Effects of low salinity on echinoderm larval growth

Sam Beshevkin, Tufts University

George SB, Walker D. 2007. Short-term fluctuation in salinity promotes rapid larval development and metamorphosis in *Dendraster excentricus*. J. Exp. Mar. Biol. Ecol. 349: 113-130.

Salinity can drop quickly in near-shore environments, especially near river outflows. These salinity decreases can persist for days and severely stress marine organisms. Echinoderms are especially vulnerable since they lack the ability to osmo- or ion-regulate and therefore cannot adjust their internal salinity with respect to the surrounding water. George and Walker (2007) investigated the effects of these short-term salinity decreases on larval development of the sand dollar *Dendraster excentricus*. Specifically, they set out to discover which developmental stage is most sensitive to low salinity and how low salinity would impact the growth of these larvae.

To answer this question, the authors reared plutei of *D. excentricus* in 5 treatments with 3 replicate jars per treatment and 2000 larvae per jar: **control** (constant 32‰ salinity), **low salinity 4-arm** (larvae transferred from 32‰ to 22‰ at the 4-arm stage), **low salinity 6-arm** (larvae transferred from 32‰ to 22‰ at the 6-arm stage), **fluctuating salinity 4-arm** (larvae transferred from 32‰ to 22‰ at the 4-arm stage for 7 days, then transferred back to 32‰) and **fluctuating salinity 6-arm** (larvae transferred from 32‰ to 22‰ at the 6-arm stage for 7 days, then transferred back to 32‰). When the larvae were 15, 18, and 20 days old, samples of 10 larvae were taken from each treatment and total larval and rudiment lengths were measured. In addition, when the larvae were 15 days old, the posterodorsal arm length was measured and when larvae were 18 days old the anterolateral arm length was measured.

Larvae in the low salinity treatments had significantly smaller total larval, rudiment, posterodorsal arm, and anterolateral arm lengths than the controls on every day that measurements were made. For all variables measured, larvae exposed to low salinity at the 6-arm stage were either significantly smaller or the same size as those exposed at the 4-arm stage, indicating that 6-arm plutei are more vulnerable to low salinity. In addition, larvae exposed to a short salinity fluctuation were significantly bigger and had longer arms than those exposed to constant low salinity.

These results show that the larval growth of *D. excentricus* is negatively affected by low salinity and most vulnerable to salinity stress at the older, 6-arm stage of development. Why a later life stage is more strongly affected by reduced salinity is a mystery, but it could indicate that larvae are able to adapt to low salinity when exposed early on in development but lose that ability as they grow older. This study prompts many other questions as well: What effect does this slowed growth have on larval swimming ability and dispersal? Do effects of low salinity persist through the juvenile stage, even after the larvae are transferred back to normal salinity? And through what mechanism is low salinity slowing larval growth?

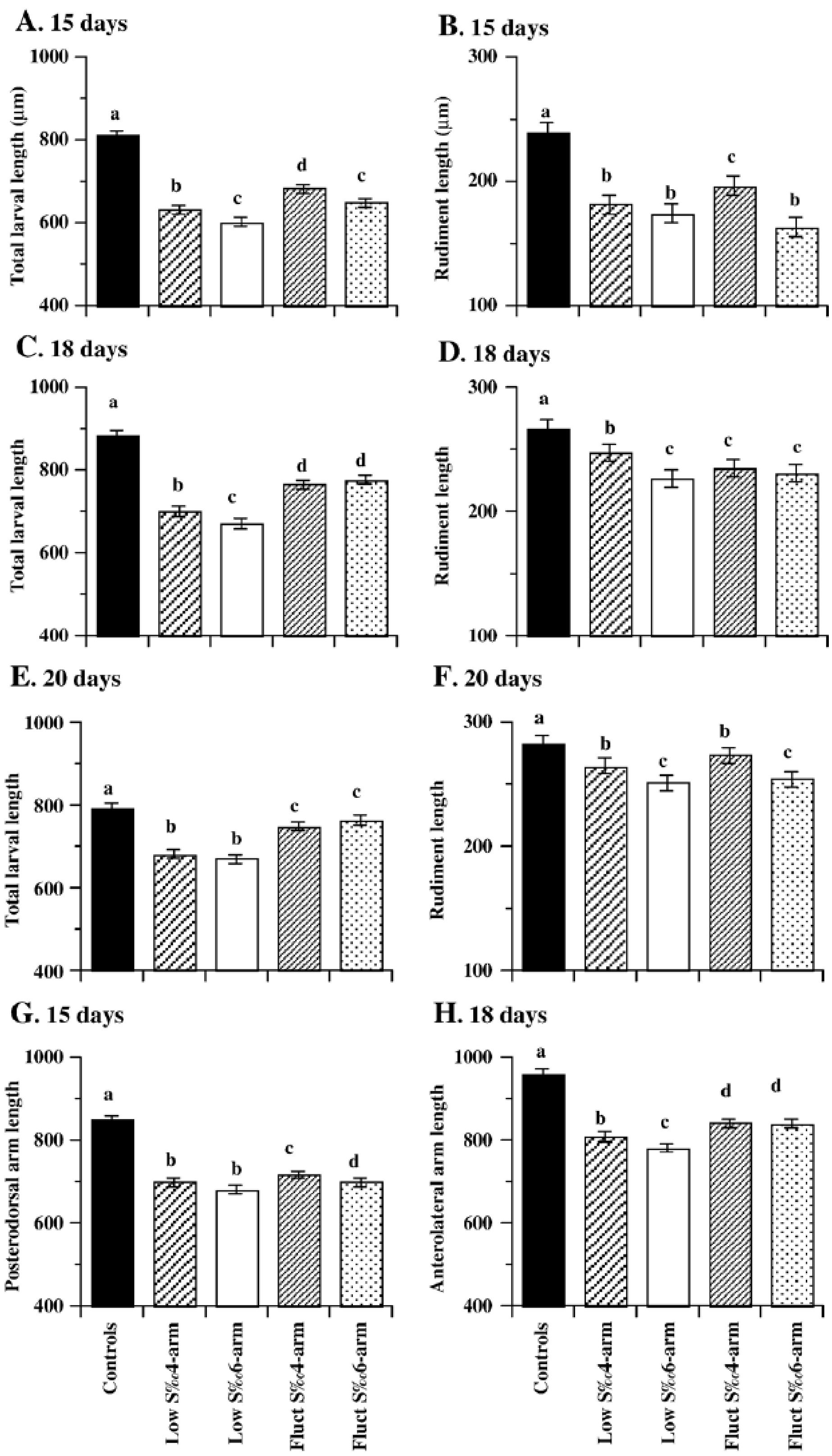

Fig. 6. Growth of body parts of 15, 18 and 20 day-old *Dendraster excentricus* larvae in three salinity treatments; *controls* (32‰ salinity), *constant low salinity* (low salinity 4-arm: 4-arm larvae transferred from 32 to 22‰ sea water; low salinity 6-arm, 6-arm larvae transferred from 32 to 22‰ seawater); *fluctuating salinity* (4-arm larvae originally in 32‰ transferred to 22‰ for 7 days then returned to 32‰; 6-arm larvae originally in 32‰ transferred to 22‰ for 7 days then returned to 32‰). All measurements are in microns. Values are means ± standard error. Different letters indicate significant differences between treatments at the 0.05 significance level.