Onchidoris bilamellata

Many-gilled onchidoris nudibranch

Phylum: Mollusca

Class: Gastropoda, Heterobranchia, Euthyneura, Ringipleura

Order: Nudipleura, Nudibranchia, Doridina, Doridoidei

Family: Onchidoridoidea, Onchidorididae

Description

Size: Usual length 15 mm (McDonald 1980); this specimen 15.5 mm long, 11 mm wide, 6 mm high. Far northern and Atlantic specimens can reach 31 mm length (Marcus 1961).

Color: Translucent brownish-white with irregular dark or rusty brown splotches, sometimes as irregular longitudinal stripes. Commonly a light spot between the dark rhinophores; gills dull white, underside a dull white (Marcus 1961). No yellow pigment, but some specimens without brown color (Kozloff 1974). Cryptic coloration (Potts 1981).

Body: Doridiform: oval; slightly broadened towards front. With a broad flat foot, thick fleshy mantle, and conspicuous double circlet of gills dorsally (Figs. 1, 2). Dorsum covered with many large round papillae, becoming smaller at edges. Surface firm. No large processes except rhinophores, gills, and papillae.

Rhinophores: A single pair, with 15-20 leaflets on either side (Marcus 1961) (Fig. 1). Rhinophores not especially long.

Papillae: Mushroom-shaped, with protruding spicules (Fig. 3). Numerous club-like tubercles of unequal size with a slight convex top. 10-15 spicules covered with epithelium project out over the surface. Spicules are thick with blunt tips and are centrally bent, sloping obliquely toward the base of the tubercle (Kress 1981). Spicules support the body and make it unpalatable (Potts 1981).

Oral Tentacles: None; fused as an oral veil.

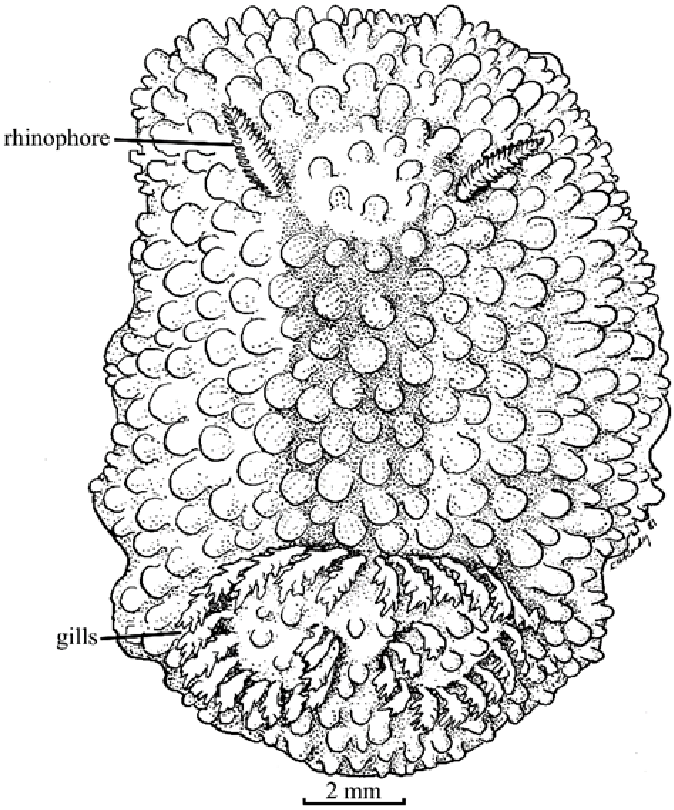
Gills: 16-32 (or more: 36 this specimen); The number of gills depends on the size of the dorid, with a variable number of lateral pinnules. Proximal pinnules are larger than distal (Potts 1981). Unipinnate. Simple pinnate gills form almost erect branchial plumes arranged in two semicircles just anterior to the anus. Gills are not completely retractable (Kozloff 1974) (Fig. 1). While there is no branchial pocket into which the gills can be withdrawn, there are localized muscle fibers around the base of each gill; contraction causes a depression in the mantle surface, and gills can be brought in closer to the body (Potts 1981). Countercurrent exchange through the gills (Potts 1981). Clusters of branchial glands between every two gills (Marcus 1961).

Eggs: Type A, defined as an egg mass in ribbon form, attached along the length of one edge, with capsules occurring throughout (Hurst 1967). With a short, stout spiral ribbon attached along one edge, flaring out on the other (O'Donoghue and O'Donoghue 1922) (Fig. 5); capsules have a smooth wall and contain 1-3 eggs; 60,000 eggs in a ribbon 4 cm long (Hadfield 1963). Eggs 100µm. Eggs laid preferentially near conspecifics, masses are common only in winter (Hurst 1967).

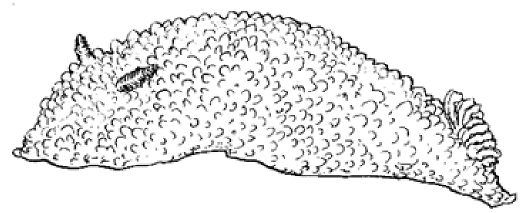
Possible Misidentifications

There are other oval dorid nudibranchs of the same general coloration and shape as *Onchidoris: Discocordis, Anisodoris, Archidoris,* and especially *Acanthodoris brunnea* are all found in our area. None of these have 16-32 single, branchial plumes arranged in the unusual two semicircles. *Acanthodoris brunnea* can be distinguished immediately by its very long rhinophores and conical papillae (not round ones), and by its seven branchial

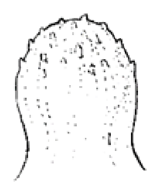
Onchidoris bilamellata



1. *O. bilamellata* (dorsal view) x8:
actual lenth 15.5 mm; solid oval, dorid nudibranch; covered with round papilla; posterior double circle of 16-32 or more gills; bilamellate rhinophores.

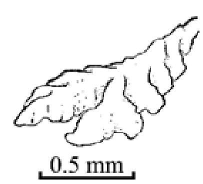


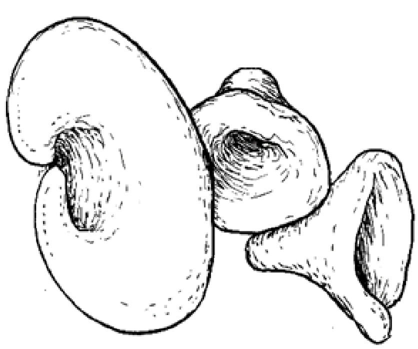
2. *O. bilamellata* (lateral view) x5.



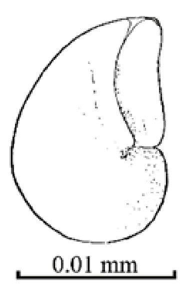
3. Single papilla x40: spicules protrude.

4. Single branchial plume x30: unipinnate gill.





5. Egg ribbon x2
(O'Donoghue & O'Donoghue, 1922).



6. Veliger x250
(Hurst, 1967).

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gills.

A pulmonate, *Onchidella borealis*, resembling a small shell-less limpet, is colored quite like *Onchidoris*. Close inspection reveals it to have stalked eyes, and only 20-24 papillae dorsally (Morris et al. 1980).

Ecological Information

Range: Aleutian Islands south to Morro Bay, California (McDonald 1980). Widely distributed in temperate and arctic seas of northern hemisphere. Found as far north as Iceland and Greenland (lat. 60-70 N), the Bering Sea (lat. 70 N), Alaska (lat. 60 N) and Japan (lat. 45N). In Europe, found north of lat. 50 N, through Scandinavia and the North Sea, on E and W coasts of Scotland and Ireland and on both sides of the English Channel. Found as far south as California (lat. 39) (Potts 1970).

Local Distribution: Coos Bay: Pigeon Point.

Habitat: Usually found with barnacle *Balanus balanoides*; at Pigeon Point on and under rocks; mudflats. Requires shade and dampness. Does not extend as high in the intertidal as its prey, *Balanus*, as exposure is a limiting factor (Miller 1961). Range is limited by desiccation (Todd 1979).

Salinity: Collected at 30.

Temperature: 8-11° C (Hurst 1967).

Tidal Level: Intertidal to 250 m (McDonald 1980); collected at mid-intertidal.

Associates: *Balanus*, chiton *Mopalia*, crabs *Hemigrapsus* and *Cancer oregonensis*, gastropods *Tegula* and *Nucella*, sea star *Pisaster ochraceus*, anthozoans *Anthopleura elegantissima* and *A. artemisia,* as well as isopod *Idotea P. wosnesenskii*. *Nucella* is a main competitor for food, which consumes *B. balanoides* at a rate of up to 8 times that of *O. bilamellata* (Potts 1970).

Weight: 0.7 gm., wet.

Abundance: "Frequent" (McDonald 1980); seasonally common.

Life-History Information

Reproduction: Hermaphroditic, but not self-fertilizing; internal fertilization (Hurst 1967). Reproductive output increases allometrically with size (Todd 1979). Individuals may lay more than one egg ribbon (Potts 1970). Copulation takes place before each spawning (Hadfield 1963). Eggs are laid in ribbons during February-March, and October-December (Puget Sound) (Hurst 1967); May to mid-June (British Columbia) (O'Donoghue and O'Donoghue 1922). Annual species, with pattern not rigidly fitted to calendar month (Bleakney and Saunders 1978). Breeding populations have a similar size and structure from year to year in spite of variation in annual recruitment (Todd 1979). Larval settlement of both *Onchidoris* and *B. balanoides* determines level of recruitment (Todd 1979). Newly metamorphosed *Onchidoris* settle below rock overhangs during summer months and are likely to remain on the rock where they first settle. Growing dorids migrate to the upper sides of rocks later in the season and spawn on these surfaces. This migration explains cited "sudden appearance" of animals on shore, though they have been there for several months. This migration up the rock surface may be motivated by a lack of food, reduction in temperature, or a physiological change associated with the onset of maturity (Potts 1970). Aside from this maturity-associated event, on-shore migrations do not occur, and colonization of the shore is achieved by pelagic larvae, not by juvenile animals moving up from deeper water (Potts 1970).

These animals stop feeding during spawning, and become weakened during this period; a reduction of pigmentation on the dorsal mantle has been observed. After this annual spawning event, animals are washed away and die (Potts 1970).

Larva: Shell dimensions, on average, are 146.9µm length, 95µm width, and 108µm depth. The shell is typically sinistral (Hurst

1967, Table 9). Type C shells (Hadfield 1963), defined as “egg shaped ‘inflated’ shells” (Vestergaard and Thorson 1938). Planktotrophic (Goddard 1992). Long larval life facilitates wide distribution (Potts 1970). Ability to delay metamorphosis until suitable settlement substrate is reached (Potts 1970). Larvae exhibit positive phototaxis (Hadfield 1963). Planktotrophic veliger larvae only metamorphose in the presence of live barnacles (Todd 1979). Settlement and metamorphosis are separable events. Settlement is reversible and can be repeated (Chia and Koss 1988). Propodia of the advanced veliger larva contain a unique set of anterolateral ganglia (Chia and Koss 1989). The primary receptor cells on the propodia of metamorphically competent veligers have been identified and implicated in the settlement response to cues found in barnacle water (Arkett et al. 1989). Cells in the apical sensory organ of the veliger are thought to contain receptors for inducers of metamorphosis (Hadfield et al. 2000). Metamorphosis involves the resorption of the velum, loss of the larval shell, and incorporation of the visceral mass into the cephalopedal mass (Chia and Koss 1988). Chia and Koss (1988) emphasize the hardiness and durability of these larvae, suggesting they be used in teaching at inland universities to demonstrate the morphological and behavioral changes associated with metamorphosis. Large numbers of larvae can be cultured in the laboratory on a variety of phytoflagellates and diatoms, at various temperatures, without excessive media changes.

Juvenile:

Longevity: Most opisthobranchs live less than a year (Morris et al. 1980). Not observed to live past 9-10 months (Todd 1979).

Growth Rate: Embryonic period 12-13 days (Hurst 1967). Spawning December-April (Potts 1970) with a peak in mid-January. Majority of larvae hatch in February and spend 2-3 months feeding and growing before settling. Fully grown by December (Todd 1979). Some rapidly growing individuals undergo spawning and death in August. (Todd 1979).

Food: Barnacles, mostly *Balanus* (McDonald 1980). Only feeds on soft parts of barnacle. Until they can take adult prey, newly metamorphosed dorids eat barnacle cyprids and/or spat (Todd 1981), and debris associated with barnacles (Todd, unpublished, in Chia and Koss 1988).

Predators: Many opisthobranchs are toxic or bad-tasting; predators are mostly other nudibranchs (Morris et al. 1980). Currents generated by cilia on the body and gills, coupled with the continuous discharge of epithelial glands, branchial glands, and mucus, creates an unpleasant “envelope” surrounding the dorid (Potts 1981). Tactile stimulation of the dorsum triggers the release of a large amount of colorless, viscous mucus containing distasteful or toxic substances, which play a defensive role (Potts 1981).

Behavior: When reared in the laboratory, veligers are observed to actively feed off the bottom of the dish, inverting onto their velum and using it to plough through food accumulations (Chia and Koss 1988).

Settlement behavior involves a descent to the bottom, in the normal swimming position, with the velum pointed upward. Upon contact, the larval foot undergoes contortions. The top of the foot extends downward, beyond the operculum, and contacts the substratum. The veliger then inverts onto the pedal sole, and a period of crawling ensues. Active crawling varies from minutes to several hours before metamorphosis is triggered, and may be continuous or involve stationary periods. While crawling, the velum is retracted, folded into the larval shell. Crawling will take place for a maximum of 30 minutes if no barnacles are encountered, and the larva will resume swimming (Chia and Koss 1988).

Feeding behavior involves entry by rupture and downward displacement of the barnacle operculum. The dorid comes to lie on top of the opercular orifice by gliding up over the side of the barnacle capitulum at the rostral end (even if initial contact is made with carinal end) and remains in this position for several hours. Afterwards, it moves off and is inactive during a period of digestion. Soft barnacle tissue may be removed by the action of the radula (reduced), or the buccal crop may function as a suction organ in the feeding process (Barnes and Powell 1954).

Bibliography

1. ARKETT, S., CHIA, F., GOLDBERG, J., and KOSS, R. 1989. Identified settlement receptor cells in a nudibranch veliger respond to specific cue. Biological Bulletin. 176(2): 155-160.
2. BARNES, H., and POWELL, H. 1954. *Onchidoris fusca* (Müller): a predator of barnacles. Journal of Animal Ecology. 23 (2): 361-363.
3. BLEAKNEY, J., and SAUNDERS, C. 1978. Life-history observations on nudibranch mollusk *Onchidoris bilamellata* in intertidal zone of Nova-Scotia. The Canadian Field-Naturalist. 92(1): 82-85.
4. CHIA, F.S., and KOSS, R. 1988. Induction of settlement and metamorphosis of the veliger larvae of the nudibranch, *Onchidoris bilamellata*. International Journal of Invertebrate Reproduction and Development. 14(1): 53-69.
5. CHIA, F.S., and KOSS, R. 1989. The fine structure of the newly discovered propodial ganglia of the veliger larva of the nudibranch *Onchidoris bilamellata*. Cell and Tissue Research. 256(1):17-26.
6. GODDARD, J. 1992. Patterns of development in nudibranch mollusks from the northeast Pacific Ocean, with regional comparisons. Ph.D., University of Oregon.
7. HADFIELD, M. 1963. The Biology of nudibranch larvae. Oikos. 14(1): 85-95.
8. HADFIELD, M., MELESHKEVITCH, E., and BOUDKO, D. 2000. The apical sensory organ of a gastropod veliger is a receptor for settlement cues. The Biological Bulletin. 198(1): 67-76.
9. HURST, A. 1967. The egg masses and veligers of thirty northeast Pacific opisthobranchs. The Veliger. 9:255-288.
10. KOZLOFF, E.N. 1974. Keys to the marine invertebrates of Puget Sound, the San Juan Archipelago, and adjacent regions. University of Washington Press, Seattle & London.
11. KRESS, A. 1981. A scanning electron microscope study of notum structures in some dorid nudibranchs (Gastropoda: Opisthobranchia). Journal of the Marine Biological Association of the United Kingdom. 61(1): 177-191.
12. MARCUS, E. 1961. Opisthobranch mollusks from California. The Veliger. 3 (Supplement 1).
13. MCDONALD, G.R. 1980. Guide to the nudibranchs of California. American Malacologists, Inc., Melbourne, FL.
14. MILLER, M. 1961. Distribution and food of the nudibranchiate mollusca of the south of the Isle of Man. Journal of Animal Ecology. 30(1): 95-116.
15. MORRIS, R. H., D. P. ABBOTT, and E. C. HADERLIE. 1980. Intertidal invertebrates of California. Stanford University Press, Stanford, California.
16. O'DONOGHUE, C. H., and E. O'DONOGHUE. 1922. Notes on the nudibranchiate mollusca from the Vancourver Island region. Transactions of the Royal Society of Canada. 14:131-143.
17. POTTS, G. 1970. The Ecology of *Onchidoris fusca* [Nudibranchia]. Journal of the Marine Biological Association of the United Kingdom. 50(2): 269-292.

18. POTTS, G. 1981. The anatomy of respiratory structures in the dorid nudibranchs, *Onchidoris bilamellata* and *Archidoris pseudoargus*, with details of the epidermal glands. Journal of the Marine Biological Association of the United Kingdom. 61(4): 959-982.
19. TODD, C. 1979. The population ecology of *Onchidoris bilamellata* (L.) (Gastropoda: Nudibranchia). Journal of Experimental Marine Biology and Ecology. 41(3): 213-255.
20. VESTERGAARD, K. and G. THORSON, 1938. Über den Laich und die Larven von *Duvaucelia plebeja, Polycera quadrilineata, Eubranchus pallidus* und *Limapontia capitate.(Gastropoda Opisthobranchiata.).* Zoologischer Anzeiger. 124: 129-138.

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