Effects of Hypoxia on the Macrobenthic Community



Kevin B. Briggs

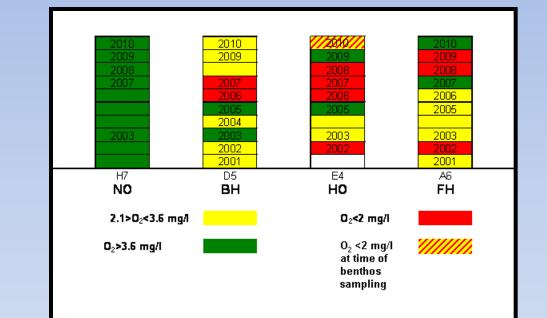
Naval Research Laboratory Seafloor Sciences Branch Stennis Space Center, MS

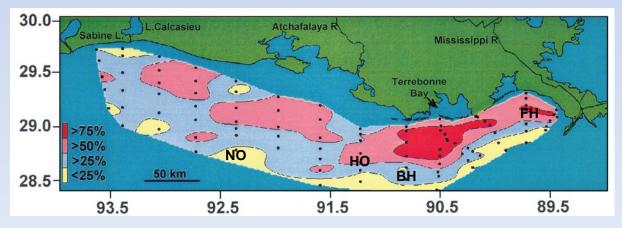
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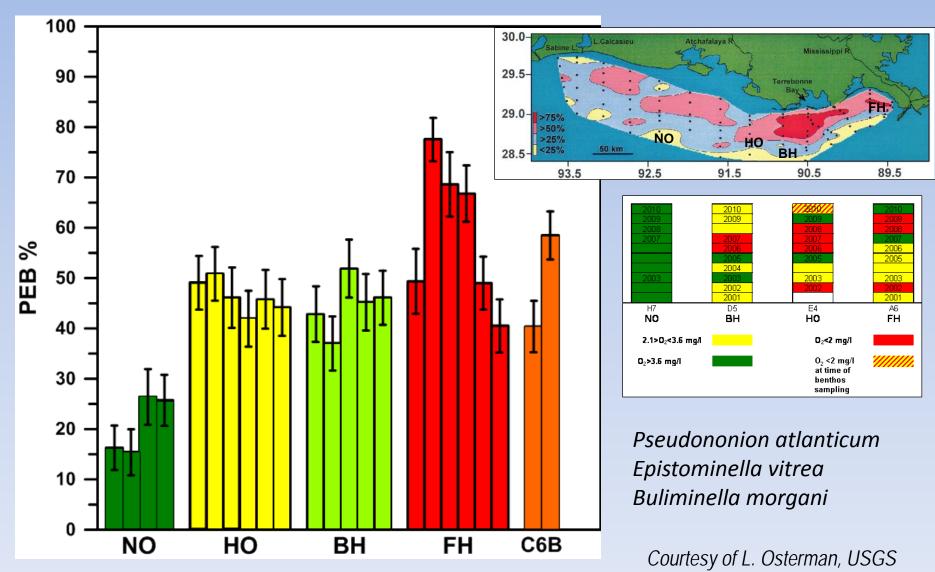
Hypoxia in the Northern GOM

- Field measurements at 4 sites with differing exposures to hypoxia
- Frequency of hypoxia ascertained using NOAA Rabalais data from 1992-2010
- Sampling in April and Sept 2009, Aug 2010

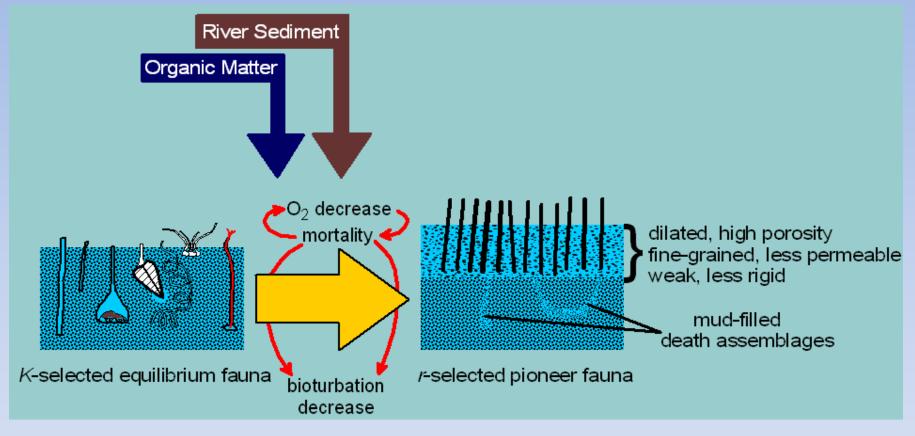




Hypoxia History: Foraminifera



Conceptual Model



Hypoxia restricted hydraulic conductivity decrease in <u>shear strength</u> increase in sediment water content increase in <u>erodibility</u>

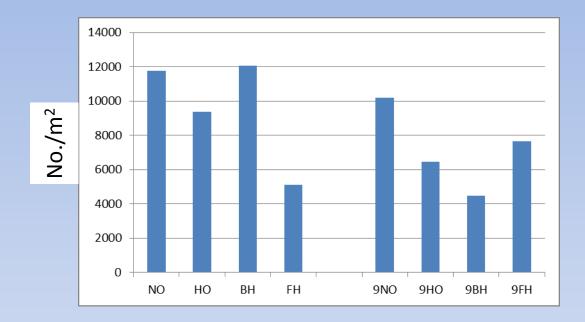
April 2009 cruise aboard R/V Pelican

24 box cores 3 subcores for macrofauna 648 sieved, preserved samples for macrofauna (300-µm) September 2009 cruise (repeat) August 2010 cruise (only 336 macrofauna samples)



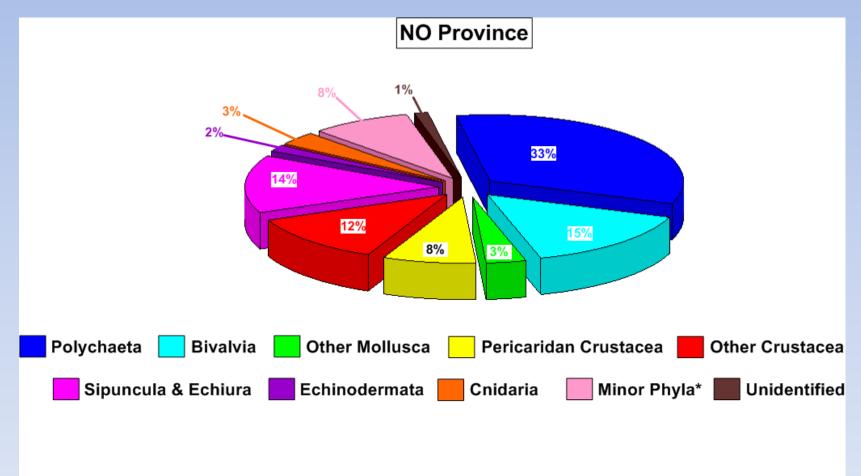


Standing Crop of Macrofauna: April 2009



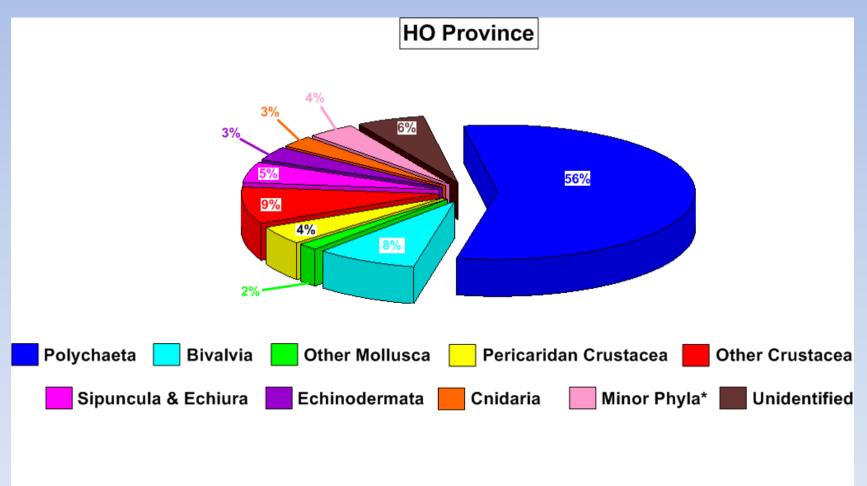
- NO and BH provinces have the highest numerical densities /m² of macrofauna in April 2009
- NO and FH provinces are highest at end of summer
- Abundance is not the whole story!

Diversity of Macrofauna April 2009



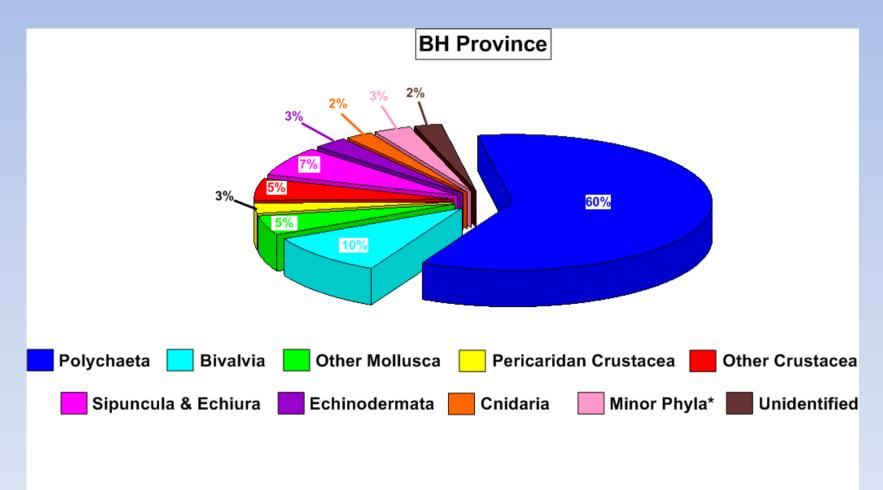
*includes Turbellaria, Nemertina, Kinorhyncha, Priapulida, Entoprocta, Pycnogonida, Phoronida, Ectoprocta, Hemichordata

Diversity of Macrofauna April 2009



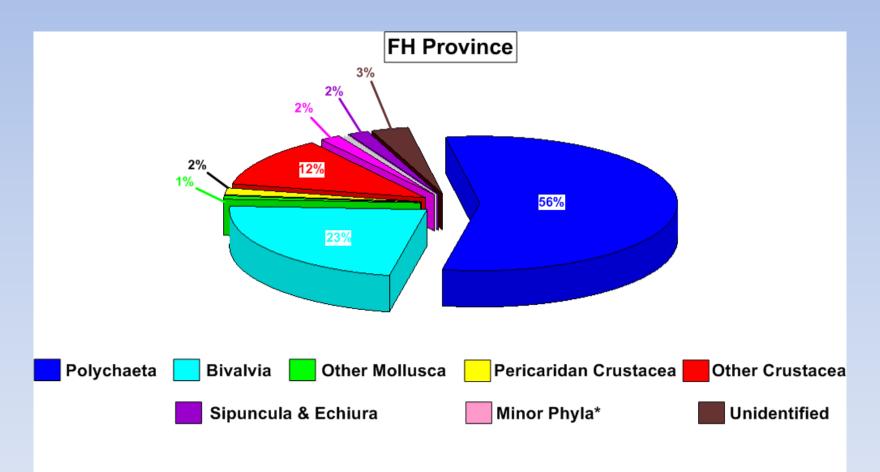
*includes Nemertina, Kinorhyncha, Priapulida, Entoprocta

Diversity of Macrofauna April 2009



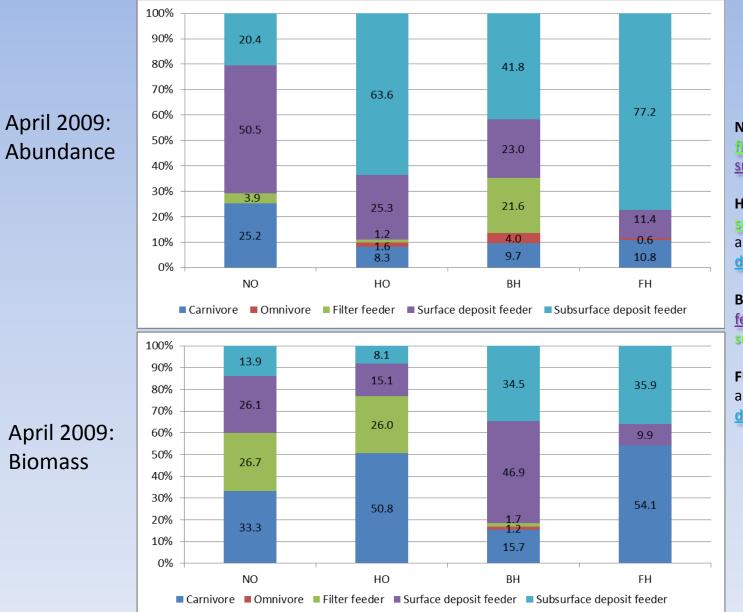
*includes Nemertina, Kinorhyncha, Priapulida, Entoprocta, Pycnogonida, Tardigrada, Phoronida, Ectoprocta, Hemichordata

Diversity of Macrofauna April 2009



*includes Cnidaria, Nemertina, Gastrotricha, Kinorhyncha, Priapulida, Entoprocta, Holothuroidea

Feeding Guilds for Polychaete Worms



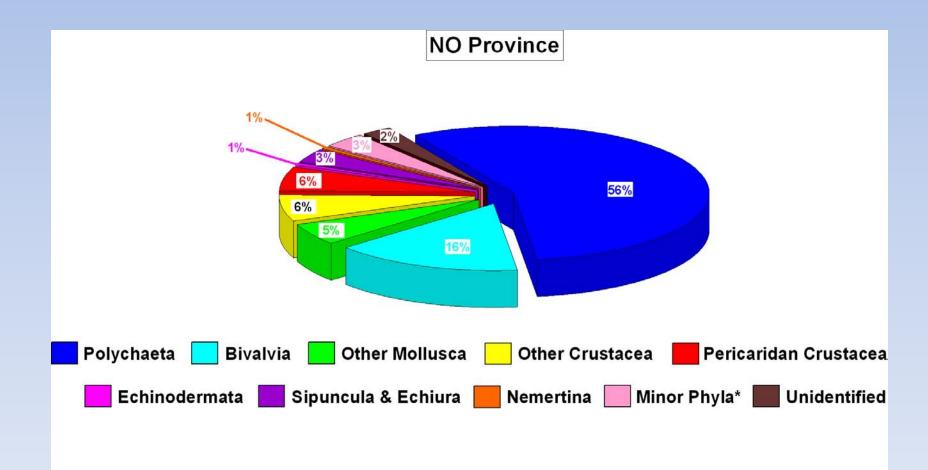
NO: Few large suspension/ filter feeders and a lot of small surface deposit feeders

HO: Few large carnivores and suspension/filter feeders and a lot of small subsurface deposit feeders

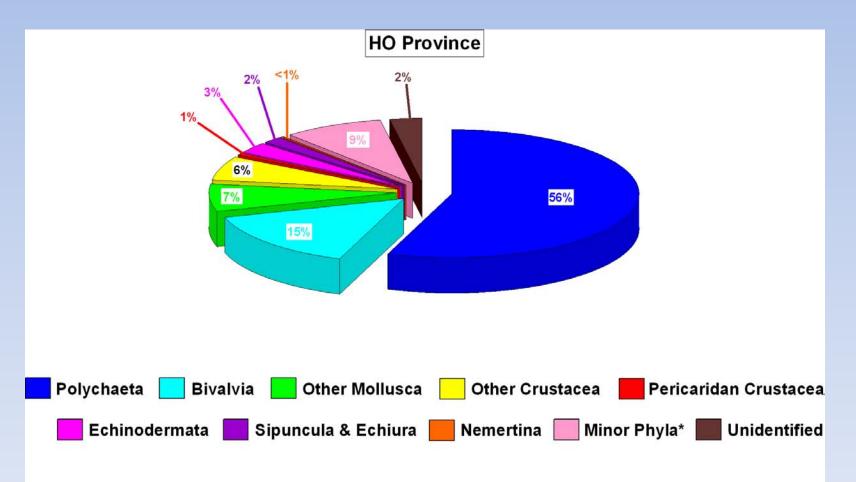
BH: Few <u>large surface deposit</u> feeders and a lot of small suspension feeders

FH: Few <u>large carnivores</u> and a lot of <u>small subsurface</u> <u>deposit feeders</u>

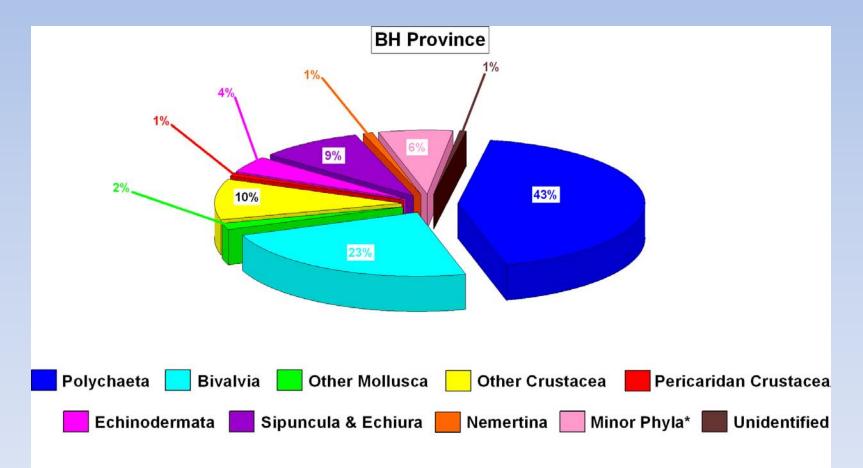
11 of 23



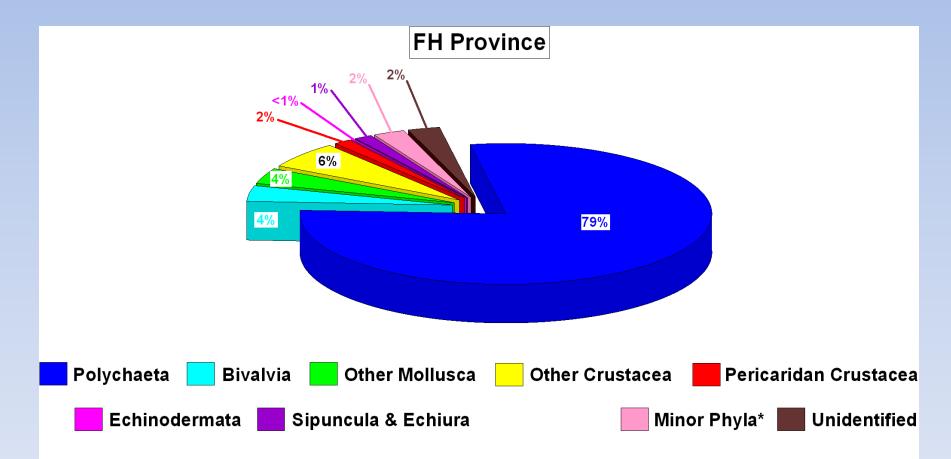
*includes Cnidaria, Kinorhyncha, Priapulida, Brachiopoda, Ectoprocta



*includes Cnidaria, Kinorhyncha, Gastrotricha, Phoronida



*includes Cnidaria, Kinorhyncha, Phoronida, Hemichordata



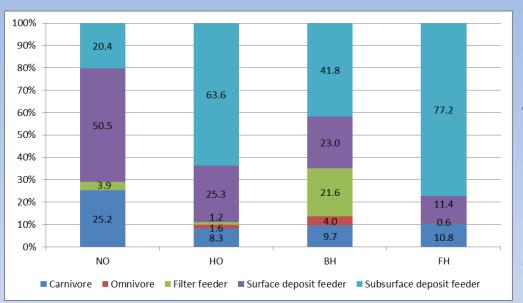
*includes Cnidaria, Kinorhyncha

Feeding Guilds for Polychaete Worms

April 2009: Abundance

September 2009:

Abundance



100% 6.5 15.8 18.8 90% 80% 43.5 70% 62.0 60% 40.9 62.3 50% 1.8 40% 12.4 30% 27.2 48.2 20% 14.2 13.2 10% 13.2 11.4 8.7 0% FH NO HO BH Carnivore Omnivore Filter feeder Surface deposit feeder Subsurface deposit feeder

After Summer Season NO: Carnivore/omnivore/ deposit feeder proportion changes little

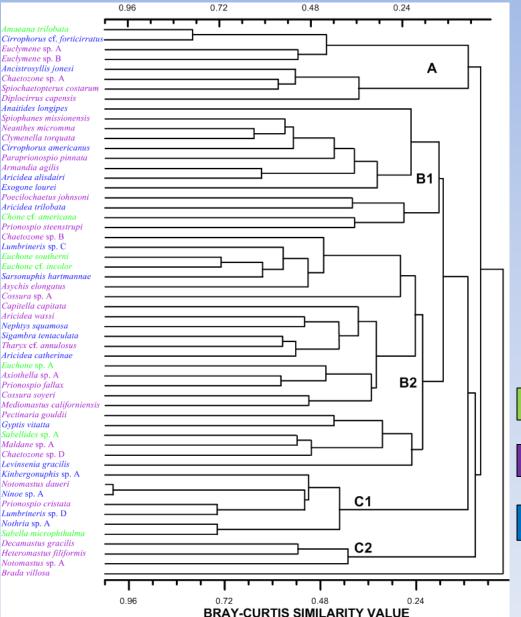
HO: More carnivores/ omnivores, deposit feeders; less subsurface deposit feeders

BH: More carnivores; less deposit feeders

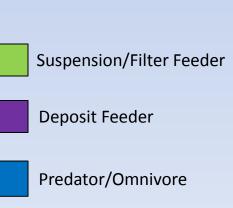
FH: More carnivores/ omnivores, but not large gains in numbers

Polychaete Community Analysis

Euclymene sp. A Euclymene sp. B Ancistrosyllis jonesi Chaetozone sp. A Spiochaetopterus costarum Diplocirrus capensis April 2009: Anaitides longipes Spiophanes missionensis Neanthes micromma **Abundance** Clymenella torquata Cirrophorus americanus Paraprionospio pinnata Armandia avilis Aricidea alisdairi Exogone lourei Poecilochaetus johnsoni Aricidea trilobata Chone cf. americana Prionospio steenstrupi Chaetozone sp. B Lumbrineris sp. C Euchone southerni Euchone cf. incolor Sarsonuphis hartmannae Asychis elongatus Cossura sp. A Capitella capitata Aricidea wassi Nephtys squamosa Sigambra tentaculata Tharvx cf. annulosus Aricidea catherinae Euchone sp. A Axiothella sp. A Prionospio fallax Cossura soveri Mediomastus californiensis Pectinaria gouldii Gyptis vitatta Sabellides sp. A Maldane sp. A Chaetozone sp. D Levinsenia gracilis Kinbergonuphis sp. A Notomastus daueri Ninoe sp. A Prionospio cristata Lumbrineris sp. D Nothria sp. A Sabella microphthalma Decamastus gracilis Heteromastus filiformis Notomastus sp. A Brada villosa



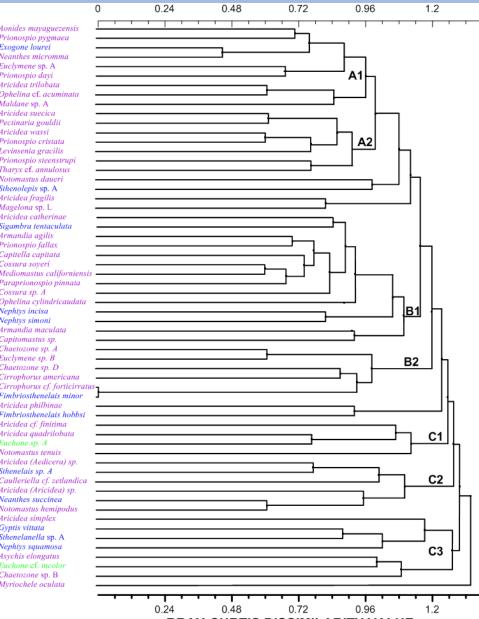
Groups A, B, C have associations of suspension/filter feeders, deposit feeders, and predators that show affinity



Polychaete Community Analysis

September 2009: **Abundance**

Prionospio pygmaea Exogone lourei Neanthes micromma Euclymene sp. A Prionospio davi Aricidea trilobata Ophelina cf. acuminata Maldane sp. A Aricidea suecica Pectinaria gouldii Aricidea wassi Prionospio cristata Levinsenia gracilis onospio steenstrupi Tharyx cf. annulosus Notomastus daueri Sthenolepis sp. A Aricidea fragilis Magelona sp. L Aricidea catherinae Sigambra tentaculata Armandia agilis Prionospio fallax Capitella capitata Cossura soyeri Mediomastus californiensis Paraprionospio pinnata Cossura sp. A Ophelina cylindricaudata Nephtys incisa Nephtys simoni Armandia maculata Capitomastus sp. Chaetozone sp. A Euclymene sp. B Chaetozone sp. D Cirrophorus americana Cirrophorus cf. forticirratus Fimbriosthenelais minor Aricidea philbinae Fimbriosthenelais hobbsi Aricidea cf. finitima Aricidea quadrilobata Euchone sp. A Notomastus tenuis Aricidea (Aedicera) sp. Sthenelais sp. A Caulleriella cf. zetlandica Aricidea (Aricidea) sp. Neanthes succinea Notomastus hemipodus Aricidea simplex Gyptis vittata Sthenelanella sp. A Nephtys squamosa Asychis elongatus Chaetozone sp. B Mvriochele oculata



BRAY-CURTIS DISSIMILARITY VALUE

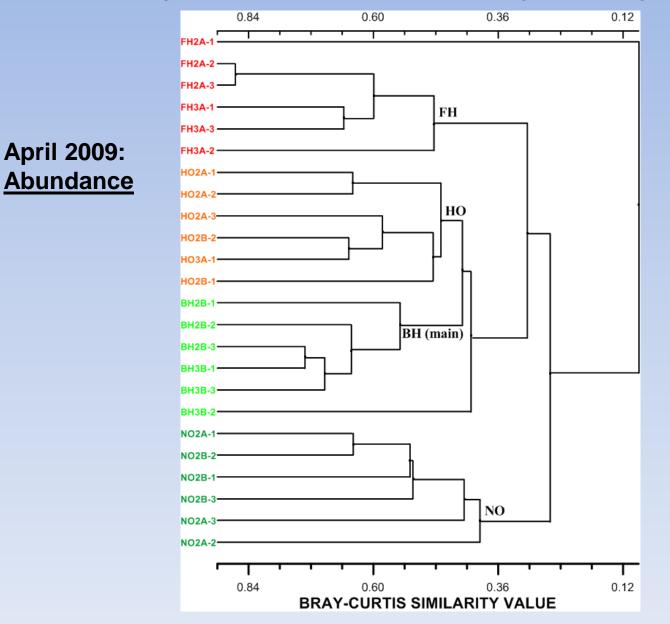
Post-summer census shows weaker affinities within groups, less suspension/filter feeders



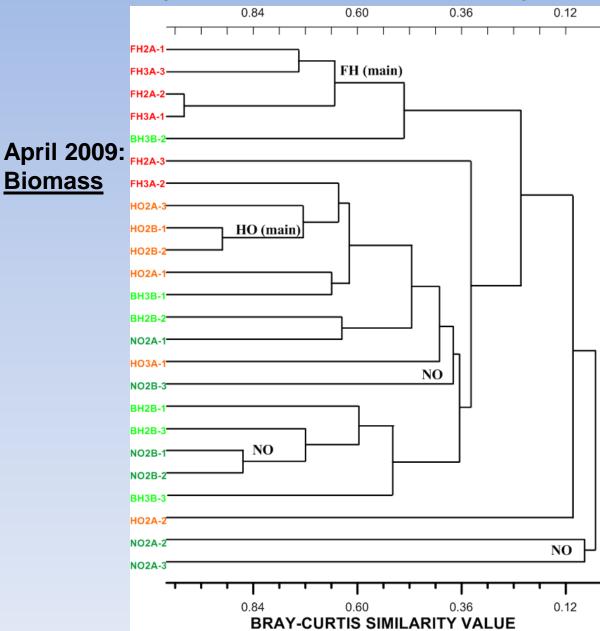
Deposit Feeder

Predator/Omnivore

Polychaete Community Analysis

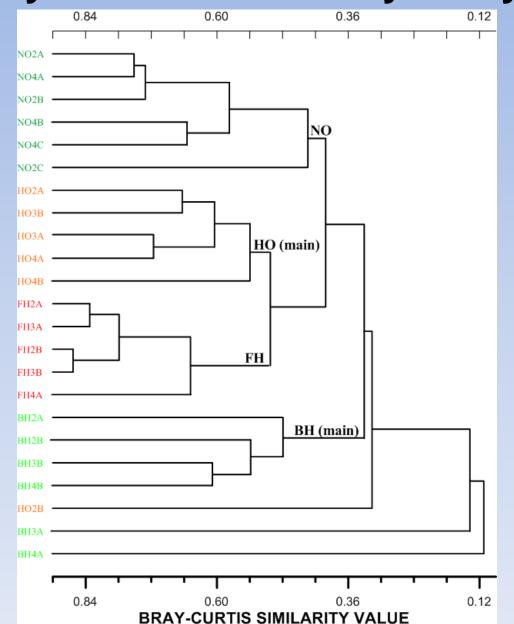


Polychaete Community Analysis



Some affinity within FH and HO due to biomass, but most subcores are too variable in terms of biomass

Polychaete Community Analysis



September 2009:

Abundance

NO and FH show the strongest affinities; More variability in abundance data of HO and BH may be a result of recovery from hypoxia

Diversity Indices: Polychaete Abundance

April	NO	НО	вн	FH
SR	9.4	7.4	10.4	4.1
H'	4.4	2.8	3.5	2.2
J'	0.8	0.5	0.6	0.5

 Before summer 2009 NO and BH have comparable Species Richness, Diversity, and Evenness

• Before summer 2009 HO and FH have the least diverse communities

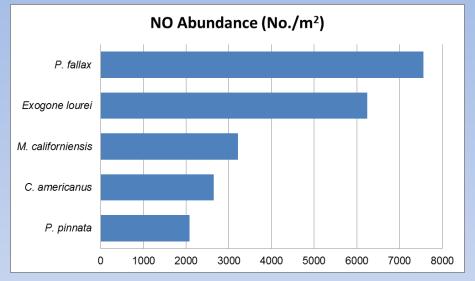
September	9NO	9НО	9BH	9FH
SR	12.2	10.6	8.1	5.3
H'	4.9	4.6	4.3	2.9
J'	0.8	0.8	0.8	0.6

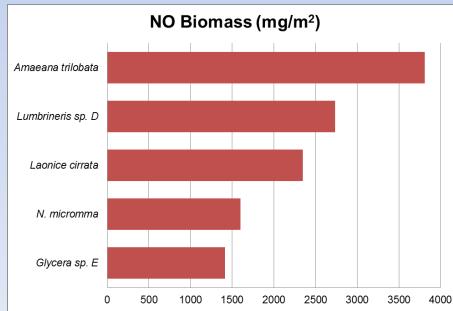
After summer 2009 all sites show diversity gains
After summer 2009 hypoxic event FH has the least diverse community; HO has the greatest evidence of recovery

Conclusions

- Real differences observed among control, hypoxic and recovering hypoxic provinces:
 - Diversity substantially depressed in hypoxic areas
 - Suspension/filter feeders depleted from hypoxic areas
 - Abundance of carnivore/omnivores increases proportionately in hypoxic and recovering hypoxic areas
- Trends exhibited by polychaetes likely to be accentuated with inclusion of other taxa (crustaceans, bivalves)
- Recovery starts soon after hypoxic episode advanced after 2 years post-hypoxia (BH)

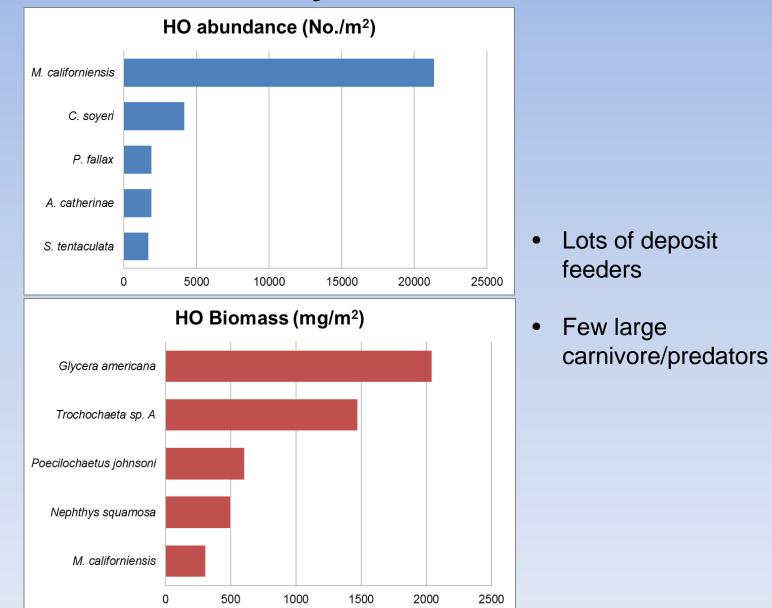
Dominant Polychaetes: NO



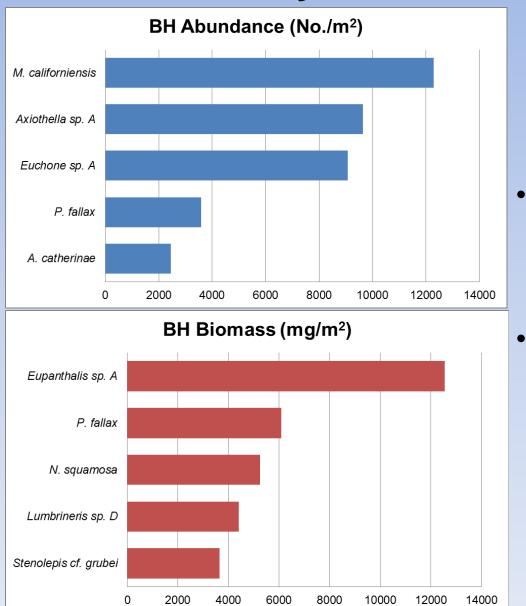


- Lots of deposit feeders
- Large carnivore/ predators (3/5)

Dominant Polychaetes: HO

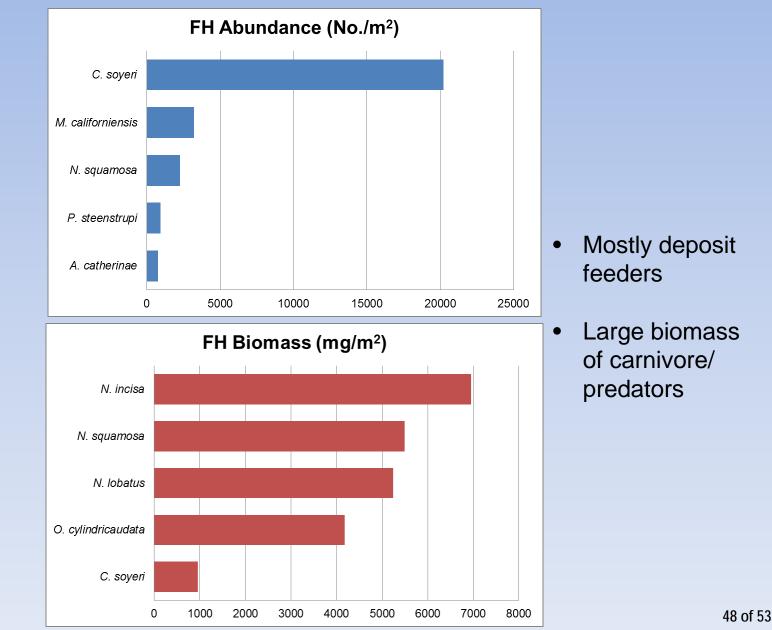


Dominant Polychaetes: BH



- Lots of deposit feeders and suspension/filter feeders
- Similar large mass of deposit feeders and carnivore/ predators

Dominant Polychaetes: FH



Principal Component Analysis: April Polychaete Abundance

