Can temperature-dependent egg development affect connectivity between spawning areas and nursery grounds for arrowtooth flounder (*Atheresthes stomias*) in the Gulf of Alaska?

**Introduction**

As part of the GOA-IERP Modeling Component, we hypothesize that fish recruitment is principally determined by processes acting on early life stages between offshore spawning sites and the end of the young of year stage, the "gauntlet". Among these processes, temperature-dependent egg development and/or larval growth rates may be important sources of variability. Here, we examined the potential importance of interannual and spatial variation in temperature experienced by arrowtooth flounder eggs on connectivity between the spawning areas and nursery grounds by developing a temperature-dependent egg development model, incorporating it within a coupled IBM/physiologic model (DisMELS), and performing a set of numerical experiments.

**Approach**

We ran the arrowtooth flounder IBM (below) for 16 years (1996-2011) using daily output from the CGOA ROMS model to provide 3D current and temperature fields.

Each year, 1000's of simulated stage-1 eggs were released at 500 m depth along the shelf edge in 12 potential spawning areas (red zone on map at right) at bi-weekly intervals during January-March. Individuals were tracked in space for 200 days, and those that successfully settled in inshore nursery grounds prior to the end of each year were counted as “successful” recruits. Individuals that exited the model grid or failed to find suitable nursery habitat within the period during which they were competent to settle were regarded as “unsuccessful. For each model year, the fraction of “successful” individuals from each of the 12 potential spawning areas was quantified, as was the connectivity between the spawning areas and 26 potential nursery areas (12 alongshore zones + Prince William Sound x 2 depth zones).

To examine the potential importance of temperature-dependent egg development rates on connectivity between offshore spawning and inshore nursery grounds, we repeated the above numerical experiment above for 4 different temperature scenarios: 3 constant-temperature scenarios (1°C, 4.25°C, 7.5°C), and an *in situ* temperature scenario. In the constant temperature scenarios, all eggs experienced identical temperature regimes during development. For the *in situ* scenario, individual eggs developed according to the local (ROMS model) temperature, which varied temporally and spatially.

**Results**

The fraction of individuals spawned that successfully settled in juvenile nursery areas was consistently lower in the 1.0°C constant temperature treatment than in the other treatments, all of which yielded similar results. The dependence on spawning area, however, was fairly similar across all treatments: spawning in areas 2-5 resulted in the highest fractions settling.

**Conclusions**

Higher temperatures (faster egg development rates) led to higher fractions of individuals recruiting to nursery grounds from individual spawning areas. With faster egg development rates, individuals were able to reach the life stage capable of settling in the nursery grounds in a shorter amount of time and were thus less likely to be transported westward out of the system by the Alaskan Stream and Alaskan Coastal Current.

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