

Appendices to: Circulation constrains the evolution of larval development modes and life histories in the coastal ocean

James M. Pringle, James E. Byers, Paula Pappalardo, John P. Wares, Dustin Marshall

Appendix E: Variation of larval growth g with temperature: O'Connor et al. (2007)

(hereafter OC07) find a universal relation for variation of planktonic duration T_{PLD} within a species:

$$T_{PLD} = \exp(\beta_0)(T/T_c)^{(-1.40-0.27\ln(T/T_c))} \quad E.1$$

where T is the temperature and T_c is a reference temperature of 15°C. β_0 is a species dependent parameter. (E1) is set equal to T_{PLD} from (4) to give:

$$g^{-1} \ln(S_{crit}/S_{larvae}) = \exp(\beta_0)(T/T_c)^{(-1.40-0.27\ln(T/T_c))}$$

We then assume that variation in $\exp(\beta_0)$ largely represents the variation in maternal provisioning of the larvae $\ln(S_{crit}/S_{larvae})$. This is supported by OC07's finding that β_0 is significantly smaller for lecithotrophic species (i.e. they have a smaller T_{PLD} for a given temperature). Under this assumption, the growth scales, to within some unknown multiplicative constant, as

$$g \propto (T/T_c)^{(1.40+0.27\ln(T/T_c))} \quad E.2$$

This relation conflates with-species variation of T_{PLD} with temperature with between species variation with temperature. This is likely to over-estimate the variation of g with temperature, for Hoegh-Guldberg & Pearse (1995) found that some, but not all, of the variation in growth of larvae with temperature between species which live in habitats of different temperatures can be physiologically compensated for. However, they found that this compensation was limited and incomplete.

LITERATURE CITED

- Hoegh-Guldberg, O., and J. S. Pearse. 1995. Temperature, food availability, and the development of marine invertebrate larvae. *American Zoologist* 35:415–425.
- O'Connor, M. I., J. F. Bruno, S. D. Gaines, B. S. Halpern, S. E. Lester, B. P. Kinlan, and J. M. Weiss. 2007. Temperature control of larval dispersal and the implications for marine ecology, evolution, and conservation. *Proceedings of the National Academy of Sciences of the United States of America* 104:1266–1271.