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First record of the sea anemone *Diadumene lineata* (Verrill, 1869) from the Chilean coast

(Cnidaria, Anthozoa, Actiniaria)

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The orange-striped green sea anemone *Diadumene lineata* (Verrill 1871) was originally described from Japan but has been recorded as an invasive species from temperate and tropical coasts all over the world, being presumably transported on ship hulls or with seafood shipments. Here, we report the occurrence of this species for the first time from the South East Pacific, specifically on the coast of Coquimbo, northern Chile. Two specimens were spotted in 2012 and approximately 15 individuals were collected and examined in 2014. Most specimens were identified both externally and internally, confirming the cnidome described for the species in several individuals. Generally, the greenish-brown specimens had a pedal disc diameter of up to 7 mm and possessed between 2 and 11 irregularly distributed orange stripes. Since *D. lineata* is known to proliferate quickly, it is strongly recommended to start monitoring the area for possible outbreaks.

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Introduction

The orange-striped green anemone (Cnidaria, Anthozoa, Actiniaria), *Diadumene lineata* (Verrill, 1869), was originally described from Japan as *Sagartia lineata* but has already been recorded for North America and Northern Europe by the end of the 18th and early 19th century (Fautin 2013). Dispersal out of Asia is supposed to have occurred by attachment to ship

hulls or seaweed, mussel and oyster shipments (Shick & Lamb 1977, Gollasch & Riemann-Zürneck 1996). During the last decades *D. lineata* has been spotted at many temperate and tropical coasts all over the world, mainly in the northern hemisphere (Fautin 2013). In the southern hemisphere, it has only been reported from the South West Atlantic, specifically in Brazil (Belem & Monteiro 1977, Zamponi et al. 1998, Farrapeira et al. 2007) and Argentina (Excof-

fon et al. 2004, Molina et al. 2009). So far, there is no record for the southeastern Pacific coast. The species has a complex history of synonymy, the specific names that have been used are *luciae*, *lineata*, *chryso-splenium*, *davisi* and *postulata*, in combination with the generic names *Diadumene*, *Haliplanella*, *Sagartia*, *Actinia*, *Aiptasiomorpha* and *Chrysoela* (Fautin 2013).

Material

The findings reported herein were made in the mid intertidal zone of La Herradura, sector Bucanero (Fig. 1A) in Coquimbo, Chile (29°58'S, 71°21'W). The average seasonal seawater temperature in Coquimbo ranges from 13.4 °C in winter (min.: 12.0 °C, max.: 16.0 °C) to 17.6 °C in summer (min.: 16.2 °C, max.: 21.2 °C) (Fadia Tala & Martin Thiel, unpublished data). Average annual precipitation in the area (data from La Serena, directly adjacent to Coquimbo) is 78.48 mm and relative humidity 83.17 % (World Climate 2014).

The site where the species was found belongs to a small, protected boulder/cobble beach, which is located near an old, 19th century, iron smelter; the beach consists of several layers of boulders and cobble (10–30 cm diameter) of either natural origin (granite) or slag from the iron smelter. The beach is close to La Herradura Yacht Club, where occasionally international yachts are residing for a few weeks or months.

We collected approx. 15 specimens of *D. lineata* of which we studied internal and external anatomy and cnidae to confirm identification, and deposited voucher specimens in 10 % formalin and 99 % ethanol at the Zoological State Collection Munich (ZSM20150068) and at the museum of the University of Concepción (MZUC-UCCC43685).

Results

On May 1st, 2012, searching the intertidal zone for sea anemones of the genera *Anthopleura* Duchassaing de Fombressin & Michelotti, 1860 and *Bunodactis* Verrill, 1899, CS observed two small individuals of *Diadumene lineata* (approx. 5 mm diameter) under a stone in the mid intertidal zone of La Herradura, sector Bucanero, Coquimbo, Chile (29°58'S, 71°21'W). MT did not find *D. lineata* during two searches during which he specifically looked for the species between September and November 2014, but an intensive search on December 15th, 2014 revealed a small patch of three fist-sized boulders lying very close together in the low intertidal zone with a total of approximately 15 individuals between 2–3 mm and 6–7 mm pedal disc diameter; the stones with *D. lineata* were covered by two further layers of boulders/cobbles. All specimens found in this patch were collected.

None of the examined specimen of *Diadumene lineata* had reproductive tissue. The fact that the photographed specimens have between 2 and 11 irregularly distributed stripes suggests that they were most probably produced by asexual reproduction.

Other sea anemone species we have recorded on the rocks of La Herradura in our surveys since 1998 were *Anthothoe chilensis* (Lesson, 1830), *Anemonia alicemartinae* Häussermann & Försterra, 2001, *Phymactis papillosa* (Lesson, 1830), *Phymanthea pluvia* Carlgren, 1959, and *Anthopleura hermaphroditica* Carlgren, 1899, which also were common during the surveys in September–December 2014.

Discussion

The most common, distinctive and eye-catching colour morph of *Diadumene lineata* has a greenish-brown column with orange stripes (in regular forms there are 12 stripes, but the number of stripes can be irregular due to asexual reproduction, see Fig. 1); other varieties have 48 paired white stripes or, rarely, no stripes (Shick & Lamb 1977). Within its native range, specimens of *D. lineata* have a diameter of up to 40 mm (oral disc including tentacles when alive) and reproduce sexually. In areas where they are introduced, individuals are smaller since they mostly reproduce by longitudinal fission and occasionally by pedal laceration (Shick & Lamb 1977, Carlton 1979, Molina et al. 2009).

Diadumene lineata is a common member of fouling communities (Farrapeira et al. 2007). It can be found in the intertidal and shallow subtidal zone, both on solid substrata, as well as on roots and stems in protected marshland areas (Molina et al. 2009). Specimens are highly tolerant to intertidal exposure where they withstand low tide conditions up to twice a day for six hours each, even in summer heat (Molina et al. 2009). They form cysts in freezing climates, acclimatize to very low salinities and survive extreme fluctuations of temperature and salinity (Verrill 1898, Shick & Lamb 1977). The species often appears suddenly and is able to proliferate very quickly (Stephenson 1935) which makes

Fig. 1. Specimens and sampling site of *Diadumene lineata* from the mid intertidal zone of La Herradura beach, Coquimbo, Northern Chile. **A.** Sampling site at La Herradura beach. **B,C.** Specimens of *D. lineata* in situ (**B.** retracted specimen, **C.** expanded specimens). **D–F.** Specimens of *D. lineata* in laboratory (**D.** expanded specimen from above, **E.** expanded specimen from side, **F.** specimen from above, after disturbance, arrows: released acontia). Photos: Carlos Spano (A–B: May 2012), Javier Sellanes (C–F: December 2014). Scale bar: 2 mm.



it a successful colonizer. However, it has also been reported to vanish quickly from an area with no warning in short time (Stephenson 1935).

Since *D. lineata* is known to proliferate quickly it is necessary to start monitoring the area for possible outbreaks.

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