

On track with microzooplankton of the northern Benguela Upwelling System

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Microzooplankton

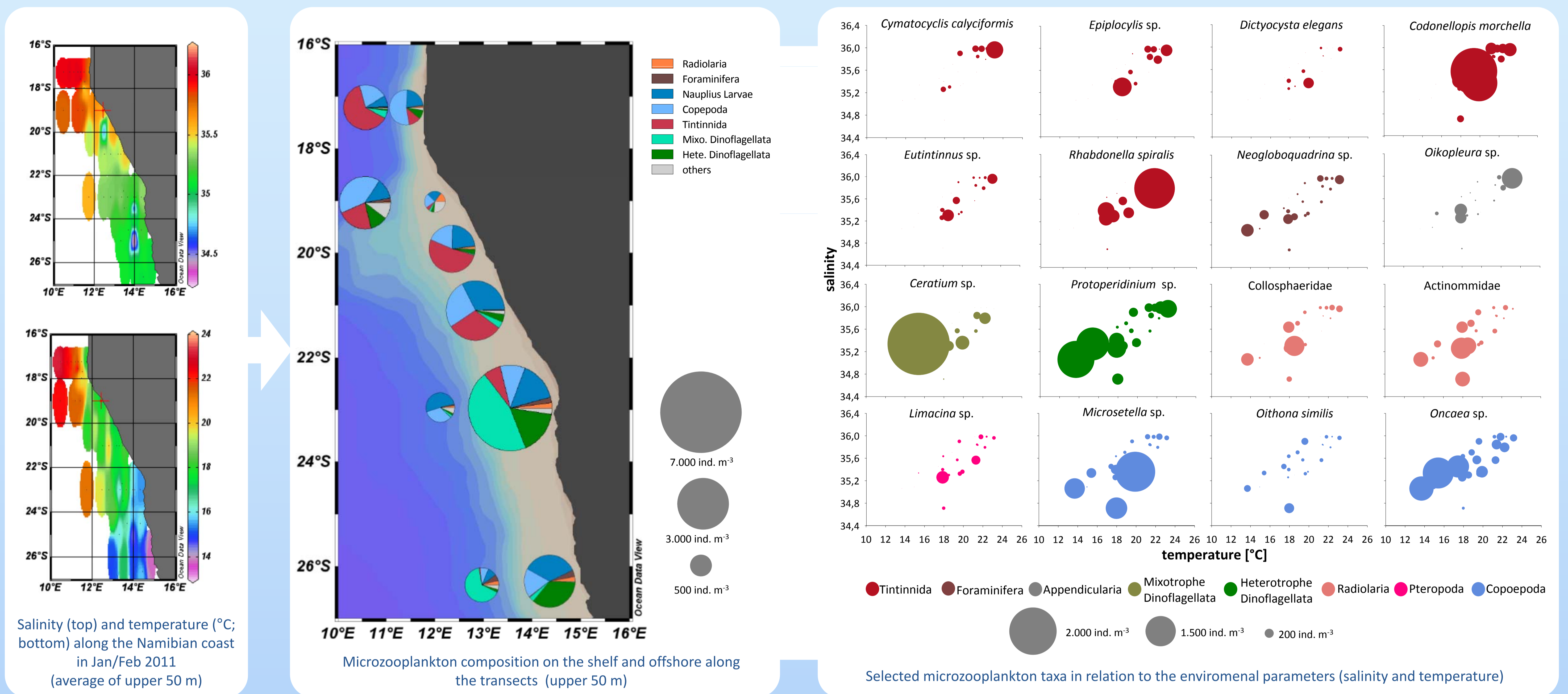
Microzooplankton are marine mixo- or heterotrophic organisms (20-200 μm) which mainly consist of ciliates, tintinnids, dinoflagellates, foraminiferas, radiolarians, copepod nauplius and small copepod species. They act as one of the major controls on phytoplankton production in diverse aquatic environments (Calbet & Landry, 2004; Sherr & Sherr, 2007) and provide important links between small primary producers and mesozooplankton (Burkill *et al.*, 1993). This group plays a key role in marine ecosystems as nutrient recyclers and CO_2 producers (Calbet & Alcaraz, 2011).

Sampling and analysis

The abundance and biomass of microzooplankton was investigated during an alleviated period off the Namibian coast in January and February 2011 (southern summer) as a part of the GENUS-project on RV Maria S. Merian. The samples were collected by stratified hauls with a Multi-Closing-Net (Hydrobios) with a mesh size of 55 μm on 27 stations along 6 transects off the coast. The environmental data were obtained with a CTD (SBE 911).

Benguela Upwelling System (BUS)

The BUS is one of the major eastern boundary current regions of the World's ocean. The coastal upwelling is driven by equatorward wind stress along the entire west coast of southern Africa. This large ecosystem can be divided into two sub-ecosystems, the southern and northern BUS, which are separated by a permanent upwelling cell of Lüderitz. Upwelling in the northern BUS occurs throughout the whole year with high intensity during late winter and spring. The northern part of the northern BUS is influenced by seasonal intrusions of the warm and saline waters from the Angola Current.



Conclusion

Our study showed that microzooplankton may be used as a good indicator for intensity of the upwelling event, respective different water masses in the northern BUS. Three different groups have been determined: **warm water adapted taxa** which were found in the northern part of the region and mainly consist of Tintinnida, Pteropoda and Appendicularia; **trans-present taxa** which were found all over the region; **upwelling taxa** which were detected mainly in the southern part of the region, especially near the Lüderitz upwelling cell and are well adapted to strong upwelling, consisting of hetero- and mixotrophic Dinoflagellata and different *Oncaea* species.

The seasonality in intensity of the upwelling events has an effect on the distribution of the microzooplankton groups. The importance of heterotrophic Dinoflagellata as main grazers of the primary producers increases during winter and spring when the intensity of the upwelling rises. Heterotrophic Dinoflagellata are able to feed on cells several times larger than their bodysize, such as large phytoplankton-blooming species. Due to their short developmental times, they are able to cope with algae blooms. These characteristics make this group ideal primary consumers in areas with changing environmental conditions such as the BUS.



Northern and southern part of the northern BUS characterized by environmental and biological parameters

	environmental parameters			biological parameters									
	Upwelling	Salinity	Temperature	Mix. Dinoflagellata	Het. Dinoflagellata	Radiolaria	Foraminifera	Tintinnida	Poecilostomatoida	Calanoida	Oithonidae	Pteropoda	Appendicularia
northern part	low	mid	high	low	mid	high	low	mid	high	low	mid	high	low
southern part	high	low	mid	high	low	mid	high	low	mid	high	low	mid	high

intensity of the parameters: low (grey), mid (light blue), high (dark blue)

References

Calbet A, Landry MR (2004): Phytoplankton growth, microzooplankton grazing, and carbon cycling in marine systems. *Limnol Oceanogr* 49: 51-57.
 Calbet A, Alcaraz M (2011): Microzooplankton, key organisms in the pelagic food web. In *Fisheries and Aquaculture: Towards Sustainable Aquatic Living Resources Management*, Safran P (Ed.), in *Encyclopedia of Life - Support Systems (EOLSS) UNESCO*. Eolss Publishers, Oxford, UK
 Burkill PH, Leakey RJG, Owens NJP, Mantoura RFC (1993b): Microzooplankton and their herbivorous activity in the northern Atlantic Ocean. *Deep-Sea Res* II 40: 773-782.
 Sherr EB, Sherr BF (2007): Heterotrophic dinoflagellates: a significant component of microzooplankton biomass as major grazers of diatoms in the sea. *Mar Ecol Prog Ser* 352: 187-197.