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GENUS

Physiological characteristics of plankton organisms and their role for ecosystem functioning. Results from GENUS I and II

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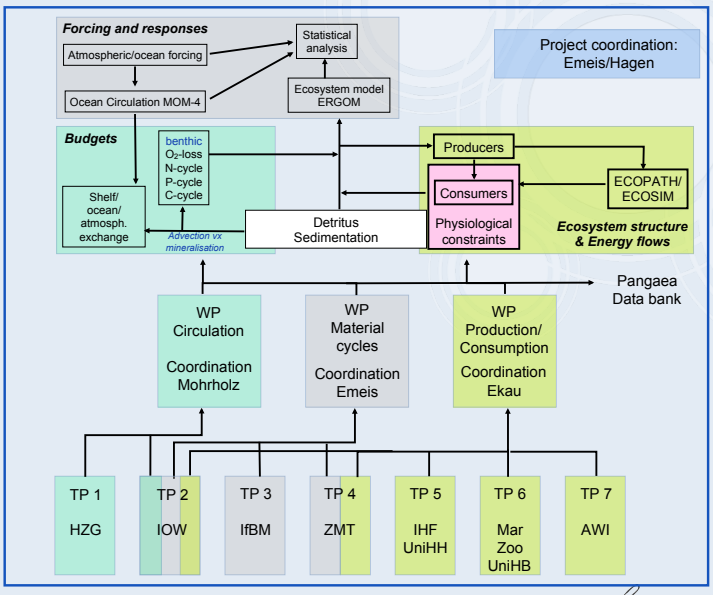
GENUS Goals

- GENUS is an integrative project that uses a large coastal upwelling system to investigate and model the relationships between climate change, biogeochemical cycles of nutrients, climate relevant gases and ecosystem structures.

- Project phase I: 2009-2012
- Project phase II: 2012-2015

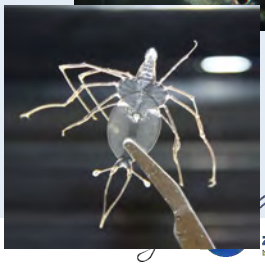
Project structure



- Target groups of plankton:
  - Phytoplankton
  - Micro Zooplankton
  - Copepods
  - Euphausiids
  - Fish larvae
- Areas of concern
  - Physiology
  - Distribution
  - Growth

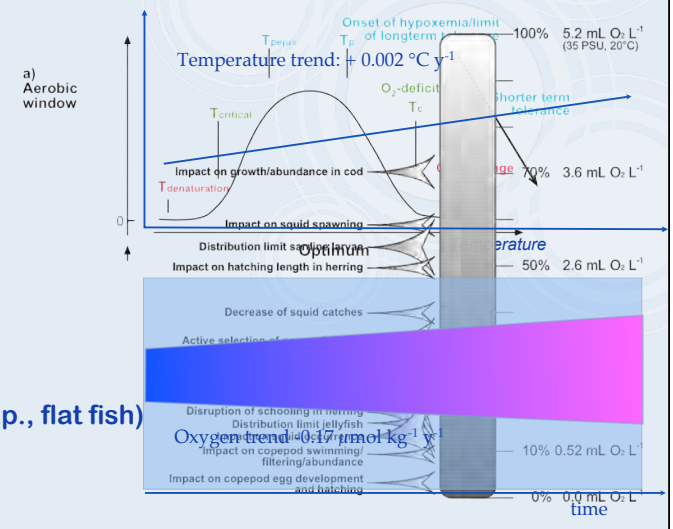




Physiology

- Respiration &
- Hypoxia tolerance
  - Copepods
  - Euphausiids
  - Fish larvae (T.cap., flat fish)

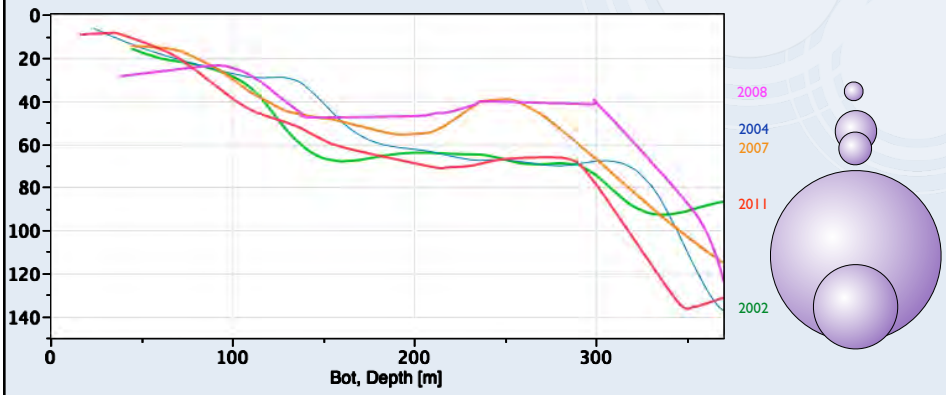


Ekau et al. 2010
Stramma et al. 2008

Depth of oxycline & sardine abundance

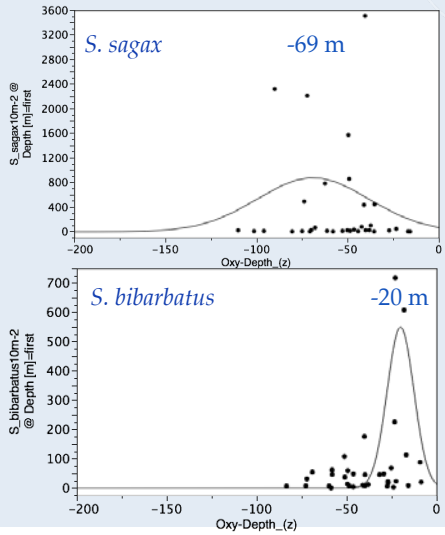
- Shoaling of oxycline

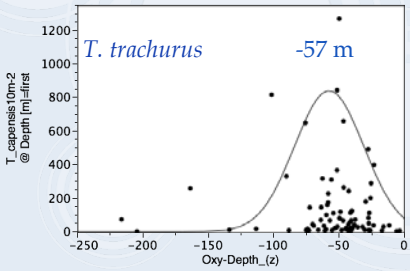
2014 ?



Preference of oxycline depth

- **Distribution related to oxycline depth**

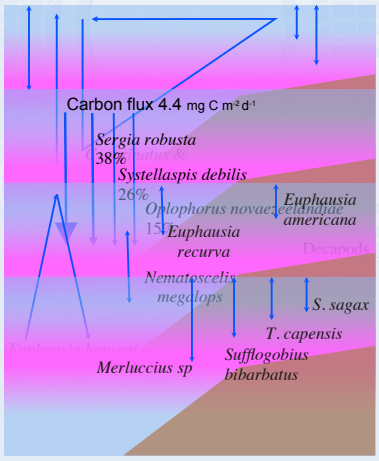




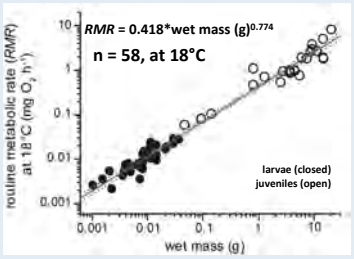
- *E.capensis* -50 m
- *Merluccius spp.* -40 m

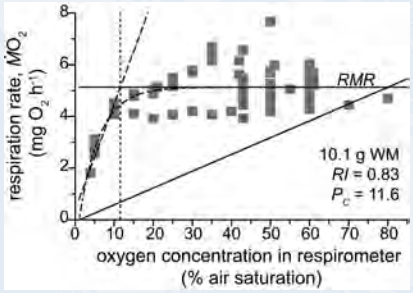
Distribution, Migration and Transport

- **Investigated taxa**
  1. Gelatinous Zooplankton
  2. Microzooplankton
  3. Copepods
  4. Decapods
  5. Euphausiids
  6. Chaetognaths
  7. Gastropods (Thecosomata)
  8. Fish larvae (Sardine, hake, horse mackerel, etc.)



Metabolic rates and energy requirement of *T. capensis*





***T. capensis* larvae:**

no response until 30% O_2 saturation (at 17-19°C, ~ 1.7 mL O_2 L^{-1})

→ short term hypoxia tolerance

minimal prey requirements of unfed *T. capensis* larvae and juveniles at 5 sizes

	0.001 g	0.01 g	0.1 g	1 g	10 g
RMR (mg C d^{-1})	0.013	0.076	0.450	2.674	15.885
Small copepods (Cyclopoida, Harpacticoida, Poecilostomatoida, Calanoida small)	0.5-0.9	3-5	18-30	107-178	635-1059
Calanoida medium		1	6	36	211
Calanoida large				9	56

Geist et al. 2013

Physiology

- Respiration &
- Hypoxia tolerance
  - Copepods
  - Euphausiids
  - Fish larvae (*T.cap.*, flat fish)

Copepods	mg C m^{-2}	µl O_2 h^{-1} $ind.^{-1}$ (15°C)	O_2 threshold	$\delta^{15}N$	$\delta^{13}C$	TL
Calanoides carinatus (C5/f)	458(50-1645)	44,9	-	8,1/8,1	-17,1 bis -17,5	2,4 bis 3,0
Rhincalanus nasutus (f)	49(0-124)	15,9	-	8,7	-17,8	3,2
Aetideopsis carinata (f)	160(0-917)	17,7	-	8	-16,3	2,4
Decapods						
Pasiphaea semispinosa	50(0-897)	8,9	-	8,7	-15,4	3,1
Oplophorus novaezeelandiae	62(0-287)	12,7	-	6,5	-16,1	2,5
Sergia robusta	64(0-322)	7	-	8,8	-14,8	3,2

Taxon, group	Biomass (WM* mg/m^3)	O_2 (µmol O_2 h^{-1} gww^{-1})	O_2 threshold	$\delta^{15}N$	$\delta^{13}C$	TL
Krill	0-144440					2,6-3,9
Euphausia hanseni	0-19080	12,4±3,7 (10°C) 18,1±2,7 (20°C)	16%/1,80 mg L^{-1}(12°C) 20%/1,74 mg L^{-1} (20°C)	4,1	-23 bis -16	2,6-3,1
Nematoscelis megalops	0-20686	9,6±2,7 (10°C) 23,4±2,7 (20°C)		7,12	-21 bis -17	3,2-3,9
Nyctiphanes capensis	0-144440	8,4±1,4 (10°C)		7,11	-22 bis -18	3,2-3,4

Fish larvae	mg C m^{-2}	µl O_2 h^{-1} $ind.^{-1}$ (15°C)	O_2 threshold	$\delta^{15}N$	$\delta^{13}C$	TL
Trachurus capensis		13,5	Larvae ca. 30% at 18°C, Juv. ca. 13% at 20°C	6,31 - 13,8	-21,0 bis -15,7	3
Sardinops sagax				7,6 - 11,6	-20,84 bis -16,3	3
Engraulis capensis				6,2 - 12,0	-21,33 bis -15,9	3
Adults						
T. capensis				9,11 - 14,1	-18,7 bis -15,4	
S. sagax				8,25 - 11,2	-17,9 bis -14,8	
E. capensis				10,5 - 14,7	-18,7 bis -15,3	

Geist et al. 2013
Werner et al. 2012

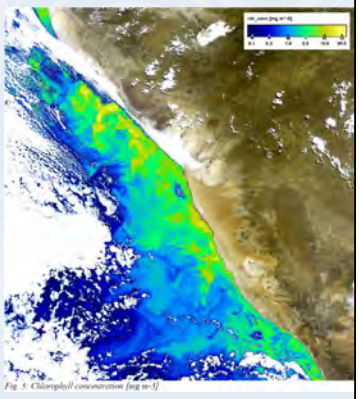
GENUS Outlook

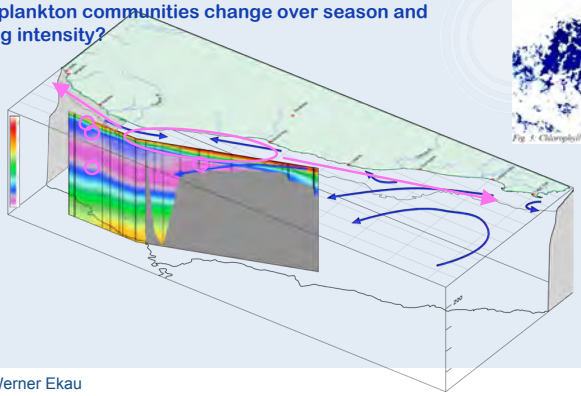
Which mechanisms regulate or limit, respectively, the transfer of energy from low to upper trophic levels? (High PP, low fish)

What is the share of production exported from the system by organisms? Pathways?

What is the importance of filaments for development of organisms (food, production, migration, predation?)

How do plankton communities change over season and upwelling intensity?





GENUS Cooperators:

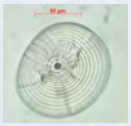
funded by Bundesministerium für Bildung und Forschung

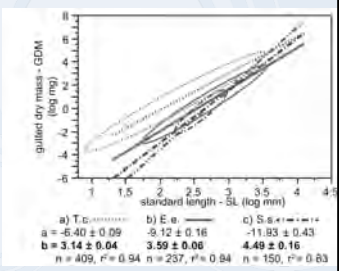
- The German Ministry for Education and Research (funding agency)

- Alfred Wegener Institute for Polar and Marine research
- Leibniz Center for Tropical Marine Ecology ZMT
- Leibniz Institute for Baltic Sea Research IOW
- University of Bremen (BreMarE)
- University of Hamburg (IHF, IfBM)
- Department of Environmental Affairs DEA
- National Museum, Information and Research Center, Swakopmund
- Instituto National de Investigação de Pesca, Luanda

Daily growth

Average growth in biomass at 6 mm SL:
T. capensis > *E. encrasicolus* > *S. sagax*





Geist 2013

***Sardinops sagax* larvae**

- spatial distribution limited by warm water-intrusions (?)
- if occurring in high densities, poor nutritional condition

→ Present environmental conditions unfavourable > Low abundance

***Trachurus capensis* larvae**

- hypoxia tolerant
- wide prey spectrum, high feeding success; better nutritional condition

→ cope best with present environmental conditions > High abundance

Geist et al. 2014