Anthopleura elegantissima

Aggregating or clonal anemone

Phylum: Cnidaria

Class: Anthozoa, Hexacorallia

Order: Actiniaria, Enthemonae

Family: Actinioidea, Actiniidae

Taxonomy: *Anthopleura elegantissima* was originally described by Brandt in 1835 as *Actinia elegantissima*. The subclass Zoantharia has been synonymized with Hexacorallia (Hoeksema 2015).

Description

Medusa: No medusa stage in Anthozoans

Polyp:

Size: The average diameter is about 2.5-4 cm, though the maximum is 5 cm (Fautin and Hand 2007). Specimens are often larger in bays than on the open coast (Hand 1955). The illustrated specimen was 3.5 cm high, with a 4.5 cm disc diameter.

Color: The tentacles are tipped with pink, purple or other colors; the illustrated specimen had white, green, and maroon tentacles, and a green disc with maroon radial lines. The column is usually green, and sometimes shades to white at the base (Fautin et al. 1987). The collar is green and acrorhagi are white to yellow (Fautin and Hand 2007) (figs. 2, 3). Puget Sound forms are often pink and green (Ricketts et al. 1985). Some of the green, especially in the tentacles, is caused by symbiotic algae cells (Kozloff 1983); however, the majority of the coloring is from pigment cells produced by the anemone to protect against UV rays. Thus, in darker habitats the greens fade until the anemone is white (Fautin and Hand 2007).

Body: The anemone has a strong collar, broad flat disc, and slender pointed tentacles. The column has longitudinal rows of tubercules, which are adhesive and create a layer of attached shells and debris. Body walls are soft and thin (Haderlie et al. 1980). The column has a groove below the tentacles (fosse) covered by a distinct fold (parapet or collar). The anemone becomes a hemispheric glob when contracted (fig. 3), and blends into its rocky intertidal habitat. It has a hydrostatic skeleton and will emit water when stepped on (Kozloff 1983; Ricketts et al. 1985).

Column: The column can be twice as high as the diameter when extended, and is hemispherical when contracted. The entire column is covered with round verrucae (tubercules) in longitudinal rows (Hand 1975).

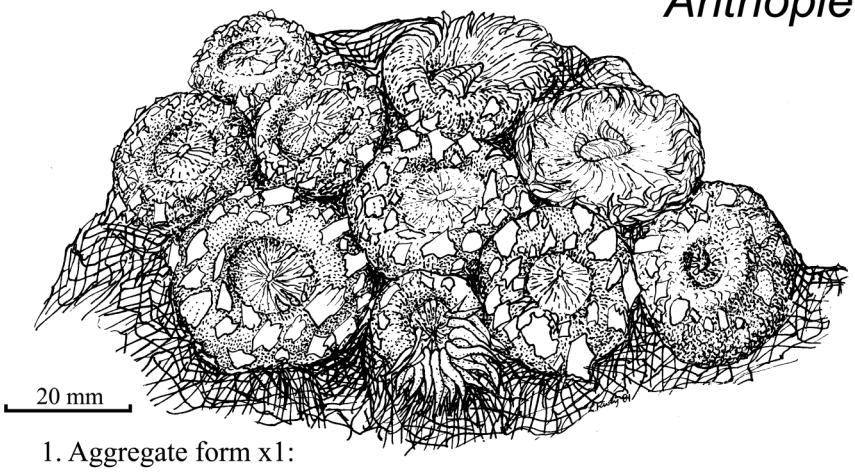
Collar: The parapet is strong, with a well-developed fosse (groove) (fig. 2).

Oral Disc: The oral disc is a large central area without tentacles on the top of the column. It is broad and flat, with radiating lines (mesenterial insertions). It is slightly wider than the column, or of a similar width. The mouth is in the center of the oral disc, and the lips may be swollen or flush with the surface of disc and are not ribbed.

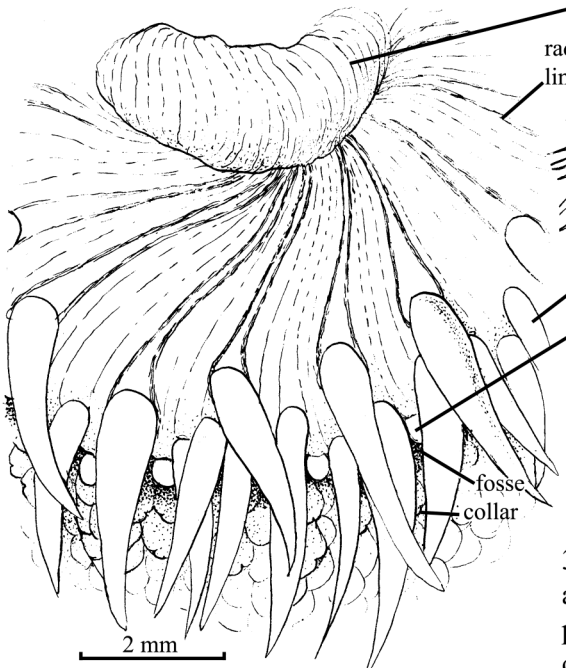
Tentacles: There are more than 24 tentacles (Fautin and Hand 2007). They are pointed, and about 1/4 as long as the diameter of the disc (fig. 3). There is no oral inner ring of tentacles, and usually more than 5 orders (rows) are present. There are no acontia (thread-like defensive structures expelled through column wall).

Mesenteries: These are vertical body partitions. There are from 6 in young specimens to more than 24 pairs in mature adults. They are visible at high magnification as vertical lines on column, particularly near the base, and can be irregular, due to asexual fission (not shown).

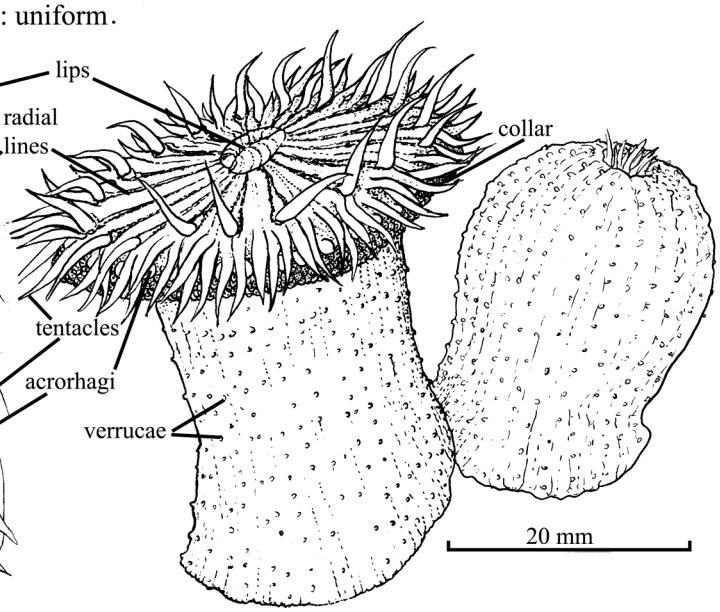
Anthopleura elegantissima



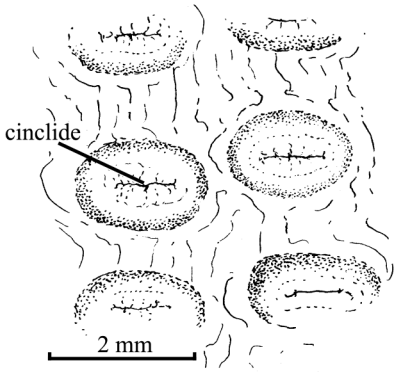
1. Aggregate form x1:
shell and debris adhere to verrucae; clones: uniform.



2. Oral disc (part) x12:
radial lines from mouth to tentacles;
white marginal spherules inside collar.



3. *Anthopleura elegantissima* solitary form x2:
actual height 35 mm, crown width 45 mm; tentacles short, pointed, in about 5 rows, pink, green and white; collar green; collar green/white, with vertical rows of verrucae.



4. Verrucae (tubercules) x12.

Piazzola, C.D. 2015. *Aequorea victoria. In:* Oregon Estuarine Invertebrates: Rudys' Illustrated Guide to Common Species, 3rd ed. T.C. Hiebert, B.A. Butler and A.L. Shanks (eds.). University of Oregon Libraries and Oregon Institute of Marine Biology, Charleston, OR.

Pedal Disc: This species has a well-developed pedal disc that attaches to the substrate. Its shape varies from circular to very irregular (Hand 1955). The base is usually the same diameter as column. There are no physa (bulbs) at the base.

Cnidae: There are several kinds of cnidae in the tentacles, column, acrorhagi, actinopharynx and filaments (not shown); see *Metridium* (Hand 1955).

Acrorhagi: Also known as spherules, these fighting tentacles are round, hollow bodies covered with nematocysts. They are inconspicuous at the top of the column just outside the tentacles (fig. 2) (Hand 1955).

Verrucae: These are simple, circular tubercules (Fautin and Hand 2007). They are adherent, and collect gravel, shell, and debris. This layer helps prevent desiccation and protects the anemone from UV rays (MacGinitie and MacGinitie 1968; Ricketts et al. 1985). Verrucae on the collar are forked and compound (see *A. artemisia*, fig. 3 in this guide). Those on the column are arranged in distinct longitudinal rows, are not densely packed, and become fewer toward the base ("limbus") (Hand 1955; Fautin and Hand 2007). There are many cinclides (temporary or permanent pores at tips of verrucae) on the column (fig. 4).

Possible Misidentifications

The genus *Anthopleura* can be distinguished from other estuarine anemones (*Metridium*, *Diadumene*) by their acrorhagi inside the fosse under the tentacles, and by the verrucae on their columns. *Anthopleura* always have a well-developed pedal disc and a flat, oral disc with a clear central area.

Two other species of *Anthopleura* occur in this area: *Anthopleura xanthogrammica* is a large open coast species occasionally found in the most marine parts of our estuaries. It is very large, solitary (not aggregating), with uniformly colored disc and tentacles (not pink-tipped or with radial lines on the disc). The tentacles are in 5 or more rows (Haderlie et al. 1980). Its verrucae completely cover the column (they are not in rows). *Anthopleura artemisia* has tubercules on the upper 2/3 of its column only; the column is white or pink below and usually gray or black above; tentacles are brightly colored and patterned (red in Coos Bay). *Anthopleura artemisia* is more likely to be found burrowing in a sandy or muddy substrate than *A. elegantissima*, which can live close by. It also lacks the algae symbionts that are found in *A. elegantissima*.

A third species of *Anthopleura*, *A. sola*, is very similar in appearance to *A. elegantissima*. The primary difference between the two is that *A. elegantissima* is clonal while *A. sola* is solitary. Though *A. sola* is not found locally, there are many examples in the literature of *A. sola* being misclassified as *A. elegantissima* (Pearse and Francis 2000).

Other sand-dwelling anemones might include *Flosmaris grandis*, a southern form, which is vermiform and has a translucent or white column (Fautin and Hand 2007). Most other elongated or tube-dwelling forms, i.e., Order Cerinatharia, are rarely intertidal in our area.

Ecological Information

Range: The type locality is Sitka (Sitchae Islands), Alaska (Brandt 1835). The range is Alaska to southern California.

Local Distribution: In Coos Bay, they can be found in high abundance at Pigeon Point.

Habitat: Specimens are found on rocky substrates in the mid to high intertidal, often in full sun, where it aggregates in beds of up to 20 m and 100,000 animals (Childress 1969; Fautin and Hand 2007). They are especially prevalent in exposed-rocky habitats where sand collects, and are more occasional on open coasts and exposed pilings (Ricketts et al. 1985). When found in sand, *A. elegantissi-*

ma is attached to underlying rock, and can be fully buried at times (Fautin and Hand 2007). Algae mats in the intertidal create hospitable, moist habitats for the aggregations (Niesen 2007). Specimens can survive in polluted waters (Ricketts et al. 1985), and can hang from the roof of overhangs (Niesen 2007).

Salinity: Collected at 30.

Temperature: Specimens are kept in lab at 12°C. 20°C is considered high temperature and causes cnidarian bleaching (loss of symbiotic algae) (Richier et al. 2008).

Tidal Level: Found from 0 to +4.5 feet above mean lower low water level (Hand 1955).

Associates: Green algae (zoochlorellae) and dinoflagellates (zooxanthellae) live in the anemone's gut tissue and create some of the green coloring; the algae provide some nutritional value to their host, though the anemone still requires carnivorous meals (Ricketts et al. 1985; Kozloff 1983). The amphipod *Orchomenella recondita* sometimes lives in the digestive cavity. Many organisms, including the amphipods *Gibberosus myersi* and *Macronassa macromera*, the snail *Epitonium tinctum*, and the chiton *Lepidochitona fernaldi*, live in the aggregations (Chapman 2007; McLean 2007; Strathmann and Eernisse 1987).

Abundance: *Anthopleura elegantissima* is the most abundant anemone on the coast (Ricketts et al. 1985), and is the most abundant *Anthopleura* in Coos Bay. The peak of the breeding season is Sept-Oct, and recruitment is late fall-winter (Fautin and Sebens 1987).

Life-History Information

Reproduction: There are both sexual and asexual reproductive cycles. Individual polyps and clonal aggregations are dioecious (Fautin and Sebens 1987). Sexual spawning is in September (San Francisco) (Haderlie et al. 1980). Eggs are freely-spawned and brown, no larger than 250 µm (Sadro 2001), and covered with clusters of spines (Fautin and Sebens 1987). Asexually, anemones divide via longitudinal binary fission, producing aggregations of "clones" common to this species (all are similar in coloration and sex) (Hand 1955; Fautin and Hand 2007). Each division takes about two days to complete, and only the outer edge of the clonal colony divides by fission (MacGinitie and MacGinitie 1968).

Larva: Sexual reproduction produces feeding planula larvae. At three weeks larvae are ovaloid to cylindrical, covered in cilia, and no longer than 250 µm with a 70 µm apical tuft. They actively swim using the cilia on their apical tuft (Sadro 2001; Siebert 1974). They feed by releasing a mucus strand as they swim. The strand collects food particles, and the cilia then pull the strand up to the mouth and ingest it (Siebert 1974). There are no symbiotic algae in the larvae; this relationship between algae and *A. elegantissima* must be established at a later life stage (Siebert 1974).

Juvenile: Anemones are considered juveniles if they are less than 6.5 cm in diameter (Sebens 1982b). They are common in intertidal mussel beds and less common but present in rock crevices. It is possible that they settle higher in the intertidal and migrate lower to the tidepools as they grow (Sebens 1982b).

Longevity: These anemones are reputed to be very long lived, and are especially successful as an aquarium animal (one particular specimen died after about 80 years due to lab failure rather than old age) (Ricketts et al. 1985).

Growth Rate: Specimens reach adult size two years after settlement (Sebens 1982b; Fautin and Sebens 1987). The highest growth rate is concurrent with the lowest clonal division rate in the spring and summer, while the highest division rate and lowest growth rate both occur in the fall and winter (Sebens

1982a).

Food: *Anthopleura elegantissima* is a carnivorous stationary hunter in the tidepools (Niesen 2007) that uses tentacles to capture prey (Ricketts et al. 1985). It primarily eats crustaceans, such as copepods, amphipods, and isopods (Haderlie et al. 1980). Food preference seems to be genetically determined (Waters 1975).

Predators: Specimens are eaten by varied intertidal predators, including seastars. The nudibranchs *Aeolidia papillosa* and *Hermissenda crassicornis* attack the column (McDonald 2007; Ricketts et al. 1985). The snail *Epitonium tinctum* eats the tips of tentacles (McLean 2007).

Behavior: Anemones at the edges of clonal groups will "attack" neighboring clonal aggregations with their acrorhagi, causing wounds; a corridor between clonal groups is thus maintained (Francis 1973; Ricketts et al. 1985). Symbiotic green algae may aid the anemone in modifying phototaxis (Buchsbaum 1968) and in averting starvation (Kozloff 1983). Anemones contract, inflate, and expel nematocysts or detach their pedal disc and move when their column is attacked by the nudibranch *Aeolidia papillosa* (Waters 1975).

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Updated 2015

C.D. Piazzola and T.C. Hiebert

Piazzola, C.D. 2015. *Aequorea victoria. In:* Oregon Estuarine Invertebrates: Rudys' Illustrated Guide to Common Species, 3rd ed. T.C. Hiebert, B.A. Butler and A.L. Shanks (eds.). University of Oregon Libraries and Oregon Institute of Marine Biology, Charleston, OR.