



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

MARY K. WICKSTEN^{1,3} & JOHN J. STACHOWICZ²

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

²Department of Evolution and Ecology, University of California, One Shields Avenue, Davis California 95616.

E-mail: jjstachowicz@ucdavis.edu

³Corresponding 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, (“Cabezones”) caught off Monterey, California, by A.S. Taylor”. Cabezon 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).

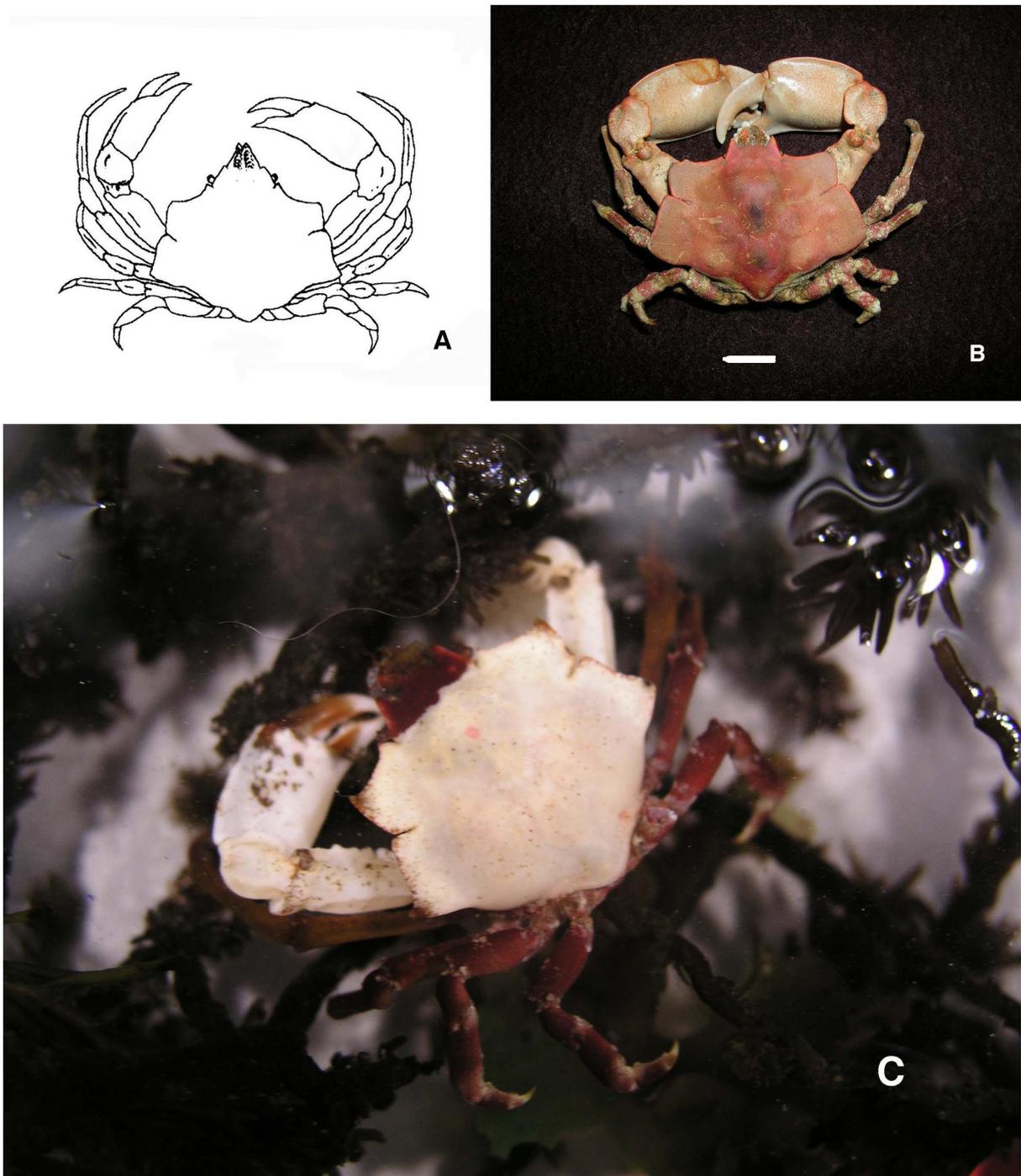


FIGURE 1. *Pugettia foliata* (Stimpson, 1860). A, Original illustration of *Mimulus foliatus* (Stimpson 1860: plate 5, fig. 1). B, Adult male from Monterey Bay, California. Scale = 10 mm. Photograph by T.J. Boyle, Texas A&M University. C, Adult male from Sonoma County, California. Photograph by Kristin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

Acknowledgments

We thank the late Lu Eldridge (Bishop Museum, Honolulu, Hawaii) for allowing the first author to examine specimens of *Huenia heraldica*; T.J. Boyle (Texas A&M University) and Kristin Hultgren (University of California, Davis) for providing photographs, Adam Wall and Joel Martin (Natural History Museum of Los Angeles County) for the loan of a specimen of *Talipeus nuttallii*; Danièle Guinot (Muséum National d'Histoire Naturelle, Paris) for information on missing decapod specimens, and Peter K.L. Ng (National University of Singapore) for helpful comments on the manuscript.

References

- Dana, J.W. (1851) Conspectus Crustaceorum quae in Orbis Terrarum circumnavigatione, Carolo Wilkes e Classe Reipublicae Foederatae Duce, lexit et descripsit. Pars VI. *American Journal of Science*, 11, 268–274.
<http://dx.doi.org/10.5962/bhl.title.53615>
- Evans, A.C. (1967) Syntypes of Decapoda described by William Stimpson and James Dana in the collections of the British Museum (Natural History). *Journal of Natural History*, 1, 399–411.
<http://dx.doi.org/10.1080/00222936700770391>

- Garth, J.S. (1958) Brachyura of the Pacific coast of America Oxyrhyncha. *Allan Hancock Pacific Expeditions*, 21, part I, text, 1–499 (text); vol. 2, 500–854, Tables 1–107, Plates A–Z, 1–55.
- Gordon, I. (1931) Brachyura from the coast of China. *Journal of the Linnean Society of London*, 37, 525–558.
<http://dx.doi.org/10.1111/j.1096-3642.1931.tb02365.x>
- Griffin, D.J.G. & Tranter, H.A. (1986) The Decapoda Brachyura of the *Siboga* Expedition Part VIII. Majidae. *Siboga-Expeditie* XXIX, C4, 1–335.
- De Haan, W. (1839) Crustacea. In: von Siebold, P.F. (Ed.) *Fauna Japonica sive Descriptio Animalium, Quae in Itinere per Japoniam, Jusse et Auspiciis Superiorum, qui Summun in India Batavia Imperium Tenent, Suscepto, Annis 1823-1830 Collegit, Notis Observationibus et Adumbrationibus Illustravit*, A. Arnz, Lugdunum Batavorum, Leiden, 243 pp.
- Holmes, S.J. (1900) Synopsis of California stalk-eyed Crustacea. *Occasional Papers of the California Academy of Sciences*, VII, 1–248.
<http://dx.doi.org/10.5962/bhl.title.53705>
- Hultgren, K. & Stachowicz, J. (2008a) Alternative camouflage strategies mediate predation risk among closely related co-occurring kelp crabs. *Oecologia*, 155, 519–528.
<http://dx.doi.org/10.1007/s00442-007-0926-5>
- Hultgren, K. & Stachowicz, J. (2008b) Molecular phylogeny of the brachyuran crab superfamily Majoidea indicates close congruence with trees based on larval morphology. *Molecular Phylogenetics and Evolution*, 48, 986–996.
<http://dx.doi.org/10.1016/j.ympev.2008.05.004>
- Komatsu, H. (2011) Crabs dredged off the Ogasawara Islands (Crustacea, Decapoda, Brachyura). *Memoirs of the National Museum of Natural Science* (Tokyo), 47, 219–277.
- MacLeay, W.S. (1838) On the brachyurous Crustacea brought from the Cape by Dr. Smith. In: Smith, A. *Illustrations of the Annulosa of South Africa; Being a Portion of the Objects of Natural History Chiefly Collected During an Expedition into the Interior of South Africa, Under the Direction of Dr. Andrew Smith, in the Years 1834, 1835, and 1836; Fitted out by "The Cape of Good Hope Association for Exploring Central Africa"*. Smith, Elder and Company, London, pp. 53–71.
- Miers, E.J. (1879) On the classification of the maioid Crustacea or Oxyrhyncha, with a synopsis of the families, subfamilies and genera. *Journal of the Linnean Society of London, Zoology*, 14, 634–673.
<http://dx.doi.org/10.1111/j.1096-3642.1879.tb02457.x>
- Milne-Edwards, A. (1867) Descriptions du quelques espèces nouvelles de Crustacés Brachyours, Tribu des Oxyrhinques. Famille des Maiens. *Annals de la Société Entomologique de France*, sér. 5, 7, 263–288.
- Milne-Edwards, H. (1834) *Histoire Naturelle des Crustacés, Comprenant l'Anatomie, la Physiologie et al Classification de ces Animaux*. Paris, vol. 1. 468 pp.
- Newcombe, C.F. (1893) Catalogue of the Crustacea in the Provincial Museum, Victoria. *Bulletin of the Natural History Society of British Columbia*, Article 4, 19–30.
- Ng, P., Guinot, D. & Davie, J.F. (2008) Systema brachyurorum: Part I. An annotated checklist of extant brachyuran crabs of the world. *Raffles Bulletin of Zoology*, 17, 1–286.
- Ortmann, A.E. (1893) Die Decapoden-Krebse des Strassburger Museums. VI. Theil. Abtheilung: Brachyura (Brachyura genuina Boas) I. Unterabtheilung: Majoidea und Cancroidea, I. Section Portuninea. *Zoologische Jahrbuch, Systematik*, 7, 23–88.
- Randall, J.W. (1840) Catalogue of the Crustacea brought by Thomas Nuttall and J.K. Townsend, from the west coast of North America and the Sandwich Islands, with descriptions of such species as are apparently new among them which are included several species of different localities, previously existing in the collection of the Academy. *Journal of the Academy of Natural Sciences, Philadelphia*, 16, 233–260.
<http://dx.doi.org/10.5479/si.00963801.13-797.49>
- Rathbun, M.J. (1893) Scientific results of explorations by the U.S. Fish Commission steamer Albatross. XXIV. Descriptions of new genera and species of crabs from the west coast of America and the Sandwich Islands. *Proceedings of the United States National Museum*, 16, 223–260.
- Rathbun, M.J. (1894) Notes on the crabs of the family Inachidae in the United States National Museum. *Proceedings of the United States National Museum*, 17, 43–75.
<http://dx.doi.org/10.5479/si.00963801.17-984.43>
- Rathbun, M.J. (1904) Decapod crustaceans of the northwest coast of North America. *Harriman Alaska Expedition*, 10, 1–219.
<http://dx.doi.org/10.5962/bhl.title.10681>
- Rathbun, M.J. (1916) New species of crabs of the families Inachidae and Parthenopidae. *Proceedings of the United States National Museum*, 50, 527–559.
<http://dx.doi.org/10.5479/si.00963801.2135.527>
- Rathbun, M.J. (1924) New species and subspecies of spider crabs. *Proceedings of the United States National Museum*, 64, 1–5.
<http://dx.doi.org/10.5479/si.00963801.2504>
- Rathbun, M.J. (1925) The spider crabs of America. *Bulletin of the United States National Museum*, 97, 1–445.
<http://dx.doi.org/10.5479/si.03629236.129.i>
- Rathbun, M.J. (1932) Preliminary descriptions of new species of Japanese crabs. *Proceedings of the Biological Society of Washington*, 45, 29–37.

- Richer de Forges, B. (1993) Deep sea crabs of the Tasman seamounts (Crustacea: Decapoda: Brachyura). *Records of the Australian Museum*, 45, 11–24.
<http://dx.doi.org/10.3853/j.0067-1975.45.1993.126>
- Sakai, T. (1938) *Studies on the Crabs of Japan. III. Brachygnatha, Oxyrhyncha*. Yokendo, Tokyo, 193–364.
- Sakai, T. (1965) *The Crabs of Sagami Bay, Collected by His Majesty the Emperor of Japan*. East-West Press Center, Honolulu, Hawaii, 206 pp.
- Samouelle, G. (1819) *The Entomologist's Useful Compendium or an Introduction to the Knowledge of British Insects, Comprising the Best Means of Obtaining and Preserving Them, and a Description of the Apparatus Generally Used; Together with the Genera of Linné, and the Modern Method of Arranging the Classes Crustacea, Myriapoda, Spiders, Mites and Insects, from their Affinities and Structure, According to the Views of Dr. Leach, also an Explanation of the Terms used in Entomology, a Calendar of the Times of Appearance and Usual Situations of near 3,000 species of British Insects; with Instructions for Collecting and Fitting Up Objects for the Microscope*. Thomas Boys, London, 496 pp.
- Schmitt, W.L. (1921) The marine decapod Crustacea of California. *University of California Publications in Zoology*, 23, 1–470.
- Stimpson, W. (1860) Notes on North American Crustacea, in the Museum of the Smithsonian Institution. No. II. *Annals of the Lyceum of Natural History* (New York), 7, 176–246.
<http://dx.doi.org/10.1111/j.1749-6632.1862.tb00153.x>
- Stimpson, W. (1907) Report on the Crustacea (Brachyura and Anomura) collected by the North Pacific Exploring Expedition, 1853–1856. *Smithsonian Institution Miscellaneous Collections*, 49, 1–240.
- Takeda, M. & Miyake, S. (1972) New crabs from the sea around the Tsushima Islands. *Bulletin of the National Science Museum* (Toyko), 15, 253–265.
- Wicksten, M.K. (2012) Decapod Crustacea of the Californian and Oregonian zoogeographic provinces. *Zootaxa*, 3371, 1–307.