

# First record of *Odontaster penicillatus* populations (Philippi, 1870) (Echinodermata: Asteroidea) in the Atacama and Antofagasta regions, Chile (Southeast Pacific)

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## Abstract

We report for the first time the presence of local populations of the starfish *Odontaster penicillatus* in the regions of Atacama and Antofagasta, Chile. This finding indicates an extension of the distribution limit of 500 km with respect to the last observation made in 2007 in Isla Grande de Atacama. A total of 121 specimens of *O. penicillatus* were recorded at depths of between 8 m and 24 m. They were associated with rocky substrate and with different species of barnacles, sponges and bryozoans. The presence of *O. penicillatus* expands the knowledge of the benthic biodiversity of the region, and the development of studies on its ecological importance will be promoted.

**Key words:** *Odontaster penicillatus*, new record, Antofagasta, Atacama, South Pacific Ocean

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## 1 Introduction

Sea stars are common invertebrates in benthic communities, acting as omnivorous, opportunistic (Martín et al., 2001), predatory, herbivorous, detritivorous or scavenging species (Dayton et al., 1974; McClintock, 1994; Gil and Zaisxo, 2008; Loh and Todd, 2011). In the Southern Ocean and southern South America, the genus *Odontaster* is represented by five species of sea stars: *Odontaster meridionalis* (E.A. Smith, 1876), *O. validus* (Koheler, 1906), *O. penicillatus* (Philippi, 1870), *O. pearsei* (Janosik and Halanych, 2010) and *O. roseus* (Janosik and Halanych, 2010) (Janosik and Halanych 2010, Janosik et al., 2011). In the Subantarctic and Antarctic zones of Chile, the species *O. meridionalis*, *O. validus* and *O. penicillatus* stand out (Vasquez et al., 1980).

The asteroid *O. penicillatus* is distributed in the Pacific Ocean between 27°S Large Island of Atacama to 54°S Strait of Magellan Chile (SE Pacific) and in 36°S in the Atlantic Ocean and Falkland Islands (SW Atlantic) 51°S (Mutschke and Rios, 2006; Gaymer et al., 2008; Mutschke and Mah, 2009), inhabiting depths from 8 m to 400 m (Codoceo and Andrade, 1978). In Chile, the main area of distribution of *O. penicillatus* is limited to the Subantarctic and Antarctic regions. However, the most recent information on the distribution of this species was provided by Gaymer et al. (2008), who registered *O. penicillatus* inhabiting hard substrates (~25 m depth) in the Isla Grande de Atacama (Pacific Ocean) at approximately 27°S. In the present study, we report for the first time an

extension of the distribution of the starfish *O. penicillatus*, more than 500 km to the north with respect to the last record of its distribution, in the Mejillones Peninsula (Antofagasta) and intermediate zones in the Atacama region of Chile.

## 2 Materials and methods

Between August 2017 and February 2021, sampling was conducted in different sectors of coastal areas, located in the southeastern Pacific between parallels 28°19'S (Atacama region) and 23°27'S (Antofagasta region). This coastal zone is strongly influenced by the Humboldt Current System (HCS) and is characterised as one of the most productive marine ecosystems in the world (Thiel et al., 2007).

Photographs and video recordings were taken of *O. penicillatus* specimens in the subtidal benthic environments, and eventually organisms of this echinoderm were collected. It is important to note that the sampling was carried out during assessments for benthic fishery resources in Management Areas for Exploitation of Benthic Resources and in open access management areas on the northern coast of Chile, and as such, the sampling design was not designed to assess communities. The particular shape, colour and size of *O. penicillatus* caught the attention of the divers, and they made the visual records and collection without considering a rigorous experimental design. Organisms were identified to species taxonomic level based on Mutschke and Mah (2009).

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### 3 Results

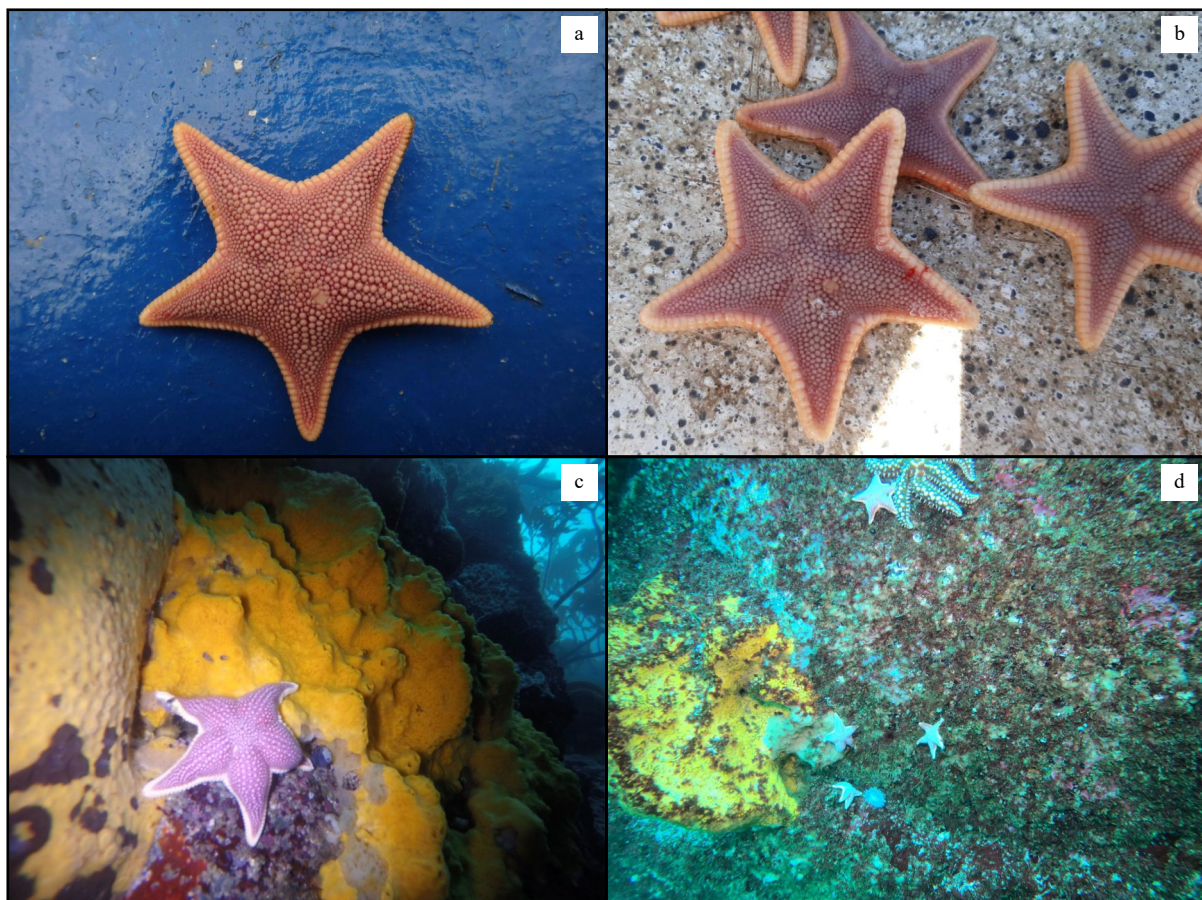
A total of 121 specimens of *O. penicillatus* were recognised; 34 were observed on rocky bottoms dominated by the cirripedium *Austromegabalanus psittacus* south of Isla Grande de Atacama at Punta de Lobos (28°19'S) (Figs 1a and 2), 41 specimens were observed on rocky bottoms with the sponge *Tedonia mucosa* north of Isla Grande at Playa del Rodillo in the Atacama (26°58'S) (Figs 1b and 2) and 46 individuals were observed on rocky bottoms with *Bugula* spp. bryozoans and the sponge *T. mucosa* at Isla Santa María Península de Mejillones (23°27'S) (Figs 1c, d and 2). The organisms presented a  $R$  radius (center to the tip of the arm) from 1 cm to 2 cm, and  $r$  (center to a notch) from 0.6 cm to 1.4 cm and showed a central pink colour and a pale yellow rim as well as actinolateral plates covered with spines. Viewed from above, the granuliform marginal plates form a prominent rim (Mutschke and Mah, 2009). All individuals were recorded at a depth of 8 m, with the exception of Isla Santa María (Mejillones Peninsula), where *O. penicillatus* was recorded in a bathymetric range between 18 m and 24 m. It is relevant to mention that there is no record of any other asteroid species similar to *O. penicillatus* in the study area.

### 4 Discussion

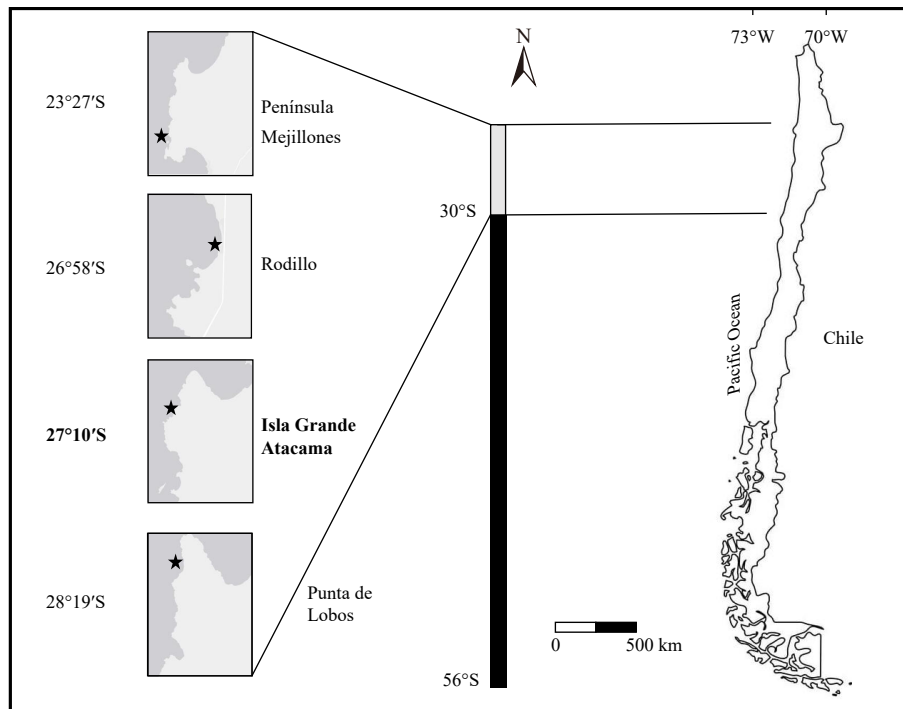
The existence of local populations of *O. penicillatus* in the Atacama and Antofagasta regions suggests an expansion of its distribution in the Pacific Ocean of South America. Due to the

lack of biological and ecological studies of this asteroid, the causes of this expanded distribution are still unclear. Studies conducted with the starfish *O. validus* in the Antarctic region have shown that the increase in water temperature can cause loss of coordination in organisms, while other studies indicate that adults can acclimatise to higher temperatures than usual (Peck et al., 2008; Kidawa et al., 2010). Regarding *O. penicillatus*, its main distribution area has a sea surface temperature of  $<5^{\circ}\text{C}$  (SHOA), while at the site of the last observation, average values of  $13.7^{\circ}\text{C}$  (SHOA) were recorded, and at the limit of records found in this study (Mejillones Peninsula), an average temperature of  $14.7^{\circ}\text{C}$  (SHOA) was recorded. In this context, it can be suggested that temperature is not a conditional factor in the distribution of *O. penicillatus*. However, this assertion should be taken with caution because there are no corroborating studies.

On the other hand, studies with asteroids suggest that the planktotrophic larval stage may help the distribution of the organisms, because the larvae obtain necessary energy from the nutrients present in the water column, which reduces larval mortality (Tyler et al., 1990; Benítez-Villalobos et al., 2007). In addition, it has been shown that the larval stages of sea stars have a prolonged duration in the water column and a high dispersal capacity (Moran et al., 1992). In the species *O. validus*, its planktotrophic larvae can remain in the water column for 180 days (Pearse and Bosch, 1986). In the present study, the sectors where *O. penicillatus* was recorded are strongly influenced by the HCS,



**Fig. 1.** Photographic records of *Odontaster penicillatus* in subtidal environments of northern Chile. a. *Odontaster penicillatus* collected at Punta de Lobos, Atacama, Chile. b. Specimens of *O. penicillatus* collected at Rodillo Atacama, Chile. c. Individual of *O. penicillatus* photographed in its marine habitat at Mejillones Peninsula, Antofagasta, Chile. d. Group of *O. penicillatus* photographed on the seafloor at Mejillones Peninsula.



**Fig. 2.** Distribution area of *Odontaster penicillatus* in the Pacific Ocean coast of South America. The black bar indicates their frequent distribution area. The gray bar indicates the extended distribution area of *O. penicillatus* recorded in the present study. The small rectangles show the sites and geographic coordinates where the specimens were photographed and collected. The last report in 2008 is highlighted in black letters.

which would imply that this nutrient-rich marine current is an optimal source of energy for the planctotrophic larvae of *O. penicillatus*. Likewise, the south-to-north flow of the Humboldt Current could favour the transport of larvae to areas outside their frequent distribution area. In addition, it should be considered that kelp rafting might contribute to broaden the dispersal of sea stars, as occurs with the genus *Anasterias* (Waters et al., 2018).

The present report contributes to an increase in the scarce information on echinoderm species present in northern Chile and highlights the presence of populations of *O. penicillatus* in the Atacama and Antofagasta regions. In South America, different species of echinoderms reach 18% endemism (Arntz et al., 1997), so it is important to improve the knowledge of these invertebrates in this region. Recent studies in coastal areas of northern Chile have shown the importance of asteroids and their direct and indirect interactions as part of a complex of key species, where they contribute to the complexity and resistance to disturbances in macroalgal forest ecosystems (Hermosillo-Núñez, 2020). Therefore, the presence of *O. penicillatus* will expand the knowledge about the asteroids of northern Chile and will increase the generation of studies on their ecological role in these ecosystems.

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