Biogeosciences Discuss., 10, C2885–C2887, 2013
www.biogeosciences-discuss.net/10/C2885/2013/

Biogeosciences
Discussions
Open Access

Interactive comment on "Fertilization success of an arctic sea urchin species, *Strongylocentrotus droebachiensis* (O. F. Müller, 1776) under CO_2-induced ocean acidification" *by* D. Bögner et al.

F. Melzner (Referee)

fmelzner@geomar.de

Received and published: 19 June 2013

Bögner et al. studied the acidification sensitivity of fertilization success in S. droebachiensis, an important echinoderm species of temperate and polar waters. The authors have explored the impacts of exposure of unfertilized gametes to simulated ocean acidification. This is a neglected area of research, yet an important one: recent evidence suggests that S. droebachiensis eggs stay viable for hours to days, which increases chances of fertilization (Meidel & Yund 2001). The paper also contains exciting data on intracellular pH regulation of unfertilized oocytes that indicate limited pHi regu-

latory capacity at a pCO2 of 1400 μatm and above. In general, the paper is innovative and presents novel approaches.

As Sam and Jon already pointed out, the lack of quantification of sperm density is a problem, particularly as it is known that sperm concentration and exposure time have very large impacts on fertilization success in this species (see Levitan 1998 Fig 10). It is difficult to address this problem post – experiment, but one option could be to take multiple samples (>10) of sperm from males from the same population at the same time of year to measure sperm concentration at the chosen dilution factor to assess variability. If variability should be low (e.g. CV of 10% or so), I see no problem with using the data presented in this ms. If the authors chose to follow this suggestion, they should probably also use the opportunity to study the relationship between sperm concentration, fertilization success and polyspermy for this population and compare it to results obtained by Levitan (1998) for a Pacific population of the same species.

The intracellular pH determinations are very interesting. However, the authors should (if possible) provide a calibration curve to the able to assign approximate pHi changes to the measured ratios (Fig 6), see Stumpp et al. 2012 PNAS for an example with the same species. The experimental protocol for these experiments needs to be described in more detail. The authors note that eggs were exposed to different seawater chemistries for 30 min, then to BCECF solution (in ASW) for 30 minutes, then imaged. How was carbonate chemistry maintained during the imaging process? Were oocytes perfused in a bath with seawater of the relevant pCO2 and T during pH imaging? How long did these measurements take until completion?

Introduction and discussion should be modified to better reflect the primary literature on the relevant topics and species studied. As noted by Sam, there are several papers available on S. droebachiensis larval and adult reaction to simulated OA (Siikavuopio et al. 2007 Aquaculture, Stumpp et al. 2012 Aquatic Toxicology, Dupont et al. 2013 Mar Biol, Dorey et al. 2013 Glob Change Biol) and many papers that discuss polyspermy in sea urchins (e.g. multiple good papers by Styan and coworkers). Another aspect that

should be discussed are the fascinating mechanisms of sperm – oocyte communication, that are intricately related to ion regulation processes (see review by Kaupp et al. 2008 Annu Rev Physiol). Other, very general sections in the introduction (e.g. 13-21) could be deleted.

Specific points: P8032 give details on when the study was carried out in relation to the main spawning season of the species. P8033 use CT for DIC according to Dickson et al. 2007 Best practice guide. P8035 algae concentration? Why feed non-feeding larval stages? P8044 Stumpp et al. 2011 studied S. purpuratus, not S. droebachiensis.

Interactive comment on Biogeosciences Discuss., 10, 8027, 2013.