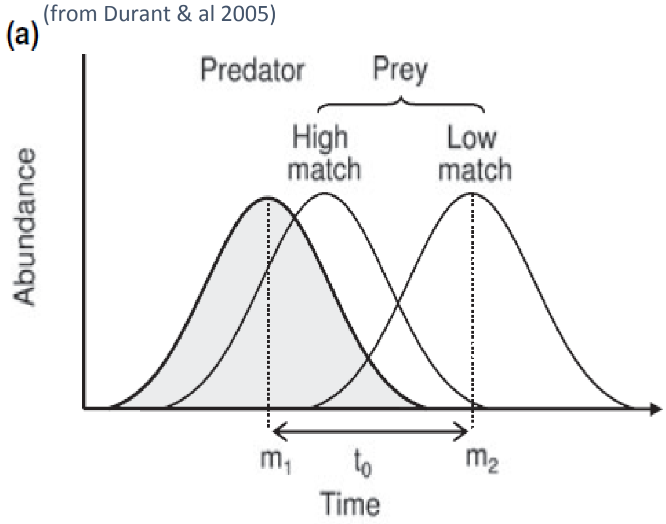
The fitness of hatching times in fish: when is the best time to be born?

The match-mismatch hypothesis is the most common explanation of why fish hatch at a certain time in the seasonal cycle (Cushing, 1990;Bollens et al., 1992;Durant et al., 2005). Fish spawn at almost any time of the year, but cod tend to spawn in late winter. Some recent data suggest that the spawning of North-East Arctic cod now takes place later in the year than it used to. We do not know why this has happened, but one hypothesis is that the oceanography and phytoplankton blooming has shifted in time, and that the success of later spawners have increased due to this.

Figure 1 Conceptual drawing of the match-mismatch hypothesis (from Durant & al 2005)



Method

In this project, we will use models of cod eggs and larvae and calculate the survival of eggs spawned at different times of the season. We construct environments from several variables that we think have an impact on growth and survival of larval cod: temperature, prey availability, phytoplankton, light, optical properties of the water, and predator abundance and efficiency. We have built detailed models for growth and development of cod, and applied it in other projects (Fiksen et al., 1998;Fiksen and MacKenzie, 2002;Kristiansen et al., 2007;Kristiansen et al., 2009;Fiksen and Jørgensen, 2011;Jørgensen et al., 2014;Fiksen and Opdal, 2015;Fouzai et al., 2015). The student can use this individual-based model directly for the current analysis.

The model can clarify some questions we have about how the various seasonal factors influence ‘egg fitness’ – the expected survival chance to a certain development stage. For instance; what are the most important environmental drivers? Prey, temperature, predators? The spring bloom has many effects - it may reduce the efficiency of visually searching predators (Fiksen et al., 2002)– how important is that for egg fitness?

The student should have an interest for computers and numbers. Most of the code is available at the start, so the project is quite safe. The code is in FORTRAN, but other simulation tools are possible.

Research environment

The master student will be a member of the Theoretical Ecology Group http://bio.uib.no/te/. We supply programming tools, a computer and support.

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Expected results

The results from this project are theoretical predictions on how day of hatching (or spawning) drive egg fitness under various seasonal patterns of environmental conditions. We intend to take environmental scenarios from historical data from the coastal current, and consequently it can be relevant to understand how climate change or linkages with runoff from land ventures into marine ecosystems.

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