

The Nassariidae of the West Coast of North America between Cape San Lucas, Lower California, and Cape Flattery, Washington

JOAN DEMOND¹

THE MOLLUSCS which constitute the family Nassariidae are worldwide in distribution and include several hundred species. The family has long been, and still is, in need of complete taxonomic revision. However, such a revision is beyond the scope of this paper, which is arbitrarily limited to a consideration of those species of Nassariidae found living on the west coast of North America within the area between Cape San Lucas, Lower California, and Cape Flattery, Washington.

A summary of the known ecology of these molluscs was thought valuable since the literature on this subject is scattered and difficult of access. To the author's knowledge, no such compilation has previously been attempted.

As far as possible, detailed synonymies, shell descriptions, distributional records, and habitat remarks have been compiled for each of the 12 species and two subspecies found in this area. Revisions of the west coast faunal list are suggested. A key based entirely upon external shell characteristics of adult specimens is presented. Illustrations of all west coast species are included.

In making this study, collections were examined at the California Academy of Sciences in San Francisco, at Stanford University, and at both the Los Angeles and Berkeley campuses of the University of California. Reference was also made to remnants of the Josiah Keep Collection at Mills College. In addition,

specimens were collected at several west coast localities.

I wish to thank Dr. Leo George Hertlein, California Academy of Sciences, for making the collection of that institution available to me, for his hours of assistance, and for his suggestions. I am particularly indebted to Dr. William M. Ingram, Mills College, who inspired and guided the entire project.

My sincere thanks are also extended to the following individuals: Dr. W. A. Hilton, Pomona College; Dr. Willis P. Popenoe and Dr. Ulysses S. Grant, University of California at Los Angeles; Dr. Howard Hill, Curator of Zoology, Los Angeles County Museum; Dr. A. Myra Keen, Stanford University; Frank R. Rogers, Photographer, and Veronica Sexton, Librarian, California Academy of Sciences.

ECOLOGY OF THE NASSARIIDAE

Habitat

The Nassariidae are distributed throughout the marine waters of the world; the only portions of the globe where they have not been found is in the icy seas near the poles. However, they occur principally in tropical and subtropical waters. Most of the species are littoral, although a few live at considerable depths.

These gastropods are called mud snails, since many aggregate on mud flats and in the shallow water of bays and inlets. For example, I have collected *Nassarius tegula* in great numbers from the mud flats at Estero de Punta Banda, Lower California, and in lesser numbers from the flats of Anaheim and Alamitos

¹ Scientific Assistant, Inter-American Tropical Tuna Commission, Scripps Institution of Oceanography, La Jolla, California. Manuscript received May 15, 1951.

bays, Southern California. I have taken *N. fossatus* from the flats at Anaheim Bay and MacGinitie (1935) reports this species from the flats at Elkhorn Slough, California. During low tide at Bay Farm Island, San Francisco Bay, I have seen the mud dotted with hundreds of *N. obsoletus*.

Behavior

The Nassariidae are active molluscs. They burrow readily, leaving a small mound of dirt which discloses their location. By means of their large, muscular foot, they plow through the mud, usually in search of food, the bifurcated foot leaving a characteristic trail behind.

Since most Nassariidae are burrowers, they avoid desiccation and can often escape from predators. Also, this burrowing habit, as well as the habit of living in sheltered bays, isolates these gastropods from the destructive action of waves and currents.

There is disagreement regarding the actions of the Nassariidae when left exposed by the tide's recession, or perhaps some species react in an opposite manner from others. Tryon (1882) says that, when the tide goes out, *N. reticulatus* buries itself in the sand to await the water's return. MacGinitie (1935) also states that the Nassariidae burrow when exposed. However, according to Rogers (1939), when the tide recedes, *N. trivittatus* comes up from beneath the sand and crawls toward the water.

Food and Feeding

Because the Nassariidae are carnivorous, they are pests to oyster growers. They bore into oyster shells, insert their extensible proboscis, and eat out the contents. An adult *Nassarius* bores through a 3-year-old oyster shell in 8 hours, but the younger gastropods are far more destructive, selecting the delicate shells of the very young oysters and piercing 15 or 20 in rapid succession. A month-old oyster is eaten in half an hour.

These snails also bore through shells of

other pelecypods and gastropods, devouring the soft parts. At Estero de Punta Banda, I have seen live specimens of the large Bubble Shell, *Bullaria gouldiana*, covered with hungry *Nassarius tegula* apparently enjoying a fresh meal at the expense of their ill-fated neighbor. Several authors suggest that the Nassariidae even attack their own kind.

The Nassariidae are voracious scavengers. They have often been reported climbing into lobster pots for the dead bait. I have seen hordes of *N. tegula* feeding on putrid animal matter in the shallow pools at Estero de Punta Banda.

MacGinitie (1935) describes the eating method of *N. fossatus*. When a snail discovers a piece of food, it turns over and lies shell downward with its foot held high and tightly wrapped about the food, which is thus hidden while the animal devours it. He also (1949) describes the powerful sucking action of its mouth, located at the end of the long proboscis which can be extended 1.5 inches. These snails cling so tightly to a bit of food that they allow themselves to be lifted entirely out of the water before relaxing their hold.

That the keen olfactory sense of these gastropods is their principal means of finding food is thoroughly established by interesting experiments recorded by Cooke (1895) and MacGinitie (1935).

Predators

The Nassariidae are, in turn, eaten by larger animals. Keep (1935) tells of removing *Nassarius* from the stomach of a fish. According to Tryon (1883), in Italy *Nassarius mutabilis* is prepared for human consumption. Several authors report *Nassarius* shells inhabited by hermit crabs. At Estero de Punta Banda, I have seen many *N. tegula* possessed by hermit crabs. At Bay Farm Island, numbers of *N. obsoletus* had been invaded by these crabs. Of the Nassariidae in the California Academy of Sciences collection, there are shells of *N. catallus*, *N. cerritensis*, and *N. insculptus* retain-

ing crab remnants. This evidence seems to indicate these species are preyed upon, or at least have their shells appropriated, by hermit crabs.

Some Nassariidae seem adapted to escape particular enemies. A striking behavior was observed by Bauer (Flattely, 1922). He watched *Nassarius reticulatus* flee a pursuing starfish, *Astropecten bispinosus*. The snail fled by curious leaps, using its foot as a lever, in the manner of a cockle. The movement was such a convulsive one that Bauer found it difficult to follow, but it appeared to be a kind of somersault. This escaping reflex occurred only when the gastropod was directly touched by the starfish. Also, the snail's body was not everywhere equally sensitive to this stimulus; only when the two tails of the mollusc's foot were touched was the reaction produced. Bauer was unable to induce the reflex either mechanically or chemically—only through the medium of a starfish.

Oviposition

The Nassariidae are dioecious. They lay eggs in strong, leathery capsules, the capsules of each species having a characteristic appearance. Each capsule contains a varying number of ova, and there is competition among the embryos within the capsule, so that only a very small percentage survive.

According to Tryon (1883), *Nassarius reticulatus* deposits its spawn on various objects, such as *Zostera* leaves, which are out of the water only during spring tides. These egg-capsules are tiny, compressed pouches, supported by a tiny stalk and arranged in closely overlapping rows. The larvae remain within the capsule for several days after hatching before escaping through a small aperture at the top of the capsule.

Tryon (1882) says *N. obsoletus* lays its ova-capsules during April and May. These capsules are attached singly and are crowded together. During May, I have seen thousands of capsules of *obsoletus* at Bay Farm Island. The capsules were attached to pilings, to

living and dead gastropods and pelecypods, to rocks, driftwood, and the inside of an old rubber tire.

Ricketts and Calvin (1948) state that ovipositing *N. fossatus* may be found among eelgrass during late summer. Burch (1945) says *fossatus* is not seasonal; he records their spawning in Anaheim Bay during January.

The egg-laying process of *N. fossatus* has been observed and recorded in detail by MacGinitie (1931).

Adaptation to Environment

The recurved anterior canal of most *Nassarius* shells aids those gastropods living on a muddy substrate. This structure protects the animal's respiratory organ, the siphon, which projects above the mud, thus allowing the snail to breathe while concealed in the sediment.

In many cases, the color of *Nassarius* shells, by blending with the environment, protects the inhabitants from discovery. For example, the shell of *N. obsoletus* is dark brown or blackish, so it is not easily seen on the mud. The body of this mollusc, too, is a dark color, like the muddy sand in which the animal lives. *N. obsoletus* is made even more inconspicuous by its somewhat latticed shell surface. Particles of substrate collect in the irregularities of this surface and conceal the shell.

TAXONOMIC STUDY

Family NASSARIIDAE

These gastropods usually possess a more or less ovate shell with a raised spire and a short, recurved anterior canal. Typically, a callus covers the inner lip, often spreading over the body whorl.

Characteristically, these molluscs develop a long siphon and a broad foot. In almost all species, the foot is divided posteriorly into two slender appendages; the only west coast species lacking such bifurcation is *Nassarius obsoletus*. Eyes are present on the outer bases of the tentacles. The operculum is

usually corneous, ovoid in shape, with plain or serrated margins. The lingual teeth are arched and pectinate; the uncini possess a basal horn and, occasionally, intermediate serrations.

Genus NASSARIUS Duméril, 1805

Arcularia Martini, Neves Syst. Conch. Cab., 2: 18, 1771.

Nassarius Duméril, Zool. Analyt., p. 166, 1806 [genus without species]; Froriep's translation, p. 167, 1806, only species added, *Buccinum arcularia* [fide Iredale, Malac. Soc. London, Proc. 12: 80, 81, 82, 1916].

Arcularia Link, Besch. Nat. Samml. Univ. Rostock, p. 126, 1807.

? *Eione* Risso, Hist. Nat. Eur. Mérid., 4: 171, 1826; Herrmannsen, Indicis Gen. Malac., 1: 414, 1847.

"*Nassa* Martini" H. and A. Adams, Gen. Rec. Moll., 1: 116, 1853.

TYPE SPECIES: *Buccinum arcularia* Linnaeus, Syst. Nat., ed. 10, p. 737, 1758; figured by Reeve, Conch. Icon., Vol. 8, *Nassa*, pl. 4, figs. 25a, 25b, 1853.

TYPE LOCALITY: Philippine Islands; Recent (Reeve, 1853).

Since the Nassariidae are molluscs which have been known and collected for many years, they have a long and varied taxonomic history. Martini's genus *Arcularia*, 1771, seems to be the earliest name in the literature. This author named *Arcularia* as a section of *Galeodes* or *Semicassis*, which he called a subgenus of *Cassis*. He included *Arcularia major* Martini in his species list. This species is said to be synonymous with *Buccinum arcularia* Linnaeus. Consequently, *Buccinum arcularia*, by absolute tautonymy, becomes the genotype. However, Martini's work is generally disregarded as not being consistently binomial.

Arcularia Link, 1807, has been used by some authors for this genus. However, it is an absolute synonym of *Nassarius* Duméril.

Dall (1917, 1921) and Oldroyd (1927) used the family name Alectrionidae and the gen-

eric name *Alectrion* Montfort, 1810. The type of Montfort's genus was *Buccinum papillosum* Linnaeus, a mollusc which differs greatly from *B. arcularia*; the type of *Nassarius*. The shell of *B. papillosum* is heavy and large, with a thick outer lip, a prominent posterior canal, and a somewhat narrow but heavy callus. As *B. papillosum* differs so much from the west coast species, the use of *Alectrion* for these species has been rejected.

Although Woodring (1946) doubts the validity of using *Nassarius* and prefers "*Nassa*," the opinion of recent authors seems to be to accept *Nassarius* Duméril as a substitute for *Nassa* Lamarck. Froriep (1806), in his translation of Duméril, assigned only the species *Buccinum arcularia* Linnaeus to *Nassarius*. Consequently, this species becomes the genotype by monotypy.

The author's opinion is that *Nassarius* Duméril is the preferable name to use until a comprehensive taxonomic revision of the family is completed.

The question of the valid subgeneric divisions of *Nassarius* also awaits further study. Various subgenera have been proposed, but many are arbitrary and difficult to apply. A general practice has been to use *Schizopyga* for *N. fossatus*, *N. perpunguis*, *N. californianus*, *N. cerritensis*, and *N. mendicus*. *N. tegula* is close to the type of the genus and is considered to represent *Nassarius* proper. The entire family needs careful evaluation before valid subgenera can be recognized. Since only a limited geographic area is covered in the present paper, the author has entirely excluded subgeneric classification.

Twelve species and two subspecies of *Nassarius* live in the area between Cape San Lucas and Cape Flattery. Some of these species are among the earliest molluscs known to science from this area. Only species found living in this area at present are considered here, although many members of the family are also common as fossils.

Nassarius is the only genus of this family found within the area considered here.

KEY TO THE WEST COAST SPECIES
OF NASSARIIDAE

- A. Orange callus spreading over body whorl
..... *Nassarius fossatus*
Orange callus absent..... B
- B. Length of shell greater than width of
body whorl..... C
Length of shell approximately equal to
width of body whorl..... *N. corpulentus*
- C. With distinct groove over dorsum of
anterior canal..... D
Without distinct groove over dorsum of
anterior canal..... *N. obsoletus*
- D. Narrow shelf just at sutures..... E
Shelf at sutures absent..... F
- E. Raised ribs formed by axial lines present
within aperture; shell sturdy; maximum
length, 26 mm..... *N. perpinguis*
Raised ribs within aperture usually absent;
shell thin; maximum length, 37 mm...
..... *N. californianus*
- F. Callus spreading at least slightly over
body whorl..... G
Callus definitely delimited, not spreading
over body whorl..... I
- G. Transverse sculpture of definite nodes. H
Transverse sculpture of ribs which do not
form definite nodes..... *N. cerritensis*
- H. Shell white or with brown spiral bands
on body whorl; length approximately 13
mm..... *N. tegula tiarula*
Shell dark brown or purplish without
color bands; length approximately 18 mm.
..... *N. tegula*
- I. Outer lip sharp and thin; shell slender
and elongate..... J
Outer lip swollen; shell not slender and
elongate..... K
- J. Nodes prominent on body whorl.....
..... *N. mendicus cooperi*
Nodes absent or poorly developed on
body whorl..... *N. mendicus*
- K. Anterior canal somewhat long and curved;
length 18 to 27 mm.; whorls angular....
..... *N. pagodus*
Anterior canal short..... L
- L. Transverse sculpture prominent on all
whorls..... M
Transverse sculpture prominent only on
upper whorls; dominant sculpture of
numerous extremely faint spiral lines
encircling all whorls..... *N. insculptus*
- M. Transverse sculpture forming nodes on
body whorl; axial sculpture of impressed
lines..... *N. versicolor*
Transverse sculpture not forming nodes
on any whorls; axial sculpture of raised
lines..... *N. catallus*

Nassarius fossatus (Gould)

Pl. I, Fig. 2

- Buccinum elegans* Reeve, Zool. Soc. London,
Proc. (10): 199, 1843, [non] *Buccinum elegans*
Costa, 1822.
- Buccinum fossatum* Gould, Boston Soc. Nat.
Hist., Proc. 3: 152, 1849.
- Nassa reevei* A. Adams, Zool. Soc. London,
Proc. for 1851: 109 [nomen novum for
Buccinum elegans Reeve].
- Nassa fossata* Gould, Gabb, Geol. Survey
Calif., Paleontol. 2: 74, 1868-69; Cooper,
Amer. Jour. Conch. 6: 68, 1870; Keep,
West Coast Shells, p. 36, fig. 16, 1893;
Packard, Calif. Univ., Pubs., Zool. 18(13):
303, 1918.
- Nassa (Tritia) fossata* Gould, Tryon, Man.
Conch. I, 4: 55, pl. 17, figs. 316, 317, 1882.
- Alectrion fossata* Gould, Chace, E. P., Nauti-
lus 29(11): 130, 1916; Jordan, South. Calif.
Acad. Sci., Bul. 23: 149, 1924; Johnson
and Snook, Seashore Animals of the Pacific
Coast, p. 513, fig. 530, 1927.
- Alectrion fossatus* Gould, Dall, U. S. Natl.
Mus., Proc. 51: 575, 1917; Oldroyd, I. S.,
Wash. Univ., Puget Sound Biol. Sta. Pubs.
4: 95, pl. 22, figs. 3, 4, 1924.
- Alectrion (Schizopyga) fossata* Gould, Dall, U.
S. Natl. Mus., Bul. 112: 102, 1921; Water-
fall, Calif. Univ., Pubs., Geol. Sci. 18: 78,
1929.
- Alectrion (Schizopyga) fossatus* Gould, Oldroyd,
I. S., Stanford Univ., Pubs., Univ. Ser.

Geol. Sci. 2(1): 264, pl. 26, figs. 1, 3, 5, 7, 9, 1927.

Nassarius (Schizopyga) fossatus (Gould), Grant and Gale, San Diego Soc. Nat. Hist., Mem. 1: 675, pl. 26, figs. 55, 56, 1931; Keep, West Coast Shells, p. 229, fig. 220, 1935.

Nassarius fossatus (Gould), Jordan, Stanford Univ., Dept. Geol. Contrib. 1(4): 107-173, 1936; Smith and Gordon, Calif. Acad. Sci., Proc. IV, 26(8): 187, 1948.

"*Nassa*" *fossata*, Woodring, U. S. Geol. Survey, Prof. Paper 207: 73, 1946.

TYPE LOCALITY: Puget Sound at mouth of Columbia River (Oldroyd, 1927).

DESCRIPTION: Maximum length, 48 mm.; average length, 36 mm.; usually 8 whorls, last whorl pronouncedly ventricose; spiral and transverse ridges over shell surface; conspicuous orange callus on inner lip, spreading over body whorl; outer lip sharp, denticulated by ends of spiral ridges; sutures distinct, deeply impressed; mature specimens often with prominent posterior canal; anterior canal broad, short, sharply reflected; deep fossa at base of body whorl; main shell color ashen.

This species was named *Buccinum elegans* by Reeve, but since *Buccinum elegans* was preoccupied for a fossil species, A. Adams changed the name to *Nassa reevei*, which falls before Gould's prior name of *Buccinum fossatum*.

RECENT GEOGRAPHIC RANGE: Sitka, Alaska, to Cedros Island, Lower California.

HABITAT: Common on mud flats; rare in 10 or 15 fathoms.

Nassarius perpinguis (Hinds)

Pl. II, Figs. 4, 5

Nassa perpinguis Hinds, Zool. Voy. Sulphur, Mollusca, p. 36, pl. 9, figs. 12, 13, 1844; Carpenter, Brit. Assoc. Adv. Sci., Rpt. for 1863: 662, 1864; Tryon, Man. Conch. I, 4: 56, pl. 17, fig. 319, 1882; Keep, West Coast Shells, p. 38, fig. 19, 1893.

Nassa intastriata Conrad, U. S. House of Representatives, House Document 129: 17,

July 1855, reprinted by Dall, U. S. Geol. Survey, Prof. Paper 59: 169, 1909.

Nassa interstriata Conrad, U. S. Pacific Railroad Survey 5: 327, 1856, correction in spelling of "intastriata."

Nassa perpinguis Gould, Keep, West Amer. Shells, p. 184, fig. 186, 1904.

Nassa perpinguis var. *bifasciata* Berry, Nautilus 22: 39, 1908.

Alectrion perpinguis Gould, Chace, E. P., Nautilus 29: 130, 1916.

Alectrion perpinguis Hinds, Dall, U. S. Natl. Mus., Proc. 51: 576, 1917; Oldroyd, I. S., Wash. Univ., Puget Sound Biol. Sta. Pubs. 4: 96, pl. 22, fig. 5, 1924; Jordan, South. Calif. Acad. Sci., Bul. 23: 149, 1924; Johnson and Snook, Seashore Animals of the Pacific Coast, p. 513, fig. 532, 1927.

Alectrion (Schizopyga) perpinguis Hinds, Dall, U. S. Natl. Mus., Bul. 112: 103, 1921; Oldroyd, I. S., Stanford Univ., Pubs., Univ. Ser. Geol. Sci. 2(1): 266, pl. 26, fig. 11, 1927.

Nassarius perpinguis (Hinds), Jordan, Stanford Univ., Dept. Geol. Contrib. 1(4): 114, 1936; Smith and Gordon, Calif. Acad. Sci., Proc. IV, 26(8): 187, 1948.

Nassarius (Schizopyga) perpinguis (Hinds), Grant and Gale, San Diego Soc. Nat. Hist., Mem. 1: 673, pl. 26, figs. 51, 52, 1931; Keep, West Coast Shells, p. 228, fig. 218, 1935.

"*Nassa*" *perpinguis*, Woodring, U. S. Geol. Survey, Prof. Paper 207: 73, 1946.

TYPE SPECIMEN: Zoological Museum, Copenhagen (Oldroyd, 1927).

TYPE LOCALITIES: Of *perpinguis*, Magdalena Bay, Lower California (Recent); of *intastriata* Conrad, Santa Barbara, California (Pleistocene); of *bifasciata*, San Pedro, California (Recent) (Grant and Gale, 1931).

DESCRIPTION: Maximum length, 26 mm.; average length, about 22 mm.; usually 7 rounded whorls; many sharp, spiral ridges crossed by posteriorly sloping transverse ridges, giving shell reticulate surface; transverse

ornamentation typically most prominent on upper whorls, spiral most prominent on lower whorls; transverse ridges sometimes nearly obsolete on body whorl; inner lip with slight callus; outer lip plain, thin; aperture about $1/3$ length of shell, ridged inside by spiral sculpture; sutures distinct, usually with narrow shelf just at sutures; short, curved anterior canal; conspicuous groove at base of body whorl; columella spirally ornamented, often with groove on upper part; shell color ashen.

Some specimens of *N. perpunguis* possess one or two bands of darker color around the middle of each whorl (Pl. II, Fig. 4). Berry (1908) named these specimens variety *bifasciata*. However, these shells are now considered merely color variations of no taxonomic significance.

RECENT GEOGRAPHIC RANGE: Puget Sound, Washington, to Magdalena Bay, Lower California.

HABITAT: Common in 10 to 50 fathoms, in sand.

Nassarius californianus (Conrad)

Pl. II, Fig. 6

Schizopyga californiana Conrad, Acad. Nat. Sci. Phila., Proc. for 1856: 315, 1856; Carpenter, Brit. Assoc. Adv. Sci., Rpt. for 1863: 593, 1864.

Schizopyga californica Conrad, Tryon, Man. Conch. I, 4: 55, pl. 3, fig. 32, 1882.

Nassa californiana Conrad, Keep, West Amer. Shells, p. 185, 1904; Arnold, Calif. Acad. Sci., Mem. 3: 231, [non] pl. 4, fig. 3, 1903.

Alectrion (Schizopyga) californiana Conrad, Dall, U. S. Natl. Mus., Proc. 51: 576, 1917; Dall, U. S. Natl. Mus., Bul. 112: 102, pl. 11, fig. 4, 1921.

Alectrion (Schizopyga) californianus Conrad, Oldroyd, I. S., Stanford Univ., Pubs., Univ. Ser. Geol. Sci. 2(1): 264, pl. 26, fig. 13, 1927.

Alectrion californiana Conrad, Jordan, South. Calif. Acad. Sci., Bul. 23: 149, 1924.

Nassarius (Schizopyga) californianus (Conrad),

Grant and Gale, San Diego Soc. Nat. Hist., Mem. 1: 672, pl. 26, fig. 49, 1931; Keep, West Coast Shells, p. 228, 1935.

Nassarius californianus (Conrad), Jordan, Stanford Univ., Dept. Geol. Contrib. 1(4): 114, 1936; Smith and Gordon, Calif. Acad. Sci., Proc. IV, 26(8): 187, 1948.

TYPE LOCALITY: Santa Clara, California (Oldroyd, 1927).

There is much confusion concerning *N. californianus*. Woodring (1946) says the species is based on fossil material which has been lost, so the status of this species is uncertain until a neotype is designated. The locality of this type material was near Santa Clara, California, presumably Pliocene. Woodring believes this fossil material probably was the species later described as "*Nassa*" *moraniana*. "*N.*" *moraniana* is an extinct Pliocene species not known to occur in the Pleistocene. He claims the Recent species identified by Dall as *californiana* is not *moraniana* and evidently is not *californiana* and thus needs a new name. Grant and Gale (1931) state, "Whether the shell figured by Dall (1921) as *californianus* is identical with Conrad's presumed Miocene species cannot be said at the present time." Grant and Gale (1931) further state that "Arnold's figure in his San Pedro memoir (1903) is not typical of Conrad's species, and may be of an undescribed variety or even a new species." Woodring (1946) proposes a new name, "*Nassa*" *delosi*, for Arnold's figured *californiana*.

The shell figured by Dall (1921) represents the species generally recognized today as *Nassarius californianus*. Consequently, Dall's species is the basis of the following description.

DESCRIPTION: Maximum length, 37 mm.; average length, 23–25 mm.; 6 or 7 rounded whorls; spiral ribs crossed by transverse ridges; spiral and transverse sculpture about equally well developed, giving shell reticulate surface; sutures well defined; aperture about $1/3$ length of shell, with ribs usually not apparent within; outer lip plain; callus usu-

ally quite thin; basal groove deep; posterior canal absent; closely resembles *N. perpinguis*, but almost twice as large.

RECENT GEOGRAPHIC RANGE: Oregon coast to San Ignacio Lagoon, Lower California.

HABITAT: 30 to 40 fathoms, in mud and sand; rare.

Nassarius tegula (Reeve)

Pl. II, Fig. 8

Nassa tegula Reeve, Conch. Icon. 8: 98, pl. 15, fig. 98, 1853; Carpenter, Brit. Assoc. Adv. Sci., Rpt. for 1863: 662, 1864; Tryon, Man. Conch. I, 4: 39, pl. 13, figs. 166, 167, 1882; Keep, West Coast Shells, p. 37, fig. 17, 1893; Stearns, U. S. Natl. Mus., Proc. 17: 180, 1894; Arnold, Calif. Acad. Sci., Mem. 3: 235, 1903.

Arcularia tegula Reeve, Dall, U. S. Natl. Mus., Proc. 51: 577, 1917.

Alectrion (Zeuxis) tegula Reeve, Dall, U. S. Natl. Mus., Bul. 112: 103, 1921; Waterfall, Cal. Univ., Pubs., Geol. Sci. 18: 78, 1929.

Alectrion tegula (Reeve), Jordan, South. Calif. Acad. Sci., Bul. 23: 149, 1924; Johnson and Snook, Seashore Animals of the Pacific Coast, p. 513, fig. 533, 1927.

Alectrion (Schizopyga) tegulus Reeve, Oldroyd, I. S., Stanford Univ., Pubs., Univ. Ser. Geol. Sci. 2(1): 267, pl. 26, fig. 10, 1927.

Nassarius tegulus, Keen, West North Amer. Mar. Moll., p. 41, 1937.

Nassarius (Nassarius) tegula (Reeve), Grant and Gale, San Diego Soc. Nat. Hist., Mem. 1: 671, pl. 26, fig. 43, 1931; Keep, West Coast Shells, p. 228, fig. 217, 1935; Jordan, Stanford Univ., Dept. Geol. Contrib. 1(4): 114, 1936.

"*Nassa*" *tegula* Woodring, U. S. Geol. Survey, Prof. Paper 207: 73, 1946.

TYPE SPECIMEN: Cuming Museum, London, England (Oldroyd, 1927).

TYPE LOCALITY: Habitat unknown (Reeve, 1853); California or Lower California (Oldroyd, 1927).

DESCRIPTION: Maximum length, 21 mm.;

average length, 16–18 mm.; typically 6 whorls; spire short and sharp; low axial folds becoming nodose at shoulders of whorls; sometimes faint spiral ridges; typically, body whorl smooth below nodes; prominent callus on parietal wall of body whorl; outer lip often thickened externally, denticulate; sutures distinct; aperture usually slightly greater than 1/3 length of shell with small canal at each end; groove at base of body whorl; much color variation, frequently purplish brown.

RECENT GEOGRAPHIC RANGE: San Francisco, California, to Lower California.

HABITAT: Common on mud flats.

Nassarius tegula tiarula (Kiener) new comb.

Pl. I, Fig. 4

Buccinum tiarula Kiener, Spéc. Gén. et Icon. des Coq. Viv. (2): 111, pl. 30, fig. 4, 1834.

Nassa tiarula Kiener, Tryon, Man. Conch. I, 4: 41, pl. 12, figs. 174–178, 1882.

Arcularia tiarula Kiener, Dall, U. S. Natl. Mus., Proc. 51: 577, 1917.

Nassarius tiarulus (Kiener), Jordan, Stanford Univ., Dept. Geol. Contrib. 1(4): 114, 1936.

DESCRIPTION: Maximum length, 18 mm.; average length, 13–15 mm.; shell small, strong; spire short, sharp; typically 7 or 8 whorls; body whorl about 1/2 length of shell; ornamentation of low axial folds, nodose at shoulders of whorls; body whorl usually smooth below nodes; sometimes faint spiral ribs; noticeable callus on inner lip; outer lip usually thickened; aperture slightly greater than 1/3 length of shell, denticulate within; sutures impressed, wavy; groove at base of body whorl not prominent; anterior canal short, recurved; posterior canal small; much color variation; basic color usually whitish or faintly yellow, often with varying numbers of brown spiral bands, particularly on body whorl; often highly polished.

This species is exceedingly variable, particularly in color and ornamentation. Some specimens possess no spiral threads, while

others have such threads running around the entire shell, even on the body whorl, which is typically smooth. The transverse ridges and nodes are seldom the same in number or in size.

This mollusc was described by Kiener (1834) as a separate species, while Stearns (1894), Grant and Gale (1931), and others have put it into synonymy with *Nassarius tegula*. In my opinion, however, *N. tiarula* is a subspecies of *N. tegula*. *N. tiarula* has a more southern range than does *N. tegula*, *tiarula* ranging from Panama to Lower California, while *tegula* ranges from Lower California as far north as San Francisco. Also, *tiarula* has a smaller shell and finer sculpture than does *tegula*. The color of the two forms is usually different; *tiarula* is generally white or yellowish, while *tegula* is usually purplish brown. Of course, variations from the typical form of each are often seen, particularly where their geographic ranges overlap.

RECENT GEOGRAPHIC RANGE: Lower California to Panama.

HABITAT: Mud flats or in a few fathoms.

Nassarius cerritensis (Arnold)

Pl. II, Fig. 7

Nassa cerritensis Arnold, Calif. Acad. Sci., Mem. 3: 231, pl. 4, fig. 1, 1903.

Alectrion cerritensis Arnold, Dall, U. S. Natl. Mus., Proc. 51: 576, 1917; Jordan, South. Calif. Acad. Sci., Bul. 23: 149, 1924.

Alectrion (Schizopyga) cerritensis Arnold, Dall, U. S. Natl. Mus., Bul. 112: 102, 1921; Oldroyd, I. S., Stanford Univ., Pubs., Univ. Ser. Geol. Sci., 2(1): 266, 1927.

Nassarius (Schizopyga) cerritensis (Arnold), Grant and Gale, San Diego Soc. Nat. Hist., Mem. 1: 675, 1931.

Nassarius cerritensis (Arnold), Jordan, Stanford Univ., Dept. Geol. Contrib. 1(4): 114, 1936.

"*Nassa*" *cerritensis* Arnold, Woodring, U. S. Geol. Survey, Prof. Paper 207, pl. 35, figs. 16-19, 1946.

TYPE SPECIMEN: U. S. National Museum, No. 162,553 (Grant and Gale, 1931).

TYPE LOCALITY: Los Cerritos (Signal Hill), Los Angeles County (Pleistocene).

DESCRIPTION: Maximum length, 20 mm.; average length, about 17 mm.; 7 to 8 somewhat rounded whorls; several prominent, rounded, transverse ridges, not forming nodes, crossed by several sharp, raised, spiral lines, giving reticulate surface; cancellation not as prominent as in *N. californianus* or *N. perpinguis*; inner lip smooth with thin callus spreading somewhat onto body whorl; outer lip thickened internally by denticulated ridge; sutures wavy; deep groove below body whorl; short, broad, recurved anterior canal.

RECENT GEOGRAPHIC RANGE: Lower California to Gulf of California.

Dall (1917) claims this species is found living from San Pedro to the Gulf of California. However, Burch (1945) says, "It is a common fossil in local Pleistocene deposits but seems to be of the southern [Recent] fauna. The consensus of opinion regarding this species is stated by Dr. George Willett briefly, 'Probably lower Californian.'" Woodring (1946) states that, according to numerous specimens in the National Museum, a small race of *cerritensis* or a closely related species is living along the Lower California coast at Point Abrejos and Ballenas Bay and in the Gulf of California at Guaymas.

I agree that *N. cerritensis* does not belong to the Recent fauna of the west coast of California, although it apparently lives on the Lower California coast. I have never found any specimens living on our coast, nor have I located any specific record of its being taken alive on this coast. Statements in the literature of occurrences at Long Beach (Grant and Gale, 1931) and Santa Monica (Keen, 1937) probably refer to fossil collections.

HABITAT: 20 to 30 fathoms.

Nassarius mendicus (Gould)

Pl. I, Fig. 3

Nassa mendica Gould, Boston Soc. Nat. Hist.,

- Proc. 3: 155, 1851; Carpenter, Brit. Assoc. Adv. Sci., Rpt. for 1863: 662, 1864; Tryon, Man. Conch. IV, 4: 56, pl. 17, figs. 320–323, 1882; Keep, West Coast Shells, p. 37, [non] fig. 18, 1893; Arnold, Calif. Acad. Sci., Mem. 3: 233, 1903.
- Nassa woodwardi* Forbes, Zool. Soc. London, Proc. for 1850: 273, pl. 11, fig. 3, 1850.
- Nassa gibbsii* W. Cooper, U. S. Pacific Railroad Rpts., Sup. to 1(3): 371, 1859.
- Alectrion mendicus* Gould, Dall, U. S. Natl. Mus., Proc. 51: 576, 1917; Oldroyd, I. S., Wash. Univ., Puget Sound Biol. Sta., Pubs. 4: 95, pl. 22, fig. 6, 1924; Jordan, South. Calif. Acad. Sci., Bul. 23: 149, 1924.
- Alectrion (Schizopyga) mendica* Gould, Dall, U. S. Natl. Mus., Bul. 112: 102, 1921; Oldroyd, I. S., Stanford Univ., Pubs., Univ. Ser. Geol. Sci. 2(1): 265, pl. 26, fig. 2, [non] figs. 6, 14, 1927.
- Alectrion cooperi* var. *woodwardi* Forbes, Oldroyd, I. S., U. S. Natl. Mus., Proc. 65(22): 12, 1925.
- Alectrion mendica* (Gould), Johnson and Snook, Seashore Animals of the Pacific Coast, p. 513, [non] fig. 531, 1927.
- Nassarius (Schizopyga) mendicus* (Gould), Grant and Gale, San Diego Soc. Nat. Hist., Mem. 1: 674, pl. 26, fig. 54 [immature], 1931; Keep, West Coast Shells, p. 229, [non] fig. 219, 1935.
- Nassarius mendicus* (Gould), Jordan, Stanford Univ., Dept. Geol. Contrib. 1(4): 114, 1936; Smith and Gordon, Calif. Acad. Sci., Proc. IV, 26(8): 187, 1948.
- "*Nassa*" *mendica*, Woodring, U. S. Geol. Survey, Prof. Paper 207: 73, 1946.
- TYPE SPECIMEN: Boston Society of Natural History (Oldroyd, 1927).
- TYPE LOCALITY: Nisqually, Port Discovery, Puget Sound (Oldroyd, 1927). According to Burch (1945), A. M. Keen states that, "The holotype label of *N. mendicus* at the National Museum gives the type locality as Straits of Fuca."
- DESCRIPTION: Maximum length, 25 mm.; average length, about 14 mm.; shell elongate; spire elevated; 6 to 7 whorls; length of body whorl almost half the shell length; many fine, raised, spiral threads crossed by fewer, coarser, transverse ridges; definitely delimited white callus on inner lip, not spreading over body whorl; outer lip sharp, simple; line of about 10 raised ribs within aperture, not reaching edge of lip; definite groove at base of body whorl; anterior canal broad, short, slightly reflected; posterior canal typically absent; shell color usually reddish brown or light ash.
- RECENT GEOGRAPHIC RANGE: Forrester Island, Alaska, to Magdalena Bay, Lower California.
- HABITAT: 5 to 40 fathoms, in sand.
- Nassarius mendicus cooperi* (Forbes)
Pl. I, Fig. 1
- Nassa cooperi* Forbes, Zool. Soc. London, Proc. for 1850: 273, pl. 11, fig. 4, 1850; Carpenter, Brit. Assoc. Adv. Sci., Rpt. for 1863: 662, 1864; Keep, West Coast Shells, p. 37, figs. 18, 1893.
- Nassa mendica* Gould var. *cooperi* Forbes, Dall, U. S. Natl. Mus., Proc. 19: 377, pl. 33, fig. 9, 1897; Arnold, Calif. Acad. Sci., Mem. 3: 234, 1903; Berry, Nautilus 22: 38, 1908.
- Alectrion mendica cooperi* Forbes, Chace, E. P., Nautilus 29(11): 130, 1916.
- Alectrion cooperi* Forbes, Dall, U. S. Natl. Mus., Proc. 51: 576, 1917; Oldroyd, I. S., Wash. Univ., Pubs., Puget Sound Biol. Sta. 4: 96, 1924.
- Alectrion (Schizopyga) cooperi* Forbes, Dall, U. S. Natl. Mus., Bul. 112: 102, 1921; Oldroyd, I. S., Stanford Univ., Pubs., Univ. Ser. Geol. Sci. 2(1): 265, pl. 26, fig. 8, 1927.
- Nassarius (Schizopyga) mendicus cooperi* (Forbes), Grant and Gale, San Diego Soc. Nat. Hist., Mem. 1: 674, pl. 26, figs. 40, 50, 1931; Keep, West Coast Shells, p. 229, fig. 219, 1935.
- Nassarius (Schizopyga) cooperi* (Forbes), Vokes, Nautilus 50(2): 47, 1936.
- "*Nassa*" *mendica cooperi*, Woodring, U. S.

Geol. Survey, Prof. Paper 207: 73, pl. 34, fig. 12, 1946.

Nassarius cooperi (Forbes), Smith and Gordon, Calif. Acad. Sci., Proc. IV, 26(8): 187, 1948.

TYPE SPECIMEN: British Museum? (Oldroyd, 1927).

TYPE LOCALITY: Said to be "Sandwich Islands," probably a ballast shell (Oldroyd, 1927).

DESCRIPTION: The preceding description of *Nassarius mendicus* may be applied to *cooperi* except that the transverse sculpture is more pronounced on the latter form; the longitudinal ridges become actual nodes in the middle of the whorls on *cooperi*.

Several authors place *N. cooperi* in synonymy with *N. mendicus*. However, I am inclined to call *cooperi* a subspecies. It is true that these two forms occur together at many points along the Pacific coast. However, most authors give Alaska as the northernmost range of *mendicus* and Puget Sound as the northernmost range of *cooperi*. Thus, *cooperi* seems to be a more southern form. It is also true that several workers record collections of specimens showing perfect intergradation between the two forms. However, I believe that the difference between the typical *mendicus*, having relatively smooth whorls completely lacking nodes, and the prominently tubercled *cooperi* is sufficient to separate *cooperi* as a subspecies of *mendicus*.

RECENT GEOGRAPHIC RANGE: Puget Sound, Washington, to San Diego, California.

HABITAT: 3 to 24 fathoms, in sand.

Nassarius pagodus (Reeve)

Pl. I, Fig. 7

Triton pagodus Reeve, Conch. Icon. 2: 97, pl. 20, fig. 97, 1843.

Buccinum decussatum Kiener, Spéc. Gén. et Icon. des Coq. Viv. (2): 109, pl. 30, fig. 3, 1834.

Nassa pagoda Reeve, Tryon, Man. Conch. I, 4: 45, pl. 14, figs. 226-228, 1882; Pilsbry

and Lowe, Acad. Nat. Sci. Phila., Proc. 84: 115, 1932.

Alectrion pagoda Reeve, Dall, U. S. Natl. Mus., Proc. 51: 576, 1917.

Nassarius pagodus Reeve, Strong, Hanna, and Hertlein, Calif. Acad. Sci., Proc. IV, 21(10): 119, 1933.

TYPE SPECIMEN: In Cuming collection, Museum Norris? (Reeve, 1844).

TYPE LOCALITY: Bay of Montija, West Columbia (Reeve, 1844).

DESCRIPTION: Maximum length, 27 mm.; average length, about 23 mm.; usually 8 whorls; prominent transverse ridges forming angular nodes in middle of whorls; fine spiral threads; inner lip with definitely margined callus, not spreading over body whorl; prominent tooth on upper part of columella; outer lip swollen; somewhat long, recurved anterior canal; wide, deep groove at base of body whorl; aperture almost half length of shell, denticulate within; shell color varies, often white or yellowish or variously banded with brown.

RECENT GEOGRAPHIC RANGE: Cape San Lucas, Lower California, to Panama.

HABITAT: 3 to 40 fathoms; also on mud flats.

Nassarius versicolor (C. B. Adams)

Pl. I, Fig. 5

Nassa versicolor C. B. Adams, N. Y. Lyceum Nat. Hist., Ann. 5: 66 [pagination of separate], 1852; Cooper, J. G., Calif. Acad. Sci., Proc. II, 5: 45, 1895.

Nassa versicolor var. *striatula* C. B. Adams, N. Y. Lyceum Nat. Hist., Ann. 5: 66, 1852.

Nassa (Hima) versicolor C. B. Adams, Tryon, Man. Conch. I, 4: 50, pl. 15, fig. 270, 1882.

Alectrion versicolor C. B. Adams, Dall, U. S. Natl. Mus., Proc. 51: 576, 1917.

Nassarius versicolor (C. B. Adams), Grant and Gale, San Diego Soc. Nat. Hist., Mem. 1: 677, 1931.

Nassarius versicolor (A. Adams), Jordan, Stan-

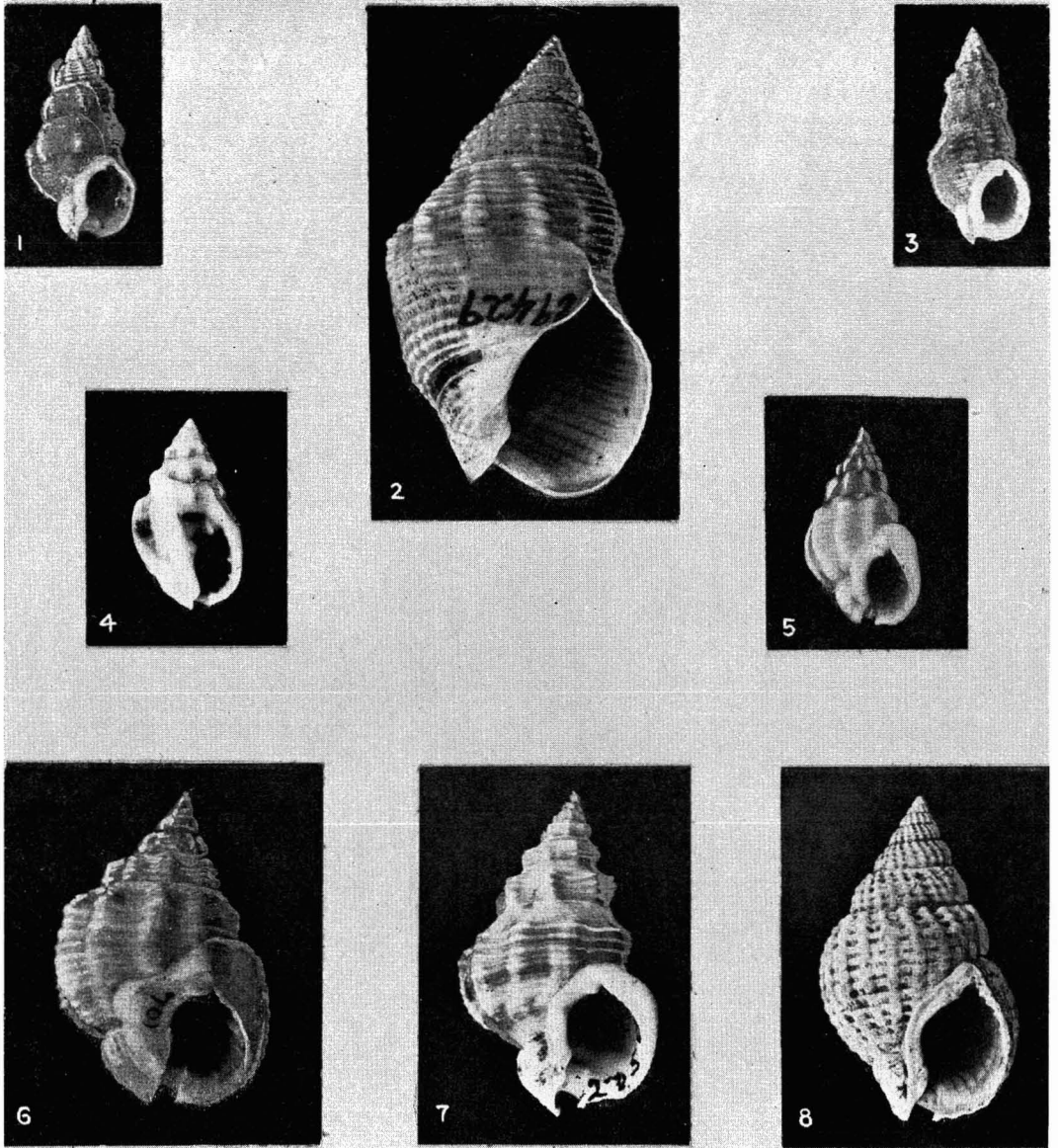


PLATE I

(All measurements are actual dimensions of specimens photographed)

FIG. 1. *Nassarius mendicus cooperi* (Forbes); Santa Rosa Island, California. Calif. Acad. Sci. Loc. 23681. Length: 15 mm. Max. diameter: 7.9 mm.

FIG. 2. *Nassarius fossatus* (Gould); Long Beach, California. Calif. Acad. Sci. Loc. 29429. Length: 37.9 mm. Max. diameter: 22.5 mm.

FIG. 3. *Nassarius mendicus* (Gould); 20 to 30 fathoms in Monterey Bay, California. Calif. Acad. Sci. Loc. 24147. Length: 14.6 mm. Max. diameter: 6.8 mm.

FIG. 4. *Nassarius tegula tiarula* (Kiener); Puerto Escondido, Gulf of California. Calif. Acad. Sci. Loc. 23805. Length: 13.0 mm. Max. diameter: 7.3 mm.

FIG. 5. *Nassarius versicolor* (C. B. Adams); 12 to 15 fathoms in Port Parker, Costa Rica. Calif. Acad. Sci. Loc. 17924. Length: 13.8 mm. Max. diameter: 7.9 mm.

FIG. 6. *Nassarius corpulentus* (C. B. Adams); Margarita Island, Lower California. Calif. Acad. Sci. Loc. 701 (H. Hemphill Coll.). Length: 19.2 mm. Max. diameter: 13.5 mm.

FIG. 7. *Nassarius pagodus* (Reeve); near Mazatlan, Mexico. Calif. Acad. Sci. Loc. 27581. Length: 27.3 mm. Max. diameter: 17.3 mm.

FIG. 8. *Nassarius catallus* (Dall); 35 to 40 fathoms in the Gulf of Chiriqui, Panama. Calif. Acad. Sci. Loc. 17986. Length: 20.8 mm. Max. diameter: 12.5 mm.

ford Univ., Dept. Geol. Contrib. 1(4): 114, 1936.

TYPE LOCALITY: Panama; Recent (Grant and Gale, 1931).

DESCRIPTION: Maximum length, 17 mm.; average length, 13–15 mm.; usually 7 whorls; length of body whorl almost half shell length; sculpture of numerous, evenly spaced spiral grooves, crossed by fewer prominent transverse ridges, forming nodules at tops of first 3 whorls; sculpture faint on upper whorls; inner lip with definitely delimited callus, not spreading over body whorl; outer lip somewhat thickened; aperture denticulate within; sutures distinct, wavy; shallow groove at base of body whorl; anterior canal short, broad, curved; sometimes a small posterior canal with a distinct ridge below it on columella; color usually white with scattered brown spots or bands; much variation in color and amount of sculpture.

RECENT GEOGRAPHIC RANGE: Magdalena Bay, Lower California, to Payta, Peru.

HABITAT: 3 to 45 fathoms.

Nassarius catallus (Dall) new comb.

Pl. I, Fig. 8

Alectrion (Hima) catallus Dall, Harvard Univ., Mus. Compar. Zool., Bul. 43(6): 307, pl. 11, fig. 11, 1908.

Alectrion catallus Dall, U. S. Natl. Mus., Proc. 51: 576, 1917.

TYPE SPECIMEN: U. S. National Museum (Dall, 1908).

TYPE LOCALITY: U. S. S. "Albatross" Station 3355, Gulf of Panama (Dall, 1908).

DESCRIPTION: Shell solid; spire acute; usually 8 whorls; sharp reticulate sculpture of many axial riblets and larger transverse ridges; sutures very distinct, not channeled; callus definitely margined; aperture rounded-quadrate with about 19 rather distinct axial ribs within; outer lip with strong varix; usually 1 or 2 elongate pustules on columella below posterior canal; anterior canal short, recurved; deep sulcus at base of body whorl.

RECENT GEOGRAPHIC RANGE: Off San Miguel Island, California, to Panama.

HABITAT: 20 to 182 fathoms; rare.

Nassarius insculptus (Carpenter)

Pl. II, Figs. 1, 3

Nassa insculpta Carpenter, Brit. Assoc. Adv. Sci., Rpt. for 1863: 662, 1864; Arnold, Calif. Acad. Sci., Mem. 3: 233, 1903.

Nassa (Zeuxis) insculpta Carpenter, Tryon, Man. Conch. I, 4: 38, pl. 12, fig. 154, 1882.

Alectrion insculptus Carpenter, Dall, U. S. Natl. Mus., Proc. 51: 576, 1917.

Alectrion insculptus eupleura Dall, U. S. Natl. Mus., Proc. 51: 576, 1917.

Alectrion (Zeuxis) insculptus Carpenter, Dall, U. S. Natl. Mus., Bul. 112: 103, 1921.

Alectrion (Zeuxis) insculptus eupleura Dall, U. S. Natl. Mus., Bul. 112: 103, 1921.

Alectrion (Schizopyga) insculptus Carpenter, Oldroyd, I. S., Stanford Univ., Pubs., Univ. Ser. Geol. Sci. 2(1): 267, pl. 26, fig. 12, 1927.

Alectrion (Schizopyga) insculptus eupleura Dall, Oldroyd, I. S., Stanford Univ., Pubs., Univ. Ser. Geol. Sci. 2(1): 267, 1927.

Nassarius insculptus (Carpenter), Grant and Gale, San Diego Soc. Nat. Hist., Mem. 1: 677, 1931; Keen, A. M., West North Amer. Mar. Moll., p. 41, 1937; Smith and Gordon, Calif. Acad. Sci., Proc. IV, 26(8): 187, 1948.

Nassarius eupleurus, Keen, A. M., West North Amer. Mar. Moll., p. 41, 1937.

"*Nassa*" *insculpta*, Woodring, Bramlette, and Kew, U. S. Geol. Survey, Prof. Paper 207: 73, pl. 29, fig. 27, 1946.

TYPE SPECIMENS: Of *insculptus*: State Collection, University of California (Oldroyd, 1927). Of *eupleura*: U. S. National Museum, No. 209046 (Dall, 1917).

TYPE LOCALITIES: Of *insculptus*: 3 to 40 fathoms off Catalina Island, California (Recent). Of *eupleura*: Not stated by Dall, but somewhere between San Simeon, California, and Cedros Island, Lower California (Grant and Gale, 1931).

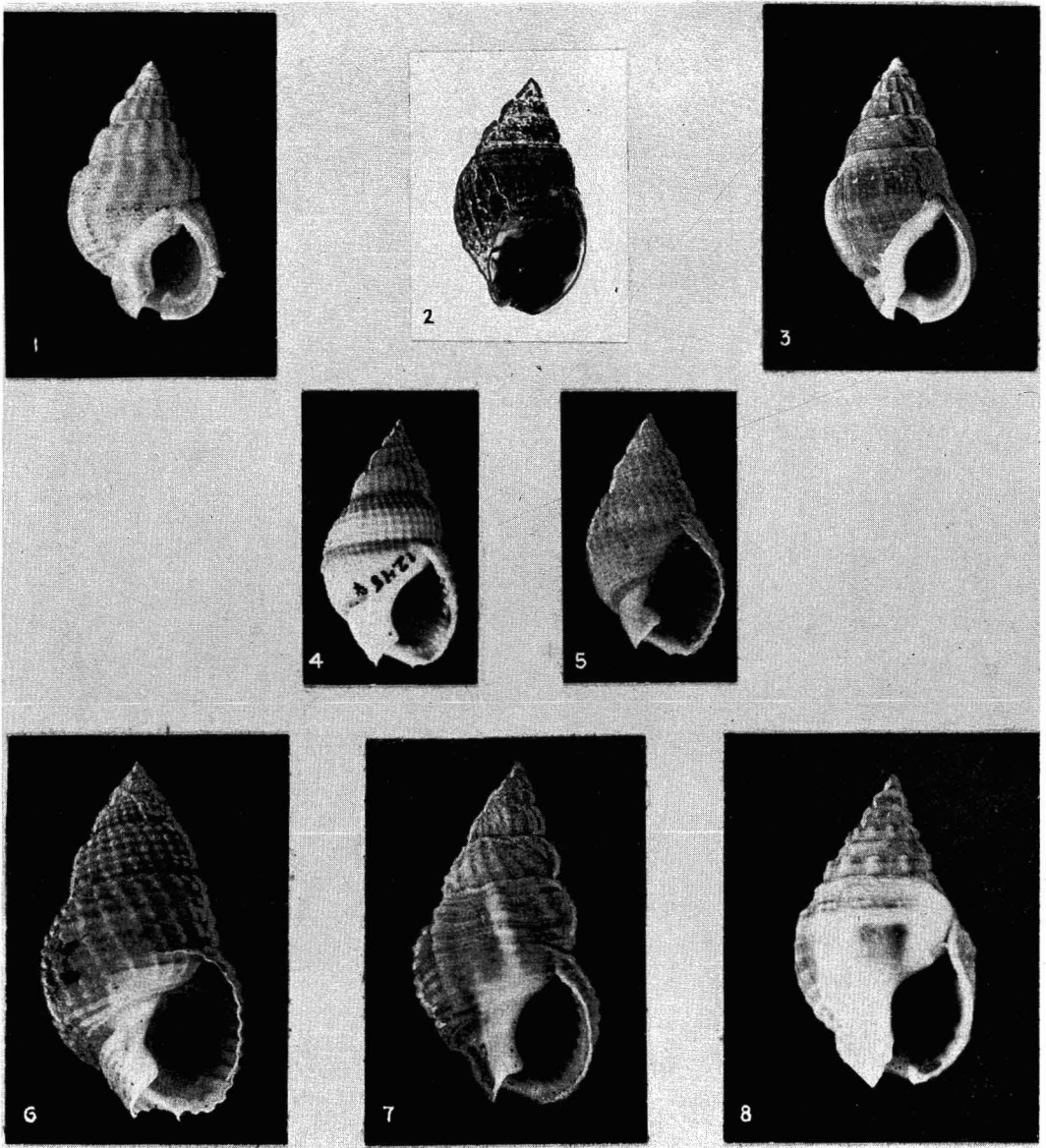


PLATE II

(All measurements are actual dimensions of specimens photographed)

FIG. 1. *Nassarius insculptus* (Carpenter); Cortez Banks, California. The variation possessing transverse ridges on the body whorl, named *eupleura* by Dall (1917). Calif. Acad. Sci. Loc. 27602. Length: 16.9 mm. Max. diameter: 9.6 mm.

FIG. 2. *Nassarius obsoletus* (Say); Alameda, California. Introduced with oysters from eastern states. Calif. Acad. Sci. Loc. 15159.

FIG. 3. *Nassarius insculptus* (Carpenter); Cortez Banks, California. Calif. Acad. Sci. Loc. 27602. Length: 23.0 mm. Max. diameter: 13.0 mm.

FIG. 4. *Nassarius perpunguis* (Hinds); San Diego, California. The banded variation called *bifusciata* by Berry (1908). Calif. Acad. Sci. Loc. 12458. Length: 16.8 mm. Max. diameter: 9.4 mm.

FIG. 5. *Nassarius perpunguis* (Hinds); San Pedro, California. Calif. Acad. Sci. Loc. 25459. Length: 19.2 mm. Max. diameter: 10.9 mm.

FIG. 6. *Nassarius californianus* (Conrad); 30 fathoms off Point Bonito, California. Calif. Acad. Sci. Loc. 28592. Length: 30.7 mm. Max. diameter: 16.7 mm.

FIG. 7. *Nassarius cerritensis* (Arnold); 20 to 30 fathoms in San Bartolome Bay, Lower California. Calif. Acad. Sci. Loc. 32294. Length: 21.8 mm. Max. diameter: 11.8 mm.

FIG. 8. *Nassarius tegula* (Reeve); San Diego, California. Calif. Acad. Sci. Loc. 24820. Length: 18.8 mm. Max. diameter: 11.7 mm.

DESCRIPTION: Maximum length, 23 mm.; average length, 18–22 mm.; usually 7 whorls; numerous fine, spiral furrows, most prominent on lower portion of body whorl; typically, no transverse sculpturing except on last few whorls; definitely margined callus on inner lip, not spreading over body whorl; spiral sculpture usually apparent through callus; outer lip thickened by slightly denticulate ridge; columella often separated from body whorl by deep, narrow groove; anterior canal short, broad, curved.

Typical *N. insculptus* possesses no transverse sculpture on the body whorl or the penultimate whorl. In my opinion, the form *eupleura*, in which the axial ribs continue onto the body whorl, is a variation of no taxonomic value. I have seen collections containing specimens grading from the typical *insculptus*, with no longitudinal ridges on the body whorl, to specimens possessing conspicuous transverse ribs on the body whorl. The ribbed form cannot be called a subspecies because its geographic range coincides with that of the typical form.

RECENT GEOGRAPHIC RANGE: Point Arena, California, to Cedros Island, Lower California.

HABITAT: 10 to 200 fathoms, in mud, sand, gravel; rare.

Nassarius obsoletus (Say)

Pl. II, Fig. 2

Nassa obsoleta Say, Acad. Nat. Sci. Phila., Jour. 2: 232, 1822.

Nassa (Ilyanassa) obsoleta Say, Tryon, Man. Conch. I, 4: 60, pl. 18, figs. 237–249, 1882.

Ilyanassa obsoleta Say, Dall, Nautilus 21: 91, 1907; U. S. Natl. Mus., Proc. 51: 578, 1917.

Alectrion (Ilyanassa) obsoleta Say, Dall, U. S. Natl. Mus., Bul. 112: 103, 1921; Oldroyd, I. S., Stanford Univ., Pubs., Univ. Ser. Geol. Sci. 2(1): 269, pl. 26, fig. 15, 1927.

Nassarius (Ilyanassa) obsoletus Say, Keep, West Coast Shells, p. 230, 1935.

Nassarius obsoletus, Keen, A. M., West North Amer. Mar. Moll., p. 41, 1937.

TYPE SPECIMEN: Philadelphia Academy of Natural Sciences (Oldroyd, 1927).

TYPE LOCALITY: East coast (Oldroyd, 1927).

DESCRIPTION: Maximum length, 25 mm.; average length, about 20 mm.; shell solid; 6 or 7 convex whorls; sutures simple, not deeply impressed; body whorl longer than length of spire; apex blunt, usually broken; numerous faint spiral ribs crossed at an angle by slightly raised transverse ridges; cancellate sculpture sometimes giving granulated appearance to shell surface, particularly on upper whorls; outer lip plain or slightly thickened at edge; aperture often lined within by elevated, interrupted spiral lines; thin white or brownish callus on inner lip, spreading only slightly onto body whorl; posterior canal typically absent, if present a faint groove; anterior canal but a slight notch; no groove at base of body whorl; shell dark reddish brown, blackish, or lighter brown, sometimes tinged with olive green or banded with lighter color.

This species is called the "Worn-Out Dog Whelk" because of its eroded appearance. Rarely are perfect shells found, since the spire is usually broken at the apex. This species lacks the bifurcated foot typical of most Nassariidae.

RECENT GEOGRAPHIC RANGE: On West Coast: Boundry Bay, British Columbia; San Francisco, Oakland, Alameda, and Palo Alto, California. Introduced from east coast with oyster seed.

HABITAT: Flourishing on oyster beds and mud flats.

Nassarius corpulentus (C. B. Adams)

Pl. I, Fig. 6

Nassa corpulenta C. B. Adams, N. Y. Lyceum Nat. Hist., Ann. 5: 284, 529 [pagination of separate: 60, 305], 1852; Stearns, U. S. Natl. Mus., Proc. 17: 181, 1894; Pilsbry and Lowe, Acad. Nat. Sci. Phila., Proc. 84: 115, 1932.

Nassarius corpulenta C. B. Adams, Bales, Nautilus 52: 45, 1938.

DESCRIPTION: Maximum length, 20 mm.; average length, about 17 mm.; 7 or 8 convex whorls; body whorl longer than half length of shell; body whorl almost as wide as length of shell; sutures impressed, somewhat wavy; several prominent transverse ridges, most noticeable on first 3 whorls, forming small nodes near sutures; many fine, evenly-spaced, raised, spiral threads; outer lip considerably thickened; row of denticles within aperture; columella concave, covered with heavy callus, which is often denticulate; posterior canal faintly indicated on some specimens; anterior canal short, rather broad, slightly reflected; deep groove at base of body whorl; shell whitish or ashen, often with few brown bands encircling body whorl.

RECENT GEOGRAPHIC RANGE: Cape San Lucas, Lower California, to Colombia.

*Species of Doubtful Occurrence
or Uncertain Systematic Position*

Several Nassariidae reportedly have been collected within the area treated in this paper which, in my opinion, do not belong to this fauna. These species are discussed below.

Nassarius nodicinctus (A. Adams)

Dall (1921) states that *N. nodicinctus* ranges from San Diego, California, to Panama and the Galapagos Islands. This range has been copied by succeeding authors, such as Oldroyd (1927) and Keen (1937). However, these authors cite no actual specimens taken as far north as San Diego. In the collections consulted, there were no specimens from the west coast of North America; all were from the Galapagos Islands. I have located no mention, other than Dall's report, of specimens found in this area. In collecting along the California coast, I have never discovered *N. nodicinctus*. Furthermore, the type locality of this species is in the Galapagos. For these reasons, I believe Dall's record from San

Diego is a mistake perpetuated by subsequent conchologists and that this species should be excluded from the faunal record for this area.

Nassarius noduliferus (Philippi)

N. noduliferus is also reported by Dall (1921) to occur at San Diego, ranging from San Diego to the Gulf of California. Here again, Oldroyd (1927) and Keen (1937) record the same range. However, in this case too, I have found no record, either in the collections or the literature, of actual specimens from the west coast. Also, the type locality of *noduliferus* is in the China Seas. In my opinion, this species definitely is not a member of the west coast fauna.

Nassarius nodiferus (Powys)

N. nodiferus, recognized by Carpenter (1864) as living in Panama and the Galapagos, has been confused with *N. noduliferus*. *N. nodiferus* is not a west coast form either; I have found no record of its being taken from this coast, and I have never collected it here myself.

Alectrion tschudii (Troschel)

If Dall's (1917) report of a species named *Alectrion tschudii*, ranging from Cedros Island, Lower California, to Peru, is correct, this mollusc should be included in this paper, since it would occur within the area from Cape San Lucas to Cape Flattery. However, in my opinion, this name should be discarded entirely. In all the literature, Dall's reference to this species is the only one I have located. Dr. Howard Hill, Curator of Zoology at the Los Angeles County Museum, writes (personal communication) that *A. tschudii* is a name given the juvenile form of *Nassarius dentiferus*. Since *N. dentiferus* lives in Mexico, Panama, and Peru, not ranging as far north as Cape San Lucas, it is not considered in this paper.

Alectrion lirata (Dunker)

A. lirata should merely be mentioned in this list. Bonnot (1935) reports that a shipment of Japanese seed oysters was inspected at Elkhorn Slough. The *Nassarius* specimens therein were identified by Dr. Paul Bartsch of the U. S. National Museum as *Alectrion lirata* (Dunker). However, this is the only reference to this species' being found on our coast, so I assume that, unlike *N. obsoletus*, it has not become established in this area.

Nassarius onchodes (Dall)

Dall (1917) described a species of Nassariidae which he named *Alectrion onchodes*, ranging from Cedros Island, Lower California, to Panama. This species was never figured. In the collections, I found no example of this mollusc. Although Jordan (1936) reports *N. onchodes* from the Pleistocene of Magdalena Bay, Lower California, I have discovered no other record of its being collected either living or as a fossil. Consequently, the position of this species remains uncertain.

Nassarius mendicus indisputabilis (Oldroyd)

The systematic status of *N. mendicus indisputabilis* is also problematic. This mollusc was figured and named as a subspecies of *N. mendicus* by Oldroyd (1927), but no description of it was given. According to Grant and Gale (1931), *indisputabilis* is of no value. However, although I was able to locate only two specimens identified as *indisputabilis*, they do differ from typical *mendicus*, as well as from the subspecies *cooperi*. The shells of *indisputabilis* are about 8 millimeters in length, smaller than *mendicus* or *cooperi*. The sculpture of *indisputabilis* is sharper, the axial threads being more prominent than on either *mendicus* or *cooperi*. Unlike either *mendicus* or *cooperi*, the transverse and axial ornamentation is about equally well developed and distinct on all whorls. Both the basal groove and the anterior canal of *indisputabilis* are larger in relation to shell size than on *mendicus* or

cooperi. *N. indisputabilis* seems to have a more northern range than *mendicus* or *cooperi*; the specimens I examined, housed at the California Academy of Sciences, were from Annette Island, Alaska.

Further to confuse the question, the California Academy of Sciences specimens of *indisputabilis* are much closer to Oldroyd's (1927) Figure 14, representing *mendicus*, than to Oldroyd's (1927) Figure 4, which supposedly shows *indisputabilis*. Until a description of *indisputabilis* is published and more specimens are collected, the true position of this form cannot be determined.

REFERENCES

- BONNOT, PAUL. 1935. A recent introduction of exotic species of molluscs into California waters from Japan. *Nautilus* 49(1): 1-2.
- BURCH, J. Q. 1945. Distributional list of the west American marine mollusks from San Diego, California, to the Polar Sea. *South. Calif. Conch. Club, Proc.* 1(2 [51]): 3-64. [Mimeo.]
- CARPENTER, P. P. 1864. Supplementary report on the present state of our knowledge with regard to the molluscs of the west coast of North America. *Brit. Assoc. Adv. Sci., Rpt.* 1863: 517-686.
- COOKE, A. H. 1895. Molluscs. *The Cambridge Natural History*. Vol. 3. 459 pp. The Macmillan Company, London.
- DALL, W. H. 1917. Summary of the mollusks of the family Alectrionidae of the west coast of America. *U. S. Natl. Mus., Proc.* 51: 575-579.
- . 1921. Summary of the marine shell-bearing mollusks of the northwest coast of America, from San Diego, California, to the Polar Sea, mostly contained in the collection of the U. S. National Museum, with illustrations of hitherto unfigured species. *U. S. Natl. Mus., Bul.* 112: 1-217.
- FLATTELY, F. W., and C. L. WALTON. 1922. *The Biology of the Seashore*. 336 pp. The Macmillan Company, London.

- GRANT, U. S., and H. R. GALE. 1931. Catalogue of the marine Pliocene and Pleistocene mollusca of California and adjacent regions. . . . *San Diego Soc. Nat. Hist., Mem.* 1: 1-1036.
- JORDAN, E. K. 1924. Quaternary and Recent molluscan fauna of the west coast of Lower California. *South. Calif. Acad. Sci., Bul.* 23: 145-156.
- 1936. The Pleistocene fauna of Magdalena Bay, Lower California. *Stanford Univ., Dept. Geol. Contrib.* 1: 107-173.
- KEEN, A. M. 1937. *An abridged check list and bibliography of west North American marine mollusca.* 86 pp. Stanford University Press, Stanford University.
- KEEP, JOSIAH. 1935. *West coast shells.* [Revised.] 350 pp. Stanford University Press, Stanford University.
- MACGINITIE, G. E. 1931. The egg-laying process of the gastropod *Alectrion fossatus* Gould. *Ann. and Mag. Nat. Hist.* X, 8: 258-261;
- 1935. Ecological aspects of a California marine estuary. *Amer. Midland Nat.* 16(5): 629-765.
- and NETTIE MACGINITIE. 1949. *Natural history of marine animals.* 473 pp., 282 text figs. McGraw-Hill, New York.
- OLDROYD, I. S. 1927. The marine shells of the west coast of North America. *Stanford Univ., Pubs., Univ. Ser. Geol. Sci.* 2(2): 1-304.
- RICKETTS, E. F., and JACK CALVIN. 1948. *Between Pacific tides.* [2nd ed.] 320 pp. Stanford University Press, Stanford University.
- ROGERS, J. E. 1939. *The shell book.* 485 pp., 8 pl., 103 figs. Doubleday Doran, New York.
- STEARNS, R. E. C. 1894. The shells of the Tres Marias and other localities along the shores of Lower California and the Gulf of California. *U. S. Natl. Mus., Proc.* 17: 139-204.
- TRYON, G. W. 1882. *Manual of conchology.* Vol. 4. 276 pp. Private Pub., Philadelphia.
- 1883. *Structural and systematic conchology.* Vol. 2. 430 pp. Private Pub., Philadelphia.
- WOODRING, W. P., M. N. BRAMLETTE, and W. S. W. KEW. 1946. Geology and paleontology of Palos Verdes Hills, California. *U. S. Geol. Survey, Prof. Paper* 207. 145 pp., 37 pls.