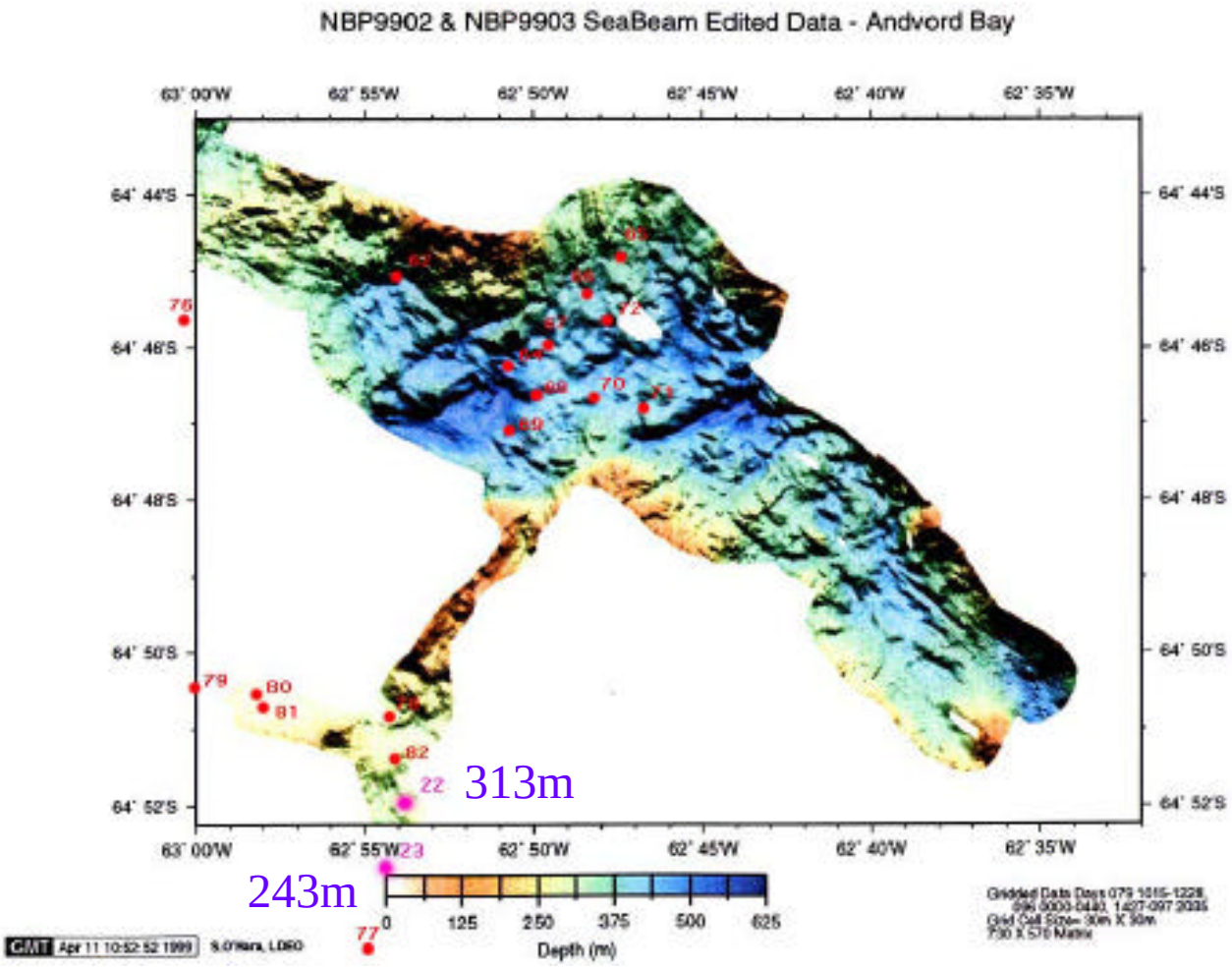
- Bivalve sp. 4
- Amphinomidae
- Lumbrineridae sp. 3
- Trichobranchidae

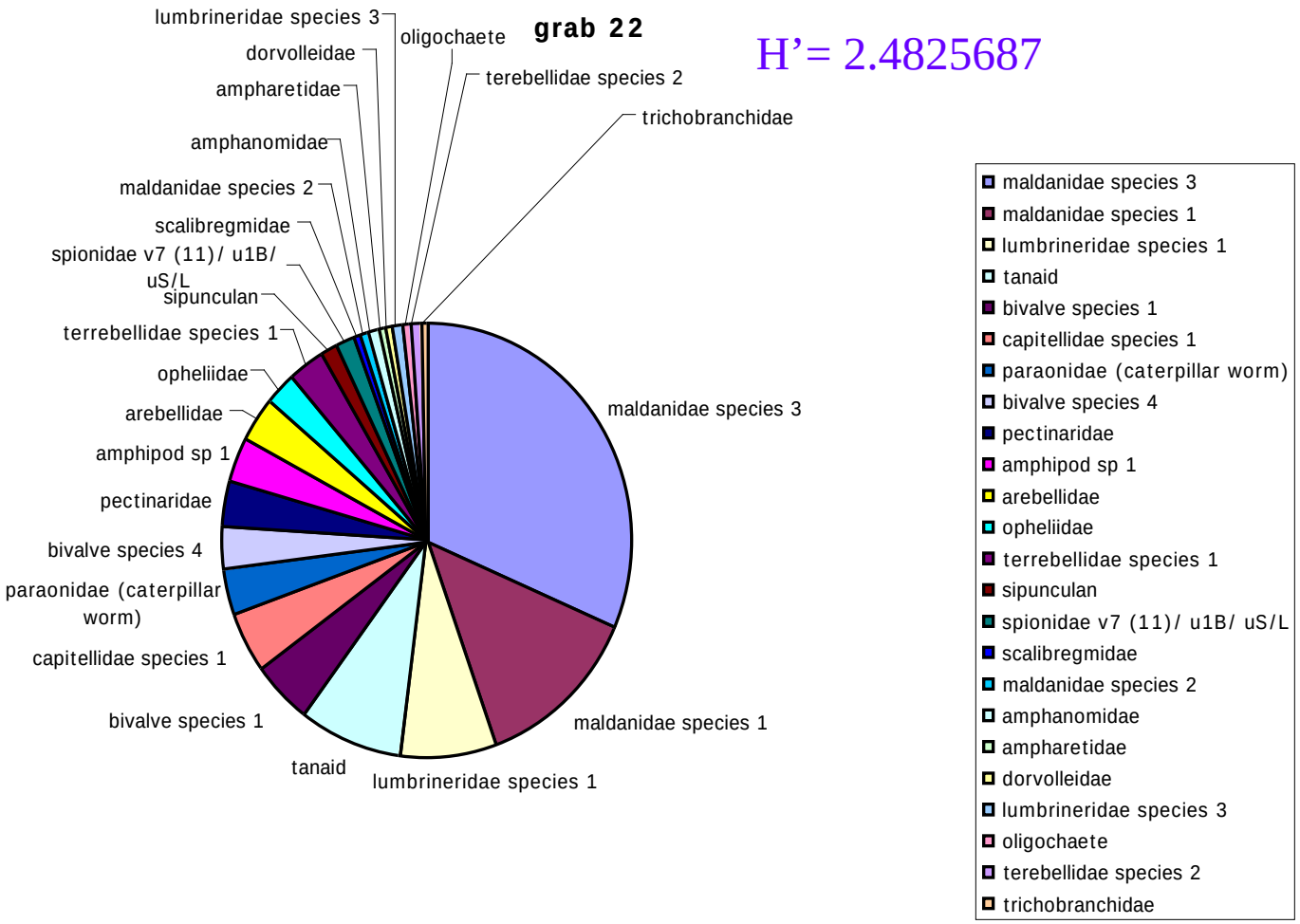
Palmer Deep

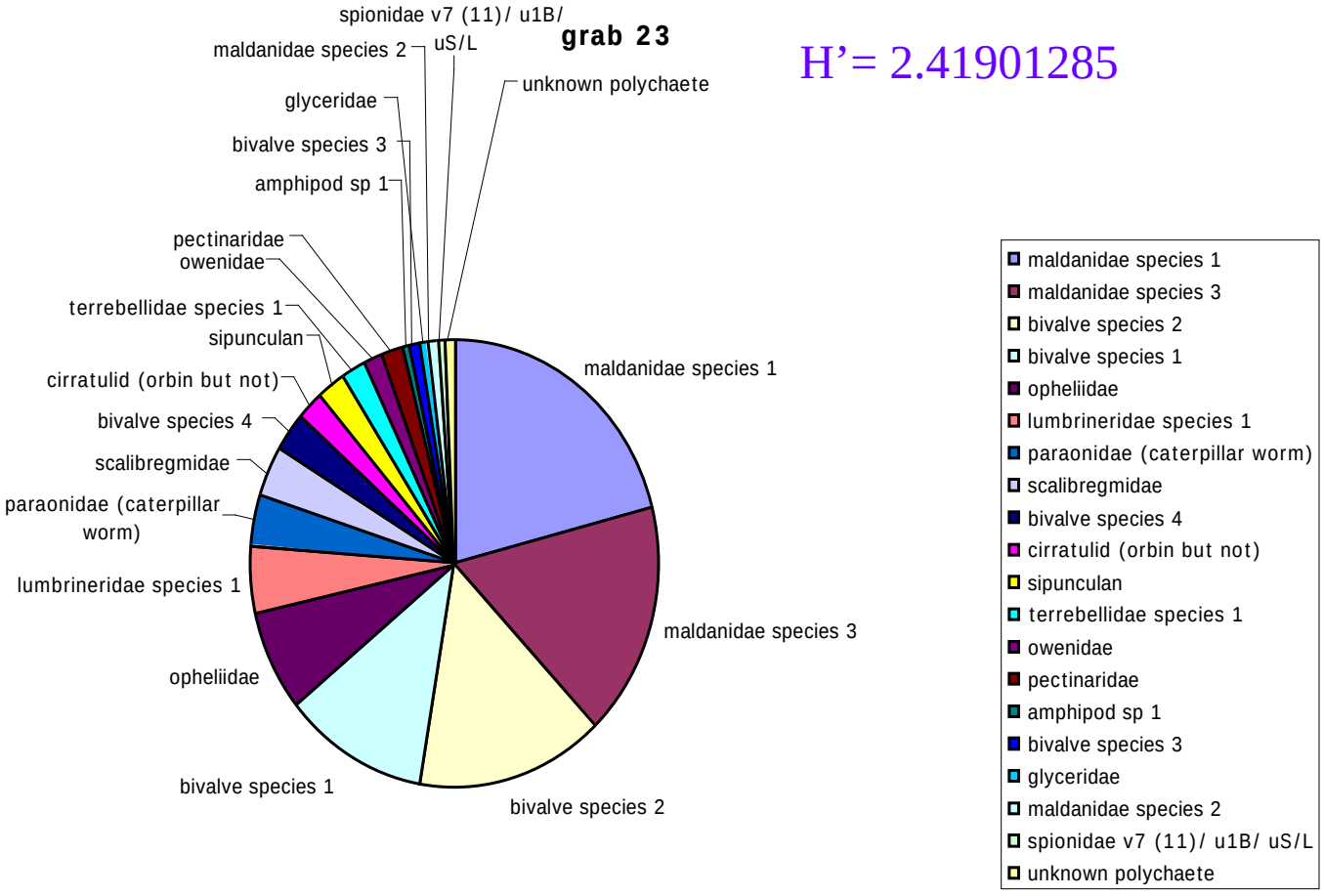


Sternaspidae

- Most dominant at 3 of the 5 shallower sites
- One of 43 species, makes up 15% of the individuals


NBP9902 & NBP9903 SeaBeam Edited Data - Andvord Bay
63° 00'W
62° 55'W
62° 50'W
62° 45'W
62° 40'W
62° 35'W
64° 44'S
64° 46'S
64° 48'S
64° 50'S
64° 52'S
76
79
80
81
82
22
23
77
313m
243m
0
125
250
375
500
625
Depth (m)
GMT Apr 11 10:52:52 1999

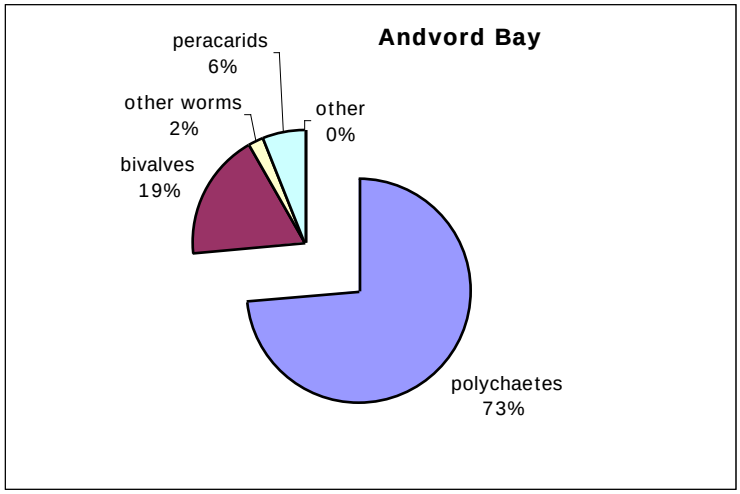

grab 22
H'= 2.4825687
lumbrineridae species 3
oligochaete
dorvolleidae
terebellidae species 2
ampharetidae
trichobranchidae
amphanomidae
maldanidae species 2
scalibregmidae
spionidae v7 (11)/ u1B/ uS/L
sipunculan
terrebellidae species 1
opheliidae
arebellidae
amphipod sp 1
pectinaridae
bivalve species 4
paraonidae (caterpillar worm)
capitellidae species 1
bivalve species 1
tanaid
lumbrineridae species 1
maldanidae species 1
maldanidae species 3
maldanidae species 3
maldanidae species 1
lumbrineridae species 1
tanaid
bivalve species 1
capitellidae species 1
paraonidae (caterpillar worm)
bivalve species 4
pectinaridae
amphipod sp 1
arebellidae
opheliidae
terrebellidae species 1
sipunculan
spionidae v7 (11)/ u1B/ uS/L
scalibregmidae
maldanidae species 2
amphanomidae
ampharetidae
dorvolleidae
lumbrineridae species 3
oligochaete
terebellidae species 2
trichobranchidae

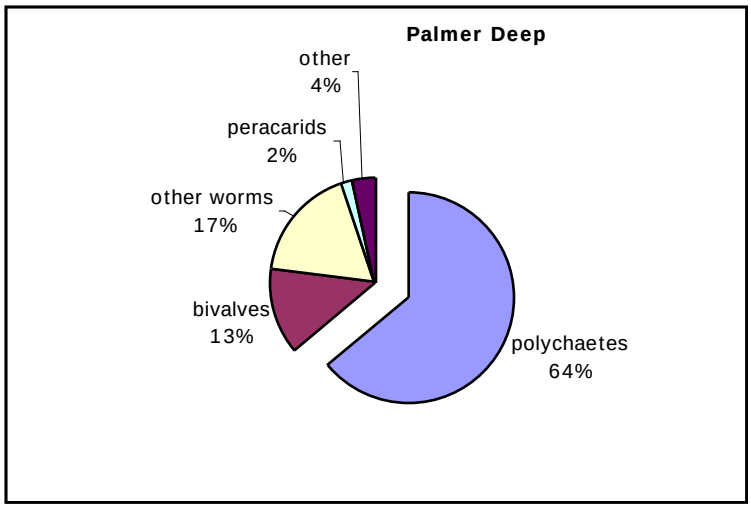

grab 23
H'= 2.41901285
spionidae v7 (11)/ u1B/ uS/L
maldanidae species 2
glyceridae
bivalve species 3
amphipod sp 1
pectinaridae
owenidae
terrebellidae species 1
sipunculan
cirratulid (orbin but not)
bivalve species 4
scalibregmidae
paraonidae (caterpillar worm)
lumbrineridae species 1
opheliidae
bivalve species 1
bivalve species 2
maldanidae species 3
maldanidae species 1
unknown polychaete
maldanidae species 1
maldanidae species 3
bivalve species 2
bivalve species 1
opheliidae
lumbrineridae species 1
paraonidae (caterpillar worm)
scalibregmidae
bivalve species 4
cirratulid (orbin but not)
sipunculan
terrebellidae species 1
owenidae
pectinaridae
amphipod sp 1
bivalve species 3
glyceridae
maldanidae species 2
spionidae v7 (11)/ u1B/ uS/L
unknown polychaete

2 sp. (Maldanidae) out of 30 total; make up 41% of individuals

Why Regional Variation?

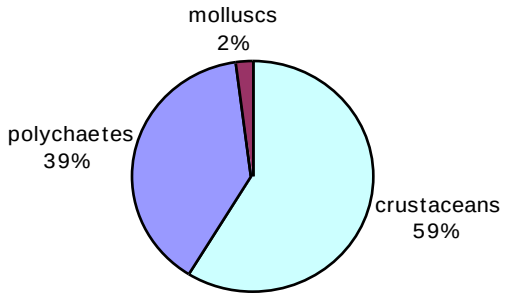
- Depth
- Temperature
- Further analysis of other environmental parameters:
  - Slope
  - MS
  - Grain size
  - Organic Carbon

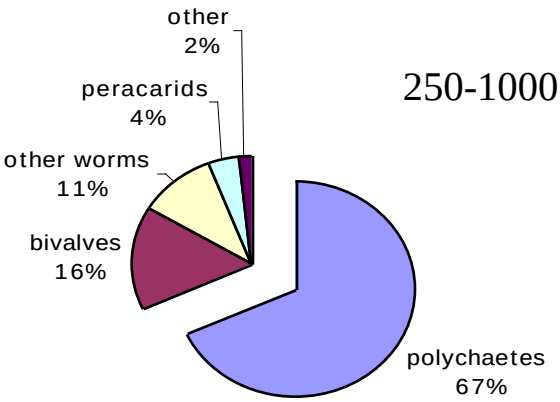

Andvord Bay
peracarids
6%
other worms
2%
other
0%
bivalves
19%
polychaetes
73%


Palmer Deep
other
4%
peracarids
2%
other worms
17%
bivalves
13%
polychaetes
64%

Arthur Harbor 26-40 m

(Lowry, 1976)

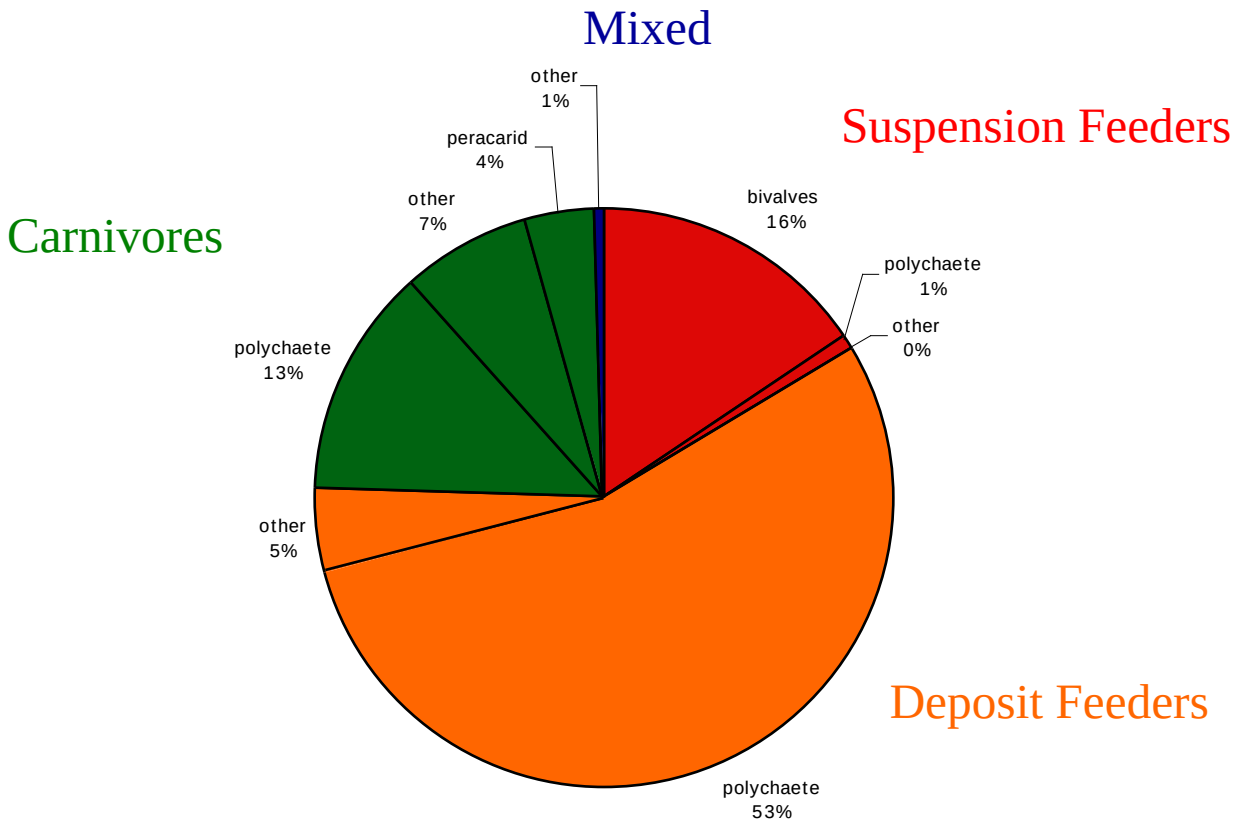


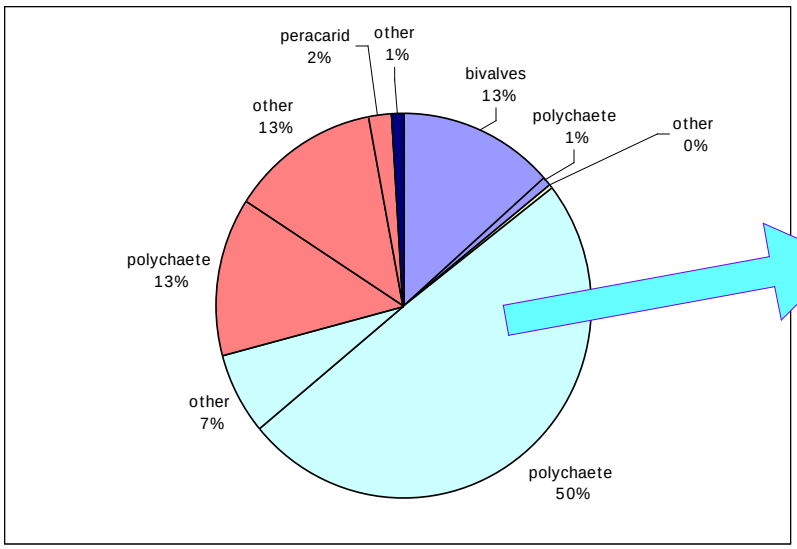


250-1000+ m

Western Antarctic Peninsula (Present study, 1999)

Trophic Structure





Palmer Deep

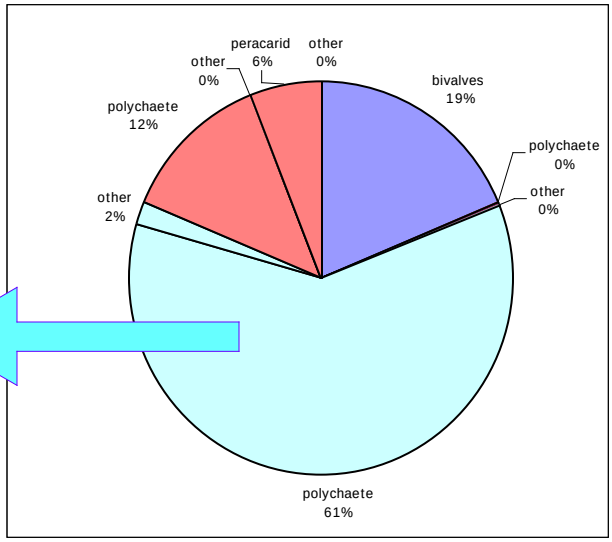
29% selective deposit

71% direct deposit

Suspension Feeders

Deposit Feeders

Carnivores



Andvord Bay

81% selective deposit

19% direct deposit

Conclusions

- Diversity decreases with increasing depth
- Faunal distribution varies among sites
  - Few species total, characterized by 1 or 2 dominant species
  - Intermediate amount of species, equitably distributed
  - Many species, with less emphasis on a singular dominant
- Assemblages dominated by deposit feeders
- Distinct communities between & within regions, related to environmental variables

Acknowledgements

Thank you so much to all who have helped along the way.

Thanks to Damhnait McHugh and Jim Blake, the polychaete experts. Other thanks to Ken Bart, Norma Cutler, Eugene Domack, Donna Moore and Lisa Rogers. Thanks to Tom Jones for his expert computer advice.

And last, but most importantly, thanks to Pat Reynolds for his countless hours, constant advice and for helping us figure out which end was the head!!!!

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