Egg production rates of *Metridia pacifica* in the Gulf of Alaska

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Highlights

Egg production rates of the two *Metridia* species in the Gulf of Alaska were examined over 2 years. Preliminary experiments in 2001, using traditional techniques, indicated unusually low egg production. On 7 cruises in 2002, we used a new incubation system that separates females from their eggs and allows observation of eggs that remain undisturbed from the time they were laid. Observations indicate *Metridia* eggs are unusually thin-shelled, such that many shells (up to 100%) break down during incubation, leading to severe underestimates in the past. *Metridia* lays distinct clutches of eggs in early morning (~dawn), with some producing clutches daily. Up to 100 eggs were laid per clutch by *Metridia pacifica* (up to 150 were laid by the larger *Metridia okhotensis*). At individual stations, egg-producing females averaged specific egg production rates up to 25 and 36% respectively, with equivalent population rates up to 18 and 20%. Egg production by *Metridia pacifica* continued throughout most of the year, except midwinter, while *Metridia okhotensis* was more confined to the spring.

The Problem:

Of the ~15 common species of copepods in the Gulf of Alaska, perhaps the most poorly known are those in the genus *Metridia*. *Metridia* adults, and later stages, undergo diel migrations, that move them into deeper waters during the day, but bring them to shallow waters during the night to feed. When properly sampled, it is clear that *Metridia pacifica* is one of the most common medium to larger bodied copepods in the temperate through sub-polar waters. Surprisingly, there are no direct estimates of egg production published for either species, and the few unp[ublished attempt have indicated unusually low rates of egg production.

Methods:

Experiments were run during the GoA LTOP cruises at Stations Gak1, 4, 9, 13 and PWS2 (Figure 1). All females were collected at night in near surface waters by 1 m^3 MOCNESS fitted with 100 µm mesh nets. Females were sorted immediately, and placed individually in 50 ml plexiglass towers inserted into polystyrene 6-place multi-well tissue culture plates. The bottom of the towers were fitted with 200 µm Nitex mesh (for *M. pacifica*), or 400 µm (for *M. okhotensis*) that were held ~0.5 cm above the bottom of the plate. Incubations of 48 females per were setup at night, maintained at constant ambient sea-surface temperature under natural lighting cycles, and pulled down in the morning after 1 full day of incubation (i.e. 1-1.5 days later). Water was removed from the towers with a large pipette fitted with a 30 µm mesh over the tip, sucking always from near the waters surface. When ~1 cm of water remained the tower was removed from the plate and the female backwashed off the mesh. This procedure rarely disturbed the eggs any eggs that had fallen through the mesh. Eggs were usually found in single distinct clusters. Clutches laid on successive evening could be distinguished by observing the number of cells in the egg. Eggs were counted and also distinguished as developing normally, infertile (and decaying), or as having no membrane (and loss of embryonic cohesion). Females and their eggs were preserved for later measurement.

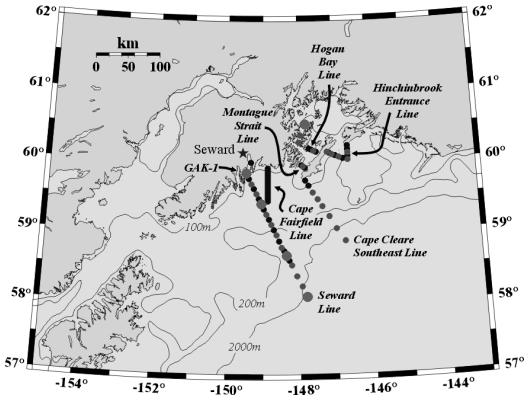

Figure 1. LTOP sampling area. Typical experimental sites indicated in purple

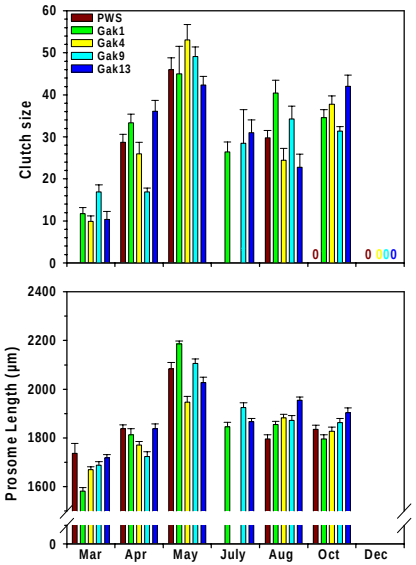

Figure 3. Clutch size increased from zero in winter, through March and April, reaching a maximum in May during the Phytoplankton Spring Bloom. Increase in female size track clutch size, and explain some of this this pattern (i.e. bigger females have bigger clutches)

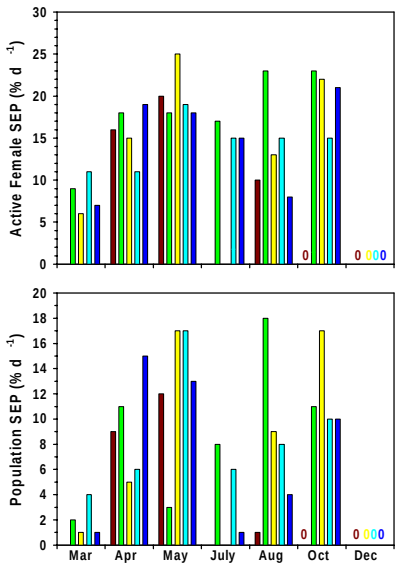

Figure 4. The percentage of female weight that goes into specific egg production increases from winter through to May, but typically varies between 10-25% for females laying eggs. Accounting for inactive females lowers the population production rate, which varies between 5-17% for most of the year. Egg production shuts down earlier in PWS than on the shelf.

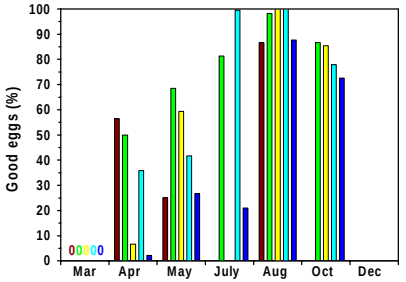

Figure 5. Interestingly, although egg production begins in March, few of these egg develop normally in the cold water. Egg development only proceeds normally in summer and fall once water has warmed and the phytoplankton community switches away from diatom dominance.

Future Directions:

More data will be collected over the next 2 years to see if these patterns occur each year. We will explore the influence of phytoplankton concentration and composition of egg production and development in both species, and compare the production of this species to that of others in the Gulf of Alaska.

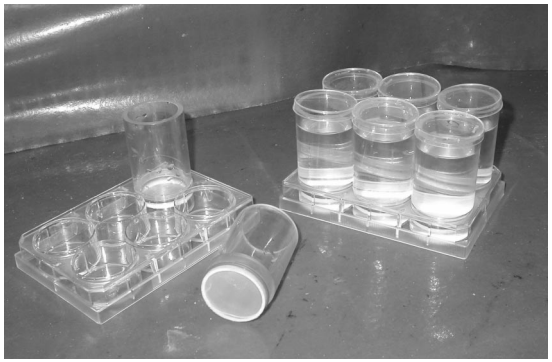

Figure 2. Egg production towers used for *Metridia* species. Without tthis system many eggs would disintegrate during harvesting, and egg production would be severely underestimated. t

Figure 6. A female *Metridia*