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# *Balanus nubilus*

## The giant barnacle

Phylum: Arthropoda, Crustacea

Class: Multicrustacea, Hexanauplia, Thecostraca, Cirripedia

Order: Thoracica, Sessilia, Balanomorpha

Family: Balanoidea, Balanidae, Balaninae

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### Description

**Size:** Largest barnacle on the Pacific coast, and probably in the world (Ricketts and Calvin 1971), with individuals up to 100 mm in diameter, and nearly as tall (Cornwall 1951). The illustrated specimen (from Coos Bay) is 90 mm in diameter.

**Color:** Shell dirty white with interior of scuta and terga (see Plate 18, Kozloff 1993) buff and tergal beak usually purple tipped (Cornwall 1951).

**General Morphology:** Members of the Cirripedia, or barnacles, can be recognized by their feathery thoracic limbs (called cirri) that are used for feeding. There are six pairs of cirri in *B. nubilus*. Sessile barnacles are surrounded by a **shell** that is composed of a flat **basis** attached to the substratum, a **wall** formed by several articulated **plates** (six in *Balanus* species) and movable **opercular valves** including **terga** and **scuta** (Newman 2007) (Figs. 1, 3, 4).

**Shell:** Exterior can be rugged and worn with well-developed ribs that become eroded with age (Figs. 1, 2) (Cornwall 1977).

**Shape:** Steeply conical and, like other barnacles, they can become cylindrical when crowded. Young specimens can also be cylindrical (Henry 1940).

**Basis:** Calcareous and flat, attached to hard substrate, rendering *B. nubilus* a sessile, or attached barnacle (Balanomorpha). Barnacle base is thick, porous at edges and thin at center.

#### Wall:

**Longitudinal Tubes:** A single row of tubes is uniform and within shell walls (Ricketts and Calvin 1971).

**Plates:** Calcareous, nearly conical and columnar. Six in family Balanidae. Each plate is composed of parietes (exposed triangular part), alae (the plate overlapping plate edges) and radii (the plate edge marked off from the parietes by a definite change in direction of growth lines) (Newman 2007).

The plates themselves include the carina, the carinolateral plates and the compound rostrum (see Fig. 3, *Balanus glandula*, this guide). Internal surfaces with fine horizontal ribbing above and smooth near base, particularly in older specimens (Pilsbry 1916). Radii rather narrow (Darwin 1854).

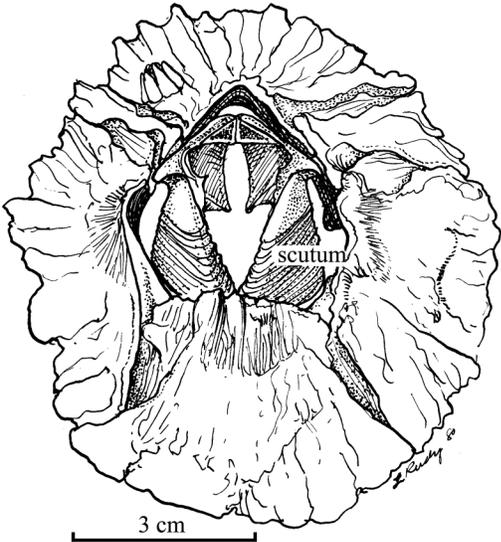
**Opercular Valves:** Thick and yellowish, buff on interior but never white. Tergal beaks project above orifice edge (Cornwall 1977). Tergal and scutal adductor and depressor muscles are very thick in *B. nubilus* (2 mm and 1.4 mm, respectively, Hoyle and Smyth 1963).

**Scuta:** External surface with prominent growth lines, a deep canal from apex and downward in old eroded specimens (Fig. 4b). Internally with low articular ridge that has a very narrow articular furrow. The prominent adductor ridge is large and with a shallow adductor pit.

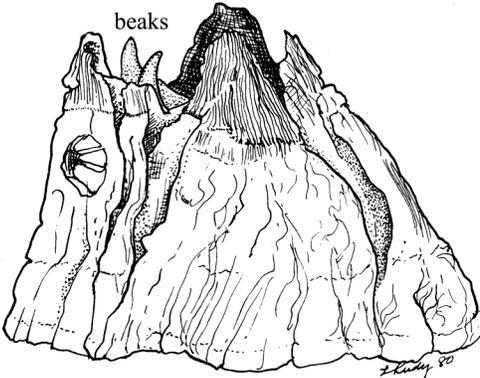
**Terga:** Beak triangular and often purple (Fig 4a), especially in older specimens (Cornwall 1951). External growth ridges narrow and regular, with narrow, shallow longitudinal furrow. Internally, numerous depressor muscle crests. Tergal spur is wide at base and tapers to a narrow truncate end (Fig. 4a). Moderate articular ridge is with shallow broad articular furrow (Fig. 4a).

**Aperture:** Large, flared and with a jag-

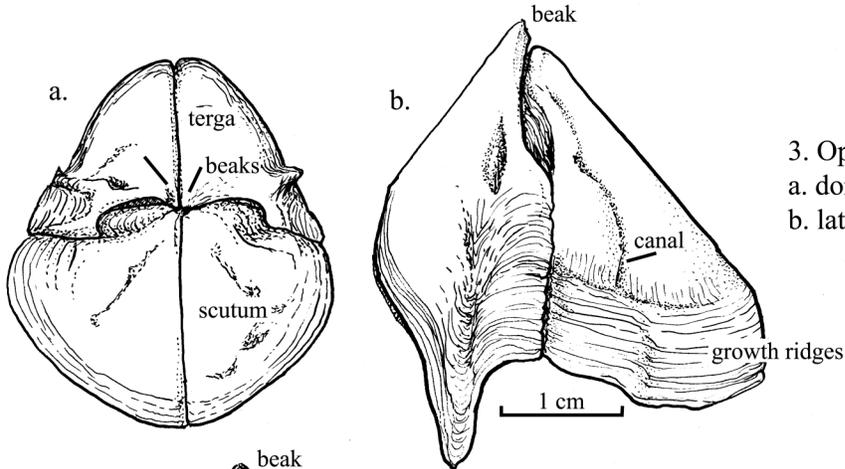
# Balanus nubilus



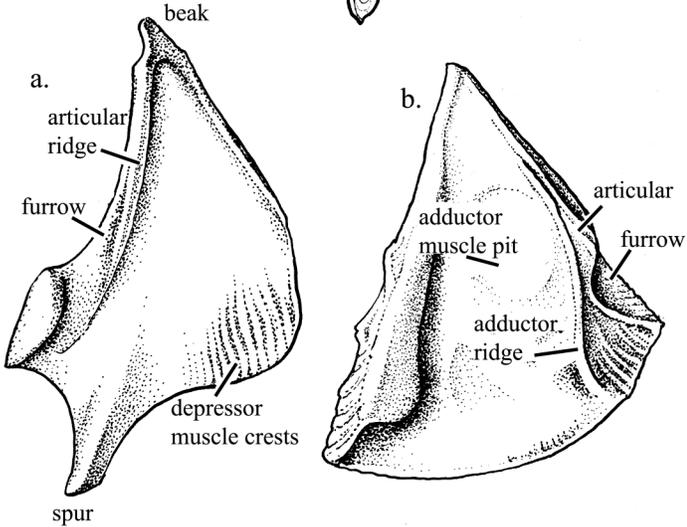
1. *Balanus nubilus* x1:  
six plates; ribs eroded;  
very large: up to 10 cm diameter.



2. Lateral view:  
walls a steep cone, steeply conical;  
orifice large, flaring.



3. Opercular plates, exterior x2:  
a. dorsal.  
b. lateral.



4. Opercular plates, interior  
a. scutum.  
b. tergum.

ged edge (Cornwall 1977).

**Cirri:** Six pairs of conspicuous feathery feeding appendages.

## Possible Misidentifications

There are three groups (i.e. superorders) of cirripeds including the Rhizocephala, (parasites among crustaceans), the Acrothoracica (shell-less burrowing forms) and the Thoracica. The Thoracica contains 1,000 species worldwide including the monophyletic taxa, Lepadomorpha, the stalked barnacles, and the Balanomorpha, or sessile barnacles (Perez-Losada et al. 2008; Chan et al. 2014). Among the sessile forms, there are four families represented locally. The family Chthamaloidea includes members of the genus *Chthamalus*, which has alae on its rostral plates, not radii. *Chthamalus dalli* is found both with and at higher tide levels than is *B. glandula*, and individuals are usually brown. The family Tetraclitoidea has one species locally (*Tetraclita rubescens*) and is characterized by a wall that is composed of four plates (rather than six in the Balanidae).

The remaining two families include the Balanidae and Archaeobalanidae. The Archaeobalanidae includes the genera *Armatobalanus*, *Conopea*, *Hesperibalanus* and *Semibalanus* (each with one local species). The latter genus includes a common local intertidal species *S. cariosus* (and former member of the genus *Balanus*). An isolated *S. cariosus*, is with splinter-like spines, nearly black cirri and is not likely to be confused with another barnacle. It has a thatched appearance, being irregularly ribbed: its walls have uneven, longitudinal tubes (Pilsbry 1916). However, where it is crowded or eroded, these spines may be worn off or not developed, and the barnacle would have to be distinguished from other common barnacles by its tergum and

scutum, and by its unique and unusual membraneous base. *Balanus nubilus*, would be most likely to be confused with *S. cariosus* at subtidal levels. Both species, as juveniles, have strong ribs. *S. cariosus* has the characteristic starry border, however, that *B. nubilus* lacks. Both species have a tergal plate with a long spur (Figs. 3b, 4a), but that of *S. cariosus* is pointed, while it is truncate in *B. nubilus*. The cirri of *S. cariosus* are conspicuous and almost black.

Balanidae encompasses the genera *Megabalanus*, *Paraconcovus*, and *Menesiniella* (each with one local species), *Amphibalanus* (three local species) and *Balanus* (four local species). *Balanus nubilus*, is easily distinguished from other species by its large size and a shell aperture that is relatively large and flaring (Newman 2007). *Balanus trigonus* is a lower intertidal species with a southern distribution (to Monterey Bay, California). *Balanus crenatus* is generally found in the intertidal at a lower level than the ubiquitous and morphologically similar *B. glandula*. *Balanus glandula* has no longitudinal wall tubes (except when young) and it differs in the structure of terga and scuta: the tergum is very wide and has longer spurs and the scutum has no adductor ridge. *Balanus crenatus*, on the other hand, has a shell wall with a single row of uniformly spaced tubes (Newman 2007).

## Ecological Information

**Range:** Type region is Monterey Bay, California (Cornwall 1951). Known distribution includes the west coast of North America from the southern boundary of Alaska to the mid Baja California coast.

**Local Distribution:** Common in Coos Bay and at several locations along the South Slough as well as south in Port Orford (Pilsbry 1916).

**Habitat:** Suitable substrates include pilings in bays with strong tidal action (Cornwall 1951),

rocks, shell hash and kelp holdfasts (Cornwall 1977). Largest specimens are observed on fairly exposed wharf pilings where individuals can grow on top of each other to make accretions one foot high (Ricketts and Calvin 1971).

**Salinity:** Collected at salinities of 30 and no known collections from brackish water.

*Balanus nubilus* individuals can regulate pH within their muscle fibers, but require external sodium ions to do so (Boron et al. 1981). Considerable research is focused on the physiology and neuroscience of *B. nubilus* (e.g. Hoyle and Smyth 1963; Morris and Lecar 1981; Stockbridge and Ross 1984; Ross et al. 1986; Callaway et al. 1989).

**Temperature:** From temperate waters.

**Tidal Level:** From low to shallow waters (3–6 meters) and occasionally to 55 meters (Cornwall 1977).

**Associates:** Often encrusted with other barnacles, sea stars and anemones on overhanging rocks (British Columbia, Canada, Cornwall 1951). Boring sponges can erode shells (Cornwall 1977). Individuals also occur on boat bottoms with mussels and congeners (MacGinitie and MacGinitie 1949) and is often covered with brown furry mats of the entoproct, *Barentsia* (Pilsbry 1916).

**Abundance:** The second most common barnacle of the low intertidal zone (most abundant is *Semibalanus cariosus*, Pilsbry 1916). More common in Puget Sound, Washington and north (Ricketts and Calvin 1971) where individuals characteristically grow in large clumps on rocky bottoms (Henry 1940).

### Life-History Information

**Reproduction:** Cirripeds usually brood their eggs and while individuals are hermaphroditic and, although self-fertilization is possible, cross-fertilization is the rule for gregarious types like *B. nubilus* (MacGinitie and MacGinitie 1949; Yonge 1963). Eggs and

embryos are retained in ovisacs within the mantle cavity and are discharged as nauplii after four months (Høeg et al. 1987; Arnsberg 2001). For detailed reproductive anatomy see Høeg et al. (1987).

**Larva:** Cirriped broods hatch as nauplius larvae and undergo 4–6 naupliar stages, each larger and more setose than the last (Høeg et al. 1987; Arnsberg 2001; Chan et al. 2014).

The generalized cirriped nauplius has a triangular or shield-shaped carapace with frontolateral horns and a conspicuous naupliar eye (Fig. 1, Arnsberg 2001; Figs. 22.1–22.2, Chan et al. 2014). In *B. nubilus*, the nauplius is characterized by straight frontolateral horns and a goblet-shaped carapace, in naupliar stages 2–6 (Fig. 11, Arnsberg 2001). The carapace shape in *B. nubilus* is recognizable and makes them easy to identify from other *Balanus* species (Arnsberg 2001). The final larval stage in cirripeds is called a cyprid, a non-feeding stage that attaches to a substrate by its antennae, secretes a cement and builds the adult calcareous shell (Ricketts and Calvin 1971). Cyprids are oblong and composed of a bivalve shell, six thoracic appendages, a pair of compound eyes and a conspicuous lipid reserve anteriorly (Fig. 3, Arnsberg 2001; Figs. 22.2–22.3, Chan et al. 2014). Cyprids prefer rough surface for settlement (Yonge 1963). Cyprid larvae in *B. nubilus* are characterized by a broadly rounded anterior and narrow posterior and a large size (800–1000 µm) (Fig. 12, Arnsberg 2001). The cyprids of *B. crenatus* are most similar to those of *B. nubilus*, but they have a narrower anterior, a distinct evenly curved posterodorsal margin, and black pigment carapace spots (Arnsberg 2001).

**Juvenile:** Often with cylindrical morphology.

**Longevity:**

**Growth Rate:** Cirriped body growth occurs in conjunction with molting (Kuris et al. 2007). Shell growth depends on barnacle density (e.g. crowded individuals tend to be tall and

columnar).

**Food:** Filter and suspension feeder.

**Predators:** *Balanus* species are usually preyed upon by sea stars (e.g. *Pisaster* species) and by the nemertean *Emplectonema gracile* (Cochran 1968). It has been suggested that predation by *Thais*, a genus of drilling gastropods has influenced plate morphology over evolutionary time in balanophore barnacles (Palmer 1982).

**Behavior:** Individuals tend to grow in accretions into deep clusters that often create a heavy clump (i.e. hummock) which falls off substrate and sinks to bottom where animals cannot live. *Balanus nubilus* individuals can detect changes in light with photoreceptors in three simple eyes. A single medial eye contains four photoreceptors, while the two lateral eyes contain three each (Stockbridge and Ross 1984; Callaway et al. 1989).

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