Hermissenda crassicornis

An opalescent aeolid nudibranch

Phylum: Mollusca

Class: Gastropoda, Heterobranchia, Euthyneura, Ringipleura

Order: Nudipleura, Nudibranchia, Cladobranchia

Family: Aeolidioidea, Facelinidae

Taxonomy: *Hermissenda crassicornis* is a complex of three distinct species (Lindsay and Valdes 2016). *H. crassicornis* is used for the species found in the northeast Pacific. Those found from Northern California to the Sea of Cortez are referred to as *H. opalescens* and those found in Japan fall under the name *H. emurai* (Lindsay and Valdes 2016).

Hermissenda crassicornis can be distinguished from the other two species by the presence of white longitudinal lines in the cerata (Lindsay and Valdes 2016). *H. opalescens* lacks these white lines in the cerata, and H. *emurai* has been described as having a pale yellow body, a broken mid-dorsal vermillion line mid-way down from the anterior end, and with two parallel lines running down the sides of the body, bluish and vermilion in color (Lindsay and Valdes 2016).

Description

Size: 30 mm to 80 mm long (Beeman and Williams 1980); illustrated specimen (Coos Bay) 50 mm.

Color: Ground color often white, transparent (MacFarland 1966), with opalescent white or blue line around foot, down each oral tentacle (McDonald 1975). Line down back is light or bright orange (Lindsay and Valdes 2016). Line can form diamond shape between first cerata. Cerata cores (digestive glands) are light to dark brown or bright orange and each cera has a distinct white stripe on the anterior side (Lindsay and Valdes 2016).

Body: Oblong, flat-bottomed, with rhinophores, cerata, and tail, but without posterior plume of branched gills (fig. 1).

Rhinophores: Long; with 8 - 24 slanted, faint "leaves" or rings (Farmer 1980); “weakly perfoliate” (McDonald and Nybakken 1980) or annulate, otherwise solid (fig. 1). Color: as ground.

Foot: Split in front (“anteriorly bilabiate”) (Farmer 1980); lateral angles produced into horns (fig. 1); foot extends posteriorly into long, pointed tail. Foot corners or horns also called “pedal tentacles” (Kozloff 1974).

Cerata: Large, conical, in 11 clusters of transverse rows (Farmer 1980) covering animal's back. Cerata begin posterior to rhinophores (Beeman and Williams 1980), are longest in median region of 1st two groups (Behrens 1980). Each cera with a core of digestive gland (fig. 1), and at tip a cnidosac, which collects nematocysts from cnidarian prey (MacFarland 1966).

Oral Tentacles: Usually present, order Nudibranchia (McDonald 1975). Long, white, pointed (fig. 1).

Gills: None (fig. 1). Cerata serve as gills.

Eyes: Small, black; posterior to bases of rhinophores (fig. 1). Eyes consist of a lens and five photoreceptor cells. The photoreceptor cells have position sensitivity due to their asymmetrical arrangement and send nerve impulses to the brain via an axon (Stensaas et al. 1969). *H. crassicornis* eyes are used in neurological studies (Beeman and Williams 1980).

Radula and Jaws: Ribbon of horseshoe-shaped teeth; each central cusp with a single row of up to 28 teeth; 4-6 sharp spines on either side of middle cusp whose under- surface has up to 15 small points (MacFarland 1966) (fig. 4). *Hermissenda* found in Oregon have 4-5 denticles, these are smaller than those

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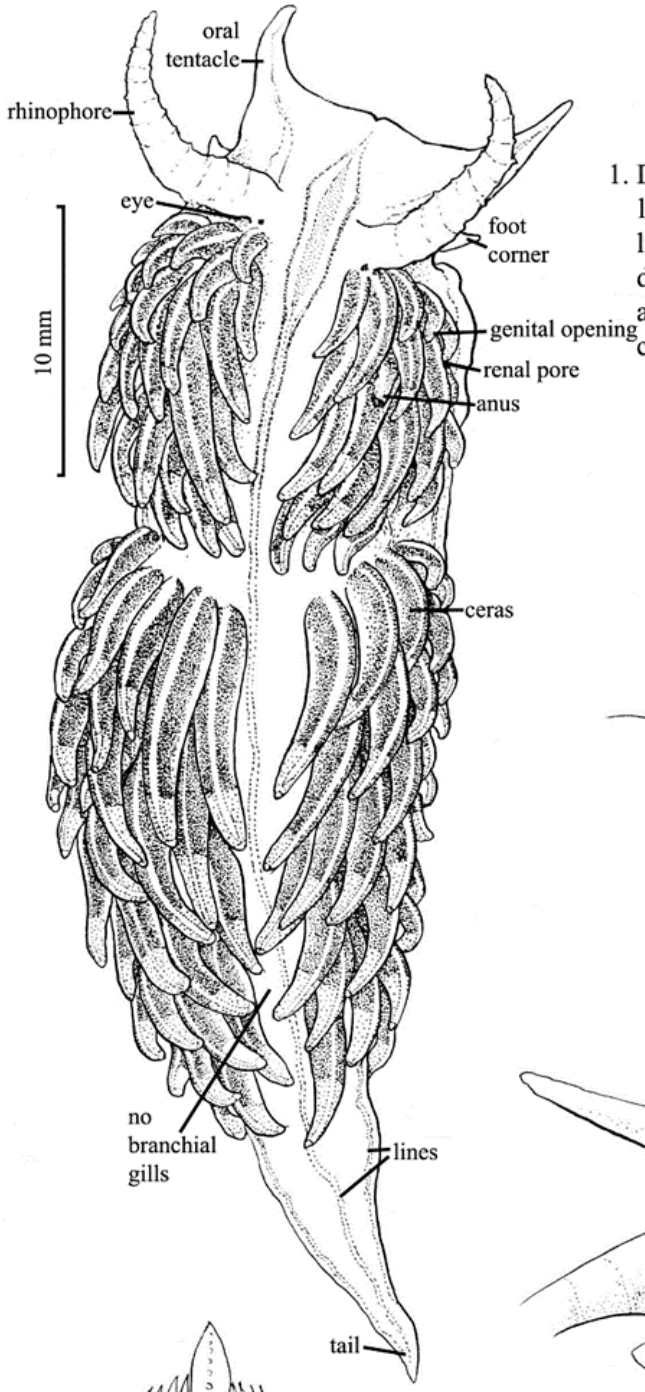
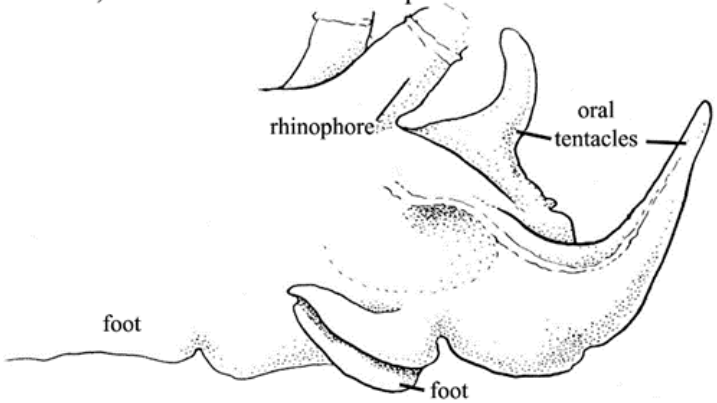
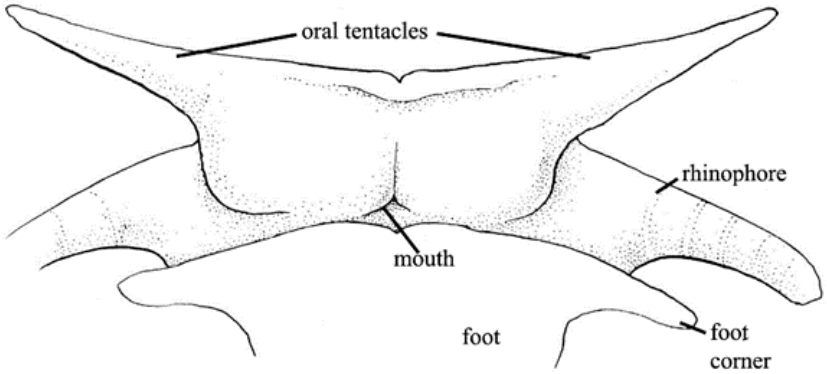


1. Dorsal view (L:50mm) x4:
long oral tentacles; prolonged foot corners; bluish-white line down oral tentacles, around dorsal edge along midline, doubling to enclose orange stripe. Rhinophores weakly annulate; cerata long, white tipped, with orange bands, brown cores, sometimes with white stripe.



2. Anterior, lateral view.

3. Anterior, ventral view.



4. Radular tooth:
large middle cusp with 4-6 spines either side (from Marcus 1961).

5. Egg mass (D:12mm) x3:
sausage-like ribbon of pink capsules in counter-clockwise coil.

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found in other members of the species complex and appear as bumbs (Lindsay and Valdes 2016).

Mouth: Jaw border with up to 50 denticles (MacFarland 1966). (Mandibles not figured.)

Genital Openings: Genital apertures on low posterior part of 1st group of cerata (MacFarland 1966) (not visible as drawn, but see arrow, fig. 1).

Anus: Tubular, located on the right, between 2nd and 3rd groups of cerata (fig. 1) (MacFarland 1966). Concealed (MacFarland 1966). Anus more anterior than in Aeolidiidae (Keen 1971).

Renal Pore: Lateral, between 1st and 2nd group of cerata (not visible, but see arrow, fig. 1).

Eggs: In pink, sausage-like string; each measures 1 mm in diameter, attached through much of its length to substrate. String makes tight counterclockwise spiral, which measures between 0.24 cm and 3.62 cm (Harrington and Alkon 1979). Each capsule can have 1 – 4 eggs (Beeman and Williams 1980) (fig. 5).

Possible Misidentifications

Nudibranchs can be separated from other apparently shell-less opisthobranchs by their radulae and jaws (they are carnivorous), and by their rhinophores, which are not rolled as they are in sacoglossans. Nudibranchs also have oral tentacles. In addition, they have lost all shell and opercula (as adults) as well as mantle cavity and gills. Some may have secondary gills on their backs (McDonald and Nybakken 1980). Nudibranch genital openings are on the right side.

The nudibranchs found in the *Hermissenda* suborder, Aeolidiacea, are relatively small, long, and narrow, gill-less, and have cerata. They feed partly on cnidaria, and are able to store nematocysts in their cerata (Keen 1971).

The nudibranchs in the other major suborder, Doridacea, are larger, with a large flat foot, thick mantle and obvious gills, *i.e. Onchidoris, Triopha* (McDonald and Nybakken 1980).

Another suborder, Dendronotacea, resemble aeolids, but have sheaths for their rhinophores and a mid-lateral anus. Examples are *Tritonia, Tethys, Melibe,* and especially *Dendronotus* spp.

The Arminacea are a very diverse group lacking rhinophore sheaths and usually lacking oral tentacles; the anus is anterior. Some have cerata, but others do not. *Janolus fuscus* has cerata very like *Hermissenda* (orange and white tipped), but also has a red cockscomb between the rhinophores, colored like the cerata. Cerata begin anterior to the rhinophores and fall off easily; they are found only on the periphery of the dorsum (McDonald and Nybakken 1980). *Janolus* also lacks the blueish lines on the body found on *Hermissenda.* This species was formerly called *Antiopella barbaren*sis (Cooper 1863).

The *Hermissenda* suborder Aeolidacea includes two superfamilies: Protoaeolidoidea, with one family, Notaeolidiidae; and Euaeolidoidea, with 21 families. Only a few species from this latter superfamily could be confused with *Hermissenda:*

Fiona pinnata is similar in morphology to *Hermissenda,* but has smooth rhinophores and sail-like flaps on its cerata. The cerata are dense along the margins; a large part of the back is clear (Keen 1971); it has no blue lines or orange spots. Cosmopolitan.

The Coryphellidae have produced foot corners, but not angular ones as in Facelinidae (Keen 1971). Their numerous cerata are clustered and elongate, as in *Hermissenda. Coryphella trilineata* has three white (not blue) lines on a white body, but there are no orange spots within them. The cerata can look much like *Hermissenda,* but have cadmium yellow tips. The rhinophores are annulate and col-

ored yellow or orange.

Aeolidia papillosa, the shag rug nudibranch found with anemones, is white with gray to brown spots. It has sharp pedal tentacles like *Hermissenda,* but its cerata begin anterior to the rhinophores and are lanceolate, i.e. broad-based and sharp-tipped, not conical as in *Hermissenda.*

Spurillidae (genus *Spurilla)* have rhinophores with quite oblique leaves, and have orange head markings. The cerata of *S. olivae* are quite like *Hermissenda:* orange, white tipped brown cores. Both this species and *S. chromosoma* are found only from central California south however (McDonald and Nybakken 1980).

There are two other nudibranchs in the family Facelinidae (was Phidianidae (McDonald and Nybakken 1980). Both are of the genus *Phidiana* and found only from central California south. Both *P. hiltoni (=pugnax)* and *P. morrowensis* have orange markings on the head and on the rhinophores. These two are closely related, but not likely to be confused with each other or with *Hermissenda.*

Several other nudibranchs of diverse families could resemble *Hermissenda* superficially in color, so care must be taken to observe carefully the rhinophores, foot tentacles, and especially the blue/white lines of *Hermissenda.*

Ecological Information

Range: Sitka, Alaska to Baja California, Mexico (Beeman and Williams 1980).
Local Distribution: Coos Bay: small boat basin, Charleston, seasonally, especially in summer.
Habitat: Varied: rocky tidepools, floats, mud and sand flats (Beeman and Williams 1980; Goddard 1985), eelgrass beds (Puget Sound), bare rock and on seaweed. Also found on boat docks (Hoover et al. 2012).
Salinity: Collected at 30 (Coos Bay).
Temperature: Annual range 9-18 °C (Beeman and Williams 1980).
Tidal Level: Low intertidal; subtidal down to 35m (Beeman and Williams 1980).
Associates: Copepod *Hemicyclops thysanotus* often found on its back (Beeman and Williams 1980). Found on fouling panels regardless of presence of other organisms. Sea pen *Ptilosarcus* (Puget Sound) (Birkeland 1974). Also see “Food”.
Weight: 5-8 grams (Harrigan and Alkon 1978).
Abundance: One of the most common aeolids in northeastern Pacific, especially in middle of range, but its occurrence is temporally variable at any one part of the range (Ricketts and Calvin 1971). Dominant littoral opisthobranch in abundance and geographical distribution, Humboldt Bay, California (Jaeckle 1984). Occurs in Puget Sound sea pen beds at densities up to 2-3/m^2 (Birkeland 1974).

Life-History Information

Reproduction: *Hermissenda crassicornis* are sub annual species that reproduce year round. They are hermaphroditic, but self-fertilization is probably unlikely (Harrigan and Alkon 1978). Mating animals and egg masses are found all year (Puget Sound) (Beeman and Williams 1980). Egg-laying begins when animal is 45 days old, continues until death (in lab) at 128+ days (Harrigan and Alkon 1978). Eggs are pink and have a counter-clockwise spiral shape ranging in size from 0.24 cm to 3.62 cm and are deposited on algae or *Zostera* (Harrigan and Alkon 1978). Motile sperm found in 34 mg animals, and egg laying by 73 mg animals in lab (Harrigan and Alkon 1978). Sperm from one copulation enough to fertilize most eggs in about three egg masses (Rutowski 1983).

Copulation in Hermissenda is relatively short compared to other sea slugs. The process of intromitting between simultaneous hermaphrodites will last only a couple of sec-

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onds. Two individuals will meet head to head and will go through flagellation, the process of sensing each other with their tentacles. Following this process both animals will "slide" towards the right side of each other where the gonopores are located and simultaneously copulate by erecting their cerata and intromitting. Violent lunging and biting behavior once thought to be aggressive now known to be part of brief mating sequence (Rutowski 1983); many attempts at copulation are unsuccessful.

Eggs hatch after 5-6 days into a planktonic veliger stage that lasts at least 34 days. Veligers that are ready to metamorphose have eyes, a shell measuring 300mm, and a developed foot. After completing the larval stage, veligers crawl onto a hydroid and 12-24 hours later the larva crawls out of its shell to complete metamorphosis. The new juvenile uses hydroid tissue as a food source (Harrigan and Alkon 1978).

Larva:

Juvenile:

Longevity: Average life span in lab 163 days (35 veliger + 128 day adult): a subannual species (Harrigan and Alkon 1978).

Growth Rate: Veligers hatch in 5-6 days in lab at 13-15 °C and obligatory veliger stage of at least 34 days (Harrigan and Alkon 1978). Metamorphosis occurs when veligers are at least 300μ and possess eyes, foot and enlarged propodium (Harrigan and Alkon 1978). Veligers can swim.

Food: A generalist predator: carnivore and scavenger. Locates food via chemotaxis (Tyndale et al. 1994). Actively uses chemotaxis in prey selection and chemoreception is elicited by polar compounds (Hoover et al. 2012). *Hermissenda* has been found to exhibit a preference for *A. labiata* (Hoover et al. 2012). Eats hydroids, particularly *Tubularia, Eudendrium, Sarsia* in eelgrass (Goddard 1985). Also eats small sea anemones, bryozoans, colonial ascidian *Aplidium,* botyrllid ascidians, annelids, small crustaceans, clams, and dead animals. Also feeds on cnidarians, tunicates, sponges and other gastropods (Hoover et al. 2012). Will eat other *Hermissenda,* but probably only when other food not available (Goddard 1985). Subtidally in Puget Sound has consumed sea pen *Ptilosarcus* (Birkeland 1974). In Humboldt Co., California, prey include anthomedusae, leptomedusae and chondrophore *Velella velella* (Jaeckle 1984). Veligers crawl on *Obelia,* a probable food (Harrigan and Alkon 1978).

Predators: In rocky areas below Monterey, California, the large opisthobranch *Navanax inermis* (Beeman and Williams 1980). Seastar *Crossaster* (Puget Sound) prefers *Hermissenda* as summer food (Birkeland 1974). Eggs eaten by sacoglossan *Olea hansineensis* (Crane 1971).

Behavior: Very aggressive toward other nudibranchs and other *Hermissenda.* Head-on "combats" with the latter probably often part of mating sequence (see *Reproduction).* Small *Hermissenda* have a swimming escape response to seastar predator *Crossaster* (Birkeland 1974). *Hermissenda* found to exhibit learned behavior. In one study, *Hermissenda* was able to learn to avoid foods that displayed an aversive signal (Farley et al. 1990).

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