COMIDA: What determines spatial distribution of epibenthic communities in the Chukchi Sea?

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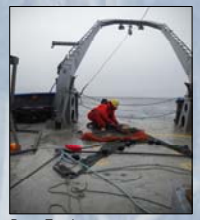
COMIDA is the Chukchi Offshore Monitoring In Development Area project. The overall goal of COMIDA is to initiate sampling to monitor anthropogenic chemicals associated with offshore oil and gas exploration and development and to monitor benthic biota in the area of potential or actual offshore drilling areas in the Chukchi Sea.

Objectives of the Epibenthic Component:

1) Produce a detailed community description for monitoring purposes.
2) Identify the potential physical drivers that are structuring the community.
3) Initiate monitoring to distinguish changes in benthic biota due to oil and gas activities from those due to changes in climate.

Questions:

1) Are epibenthic communities distributed in patches?
   -Are all species evenly distributed throughout the study area?
2) Which species are most important in determining community structure as far as abundance and biomass?
3) Which physical drivers are structuring the community?


Beam Trawl


VanVeen Grab

Methods:

- Sampling was completed during two cruises (summers 2009 and 2010)
- 1 beam trawl was deployed at each of 53 stations within the COMIDA study area (Fig. 1)
  Each trawl was (or adjusted to) 2.5 minutes at 1.5 knots
  Depths ranged from 27 to 56m (mean of 44.4 ± 0.8m)
- Trawls were sorted on deck
  Epibenthic organisms were identified, counted & weighed
- Physical data collected with SONDE & VanVeen grab:
  Bottom water temperature, salinity, pH, chlorophyll, sediment chlorophyll a, TOC, TON, C/N, various measures of grain size and DO, and water depth

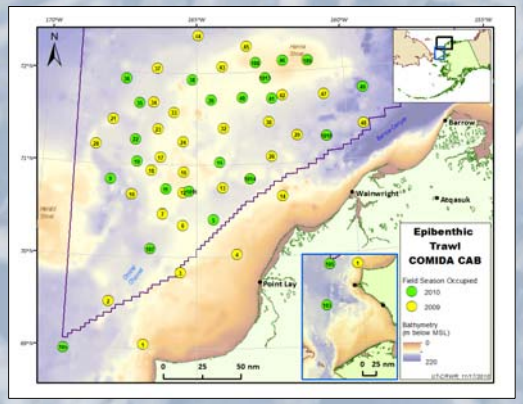


Figure 1. Map of COMIDA study area showing the trawling sites in each year.

Results:

Forty-four genera (or higher) were sorted, identified, counted, and weighed for analyses of community structure. In general, the MDS ordinations illustrate that there are five community types, based on abundance and biomass (Figs. 2 and 3). While the study area was fairly homogeneous as far as abundance, some stations were outliers (stations 14, 4, 46, and 109, Figs. 1 and 2). Many of the dominant organisms structuring these communities (*Echinarachnius* and ophiuroids, Fig 2a and b) were patchily distributed, while others (*Chionoecetes* and shrimp, Fig. 2c and d) were more evenly distributed. Other organisms that were dominant in structuring the community included hermit crabs, and the gastropods, *Neptunia* and *Cryptonatica*. Approximately 96% of the community structure for abundance was described by these seven groups (BEST Routine within Primer-E).

Fig 2a. MDS based on invertebrate abundance. Bubbles correspond to *Echinarachnius* abundance. Green circles represent 40% similarity among sites.

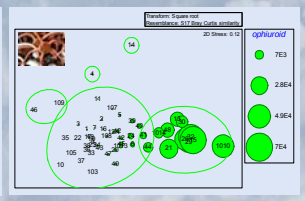


Fig 2b. MDS based on invertebrate abundance. Bubbles correspond to ophiuroid abundance. Green circles represent 40% similarity among sites.

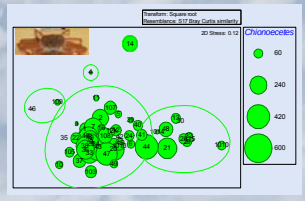


Fig 2c. MDS based on invertebrate abundance. Bubbles correspond to *Chionoecetes* abundance. Green circles represent 40% similarity among sites.

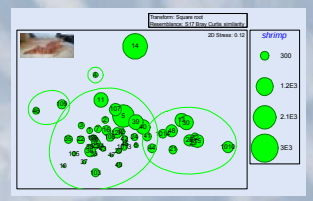


Fig 2d. MDS based on invertebrate abundance. Bubbles correspond to shrimp abundance. Green circles represent 40% similarity among sites.

MDS ordinations based on biomass show a similar grouping of sites as in the abundance MDS with the same outlying stations (Fig. 3). Similar organisms also dominate the overall structure of the community with some organisms being patchily distributed (*Echinarachnius* and ophiuroids) and others (*Chionoecetes* and shrimp) being more evenly distributed. Other organisms that were dominant in structuring the community included the cucumbers, *Psolus* and *Ocnus*, hermit crabs, the basket star, *Gorgonocephalus*, the gastropod, *Neptunia*, and the crab, *Hyas*. Approximately 96% of the community structure for abundance was described by these nine groups (BEST Routine within Primer-E).

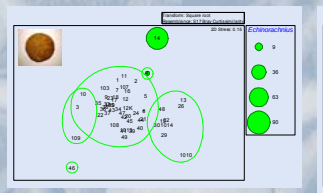


Fig 3a. MDS based on invertebrate biomass. Bubbles correspond to *Echinarachnius* abundance. Green circles represent 40% similarity among sites.

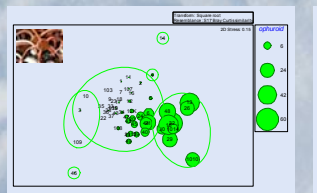


Fig 3b. MDS based on invertebrate biomass. Bubbles correspond to ophiuroid abundance. Green circles represent 40% similarity among sites.

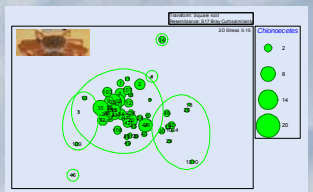


Fig 3c. MDS based on invertebrate biomass. Bubbles correspond to *Chionoecetes* abundance. Green circles represent 40% similarity among sites.

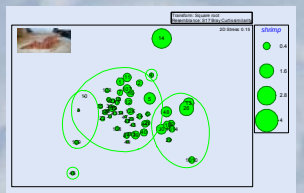


Fig 3d. MDS based on invertebrate biomass. Bubbles correspond to shrimp abundance. Green circles represent 40% similarity among sites.

Stations with similar dominant organisms generally did not appear to spatially group together (Fig. 4). MDS ordinations show that sites that are spatially grouped may or may not have the same abundances of the dominant organisms, as can be seen for the ophiuroids and *Chionoecetes*. Several physical parameters were tested to determine which parameter might be structuring the biological community using the BEST BIO-ENV routine within Primer-E. It was found that for abundance, 32% of the variability was accounted for by depth, a grain size measurement (the percent of 2 phi in the sample), % total organic nitrogen (TON), and temperature. For biomass, 42% of the variability was accounted for by depth, two grain size measurements (the percent of 2 and 4 phi in the sample), % TON, and temperature. It should be noted that TON and total organic carbon were correlated so only TON was used in the BIO-ENV analysis.

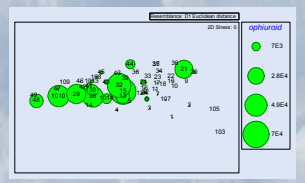


Fig 4a. MDS based on spatial location of stations. Bubbles correspond to ophiuroid abundance.

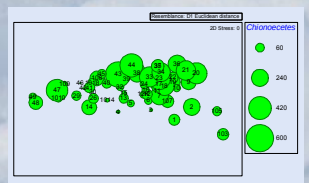


Fig 4b. MDS based on spatial location of stations. Bubbles correspond to *Chionoecetes* abundance.


Trawl contents from Station 32 showing a dominance of ophuroids.


Trawl contents from Station 18 showing a dominance of *Chionoecetes*.

Summary:

- The epibenthic organisms in the COMIDA study area are generally patchily distributed but the same suite of organisms appear at many of the stations.
- There are 7 (for abundance) to 9 (for biomass) organisms that primarily structure this community, including the economically important snow crab, *Chiocoecetes opilio*.
- Stations that were located spatially close to one another did not necessarily have similar community structure.
- The environmental variables controlling the distribution of organisms was not conclusive, however it appears that water depth, grain size, total organic carbon, total organic nitrogen, and temperature may be playing a role.

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