



Report on Student SLIP seminar

2-3 OCTOBER 2001

24th October 2001

**REPORT ON
STUDENT SLIP SEMINAR, BRORFELDE, OCTOBER 2-3, 2001**

The SLIP-network aims to organise annual gatherings of students and their supervisors to strengthen the student network. The first such gathering took place on October 2-3, 2001 at the former observatory in Brorfelde (University of Copenhagen). In addition to all the Ph.D. students directly supported by SLIP, the meeting was open to other Danish Master and Ph.D. students with projects relevant to SLIP. Altogether, 16 students and 3 supervisors participated. We also hosted three foreign scientists (Anya Waite, Australia; Anne Sell, USA/Germany; Kam W. Tang, Denmark).

The core activity of the meeting was a series of brief (15 min.) student presentations together with a few guest lectures by invited scientists (see attached program and abstracts). All lectures were given in English. There was ample time for informal discussions between presentation blocks as well as during the informal evening session.

In addition to the scientific program, a discussion session on the topic 'life as a student' was organised in the evening, where a moderate social program also took place.

It is our impression that everybody enjoyed the meeting. It was a good opportunity for students to present their work and ideas to a large but friendly audience, including scientists from abroad, and it was good practice to present talks in English. The quality of the student talks was surprisingly high, and similar arrangements will help bring the presentations up to international standards. It is also our impression that the networking activities worked well: many students did not know each other beforehand, despite working under the framework of the same research network.

The Brorfelde observatory was very suitable for the arrangement. It lies close to Copenhagen, is located in a nice area, and the facilities are excellent for a meeting of this size (nice lecture room, fine accommodation and cooking facilities). A student was hired to take care of all shopping and cooking.

The meeting was organised by

Anne Johanne Dalsgaard

Thomas Kiørboe

PROGRAM

October 2nd

09:30 - 10:00	Arrival and coffee
10:00 - 10:15	Welcome, who is who, program, etc.
10:15 - 10:30	Lars Storm
10:30 - 10:45	Marie Storr-Paulsen
10:45 - 11:15	Break
11:15 - 11:30	Rune Nielsen
11:30 - 11:45	Anders Bang
11:45 - 12:00	Maria Iversen
12:00 - 13:30	Lunch
13:30 - 14:00	Anne Sell
14:00 - 14:15	Anne Johanne Tang Dalsgaard
14:15 - 14:30	Break
14:30 - 14:45	Brian Sørensen
14:45 - 15:00	Rikke Frandsen
15:00 - 15:30	Coffee
15:30 - 16:00	Anya M. Waite
16:00 - 16:15	Kristine Engel Hansen
16:15 - 16:30	Break
16:30 - 16:45	Dorte Bekkevold
16:45 - 17:00	Hanne Jørgensen
17:00 - 18:00	Happy hour
18:00 - ...	Dinner
Evening	Discussion: "life as a graduate student"

October 3rd

08:00 - 09:00	Breakfast
09:00 - 09:30	Kam Tang
09:30 - 09:45	Maria Faldborg Petersen
09:45 - 10:15	Coffee
10:15 - 10:30	Louise Dahl
10:30 - 10:45	Fredrik Nilsson
10:45 - 11:00	Anders Nielsen
11:00 - 11:15	Break
11:15 - 11:45	Thomas Kiørboe
12:00 - ...	Lunch and departure

INFO

- Address Brorfelde Laboratoriet
Observator Gyldenkernevej 1-13, 4340 Tølløse. [See map](#)
Tel. 59 18 81 95
Fax 59 18 87 55
- Transportation Please contact Lars Storm (e-mail: lst@dfu.min.dk; Tel. 33 96 34 23).
We have reserved four cars in Copenhagen. For people coming from Jylland, we can arrange to pick them up at the nearest train station, e.g., Holbæk.
- Talks Overhead projector and PowerPoint will be available. Please bring your talk on a CD or floppy disk. Please be aware that the time allotted to each speaker includes time for questions.
- Accommodation Bedding will be provided.
Vegetarians, please contact Lars Storm (lst@dfu.min.dk).

PARTICIPANTS

Participants	Status	Title
Anders Bang anders.bang@biology.au.dk	Ph.D. student	Phenotype - environment interactions and selective processes in the early life history of fish
Anders Nielsen anielsen@math.ku.dk	Ph.D. student	Migration of Fish Stocks: An introduction to the project and a toy example
Anne Johanne Dalsgaard jtd@dfu.min.dk	Ph.D. student	Sandeels - and trophodynamic processes in tidal frontal systems
Anne Sell asell@whoi.edu	Invited speaker	The structure of plankton communities: Predator effects from fish and invertebrates
Anya M. Waite waite@cwr.uwa.edu.au	Invited speaker	The effect of <i>in situ</i> iron addition on the sinking rates and export flux of Southern Ocean diatoms
Brian Sørensen brs@dfu.min.dk	Master student	Does the feeding niche of marine fish change as the fish grow or is it constant through ontogeny?
Daniel Ruzzante dr@dfu.min.dk	Supervisor	
Dorte Bekkevold db@dfu.min.dk	Ph.D. student	Genetically effective population sizes in marine fishes - effects of reproductive behaviour
Fredrik Nilsson afn@dfu.min.dk	Ph.D. student	Formation of schools at dawn and their dissolution at dusk.
Hanne Jørgensen haj@dfu.min.dk	Ph.D. student	Conservation of intraspecific biodiversity in herring: historical and contemporary genetic structure.
Kam Tang kta@dfu.min.dk	Invited speaker	Protozoan grazing and <i>Phaeocystis</i> colony formation: towards understanding the pelagic - benthic coupling in <i>Phaeocystis</i> -dominated waters.
Karin Bohn Jensen kbj@dfu.min.dk	Master student	
Kristine Engel Hansen kre@dfu.min.dk	Master student	Reproductive success of copepods in relation to the biochemical composition of the phytoplankton community they feed on.

Participants	Status	Title
Lars Storm lst@dfu.min.dk	Master student	Temperature dependent development and drift of shrimp larvae at West Greenland
Louise Dahl lda@dfu.min.dk	Ph.D. student	Spatial variability in the distribution of marine plankton
Maria Faldborg Petersen mfp@dfu.min.dk	Ph.D. student	Physiological parameters as a predictor of metabolic rate in fish
Maria Iversen mai@dfu.min.dk	Master student	Investigating growth and body fat condition of harbour porpoise (<i>Phocoena phocoena</i>) on the basis of dissections of stranded, by-caught and directly caught animals in Danish waters
Marie Storr-Paulsen mSP@dfu.min.dk	Master student	Lipid biomarkers in cod and haddock larvae.
Peter Munk pm@dfu.min.dk	Supervisor	
Rikke Frandsen rif@dfu.min.dk	Master student	Effects of substrate type on growth and mortality of blue mussels (<i>Mytilus edulis</i> L.) exposed to the predator <i>Carcinus maenas</i> (L.)
Rune Nielsen run@dfu.min.dk	Master student	Growth dependent mortality in larvae of the North Sea cod (<i>Gadus morhua</i>)
Thomas Kiørboe tk@dfu.min.dk	Supervisor	Marine snow

ABSTRACTS

Migration of Fish Stocks: An introduction to the project and a toy example

Anders Nielsen

Spatial aspects are often neglected in fish stock assessment models. This is problematic if we wish to understand how changes in the spatial distribution affect the catches, but it is especially a problem if we wish to estimate the effect of closing an area for fishing. This Ph.D. project is concerned with models of migration of fish stocks. Focus will be on the statistical aspects of migration such as development of models, estimation of parameters and quantifying uncertainties. I will give an introduction to the project and show a small case study to present the model types we intend to work with.

Sandeels - and trophodynamic processes in tidal frontal systems

Anne Johanne Tang Dalsgaard

Sandeels (*Ammodytes marinus*) are a main target of the North Sea industrial fishery, and a key species within the ecosystem, forming an important energetic link between plankton and higher trophic levels. The abundance of sandeels undergoes large regional and inter-annual fluctuations, and it has recently been hypothesized that the fluctuations are coupled to variations in tidal frontal mixing. These are areas of increased primary production, supporting much of the biological production in the oceans.

Fatty acid lipid biomarkers will be used to test the hypothesis. These fatty acids are produced *de novo* by primary producers, and passed through the food web in a conservative manner. They vary in a characteristic manner between the different groups of primary producers, which exhibit a distinct spatial distribution relative to the fronts. Hence, the fatty acid profile of a sandeel may reveal not only what it has been eating but also where, relative to a nearby frontal system, it has been foraging.

The structure of plankton communities: Predator effects from fish and invertebrates

Anne Sell (Woods Hole Oceanographic Institution, Massachusetts, USA)

Selective feeding of fish and invertebrate predators results in differential mortality in the zooplankton. At the same time, selectivity of the dominating predator can elicit defense mechanisms in its prey organisms. Phenotypic plasticity in behavior and morphology causes temporal and spatial changes in the plankton community, and influences individual vulnerability.

Here, a summary of examples from freshwater and marine systems will be given and experimental approaches for their investigation discussed.

Specific cases will be:

- General principles in prey preference of fish versus invertebrate predators in lakes.
- Examples of predator-structured communities in freshwater systems.
- Chemical communication and predation: What do we know about inducible defenses?
- Ontogenetic shifts of selectivity in key species of marine fish.
- A mass development of marine invertebrates and its potential to affect fisheries.

This overview of results from marine and freshwater communities is intended to stimulate a discussion and consider hypotheses predicting, which of the structuring mechanisms observed elsewhere may be relevant for the recruitment of marine fish stocks.

The effect of in situ iron addition on the sinking rates and export flux of Southern Ocean diatoms

Anya M. Waite (Centre for Water Research, University of Western Australia, Nedlands 6907, WA, Australia)

During the Southern Ocean Iron RElease Experiment (SOIREE), conducted in February 1999 at 61°S, 141°E in high nutrient, low chlorophyll waters south of the Polar Front, we measured the intrinsic sinking rates of diatoms at two depths inside and outside of an iron-fertilised patch. Overall, the sinking rates of the diatoms estimated by the SETCOL method (Bienfang, 1981) were significantly lower inside than outside the patch, and a time-series of sinking rates (chlorophyll-based) indicated that the rates of cells >22 µm reduced to a minimum (0.47 m d⁻¹) 8 days after the first *in situ* iron addition. A subsequent increase in sinking rates (chlorophyll-based) of >22 µm cells coincided with an increase in algal iron stress (based on diatom flavodoxin levels). The primary bloom species, *Fragilariopsis kerguelensis* and *Nitzschia* and *Navicula* spp. reduced their sinking rates most markedly within the patch, showing a decrease of up to 87% of initial rates, over the 13 days of the time-series. In contrast, the very largest cells (>1 mm, *Trichotoxon* and *Thalassiothrix*) showed little change in sinking rate inside or outside the patch. Sinking rates of resident cells associated with a deep chlorophyll maximum (40–75 m) in and out of the patch also showed no significant sinking rate change upon iron addition. Given these results and the known longevity of the SOIREE bloom (at least 60 d), we infer that sinking rate reduction is an integral part of a species-specific bloom response to elevated Fe supply. We calculate that sinking losses of iron-saturated, unaggregated cells would have been ~ 1% d⁻¹. A 1% daily loss would have halved cell accumulation at the surface over 60 d, primarily via a reduction in growth potential.

Does the feeding niche of marine fish change as the fish grow or is it constant through ontogeny?

Brian Sørensen; Supervisors: Peter Munk (DIFRES) and Henrik Gislason (DIFRES/U. Copenhagen)

It is a well-known fact that as a fish grows it tends to eat bigger food items. Some say that the feeding niche will expand through growth, because big fish has the advantage of eating big things the small fish can't eat, as well as the small things the small fish eats. Others believe that if you look at prey data as ratios, there will be no difference in or between species.

There are many opinions on the issue and by analysing stomach content from larval and juvenile fish of 3 different species - cod (*Gadus morhua*), whiting (*Merlangius merlangus*) and sandeel (*Ammodytes* sp.) I am to test my hypothesis that the niche breath is indeed constant.

Formation of schools at dawn and their dissolution at dusk

Fredrik Nilsson

It seems to be a rather general pattern that schools disperse at night and aggregate in the morning. Using acoustic data from the Baltic Sea I will describe the process of formation and dispersion. Furthermore, I will try to fit a simple, mechanistic model for each of these, namely a coagulation process for the aggregation and a random-walk for the dispersal.

Conservation of intraspecific biodiversity in herring: historical and contemporary genetic structure

Hanne Jørgensen; Supervisors: Daniel E. Ruzzante (DIFRES/FFI); Volker Loeschcke (Aarhus University, Dept. of Genetics and Ecology).

Fisheries management should aim to conserve intraspecific biodiversity in exploited fish species by avoiding the erosion of their population structure, since genetic variation is the basis for adaptation to changes in the environment. Intraspecific biodiversity and related parameters for the Atlantic herring *Clupea harengus* L. in The Baltic Sea will be studied for this project. Differentiation among spawning locations will be estimated in two ways: Genetically and morphologically. When among-location genetic- and morphologic differentiation are compared, the proportions of genetic and environmental influence on morphology can be estimated. The proportions of genetic- and environmental influence on within-location variation in morphology will also be estimated. Previous studies have shown morphologic differentiation between herring stocks, whereas no genetic differentiation has been found from allozyme data. For this project, the genetic variation will be estimated based on microsatellite markers, which have a higher resolution than allozymes.

Protozoan grazing and *Phaeocystis* colony formation: towards understanding the pelagic-benthic coupling in *Phaeocystis*-dominated waters

Hans H. Jakobsen and Kam W. Tang – presented by Kam W. Tang (Danish Institute for Fisheries Research, Kavalergården 6, Charlottenlund DK-2920, Denmark)

The complex life cycle of the prymnesiophyte *Phaeocystis* involves solitary and colonial phases. Massive blooms of mucilaginous *Phaeocystis* colonies and their subsequent sedimentation are major driving forces of material fluxes in the oceans. Therefore, understanding the regulation of life stage transition and colony development remains the key to resolving the pelagic-benthic coupling in *Phaeocystis*-dominated waters. We studied experimentally how protozoan grazing on the solitary cells affected colony development in *Phaeocystis globosa*. Colony formation by *P. globosa* was enhanced in terms of colony abundance and/or size when solitary *P. globosa* cells were grazed by the heterotrophic dinoflagellates *Noctiluca scintillans* and *Gyrodinium dominans*. Up to 92% of *P. globosa* cells were in colonial form when grazers were present, in contrast to <31% in the controls. Mean colony diameters in the grazing treatments were increased by as much as 4-fold relative to the controls. Enhanced colony formation provided refuge for *P. globosa* cells such that the protozoan grazers starved and declined after the initial depletion of solitary *P. globosa* cells. Slow recovery of starved grazers subsequently allowed solitary *P. globosa* cells to resume exponential growth. These observations have important implications on the dynamics and size spectrum of *Phaeocystis* blooms, and the related flux processes in the water column.

Reproductive success of copepods in relation to the biochemical composition of the phytoplankton community they feed on

Kristine Engel Hansen; Supervisors: Sigrún H. Jónasdóttir (DIFRES) and Per Juel Hansen (MBL KU)

Reproduction success of copepod depends of egg production rates and hatching success of the eggs produced. Egg production rates (number of egg produced/female/day) have been found to be depend on number of factors such as, food availability, food quality, toxicity, temperature, female size, as well as feeding history of the copepod (see Mauchline 1998 for review p.284-290).

The aim of this study is to investigate the role of biochemical composition of phytoplankton communities and individual phytoplankton species on the reproduction success of copepods. The study will be conducted both in the field and in the laboratory.

Temperature dependent development and drift of shrimp larvae at West Greenland

Lars Storm

From hatch to settling shrimp larvae go through six pelagic zoea stages that follow the dominating currents. Drift buoys showed a northbound current with an average velocity of 0.06 m s^{-1} . Duration of stage development as a function of temperature was estimated using the Belehrádek function ($D = a \cdot (T + b)^c$). Potential spawning grounds of shrimp larvae were located from back-calculation by coupling development times and mortality rates with current velocity. This showed larval transport of up to 500 km. The adult female shrimp abundances were estimated to 0.12-96 females 100 m^2 , and locations of the estimated spawning stock agreed with observations from trawl surveys.

Spatial variability in the distribution of marine plankton

Louise Dahl

Marine planktonic organisms are patchily distributed in both space and time, and there is great biological variability and heterogeneity over a wide range of spatial scales. This makes quantitative studies of distributions and population dynamics difficult. It is the goal of this project to investigate quantitatively the spatial distributional patterns and trophic interactions in zooplankton organisms using advanced mathematics.

Target organisms are fish larvae and their major prey species, mainly copepods, around frontal areas in the North Sea. Samples were collected during three cruises in the North Sea in March-May 2001 and are currently being worked up. Preliminary results show that sandeels and flatfish were most abundant on all cruises, and that whiting tended to dominate over cod and other gadoid species. As expected, the results indicate a considerable degree of spatial patchiness over small as well as large scales.

The differences in species composition and abundances between samples will be evaluated using multivariate statistics based on similarity indices between the individual samples. The observed distributional patterns and scaling behaviour will then be analysed quantitatively using nonlinear mathematical methods, such as spectral analysis and fractal dimensions. Finally, I will try to fit the results into mathematical models also based on nonlinear mathematics.

Physiological parameters as a predictor of metabolic rate in fish

Maria Faldborg Petersen

The increasing use of bioenergetics models in fisheries management makes knowledge about the bioenergetics parameters as energy in consumed food, growth and metabolism indispensable. For gadoid fish the energy spent on swimming metabolism is considerable, but since metabolism cannot be measured directly in the field, what physiological parameter should then be monitored to estimate the metabolic rate in fish? Discussion of the use of tail beat frequency; cardiac output and heart rate are being presented as well as perspectives for future studies.

Investigating growth and body fat condition of harbour porpoise (*Phocoena phocoena*) on the basis of dissections of stranded, by-caught and directly caught animals in Danish waters

Maria Iversen

Seasonal fluctuations in weight of two captive harbour porpoise (*Phocoena phocoena*) over a 4 years period were recently discovered. The seasonal weight fluctuations were observed to be mirrored in the girth, blubber thickness and food intake of the animals.

The weight fluctuations are expected to be reflected in the wild and to be correlated with water temperature and reproduction. To address this hypothesis the monthly or seasonally weight and growths variations are investigated in detail and compared to measures such as body condition measurements, girth, etc. Furthermore, the energy budgets of both live and dissected porpoises will be investigated to calculate if the main parts of the weight fluctuations are caused by differences in food choice, increased/decreased food intake or by allocation of energy. This study is mainly done on the basis of dissected porpoises stranded, by-caught or directly caught in Danish waters collated in an existing database.

Marine snow

Thomas Kiørboe

Marine snow aggregates are believed to be the main vehicles for vertical material transport in the ocean. However, aggregates are also sites of elevated heterotrophic activity, which may rather cause enhanced retention of aggregated material in the upper ocean. Small-scale biological-physical interactions govern the formation and fate of marine snow. Aggregates may form by physical coagulation: fluid motion causes collisions between small primary particles (e.g. phytoplankton) that may then stick together to form aggregates with enhanced sinking velocities. Bacteria may subsequently solubilise and remineralise aggregated particles. Because the solubilization rate exceeds the remineralization rate, organic solutes leak out of sinking aggregates. The leaking solutes spread by diffusion and advection and form a chemical trail in the wake of the sinking aggregate that may guide small zooplankters to the aggregate. Also, suspended bacteria may enjoy the elevated concentration of organic solutes in the plume. I explore these small-scale formation and degradation processes by means of models, experiments and field observations. The larger scale implications for the structure and functioning of pelagic food chains of export vs. retention of material will be discussed.

Lipid biomarkers in cod and haddock larvae

Marie Storr-Paulsen

A better understanding of factors that influence the recruitment success in fish larvae is needed to improve fisheries management strategies. Laboratory- and field-studies on phytoplankton, zooplankton and larval fish suggest that specific food web has potential as trophic markers. This gives a possibility to link condition to a physical regime as a frontal area. An investigation of the fatty acid composition of cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*) larvae in the frontal area of Georges Bank were carried out. In two cruises (April and May 1999) 320 larvae fish were sampled along a transect and correlated to the fatty acid profile. It was not possible to link a better condition to the fish larvae caught in the front vs. off shore the front. This could be caused by a low diatom production in the frontal area. A highly significant increase was seen in larger fish larvae regarding diatom ratio 20:5/18:4 ($P < 0.001$) and the nutrient ratio $n3/n6$ ($P < 0.01$), as well as a decrease in the flagellate signal PUFA 18/ total FA ($P < 0.01$) (fatty acids). This could indicate that larger fish have a higher condition due to their utilization of a diatom-dominated food web. 5 biomarkers were investigated and correlated to one other to see if a trend between different biomarkers were sustained. Three of the biomarkers showed a highly significant correlation ($P < 0.0001$) with one other and the condition index TAG (triacylglyceride)/Cholesterol, thereby indicating their value as biomarkers.

Effects of substrate type on growth and mortality of blue mussels (*Mytilus edulis* L.) exposed to the predator *Carcinus maenas* (L.)

Rikke Frandsen

Structure and complexity of the substrate are important habitat characteristics for the benthic epifauna. The specific growth, mortality rates and inducible defence characters on medium sized blue mussels (*Mytilus edulis* L.) exposed to shore crabs (*Carcinus maenas* L.) were examined on three different substrate types in combined field and laboratory experiments. The experiments showed that blue mussels on a structurally complex substrate, had significantly higher survival due to reduced predation. However, increased intraspecific competition for food on the complex substrate resulted in significantly lower growth rates of the mussels. Inducible defence characters were also influenced by substrate type. Blue mussels were more affected by predators on the structurally simple substrate where they developed thicker shells and a larger posterior adductor muscle.

Growth dependent mortality in larvae of the North Sea cod (*Gadus morhua*)

Rune Nielsen

The growth and size is believed to be an important factor in the survival of fish larvae. Several investigations have shown that otolith in fish larvae can be used in determination of age and growth. To investigate the hypothesis that fast growing larvae have a better chance of survival, I am looking at a group of cod larvae in the

North Sea at different times, April and May 2001. My hope is to find a difference in the early growth of otoliths between the larvae found in April and May. I want to use the difference in otolith growth, to see if larvae that experienced a high growth (big of age) in the period before the 1st sampling, had a better chance of survival in the period between the samplings.