

## Rapid Communication

## First record of *Dendronotus orientalis* (Baba, 1932) (Nudibranchia: Dendronotidae) in the temperate Eastern Pacific

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### Abstract

This study reports the first record of the Indo-West Pacific nudibranch *Dendronotus orientalis* (Baba, 1932) in the Northeastern Pacific Ocean. A reproducing population was discovered in fouling communities on floating docks in South San Francisco Bay, California, in March 2016. *Dendronotus orientalis* joins a large number of introduced marine invertebrates that have taken up residence in San Francisco Bay.

**Key words:** introduced, nudibranch, San Francisco Bay, citizen science

### Introduction

The San Francisco Bay, in Central California (USA), supports a worldwide array of introduced marine animals and plants, a characteristic that is due in large part to extensive international shipping activity and a long history of the importation of commercial oysters from the Western Atlantic and Western Pacific Oceans (Cohen and Carlton 1995; Cohen and Carlton 1998; Carlton and Cohen 2007). This study adds a rare Asian nudibranch to this assemblage, and represents the first example of a non-native dendronotid nudibranch in the temperate Eastern Pacific.

### Methods

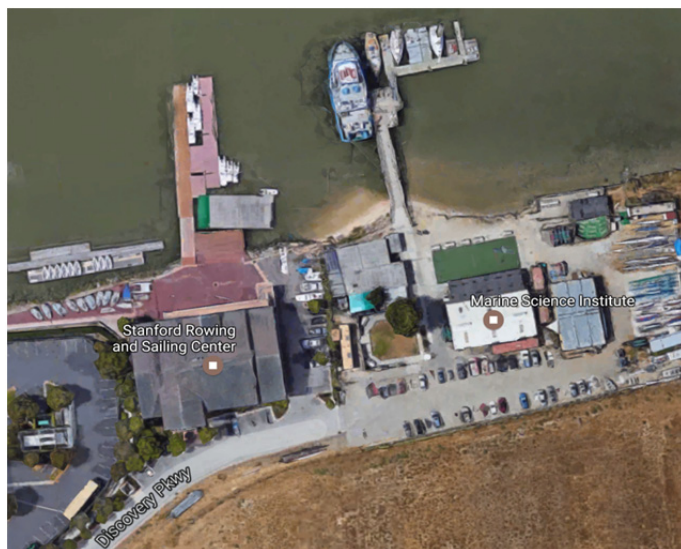
Independent citizen science surveys of fouling organisms on submerged floating docks in the southern half of San Francisco Bay have been undertaken biweekly since 2014. Surveys were conducted by one to four observers focusing on sessile invertebrates, including nudibranchs and their hydroid and other potential prey. Species of interest are typically measured and photographed using a Panasonic Lumix DMC-TS5, Panasonic Lumix DMC-TS6, or an iPhone 6 camera. In accordance with mandatory survey protocol, all living organisms were returned to the environment.

### Results and discussion

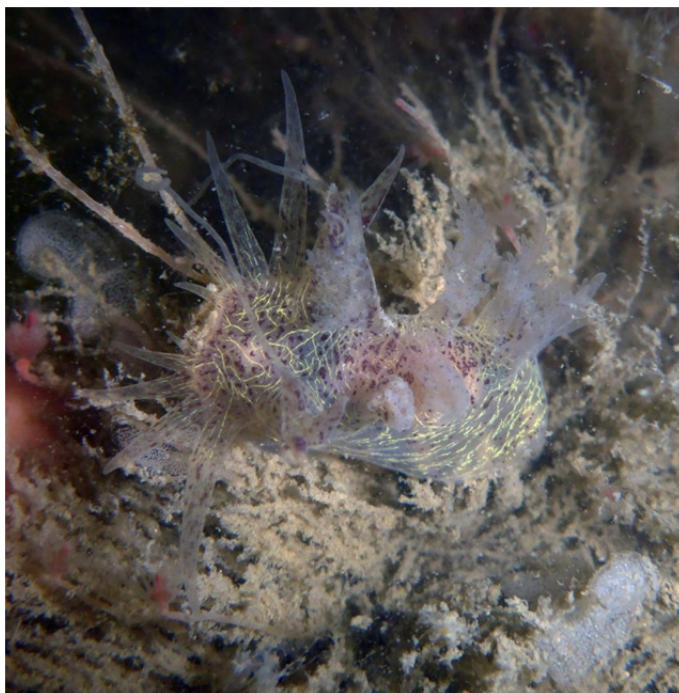
On 29 March 2016, a single specimen of an unusual, unidentified nudibranch was discovered at the Marine Science Institute floating docks in Redwood City (37.5049°N; 122.2171°W), in southern San Francisco Bay (Figure 1). The nudibranch was found at 1.5 m depth on a rope heavily covered with the hydroid *Ectopleura* sp., which it was observed eating (Figure 2). Photographs were posted on iNaturalist.org, where it was subsequently identified as *Dendronotus orientalis* (Baba, 1932) (= *Pseudobornella orientalis*) by Alison Young, Citizen Science Engagement Coordinator at the California Academy of Sciences (CAS). This identification was confirmed by Rebecca Johnson, CAS Citizen Science Research Coordinator, Gary McDonald of the Long Marine Laboratory of the University of California, Santa Cruz, and Jeffrey Goddard of the University of California, Santa Barbara.

On 1 April 2016, 16 additional specimens of *Dendronotus orientalis* and approximately 20 egg masses were observed in the same location on the same fouled rope as in March; five additional egg masses, but no nudibranchs, were found on *Ectopleura* on other ropes on the same dock. While *D. orientalis* was not directly observed depositing eggs, three lines

**Figure 1.** The docks at the Marine Science Institute, on Redwood Creek in Redwood City, South San Francisco Bay, California. The floats sampled are at the top right.



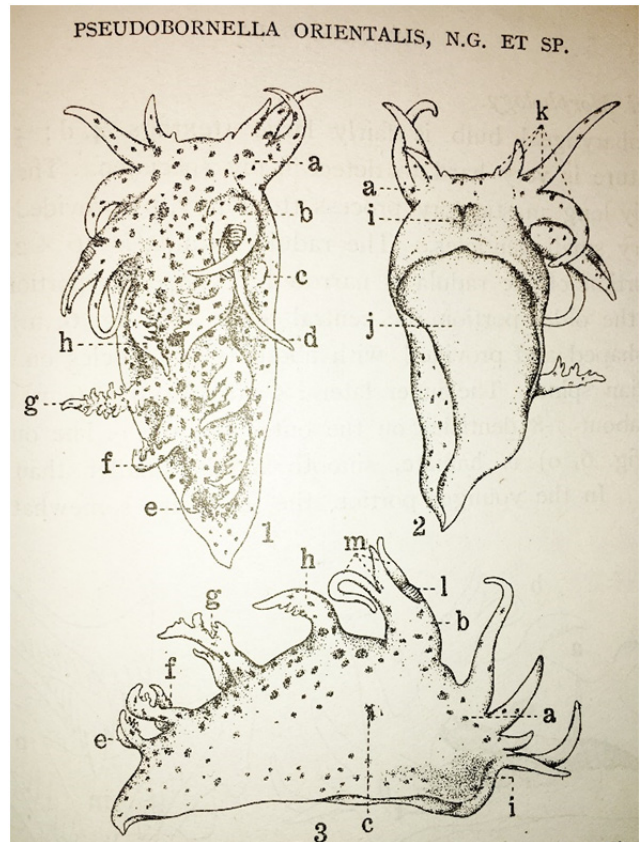
**Figure 2.** *Dendronotus orientalis* feeding on the hydroid *Ectopleura* on docks at Redwood City, San Francisco Bay. Photograph by M. Agarwal.



of evidence suggest that the egg masses seen and photographed were those of this species: (1) the eggs were immediately adjacent to *D. orientalis* (Figure 4), with no other sea slugs in close proximity; (2) the egg masses are unlike those known and recognized for other sea slugs in the same community; (3) they match photographs of egg masses associated with *D. orientalis* in the South China Sea (Song 2005). These 16 specimens were also photographed and measured. Video (by Robin Agarwal) of living

*D. orientalis* from Redwood City is available on line at <https://www.flickr.com/photos/30314434@N06/> (accessed December 15, 2016).

On 5 April 2016, Alison Young and Rebecca Johnson of the California Academy of Sciences, as well as Benson Chow of Romberg Tiburon Center, San Francisco State University, collected six additional specimens from this location. These latter specimens are deposited in the collections of the CAS Department of Invertebrate Zoology (CASIZ 209521).



**Figure 3.** *Dendronotus orientalis* (= *Pseudobornella orientalis*), showing dorsal, ventral, and lateral views (from Baba 1932).



**Figure 4.** *Dendronotus orientalis* with eggs on docks at Redwood City, San Francisco Bay. Photograph by R. Agarwal.

Specimens of *D. orientalis* (Figures 3 and 4) measured 2 to 3.5 cm in length. *Dendronotus orientalis* is characterized by long, thin tentacles up to twice the body length that extend back from the upper portion of the rhinophoral sheath. The translucent to white body has scattered brown spots with several yellow diagonal streaks interspersed between and around the spots. There was slight color variation between individuals, with some specimens having larger brown dorsal patches.

*Dendronotus orientalis* ranges throughout the Indo-Pacific (Gosliner et al. 2015) with most observations recorded in Japan and China (Masayoshi 2002; Song 2006). Martynov et al. (2015) newly report *D. orientalis* from Russia, based upon specimens collected in 2014 from Peter the Great Bay in the Sea of Japan. Of interest is that there was a long gap between its description in 1932 and the next reported sighting by Hamatani (2000) from Sagami and Osaka Bays in Japan. Baba (1932) reported it feeding on the hydroid *Ectopleura crocea* (Agassiz, 1862) (under the synonym *Tubularia mesembryanthemum* Allman, 1871) that was growing on the eelgrass *Zostera marina*. *Dendronotus orientalis* was likely carried from the Western Pacific Ocean to California either in ships' ballast water or within hull-fouling communities.

At least six additional Asian sea slugs are established in San Francisco Bay, including three nudibranchs, *Okenia plana* (Baba, 1960), *Eubranthus misakiensis* (Baba, 1960) and *Sakuraeolis enosimensis* (Baba, 1930) (Cohen and Carlton 1995), and three cephalaspideans, *Melanochlamys ezoensis* (Baba, 1957) (Cooke et al. 2014), *Philine orientalis* (A. Adams, 1854), (Krug et al. 2012), and *Haminoea japonica* (Pilsbry, 1895) (Gosliner and Behrens 2006; Hanson et al. 2013). Of these species, *Eubranthus misakiensis*, *Sakuraeolis enosimensis*, *Philine orientalis*, and *Haminoea japonica* are found at the same Redwood City location as *D. orientalis*.

No additional populations were observed at the docks in Redwood City between April 2015 and December 2016. South San Francisco Bay is characterized by numerous marinas with rich fouling communities similar if not identical to the environment at the Marine Science Institute. Long-term monitoring of *D. orientalis* will determine if this species is now a permanent new addition to San Francisco Bay and whether it has a measurable effect on community structure and function.

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