

## **Northward range extension of the crowned sea urchin (*Centrostephanus coronatus*) to Monterey Bay, California**

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Keywords: *Centrostephanus coronatus*, Monterey Bay, range extension, El Niño, central California

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A crowned sea urchin, (*Centrostephanus coronatus*) was seen and documented on 12 April 2016 on rocky reef substrate in the kelp forest near the Monterey breakwater in Monterey Bay, California (36° 36.63' N, 121° 53.66' W) by the first author during a scuba dive. This observation represents a northward range extension of about 330 kilometers from the previously reported northernmost occurrence of this species at the northern Channel Islands, California (Engle and Richards 2001; Pearse 1972). This subtropical species has a reported distribution from the Galapagos Islands (Ecuador) in the south to the northern Channel Islands (California, USA) in the north (Gotshall 2005). The specimen was photographed and its test diameter was estimated to be about 4 centimeters (Figure 1). Its identification as *Centrostephanus coronatus* was confirmed by the co-authors based on photographs. There is no other known, almost black species of sea urchin in California waters with the characteristic blue around the base of the spines (R. Mooi, California Academy of Sciences, personal communication).

In southern California, this species is present in much lower densities than other common sea urchin species. Nevertheless, *C. coronatus* has increased in abundance over the last seven years in the southern Californian region. Reef Check California, a program that uses citizen scientists to survey California's rocky reefs using standardized 60 m<sup>2</sup> belt transects, has surveyed the densities of this species since 2006 (Freiwald et al. 2015; Gillett et al. 2012). These surveys document the spatial and temporal variation of crowned urchin recruitment and increases in population densities in southern California and show how, especially in 2015, its abundance has increased in the northern Channel Islands (Figure 2).

Adult crowned sea urchins occupy holes and crevices on shallow reefs and do not move far. After nightly feeding excursions of a few meters at most, they return to their home crevice before sunrise (Nelson and Vance 1979). Limited adult movement in combination with the body size of the observed individual suggests that it settled at least a year or two ago and has survived and grown on the reef in Monterey Bay. The northward range expansion



FIGURE 1.—Crowned urchin (arrow) photographed on 12 April 2016 near the Monterey breakwater in Monterey Bay, California. Specimen was found next to purple urchins in a crevice on rocky reef substrate at a depth of about 4 m.

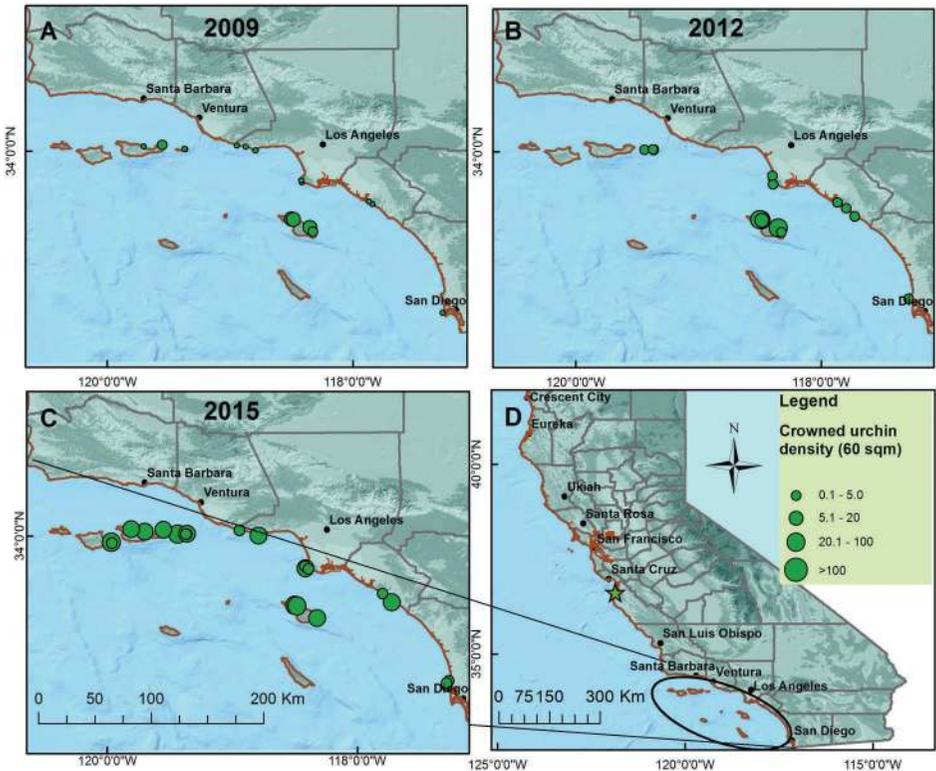


FIGURE 2.—Distribution of crowned urchins (*Centrostephanus coronatus*) in southern California as documented during Reef Check California surveys from 2009 to 2015 (panels A-C) and location of a single crowned urchin observed and photographed on 12 April 2016 (panel D, star). Oval in panel D indicates historic range of crowned urchins in California and dashed lines show section of coast shown in panels A-C.

of the crowned urchin is likely due to the recent marine coastal warming that has persisted along the California coast since 2013, and is referred to as the ‘warm blob’ (Leising et al. 2015; Peterson et al. 2015). Similar recruitment of this species was observed in association with a warm water event during the 1997/98 El Niño around the northern Channel Islands where it had been rare before that (Engle and Richards 2001). In the southern part of the species’ range, increases in population density associated with warm water events have also been documented during an El Niño in 2009/10 when populations increased by about 70% at a site in southern Mexico (López-Pérez *et al.* 2016).

The observation of this subtropical species of sea urchin in central California is not the only case of a southern species being observed in this region during the recent warming along central California. In 2015, two species of urchins, *Lytechinus pictus* and *Arbacia stellata*, were found on a reef about one km upcoast of the site at which the crowned urchin was observed (Lonhart 2015). Along with recent sightings of several species of fish typically found in southern California (J. Freiwald, personal communication), these observations support the conclusion that this range extension of *C. coronatus* is related to the unusually warm water and El Niño conditions that have persisted over several years in central California since late 2013 (i.e. warm blob 2013-15 and El Niño in 2015-16).

#### ACKNOWLEDGMENTS

We would like to thank the many Reef Check California volunteers that have helped collect the data used in this paper. We are truly grateful to those who have generously donated their time and effort to monitor California’s kelp forest ecosystems. We would like to thank M. Carr for comments that helped improve this paper. Over many years, major supporters of the Reef Check California program have been the Resources Legacy Fund Foundation, the Keith Campbell Foundation for the Environment, the Lisa and Douglas Goldman Foundation, the California State Coastal Conservancy and California Ocean Protection Council (California Sea Grant) and the Annenberg Foundation.

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*Received 17 May 2016*

*Accepted 24 May 2016*

*Associate Editor was Peter Kalvass*