Nematostella vectensis

Starlet sea anemone

Phylum: Cnidaria

Class: Anthozoa, Hexacorallia

Order: Actiniaria, Anenthemonae

Family: Edwardsioidea, Edwardsiidae

Taxonomy: *Nematostella vectensis* was described by Stephenson in 1935. *Nematostella pellucida* is a synonym (Hand 1957). In the larger taxonomic scale, the subclass Zoantharia has been synonymized with Hexacorallia (Hoeksema 2015).

Description

Medusa: No medusa stage in Anthozoans

Polyp:

Size: The column (Fig. 1) can be up to 15 mm long in the field, but can grow much longer (160 mm) when raised in the laboratory (Hand and Uhlinger 1992; Fautin and Hand 2007). The maximum diameter is 4 mm at the base near the bulb (physa) (Hand 1957) and increases to 8 mm at the crown of tentacles; the diameter is not often this large, and a more average diameter of the column is 2.5 mm.

Color: The anemone is white and transparent when expanded (Fautin and Hand 2007), while the internal color depends on food.

Body: *Nematostella vectensis* is radially symmetrical, consisting of a tall cylinder and a crown of tentacles. Aberrant forms (e.g., two headed, tentacleless) are found as well (Williams 1976). The body is slightly worm-like, in that the column is longer than it is wide (Fautin et al. 1987). Usually, the anemone is buried up to its oral disc and tentacles (Fautin and Hand 2007). Mesenteries divide the internal structure and cannot be seen through the body walls. On the oral disc, specimens occasionally have ciliated grooves to direct water (siphonoglyphs).

Column: The column is longer than wide, cylindrical, and transparent. The eight mesenteries are visible through its walls. There is a thin capitulum (collar) around the oral disc at the top of the column (Williams 1975). There is a single ventral siphonoglyph (Williams 1975).

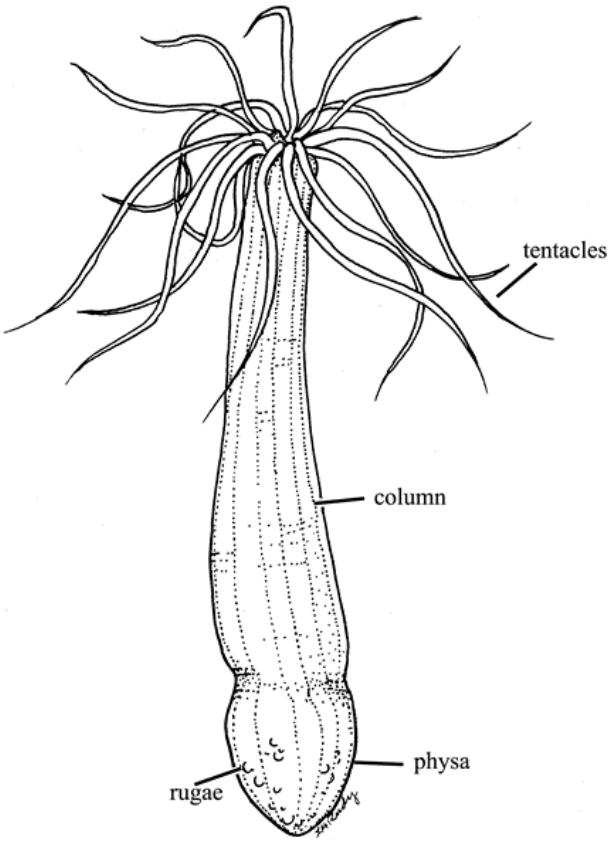
Oral Disc: There is no inner ring of tentacles, and there are no siphonoglyphs, on the oral disc.

Tentacles: Tentacles are retractile, cylindrical, and tapered. They are not capitate, or knobbed. Though they can vary from 12-18, there are usually 16 (Stephenson 1935; Fautin and Hand 2007). There are 6-7 outer (exocoelic) tentacles that are longer than inner (endocoelic) tentacles, and are often reflexed down the column (they can be longer than column). The inner tentacles can be raised above the mouth (Fig. 1), and can have white spots on their inner edges (Crowell 1946). Nematosomes can be seen moving inside the tentacles.

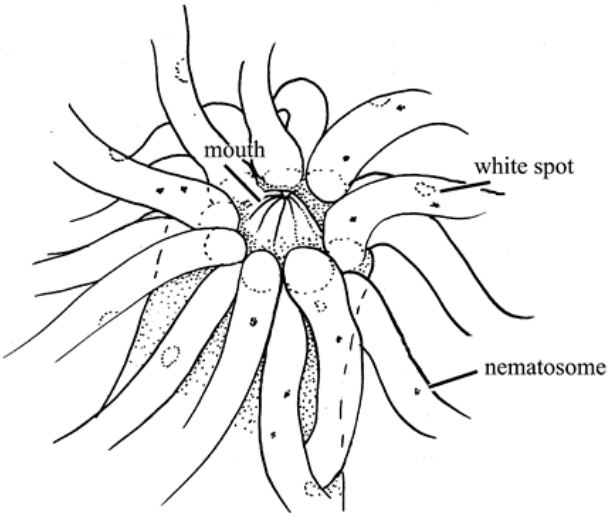
Mesenteries: Mesenteries are vertical partitions (eight in this species) below the gullet and visible through the column. Gonads appear as thickened bands on the mesenteries (Fig. 3) (Lindsay 1975). Eggs are produced from these partitions. The mesenteries can be green, brown, black, etc., depending on food (Williams 1975).

Pedal Disc: The physa is a swollen, bulb-like burrowing structure at the base of the column (Fig. 1), which replaces the pedal disc of other anemones. It is covered with rugae (ridges), which secrete mucus and aid in digging and climbing (Williams 1975). *Nematostella vectensis* does not attach to solid substrate, but rather burrows into

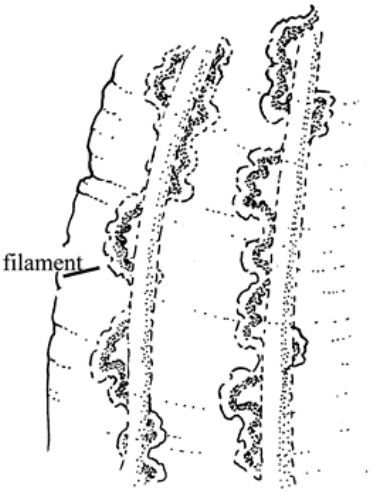
Nematostella vectensis



1. *Nematostella vectensis* x10:
cylindrical column; physa with rugae;
12-18 transparent tentacles, white spotted;
actual size 11 mm.

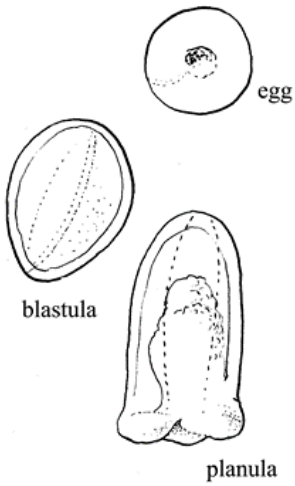


2. Crown of tentacles x30:
usually 16 white-spotted tentacles; nematosomes visible;
mouth cone-shaped.



3. Menenteries (seen through
column wall) x30: 8 vertical
partitions; filaments contain eggs.

4. Dorsal view,
tentacles retracted x40.



5. Development.

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muddy habitats (Fautin et al. 1987).

Cnidae: According to Matus et al. (2007), there are three types of cnidae in this species: basitrichs, microbasic basitrichs, and spirocysts.

Nematosomes: These are rather mysterious spherical, ciliated bodies, sometimes found in the coelenteron (digestive cavity) and in tentacles (Fautin et al. 1987) (Fig. 2). They contain nematocysts (Hand and Uhlinger 1992), and their function is not known.

Possible Misidentifications

This is the only species of the genus *Nematostella* known in the temperate northern hemisphere. *Nematostella polaris*, a similar Arctic anemone, lives under conditions which *N. vectensis* could tolerate. They are not believed to be the same species (Hand 1957). There is certainly no other very small, mud-dwelling burrowing anemone in our area, which could be confused with *N. vectensis*.

Flosmaris grandis is another elongate, mud-burrowing, translucent anemone, but it is usually very large (to 50 cm), has over 24 tentacles, and instead of a physa, has a basal disc attached to something solid (Fautin and Hand 2007). This species also has acontia (defensive tentacles that extrude through the column), which *N. vectensis* lacks (Fautin and Hand 2007). *Diadumene* sp. are often long and pale, but they have pigmentation of some sort and don't burrow. Only *N. vectensis* of these anemones has nematosomes.

Ecological Information

Range: The type locality is the Isle of Wight, where it likely no longer exists due to destruction of habitat (Williams 1975). Its range covers the Atlantic coasts of Europe; from Florida to Louisiana in the Gulf of Mexico; the east coast of North America from Nova Scotia to Georgia; and the west coast of North America from California to Washington (Hand and Uhlinger 1992; Fautin and Hand 2007).

Local Distribution: Locally, *N. vectensis* is found at five sites in Coos Bay, including in South Slough, near downtown Coos Bay, and at the mouth of Coos River.

Habitat: This species is primarily estuarine (in temperate northern estuaries), and is common in shallow pools of salt marshes (Fautin et al. 1987; Fautin and Hand 2007). It often lives in pondweed masses, like soft muds of *Salicornia* marshes; *Ruppia*, *Cladophora*, and *Chaetomorpha* ponds (New England); and *Enteromorpha* and *Vaucheria* ponds (Coos Bay) (Williams 1976). These anemones are sensitive to pollution, and so will not be found in habitats that become contaminated (Williams 1976).

Salinity: *Nematostella vectensis* can tolerate a wide range of salinities, from less than 50% seawater to over 100% in Coos Bay (Hand 1957). It is an osmoconformer, has been found from 8 to 38, and is very adaptable to salinity changes (Inouye 1976).

Temperature: This species lives in a wide range of temperatures; in northern California alone, it can be found from 0-30° C (Hand 1957). It has been kept for long periods in the lab at 21-22° C (Inouye 1976). In Coos Bay (South Slough), it ranges from 6-18° C (ibid).

Tidal Level: This anemone is generally found in salt marsh tide pools above + 3 ft, but is sometimes found living subtidal (Hand and Uhlinger 1992).

Associates: It often lives in association with the algae *Distichlis, Salicornia*, and *Enteromorpha*; the diatom *Vaucheria*; and the invertebrates nemerteans, polychaete larvae, harpacticoid copepods, ciliates, sphaeromid isopods, and gammarid amphipods.

Abundance: A rarely occurring animal, it can be densely abundant over a small area where it does occur (Hand and Uhlinger 1992). Because of its sensitivity to pollution, it quickly

retreats from areas where the habitat is compromised.

Life-History Information

Reproduction: This anemone propagates using both sexual and asexual reproduction. It is dioecious (separate sexes) (Hand and Uhlinger 1992), and its gonads on the mesenteries produce gametes. Animals are found with developed gonads in summer and fall (Williams 1976), but in laboratory settings they will reproduce year-round (Hand and Uhlinger 1992). Egg production can be induced in lab by lowering salinity (Lindsay 1975); the eggs are released in sticky, gelatinous egg masses that also contain nematosomes (Hand and Uhlinger 1992). In lab these anemones can maintain a schedule of spawning once a week (Hand and Uhlinger 1992). Sexual reproduction produces planula larvae, which settle as new polyps. There is no medusoid stage. It takes two to three days for the fertilized egg to grow to a planula, and seven days to setting into a juvenile (Hand and Uhlinger 1992). Asexual reproduction is also possible by transverse binary fission (Fautin and Hand 2007). This division can occur in two ways. In the first (physal pinching), the column constricts until a piece of the physa is divided from the rest of the body. This piece develops into a full clonal anemone. In the second, less common way (polarity reversal), the aboral end of the anemone develops into an oral structure, and the anemone pinches off in the middle to yield two fully-formed anemones (Darling et al. 2005).

Larva: Spherical ciliated planula larvae develop 2 days after fertilization (Hand and Uhlinger 1992). They will change shape as they develop to become elongate and have an apical tuft (Hand and Uhlinger 1992). They actively swim using the cilia on their apical tuft (Sadro 2001).

Juvenile: When it settles, the juvenile has four tentacles and is 250-500 µm long (Hand and Uhlinger 1992). This process occurs about a week after fertilization. Two to three weeks after fertilization it grows more tentacles and has formed all eight mesenteries (Hand and Uhlinger 1992).

Longevity: Specimens have been kept in lab for up to five years (Hand and Uhlinger 1992).

Growth Rate: This species can grow from fertilization to sexual maturity in 69 days, though the process usually takes three to four months (Hand and Uhlinger 1992).

Food: Like other anemones, *N. vectensis* is an active predator, using tentacles with stinging nematocysts to capture prey. Its diet largely consists of the snail *Hydrobia* (New England, Nova Scotia) (Frank 1978), copepods, midge larvae, egg masses, crustacean remains, ostracods, varied worms, corixids, rotifers, and veliger larvae (Hand and Uhlinger 1994). It is unique in that it also eats insects (Hand and Uhlinger 1994). In lab, in can be fed *Artemia* nauplii, bivalve veliger larvae, mussel tissue, and yolk from hard-boiled hen eggs (Hand and Uhlinger 1992).

Predators: This species is an important prey item for the grass shrimp *Palaemonetes pugio* (Kneib 1985). As of 2008, this shrimp was the only known predator of *N. vectensis* (Moran et al. 2008).

Behavior: Specimens are usually buried to the tentacles, but they are also found extended over the mud. The anemone can move by short, peristaltic-like movements, or by throwing itself (Lindsay 1975). It secretes a mucus "tube" to protect its epidermis (Crowell 1946). This species has also become an important specimen in genetic research due to its short generation time and tolerance to most conditions, among other reasons (Hand and Uhlinger 1992; Darling et al. 2005), and its genome has been mapped (Putnam et al. 2007).

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C.D. Piazzola and T.C. Hiebert

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