Zoosymposia 13: 070–082 (2019)
http://www.mapress.com/j/zs/

ISSN 1178-9905 (print edition)
ZOOSYMPOSIA
ISSN 1178-9913 (online edition)

http://dx.doi.org/10.11646/zoosymposia.13.1.8
http://zoobank.org/urn:lsid:zoobank.org:pub:9B5BA089-ADC6-452E-91B7-C477979BCA3A

Tegulidae and Turbinidae of the northeast Pacific

AXEL ALF
Dr.-Mueller-Strasse 9, 91746 Weidenbach, Germany. E-mail: axel49.1@gmx.de

Abstract

The northeast Pacific species of the trochoidean families Tegulidae and Turbinidae are described and illustrated. These two families are discussed and each includes two genera: Tegulidae with the genera *Tegula* (eight species) and *Norrisia* (one species), and Turbinidae with the genera *Megastrea* (two species) and *Pomaulax* (one species).

Introduction

The former separation of the two trochoidean families Trochidae and Turbindae on the basis of a calcified operculum in Turbinidae and corneous operculum in Trochidae, was abolished in the revision by Hickman & McLean (1990). These two families, with a number of subfamilies distinguished by the construction of the opercula independent from the calcification were retained. Williams *et. al*. (2008) and Williams (2012) raised most of the subfamilies to the family level, including Tegulidae, which initially was part of Trochidae and then part of Turbinidae.

In the eastern Pacific, Tegulidae occupy the same ecological position as the Trochidae in the eastern Atlantic (especially the genera *Phorcus* and *Gibbula*), as common inhabitants of shallow, rocky (and rarely mud and sand) environments . In the northeast Pacific, nine species are recorded herein.

Turbinidae includes the subfamilies Turbininae and Prisogastrinae, which both have calcareous opercula. The turbinids are predominantly tropical, but three species are found in the northeast Pacific.

Repositories

AAC	Axel Alf Collection, legally transferred to Zoologische Staatssammlung, Munich, Germany.
AMNH	American Museum of Natural History, New York, New York, USA.
CASG	California Academy of Sciences, Geology, San Francisco, California, USA.
CASIZ	California Academy of Sciences, Invertebrate Zoology, San Francisco, California, USA.
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA.
SBMNH	Santa Barbara Museum of Natural History, Santa Barbara, California, USA.
USNM	United States National Museum of Natural History, Washington, D.C., USA.

Systematics

The following species descriptions were compiled from a manuscript by the late James H. McLean.

Tegulidae Kuroda, Habe, & Oyama, 1971

Description. Shell small to large in size; solid, globose to conical; smooth to strongly sculptured, sculpture variable with more or less distinct axial, spiral ridges; unicolored or with variegated color patterns predominantly in dark tones of dark brownish or gray to black, surface often eroded; aperture oblique, interior

 Accepted by Daniel Geiger: 29 Jan. 2019; published: 28 Feb. 2019

nacre, always with one or a few denticle(s) at base of columella, peristome incomplete, final lip not thickened. Operculum uncalcified, multispiral. Juvenile shell umbilicate, closed in mature shell of some members, open in others.

Remarks. Most of the rather few Tegulidae species are known from the eastern Pacific, with some additional representation in the northwestern Pacific and the western Atlantic.

Tegula Lesson, 1832

Tegula Lesson, 1832 [1832–1835]: pl. 51. Type species (M): *Tegula elegans* Lesson, 1832 [= *Trochus pellisserpentis* Wood, 1828]. Panama.
Agathistoma Olsson & Harbison, 1971: 350. Type species (OD) *Trochus viridulus* Gmelin, 1791. Caribbean.
Promartynia Dall, 1909: 94. Type species (OD): *Trochus pulligo* Gmelin, 1791. Northeast Pacific.

Diagnosis. Shell small to medium in size, sturdy with dome-like spire or coniform; periphery sharply angulate or rounded; sculpture smooth, spiral, or rugose. Umbilicus open in juvenile shells, opened in mature specimens or covered with callus, leaving broad umbilical depression. Columellar wall arched, columella with denticles, largest one at termination of spiral cord bordering or passing into umbilical cavity; aperture oblique, sometimes with lirations inside, interior nacreous, white or brightly colored. Operculum uncalcified. Color always dark, usually gray, black, or brown.

Remarks. The genus name *Chlorostoma* was used for the West American *Tegula*-species by different authors in the past (see below). Williams *et al.* (2008) showed that *Tegula* and *Chlorostoma* are well separated and *Chlorostoma* is only available for 3 species form the West Pacific.

Tegula funebralis (A. Adams, 1855)
(Figures 1–2)

Chlorostoma funebrale A. Adams, 1855: 316. Types ?. California.
Chlorostoma funebrale var. *subapertum* Carpenter, 1864: 652. Holotype USNM 123496 (Palmer 1958: pl. 19, figs 1–2). Neah Bay, Washington.

Diagnosis. Shell solid, small to medium in size (22–54 mm); whorls slightly rounded, body whorl base with faint spiral cords; first few cords below suture with raised scaly lamellae; umbilicus closed, but with umbilical impression, 1–2 spiral ridges inside umbilical impression terminating in two denticles; surface dull grayish black or black, often badly eroded, apex usually eroded, yellowish; umbilical area white.

Distribution. North end of Vancouver Island, British Columbia (51°N), to San Geronimo Island, Baja California (30°N). Restricted to the mid-intertidal zone; abundant in most rocky areas.

Remarks. *Tegula funebralis* often occurs with *T. gallina* in southern California, from which it may be distinguished by having a scaly subsutural band. Occasional specimens have a deep umbilical pit. Exceptionally large specimens are proportionately taller. The height of most specimens is about 25 mm.

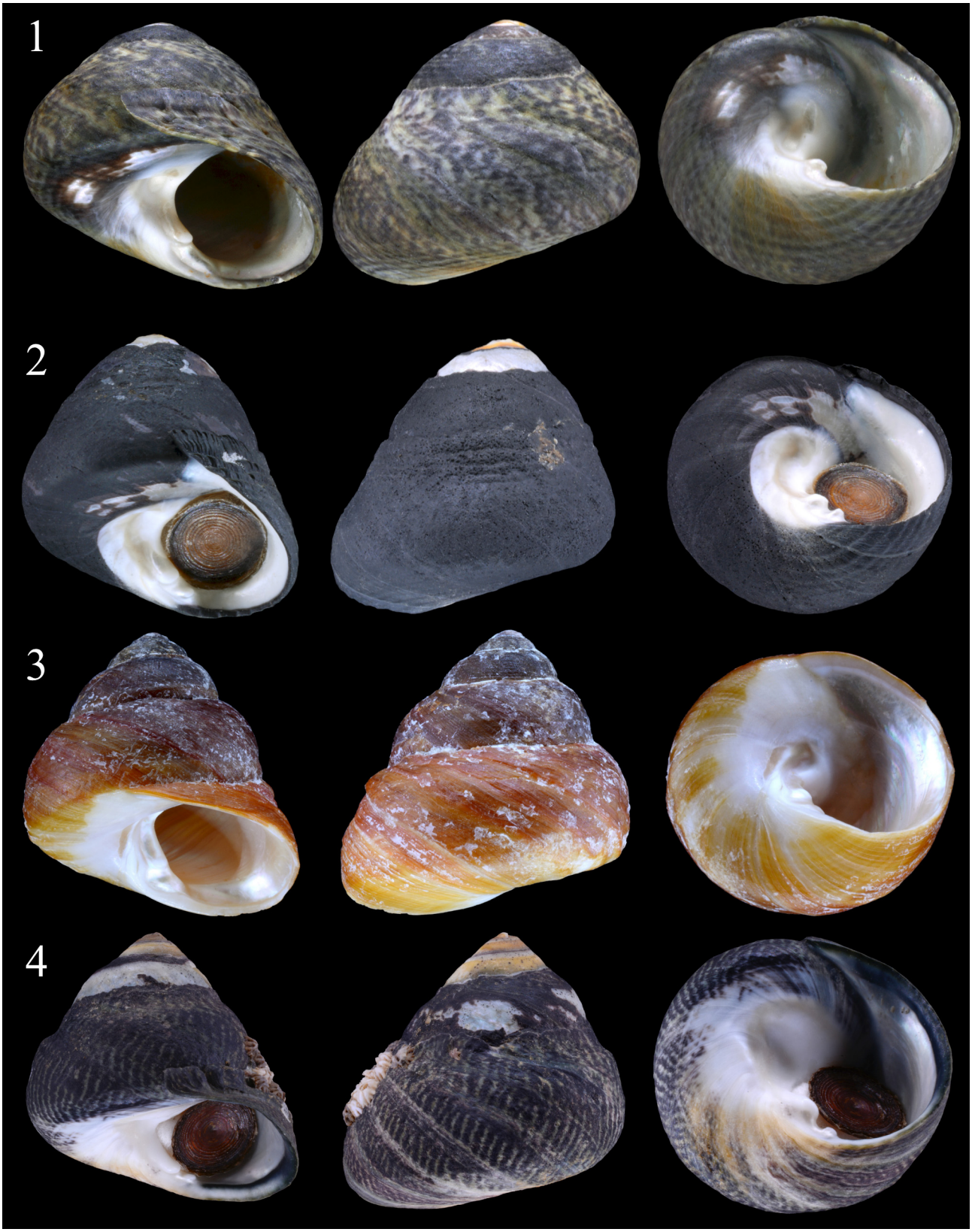
Tegula brunnea (Philippi, 1849)
(Figure 3)

Trochus (*Chlorostoma*) *brunneus* Philippi, 1849: 188. Type ? Whereabouts unknown (Coan & Kabat 2017). California.
Trochus striatulus Kiener, 1850: (this is the volume no.) pl. 33, fig. 3.
Chlorostoma brunneum var. *fluctuatum* Dall, 1871: 130. Type ? [Locality not given].
Chlorostoma brunneum var. *fluctuosum* Dall, 1919: 359. Holotype USNM 60055. Monterey, California.

Diagnosis. Shells 20–35 mm, solid with rounded whorls, top often eroded; early whorls with fine spiral striae, later whorls smooth or with weak axial ridges running perpendicular to lip; suture impressed; imperforate, columella with two weak denticles; color russet brown or dark orange.

Distribution. Cape Arago, Coos County, Oregon (Belcik 1965), to S of Morro Bay, San Luis Obispo County, on the mainland; extending further south to San Miguel Island (34°N) and San Nicolas Island (33°N), Channel Islands, California. At low tide and in the sublittoral zone to 15 m, often attached to brown algae. Common.

Remarks. This species has a relatively short range within the Oregonian faunal province.



FIGURES 1–4. 1–2. *Tegula funebralis*. 1. Point Cabrillo, San Diego, San Diego County, California, AAC 107175d, height = 18 mm. 2. W Vancouver Island, British Columbia, AAC 107175b, height = 24 mm. 3. *Tegula brunnea*. Humboldt Bay, Humbodt County, California, USA, AAC 107230a, height = 27 mm. 4. *Tegula gallina*. San Ignacio Lagoon, Baja California Sur, AAC 107119a, height = 37 mm.

***Tegula gallina* (Forbes, 1850)**
(Figure 4)

Trochus (*Monodonta*) *gallina* Forbes, 1850: 271, pl. 11, fig 8. Type ?. NHMUK? "Probably from Mazatlan coast."
Trochus (*Monodonta*) *pyriformis* Gould, 1853: 382–383. Holotype MCZ 169435 (Johnson 1964: pl. 15, fig. 3). San Diego, California.
Chlorostoma gallina var. *multifilosum* Stearns, 1892: 86; 1893, pl. 1, figs 8–9. USNM 125315. Guadalupe Island, Baja California.
Chlorostoma gallina var. *tincta* "Hemphill," Pilsbry, 1889: 169–170. Type ? [No locality given].
Chlorostoma gallina var. *umbilicatum* Dall, 1919: 359. Holotype USNM 152998. San Quentin Bay, Baja California.

Diagnosis. Shells 20–40 mm, solid, apex normally eroded, surface sculptured with faint spiral striations, fine growth lines; dull gray to greenish brown marked with diagonal stripes of white, sometimes interrupted; imperforate, umbilical callus broad, white; columella with two denticles.

Distribution. Santa Barbara County, California, to Punta Entrada, Magdalena Bay, Baja California (25° N). In the mid-intertidal zone, usually more common than *T. funebralis* where the two occur together. Abundant.

Remarks. The color form named *tincta* has a smooth greenish surface; it occurs in sheltered environments near entrances to bays. The form named *multifilosa*, with chalky white spiral lines, occurs at Guadalupe Island, but specimens from other localities in Baja California also show the predominance of spiral rather than diagonal markings; therefore, a geographic distinction cannot be drawn.

***Tegula aureotincta* (Forbes, 1850)**
(Figure 5)

Turbo cateniferus Kiener, 1847: pl. 31, fig. 1 [not *Turbo cateniferus* Potiez & Michaud, 1838].
Trochus (*Monodonta*) *aureo-tinctus* Forbes, 1850: 271, pl. 11, fig. 271. Types ?. Locality unknown.

Diagnosis. Shell of medium size (21–41 mm), higher than wide; suture expressed, sometimes channeled; body whorl with two broad but low cords and groove above suture, axial sculpture of diagonal ridges perpendicular to lip; narrowly umbilicate; base with four strong, broad cords; columellar denticle weak; dark gray or greenish white with bright orange stain on umbilical wall, inner edge of aperture green; shell often badly eroded.

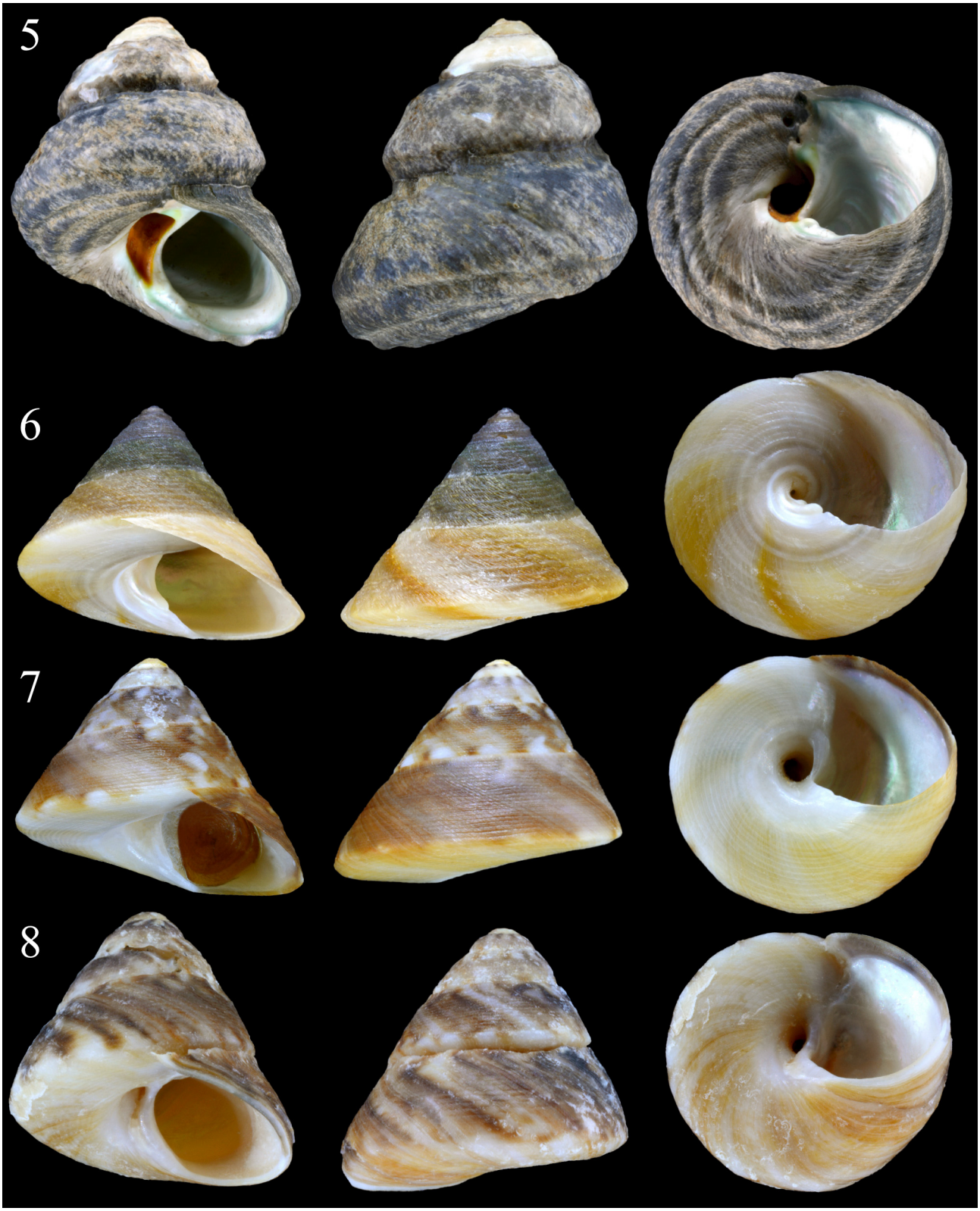
Distribution. Rincon Point,Ventura County, California to Magdalena Bay, Baja California (25° N). At low tide and in the rocky sublittoral to 15 m. Common.

***Tegula montereyi* (Kiener, 1850)**
(Figure 6)

Trochus montereyi Kiener, 1850: pl. 33, fig. 1. Types ?. Monterey, California.

Diagnosis. Shell 25–50 mm, thin, conical, whorls flat-sided, base flat; aperture strongly oblique; early whorls with mid-whorl carination; sculpture of fine spiral lirae crossed by lamellar growth increments; some specimens with weak oblique ridges perpendicular to growth lines; base spirally lirate, acutely angled in young specimens, slightly rounded in old specimens; umbilicus open, umbilical area separated from base by groove, umbilicus with edge, strong ridge inside turning into prominent denticle in middle of columella; color yellowish brown, umbilical wall white.

Distribution. From Salt Point State Park, Sonoma County, to Point Estero, San Luis Obispo County, and San Miguel lsland, Channel Islands, California; in rocky areas to 15 m, often attached to brown algae. Uncommon.



FIGURES 5–8. 5. *Tegula aureotincta*. Estero de San Jose, Baja California Sur, AAC 107193a, height = 30 mm. 6. *Tegula montereyi*. Monterey, Monterey County, California, AAC 107372a, height = 15 mm. 7–8. *Tegula pulligo*. 7. Monterey, California, AAC 107227b, height = 18 mm. 8. Terrace Cove, Ucluelet, Vancouver Island, British Columbia, AAC 107227a, height = 16 mm.

***Tegula pulligo* (Gmelin, 1791)**
(Figures 7–8)

Trochus pulligo Martyn, 1784: pl. 76 [unavailable. ICZN 1957: opinion 456]. “King George’s Sound”, error.
Trochus pulligo "Martyn," Gmelin, 1791: 3585.
Trochus marcidus Gould, 1853: 381, pl. 14, fig. 1. Type ? (Johnson 1964: 108). Monterey, California.
Tegula pulligo taylori Oldroyd, 1924: 171, pl. 20, figs 1–2. Holotype CASIZ 60977.00. Hope Island off N end Vancouver Island, British Columbia.

Diagnosis. Shell 20–40 mm, coniform with straight sides, umbilicate, columellar denticles very weak; early whorls flat-sided, finely striate, later whorls slightly rounded with impressed suture, some specimens sculptured with oblique rugose ridges; basal angularity sharp or slightly rounded; base smooth or with fine spiral grooves, evenly sloping into broad, funnel-like umbilicus, not bordered by spiral cord; juvenile shell gray with white mottling at periphery; mature shell purplish brown to orange, sometimes with alternating light, dark zones, often with row of lighter spots beneath the suture, color of base lighter.

Distribution. Chicagof Island, southeastern Alaska to Puerto Santo Tomas, Baja California (32° N). Chiefly sublittoral on *Macrocystis* and other brown algae in northern California; Common at low tide in southeastern Alaska.

Remarks. Brightly marked juvenile shells are common. There are few records from southern California, although large specimens have been collected on kelp at Puerto Santo Tomas, Baja California, an area of cold-water upwelling. *Tegula pulligo* has the general appearance of *T. montereyi*, which is easily distinguished by a strong columellar dentition and a spiral ridge inside the umbilicus.

***Tegula eiseni* Jordan, 1936**
(Figures 9–10)

Tegula eiseni Jordan, 1936: 161, pl. 17, figs 3–5. CASG 5487.00. Magdalena Bay, Baja California, Pleistocene.
Tegula (*Agathistoma*) *mendella* McLean, 1964: 131, pl. 254, figs 5–6 [retracted, p. 133] Holotype USNM 636090. Mission Bay, San Diego.

Diagnosis. Shell small, thick; whorls evenly rounded; sculpture of strong to weak nodular spiral cords; base with more or less nodulose, broad spiral ridges becoming smooth towards the aperture; lip lirate within; umbilicus wide, with a spiral ridge inside; color dark brown to blackish with alternating light and dark markings on the spiral cords, umbilical area white. Height 20-25 mm.

Distribution. Los Angeles County, California (34° N) to Punta Entrada, Magdalena Bay, Baja California (25° N). Common at low tide and in the sublittoral zone on rocks to 20 m.

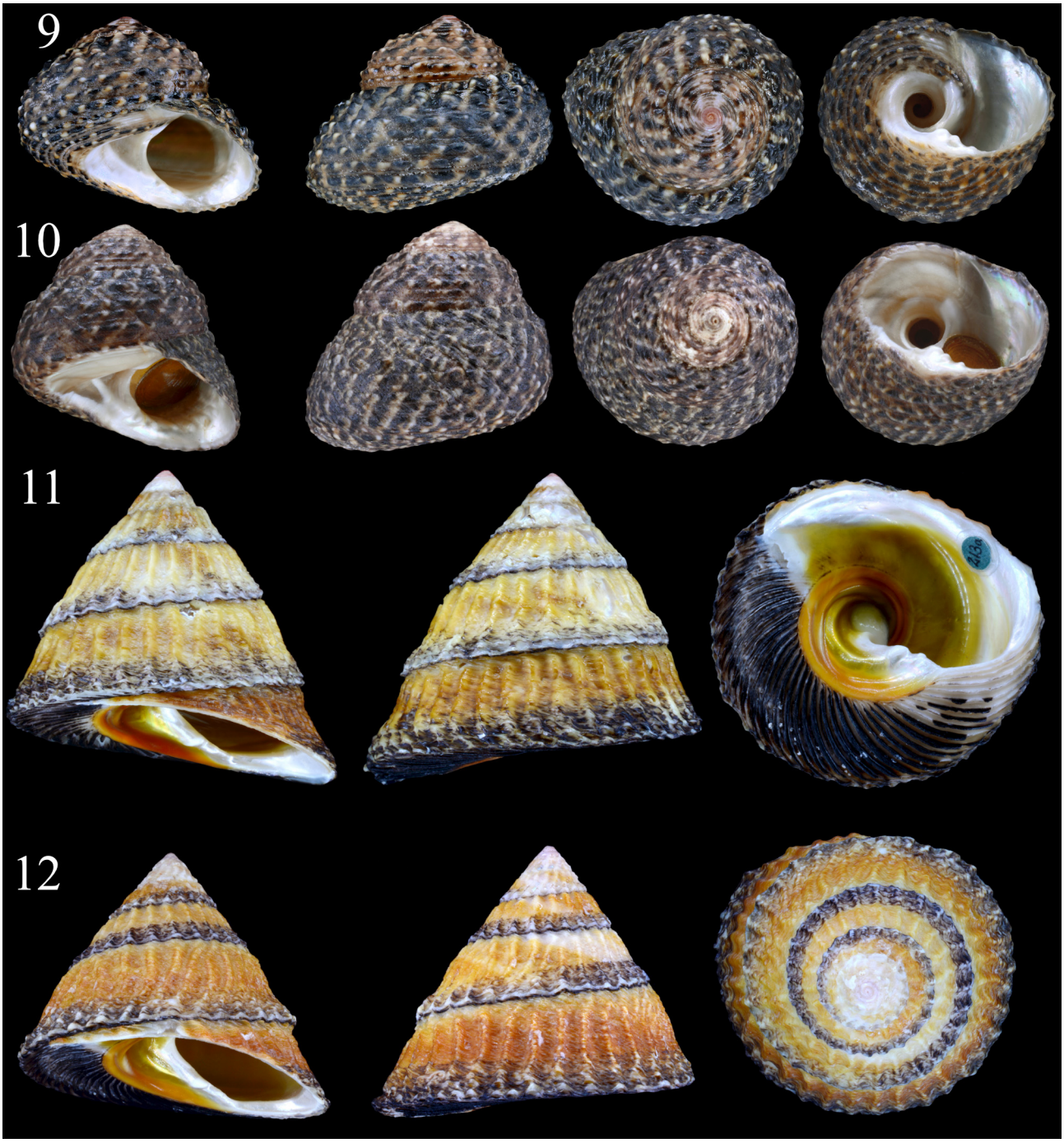
Remarks. This species had long been known as *Tegula ligulata* (Menke, 1850), but that name applies to an uncommon, related species from Mazatlan, Mexico.

***Tegula regina* (Stearns, 1892)**
(Figures 11–12)

Uvanilla regina Stearns, 1892: 85; 1893: 350, pl. 50, figs 6–7. Holotype USNM 125314. Guadalupe Island, Lower California.

Diagnosis. Shell relatively large (35–55 mm); coniform, straight sided, sculptured with axial ribs, basal keel pinched, projecting, made crenulate by projections of strong axial ribs; base concave, smooth in juvenile, base of mature shell with sharp arcuate radial ridges that abruptly terminate at smooth columellar callus; umbilicus closed in mature shells, with weak umbilical ridge ending in denticle in middle of columella, another weak denticle below; color grayish black, upper part of whorl lighter yellow to orange, columellar callus orange, nacreous layer of aperture (except margin) stained yellow; juvenile shells bicarinate, periphery becoming stellate by third whorl, spiral sculpture of early whorls lost by fifth whorl.

Distribution. Anacapa Island, Channel Islands, California to Santa Margarita Island, Baja California (25° N). Sublittoral, on vertical sides of large boulders, 5–20 m. Uncommon. North of San Diego it has been reported only on offshore islands.



FIGURES 9–12. 9–10. *Tegula eiseni*. 9. Estero de San Jose, Baja California, AAC 107192a, height 19 mm. 10. Corona del Mar, Orange County, California, AAC 107192c, height = 20 mm. 11–12. *Tegula regina*, Gulf of California, AAC 107213a. 11. Height = 46 mm. 12. Height = 43 mm.

Norrisia Bayle, 1880

Trochiscus Sowerby I, 1838: 96 [not Heyden, 1826, Held, 1837, or Jakolev, 1879]. Type species (M): *Trochiscus norrisi* Sowerby I, 1838. California.
Norrisia Bayle, 1880: 241 [new name for *Trochiscus* Sowerby].

Diagnosis. Shell medium size; thick shelled; broadly trochiform, spire short coniform; whorls convex to almost straight, periphery, base rounded; smooth, only with microscopic growth lines; broardly umbilicate;

outer lip sharp, oblique; columella concave with one tubercle at base; operculum with spiral tufts on each volution.

Remarks. *Norrisia* is a monotypic genus, clearly distinct based on radular characters. The single species of the genus is unlike any other.

***Norrisia norrisii* (Sowerby I, 1838)**
(Figure 13)

Trochiscus norrisii Sowerby I, 1838: 97, text-fig. Types ?. No locality given.
Turbo rotelliformis Jay, 1839: 111, pl. 1, figs 2–3. Holotype AMNH 56071. South Seas.
Trochiscus convexus Carpenter, 1864: 652. Type ? (Palmer 1958: 143). Monterey, California.

Diagnosis. Shell 27–52 mm, thick, heavy, broader than high, spire dome-shaped, whorls smooth, rounded; umbilicus deep, columella with low tubercle at base; color chestnut brown to light brown on upper part of whorl, changing gradually to black near umbilicus, columellar wall tinged with light green; interior pearly white; juvenile shell bicarinate, sculptured with incised spiral striae, mottled with white on spire; base, umbilical area white; operculum spirally tufted along outer edge of each volution Living animal bright reddish orange.

Distribution. Point Conception, California to Punta Abreojos, Baja California (27°N). Small specimens live intertidally, large specimens occur in the sublittoral zone, most frequently on the brown alga *Eisenia*, to 15 m. Common.

Remarks. The calyptraeid *Crepidula norrisiarum* is often attached to the shell of *N. norrissii.*

Turbinidae Rafinesque, 1815

Diagnosis. Shell small to large-sized; relatively thick; quite different in shape: turbiniform to coniform, from shells with rounded whorls, periphery and base to straight-sided whorls with peripheral angulation, flat base; sculpture from smooth to well expressed, often pustular, scaly or with axial or spiral ridges and protrusions, sometimes highly variable within species; aperture markedly oblique, interior nacreous; columellar callus covering umbilicus, most of base present in some genera; juvenile shells bicarinate, umbilicate; operculum calcareous , with later whorls rapidly expanding, changing from multispiral to paucispiral, fitting perfectly into aperture, exterior surface convex, smooth to variously sculptured; some species with spectacular coloration, pattering.

Remarks. Today, Turbinidae only contains the former Turbininae and the Prisogasterinae, while the Liotiidae, Angariidae, Tegulidae, Colloniidae and Phasianellidae are considered as valid and separate families (Williams *et al*. 2008, Alf & Kreipl 2011). Most Turbinidae species live on hard substrates from shallow water to about 30 meters.

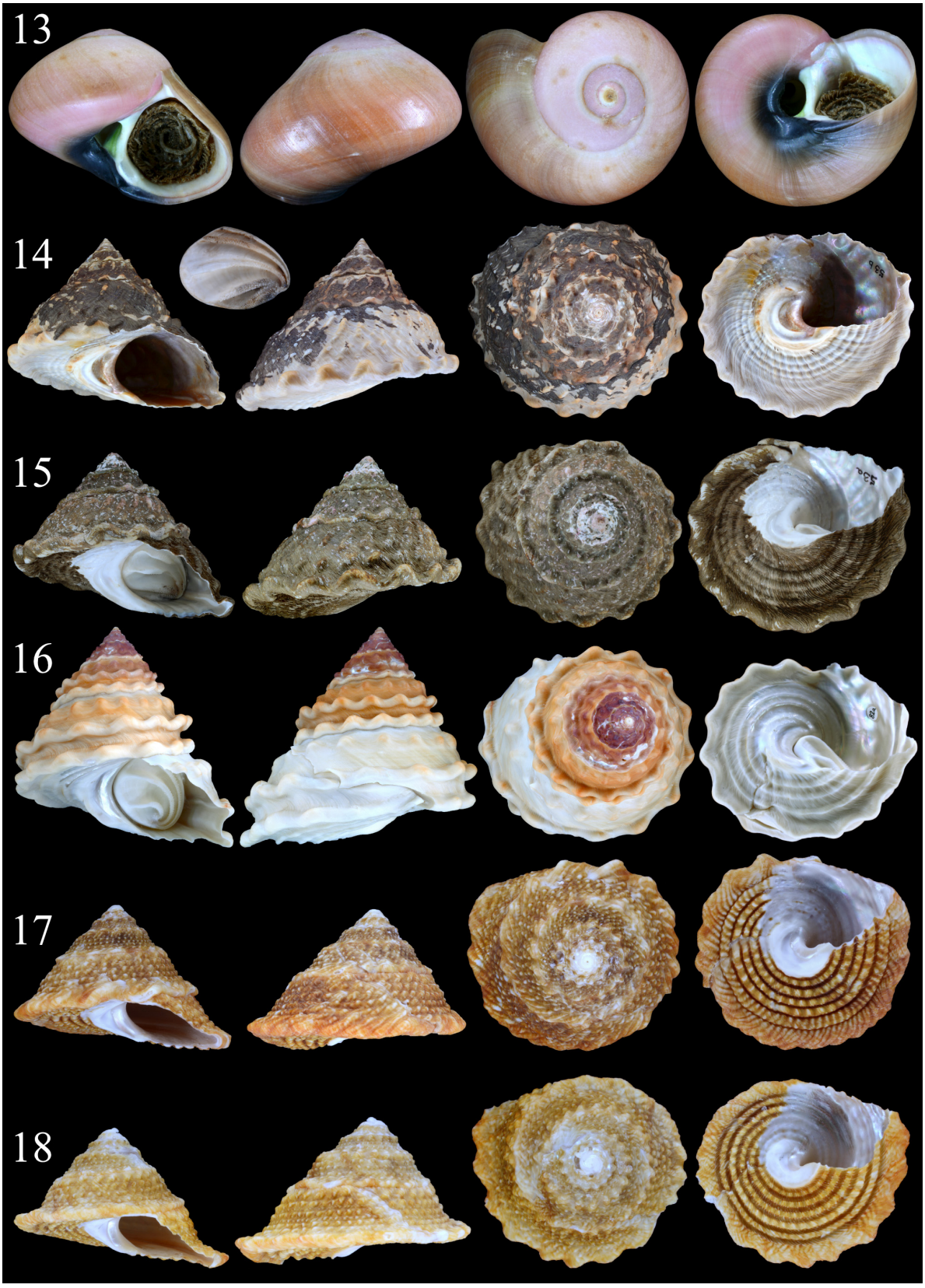
***Megastraea* McLean, 1970**

Megastraea McLean, 1970: 71–72. Type species (OD) *Trochus undosus* Wood, 1828. California.

Diagnosis. Shell large, broad coniform, imperforate, whorls straight to shouldered, strong sculpture consisting of oblique axial ridges, one or two wavy spiral ridges on periphery, periostracum brown, thick, forming raised lamellae, outer surface of operculum with three raised, tuberculate ridges.

Remarks. The genus only contains the two northwestern American species.

***Megastraea undosa* (Wood, 1828)**
(Figures 14–15)
Trochus undosus Wood, 1828: 16, pl. 5, fig. 1. Types ? California.
Trochus balaenarum Valenciennes, 1846: pl. 3. Types?. No locality given.
Imperator serratus Carpenter, 1864: 652. Holotype USNM 11832 (Palmer 1958: pl. 19, figs 17–18). Santa Catalina Island.



FIGURES 13–18. 13. *Norrisia norrisi*, Santa Cruz Island, Santa Barbara County, California, AAC 107146b, height = 46 mm. 14–15. *Megastraea undosa*. 14. Laguna Beach, Orange County, California, AAC 112053b, height = 83 mm. 15. San Diego, San Diego County, California, AAC 112053a, height = 70 mm. 16 *Megastraea turbanica*, Coronados Islands, Baja California, AAC 112082a, height = 83 mm. 17–18. *Pomaulax gibberosus*. 17. Magdalena Bay, Baja California, AAC 112022d, height = 30 mm. 18. Monterey, Monterey County, California, AAC 112022c, height = 27 mm.

Diagnosis. Large, whorls flat-sided, or slightly convex; periphery marked by undulating, strongly projecting carination. Sculpture of diagonal ridges interrupted to form nodes, base with four spiral cords. Color light reddish brown to whitish under thick lamellar periostracum. Operculum with three sharply tuberculate, uncurved ridges, darkly stained near nucleus. Height 60–117 mm.

Distribution. Avila Beach, San Luis Obispo County, California (35° N) to Punta Pequena, Baja California (26° N). Intertidal zone to 10 m, common on rocky bottoms near kelp.

Remarks. The fibrous periostracum and the operculum readily distinguish this species from *P. gibberosa*. Small specimens up to 50 mm in height commonly occur at low tide, but mature specimens occur in the sublittoral zone near kelp holdfasts. A dwarf population reaching only 80 mm in height occurs at Guadalupe Island, Baja California.

Megastraea turbanica (Dall, 1910)

(Figure 16)

Pomaulax turbanicus Dall, 1910: 134. Holotype USNM 111242 (Grant & Gale 193: pl. 31, fig. 2). US Fish Commission station 2989, Magdalena Bay, Baja California, 36 fms.

Astraea (*Pomaulax*) *petrothauma* Berry, 1940: 10, pl. 2, figs 2–3. Holotype SBMNH 34508. Hilltop Quarry, San Pedro, California, Lower Pleistocene.

Astraea (*Uvanilla*) *rupicollina* Stohler, 1959 : 425, figs 1–7. Holotype USNM 610331; S of South Coronado Island, Baja California, 70 feet.

Diagnosis. Shell large, whorls shouldered, periphery rounded, marked by two strong ridges especially prominent in immature specimens. Sculpture of diagonal ridges, base with three prominent, narrow cords. Color yellowish tan to reddish under thick, lamellar periostracum. Operculum with sharply tuberculate upper ridge, smooth middle ridge, smooth, curved lower ridge. Height 100–150 mm.

Remarks. The operculum differs from that of *M. undosa* in having two peripheral ridges and a non spinose, curved lower ridge. Trego (2005) reported size record at 185.5 mm.

Distribution. Los Coronados Islands (32°N) to Santa Margarita Island (25°N), Baja California (25°N); 20–40 m on rocky bottoms near kelp or other brown algae. At depths of 10 m it occurs with *M. undosa*, but replaces it at greater depths. Where the two species occur together, *M. turbanica* is found in crevices on rocky reefs away from gravel bottoms; *M. undosa* tends to cluster on gravel bottoms near large rocks.

Pomaulax Gray, 1850

Pomaulax Gray, 1850: 87. Type species (SD): *Trochus japonicus* Dunker, 1845 Japan.

Diagnosis. Moderately large, broad to very broad coniform, whorls more or less flat-sided, sculpture rugose or consisting of oblique axial ridges, periphery with nodes or protrusions, base with strong spiral cords, imperforate, periostracum thin, operculum white, smooth but for shallow groove along upper margin.

Remarks. The genus contains three species, two from the eastern Pacific and one from Japan.

Pomaulax gibberosa (Dillwyn, 1817)

(Figures 17–18)

Trochus inaequalis Martyn, 1784: 31. [unavailable. ICZN 1957: opinion 456].

Trochus gibberosus "Chemnitz," Dillwyn, 1817: 803–804. Iconotype Chemnitz (1788: pl. 23, figs A–B. La Raboteuse, New Zealand, and Friendly Islands.

Trochus diadematus Valenciennes, 1846: pl. 3. Types ? No type locality given.

Trochus ochraceus Philippi, 1846: 101. Holotype Stuttgart Museum (Philippi 1846, Coan & Kabat 2017:). Provenance unknown.

Turbo rutilis C.B. Adams, 1852: 420. Holotype MCZ 177273 (Turner 1956: pl. 13, fig. 10). Panama.

Astraea (*Pachypoma*) *inaequale* var. *depressum* Dall, 1909: 93. Holotype USNM 13580 (Dall *in* Williamson 1892: pl. 23, fig. 3). RV *Albatross* without station, Monterey Bay.

Pachypoma magdalena Dall, 1910: 135. Holotype USNM 111239. RV *Albatross* Station 2989 Magdalena Bay, lower California.

Pachypoma lithophorum Dall, 1910: 135. Holotype USNM 111241. RV *Albatross* Station 2983, off Cedros Island, Lower California, 58 fms.

Astraea (*Pachypoma*) *inaequalis* var. *pacifica* Dall, 1919: 356. Holotype USNM 222320; Pacific Beach, San Diego, California.

Astraea (*Pachypoma*) *barbarensis* Dall, l919: 357. Holotype USNM 223819. RV *Albatross* Station 2945, off Santa Cruz Island of the Santa Barbara group, California, 30 fms.

Astraea (*Pachypoma*) *inaequalis montereyensis* Oldroyd, 1927: 767. Holotype CASIZ 63310.00; Monterey Bay, California}.

Astraea guadalupeana Berry, 1957: 77. Holotype CASIZ 43914.00 (Hertz 1984: fig. 14). Guadalupe Island, 26.5 fms.

Diagnosis. Shell variable, usually flat-sided, with projecting stellate periphery; some with periphery lacking stellate projections; others with outline bulging at midwhorl. Sculpture of rugose ridges sometimes broken into nodes by spiral grooves; base with 4–5 strong spiral cords, narrower interspaces. Color reddish brown under thin, closely adherent periostracum. Height 30–70 mm.

Distribution. Dall Island, southeast Alaska (55° N) to Santa Margarita Island, Baja California (25° N). The subspecies *A. gibberosa magdalena* occurs from Cedros Island, Baja California (28° N) and to the south. Not uncommon on rocky bottoms, fully exposed during daylight hours. Lives intertidally in British Columbia, in the shallow sublittoral below 5 m to the north of Point Conception, and in southern California and Baja California below the thermocline at depths greater than 20 m.

Remarks. Although the shell morphology is variable, as is suggested by the large number of synonyms, local populations tend to be relatively uniform. The largest specimens occur to the north of Point Conception, Santa Barbara County, California. Specimens from central and southern Baja California have concave bases, and are sufficiently different from northern populations to warrant recognition of a southern subspecies, *A. gibberosa magdalena* (Dall, 1910), based upon this feature.

Acknowledgements

Elizabeth Kools, (CASIZ) and Ellen Strong (USNM) provided information on type specimens.

References

Adams, A. (1855) Descriptions of twenty-seven new species of shells from the collection of Hugh Cuming, Esq. *Proceedings of the Zoological Society of London*, for 1854, 311–317.

Adams, C.B. (1852) Catalogue of shells collected at Panama, with notes on synonymy, station and habitat. *Annals, Lyceum of Natural History, New York*, 5, 229–548.

Alf, A. & Kreipl, K. (2011) The family Turbinidae, subfamilies Turbininae Rafinesque, 1815 & Prisogasterinae Hickman & McLean, 1990. In: Poppe, G.T. & Groh, K. (eds). *A Conchological Iconography*. Conchbooks, Hackenheim. 82 pp., 142 pls.

Bayle, E. (1880) Liste rectificative de quelques noms de genres et d'espèces. *Journal de Conchyliologie*, 28, 240–251.

Berry, S.S. (1940) New Mollusca from the Pleistocene of San Pedro, California. I. *Bulletins of American Paleontology*, 25(94A), 1–18, pls. 1–2.

Berry, S.S. (1957) Notices of new Eastern Pacific Mollusca. I. *Leaflets in Malacology*, l, 75–82.

Belcik, F.P. (1965) Note on a range extension and observations of spawning in *Tegula*, a gastropod. *The Veliger*, 7, 233–234.

Carpenter, P.P. (1864) Supplementary report on the present state of our knowledge with regard to the Mollusca of the west coast of North America. *Report British Association for the Advancement of Sciences*, 1863, 517–686.

Chemnitz, J.H. (1788) *Neues systematisches Conchylien-Cabinet, vol. 10*. Raspische Buchhandlung, Nürnberg. 376 pp.

Coan, E.V. & Kabat, A.R. (2017) The malacological contributions of Rudolph Amandus Philippi (1808–1904). *Malacologia*, 60, 31–322.

Dall, W.H. (1871). Descriptions of sixty new forms of mollusks from the west coast of North America and the North Pacific Ocean, with notes on others already described. *American Journal of Conchology*, 7, 93–160, pls. 13–16.

Dall, W.H. (1909) Contributions to the Tertiary paleontology of the Pacific Coast. I. The Miocene of Astoria and Coos Bay, Oregon. *U.S. Geological Survey Professional Paper*, 59, 1–278, pls. 1–23.

Dall, W.H. (1910) New species of West America shells. *The Nautilus*, 23, 133–136.

Dall, W.H. (1919) Description of new species of Mollusca from the North Pacific Ocean in the collection of the United States National Museum. *Proceedings of the United States National Museum*, 56(2295), 293–371.

Dillwyn, L.W. (1817) A descriptive catalogue of Recent shells, arranged according to the Linnaean method, with particular attention to the synonymy. London, vol. 1, pp. i-xii, 1–580 pp., vol. 2, pp. 581–1092

Forbes, E. (1850) On the marine Mollusca discovered during the voyages of the Herald and Pandora, by Capt. Kellett, R. N., and Lieut. Wood, R. N. *Proceedings of the Zoological Society of London*, Part 18, 270–274, pls. 9, 11.

Gmelin, J. F. 1791. Caroli a Linné Systema naturae per regna tria naturae. Editio decima tertia. Leipzig, vol. 1, pt. 6, Vermes, pp. 3021-3910.

Gould, A.A. (1853) Descriptions of shells from the Gulf of California and the Pacific coasts of Mexico and California. *Journal of the Boston Society of Natural History*, 6, 374–408, pls. 14–16.

Grant, U.S. IV & Gale, H.R. (1931) Catalogue of the Marine Pliocene and Pleistocene Mollusca of California and Adjacent Regions. *Memoirs of the San Diego Society of Natural History*, 1, 1–1036, pls. 1–32.

Gray, J. E. (1850) Explanation of plates and list of genera. In: M. E. Gray, Figures of molluscous animals, selected from various authors, Vol. 4. Longman, Brown and Longmans, London, 124 pp.

Hertz, C.M. (1984) Illustrations of the types named by S. Stillman Berry in his "Leaflets in Malacology," *The Festivus*,15, Supplement, 1–42

Hickman, C.S. & McLean, J.H. (1990) Systematic revision and suprageneric classification of trochacean gastropods. *Natural History Museum of Los Angeles County Science Series*, 35, vi + 1–169.

ICZN (1957) Opinion 456. *Opinions and Declarations Rendered by the International Commission on Zoological Nomenclature*, 15, 393–418.

Jay, J.C. (1839) *A catalogue of the shells arranged according to the Lamarckian System, together with descriptions of new or rare species contained in the collection of John C. Jay.* Wiley & Putnam, New York. 125 pp., 10 pls.

Johnson, Richard I. 1964. The Recent Mollusca of Augustus Addison Gould. *Bulletin of the United States National Museum,* 239, 1–182, pls. 1–45.

Jordan, E.K. (1936) The Pleistocene fauna of Magdalena Bay, Lower California. *Contributions from the Department of Geology, Stanford University*, l, 107–173, pls. 17–19.

Kiener, L.C. (1847) *Spécies général et iconographie des coquilles vivantes, 10 ,* Turbo. Russeau, Paris. 36 pls.

Kiener, L.C. (1850) *Spécies général et iconographie des coquilles vivantes, 11 ,* Trochus. Russeau, Paris. 52 pls.

Kuroda, T., Habe, T. & Oyama, K. (1971) *The Sea Shells of Sagami Bay.* Maruzen, Tokyo. xvi + 741 + 489 + 51, 121 pls.

Lesson, R. P. 1832–1835. *Illustrations de zoologie, ou, recueil de figures d'animaux peintes d'après nature*. Bertrand, Paris. 60 pls.

Martyn, T. (1784) The Universal Conchologist. [privately published], London.

McLean, J.H. (1964) New species of Recent and fossil west American aspidobranch gastropods. *The Veliger*, 7, 129–133, pl. 24.

McLean, J.H. 1970. New eastern Pacific subgenera of *Turbo* Linnaeus, 1758, and *Astraea* Röding, 1798. *The Veliger*, 13, 71.

Oldroyd, I.S. (1924–1927) *The marine shells of the west coast of North America*. Stanford University Publications, University Series, Geological Sciences, 941 pp., 108 pls.

Olsson, A.A. & Harbison, A. (1953) *Pliocene Mollusca of southern Florida.* Academy of Natural Sciences, Philadelphia, Monograph, no. 8, 457 pp., 65 pls.

Palmer, K. (1958) Type specimens of marine Mollusca described by P. P. Carpenter from the west coast (San Diego to British Columbia). *Memoir of the Geological Society of America*, 76, i–vi, 1–376, pls. 1–35.

Philippi, R.A. (1846) Diagnoses testaceorum quorundam novorum. *Zeitschrift für Malakozoologie*, 3, 97–106.

Philippi, R.A. (1849) Centuria tertia testaceorum novorum (contin.). *Zeitschrift fur Malakologie*, 5, 186–192.

Pilsbry, H.A. (1889) *Manual of Conchology. Family Trochidae*. 11, 5–519.

Sowerby, G.B., I. (1838) Description of a new genus of Trochidae, belonging to the family of Gasteropoda Phytophaga. *The Magazine of Natural History, new series*, 2, 96–97.

Stearns, R.E.C. (1892) Preliminary descriptions of new molluscan forms from west American regions, etc. *The Nautilus*, 6, 85–89.

Stearns, R.E.C. (1893) On rare or little-known mollusks from the west coast of North and South America, with descriptions of new species. *Proceedings of the United States National Museum*, 16(941): 341–352, pl. 50.

Stohler, R. (1959) Two new species of west North American marine gastropods. *Proceedings of the California Academy of Sciences, series 4,* 29, 423-444.

Trego, K. (2005): A record size for *Megastraea turbanica* (Dall, 1910). *The Festivus,* 37, 36

Turner, R.D. (1956) The Eastern Pacific marine mollusk described by C.B. Adams. *Occasional Papers on Mollusks*, 2, 21–156

Valenciennes, A. (1846) Mollusques, in du Pettit-Thuoars, A.A., *Voyage autour du monde sur la frigate la Vénus. Atlas de Zoologie*. Bide & Baudry, Paris. Pls. Mollusques 1–24.

Williams, S.T. (2012) Advances in molecular systematics of the vetigastropod superfamily Trochoidea. *Zoologica Scripta*, 41, 571–595

Williams, S.T., Karube, S. & Ozawa, T. (2008) Molecular systematics of Vetigastropoda: Trochidae, Turbinidae and trochoidea redefined. *Zoologica Scripta*, 37, 483–506

Williamson, M.B. (1892) An annotated list of the shells of San Pedro Bay and vicinity, with a description of two new species by W. H. Dall. *Proceedings of the United States National Museum*, 15, 179–220, pls. 19–23.

Wood, W. (1828) *Index testaceologicus: or, A catalogue of shells, British and foreign. Supplement*. Privately published, London. vi, 59 pp., 8 pls.