Pachygrapsus crassipes

The lined shore crab

Phylum: Arthropoda, Crustacea

Class: Multicrustacea, Malacostraca, Eumalacostraca

Order: Eucarida, Decapoda, Pleocyemata, Brachyura, Eubrachyura, Heterotremata
Family: Majoidea, Epialtidae, Epialtinae

Taxonomy: Until recently the brachyuran family Grapsidae, the shore crabs, was very large with several subfamilies and little taxonomic scrutiny. Based on molecular and morphological evidence, authors (von Sternberg and Cumberlidge 2000; Schubart et al. 2000; de Grave et al. 2009; Schubart 2011) elevated all grapsid subfamilies to the family level, reducing the number of species formally within the Grapsidae. Although recent molecular evidence suggest that *Hemigrapsus* is no longer within this family, *Pachygrapsus* remains one of the few members of the Grapsidae *sensu stricto* based on morphological evidence from adults, larvae and molecular data (Schubart 2011).

Description

Size: Carapace approximately 40 mm in width and males are larger than females (Hiatt 1948) (Fig. 1). Mature individuals weighed 15 g. (Gross and Marshall 1960) and measure 48 mm in width (Puls 2001).
Color: Dark green carapace, with dark red or blue transverse lines and some light markings (Plate 21, Kozloff 1993). Chela white ventrally and bright red dorsally (males) (Wicksten 2011).
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 and associated appendages are reduced and folded ventrally (Decapoda, Kuris et al. 2007).

Cephalothorax:

Eyes: Eyes present at anterolateral angle and eyestalks of moderate size with orbits deep and oblique (Fig. 2).

Antenna:

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). The third maxilliped in *P. crassipes* has merus, lobate and at an angle (Wicksten 2011).

Carapace: Nearly square in shape and a little broader than long, transverse lines or grooves on anterior. Lateral margins are most broad posterior to orbit (Wicksten 2011). Carapace sides nearly parallel, but arched (Fig. 1).

Frontal Area: Broad margin that is smooth, slightly arched and half as wide as carapace. Four slight lobes present below margin with small lobes at outer corners (Fig. 2).

Teeth: One strong lateral carapace tooth (below the orbital tooth) (Fig. 2).

Pereopods: Merus of each leg broad and bearing a single tooth at each posterodistal angle, except the fifth (last) pair smooth at distal end, and no sharply distinct teeth (Fig. 3) (Wicksten 2011). Leg shape broad, compressed and bristled (Rathbun 1918). Dactyls spinulose (Wicksten 2011).

Chelipeds: Usually subequal and massive. Chela almost smooth with arm and wrist striated (Rathbun 1918). Male chela broad

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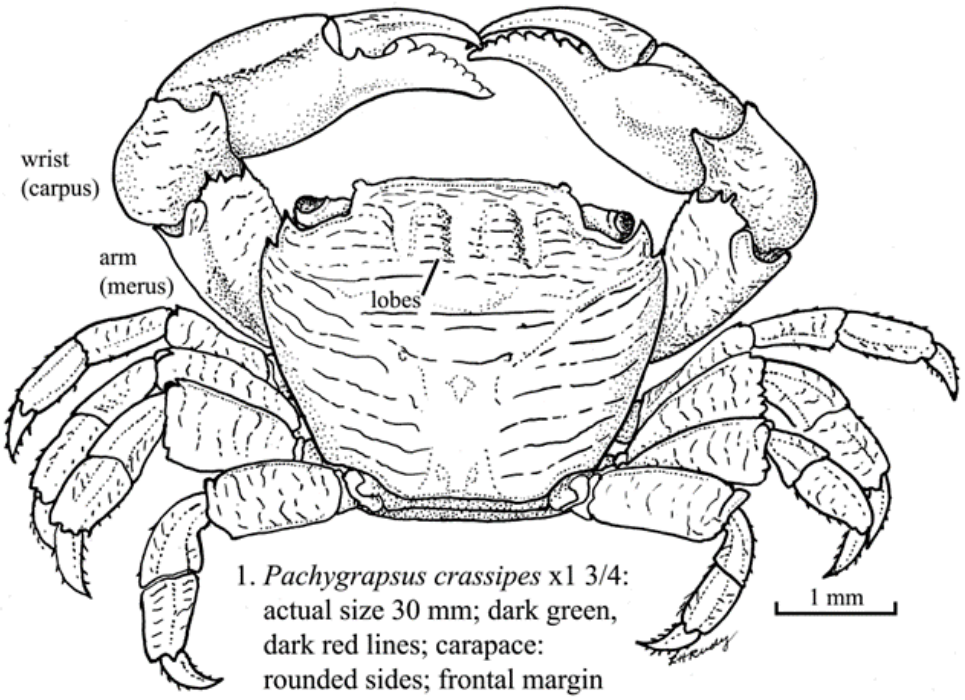
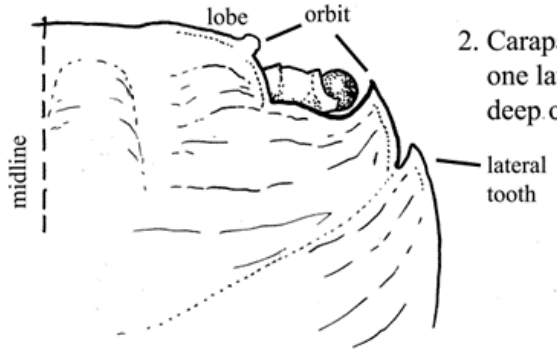
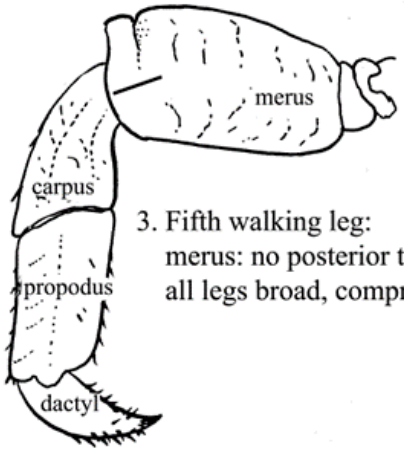


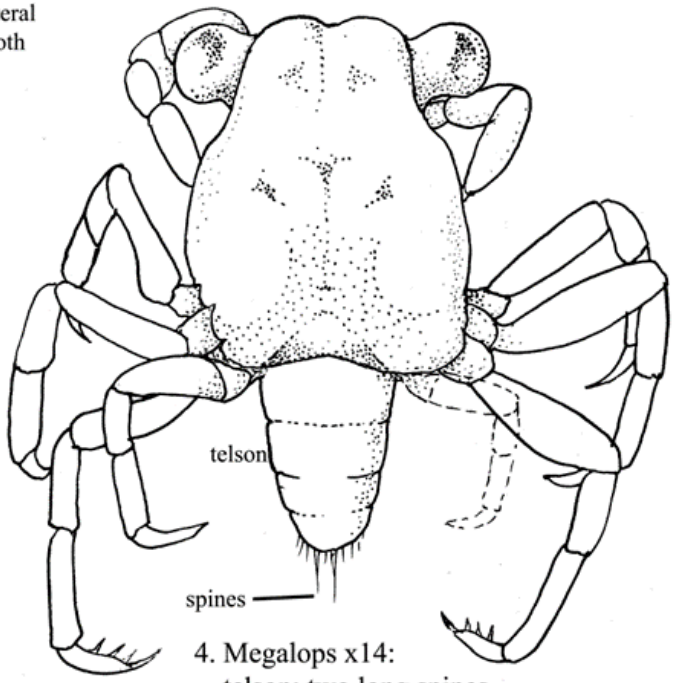
1. *Pachygrapsus crassipes* x1 3/4: actual size 30 mm; dark green, dark red lines; carapace: rounded sides; frontal margin straight; wrist and arm striated; four lobes below frontal margin.



2. Carapace (right front): one lateral tooth, one post-orbital; deep orbits.



3. Fifth walking leg: merus: no posterior teeth all legs broad, compressed.



4. Megalops x14: telson: two long spines (from Hiatt, 1948).

Hiebert, T.C. 2015. *Pachygrapsus crassipes. 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.

with raised line present on propodus, fingers spooned. Female chela, on the other hand, less broad.

Abdomen (Pleon): Females with wide abdomen and male *H. oregonensis* have narrow abdomens that exposes the sternum at the base (see **Sexual Dimorphism**, see Fig. 3, *Hemigrapsus oregonensis*).

Telson & Uropods:

Sexual Dimorphism: Male and female brachyuran crabs are easily differentiable. The most conspicuous feature, the abdomen, is narrow and triangular in males while it is wide and flap-like in females (Brachyura, Kuris et al. 2007). Male *P. crassipes* abdomen is narrow and triangular, exposing sternum at sides (as in *Hemigrapsus nudus* and *H. oregonensis*.) Female abdomen is rounded, wide and hiding sternum in the adult. Dimorphism obvious when animals only 6 mm wide (Hiatt 1948).

Possible Misidentifications

Pachygrapsus species are members of the Grapsidae, a family characterized by the carpus of the third maxilliped not articulating near the anterior merus angle and by lateral mouth margins that are parallel or convergent (Wicksten 2011). There is only one local *Pachygrapsus* species, but it may be confused with other grapsid crabs from the family Varunidae, characterized by chelae morphology, gaping third maxillipeds and setose walking legs (Ng et al. 2008). *Pachygrapsus crassipes* is superficially similar to the slower *Hemigrapsus nudus*, but the latter has obvious red spots on its chelipeds, and lacks the dark green color and transverse striations of *P. crassipes*. Furthermore, the frontal margin of *P. crassipes* is straight and it has one lateral tooth, not two (Symons 1964). Two similar shore crabs in the genus *Hemigrapsus* are *H. oregonensis,* which is smaller, and *H. nudus,* with two lateral teeth and a smooth, square carapace. The only other species of *Pachygrapsus*, the smaller *P. transversus*, occurs only as far north as California. The only other locally occurring member of the Grapsidae, *Planes cyaneus*, is a pelagic species that is only found washed ashore on drift logs with gooseneck barnacles (Kuris et al. 2007). *Rhithropanopeus harrisii*, an introduced xanthid (Panopeidae) mud crab, occurs locally with shore crabs. It has a slightly convergent sides, strong dorsal ridges on its carapace and three sharp carapace teeth.

Ecological Information

Range: Type locality is probably Oregon (erroneously Hawaii, Hiatt 1948; Wicksten 2011). Known range includes Oregon to Gulf of California, however there is significant genetic structuring between populations north and south of Pt. Conception, California (Cassone and Boulding 2006).

Local Distribution: Northernmost boundary is 45° N (Newport, Oregon), probably due to cold winter temperatures found on protected rocky beaches and in southern Oregon estuaries.

Habitat: Prefers hard substrates, especially rocks, jetties and boulders with crevices and crannies covered in algal growth. Also occurs in *Salicornia* marshes where *Salicornia* roots provide burrows.

Salinity: Most aspects of the biology of *P. crassipes,* in the following categories, were described by Hiatt (1948). Osmoregulatory adaptations indicate movement toward terrestrial habitat and can regulate against salt concentrations in the body during periods of exposure, and thus maintain a constant body salinity (Jones 1941). Occurs less frequently in brackish water than does *Hemigrapsus* (Hiatt 1948).

Temperature: Northern limit of range apparently determined by low winter temperatures and individuals can tolerate greater temperature fluctuation than can *Hemigrapsus* (Hiatt

1948).

Tidal Level: Lives over an extensive vertical range from mean low water to + 2.5 m. *Pachygrapsus crassipes* is found highest in intertidal of all Pacific Northwest crabs and is especially abundant at the higher levels (upper intertidal, Schmitt 1921) progressing toward terrestrial habitat (Hiatt 1948). However, as blood concentrations of potassium, calcium, and magnesium increase more than sodium when animal is desiccated, terrestrial adaptation may be inhibited. Also, efficiency of the animal's vascular system, affected by osmotic stress, further limits ecological range (Gross 1959).

Associates: *Pachygrapsus crassipes* occurs with *Hemigrapsus oregonensis* in bays, and with *H. nudus* on rocky outer shores. , It competes with both for shelter (Hiatt 1948), but not for food. *Fucus* (alga) and *Salicornia* (pickleweed) often provide protection. Individuals can be infested by bopyrid isopods (Southern California, Schmitt 1921). *Hemigrapsus oregonensis*, *H. nudus* and *P. crassipes* can be all be host to the nemertean egg predator, *Carcinonemertes epialti*, which can negatively impact brood mortality in these species (Shields and Kuris 1988). These three species can also serve as intermediate hosts for a variety of parasites including trematode metacercariae, trypanorhynch tapeworm, *Polymorphus* acanthocephalan and *Ascarophis* nematode larvae (Kuris et al. 2007).

Abundance: Ubiquitous in upper intertidal of rocky areas (Kuris et al. 2007) and more abundant on outer shores than in bays.

Life-History Information

Reproduction: No pairing or exhibitionism. Copulation occurs when females are soft (post-molting) and copulatory behavior has been described by Hiatt (1948) and Bovbjerg (1960a). Females ovigerous from April to September (Pacific Grove, California, Hiatt 1948) and May to November (Sea Beach, California, Schlotterbeck 1976; Puls 2001), but off-season mating occurs (Ricketts and Calvin 1971). Most breeding, however, takes place in summer months (Boolootian et al. 1959). Impregnation to extrusion of eggs takes 16–25 days with incubation period averaging 29 days. Mating generally occurs once a year and occasionally second broods are produced (Hiatt 1948). Upon hatching embryos are deep purple brown in color (Schlotterbeck 1976). The reproduction and life-cycle of the parasitic nemertean, *C. epialti* is dependent on and corresponds to that of its host species. However, this nemertean is not host specific (unlike *Carcinonemertes errans* on *Cancer magister*) and occurs amongst egg masses of other species including *H. nudus*, *H. oregonensis* (Kuris 1993; Roe et al. 2007; Kuris et al. 2007).

Larva: Larval development in *P. crassipes* proceeds via a prezoea and a series of zoea (five total) and megalopa stages, each marked by a molt with total larval duration (to fifth zoea, as measured in the lab) of approximately 95 days (described by Schlotterbeck 1976). The zoea are planktotrophic and have large compound eyes and four spines: one each dorsal and rostral and two lateral (see Fig. 2–11, Schlotterbeck 1976; Fig. 32, Puls 2001; Fig. 54.5, Martin 2014). The rostrum and dorsal spines are of equal length and the two lateral spines are shorter (Puls 2001). The first zoeal stage lasts 18 days, the second 22 days, the third 21 days, the fourth 25 days and the final stage lasts 29 days (Schlotterbeck 1976). In *P. crassipes*, the lateral spines are not present until the second zoea stage. The first zoea has no exospines on the telson, is approximately 1.0 mm (measured from tip of rostrum to tip of telson) and has lateral knobs on the second and third segments, where *H. oregonensis* has lateral knobs on only the second segment (Puls 2001). The zoea of *Hemigrapsus* species and

P. crassipes can be differentiated by body and eye size (Schlotterbeck 1976). *Pachygrapsus crassipes* megalopae have a square carapace and, at 5.6 mm in length and 2.7 in width, are much larger than that of *Hemigrapsus*. Megalopae are transparent and with telson bearing two long medial spines and several short ones (Fig. 4) (Hiatt 1948; Fig. 33, Puls 2001). Developmental time to megalopa stage is approximately six weeks and pelagic larvae may be transported shoreward in surface slicks associated with internal waves (Shanks 1983, 1985).

Juvenile: Juveniles alert and quick, are especially long-legged and have large eyes. At sexual maturity female carapace width is 15 mm and males is 12 mm (Hiatt 1948).

Longevity: Probably about three years (Hiatt 1948).

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). Female P. crassipes reach sexual maturity (to 15 mm wide) after 11–12 months and males in 7 months (about 12 mm) (Hiatt 1948).

Food: Mostly herbivorous, scrapes off algal film (*Fucus, Ulva*) with excavated chelae (Hiatt 1948; Kozloff 1993) and also eats detritus or other live animals. Perception of food is by visual, chemical and tactile stimuli, but not by odor. Feeds diurnally as well as nocturnally (Hiatt 1948), and chiefly in tide pools (Bovbjerg 1960b).

Predators: Gulls, rats, other *Pachygrapsus* (while soft), and large anemones (*Bunodactis, Anthopleura*) which can capture small animals. Because they are nocturnal and fast, *Pachygrapsus* are not bothered by most birds (Hiatt 1948).

Behavior: Mud dwellers that are seldom more than 4–5 feet from their home hole (Morgan et al. 2006). Pugnacious, solitary, active and move easily and quickly in any direction. Poor swimmers (Hiatt 1948). Aggregate in crevices well above the water in daylight (Bovbjerg 1960b).

Bibliography

1. BOOLOOTIAN, R. A., A. C. GIESE, A. FARMANFAMAIAN, and J. TUCKER. 1959. Reproductive cycles of five west coast crabs. Physiological Zoology. 32:213-220.
2. BOVBJERG, R. V. 1960a. Behavioral ecology of the crab, *Pachygrapsus crassipes*. Ecology. 41:668-672.
3. —. 1960b. Courtship behavior of the lined shore crab, *Pachygrapsus crassipes* Randall. Pacific Science. 14:421-422.
4. CASSONE, B. J., and E. G. BOULDING. 2006. Genetic structure and phylogeography of the lined shore crab, *Pachygrapsus crassipes*, along the northeastern and western Pacific coasts. Marine Biology. 149:213-226.
5. GROSS, W. J. 1959. The effect of osmotic stress on the ionic exchange of a shore crab. Biological Bulletin. 116:248-257.
6. GROSS, W. J., and L. A. MARSHALL. 1960. The influence of salinity on the magnesium and water fluxes of a crab. Biological Bulletin. 119:440-453.
7. HIATT, R. W. 1948. The biology of the lined shore crab *Pachygrapsus crassipes* Randall. Pacific Science. 2:135-213.
8. JONES, L. 1941. Osmotic regulation in several crabs of the Pacific coast of North America. Journal of Cellular and Comparative Physiology.
9. KOZLOFF, E. N. 1993. Seashore life of the northern Pacific coast: an illustrated guide to northern California, Oregon,

Washington, and British Columbia. University of Washington Press, Seattle, WA.
10. KURIS, A. M. 1993. Life cycles of nemerteans that are symbiotic egg predators of decapod crustacea: adaptations to host life histories. Hydrobiologia. 266:1-14.
11. KURIS, A. M., P. S. SADEGHIAN, J. T. CARLTON, and E. CAMPOS. 2007. Decapoda, p. 632-656. *In:* The Light and Smith manual: intertidal invertebrates from central California to Oregon. J. T. Carlton (ed.). University of California Press, Berkeley, CA.
12. MARTIN, J. W. 2014. Brachyura, p. 295-310. *In:* Atlas of crustacean larvae. J. W. Martin, J. Olesen, and J. T. Høeg (eds.). Johns Hopkins University Press, Baltimore, MD.
13. MORGAN, S., S. SPILSETH, H. PAGE, A. BROOKS, and E. GROSHOLZ. 2006. Spatial and temporal movement of the lined shore crab *Pachygrapsus crassipes* in salt marshes and its utility as an indicator of habitat condition. Marine ecology. Progress series. 314:271-281.
14. NG, P. K. L., D. GUINOT, and P. J. F. DAVIE. 2008. Systema brachyurorum: Part I. Annotated checklist of the extant Brachyuran crabs of the world. Raffles Bulletin of Zoology Supplement. 17:1-286.
15. PULS, A. L. 2001. Arthropoda: Decapoda, p. 179-250. *In:* Identification guide to larval marine invertebrates of the Pacific Northwest. A. Shanks (ed.). Oregon State University Press, Corvallis, OR.
16. RATHBUN, M. J. 1918. The grapsoid crabs of America. Bulletin of the United States Natural Museum. 97:128-145.
17. RICKETTS, E. F., and J. CALVIN. 1971. Between Pacific tides. Stanford University Press, Stanford, California.
18. ROE, P., J. L. NORENBURG, and S. MASLAKOVA. 2007. Nemertea, p. 221-233. *In:* Light and Smith manual: intertidal invertebrates from central California to Oregon. J. T. Carlton (ed.). University of California Press, Berkeley, CA.
19. RUPPERT, E. E., R. S. FOX, and R. D. BARNES. 2004. Invertebrate zoology: a functional evolutionary approach. Thomson Brooks/Cole, Belmont, CA.
20. SAMMY DE GRAVE, N., D. PENTCHEFF, and S. T. AHYONG. 2009. A classification of living and fossil genera of decapod crustaceans. Raffles Bulletin of Zoology:1-109.
21. SCHLOTTERBECK, R. E. 1976. Larval development of the lined shore crab, *Pachygrapsus crassipes* Randall, 1840. (Decapod: Brachyura: Grapsidae) reared in the laboratory. Crustaceana. 30:184-200.
22. SCHMITT, W. L. 1921. The marine decapod crustacea of California. University of California Publications in Zoology. 23:1-470.
23. SCHUBART, C. D. 2011. Reconstruction of phylogenetic relationships within Grapsidae (Crustacea: Brachyura) and comparison of trans-isthmian versus amphi-atlantic gene flow based on mtDNA. Zoologischer Anzeiger. 250:472-478.
24. SCHUBART, C. D., J. A. CUESTA, R. DIESEL, and D. L. FELDER. 2000. Molecular phylogeny, taxonomy, and evolution of non-marine lineages within the American grapsoid crabs (Crustacea: Brachyura). Molecular Phylogenetics and Evolution. 15:179-190.
25. SHANKS, A. L. 1983. Surface slicks associated with tidally forced internal waves may transport pelagic larvae of benthic invertebrates and fishes shoreward. Marine Ecology Progress Series. 13:311-315.
26. —. 1985. Behavioral basis of internal wave induced shoreward transport of megalopae of the crab *Pachygrapsus crassipes*. Marine Ecology Progress Series. 24:289-

295.
27. SHIELDS, J. D., and A. M. KURIS. 1988. Temporal variation in abundance of the egg predator *Carcinonemertes epialti* (Nemertea) and its effect on egg mortality of its host, the shore crab, *Hemigrapsus oregonensis*. Hydrobiologia. 156:31-38.
28. SYMONS, P. E. K. 1964. Behavioral responses of the crab *Hemigrapsus oregonensis* to temperature, diurnal light variation, and food stimuli. Ecology. 45:580-591.
29. VON STERNBERG, R., and N. CUMBERLIDGE. 1998. Taxic relationships within the Grapsidae MacLeay, 1838 (Crustacea: Decapoda: Eubrachyura). Journal of Comparative Biology. 3:115-136.
30. WICKSTEN, M. K. 2011. Decapod crustacea of the Californian and Oregonian Zoogeographic Provinces. http://escholarship.org/uc/item/7sk9t2dz. Scripps Institution of Oceanography, UC San Diego, San Diego, CA.

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T.C. Hiebert