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## ***Mimulus* Stimpson, 1860, a junior synonym of *Pugettia* Dana, 1851 (Decapoda: Brachyura: Majoidea: Epialtidae)**

MARY K. WICKSTEN<sup>1,3</sup> & JOHN J. STACHOWICZ<sup>2</sup>

<sup>1</sup>Department of Biology, Texas A&M University, College Station Texas 77843-3258. E-mail: Wicksten@bio.tamu.edu

<sup>2</sup>Department of Evolution and Ecology, University of California, One Shields Avenue, Davis California 95616.

E-mail: jjstachowicz@ucdavis.edu

<sup>3</sup>Corresponding author

### **Abstract**

William Stimpson (1860) established *Mimulus* (Brachyura: Majoidea: Epialtidae), with a single species, *M. foliatus*. Rathbun (1894) placed the genus in synonymy with *Pugettia* Dana, 18951, but subsequent authors have considered *Mimulus* to be a valid genus. Genetic evidence and re-examination of the morphology indicate that *M. foliatus* belongs to a clade of majoid crabs consisting of species of *Pugettia*. We therefore consider *Mimulus* to be a junior synonym of *Pugettia*. We provide a list of all species of *Pugettia*.

**Key words:** *Mimulus*, *Pugettia*, kelp crab

### **Introduction**

William Stimpson (1860, 200, pl. 5, fig. 1) described and figured a new genus and species of brachyuran crab, *Mimulus foliatus*. A second species, *M. acutifrons* A. Milne-Edwards, 1867, was described without illustrations or a type locality. With the exception of Newcombe (1893) and Rathbun (1894), subsequent authors have used the name *M. foliatus* in reference to the species of *Mimulus* found in the northeastern Pacific. A recent genetic analysis co-authored by the second author (Hultgren & Stachowicz 2008b) indicates that *M. foliatus* is closely related to *Pugettia gracilis* Dana, 1851 and does not warrant designation as a species of a different genus. We examined specimens and studied descriptions and illustrations of *M. foliatus* and compared its morphology to that of species of *Pugettia* and other epialtid crabs. We herein synonymize *Mimulus* Stimpson, 1860 with *Pugettia* Dana, 1851, and provide a list of species.

### **Material and methods**

Hultgren & Stachowicz (2008b: table 1) analyzed four specimens of *M. foliatus* from Bodega Bay, California (38°20'N 123°2.9'W) and compared them to 12 specimens of five other species of *Pugettia*. The first author examined specimens of a male (carapace width 38 mm) and a female (carapace width 22 mm) taken by scuba diving at 8 m on 7 August 1971 from Monastery Beach, Carmel, California (36°31.5'N 121°55.5'W) (Texas A&M University Teaching Collection). These specimens were compared with descriptions given by Stimpson (1860) and Garth (1958), and with a diagnosis given by Wicksten (2012). The gonopods of the male *M. foliatus* were compared with those of one specimen each of *Pugettia richii* Dana, 1851, and *P. producta* (Randall, 1840), from the Texas A&M Collection, and a male *Talipeus nuttallii* (Randall, 1840) from the Natural History Museum of Los Angeles County (LACM 41120), as well as with those illustrated by Garth (1958) for *M. foliatus*, six species of *Pugettia* and *T. nuttallii*. We follow the classification of Ng *et al.* (2008) for majoid crabs. The list of species of *Pugettia* is from Ng *et al.* (2008) with the addition of *P. ogasawarensis* Komatsu, 2011.

## Taxonomy

### Superfamily Majoidea Samouelle, 1819

### Family Epialtidae Macleay, 1838

### Subfamily Epialtinae Macleay, 1838

### Genus *Pugettia* Dana, 1851

*Pugettia* Dana, 1851: 268 (type species *Pugettia gracilis* Dana, 1851, subsequent designation by Miers 1879).—Miers 1879: 650.—Stimpson 1907: 24.—Holmes 1900: 24.—Rathbun 1925: 167.—Schmitt 1921: 205.—Garth 1958: 186.—Sakai 1965: 72.—Griffin & Tranter 1986: 92.—Ng *et al.* 2008: 101.—Wicksten 2012: 209.

*Mimulus* Stimpson, 1860: 199.—A. Milne-Edwards 1878: 144.—Holmes 1900: 23.—Rathbun 1904: 173.—Rathbun 1925: 182.—Schmitt 1921: 204.—Garth 1958: 183.—Ng *et al.* 2008: 101.—Wicksten 2012: 208.

Type locality Puget Sound, Washington.

### Species included

*Pugettia dalli* Rathbun, 1894

*Pugettia elongata* Yokoya, 1933

*Pugettia foliata* (Stimpson, 1860)

*Pugettia gracilis* Dana, 1851 (type species)

*Pugettia hubbsi* Garth, 1958

*Pugettia incisa* (De Haan, 1839)

*Pugettia intermedia* Sakai, 1938

*Pugettia kagoshimensis* Rathbun, 1932

*Pugettia leytensis* Rathbun, 1916

*Pugettia marissinica* Takeda & Miyake, 1972

*Pugettia mindanaoensis* Rathbun, 1916

*Pugettia minor* Ortmann, 1893

*Pugettia nipponensis* Rathbun, 1932

*Pugettia ogasawaraensis* Komatsu, 2011

*Pugettia producta* (Randall, 1840)

*Pugettia quadridens* (De Haan, 1839)

*Pugettia pellucens* Rathbun, 1932

*Pugettia richii* Dana, 1851

*Pugettia similis* Rathbun, 1932

*Pugettia tasmanensis* Richer de Forges, 1993

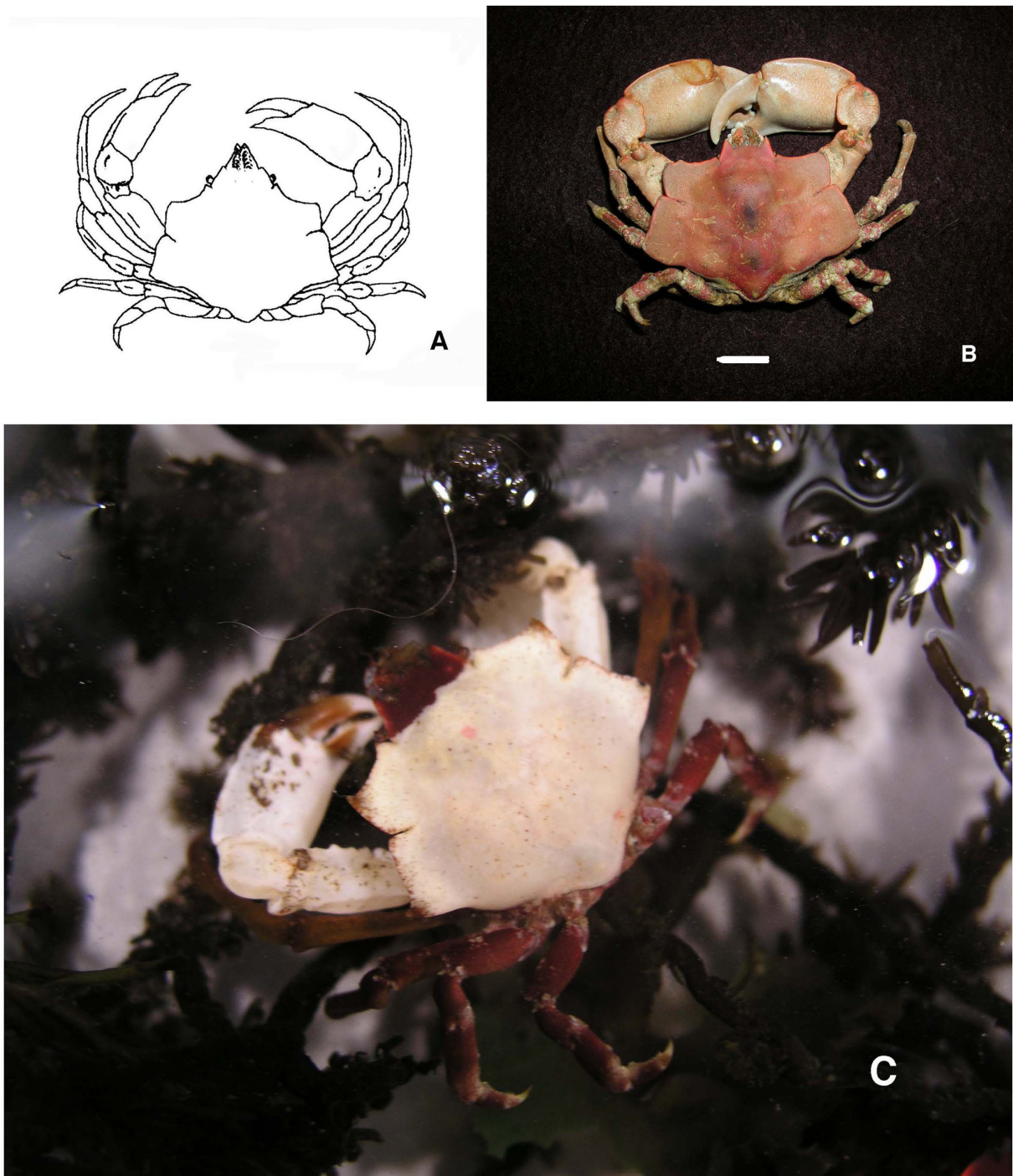
*Pugettia venetiae* Rathbun, 1924

**Remarks.** In his Latin description (translated by Holmes 1900), Stimpson (1860) defined the genus as:

“Carapace flattened, more or less pentagonal; antero-lateral margin laminate and cut by a narrow fissure into two closely approximate lobes. Rostrum short, bifid, and horizontal. Orbits incomplete below, but furnished above with a preorbital and postorbital spine. Eyes not concealed when retracted. Merus of the external maxillipeds short, the external angle obtuse, the internal angle incised; outer margin of the exognath dilated. Hand of the chelipeds much compressed and sublaminar. The propodi of the ambulatory legs have a setose tooth near the middle of the inferior margin. First pair of ambulatory legs exceeding the others.”

Stimpson stated "this genus is near *Epialtus*, with lamellar expansions of the sides of the carapax as in some *Hueniae*". The narrow chelipeds shown in the original illustration demonstrate that this individual was a female (Stimpson 1860: pl.1A). The type locality was “taken from the stomachs of percoid fishes, (“Cabesones”) caught off Monterey, California, by A.S. Taylor”. Cabeson is the common name of *Scorpaenichthys marmoratus* (Ayres, 1854), family Cottidae, a crab-eating fish. Stimpson made no mention of or made comparison to species of *Pugettia*. Stimpson’s specimens were housed in the Chicago Academy of Sciences, which was destroyed in a fire in

1871. The type specimen almost surely was destroyed. Garth (1958) reported that a “male cotype without chelipeds or legs” existed in the Museum of Comparative Zoology, Harvard University, but no syntypes of *M. foliatus* have been found in the British Museum (Natural History) (Evans 1967).



**FIGURE 1.** *Pugettia foliata* (Stimpson, 1860). A, Original illustration of *Mimulus foliatus* (Stimpson 1860: plate 5, fig. 1). B, Adult male from Monterey Bay, California. Scale = 10 mm. Photograph by T.J. Boyle, Texas A&M University. C, Adult male from Sonoma County, California. Photograph by Kristin Hultgren, Seattle University.

A. Milne-Edwards (1867) described a second species, *Mimulus acutifrons*, which supposedly could be distinguished from *M. foliatus* by the “frontal teeth” (rostral horns), which are “short and hardly separated from the median line, and by the supra-orbital angles not reaching as far” (translated from the French). There were no illustrations and there was only a single specimen (sex not stated), and no information on the type locality was given except that the specimen had been part of the collections of “Baron de Lafresnaye”. The type material, which

seems to have been deposited in the Muséum National d'Histoire Naturelle, Paris, is apparently lost (D. Guinot, pers. comm.) Garth (1958) questionably placed *M. acutifrons* in synonymy with *M. foliatus*. The length of the rostral horns is variable in specimens of *M. foliatus*, and the supra-orbital angles can vary with age and sex. It is impossible without the examination of the holotype to know for certain if Milne-Edwards' specimen could be assigned to *Mimulus* or a related genus, or in which localities one might look for a similar specimen.

Newcombe (1893) contacted M.J. Rathbun regarding a specimen collected in Clayoquot Sound, British Columbia. She stated that she was "unable to separate the genus from *Pugettia*". Newcombe (1893) recorded the species as *Pugettia (Mimulus) foliata* Stimpson. Rathbun (1894:72) wrote "there seems to be no good reason for placing this (*Mimulus foliatus*) in a genus distinct from *Pugettia*," and referred to the species as *Pugettia foliata*. The "antennae have the basal joint as in that genus" (*Pugettia*) and the flagellum is flattened and exposed at the side of the rostrum, the "carapace is wider than in other species of *Pugettia*" and the chelipeds present showed "nothing distinctive". The maxillipeds, abdomen, sternum, and ambulatory legs were considered as "almost exactly" as in *Pugettia gracilis* Dana, 1851.

Holmes (1900: 23) translated Stimpson's original Latin description of *Mimulus* but made no comparisons to species of *Pugettia*. Without explanation, he cited *Pugettia foliata*, as given by Rathbun (1894), as a junior synonym of *M. foliatus*. Rathbun (1904: 173) referred it as *M. foliatus*. Schmitt (1921), Rathbun (1925), and Garth (1958) considered *Mimulus* a valid genus, containing only one species, *M. foliatus*. Garth's work provided a brief re-description of the species along with illustrations, and Garth (1958) and Wicksten (2012) provided extensive synonymies.

Schmitt (1921), Rathbun (1925), and Garth (1958) distinguished species of *Pugettia* from *Mimulus* on the basis of the lateral margins of the carapace being markedly flattened or produced. Schmitt (1921) stated that the upper surface of the carapace of *Pugettia* bore spines or tubercles instead of being smooth, and assigned *P. producta* Randall, 1839, to *Epialtus* H. Milne-Edwards, 1834. The dorsal surface of the carapace of *P. producta* is smooth. Schmitt's description of *M. foliatus* noted that it possessed two median "obsolescent" tubercles as well as a tubercle on the posterior branchial region, and thus contradicted the generic distinction from *Pugettia* given in his key.

Garth (1958: pls. L, O, P, Q) figured the right first pleopods of male epialtid crabs (as subfamilies Acanthonychinae and Pisinae of the Majidae), including *M. foliatus*, *P. producta*, *P. richii*, four other *Pugettia* species, and *Talipeus nuttallii*. In both *M. foliatus* and the species of *Pugettia*, this pleopod bears a flared apex with a pointed tip and one or two opposing grooved projections of equal or slightly shorter length. Both *M. foliatus* and the species of *Pugettia* bear some form of median protuberance: a spinulose lobe, "tongue," rounded lobule, or two smaller lobes. In contrast, the first pleopods of *T. nuttallii* do not have the median protuberance, and the lateral projections are not curved, as in *Pugettia*. The male pleopods of other species of Epialtidae vary, ending in a curved, spiny, or flattened apex, two concave points, small and blunt lobes or a complicated structure of depressed areas and protrusions. The shapes of the distal areas of the male first pleopods of *M. foliatus*, *P. producta*, *P. richii*, and *T. nuttallii* are in close agreement with those figured by Garth. Griffin & Tranter (1986: fig. 28) figured the male first pleopods of the western Pacific *P. incisa*, *P. intermedia*, *P. marissinica*, and *P. quadridens*. Komatsu (2011), in the original description of *P. ogasawarensis*, and Richer de Forges (1993), in the original description of *P. tasmanensis*, also figured the first pleopods. The pleopods of all of the western Pacific and Tasman Sea species have similar apices, only varying in fine details of the angle, length, and curvature of the lobes and tubercles. The structure of the first pleopod of male *M. foliatus* falls within the range of species variation of the genus *Pugettia*.

Hultgren & Stachowicz (2008a) studied the habitat distinctions between *P. producta*, *P. richii*, and *M. foliatus*. These three species can be found in intertidal areas along the coast of California, but have distinct habitats: *P. producta* is usually found among large kelps, (*Macrocystis* or *Egregia* spp.), *P. richii* among red algae (Rhodophyta), and *M. foliatus* typically in the lowest intertidal zone into shallow subtidal regions, on rocks, among algae, or in kelp holdfasts (Fig. 1C). The relatively smooth carapaces of *P. producta* and *M. foliatus* may be related to climbing on algae or hiding among kelp holdfasts. Of the three species, only *P. richii* decorates by attaching algae or hydroids to its rostrum and the sides of the carapace. The other two species may attach a small piece of alga to the rostrum but do not cover the body from dorsal view. The three species share similar ranges: *P. producta* from the Queen Charlotte Is., Canada to Point Asunción, Baja California, Mexico; *P. richii* from Prince of Wales I., Alaska to Asunción Bay, Baja California; and *M. foliatus* from Unalaska, Alaska to San Diego, California, although it is uncommon south of Point Conception, California. A report of *M. foliatus* from Mazatlán, western Mexico is "questionable" (Garth 1958).

Hultgren & Stachowicz (2008b) used a genetic analysis to study the relationships among majoid crabs. The study included members of the Epialtidae, including six species of *Pugettia*, *M. foliatus*, and *Talipeus nuttallii*. It was found that *M. foliatus* was as closely related to other species of *Pugettia* as species of *Pugettia* were to each other. As pointed out by Rathbun (1894: 72), the closest relative to *M. foliatus* seems to be *P. gracilis*. Hultgren & Stachowicz (2008b) suggested, but did not confirm, that *Mimulus* should be considered to be a junior synonym of *Pugettia*.

Stimpson (1860) and subsequent authors gave great importance to the lateral flattened expansions of *M. foliatus*, as seen in the "Hueniae", as a difference with other majoid crabs. The first author examined specimens of *Huenia heraldica* (De Haan, 1837) (Epialtidae) in the collections of the Bishop Museum, Honolulu, Hawaii. In *H. heraldica*, the shape of the lateral expansions of the carapace is sexually dimorphic, with those of the female being less sharply defined than those of the male. These lateral expansions occur in other epialtoid crabs, such as *Epialtoides hiltoni* (Rathbun, 1894).

Large, well-separated teeth along the lateral margin of the carapace in most species of *Pugettia*, but in *P. gracilis*, the anterolateral projections of the carapace have been described as "wing-like" (Garth 1958). Hultgren & Stachowicz (2008a) related the surface of the carapace to habitat, suggesting that crabs that climb among algae or hide under rocks might be more likely to have a smooth carapace than those living among dense algae. The function of the "wing-like expansions" of the carapace remains uncertain, but combined with a color similar to the algae on or among which they live, may help to conceal the crab in the natural habitat.

As in *M. foliatus*, adult male *Pugettia* frequently have larger chelae than do mature females, often with a gap between the fingers, and a pronounced ridge along the carpus and the upper margin of the propodus (Fig. 1B). These features are prominent in *P. richii*, *P. dalli*, and *P. gracilis* from the eastern Pacific; somewhat less so in *P. producta* and *P. hubbsi*; and in the Japanese species *P. minor*, *P. incisa*, *P. quadridens*, *P. nipponensis*, and *P. sagamiensis* (Sakai 1965: pls. 31–33).

Species of *Pugettia*, with the exception of *P. tasmanensis*, are confined to the western and northern Pacific Ocean, ranging from the Philippines northward along the Asian coast, across the Aleutian Islands south to Baja California, Mexico. Thirteen of the 21 species inhabit the area from the Philippines to Russia, and seven are found in the eastern Pacific. *P. tasmanensis* is the only species reported from the southern hemisphere. In California, these are called "kelp crabs", an appropriate name because many of them live among algae.

Based on external morphology, structure of the male first pleopods, sexual dimorphism, habitat, range and new genetic data, we find no reason to separate *Mimulus foliatus* from the known species of *Pugettia*. We therefore place *Mimulus* Stimpson, 1860 in synonymy with *Pugettia* Dana, 1851. The revised name of the foliose kelp crab is hereby changed to *Pugettia foliata* (Stimpson, 1860).

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