LETTER

Attributing reductions in coral calcification to the saturation state of aragonite, comments on the effects of persistent natural acidification

The correct attribution of reductions in coral calcification rates to environmental parameters is key to predicting how coral reefs could respond under future climate change scenarios (1). Crook et al. (2) report a 35% reduction in the calcification rates of the coral *Porites astreoides* growing near submarine freshwater springs relative to specimens growing in the surrounding lagoon. Submarine springs in the area release intermittently ground water with low conductivity, low pH, low aragonite saturation (Ω_{arag}), and for most of the year, low temperature (3, 4). Although Crook et al. (2) acknowledge the challenges of attributing to one single environmental variable the observed results when multiple parameters may covary, their main conclusion identifying low Ω_{arag} as the sole driver for the observed reductions in coral calcification is misleading.

The flow of groundwater through the submarine springs is intermittent and ultimately controlled by sea level. During neap tides, submarine springs remain almost fully open, whereas during the spring tides, the springs close and open while tracking the semidiurnal tidal regime (Fig. 1). Once the sea level rises above a threshold and the spring closes, the center of the spring rapidly equilibrates with the bulk lagoon water as indicated by the rise in conductivity and temperature. In general, underwater springs remain open 75% of the time (4), although these periods can be significantly shorter depending on the prevailing oceanographic conditions. Crook et al. (2) assigned Ω_{arag} values for each coral used in the study based on their location along gradients surveyed during three periods when the springs were active (3). As the intermittent nature of the groundwater sources was ignored, the hind-casted Ω_{arag} experienced by coral colonies during their entire life was underestimated by at least 25%.

To overcome the challenges imposed by other environmental factors that covary with Ω_{arag}, Crook et al. (2) compare their results with published laboratory studies in which the Ω_{arag} was controlled by manipulating pCO_2 while maintaining the other variables constant. Considering the agreement between the apparent sensitivity of the Yucatan corals with the results obtained from laboratory manipulations, Crook et al. (2) conclude that the observed reductions in *P. asteroides* calcification result exclusively from the Ω_{arag} gradient, excluding any other factor. Unfortunately, using this comparative approximation while ignoring other well-known responses of coral calcification to covarying environmental parameters seriously compromises the conclusion.

Crook et al. (3) report a temperature difference between the springs and the lagoon of −4.45 °C (Fig. 1). These thermal anomalies would generate reductions in calcification of similar magnitude to those attributed to Ω_{arag} (5). Furthermore, increased light scattering due to the mixture of waters with different densities result in increments, as high as 30%, in the vertical attenuation coefficient relative to the lagoon. These significant changes in the light environment and temperature, alone or in synergy, are enough to explain similar reductions in coral calcification than those reported by Crook et al. (2), therefore making their sole attribution of the results to low Ω_{arag} uncertain.

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Roberto Iglesias-Prieto*[1], *Claudia Tatiana Galindo-Martínez, Susana Enríquez, and Juan P. Carricart-Ganivet
Unidad Académica de Sistemas Arrecifales, Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, Cancun, 77500 QR, Mexico

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[1]To whom correspondence should be addressed. E-mail: iglesias@cmarl.unam.mx.

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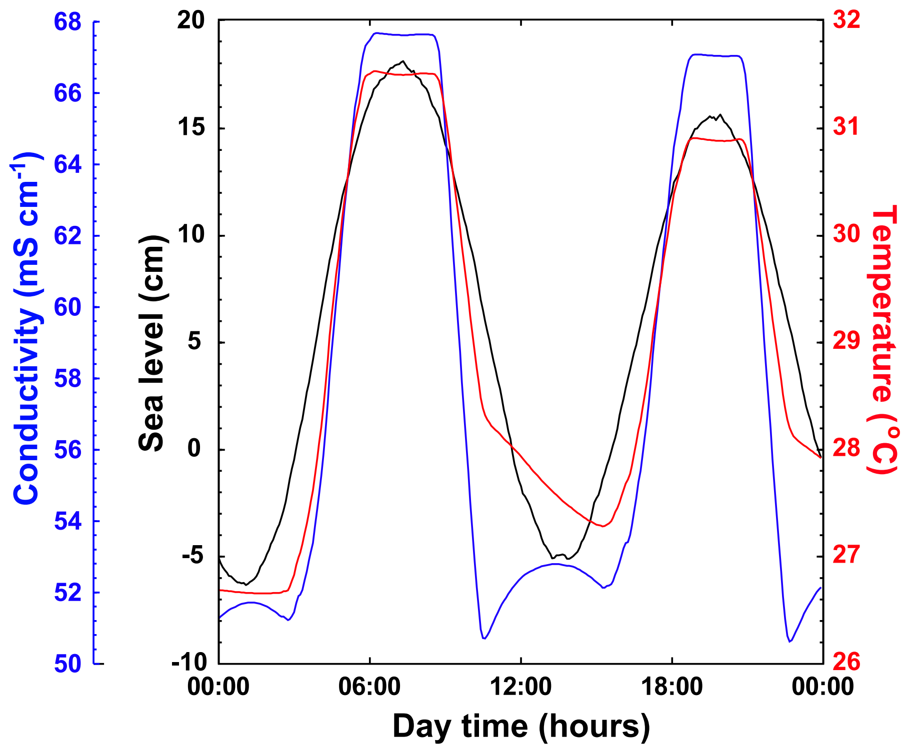

Fig. 1. Typical diurnal sea level oscillations, conductivity, and temperature recoded at the center of the Pargos submarine spring. The data were collected every 15 min with a conductivity, temperature, and depth probe (Van Essen Instruments Mod. D1263) on August 7, 2010.