Identification of potential (demersal) indicator species of climate related variability in the BCLME region – a new methodological approach

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Module 2:
Climate variability and climate impact on the marine ecosystem

Task 2.3:
Climate effects on the biodiversity of the Demersal community in the BCLME region
3 Key Questions

- What are the effects of climate variability on the demersal community?
- Which species are candidate indicators for climate variability impacts?
- Are there sensitive areas or hotspots of change/variability?

* sampling methodology, biodiversity hotspots, temporal shifts & trends, range size, spatio-temporal diversity.
Paper main Objective

- Presenting a methodology for identifying or selecting demersal species that may be potential indicators of climate-related variabilities

- Main criterion: stronger effect size of temperature on the distribution of the species, and the species should have narrower range of preferred temperature
Indicator species and their use

- Species / group of species that reflect the biotic and abiotic state of the environment
- Capture the impact of environmental change on habitat, community/ecosystem
- Most commonly used in pollution monitoring program
- Recent use in tracking long-term change in the environment: as integrator of hydroclimatic change
- Also track extreme oceanographic condition (ENSO), cyclic oceanographic phenomena (NAO, PDO)
- To track various anthropogenic disturbance (overexploitation, habitat disturbance, assemblage shifts)
- The use of indicators has frequently been incorporated into policies and regulations in order to monitor the ecological integrity of watersheds
Data Used (biological and Env)

- Spatial demersal data (biomass and abundance) from Dr Fridtjof Nansen (Nan-SIS) database
- Large supplement of data collected through national surveys by the three countries.
• Demersal monitoring surveys during summer (between Jan. & Apr.):
  - Angola: 1985-2010 (Nansen)
  - Namibia: 1990-2010 (Nansen & Blue Sea)
  - S. Africa: 1986-2010 (Africana & Nansen)
Flow chart of process of indicator species selection

1. **Selection of species occurrence** >= 5%
2. **Model logistic GLM**
3. **Determine preferred temperature range** [prob > 0.5]
4. **Select species if effect size** [prob >= 0.8]
5. **Calculate range width of preferred temperature**
6. **Indicator species ranked by range width**
Temp. pref. range: North Benguela
Temp. pref. range: Central Benguela
Temp. pref. range: South Benguela
Indicator Species: **North Benguela**

- Trichiurus lepturus
- Merluccius polli
- Brachydeuterus auritus
- Pagellus bellottii
- Trachurus traecae
- Raja miraletus
- Pterothrissus bellicii
- Dentex angolensis
- Selene dorsalis
- Citharus linguatula
- Illex coindetii
- Chloroscombrus chrysurus
- Synagrops microlepis
- Zeus faber
- Chlorophthalmus atlanticus
- MYCOTOPHIDAE
- Galeoides decadactylus
- Sphyraena guachancho
- Laemonema laureysi
- Dibranchus lauriceus
- Halosaurus ovenii
- Hoplostethus atlanticus
- Triplopus hemingi
- Dentex macrophthalmus
- Brotila barbata
- Hymenocephalus italicus
- Zenopsis conchifer
- Yarrella blackfordi
- Sardinella maderensis
- Lampris gilchristi
- Chaunax pictus
- Dentex barnardi
- Xenodermichthys copei
- Stomias boa boa
- Bathyuroconger vicinus
- Arius parkii

**Graph:**

- Temperature range

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*Images of fish species associated with North Benguela.*
Indicator Species: Central Benguela

Merluccius capensis
Trachurus capensis
Todarodes sagittatus
Lophius vomerinus
Merluccius paradoxus
Helicolenus dactylopterus
Sufflogobius bibarbatus
Caelorinchus simorhynchus
Selachophidium guentheri
Trachyrincus scabrus
Genypterus capensis
Notacanthus sexspinis
Galeus polli
Hoplostethus cadenati
Yarrella blackfordi
Ebinania costae-canarie
Raja confundens
Nezumia microrychodon
Nezumia sp.
Deania calcea
Bathyuroconger vicinus

range width
Indicator Species: South Benguela

- Merluccius capensis
- Helicolenus dactylopterus
- Merluccius paradoxus
- Lophius vomerinus
- Caelorinchus simorhynchus
- Genypterus capensis
- Todaropsis eblanae
- Callorhynchus capensis
- Trachurus trachurus capensis
- Chelidonichthys capensis
- Lucigadus ori
- Malacocephalus laevis
- Holohalaelurus regani
- Paracallionymus costatus
- Squalus megalops
- Caelorinchus braueri
- Raja straeleni
- Zeus capensis
- Bassanago albofascens
- Photichthys argenteus
- Notacanthus sexspinis
- Rossia enigmatica
- Lepidopus caudatus
- Cynoglossus zanzibarensis
- Sepia australis
- Sepia hieronis

Temperature range

1 2 3 4 5 6 7
Observations

• Although some limitations that might influence our results (e.g. sampling biases), approach suitable to ID indicator species that can be used in a further analysis to monitor the influence of long-term changes in climate (especially warming).

• The potential benefits helps one prioritize research efforts towards species that are sensitive to temperature and respond potentially rapidly, in terms of change in distribution, reproduction, growth, to changes in temp.
Observations... *cont*...

- **The strength**: relies on a simple yet, important concept – that an indicator species is the one with a narrower environmental niche.
- **Limitation**: based on environmental data collected **during 2 months (summer)** surveys, not entire year.
Way Forward

- Continue working on MS and submit the method paper
- Once method accepted and potential indicator species are identified:
  - assess their distribution and abundance retrospectively overtime and relate that to long-term environmental (temperature) trend.
Carignan and Villard (2002)

• Conclude that, *although the use of indicator species remains contentious, it can be useful if: (1) many species representing various taxa and life histories are included in the monitoring program, (2) their selection is primarily based on a sound quantitative database from the focal region, and (3) caution is applied when interpreting their population trends to distinguish actual signals from variations that may be unrelated to the deterioration of ecological integrity.*