Pagurus hirsutiusculus

Hairy hermit crab

Phylum: Arthropoda, Crustacea
Class: Malacostraca
Order: Decapoda
Section: Anomura, Paguroidea
Tribe: Paguridea

Taxonomy: The taxonomy in the Paguroidea is complicated, especially among the genera *Eupagurus*, *Bernhardus* and *Pagurus* (described in McLaughlin et al. 2010). The International Commission of Zoological Nomenclature (Opinion 472) placed the generic names *Eupagurus* and *Bernhardus* in the official index of invalid and rejected names, leaving the genera *Pagurus* (Paguridae) and *Dardanus* (Diognidae) as valid (Hemming 1958). Thus, previous synonyms for *Pagurus hirsutiusculus* include *Bernhardus hirsutiusculus* (McLaughlin et al. 2010; Wicksten 2011).

Description

Size: Carapace length 19–32 mm (Barnard et al. 1980; Kozloff 1993). Puget Sound to 50 mm (Ricketts and Calvin 1971) and body often extends past the margin of the shell and cannot be retracted (Kuris et al. 2007).
Color: Body color tan to black or green. Antennae dark green with white stripes. Propodus of walking legs hairy and tipped with white or pale blue and dactyls with vertical red stripes and blue spots at base. Tips of chela tan or orange and walking legs have white band on propodus and sometimes a blue dot. Dactyls whitish and striped with blue and red, antennal flagellum banded with translucent and brown (Wicksten 2011) or greenish with yellow spots (Barnard et al. 1980). Most recognizable patterns are white spots on antennae and white bands around base of second and third legs (see Plate 20 and Fig 117, Kozloff 1993) (Fig. 1).
General Morphology: The body of decapod crustaceans can be divided into the **cephalothorax** (fused head and thorax) and **abdomen**. They have a large plate-like carapace dorsally, beneath which are five pairs of thoracic appendages (see **chelipeds** and **pereopods**) and three pairs of maxillipeds (see **mouthparts**). The abdomen is elongated, soft and coiled in Paguridae (Kuris et al. 2007) (Fig. 1).

Cephalothorax:
Eyes: Eyestalks short, stout and with pointed ocular scales (Wicksten 2011).
Antennae: Antennal acicle usually exceeds eyestalk in length. Chemoreceptors on antennule hairs (Barnard et al. 1980).
Mouthparts: The mouth of decapod crustaceans comprises six pairs of appendages including one pair of mandibles (on either side of the mouth), two pairs of maxillae and three pairs of maxillipeds. The maxillae and maxillipeds attach posterior to the mouth and extend to cover the mandibles (Ruppert et al. 2004).
Carapace: Shield (hard, anterior portion) wider than long (McLaughlin 1972) (Fig. 1).
Rostrum: Triangular (Fig. 1), acute and not much longer than lateral projections of carapace (Wicksten 2011).
Teeth: Sharp medial frontal tooth (Barnard et al. 1980).
Pereopods: Two pairs of hairy walking legs with dactyls about as long as propodi, which are banded with white. Dactyls slender and about as long as propodi (Wicksten 2011). Two pairs of small posterior legs are adapted for holding shell.
Chelipeds: Left cheliped with small hand and granular surface, slightly hairy and wider than deep (Fig. 2). Right cheliped with large hand, rounded, twice as wide as small hand, granular, slightly hairy and with one large tubercule on ventral surface (Fig. 2). Cheliped stout and shorter than walking legs, is elongated and fingers gaping in male. Merus and carpus with setae, granules, spines and ridges.
Abdomen (Pleon): Abdomen asymmetrical, elongate, twisted, soft and not externally segmented (Fig. 1). Bears small, unpaired pleopods.

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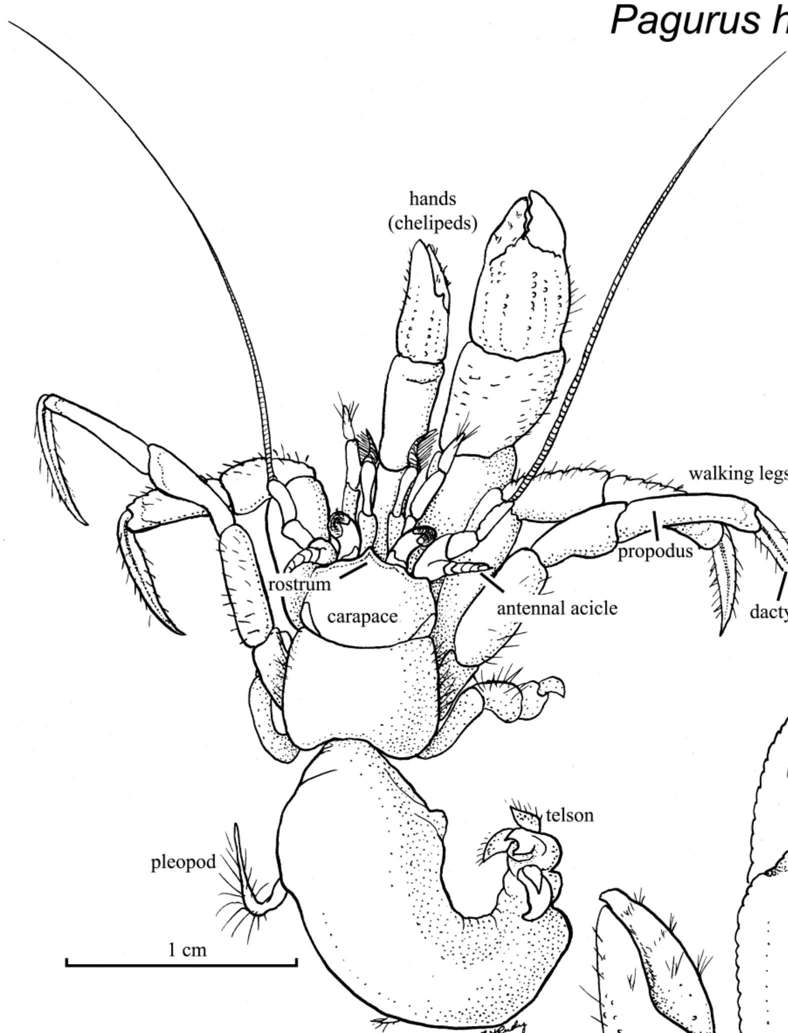
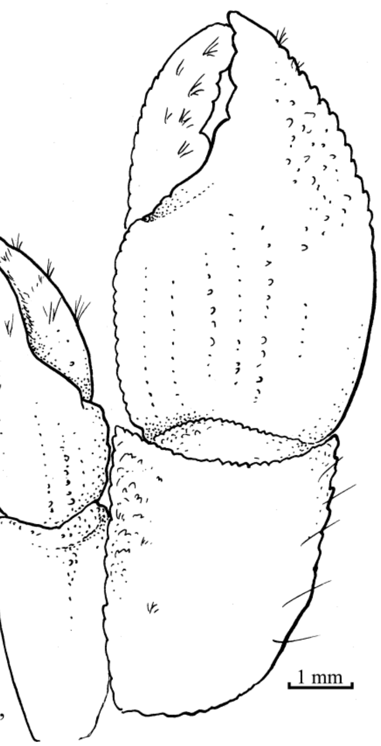
Pagurus hirsutiusculus



1. *Pagurus hirsutiusculus* x4.5:
light hair all over; color tan, dark green antennae white banding; white tips on propodi of walking legs, red lines on dactyls; eyestalks short, stout; rostrum triangular, acute.



2. Left and right chelipeds x12:
surfaces granular; right rounded, twice the width of left.

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Telson & Uropods: Telson and uropods small. Telson with slightly asymmetrical lobes and a shallow clefts laterally. Posterior margin with notch and spines. Uropods also asymmetrical (Wicksten 2011).
Sexual Dimorphism: Males usually larger than females (MacGinitie and MacGinitie 1949).
Shell: Usually inhabits *Nassarius fossatus, Nucella lamellosa* (e.g. this specimen) (in bays, Schmitt 1921), *Nucella emarginata* or *Littorina* sp. (Kozloff 1993). Individuals often inhabit shells of *Nucella* spp. except in San Francisco Bay, where it uses shells of gastropod species introduced from the Atlantic. Moves to larger shells with increased growth. Innate selection of shell is dependent on size, weight and shell volume (Reese 1962) and even the potential camouflaging properties of the shell (Partridge 1980). Individuals carefully examine and select appropriate shells with their setaceous minor chela. These setae have sensory structures and chemoreceptors that contribute to shell selection (Mesce 1993). Furthermore, shell type (i.e. snail species) may be species-specific and vary throughout ontogeny (Straughan and Gosselin 2014). Thus, available shells may be a limiting resource for hermit crabs (Vance 1972; Worcester and Gaines 1997), but this may only be the case for a specific, preferred, shell type (i.e. species).

Possible Misidentifications

Hermit crabs (superfamilies, Coenobitoidea and Paguroidea) are easily recognizable by their unique morphology and the gastropod shells they inhabit (although they also inhabit tubes, twigs or even bones). They use their last preened pears to grip the shell and their soft abdomen with reduced pleopods and small telson and uropods. Their carapace is usually rather thin, their eyes stalked and have pigmented corneae. They have active antennae, equipped with sensory setae. Their third maxillipeds are leg-like and bear setae and they have chelae that can be large enough to block their external shell aperture or sexually dimorphic.

Three hermit-crab families are currently recognized and occur on the west coast of North America: Diogenidae, Parapaguridae and Paguridae (Wicksten 2011). Parapaguridae species occur on the continental shelf. Diogenidae species, called “left-handed” (left cheliped is equal to or larger than right) hermit crabs, are generally subtidal and often inhabit the shells of moon snails. The family Diogenidae includes three local species, *Isocheles pilosus*, *Paguristes ulreyi*, and *P. bakeri*). The Paguridae, or “right-handed” (right cheliped is larger than left) hermit crabs, on the other hand, are a speciose family locally, with 10 species, inhabiting the intertidal zone to the continental shelf. Nine of the 10 local pagurid species belong to the genus *Pagurus* (Kuris et al. 2007). The hermit crabs of the genus *Pagurus* are hard to tell apart. However, many local species can be easily differentiated by their bright red or orange antennae and, likewise, many are similar to *P. hirsutiuseulus* in their lack of red antennae.

Pagurus hirsutiusculus can be distinguished from other *Pagurus* species in that the carapace shield is conspicuously wider than long and has antennae that are banded green and white. Furthermore, individuals are often not able to fully retract into their shells. They are found inhabiting the shells of *Nucella* spp. and may have *Crepidula* spp. living on the inside or outside of their shell. This species co-occurs with *P. samuelis*, but is the more common species in protected areas and bays.

Pagurus beringanus is also a low intertidal species, found at depths up to 364 m. This species has translucent antennae with a conspicuous lateral red mark and usually inhabits shells of *Nucella lamellosa*, *Ceratostoma foliata* and *Fusitriton oregonensis*. It is found on rocky substrates as well as sublittorally and has a whitish body, red banded walking legs, and has inverted V-shaped tubercules on its hands (Wicksten 2011; Kuris et al. 2007).

Pagurus quaylei is a subtidal species (to 97 m) with antennae irregularly banded and dark brown, reddish brown eyestalks and corneae with two bands. A common species amongst sand and polychaete tubes.

Pagurus samuelis, *P. hemphilli*, *P. granosimanus, P. armatus, and P. caurinus* all have red or orange antennae, where *P.*

hirsutiuseulus does not. *P. samuelis* is a high intertidal species that is common and abundant on the open coast, with red antennae and carapace with white stripes. It inhabits shells of Tegula spp and may have *Crepidula* spp. living on top of or inside the shell (Wicksten 2011). This species co-occurs with *P. hirsutiusculus* and is dominant to them in terms of shell competition and exchange (Kuris et al. 2007). *Pagurus hemphilli* is a low intertidal and mostly subtidal species (to 50 m) with red flagellum of antennae and corneae with distinct yellow rings. This species usually inhabits the shells of *Tegula* and *Astraea* spp, which are often themselves covered with red algae or small mollusks (e.g. *Crepidula adunca*, *Acmaea mitra*). *Pagurus granosimanus* is one of the most common local hermit crab species in the mid-littoral zone and within tide pools. This species has bright red antennae and commonly inhabits the shells of *Tegula* spp. *Pagurus armatus* is a low intertidal species, found at depths up to 146 m, and usually inhabits the shells of *Polinices* spp., and are often covered with the pink hydroid *Hydractinia* sp. *Pagurus caurinus* is a subtidal species, to 126 m, and while it has a northern distribution it is rare at that extent of its range. *Pagurus ochetensis* is a low intertidal and subtidal species which often inhabits moon snail shells (Kuris et al. 2007). Their chelipeds have a red stripe, and their corneae are yellowish green.

Ecological Information

Range: Type locality is Puget Sound, Washington. Known range includes the Pribilof Islands and Bering Strait to northern Japan (Barnard et al. 1980). Pacific Northwest to Monterey, California (McLaughlin 1972). Northern and southern populations used to be split into two subspecies: *P. hirsutiusculus hirsutiusculus* (northern) and *P. hirsutiusculus venturensis* (Monterey Bay, California southward) (Barnard et al. 1980). These subspecies were split into two formal species and, currently, *P. hirsutiusculus* is replaced in its southern distribution by *P. venturensis* (Wicksten 2011).

Local Distribution: Coos Bay sites include South Slough, near the channel at Collver Point and the mudflat of Metcalf Preserve.

Habitat: Protected areas with silt or in bays or harbors (Kozloff 1993; Wicksten 2011). Tidepools, under rocks (with coarse gravel), under seaweed (Kozloff 1993). South Slough specimens occur within *Zostera* bed in mudflats. Individuals appear to prefer algal cover (Orians and King 1964) and sandy tidepools (Reese 1962). Also present on the rocky coast, in tide pools, bays and with coarse sand and gravel (Kuris et al. 2007).

Salinity: Collected at 30, but tolerates brackish conditions (Barnard et al. 1980)

Temperature:

Tidal Level: Upper and middle intertidal zone to 110 m (McLaughlin 1972; Kuris et al. 2007; Wicksten 2011). In South Slough at +0.15 m and -4.5 m.

Associates: In eelgrass, associates include *Littorina* spp. and amphipods (South Slough). Associates includes those found within the shell and living with the hermit crab (e.g. polynoid worms, *Halosydna* spp.) or sessile organisms found on top of or within the shell (e.g. barnacles, limpets and slipper shells, *Crepidula* spp.) (Wicksten 2011). Polydorid worms can infect hermit crabs heavily (*Polydora commensalis*). The parasitic isopod, *Pseudione giardi,* is found with Puget Sound specimens (Barnard et al. 1980). Other parasites and their associates include the rhizocephalan parasite, *Peltogaster puguri* (22% females infected, 11.6% males, Alaska) as well as *Peltogasterella gracilis* and the hyperparasite bopyrid isopod, *Liriopsis pygmaea* in southeastern Alaska (see Fig. 1, Warrenchuk and Shirley 2000).

Abundance: Usually abundant in tidepools (Kozloff 1993) and is one of the common hermit crabs (MacGinitie and MacGinitie 1949; Kuris et al. 2007).

Life-History Information

Reproduction: Male deposits sperm near the female abdomen after molting. The sperm is stored and the female fertilizes eggs once they are laid. Females are ovigerous from December through April (California, Barnard et al. 1980). Brooding begins in late fall and larvae hatch in February, with most females carrying several (~ five) broods a year

through spring and summer months. Each brood contains up to 660 eggs and is dependent on female size (Fitch and Lindgren 1979).
Larva: Larval development in *P. hirsutiuseulus* has been described (Lough 1975; Fitch and Lindgren 1979) and proceeds via four zoea and, a final, megalopa stage, each marked by a molt (Puls 2001). *Pagurus hirsutiuseulus* zoea are shrimp-like (see paguroid zoeae Fig. 53.2–3, Harvey et al. 2014: Fig. 1, Fitch and Lindgren; Puls 2001), with telson posterior having seven 7 + 7 spines, with the fifth spine longest and secondary setae on the inner uropod margin. Zoeal size at each stage proceeds as follows (13˚C, Fitch and Lindgren 1979; McLaughlin et al. 1988): 1.9–2.4 mm (Zoea I), 2.6–2.9 mm (Zoea II), 3.2–3.8 mm (Zoea III) and 4.1–5.2 mm (Zoea IV). The zoea of the Paguridae are morphologically similar and easiest to identify by the color and distribution of their chromatophores (visible only in live specimens) (see Fig. 21, Puls 2001). The megalopae have small and reduced telson and uropods (as in adults), and chelipeds that are smooth, with no teeth or hairs (see Fig. 53.7 Harvey et al. 2014. Megalopae are 1.32 mm in length and 1.0 mm in width and are often infested with bopyrid isopod *Pseudione giardi* (Nyblade 1987; Puls 2001). Among competent larvae, settlement can be delayed due to lack of shells or unavailability of food (Harvey and Colasurdo 1993; Worcester and Gaines 1997).
Juvenile: Antennae dark green with white stripes and walking legs white-striped, but never blue. Merus of both chelipeds is dark brown, other leg segments are light brown (Bollay 1964).
Longevity:
Growth Rate: Growth occurs in conjunction with molting. In pre-molting periods the epidermis separates from the old cuticle and a dramatic increase in epidermal cell growth occurs. Post-molt individuals will have soft shells until a thin membranous layer is deposited and the cuticle gradually hardens. During a molt decapods have the ability to regenerate limbs that were previously autotomized (Kuris et al. 2007).
Food: A detritivore, eats detritus and scavenges for dead plant and animal material (Kozloff 1993). Some estuarine types filter plankton with their mouthparts (MacGinitie and MacGinitie 1949).
Predators: Other crabs.
Behavior: Lively and active, especially shallow water varieties (deepwater animals are more sluggish, MacGinitie and MacGinitie 1949) and will abandon shell in quiet waters (Ricketts and Calvin 1971). Based on a study with Alaskan and southern Californian *P. hirsutiusculus*, it was suggested that evolutionary shell loss may result from large, active species with northern populations (Blackstone 1989).

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