VKR Centre of Excellence

Meeting agenda

4th annual meeting of the Centre for Ocean Life

Søminestationen (Holbæk), December 10th-11th 2015

Welcome to the 4th annual meeting of the Centre for Ocean Life!

Please find the program and the list of talks/posters with abstracts below.

For further information please contact Anna Törnroos (annto@aqua.dtu.dk).

Looking forward to seeing you all there!

The organizing committee: Julia, Agnethe, Anna & Philipp

Hour	Min	Thursday 10th	Friday 11th
8:00	00-15		Breakfast 60 min
	15-30		
	30-45		
	45-60		
9:00	00-15	Arrival (find a room etc.)	Erik Bonsdorff
	15-30		Philipp Brun
	30-45		Nicolas Schnedler-Meyer
	45-60	Thomas Kiørboe – Welcome and opening remarks	Coffee Break 15 min
10:00	00-15		Daniel van Denderen
	15-30	Lasse Tor Nielsen	Anna Törnroos
	30-45	Julia Dölger	Laurene Pecuchet
	45-60	Coffee Break 15 min	Tim Spaanheden Dencker
11:00	00-15	Marina Pancic	Coffee Break 15 min
	15-30	Agnethe Nøhr Hansen	Christine Stawitz
	30-45	Irene Heilmann	Nis Sand Jacobsen
	45-60	Sachia Jo Traving	Rob van Gemert
12:00	00-15	Lunch 60 min	Lunch 60 min
	15-30		
	30-45		
	45-60		
13:00	00-15	Keynote speaker 45 min Markus Pahlow	Ken – Wrap up 30 min
	15-30		
	30-45		Clean up & farewells
	45-60	Jiayi Xu	
14:00	00-15	Coffee Break 15 min	-End of the meeting-
	15-30	Hans van Someren Greve	
	30-45	Rodrigo Almeda	
	45-60	Mark Wejlemann Holm	
15:00	00-15	Coffee Break	
	15-30	Group discussion - future ideas for the Centre combined with walk	
	30-45		
	45-60		
16:00	00-15		
	15-30		
	30-45		
	45-60	Andre W. Visser – Seasonality in the Ocean	
17:00	00-15		
	15-30	Kasia Kenitz	
	30-45	Esther Beukhof	
	45-60	Poster and beer 30 min	
18:00	00-15		
	15-30	Board meeting & Young researchers meeting	
	30-45		
	45-60		
19:00	00-…	Dinner	

Titles and abstracts of talks

Nis Sand Jacobsen	How efficiently are fisheries operating at the ecosystem level?	Like most natural resource management problems, managing fisheries presents tradeoffs between objectives (e.g. yields, profits, ecological objectives) that have to be weighed against one another. When navigating such conflicting objectives, a logical first target is Pareto efficiency- a state from which it is impossible to improve with respect to any objective without regressing with respect to at least one other objective. Here we use a novel calibration of size-based ecosystem models to investigate the ecosystem-level efficiency of fisheries management in five large marine ecosystems (LMEs) with respect to yield and an aggregate measure of ecosystem impact. In two of the LMEs. We find three of the ecosystems to be nearly efficient with respect to yield and ecosystem impact, whereas two could improve. In contrast, we find both LMEs (North Sea, Baltic Sea) quite inefficient with respect to economic rent and ecosystem impact, but that their efficiency is steadily improving. Our results suggest that single-species management can perform inefficiently at the ecosystem-scale.
Christine Stawitz	How diet preferences impact the size-structured community within a tropical lake	Tonlé Sap Lake in Cambodia is one of the most productive freshwater ecosystems in the world, with an estimated catch of 550-650K tons annually. The lake fish community is supported by both aquatic primary production and terrestrial input, which enters the system during flood periods and creates an additional, bacterial nutrient pathway. Over 500 fish species are estimated to reside in the lake, with some primarily dependent upon autotrophic and others dependent on bacterial food sources. Consumers of the bacterial input are contaminated by mercury, with contamination increasing with trophic level. We use a size-structured ecosystem model to understand the effect of relative availability of the two resources on growth rates, abundance, and harvest of fish species in Tonlé Sap. Additionally, we study the effect of targeted fishing on low-mercury species (i.e. autotrophic consumers) on the size-structure and composition of the lake fish community.

Julia Dölger	Feeding and Swimming of Haptophytes	Haptophytes are mixotrophic biflagellates. Many of them use their haptonema, a rod-like structure emerging from the front of the cell, for prey capture. With analytically calculated flows around model biflagellates with point forces located next to a no-slip sphere we investigate the hydrodynamics of swimming and feeding and the associated trade-offs in haptophytes. By comparison with morphologies, beat patterns and micro-PIV flow fields for two haptophyte species we find that their flagellar arrangements are rather optimized for fast swimming than for advective prey capture on the haptonema.
Marina Pancic	Benefits, cost, and tradeoffs of defense mechanisms in marine phytoplankton	Phytoplankton is a highly diverse group of photosynthetic organisms, which contributes to ~50% of the global CO_2 fixation, and concomitantly affects the biogeochemical cycles in the ocean due to their requirements for nutrients. The fact that many phytoplankton species coexist in the same space and at the same time on few resources, together with the strong top-down selective pressure, demands for identification of the traits that determine their ecological niche. In order to reduce predation from higher trophic levels, phytoplankton has developed a variety of physical and chemical defense mechanisms, and has additionally been found to be highly flexible in traits which affect their edibility. This project aims at identifying and quantifying benefits, costs and tradeoffs of those mechanisms, initially focusing on the thickness of silica walls in diatoms, since this morphological trait was found to be a plastic trait, and can be induced by the presence of herbivores.
Markus Pahlow	Optimality-based model of switching between motile and non-motile prey	A modelling analysis of mesocosm experiments in the Peru Upwelling region indicates different feeding behaviour of the ciliate community depending on dinoflagellate abundance. Owing to the absence of laboratory observations on ciliates, we used observations of copepod switching behaviour to derive optimal switching behaviour between motile and non-motile prey. The model requires only a slight modification of an existing optimality-based model for current feeders. While the model can explain individual switching behaviour, it fails to reproduce the mesocosm data. Thus, the feeding behaviour of zooplankton communities may differ fundamentally from that of individual populations.

Sachia Jo Traving	Dynamics in microbial composition and functionality over a season in two contrasting estuarine systems	In aquatic microbial ecology it remains unclear how bacterial community composition and dynamics are coupled to functionality, and whether this putative coupling varies over the season. In this study we address the questions if bacterial community composition can be linked to community function, and how this coupling is affected by environmental conditions during a season. Bacterial community composition and dynamics was determined using Illumina sequencing of the 16S gene. Community functions were assessed by carbon utilization profiles using 31 different carbon sources combined with activity patterns of five different extracellular enzymes. The community activity was estimated through respiration and bacterial production, which allowed the carbon use efficiency (CUE) to be calculated. The environment was characterized with special focus on the dissolved organic matter (DOM).
Andre W. Visser	Seasonality and the ecology of marine life	Nearly all marine ecosystems are modulated seasonally. This is particularly evident in boreal and temperate environments, in the annual cycles of primary production, with a period of intense productivity on an otherwise replete environment. This cycle of feast and famine imprints itself throughout the marine food web, from the pelagic to the bentos, from phytoplankton to zooplankton, fish and marine mammals and birds, and also to microbial processes, pathogens and parasites. Otimizing annual routines to best survive and make use of seasonal cycles is a fundamental evolutionary pressure on life in much of the world's oceans. Within Ocean Life, we have initiated an ambitious program to document seasonal patterns of marine life history strategies, focusing on activity, storage (and hibernation) and migration as key traits. These observations will be compared to a simple theoretical framework; to gauge how much of the observed patterns can be explained by optimized resource utilization.

Hans van Someren Greve	Behavior-dependent predation risk in marine planktonic copepods: an experimental and modelling approach	Zooplankton exhibit different motile behaviors related to feeding, swimming and mate searching. These differences in motility may imply different levels of predation risk, which may partially determine the structure of pelagic communities. Here, we experimentally test a behavior-dependent encounter model that considers fluid signal generation and perception as well as encounter velocities to predict predation risk in planktonic copepods. We use prey and predator motility characteristics obtained by video-observations as input to the model and conducted bottle incubation predation experiments to determine predation risk associated with i) differences in feeding strategy (active vs. passive feeders) and with ii) gender differences in mate searching behavior. Observed predation risk varied significantly with behavior and was well predicted by our model. Specifically, we found higher predation risk for copepods with active compared to passive feeding strategies, and higher predation risk in mate-searching males than in females. Overall, our results demonstrate that motile behavior is a key factor affecting predation risk in zooplankton.
Jiayi Xu	Long-term effects of the toxic dinoflagellate *Alexandrium tamarense* on copepods	This is a background introduction of my upcoming experiments which about the long-term toxic effects of *Alexandrium tamarense* on copepods. Many researches stated various long-term effects of cell toxin concentration, composition and toxicity of harmful algae on ingestion rate, egg production, hatching success and nauplius fitness of copepods. Our previous experiments described three completely different short-term (4 hours' exposure) feeding responses of *Temora longicornis* to three strains of *A. tamarense* which had various allelochemical activities, PSP toxin profiles and contents. Results showed no significant lethal or sublethal effects on *T. longicornis* during the first 4 hours' feeding on toxic *A. tamarense*. For the next stage, we are curious about whether there are any long-term toxic effects on copepods and their offspring by exposing to *A. tamarense* for several days or more.

Mark Wejlemann Holm	Resting eggs in copepods – trait related to temperature tolerance of adults?	The marine environment is ever changing. Depending on factors such a latitude and type of habitat these changes can be significant or undetectable for marine life. Changes in biotic and abiotic conditions can occur on small and large time scales, with the most important for many marine organisms being predictable seasonal cycles. Seasonal fluctuations in environmental conditions primarily depend on solar radiation, and hence temperature. Marine free-living copepods produce resting eggs to cope with these changes. Often resting eggs are thought of as a mechanism to cope with winter conditions, and thus low temperatures. However, 30% of the species, which presently are known to produce resting eggs, does so to cope with warm periods. Therefore, is the production of resting eggs a mechanism to cope with the low food availability during winter or is it a trait that is related to temperature tolerance of adult copepods?
Irene Heilmann	Predator-prey model with fitness taxis	I will present the basic idea for my next project. When predator-prey models are extended to include spatial dimensions we can have the classical Turing model. This model assumes animals move randomly, which surprisingly can create stable spatial patterns. We consider animals that do not move randomly, but instead move towards places where they have better fitness. The aim is to investigate the spatial patterns such a generalization can lead to.
Daniel van Denderen	Effects of bottom trawl fishing on benthic communities across habitats	Bottom trawl fishing has widespread impacts on benthic habitats and communities. We examined the effect of this anthropogenic disturbance on benthic species richness and community composition and function in different parts of the North Sea. We observed negative effects of trawling on richness in relatively speciose, deep areas with fine sediments. In these areas, trawling generally declined long-lived, hard-bodied and suspension-feeding organisms. Shallow areas with coarse bottoms had different community compositions, being composed of either small-sized, deposit-feeding animals, or, mobile scavengers and predators, and in these areas trawl effects were not found. These condition-dependent effects may help to identify areas that are more or less resilient to trawling and can support the development of management plans that account for the environmental effects of fishing.

Rodrigo Almeda	Trade-offs in zooplankton feeding behavior-experimental approach	Zooplankton has developed three different ways of collecting food: they can be ambush feeders that wait for prey to pass within their dining sphere; they can generate a feeding current and harvest prey that are entrained in the feeding current; or they are cruise feeders that capture prey that they encounter as they cruise through the water. We experimentally quantify the costs and benefits, "tradeoffs", in terms of feeding efficiency, predation mortality, and metabolic expenses, associated with these three main feeding behaviors in zooplankton. The copepods Temora longicornis (feeding-current feeder), Oithona nana (ambush feeder) and Centropages hamutus (cruising feeder) were used as model organisms. We will present our experimental results about how these trade-offs are interrelated and vary among feeding behaviours and optimal feeding strategies in zooplankton will be discussed.
Agnethe Nøhr Hansen	Estimating diatom size and Si content in response to environmental change	Diatoms are a class of unicellular phytoplankton that have the characteristic traits of a silicate shell and an internal vacuole. The aim of the model is to explore trade-off and fitness consequences of the physical traits; size, shell thickness and vacuole volume. The mechanisms involved in the trade-offs include uptake kinetics of nutrients, photosynthetic carbon uptake, cell density, sinking loss, grazer resistance, cost of growing and maintaining the silica shell and the vacuole. The aim is to develop a hypothetical framework within which the fitness of expressed diatom traits can be explored, and through which the seasonal succession of diatoms can be understood.
Laurene Pecuchet	Traits and life history strategies of fish assemblages in the European Seas	In this study, we investigated the spatial patterns and prevalence of traits and life history strategies of fish communities across Mediterranean and Atlantic ecosystems. These ecosystems provide a pronounced natural gradient in terms of e.g., temperature and productivity and are subjected to various anthropogenic pressures (fisheries, pollution). Based on the traits fecundity, offspring size and maximum length, species could be characterized into three strategies: opportunistic, periodic and equilibrium. There were clear spatial pattern in the different strategies prevalence. These spatial patterns could be related to the abiotic environment, notably temperature and depth, and the biotic environment, e.g. chlorophyll. The equilibrium strategies were prevailing in stable and predictable environment, while the opportunistic strategies were prevailing in environment with strong abiotic seasonality. This study demonstrates how traits and trades-offs, can be used to summarize species strategies into few key life history strategies and how it can be used to investigate communities' composition.

Esther Beukhof	Spatio-temporal patterns of fish trait diversity in the North Sea	North Sea demersal fishes form a well-studied community in terms of species diversity, community structure and composition, especially in the light of increasing fishing pressures of the previous century. However, less is known to what extent anthropogenic and environmental changes have impacted the functional diversity and composition of the community. Functional diversity is becoming an increasingly important aspect of biodiversity since it is believed to better explain and predict ecosystem functioning than species diversity does. It is calculated based on the functional traits and the range of their values that are present in the community. To better understand and explain patterns in functional diversity of the North Sea fish community, I study the underlying spatio-temporal patterns of several individual fish traits. The preliminary results of my analysis will be presented.
Anna Törnroos	Long-term functional trends and interactions in Baltic Sea coastal benthos and fish	The focus on single trophic levels or specific taxonomic groups, and the lack of knowledge on temporal variability of functional properties, is limiting our progress of understanding changes in marine systems. Here we addressed this by exploring the temporal (~ 40 years) pattern in functional structure of fish and benthic macrofauna in three Baltic Sea coastal areas (Kattegat, the Baltic Proper and the Bothnian Sea). We assembled trait information on six traits spanning morphology, life history, habitat and behaviour for > 200 macrofaunal taxa and > 40 fish taxa. To assess functional changes and potential shifts we analysed functional indices (richness, evenness and dispersion) on a community level in each area. The functional trends were also related to environmental variables measured on a local and regional scale (water temperature and salinity). In addition, we compared trends in specific traits between the two taxonomic levels in order to get a better understanding of interactions and couplings.

Nicolas Schnedler-Meyer	Global jellyfish patterns and responses to environmental forcing – insights from a mechanistic model.	Blooms of large pelagic jellyfish are notorious for causing losses in fisheries, infrastructure and tourism, and generally form alternative, less efficient pathways in marine food webs, limiting energy transfer into the higher trophic levels. In spite of being ubiquitous and abundant, jellyfish are diverse, difficult to sample and process, and have naturally fluctuating populations. This makes it hard to elucidate the key factors promoting jellyfish, especially when combined with the variety of circumstances surrounding local bloom cases. Nevertheless jellyfish share key traits which separates them from fish, and which potentially defines their role in marine ecosystems. Here we build on mechanistic descriptions of the link between individual feeding and environmental factors, to predict responses to eutrophication and fishing of an idealized food web containing jellyfish. The model is applied to the Large Marine Ecosystems and the obtained patterns are compared with other studies.
Philipp Brun	Signal of environmental regime in key traits of copepods	Pelagic copepods are ubiquitous from icy polar oceans to stratified tropical seas, dominating the mesozooplankton biomass across large areas. The success of this homogeneous group of crustaceans is only possible through efficient adaptations to the wide range of environmental conditions experienced. We argue that the signal of these adaptations is manifested in a few easily measurable key traits. We compiled a large dataset of ecologically relevant candidate traits and found body size, feeding activity, relative offspring size, and respiration rate to be proxies for its principal dimensions. We combine information on these four key traits with large observational datasets to produce trait distribution maps of pelagic copepod communities, and then test the relevance of these maps by using them to predict Longhurst's ecoregions. Besides improving our understanding of trait-environment relationships for copepods, our maps also represent a new baseline against which hypotheses and model predictions can be tested.
Lasse Tor Nielsen	Trade-offs in flagellar arrangements – why all the diversity?	All unicellular flagellates share the same basic missions of life: To survive and grow. The flagella are obviously crucial to both of these missions, yet flagellates show a profound diversity in flagellar arrangements and beat patterns. What are the trade-offs involved in flagella arrangement and beat pattern among unicellular protists? What are for instance the advantages (and disadvantages) of having multiple flagella instead of just one? Are some flagellar arrangments optimizing swimming and others feeding? Or are the two convergent? Is the flagellar arrangement coupled to trophic mode, so that heterotrophs primarily display one type and phototrophs another? We analyze flagella beat patterns and visualize the flow fields of unicellular flagellates with different flagellar arrangments in an attempt to identify

		traits and quantify trade-offs.
Tim Spaanheden Dencker	Functional diversity in the North Sea fish community	Contrary to taxonomic diversity's focus on species, functional diversity encompasses the range of functional traits in a given community. A review by Hooper *et al.* (2005) concluded that functional diversity often is better at explaining the relationship between biodiversity and ecosystem functioning. Yet, functional diversity has only recently moved into the spotlight, and there is still unchartered territory in terms of understanding the mechanisms behind it. In this study, I have explored the temporal and spatial dynamics of both taxonomic and functional diversity over a three-decade period in the North Sea fish community. The results show marked differences between hot and cold spots of species richness and functional richness, and a high degree of spatio-temporal variation over the 31-year study period.
Kasia Kenitz	Trophic trait cascade and seasonality in plankton traits – future directions	Plankton community in the English Channel is characterised by robust seasonal patterns in phytoplankton motility and zooplankton feeding traits. Non-motile diatoms bloom in spring, with dinoflagellates thriving in late summer. Feeding-current feeders target non-motile prey and reach their highest biomass in summer, following the spring diatom bloom. In contrast, passive ambushers peak in early spring and autumn. Model simulations reveal that the seasonal succession of zooplankton feeding traits is controlled by prey availability and the physical environment. Change in the optimal feeding mode driven by the physics may in fact be the driver reinforcing the seasonal succession of phytoplankton motility traits, hence illustrating the trophic trait cascade. The adaptive grazing model is a tool that provides a great insight into the mechanisms shaping plankton trait distribution across different physical regimes or latitudinal gradients. I will present ideas for further implementation and improvements required for model application across contrasting environments.

Titles and abstracts of posters

Anders Andersen	Hydrodynamics of Choanoflagellate Feeding	No abstract
Sofia Piltz	A minimalistic model for phytoplankton blooms	Inspired by analyses on satellite data, we develop a minimalistic model for phytoplankton blooms. Our model successfully reproduces qualitative patterns seen in the data. Our ongoing work involves comparing model predictions quantitatively with data for primary production and chlorophyll concentration collected in a fjord outside of Gothenburg between 1985 and 2012.
Brian MacKenzie	Predicting future shifts in herring spawning habitat in the North Sea	Herring (Clupea harengus) is one of the ecologically and commercially most important fish species in the North Sea. It produces benthic eggs at numerous sites along the British coast in the North Sea and English Channel. We used environmentally-drivenn GAMs to investigated how expected 21st century climate change could influence spawning time and location, and egg survival probability in the North Sea. Model predictions for the 2090s suggest earlier spawning for northern spawning areas and a shift towards later spawning time for a southern area (Downs). Alternatively, if the northern spawning components maintain their current spawning period via behavioural distributional changes, they would potentially face a narrower spatial distribution of suitable conditions for spawning compared to the currently known spawning locations. Expected egg survival will not likely change. These analyses illustrate processes how increasing temperatures associated with climate change could affect herring life history and ecology in the North Sea.