
Macoma inquinata

Irus clam

Phylum: Mollusca

Class: Bivalvia, Heterodonta, Euheterodonta

Order: Imparidentia, Cardiida

Family: Tellinoidea, Tellinidae, Macominae

Taxonomy: *Macoma balthica*, *M. nasuta* and *M. inquinata* were all originally described as members of the genus *Tellina*. *Tellina inquinata* and *T. irus*, initially described as different species (the former with eastern Pacific distribution, the latter with western), were synonymized in the genus *Heteromacoma*. Later, this synonymization was reversed based on characters of shell morphology and *Macoma inquinata* (previously, and confusingly, called *M. irus*) was deemed a member of the genus *Macoma*, with an eastern Pacific distribution while *H. irus*, remained a *Heteromacoma*, with a the western Pacific (see Keen 1962; Coan 1971). Thus, known synonyms for *M. inquinata* include *T. inquinata* as well as *M. irus*. Subspecific designations are also sometimes seen (e.g. *Macoma heteromacoma inquinata*, Kabat and O'Foighil 1987). *Macoma inquinata* is the name almost exclusively used in current intertidal guides (e.g. Coan and Valentich-Scott 2007).

Description

Size: Individuals up to 55 mm in length (Coan 1971). The illustrated specimen (Fig. 1) is 44 mm in length, 35 mm in height, and 18 mm in diameter.

Color: Shell is dull white, with a dark and opaque periostracum (not shiny) (see Fig. 294, Kozloff 1993). Interior shell is porcelainous white and feebly polished (Dunnill and Ellis 1969). Siphons are only barely yellowish in color (Kozloff 1993).

General Morphology: Bivalve mollusks are bilaterally symmetrical with two lateral valves or **shells** that are hinged dorsally and surround a mantle, head, **foot** and viscera

(see Plate 393B, Coan and Valentich-Scott 2007). Among the bivalves, the Heterodonta are characterized by **ctenidia** (or gills) that are eulamellibranchiate, fused mantle margins and the presence of long **siphons**. Veneroid bivalves have well-developed hinge teeth and members of the family Tellinidae have short lateral hinge teeth (when present – see **Possible Misidentifications**), shells with external striations or ribs, and deep pallial sinuses (Coan and Valentich-Scott 2007). When holding closed shell in both hands with the hinged area up and the ligaments toward you, the right valve is in the right hand (Fig. 4) (Keen and Coan 1974).

Body:

Color:

Interior: Ligament is long, strong, narrow, and prominent (Figs. 1, 4). It is not seated on a nymph, but is entirely external (Tellinidae, Coan and Valentich-Scott 2007).

Exterior:

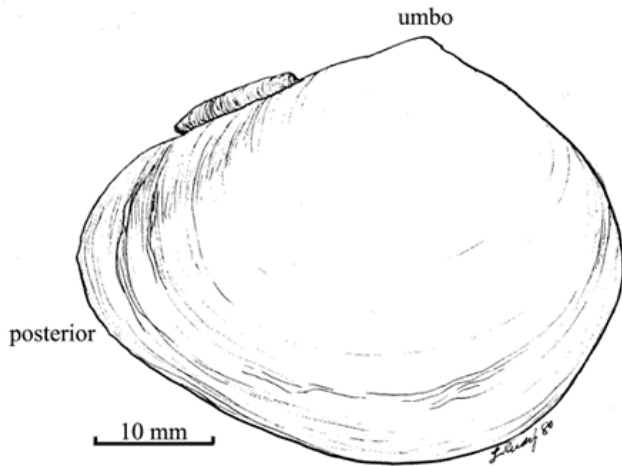
Byssus:

Gills:

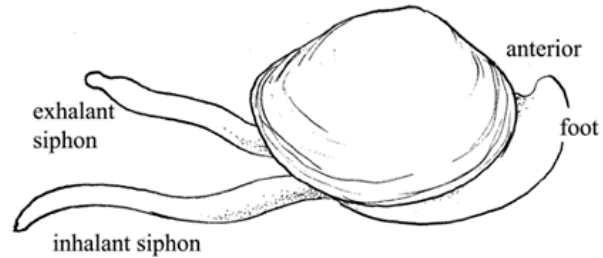
Shell: Shape ovate or subovate, but not circular. Posterior end is narrower and less rounded than anterior end. Shell is heavy, not fragile and inflated, with subcentral umbones (Fig. 1). Occasionally, there is a slight gape and flex to right on the posterior end (Dunnill and Ellis 1969).

Interior: Pallial line is not detached from the anterior ventral end of pallial sinus (Fig. 2) and is longer in the left valve (Fig. 3). The pallial sinus reaches almost to the anterior adductor scar, or just to its base in the left valve (Fig. 3) (Coan 1971). The pallial sinuses are similar in the two valves (e.g.

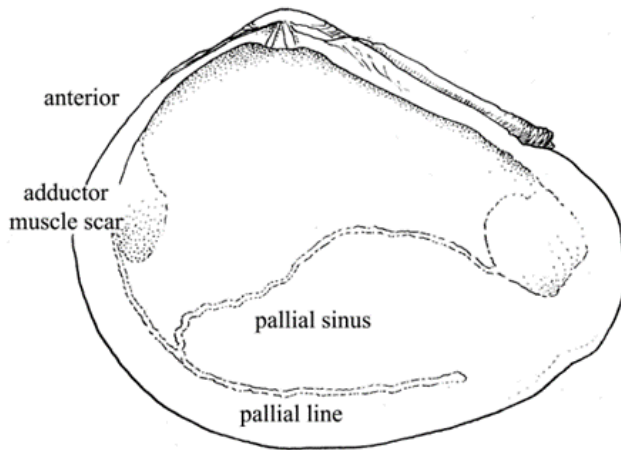
Macoma inquinata



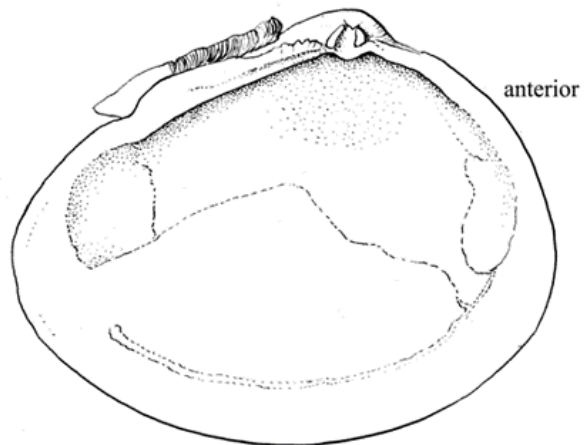
1. *Macoma inquinata*, right valve (L:44mm,D:18mm, H:35mm) x2: shell subovate, posterior narrow; valves equal, inflated; umbones subcentral; color dull white.



1a. Live clam x1: siphons separate.



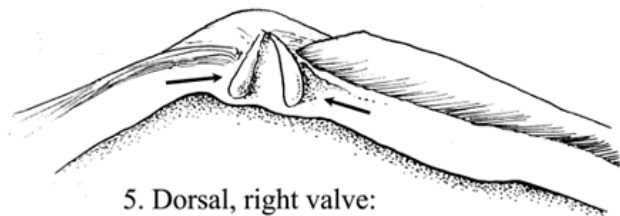
2. Interior, right valve: pallial sinus reaches almost to base of anterior adductor muscle scar.



3. Interior, left valve: pallial sinus as in right valve.



4. (Dorsal view): ligament external; valves slightly bent right posteriorly.



5. Dorsal, right valve: two cardinal teeth in each valve, no lateral teeth.

compare to *M. nasuta*, this guide).

Exterior: External shell bears conspicuous concentric sculptural undulations (Fig. 1).

Hinge: Hinge with ligament is entirely external and no lateral teeth (*Macoma*, Coan and Valentich-Scott 2007). Hinge area includes two cardinal teeth in each valve, but no lateral teeth (Fig. 5).

Eyes:

Foot:

Siphons: The inhalant and exhalant siphons are completely separate (Fig. 1a) (Quayle 1970; Kozloff 1993).

Burrow:

Possible Misidentifications

Tellinids can be distinguished from other small or young bay clams (i.e. Mactridae: *Tresus*; Veneridae: *Protothaca*, *Saxidomus*; Myidae: *Mya*, *Cryptomya*) an external ligament, an ovate shell, an inconspicuous nymph (or supporting projection for the external ligament), sometimes reddish hue and lateral teeth as well as a shell with ribs or striations (no radial pattern) and shells that never gape. Lateral teeth may or may not be present in the Tellinidae (Coan 1971). Myids have a hinge with a spoon-shaped chondrophore (left valve) and a projecting tooth (right valve) (see *Mya arenaria*, this guide). Venerids have three cardinal teeth in each valve. Mactrids have an internal ligament, A-shaped cardinal teeth, and gaping valves (Coan and Valentich-Scott 2007). The Tellinidae has around 16 species distributed between two genera locally – *Tellina* and *Macoma*. These genera can be differentiated by the hinge teeth, *Tellina* species have a hinge with lateral teeth, while *Macoma* species do not. *Macoma* species have shells that are also more rounded and inflated than *Tellina*, and are smooth, white, often chalky. They are characterized by having a ovate shell consisting of two equal

valves, a dark and deciduous periostracum, two cardinal teeth, the absence of lateral teeth and a pallial sinus that is deeper on the left valve (Scott and Blake 1998; Arruda and Domaneschi 2005). *Macoma* species may also have a more northern geographic distribution while *Tellina* are elongate, relatively compressed, conspicuously sculptured, brightly colored, and usually warm water dwellers (Coan 1971). Eleven species in the infaunal genus *Macoma* (Luttikhuisen et al. 2012) are reported locally (although 30 have been identified in the northeastern Pacific, Dunnill and Ellis 1969), but only seven are described in local keys (e.g. Coan and Valentich-Scott 2007), the four most common species of *Macoma* in our area are *M. balthica*, *M. nasuta*, *M. inquinata*, and *M. secta* (Kabat and O'Foighil 1987).

Two species, *M. secta* and *M. indentata* have a posterior dorsal flange extending from posterior end to the external ligament, this is absent in other *Macoma* species. The former species is called the sand clam and has a quadrate and truncate posterior. The latter is elongate, has a pointed posterior, unique muscle scars, is relatively rare and small (to 2.5 cm) and occurs from Trinidad, California southward. *Macoma secta*, also has a white shell, with a yellowish epidermis. Its right valve is more inflated than the left, and it can be large (to 120 mm) and is more common in clean sand, not in estuarine mud.

The morphology of the pallial sinus differentiates the other species. In species without a posterior dorsal flange, *M. acolasta* and *M. yoldiformis*, the anterior ventral edge of the pallial sinus is detached for a portion of the distance to the posterior adductor muscle scar. *Macoma acolasta* also has a rounded posterior, rather than pointed as in *M. yoldiformis* and is rare, sand-dwelling, and occurs from Bodega Bay, California, southward. *Macoma yoldiformis* is elongate, inflated, and thin, with the pallial sinus detached from the

pallial line. Although the range of this clam is from Vancouver south to Baja California, it is not included in Puget Sound or British Columbia work (Dunnill and Ellis 1969). It can be found in silt in low intertidal of protected bays (Coan and Valentich-Scott 2007).

Macoma inquinata, *M. nasuta* and *M. balthica* (see descriptions in this guide) are all species with an anterior ventral edge of pallial sinus that is not detached and they tend to be larger (up to 110 mm) than *M. acolasta* or *M. yoldiformis* (less than 30 mm). *Macoma balthica* has a pinkish hue and a pallial sinus that ends $\frac{3}{4}$ of the way to anterior adductor muscle scar and is generally more oval than *M. nasuta* or *M. inquinata* (Kozloff 1993). In *M. inquinata*, the pallial sinus does not reach the ventral end of the anterior adductor muscle. *Macoma nasuta*, on the other hand, is not as round and heavy as *M. inquinata* and its pallial sinus reaches and joins the anterior adductor scar above its base (left valve). (Its right valve may be more like *M. inquinata*'s). Furthermore, its siphons are orange and its shell posterior is bent to the right (hence the name, bent-nose clam). *Macoma inquinata* can also bend slightly posteriorly, and may be confused with the thinner *M. nasuta*, without investigations of the other aforementioned features. In *M. balthica*, the pallial sinus that reaches to $\frac{1}{4}$ the anterior adductor muscle scar and the shell has a pinkish hue. (see Plate 422 for diagrams of these distinguishing characteristics in *Macoma*).

Macoma incongrua, generally a northern species, is the species closest to *M. inquinata*. It can be found intertidally to 36 meters. It is quite circular in outline, its pallial sinuses extend longer than in *M. inquinata*, and are different between its two valves, they are similar in *M. inquinata*'s

valves. *Macoma incongrua* averages 30–40 mm in length (Dunnill and Ellis 1969).

(The following species may be present locally, but are not included in local dichotomous keys). *Macoma expansa*, is a rare, usually offshore species (to 50 mm) whose pallial sinuses are perpendicular to the pallial line. *Macoma elimata* is found only in 15–476 meters of water. *Macoma calcarea* is found from 35 meters and lower, from 37° north. Other northern subtidal species include the large *M. brota* and *M. lipara* (Dunnill and Ellis 1969).

Ecological Information

Range: Type locality is Columbia River, OR (Keen 1962). Known range includes Siberia, Aleutian Islands, British Columbia, south to Oregon and rare further south of Santa Barbara, California (Coan 1971).

Local Distribution: Distribution in many Oregon bays, particularly Tillamook, Coos, Siuslaw, Yaquina, and less common in Alsea, Nestucca, Netarts Bays (Hancock 1979).

Habitat: Usually in soft muddy sand (Dunnill and Ellis 1969; Kabat and O'Foighil 1987) and in protected areas. Individuals have also been found in coarse sand with shell hash, intertidal sand, and in fine sediment overlying flat rocks (British Columbia, Canada, Dunnill and Ellis 1969) as well as in eelgrass (Puget Sound, Washington, Kozloff 1974). Like other *Macoma* species (e.g., *M. nasuta*), *M. inquinata* individuals can be the subject of toxicity testing due to their uptake and retention of benthic compounds by deposit feeding. *Macoma inquinata* and other deposit feeders accumulate more aromatic hydrocarbons than suspension feeders (e.g., Roesijadi et al. 1978; Crecelius et al. 1980; Augenfeld et al. 1982).

Salinity: Individuals collected where salinity is 30.

Temperature: Cold to temperate waters. The presence of *M. inquinata* in the fossil record at

Newport Bay, California during the late Pleistocene suggests historically cooler temperatures in that region (Powell 2001).

Tidal Level: Intertidal and subtidal (Kabat and O'Foighil 1987) to 48 m offshore (Coan 1971).

Associates: Often co-occurs with the congener, *M. nasuta* (South Slough of Coos Bay). Juvenile pea crabs, *Pinnixia littoralis*, can occur within the mantle cavity of *M. inquinata* and *M. nasuta* in Puget Sound, Washington (Haderlie and Abbott 1980).

Abundance: Common in bays (Kozloff 1993; Coan and Valentich-Scott 2007) and can be locally abundant (e.g. over 6 million at one small Coos Bay site, Gaumer 1978). *Macoma inquinata* was one of the dominant intertidal macrobenthic species in the Chukchi Sea (67–73°N, Wang et al. 2014).

Life-History Information

Reproduction: Separate sexes, gametes are discharged into the water through excurrent siphon. Gametogenesis for *M. nasuta* and *M. secta* is described by Rae (1978), with both species ripe with gametes in summer months (Tomales Bay, California). The reproduction and development has been described for the common congener, *M. balthica* (Caddy 1967, 1969; Lammens 1967), which spawns in spring and summer (Friday Harbor, Washington, Kabat and O'Foighil 1987).

Larva: Bivalve development generally proceeds from external fertilization via broadcast spawning through a ciliate trochophore stage to a veliger larva. Bivalve veligers are characterized by a ciliated velum that is used for swimming, feeding and respiration. The veliger larva is also found in many gastropod larvae, but the larvae in the two groups can be recognized by shell morphology (i.e. snail-like versus clam-like). In bivalves, the initial shelled-larva is called a D-stage or straight-hinge veliger due to the "D"

shaped shell. This initial shell is called a prodissoconch I and is followed by a prodissoconch II, or shell that is subsequently added to the initial shell zone (e.g. see *M. balthica*, Fig. 1, Caddy 1969). Finally, shell secreted following metamorphosis is simply referred to as the dissoconch (see Fig. 2, Brink 2001). Once the larva develops a foot, usually just before metamorphosis and loss of the velum, it is called a pediveliger (Kabat and O'Foighil 1987; Brink 2001). (For generalized life cycle see Fig. 1, Brink 2001). *Macoma balthica*, *M. nasuta* and *M. secta* are all known to have free swimming veliger larvae (Marriage 1954; Rae 1978, 1979; Brink 2001).

Juvenile:

Longevity:

Growth Rate:

Food: Chiefly a deposit feeder (although also potentially a suspension feeder, see *M. nasuta* and *M. balthica*, this guide), feeding on surface bacteria and detritus with their siphons (Kabat and O'Foighil 1987). The feeding behavior of the congeners, *M. nasuta* and *M. inquinata* showed variation in response to water flow. Their inhalant siphons extended farther, allowing for deposit feeding over a larger area, when water flow was lower (Levinton 1991).

Predators: Shorebirds.

Behavior:

Bibliography

1. ARRUDA, E. P., and O. DOMANESCHI. 2005. New species of *Macoma* (Bivalvia: Tellinoidea: Tellinidae) from southeastern Brazil, and with description of its gross anatomy. *Zootaxa*:13-22.
2. AUGENFELD, J. M., J. W. ANDERSON, R. G. RILEY, and B. L. THOMAS. 1982. The fate of polyaromatic hydrocarbons in an intertidal sediment exposure system: Bioavailability to *Macoma inquinata* (Mollusca, Pelecypoda) and *Abarenicola pacifica* (Annelida, Polychaeta). *Marine*

- Environmental Research. 7:31-50.
3. BRINK, L. A. 2001. Mollusca: Bivalvia, p. 129-149. *In*: Identification guide to larval marine invertebrates of the Pacific Northwest. A. Shanks (ed.). Oregon State University Press, Corvallis, OR.
 4. CADDY, J. F. 1967. Maturation of gametes and spawning in *Macoma balthica* (L.). Canadian Journal of Zoology. 45:955-965.
 5. —. 1969. Development of mantle organs, feeding, and locomotion in postlarval *Macoma balthica* (L.) (Lamellibranchiata). Canadian Journal of Zoology. 47:609-617.
 6. COAN, E. V. 1971. The Northwest American Tellinidae. California Malacozoological Society, Berkeley.
 7. COAN, E. V., and P. VALENTICH-SCOTT. 2007. Bivalvia, p. 807-859. *In*: The Light and Smith manual: intertidal invertebrates from central California to Oregon. J. T. Carlton (ed.). University of California Press, Berkeley, CA.
 8. CRECELIUS, E. A., J. M. AUGENFELD, D. L. WOODRUFF, and J. W. ANDERSON. 1980. Uptake of trace metals by the clam *Macoma inquinata* from clean and oil-contaminated detritus. Bulletin of Environmental Contamination and Toxicology. 25:337-344.
 9. DUNNILL, R. M., and D. V. ELLIS. 1969. Recent species of the genus *Macoma* (Pelecypoda) in British Columbia. National Museum of Canada, National Historical Papers. 45:1-34.
 10. GAUMER, T. F. 1978. Clam resources in a proposed Charleston boat basin expansion site. Information report 78-1. Oregon Department of Fish and Wildlife, Charleston, OR.
 11. HADERLIE, E. C., and D. P. ABBOTT. 1980. Bivalvia: the clams and allies, p. 355-410. *In*: Intertidal invertebrates of California. R. H. Morris, D. P. Abbott, and E. C. Haderlie (eds.). Stanford University Press, California.
 12. HANCOCK, D. R., T. F. GAUMER, G. B. WILLEKE, G. P. ROBART, and J. FLYNN. 1979. Subtidal clam populations: distribution, abundance, and ecology. Oregon State University, Sea Grant College Program, Corvallis.
 13. KABAT, A. R., and D. O'FOIGHIL. 1987. Phylum Mollusca, Class Bivalvia, p. 309-353. *In*: Reproduction and development of marine invertebrates of the northern Pacific Coast. M. F. Strathmann (ed.). University of Washington Press, Seattle, WA.
 14. KEEN, A. M. 1962. Reinstatement of the specific name *Macoma inquinata* (Deshayes). Veliger. 4:161-161.
 15. KEEN, A. M., and E. COAN. 1974. Marine molluscan genera of western North America: an illustrated key. Stanford University Press, Stanford, CA.
 16. KOZLOFF, E. N. 1974. Seashore life of Puget Sound, the Strait of Georgia, and the San Juan Archipelago and adjacent regions. University of Washington Press, Seattle and London.
 17. —. 1993. Seashore life of the northern Pacific coast: an illustrated guide to northern California, Oregon, Washington, and British Columbia. University of Washington Press, Seattle.
 18. LAMMENS, J. J. 1967. Growth and reproduction in a tidal flat population of *Macoma balthica* (L.). Netherlands Journal of Sea Research. 3:315-382.
 19. LEVINTON, J. S. 1991. Variable feeding behavior in three species of *Macoma* (Bivalvia, Tellinacea) as a response to water flow and sediment transport. Marine Biology. 110:375-383.
 20. LUTTIKHUIZEN, P. C., J. DRENT, K. T. C. A. PEIJNENBURG, H. W. VAN DER VEER, and K. JOHANNESSON. 2012. Genetic architecture in a marine hybrid zone: comparing outlier detection and ge-

- onomic clines analysis in the bivalve *Macoma balthica*. *Molecular Ecology*. 21:3048-3061.
21. MARRIAGE, L. D. 1954. The bay clams of Oregon. Contribution No. 20. Fish Commission of Oregon, s.l.
 22. POWELL, C. L. 2001. Geologic and molluscan evidence for a previously misunderstood late Pleistocene, cool water, open coast terrace at Newport Bay, southern California. *Veliger*. 44:340-347.
 23. QUAYLE, D. B. 1970. The intertidal bivalves of British Columbia. British Columbia Provincial Museum, Victoria, BC, Canada.
 24. RAE, J. G. 1978. Reproduction in two sympatric species of *Macoma* (Bivalvia). *Biological Bulletin*. 155:207-219.
 25. —. 1979. Population dynamics of two sympatric species of *Macoma* (Mollusca, Bivalvia). *Veliger*. 21:384-399.
 26. ROESIADI, G., J. W. ANDERSON, and J. W. BLAYLOCK. 1978. Uptake of hydrocarbons from marine sediments contaminated with Prudhoe Bay crude oil: influence of feeding type of test species and availability of polycyclic aromatic hydrocarbons. *Journal of the Fisheries Research Board of Canada*. 35:608-614.
 27. SCOTT, P. V., and J. A. BLAKE. 1998. The Mollusca Part 1: the Aplacophora, Polyplacophora, Scaphopoda, Bivalvia and Cephalopoda. Taxonomic atlas of the benthic fauna of the Santa Maria Basin and the Western Santa Barbara Channel. Vol. 8. Santa Barbara Museum of Natural History, Santa Barbara, CA.
 28. WANG, J., H. LIN, X. HE, J. LIN, Y. HUANG, R. LI, C. ZHENG, F. ZHENG, and J. JIANG. 2014. Biodiversity and community structural characteristics of macrobenthos in the Chukchi Sea. *Acta Oceanologica Sinica*. 33:82-89.

Updated 2015

T.C. Hiebert