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Contribution of mesozooplankton to the vertical flux of carbon in the northern Benguela Upwelling System off Namibia

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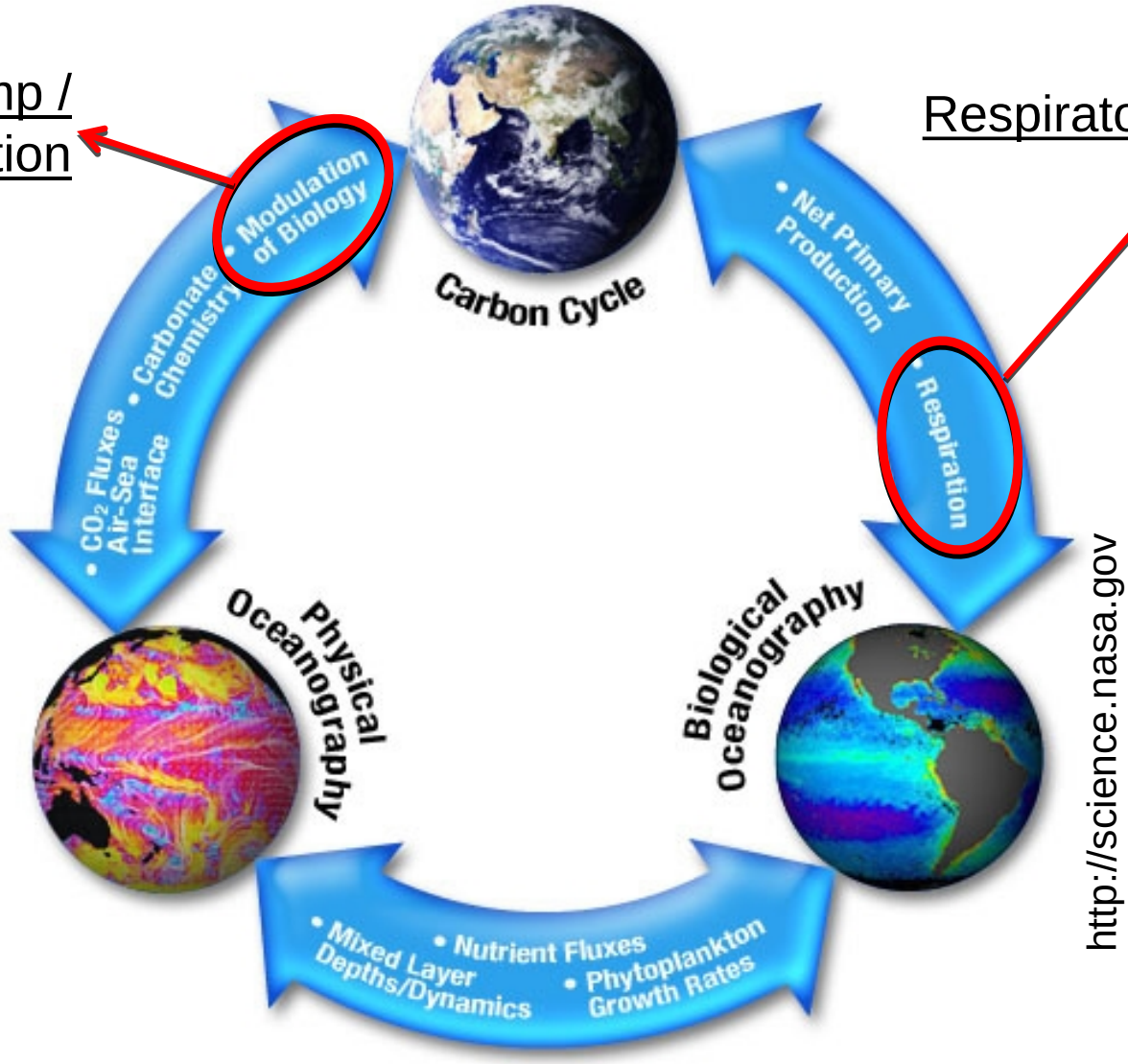
Physical and Biological Oceanography and the Carbon Cycle

Biological Pump / Vertical Migration

Respiratory Carbon Flux



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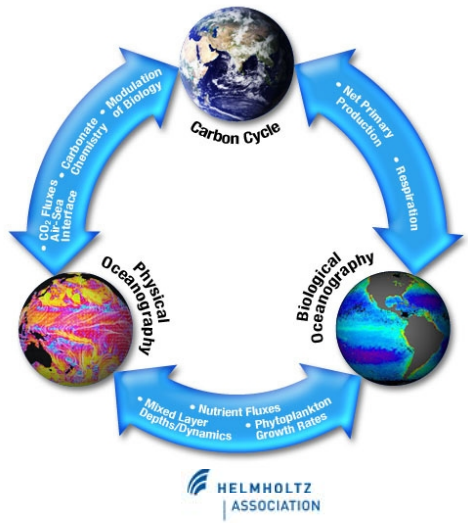
Physical and Biological Oceanography and the Carbon Cycle

Introduction

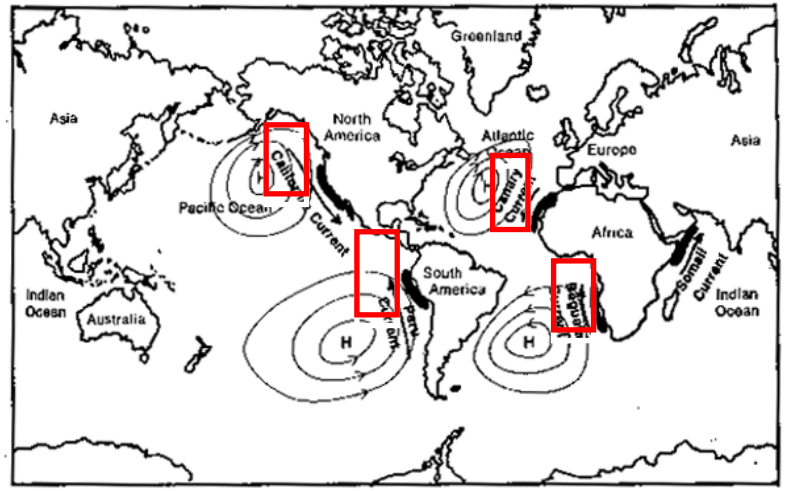
Environmental parameters and **physiological constraints** influence the **vertical migration** behaviour of zooplankton and thus affect the **Biological Carbon Pump**

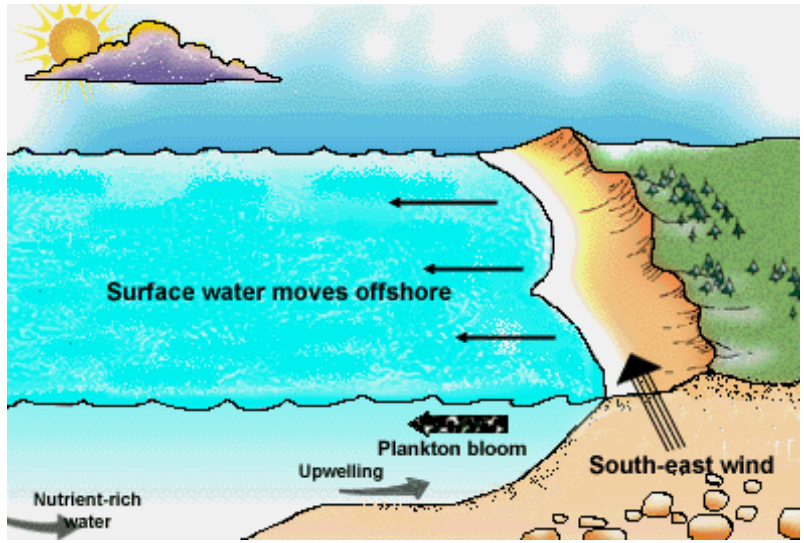
Different **dominant taxa** contribute to the **downward transport of carbon** in the northern **Benguela Upwelling system**



Northern Benguela Upwelling System (NBUS)

Introduction





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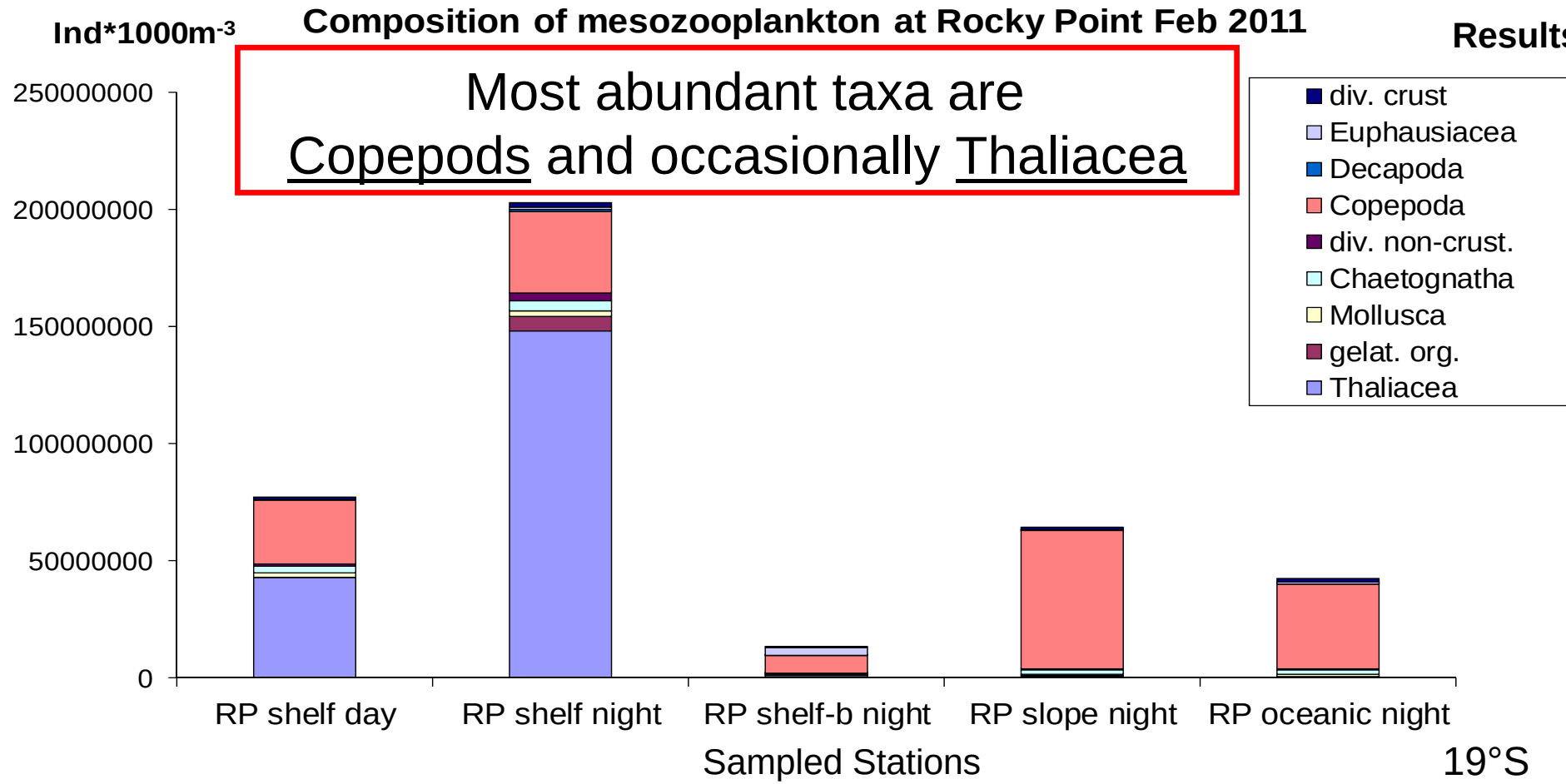
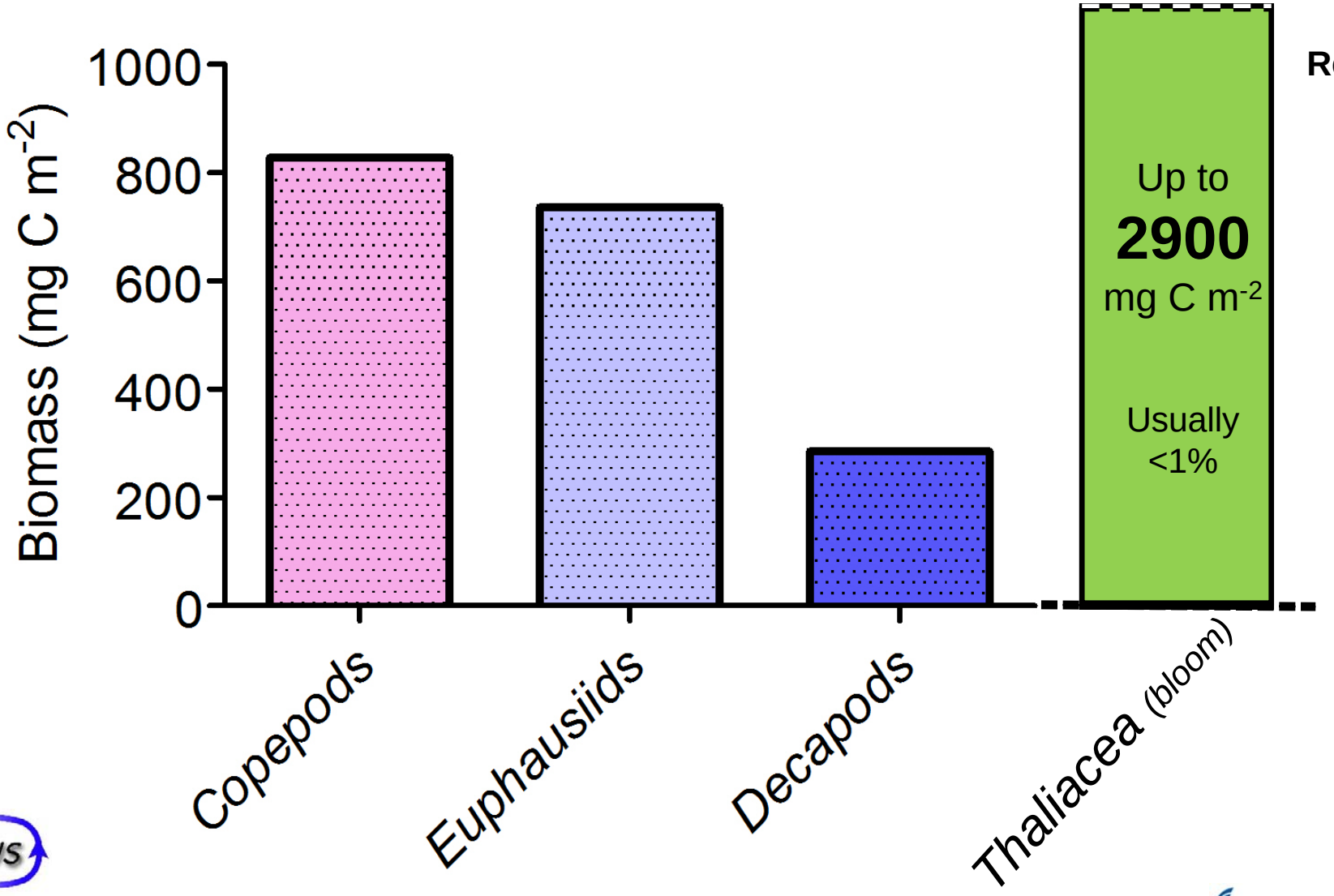
Dominant Zooplankton Taxa in the NBUS

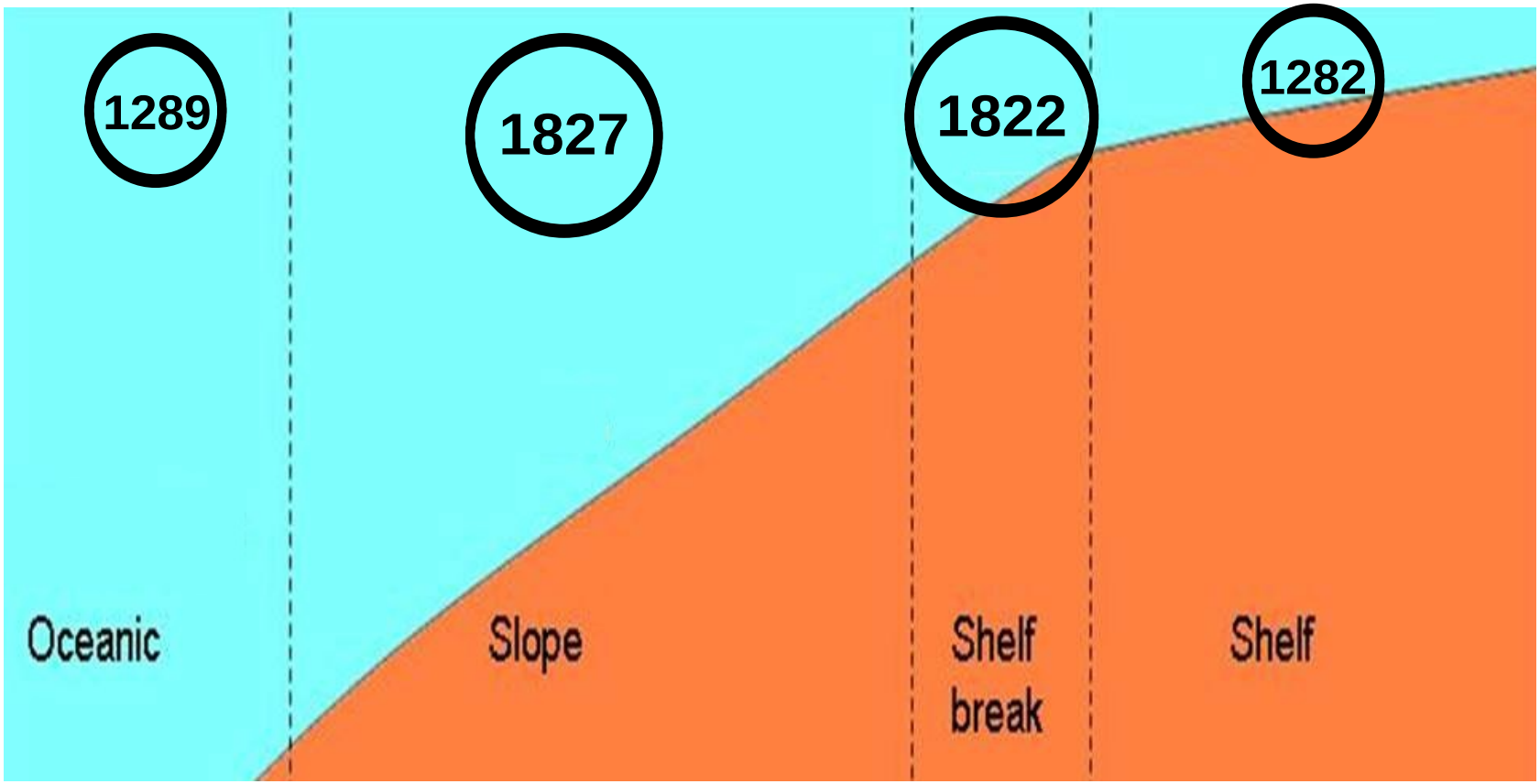


Dominant Zooplankton Taxa in the NBUS



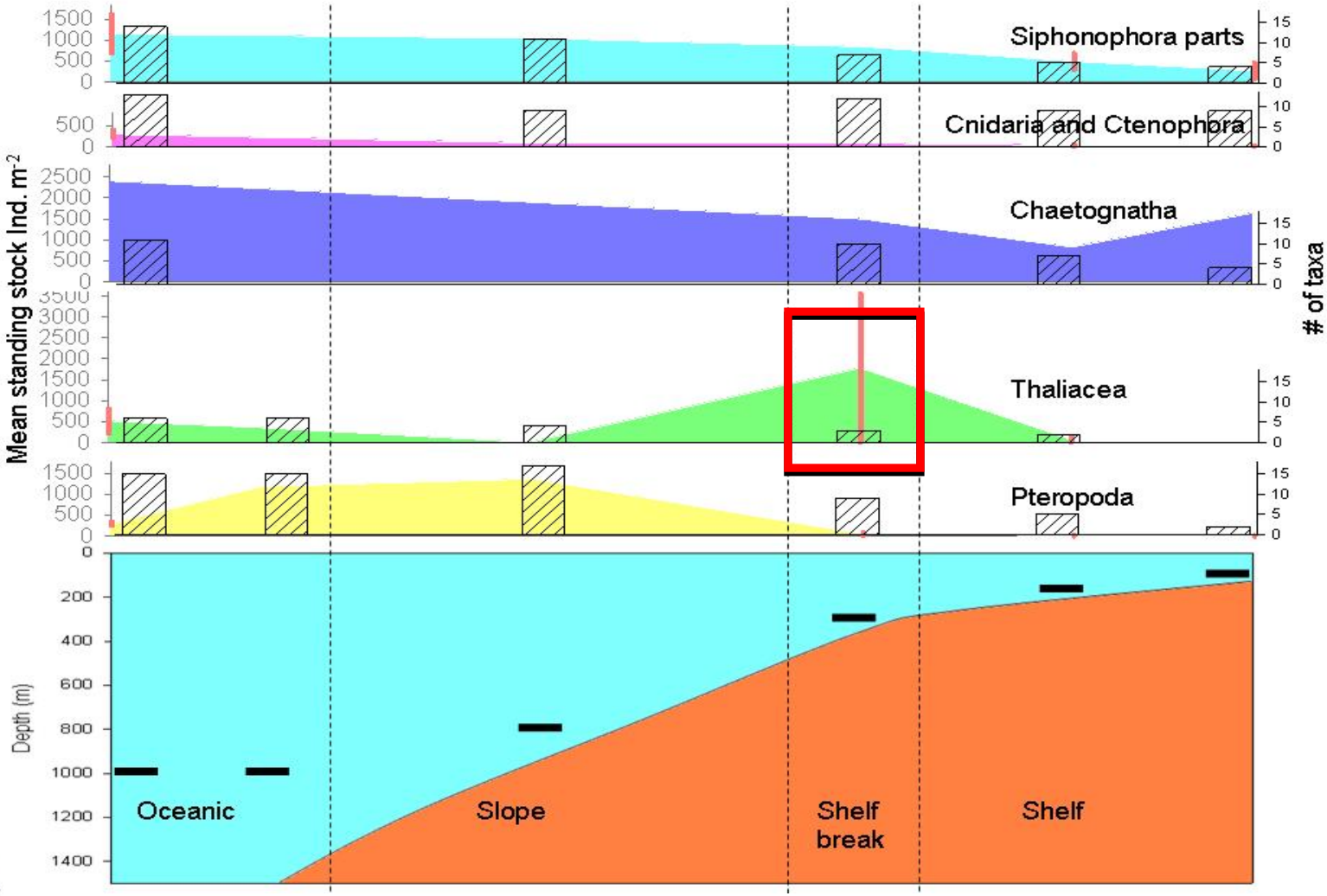
Horizontal Distribution of Dominant Zooplankton Taxa in the NBUS

Mean Zooplankton Biomass (mg C m^{-2})

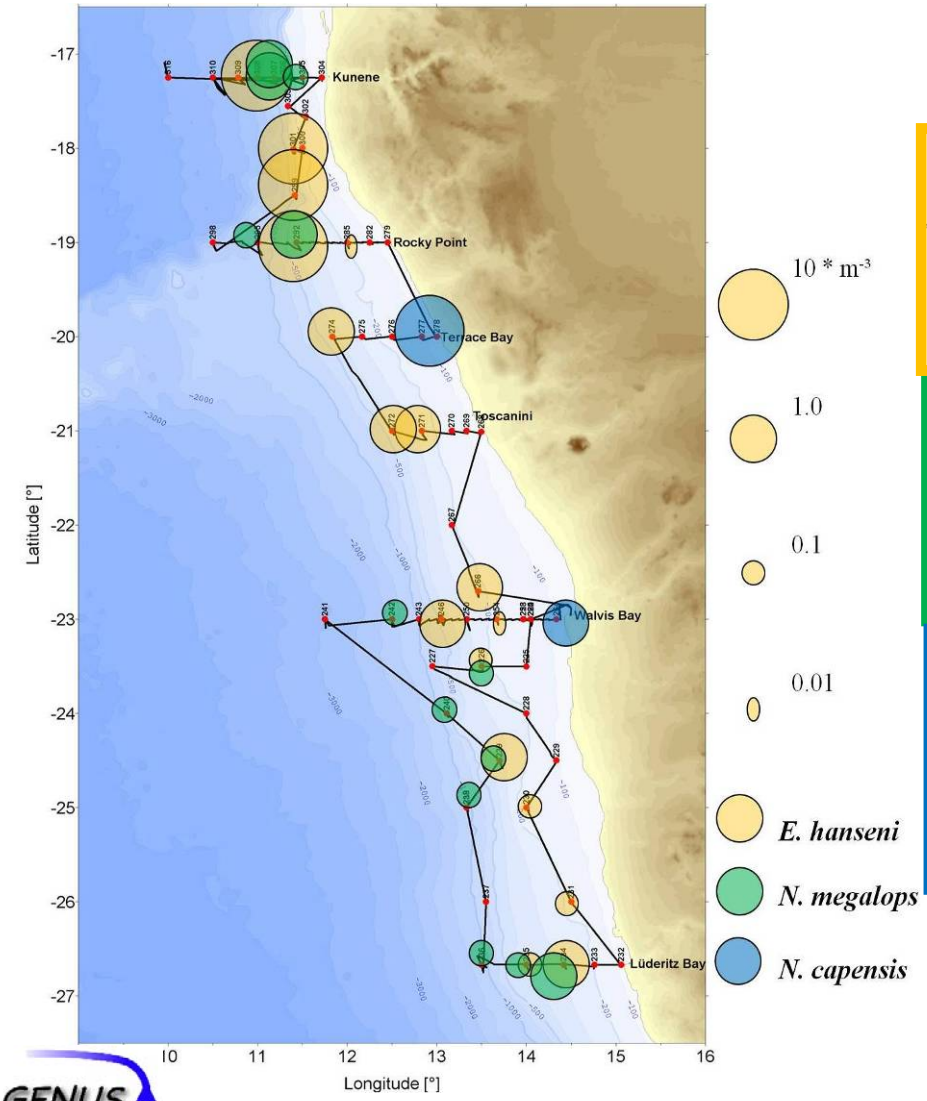


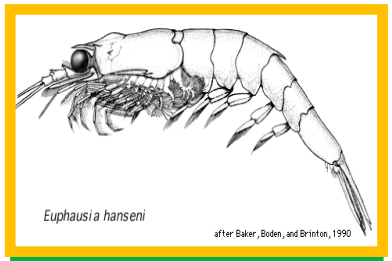
Martin, B., Eggert, A., Koppelmann, R., Diekmann, R. Mohrholz, V. and Schmidt, M. (2014) Spatio-temporal variability of zooplankton biomass and environmentalcontrol in the northern Benguela Upwelling System: field investigations and model simulation. *Marine Ecology* (in press)

Horizontal Distribution of Dominant Zooplankton Taxa in the NBUS



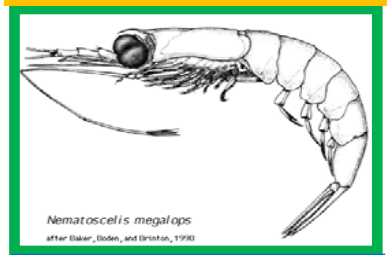
Horizontal Distribution of Dominant Zooplankton Taxa in the NBUS





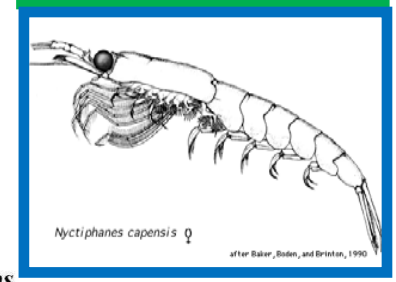
Euphausia hanseni

Shelf break species



Nematoscelis megalops

Oceanic species



Nyctiphanes capensis

Neritic species

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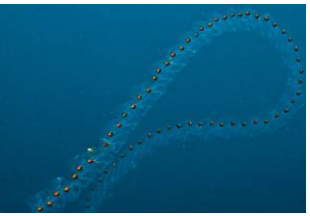
Vertical Distribution of Dominant Zooplankton Taxa in the NBUS



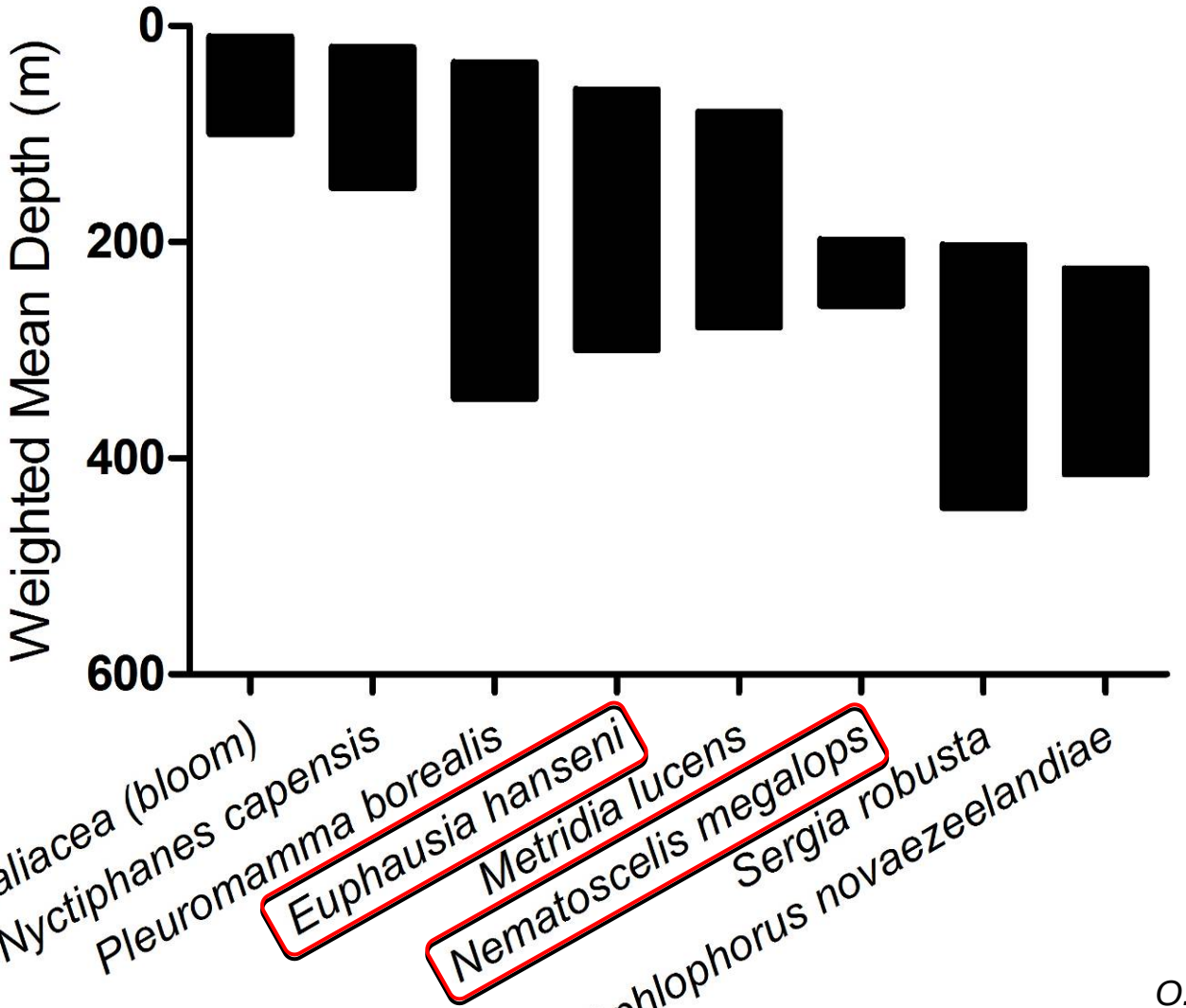
S. fusiformes
© Mark Rosenstein

N. capensis

P. borealis

E. hanseni

M. lucens ©ZIMNES



N. megalops

S. robusta

© marinespecies.org

O. novaezeelandiae

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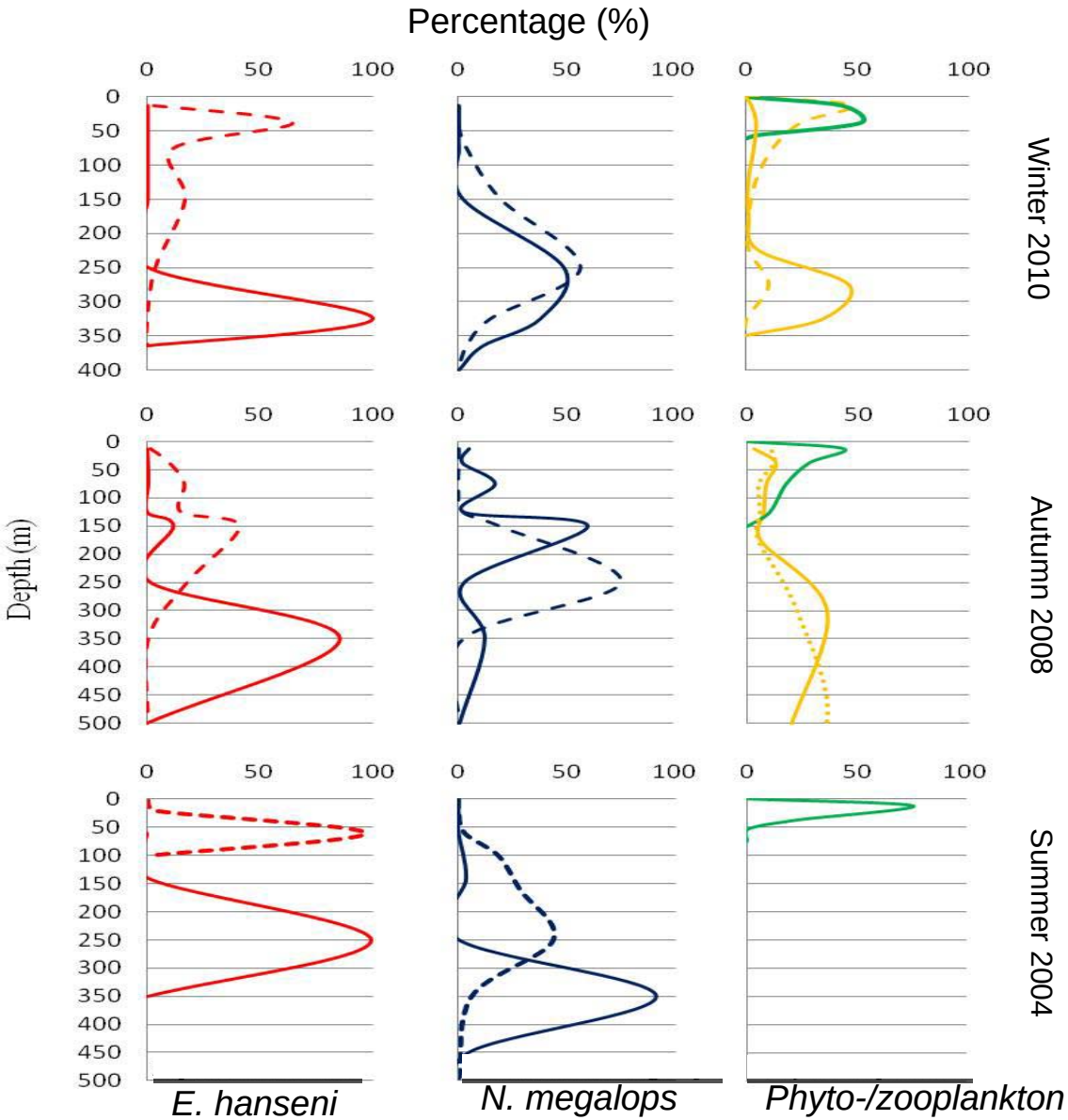
Diel Vertical Migration Behaviour of Krill

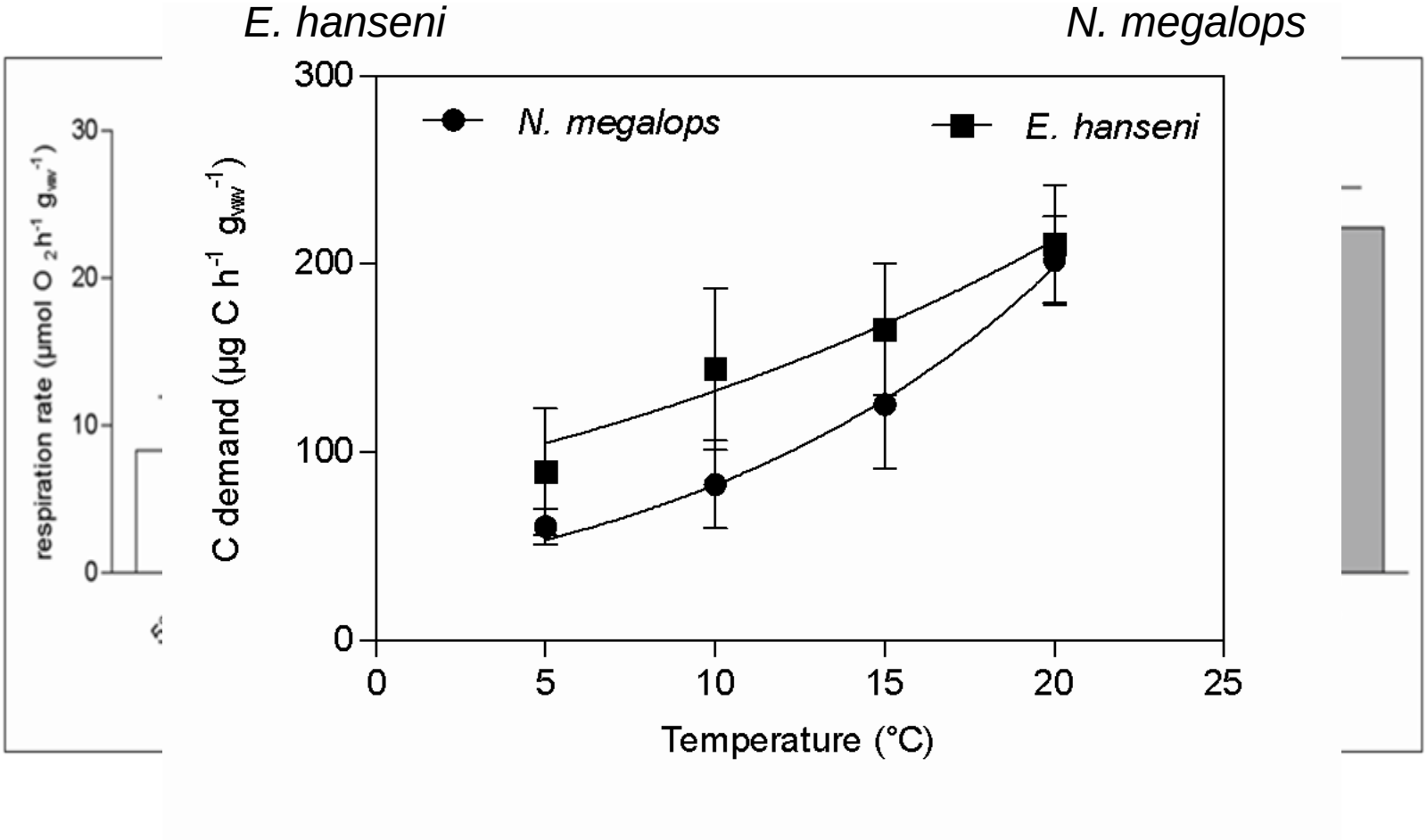


day

night

Werner, T. and Buchholz, F. (2013)
Diel vertical migration behaviour in Euphausiids of the Northern Benguela Current: Seasonal adapatations to food availability and strong gradients of temperature and oxygen .
Journal of Plankton Ressearch 35(4), 792-812

Temperature Constraints in Krill



Werner, T. Huenerlage, K., Verheye, H. and Buchholz, F. (2012) Thermal constraints on the respiration and excretion rates of krill, Euphausia hanseni and Nematoscelis megalops, in the northern Benguela upwelling system of Namibia. *African Journal of Marine Science 34(3), 391-399.*

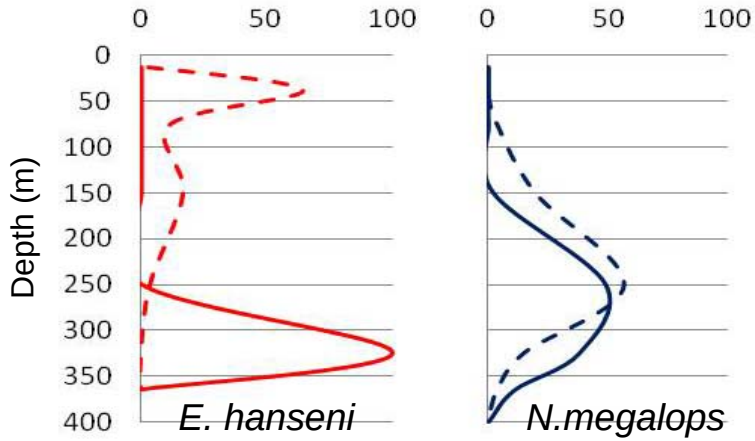
Temperature Constraints in Krill

·The **impact of temperature** on the respiration rates of both species **differed significantly**

·*N. megalops* showed **adaptations to cold waters**, whereas *E. hanseni* was adapted to **higher temperatures**

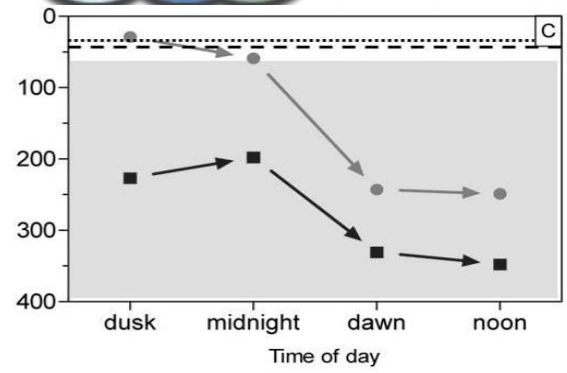
·**Thermal adaptations** of both species were **strongly related to DVM** behaviour

E. hanseni
(© E. K. Stenevik)

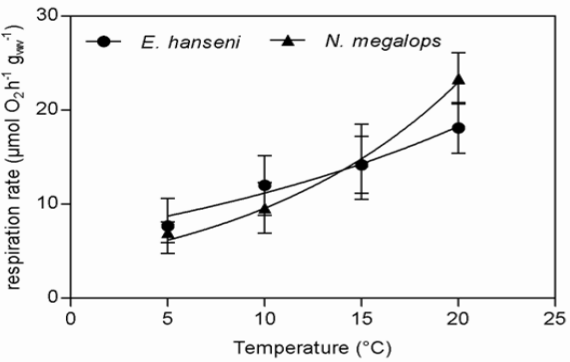


N.megalops

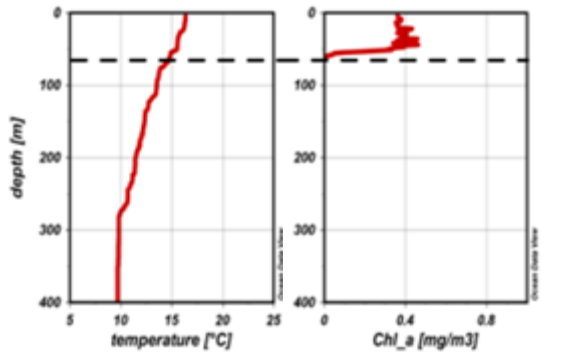
Diel Vertical Migration Model



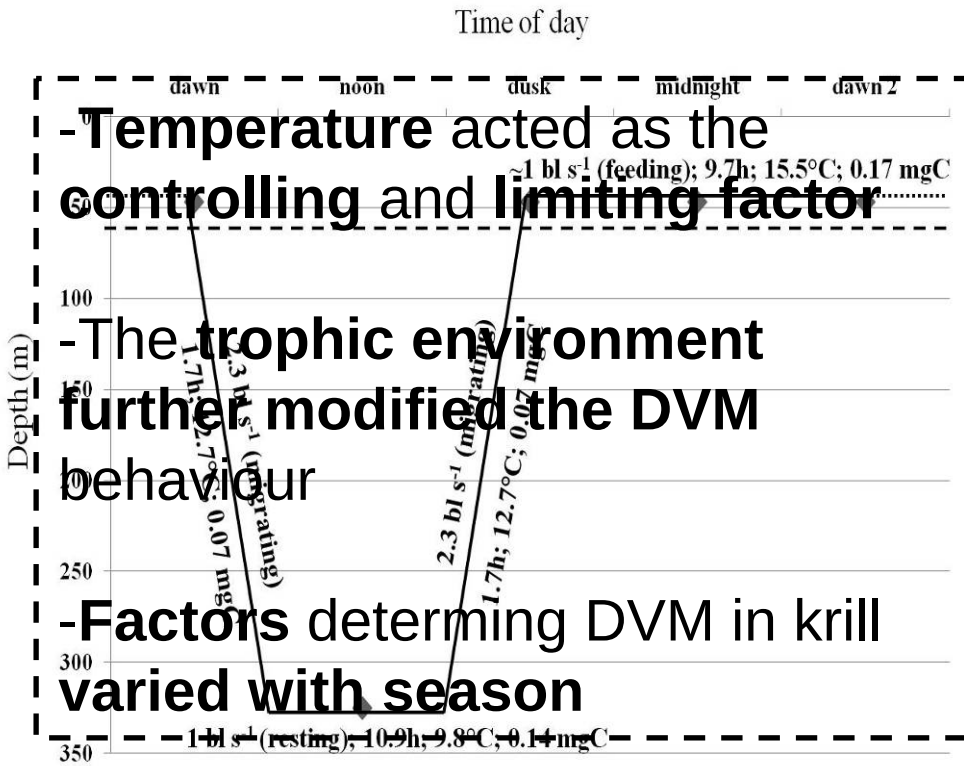
Behavioural observations



Physiological constraints



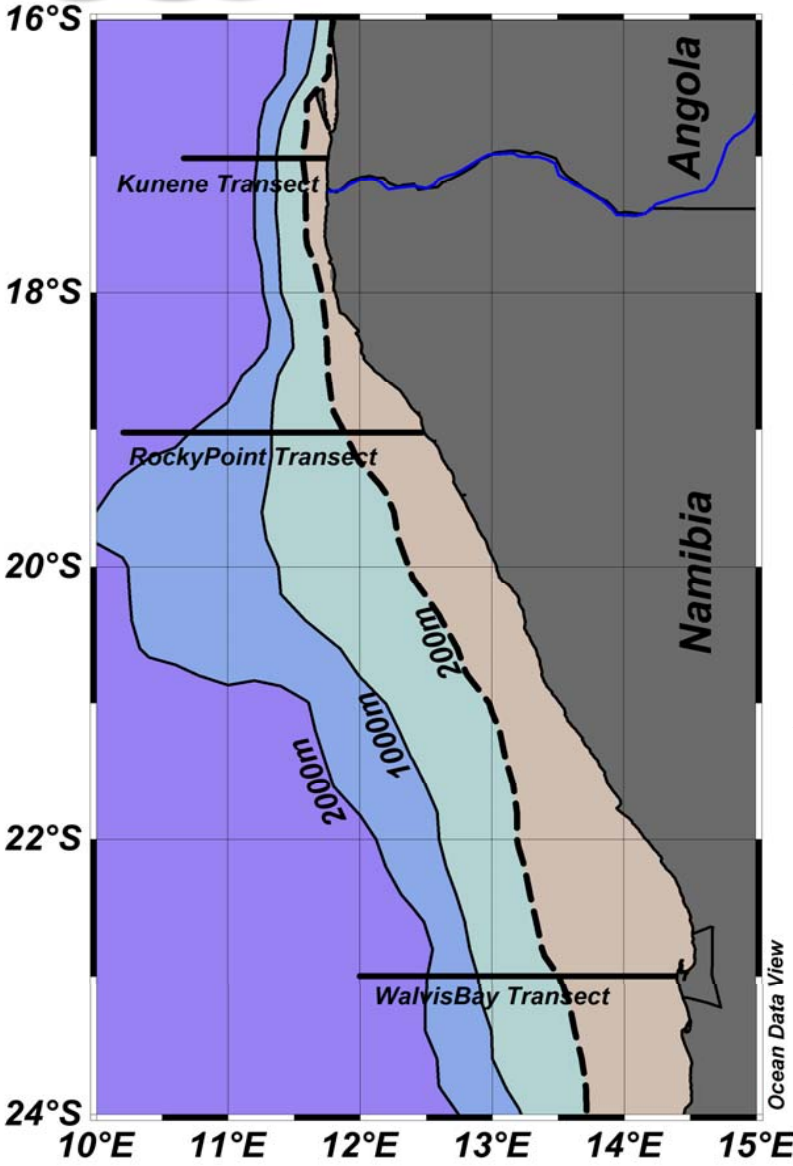
Environmental parameters



- **Temperature** acted as the **controlling** and **limiting factor**
- The **trophic environment further modified the DVM** behaviour
- **Factors** determining DVM in krill **varied with season**

Shortest feeding period to cover C-demands

Carbon Flux
Shelf / Offshore and North / South



Kunene	all migrants	mg C 12h^{-1} m^{-2}
0-50m	shelf	**1,6**
>50m	shelf	**0,1**
0-100m	oceanic	**26,0**
>100m	oceanic	**10,5**

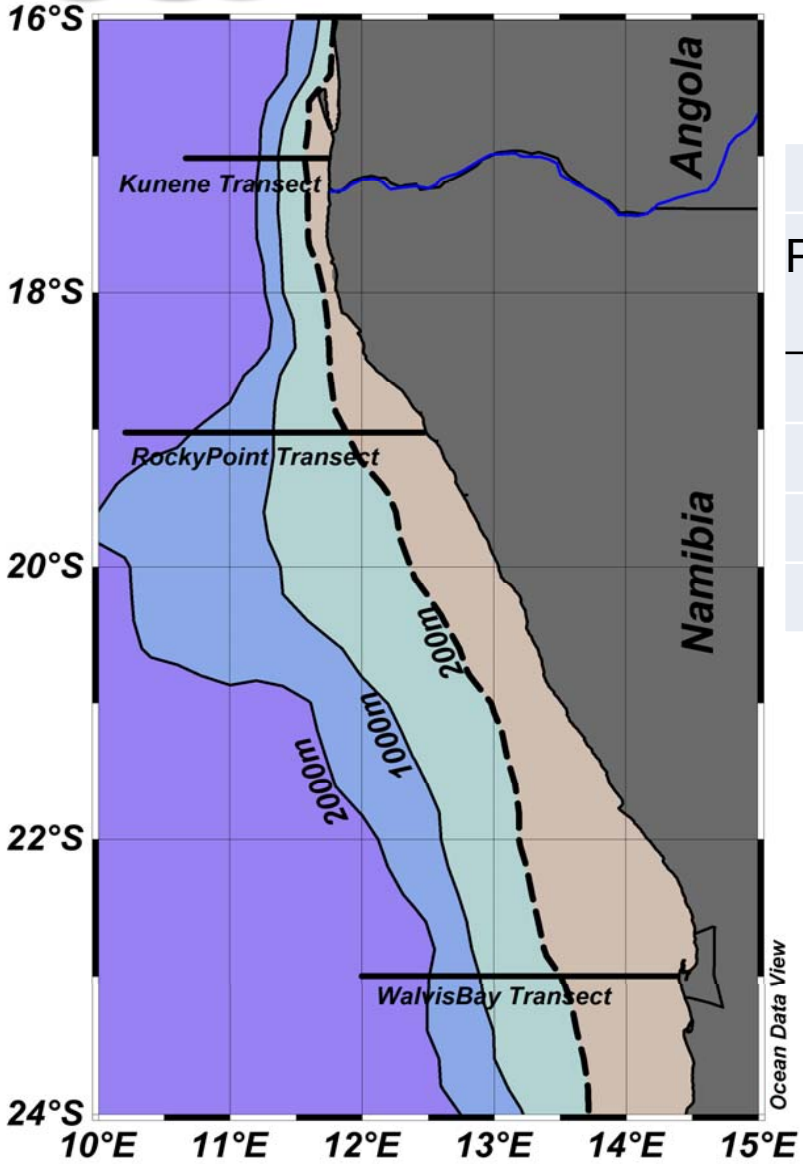
Higher C-flux towards lower latitudes

Rocky Point	all migrants	mg C 12h^{-1} m^{-2}
0-50m	shelf	**5,9**
>50m	shelf	**1,1**
0-100m	oceanic	**17,5**
>100m	oceanic	**7,0**

Higher C-flux further offshore

Walvis Bay	all migrants	mg C 12h^{-1} m^{-2}
0-50m	shelf	**1,9**
>50m	shelf	**3,9**
0-100m	oceanic	**8,0**
>100m	oceanic	**1,1**

Carbon Flux
Copepods / Decapods / Krill



Respiratory C-Flux	Area	Percentage (%) Copepods	Decapods	Krill
0-50m	shelf	58	0	42
>50m	shelf	66	0	34
0-100m	oceanic	23	10	67
>100m	oceanic	10	57	32

Shelf: Copepods and Krill mainly contribute to the respiratory carbon flux

Slope/Ocean: Krill and Decapods mainly contribute to the respiratory carbon flux

Contribution of Mesozooplankton to the Vertical Flux of Carbon

Depth (m)	POC-Flux (mg C d^{-1} m^{-2})	Copepods/Decapods/Krill (mg C d^{-1} m^{-2})	%
100m	30,4*	17,2	**57**
400m	9,2*	6,2	**67**

*after Giraudeau et al. (2000)

Depth (m)	POC-Flux (mg C d^{-1} m^{-2})	Copepods/Decapods/Krill (mg C d^{-1} m^{-2})	%
70m	178,1*	x	x
100m	131,1	17,2	**13**
400m	39,9	6,2	**16**

*Sediment trap at 70m (2009-2011), Flohr/Rixen

Contribution of Mesozooplankton to the Vertical Flux of Carbon

The **conceptual DVM model** is a suitable tool to **enhance understanding** of simultaneous effects of **proximate factors** on DVM behaviour

Mesozooplankton significantly contributes to the **active carbon flux** by vertical migration/respiration

Copepods and **Krill** dominate the respiratory carbon flux over the **shelf area**

Decapods and **Krill** dominate the respiratory carbon flux over the **slope/ocean**

Spatial differences (North/South; Shelf/Ocean) in **respiratory C-flux** depend on mesozooplankton **biomass** and horizontal **species distribution**

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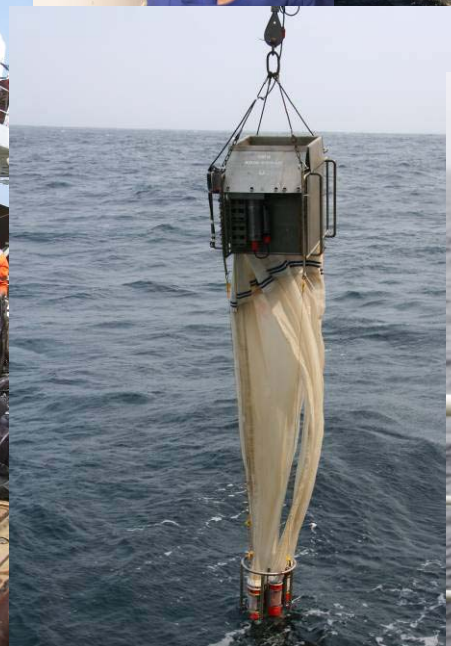


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Allow us to draw your attention to the following posters:

F4.P2	Flohr, Anita	**Carbon pumps** in the northern Benguela upwelling system
F4.P6	Martin, Bettina	Distribution of **zooplankton biomass** in the northern Benguela Upwelling System
F4.P7	Schukat, Anna	Energy demands of calanoid copepods and pelagic decapods of the Benguela upwelling system and their contribution to **active carbon flux**
F4.P9	Lahajnar, Niko	**Organic matter cycling** in the Benguela Upwelling System: Insights from amino acid biogeochemistry
F4.P13	Emeis, Kay	Nutrient and **CO_2 dynamics** in the northern Benguela Upwelling System