Collaborative Group Masters Projects with Individual Results

Looking for a masters project?
Interested in fisheries ecology, fish physiology or ecophysiology?

The Section for Ecosystem Based Marine Management, in collaboration with the Section for Marine Living Resources at DTU Aqua would like to advertise a collaborative Masters project based on a jointly run growth trial of juvenile fish.

This project is adequately funded for both equipment and technical support.

The overall approach is that 2-5 students will work closely together to run a laboratory controlled growth experiment then share the data produced to answer different questions about the productivity of juvenile fish habitats.

The projects are suited to masters students who are currently completing coursework but looking to organise their master’s thesis project for late summer / autumn of 2020. There are four possible project ideas outlined below but we are open to different suggestions. Depending on timing, it may also be possible to organise a special course, before the start of the masters, for the successful applicants to gain specific skills and experience in fish sampling, handling and experimental design.

Figure 1: Juvenile leps, a hybrid between plaice and flounder

Shared Methods

All projects will derive their data from a growth trial jointly established and run by students. Technical staff will be provided to aid in establishing and maintaining the experimental set up. The growth trial set up will be housed in DTU Aqua’s “blue area”, in the basement of building 202 in Lyngby. The setup will consist of a number of tanks containing different treatments (e.g. combinations of different salinities and temperatures) and replicates. Fish will be caught from different areas in Denmark, tagged and assigned to a treatment where they will undergo a period of acclimation before the growth trial commences. The growth trial will run for a minimum of 20 days and will be monitored and maintained by the student team (with the support of technical staff). At the end of the growth trial, fish will be killed, measured and have tissue samples taken for further analyses.
Special Course:
Depending on demand, a special course may be established in advance of the masters projects starting. This special course will focus on experimental design, the use and handling of laboratory animals, and field collections. While providing practical training and experience, the special course will also allow the student team to get a running start on their experimental setup and field collections. This special course will likely be run sometime in the summer in preparation for the field-sampling season. The specific times will be negotiated between participants and teachers.

Potential Individual Projects:
Below are some examples of potential masters projects that may come out of this growth trial. They can be chosen, adapted or not used at all.

Main and interactive effects of salinity and temperature on the somatic growth of young-of-the-year European flounder (*Platichthys flesus*).

*Aim:*
To investigate the effects of salinity, temperature and their interaction on growth of recently settled European flounder from the inner Danish waters.
To compare these effects with those reported for flounder from other regions and from a field study of the inner Danish waters.

*Content:*
In addition to the shared methods, this project will undertake basic statistical analyses of flounder growth data in response to salinity, temperature and interactive effects.
Furthermore, this project will undertake a literature review of experimental and observational studies that investigated the relationship of juvenile flounder to salinity and temperature. The results reported from the literature will be compared to the findings of the current study.

*Duration:*
This project is expected to run for 5-6 months. Sample collection will occur in August, at the beginning of the project, and is expected to take 3 weeks. The growth trial will run for approximately 1.5 months. Data analyses are expected to take one month. The literature review is expected to take one month. Dedicated thesis writing should take 1.5 months (shorter due to the effort already put into the literature review).

Main and interactive effects of salinity and temperature on the somatic growth of young-of-the-year European plaice (*Pleuronectes platessa*) from marine and brackish populations.

*Aim:*
To identify the extent to which salinity and temperature drive juvenile plaice growth.
To compare the growth responses of juvenile plaice from different populations under a range of shared salinities and temperatures.

*Content:*
In addition to the shared methods, this study will utilise basic statistical analyses to describe growth responses of juvenile plaice in response to population of origin, salinity, temperature and interactive effects. The effects determined in this study will be directly compared to those of an observational study from the same area (already published).
**Duration:**
This project is expected to run for 5-6 months. Sample collection will occur in August, at the beginning of the project, and is expected to take 3 weeks. The growth trial will run for approximately 1.5 months. Data analyses are expected to take two months. Dedicated thesis writing should take 2 months.

**Changes to the metabolism of juvenile European plaice from the Danish transition zone growing in different salinities and temperatures.**

**Aim:**
To investigate the effects of growing at different salinities and temperatures on the routine metabolism / aerobic metabolic scope of juvenile plaice.

To determine if differences exist in the metabolic rates of juvenile plaice from populations at the latitudinal extremes of the inner Danish waters transition zone.

**Content:**
In addition to the shared methods above, this study will use respirometry to measure living animal metabolic rates and compare how these differ across animals raised at different combinations of salinity and temperature. Alternatively, or additionally, this study will compare metabolic rates of juvenile plaice from different populations where they have been raised in the same environmental conditions as one another.

**Duration:**
This project is expected to run for 5-6 months. Sample collection will occur in August, at the beginning of the project, and is expected to take 3 weeks. The growth trial will run for approximately 1.5 months during which time, the respirometry experimental equipment will be setup and test-run. Respirometry and data collection will take 1 month, while data analyses are expected to take one further month. Dedicated thesis writing should take 2 months.

**Effects of salinity and temperature on the otolith growth and RNA:DNA ratios of juvenile flatfish: verifying commonly employed proxies for growth under different growing conditions.**

**Aim:**
To evaluate the use of otolith microstructure for determining recent growth rates in juvenile plaice and flounder.

To evaluate the use of RNA:DNA ratios from different tissues as a proxy for recent growth rates in juvenile plaice and flounder.

**Content:**
This study will use otoliths collected from the end of the growth trial. Otoliths will be polished, photographed under microscope, and growth ring number and width will be determined. This microstructure analysis will be used to determine age post metamorphosis and to estimate a 10-day daily growth rate prior to slaughter. Otolith based growth rates will be compared to actual somatic growth rates measured over the course of the growth trial. Additionally, tissue samples from the same fish will be sent away for RNA:DNA analyses, to be used as a proxy for instantaneous growth rates. Emphasis will be placed on how these different measures of growth react to different growing conditions.

**Duration:**
This project is expected to run for 5-6 months. Sample collection will be undertaken prior to the start of this project. Otolith microstructure analysis is expected to take 2.5 months, data analyses 1.5 months and dedicated thesis/article writing 2 months.
Timing and Teamwork:
The first three projects above, or any other student established project, must be undertaken concurrently in late summer /autumn of 2020 (up to a maximum of four students). The fourth project (otolith and RNA:DNA growth measurements) can occur any time after the end of the growth trial but is probably best suited to one of the semesters in 2021.

Students are encouraged to organise into teams/groups, whose members can work well together, and apply to the first three projects jointly. Individual applications may also be submitted for a specific project or generally, but with the projects listed in preferred order. Additional project ideas based on this growth trial are welcome.

A student that undertakes the project on otolith determined growth rates is encouraged to participate in the growth trial, but this is not necessary. This project is dependent on the growth trial being undertaken.

Contact:
In the first instance, please contact Elliot Brown (elbr@aqua.dtu.dk) for questions regarding the project and possible flexible options.

Supervision will ultimately be carried out via Elliot, Jane Behrens and Tommy Norin.

Applications:
Please submit applications before 1700 on Tuesday the 14th of April, 2020.

Applications should consist of the following:

- Brief cover letter detailing your motivations and experience.
- Academic transcript showing courses and grades (at least 1 year immediately prior) – unofficial documents are fine.
- Reference Letter or contact details for a character reference.
Additional Background Information

The juveniles of many important fisheries species aggregate in near-shore habitats during their first year of life. During this period of settlement and subsequent growth, rates of survival regulate the size of a given annual cohort that recruits into the fishery. The productivity of these near-shore juvenile habitats is therefore of direct importance for the potential productivity of the fisheries they support. Factors limiting the number of juveniles surviving to recruitment include annual variation in hydrodynamic transport of early life stages and the combinations of environmental conditions that are found in suitable juvenile habitat areas.

Basic tolerance and optimum growth studies of juvenile fish have a long pedigree and are able to establish simple causative relationships between single environmental variables and growth/survival. However, these experimental studies are not able to scale and represent the complexity of environmental conditions found in nature. Similarly, with the development of powerful statistical methods, observational studies are able to find the most likely combinations of environmental variables that drive fish abundance and growth but are unable to determine causal relationships.

Recent observational studies of young-of-the-year flatfish from the Inner Danish Waters (IDW) have found interesting and contrasting patterns of abundance and growth correlated to salinity, latitude and temperature. The transitional nature of the study area meant that there was potential for different rates of colonisation in juvenile habitats by populations from the brackish Baltic in the south and the marine North Sea populations in the north. Potential differences in physiology of individuals from these different source populations may mean that they respond differently to the same environment conditions in areas where they co-habit and share juvenile habitat.

As these environmental factors vary together in nature, targeted experiments are required to disentangle the individual and interactive effects, and to determine causative relationships between these environmental drivers and growth of juvenile fish from different populations.

This series of collaborative student projects aims to undertake such a targeted experiment. By sharing the responsibility of setting up and running the growth experiments, a variety of factors and their interactions can be investigated and multiple measures of growth and metabolic status of fish can be measured to provide a more holistic overview of what drives juvenile fish productivity.
Figure 2: Predicted growth (A, C, E) and associated standard error of predictions (B, D, F) of juvenile flounder (A, B), plaice (C, D) and sole (E, F) from the inner Danish waters, based on models of environmentally driven growth from field observations (Brown et al, 2019).