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

JOAN DEMOND

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.

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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 pectinoids 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. cerrientis*, 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, Astreopeten 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 ovum-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


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 tautonomy, 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 Duménil.

Dall (1917, 1921) and Oldroyd (1927) used the family name Alectriionidae and the generic name Alectrio 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 Alectrio 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 Duménil as a substitute for Nassa Lamarck. Froriep (1806), in his translation of Duménil, assigned only the species Buccinum arcularia Linnaeus to Nassarius. Consequently, this species becomes the genotype by monotypy.

The author’s opinion is that Nassarius Duménil 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. perpinguis, N. californianus, N. ceritensis, 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. cervitensis*

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


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


**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 reeuei*, 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* Gould, Keep, West Amer. Shells, p. 184, fig. 186, 1904.

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


*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.


**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. perpingius* 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


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


*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.


**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" deloi," 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. perpinquus*, 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


**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


**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 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.


**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 ashen.

**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


*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.

**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.


*Nassarius versicolor* (C. B. Adams)
Pl. I, Fig. 5


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


*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 cattalus* (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.
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 whors; 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 insculptus (Carpenter)

Pl. II, Figs. 1, 3


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


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).
Fig. 1. *Nassarius insculptus* (Carpenter); Cortez Banks, California. The variation possessing transverse ridges on the body whorl, named *enpleura* 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 perpinguis* (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 perpinguis* (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 cercitensis* (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


*Nassarius (Ilyanassa) obsoletus* Say, Keep, West Coast Shells, p. 250, 1935.


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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 lineated 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: Boundary 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

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.
Alectria 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 _Alectria 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 _Alectria 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


