



A taxonomic review of pterotracheoid gastropod mollusks from California Current waters off the west coast of North America

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Abstract

Taxonomic characterization of pterotracheoid gastropods, morphological characteristics and occurrence in California Current waters are reviewed. Single species of atlantid (*Atlanta californiensis*) and carinariid (*Carinaria japonica*) from these waters are described and illustrated.

Introduction

Species of pterotracheoids recorded off the the west coast of North America include the atlantid, *Atlanta californiensis*, and the carinariid, *Carinaria japonica*; both live at epipelagic depths (surface to ~200m).

SBMNH Santa Barbara Museum of Natural History, Santa Barbara, California, USA.

SD subsequent designation.

Systematics

Pterotracheoidea Rafinesque, 1814

Description. Shell thin and transparent, foot enlarged and laterally compressed forming a swimming fin, paired eyes large and image-forming with a spherical lens and basal strip-like retina, radula elongate with sickle-shaped lateral and marginal teeth.

Distribution. Cosmopolitan at tropical to subtropical latitudes, although some are restricted to one or two oceans and two (*Atlanta californiensis* and *Carinaria japonica*) are only found in the North Pacific.

Remarks. Pterotracheoidea is the correct name for the Heteropoda, commonly referred to as heteropods.

Atlantidae Rang, 1829

Atlantidae Wiegmann & Ruthe, 1832: 518, *ex* Rang, 1829: 123 (vernacular).

Diagnosis. Shell calcareous, except in *Oxygyrus* (cartilaginous), laterally compressed, coiled, resulting in flattened, discoid shape with diameter to 10 mm; keel extends outward from last whorl to varying degrees; keel calcareous (*Atlanta*) or cartilaginous (*Protatlanta*, *Oxygyrus*). Operculum chitinous, attached to posterior margin of foot.

Distribution. Most species live in the upper layer of the ocean (the epipelagic zone), which off the west coast of North America extends to a depth of 150 to 200 m.

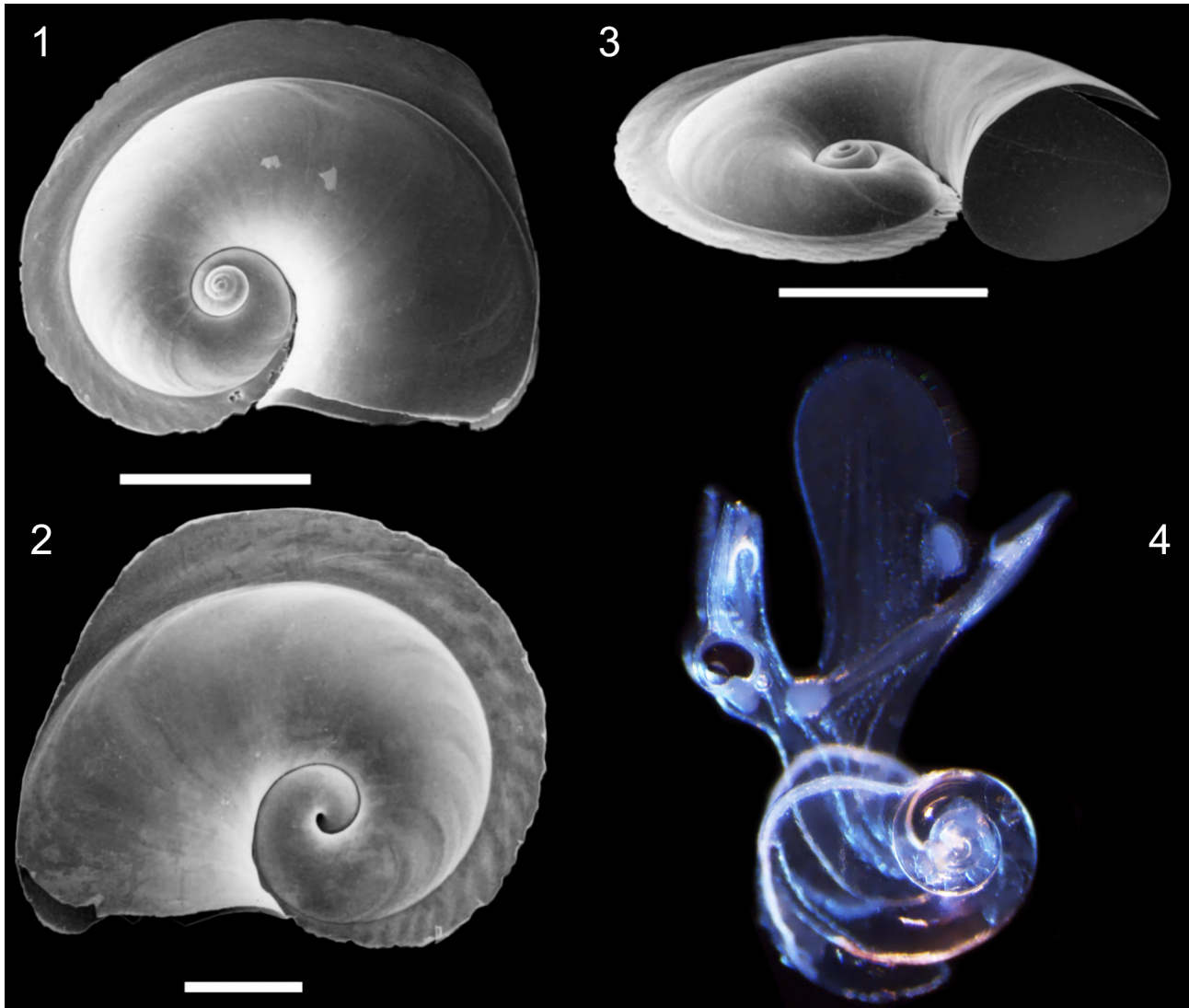
Atlanta Lesueur, 1817

Atlanta Lesueur, 1817: 390, pl. 2, figs 1–2. Type species (SD Gray 1847: 149, no. 175): *Atlanta peronii*.

Diagnosis. Shell and keel calcareous (aragonitic); following metamorphosis larva shell retained as the protoconch of the adult shell spire, with a flat to conical shape and protruding to varied degrees; number of spire whorls ranges from 2 1/2 to 6 whorls, with smooth to complex surface sculpture.

Remarks. Among the nineteen extant species of *Atlanta*, only one occurs in temperate waters while the remainder are tropical to subtropical.

The biology and paleontology of atlantids were reviewed by Wall-Palmer *et al.* (2016). Subsequently, the biogeography and genetic diversity of atlantids were studied by Wall-Palmer *et al.* (2018).



FIGURES 1–4. Atlantidae. *Atlanta californiensis* from the right side; scale bar = 0.5 mm. 2. *Atlanta californiensis* shell from left side; scale bar = 1 mm. 3. *Atlanta californiensis* shell from right side, apertural view; scale bar = 0.5 mm. 4. *Atlanta californiensis* shell from right side; scale bar = 0.5 mm.

Atlanta californiensis Seapy & Richter, 1993

(Figures 1–4)

Atlanta californiensis Seapy & Richter, 1993: 389, figs 1–4, 6a, 6c, 7, 8, 9a, 10a. Holotype SBMNH 140126; San Pedro Basin, California.

Diagnosis. Shell moderately small (to 3.5 mm), laterally compressed, transparent. Spire of 3 1/4 whorls, shape low conical, coloration variable and attributable to underlying tissues, either clear to uniform light yellow, brown or violet, or mottled light to dark yellow-brown. Suture coloration from clear to light violet or purple. Internal walls partially decalcified and replaced with thin chitinous membranes. Umbilicus deep, wide. Operculum thin, transparent, oval in shape; gyre region lacks raised spines.

Distribution. Limited to the Transition Zone Faunal Province, which includes the California Current (Seapy & Richter 1993).

Remarks. Abundances in nearshore waters off southern California are low between fall and spring, increasing in summer and peaking in August (Cummings & Seapy 2003).

Carinariidae Blainville, 1818

Carinariidae Blainville, 1818: 214.

Diagnosis. Body greatly enlarged, elongate (to 680 mm in *Carinaria cristata*), cylindrical, gelatinous, divided into three regions (proboscis, trunk, tail). Sucker small, located on posterior margin of foot.

Carinaria Lamarck, 1801

Carinaria Lamarck, 1801: 98–99. Type species by monotypy *Argonauta vitreus* Gmelin, 1791 (= *Carinaria cristata* (Linnaeus, 1767)).

Diagnosis

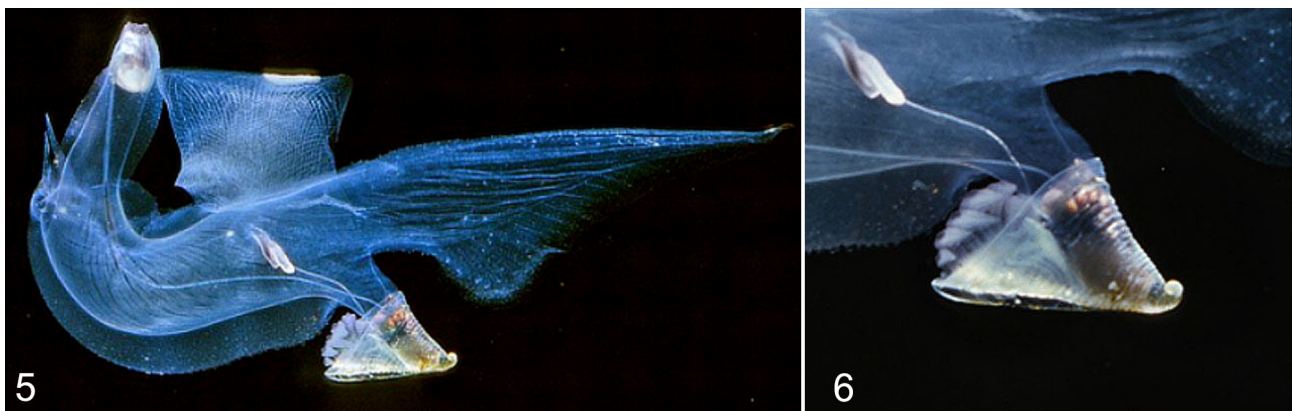
Shell and keel calcareous; shell cap-shaped, laterally compressed, covering stalked visceral nucleus. Visceral nucleus, swimming fin opposite each other on posterior portion of trunk. Tail shape, size variable, height of tail crest variable. Swimming fin with small sucker on postero-ventral margin.

Carinaria japonica Okutani, 1955

(Figures 5–6)

Carinaria japonica Okutani, 1955: 251, figs 1–3. Holotype Tokai Regional Fisheries Research Laboratory, Tokyo (no number assigned). Type locality: 36°21'N 141°00'W.

Description. Body to 130–150 mm. Shell laterally compressed, triangular in shape; height to basal length ratio 0.8–1.0; keel width low at shell apex, increasing in height with proximity to shell aperture. Tail moderately large, with tall dorsal crest.



FIGURES 5–6. Carinariidae. 5. *Carinaria japonica* from right side. 6. *Carinaria japonica* stalked visceral mass and shell. Note the small protoconch retained at the shell apex. Photographs by David Wrobel, with permission.

Distribution. Limited to the North Pacific Transition Zone Faunal Province (Seapy 1974), which extends eastward from Japanese waters in a narrow band and then diverges upon approaching the west coast of north America to the north, forming the Alaskan Gyre, and to the south, forming the California Current.

Remarks. Abundance in California Current waters varies seasonally, becoming maximal off southern California in mid-summer (Dales 1953, McGowan 1967, Seapy 1974). From the CalCOFI samples in the North Pacific Dales (1953) had identified *C. japonica* as *C. lamarcki*.

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