

Rochinia confusa, a junior synonym of *R. umbonata* (Crustacea: Brachyura: Epialtidae) as revealed by ontogenetic changes

MARCOS TAVARES¹, WILLIAM SANTANA² AND RENATA PETTAN³

¹Museum of Zoology, University of São Paulo, Ave. Nazareth 481, Ipiranga 04263-000, São Paulo, SP, Brazil, ²Laboratório de Sistemática Zoológica, Pró-Reitoria de Pesquisa e Pós-Graduação, Universidade Sagrado Coração – USC, Rua Irmã Armanda, 10-50, Jd. Brasil, 17011-160, Bauru, SP, Brazil, ³Grupo de Pesquisa em Biologia de Crustáceos – CRUSTA, UNESP – Campus Experimental do Litoral Paulista, Praça Infante Dom Henrique, s/n – Parque Bitaru – São Vicente, SP, Brazil

The carapace and chelipeds ornamentation of the deep-water spider crab Rochinia umbonata (Stimpson, 1871), from the Western Atlantic undergo very dramatic ontogenetic changes. Since the also deep-water spider crab Rochinia confusa Tavares, 1991 is differentiated from R. umbonata mostly on the basis of these characters, R. confusa is regarded herein as an ontogenetic stage and, therefore, a junior subjective synonym of R. umbonata.

Keywords: Ontogeny, synonym, spider crabs, Majoidea, deep-water, Brazil

Submitted 2 September 2015; accepted 3 September 2015; first published online 6 October 2015

INTRODUCTION

The proliferation of benthic surveys in Brazilian deep-waters in recent years has yielded a wealth of decapod crustacean material, whose study is gradually helping to improve our understanding of the taxonomic composition of the south-western Atlantic benthic fauna, and particularly its relationship with areas further north in the Caribbean Sea and Gulf of Mexico.

The Brazilian deep-water spider crab *Rochinia confusa* Tavares, 1991 (Majoidea: Epialtidae) has long been regarded as the southern counterpart of *Rochinia umbonata* (Stimpson, 1871), a species for many years only known from the east coast of the USA, Gulf of Mexico and Caribbean Sea, and recently reported from Brazil (Amapá, Pará, Pernambuco, Bahia, Espírito Santo, Rio de Janeiro) (Coelho *et al.*, 2008 and references therein). However, we have since studied a large series of specimens of *Rochinia umbonata* of different ontogenetic stages and we can now show that *R. confusa* is just an ontogenetic stage and, therefore, a junior subjective synonym of *R. umbonata*. The substantial morphological changes of the carapace and chelipeds over ontogeny are herein described and illustrated, and the synonymy between *R. confusa* and *R. umbonata* discussed.

The material used for this study is housed in the crustacean collections of the Museu de Oceanografia ‘Dr Petrônio Alves Coelho’ (MOUFPE), Museu Nacional, Universidade Federal do Rio de Janeiro (MNRJ), Muséum national d’Histoire naturelle, Paris (MNHN), Museu de Zoologia da Universidade de São Paulo (MZUSP), and National Museum of Natural History, Smithsonian Institution, Washington DC (USNM).

Standard measurements (in mm) are cl, carapace length (rostrum not included) and cw, carapace maximum width.

SYSTEMATICS

Infraorder BRACHYURA Linnaeus, 1758
Superfamily MAJOIDEA Samouelle, 1819
Family EPIALTIDAE MacLeay, 1838
Genus *Rochinia* A. Milne-Edwards, 1875
Rochinia umbonata (Stimpson, 1871)
(Figures 1–6)

Scyra umbonata Stimpson, 1871, p. 115.

Scyra umbonata — A. Milne-Edwards, 1875, p. 87; 1879: pl. 31, Figures 5, 5a, 5b; 1880a, p. 2; Sars, 1885, p. 6, 7 e 274; Smith, 1886, p. 625.

Scyramathia umbonata — Milne-Edwards, 1880b, p. 356; Milne-Edwards & Bouvier, 1923, p. 381.

Amathia modesta Stimpson, 1871, p. 124.

Amathia modesta — A. Milne-Edwards 1878, p. 135; Miers, 1886, p. 26.

Anamathia modesta — Smith, 1885, p. 493; Faxon, 1895, p. 10.

Anamathia umbonata — Rathbun, 1894, p. 61, pl. 1, Figures 1–3; Faxon, 1895, p. 10.

Rochinia umbonata — Rathbun, 1925, p. 222, text-figure 85, pl. 72, pl. 73, figure 1; Chace, 1940, p. 63; Bullis & Thompson, 1965, p. 12; Williams *et al.*, 1968, p. 61, Figure 16; Pequegnat, 1970, p. 183; Powers, 1977, p. 67; Takeda, 1983, p. 135, 1 fig; Williams, 1984, p. 323, figure 258, 260c; Abele & Kim, 1986, p. 42; Griffin & Tranter, 1986, p. 175; Soto, 1991, p. 628, table 2; Paulmier, 1993, p. 26, pl. 30, Figure 1; Poupin, 1994, p. 43, pl. 48; Silva *et al.*, 1999, p. 171; 2001, p. 97; 2002, p. 102; Viana *et al.*, 2002, p. 17; 2003, p. 17; Nizinski, 2003, p. 128; Lalana *et al.*, 2004,

Corresponding author:

W. Santana

Email: william_santana@yahoo.com.br

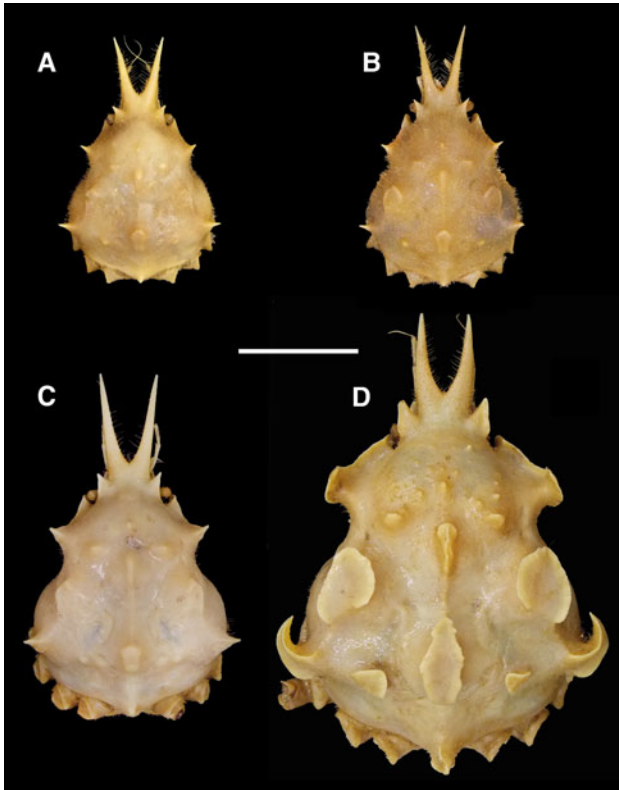


Fig. 1. Dorsal view of cephalothorax of *Rochinia umbonata* (Stimpson, 1871), cheliped and pereopods electronically removed. (A) male cl 30 mm, cw 23 mm (MZUSP 15725); (B) male cl 32 mm, cw 23 mm (MZUSP 17424); (C) male cl 42 mm, cw 31 mm (USNM 1000819); (D) male cl 57 mm, cw 43 mm (MZUSP 16228). Scale bar: 20 mm.

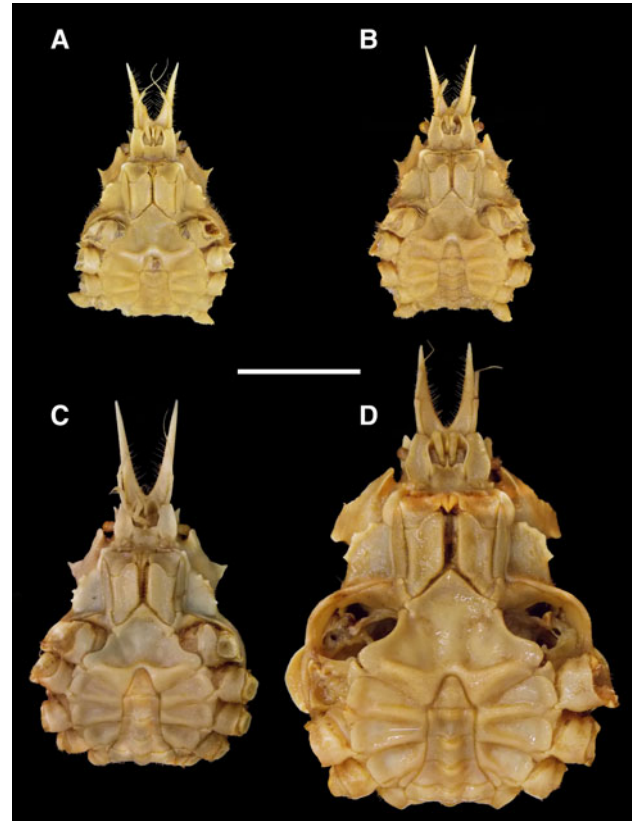


Fig. 2. Ventral view of cephalothorax of *Rochinia umbonata* (Stimpson, 1871), cheliped and pereopods electronically removed. (A) male cl 30 mm, cw 23 mm (MZUSP 15725); (B) male cl 32 mm, cw 23 mm (MZUSP 17424); (C) male cl 42 mm, cw 31 mm (USNM 1000819); (D) male cl 57 mm, cw 43 mm (MZUSP 16228). Scale bar: 20 mm.

p. 8; McLaughlin *et al.*, 2005, p. 253, 315; Casadío *et al.*, 2005, p. 159; Wicksten & Packard, 2005, p. 1762; Ng & De Forges, 2007, p. 63; Serejo *et al.*, 2007, p. 141; Coelho *et al.*, 2008, p. 17; Ng *et al.*, 2008, p. 106; Felder *et al.*, 2009, p. 1078.

Rochinia confusa Tavares, 1991, p. 162.

Rochinia confusa — Melo, 1996, p. 266; 1998, p. 468; Viana *et al.*, 2002, p. 12; 2003, p. 15; Casadío *et al.*, 2005, p. 158; Ng & De Forges, 2007, p. 63; Coelho *et al.*, 2008, p. 17; Ng *et al.*, 2008, p. 105.

TYPE MATERIAL. Not extant, presumably lost in the Great Chicago fire of 1871.

TYPE LOCALITY. Off Sand Key, Florida, 261 m.

COMPARATIVE MATERIAL EXAMINED

Gulf of Mexico: United States of America, Alabama, RV 'Oregon II', station 11580, 29°11'N 87°55'W, 10 March 1971, W. Santana det., 640 m depth, 1 ovigerous female (USNM 1191773). Louisiana, south-west of Mississippi River delta, RV 'Oregon', station 4702, 27°83'N 90°55'W, 22 February 1964, 732 m depth, 1 adult male (USNM 1184631). Louisiana, Grand Island, RV 'Citation', station WC-6, 27°42'44"N 91°32'55"W, 10 June 1985, 543–783 m depth, 1 male cl 42 mm, cw 31 mm; 1 male cl 11.1 mm, cw 7.5 mm; 1 female cl 49.5 mm, cw 37 mm; 1 female cl 22.4 mm, cw 15.6 mm; 1 female cl 17.4 mm, cw 11.3 mm (USNM 1000819). Caribbean Sea: Guadeloupe, Basse Terre, fishing traps, D. Lamy col., M. Tavares det., 500–600 m depth, 1 male cl 28 mm, cw 21 mm (MZUSP 24569). Nicaragua, RV 'Oregon', station 1926, 15°55'N 82°10'W, 549 m, 3

September 1957: 2 adult females (USNM uncatalogued). Brazil: Amapá, REVIZEE Norte, Prospecção III, Lance 2, 03°43'N 48°53'W, 15 November 1996, 186 m depth, 1 male (MOUFPE 15448). Recife, REVIZEE Nordeste, Cruzeiro V, station 117, 08°13.2'S 34°33.3'W, 19 November 1999, 575 m depth, 1 ovigerous female (MOUFPE 15449). REVIZEE, Cruzeiro V/00, station 14: 1 male (MOUFPE 15469). Espírito Santo, REVIZEE Pesca, station D-0503, 19°39.943'S 38°30.435'W, 29 June 1999, 808 m depth, 1 male, 6 females (MNRJ 13694). Espírito Santo, RV 'Marion Dufresne', TAAF MD/Brazil 1987, station 54 CB93, 19°36'S 38°53'W, 02 June 1987, 707–733 m depth, male paratype of *Rochinia confusa*, cl 12 mm, cw 8 mm (MNHN-B 24570). Rio de Janeiro, RV 'Marion Dufresne', TAAF MD/Brazil 1987, station 64 CB 105, 23°46'S 42°09'W, 2 June 1987, 592–610 m depth, female holotype of *Rochinia confusa*, cl 32 mm, cw 23 mm (MNRJ 1581). Rio de Janeiro, PADCT, station 6623, 24°13'30"S 43°10'60"W, fish trap [no depth]: 1 male, cl 30 mm, cw 23 mm (MZUSP 15275). 1 male cl 32 mm, cw 23 mm; 1 female cl 36 mm, cw 27 mm (MZUSP 17424). Brazil, [no exact locality or depth], RV 'Kinpo Maru', station 123, trawling, E. Severino-Rodrigues leg.: 1 male cl 57 mm, cw 43 mm; 1 male cl 49 mm, cw 39 mm; 1 female cl 48 mm, cw 38 mm (MZUSP 16228).

DISTRIBUTION

United States (from North Carolina to Gulf of Mexico), Nicaragua, West Indies and Brazil (Amapá, Pará,

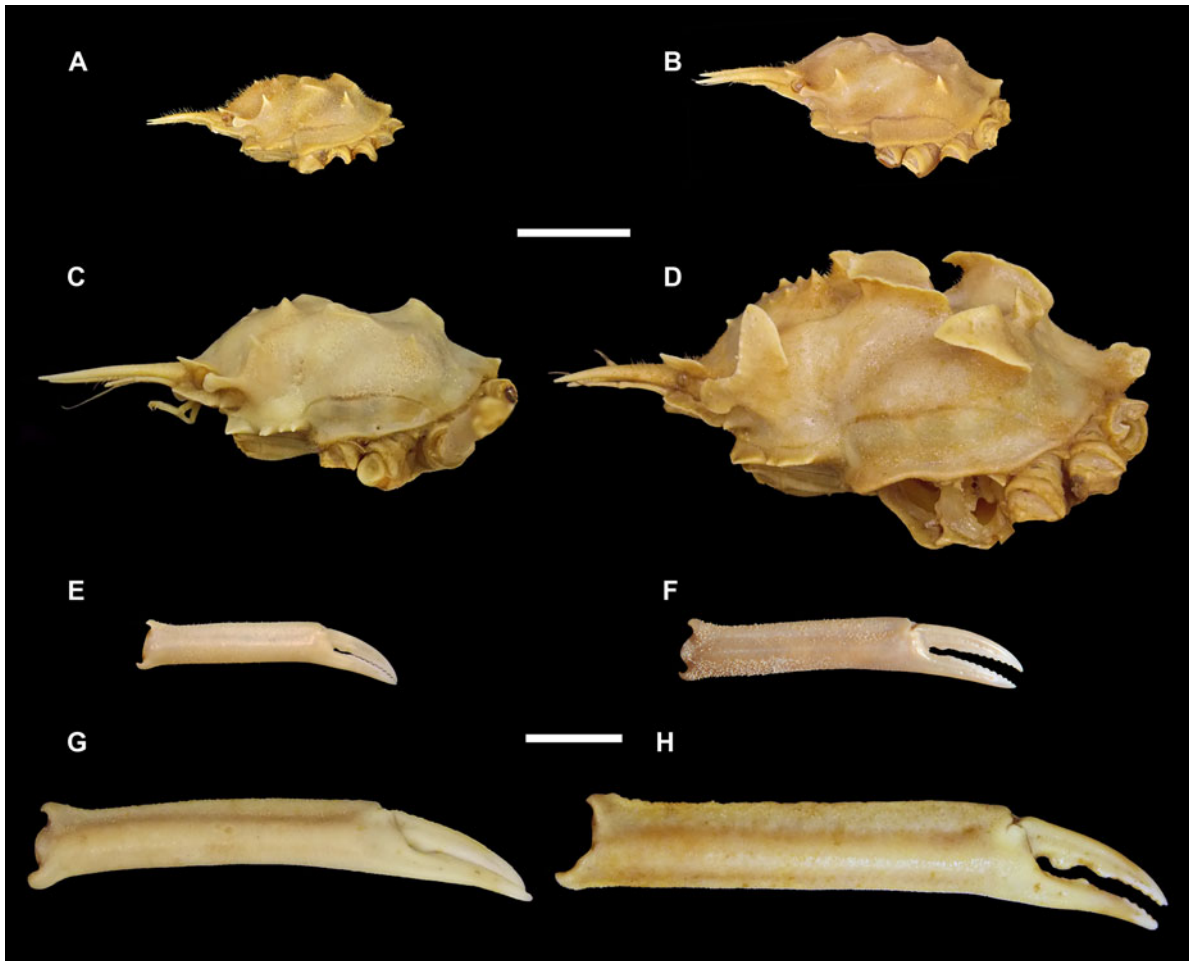


Fig. 3. Lateral view of cephalothorax and right cheliped of *Rochinia umbonata* (Stimpson, 1871), cheliped and pereopods electronically removed. (A, E) male cl 30 mm, cw 23 mm (MZUSP 15725); (B, F) male cl 32 mm, cw 23 mm (MZUSP 17424); (C, G) male cl 42 mm, cw 31 mm (USNM 1000819); (D, H) male cl 57 mm, cw 43 mm (MZUSP 16228). Scale bars: A–D, 20 mm; E–H, 10 mm.

Pernambuco, Bahia, Espírito Santo and Rio de Janeiro), between 161 and 900 m. *Rochinia umbonata* has been mistakenly recorded from São Paulo (as *R. confusa*) by Coelho *et al.* (2008).

REMARKS

Changes over ontogeny in *R. umbonata* have only been occasionally recorded in the literature. Rathbun (1894, p. 62), referring to four specimens of *R. umbonata* from off Georgia (USA), considered the morphological differences between an ovigerous female and smaller specimens sufficient to make the ovigerous female a distinct species, were it not for a specimen intermediate in form between the ovigerous female and the younger specimens. Williams (1984, p. 324) remarked that *R. umbonata* is 'Extremely variable in ornamentation. The slender legs become extremely so in large individuals.'

In *Rochinia umbonata*, the morphology of the carapace indeed undergoes very strong modifications over ontogeny regardless of sex (Figures 1–6). In fully developed specimens (e.g. cl 48 mm, cw 38 mm or larger) the rostral spines are slightly shorter and less divergent (Figures 1, 2, 4 & 5); the carapace supraorbital, preorbital, hepatic, mesogastric, proto-, meso- and metabranchial, cardiac, and intestinal tubercles become very large, flat-topped, leaf-like plates

whose circumferences are broader than the stem (Figures 1D, 3D, 4D & 6D); the lateral and mesial margins of the antennal articles 2 + 3 are distinctly expanded into lobes (Figures 2C, D, 3C, D, 5C, D & 6C, D); the pterygostomial teeth are coalescent at the base, rather indistinct distally forming a prominent pterygostomial ridge; and the carapace regions are distinctly more swollen. In contrast, in developing specimens (e.g. cl 12 mm, cw 8 mm or smaller), the carapace supraorbital, hepatic, metabranchial and intestinal protuberances show as strong, sharp spines (Figures 1A, B, 3A, B, 4A, B & 6A, B), whereas the mesogastric, proto-, mesobranchial and cardiac are flattened small nodosities (Figures 1A, B, 3A, B, 4A, B & 6A, B), the antennal articles 2 + 3 are only slightly expanded mesially and laterally (Figures 2A, B, 3A, B, 5A, B & 6A, B), the pterygostomial teeth are much less coalescent at the base, rather distinct distally, forming a lower pterygostomial ridge; and the carapace regions are distinctly less swollen. In contrast to fully developed specimens in which the circumference of the scutellate preorbital protuberance is much broader than the stem, in developing specimens the preorbital protuberance is already scutellate but its circumference is not, or only slightly, broader than the stem. In both fully developed and developing specimens the preorbital and hepatic scutellate plates are fused to each other, but only in fully developed specimens is the preorbital scutellate plate

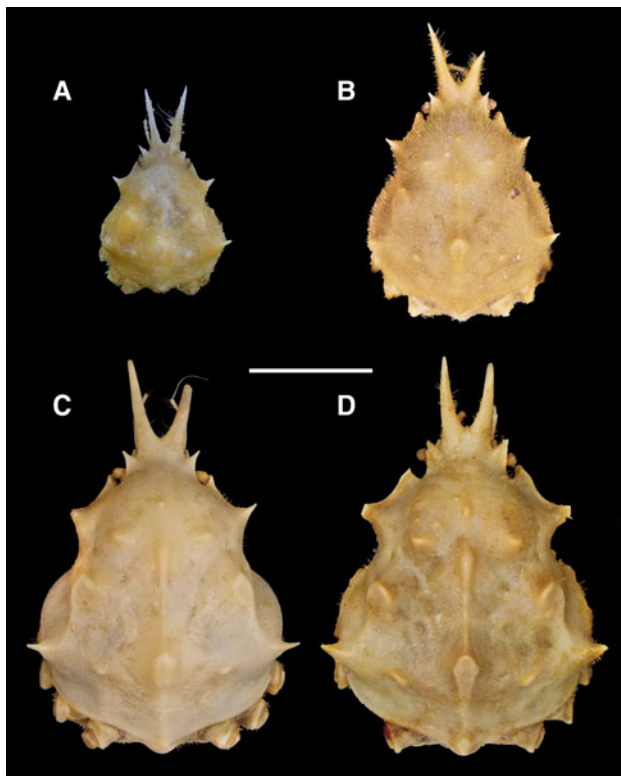


Fig. 4. Dorsal view of cephalothorax of *Rochinia umbonata* (Stimpson, 1871), cheliped and pereopods electronically removed. (A) female holotype of *Rochinia confusa* Tavares, 1991, cl 32 mm, cw 23 mm (MNRJ 1581); (B) female cl 36 mm, cw 27 mm (MZUSP 17424); (C) female cl 49.5 mm, cw 37 mm (USNM 1000819); (D) female cl 48 mm, cw 38 mm (MZUSP 16228). Scale bar: 20 mm.

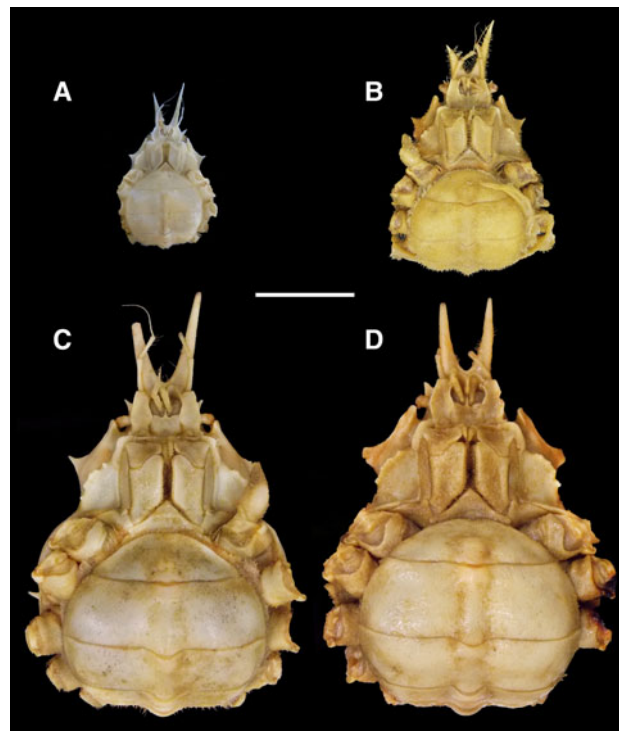


Fig. 5. Ventral view of cephalothorax of *Rochinia umbonata* (Stimpson, 1871), cheliped and pereopods electronically removed. (A) female holotype of *Rochinia confusa* Tavares, 1991, cl 32 mm, cw 23 mm (MNRJ 1581); (B) female cl 36 mm, cw 27 mm (MZUSP 17424); (C) female cl 49.5 mm, cw 37 mm (USNM 1000819); (D) female cl 48 mm, cw 38 mm (MZUSP 16228). Scale bar: 20 mm.

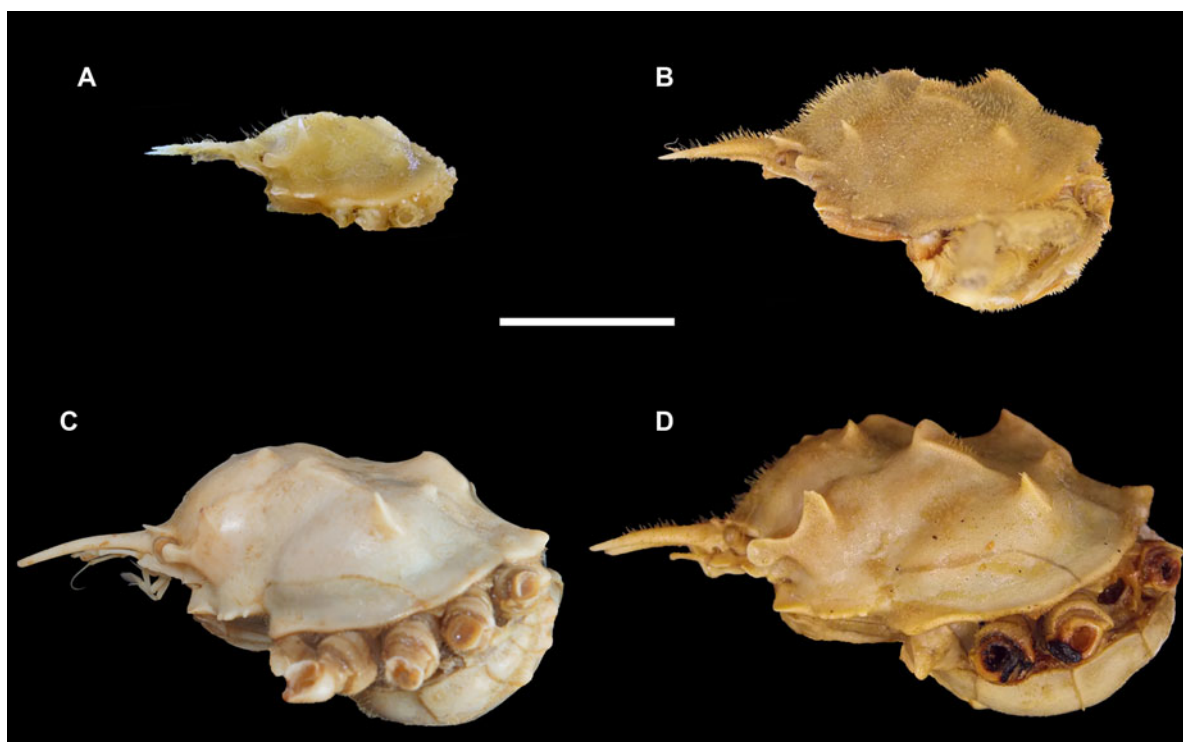


Fig. 6. Lateral view of cephalothorax of *Rochinia umbonata* (Stimpson, 1871), cheliped and pereopods electronically removed. (A) female holotype of *Rochinia confusa* Tavares, 1991, cl 32 mm, cw 23 mm (MNRJ 1581); (B) female cl 36 mm, cw 27 mm (MZUSP 17424); (C) female cl 49.5 mm, cw 37 mm (USNM 1000819); (D) female cl 48 mm, cw 38 mm (MZUSP 16228). Scale bar: 20 mm.

and the hepatic boletate ornamentation fused together to form a very large leaf-like plate whose circumference is much broader than the stem. In developing specimens, the scutellate preorbital plate is fused to a hepatic sharp spine (Figures 3 & 6).

Whereas the male abdomen does not change during ontogeny (Figure 2), that of mature females becomes dome-like, almost circular in outline, extremely broad, completely covering the thoracic sternum (Figures 5 & 6); the vulvae have much larger openings. In immature females the abdomen is flattened, remarkably longer than large, leaving the thoracic sternum exposed laterally; the vulvae are narrow and slit-like.

The chelipeds also undergo morphological modifications over ontogeny; being more evident in males (Figures 3A–H). In fully developed specimens (e.g. cl 49 mm, cw 39 mm or larger), the cutting edges of the cheliped fingers are provided with teeth distinctly dissimilar in size and shape (Figure 3H). The dactylus has two strong, submolariform teeth fitting each into a low hiatus on the cutting margin of the fixed finger, one very strong, subproximal tooth, and one much smaller tooth at the midlength of the dactylus. The submolariform teeth of the dactylus are probably the result of coalescent serrated teeth. The fixed finger has one low, rounded, massive tooth at its midlength that fits into a low hiatus on the cutting margin of the movable finger. The cutting edges of the dactylus and the fixed finger are provided with serrated teeth at their distal third. The cheliped is longer than the first pereopod and the dorsal surface of the cheliped merus is strongly laterally compressed, forming a distinct edge along its entire length. However, in developing specimens the cheliped fingers have small, serrated, similar in size juxtaposed teeth along the cutting margins; the dactylus is provided with a low subproximal tooth fitting into a low hiatus of fixed finger (the fixed finger lacks the submolariform tooth); the movable and fixed fingers slightly gap subproximally when closed (Figures 3E–G). The cheliped is shorter than the first pereopod and the cheliped merus dorsal surface is only very slightly laterally compressed.

The female holotype (cl 32 mm, cw 23 mm) (Figures 4A, 5A & 6A) and the male paratype (cl 12 mm, cw 8 mm) of *Rochinia confusa* show all the morphological characteristics of an ontogenetic stage (cf. supra) of *R. umbonata* and, therefore, they are herein regarded as conspecific with *R. umbonata*. Indeed, Tavares (1991, p. 164) had already remarked the resemblance between *R. confusa* and *R. umbonata*: ‘Par les traits généraux de la carapace, *Rochinia confusa* sp. nov. se rapproche de *R. umbonata* (Stimpson, 1871), de la mer des Caraïbes, mais elle diverge fortement de cette dernière par P2 et P3 beaucoup plus longs que les chélipèdes. Chez *Rochinia confusa* sp. nov., l’épine hépatique de la carapace est aussi nettement plus développée que chez *R. umbonata*. As more specimens from Brazilian deep-waters have become available, it is now clear that the strong morphological differences between *R. confusa* and fully developed specimens of *R. umbonata* can be attributed to ontogeny. True to its name, *R. confusa* should therefore be considered as a junior subjective synonym of *R. umbonata* and the geographic records of *R. confusa* to Brazil subsequent to those in the original description (Espírito Santo and Rio de Janeiro by Tavares, 1991), should all now be referred to *R. umbonata* Stimpson, 1871 (from Amapá, Maranhão, Pernambuco and Bahia by Silva et al., 2001; Viana et al., 2002; Serejo et al.,

2007). None of these authors, however, have suggested the synonymy between *R. confusa* and *R. umbonata*.

Feres et al. (2008) attributed to *Rochinia confusa* one ovigerous female obtained from the intertidal of Panaquatira beach, Maranhão (02°28'13"S 44°03'19"W) of which a low-quality photograph was provided. In their work, the authors never mentioned if their specimen was found alive or stranded dead along the beach. Judging from their photograph it is highly improbable that that female is identical with *R. confusa* (= *R. umbonata*). In any case, there are no intertidal species of *Rochinia* known so far.

ACKNOWLEDGEMENTS

We gratefully thank Cristiana Serejo (MNRJ), Danièle Guinot (MNHN), Jesser S. de Souza Filho (MOUFPE) and Rafael Lemaitre (USNM) for access to the collections under their responsibility and for providing working space. Thanks also to Joana d’Arc, Manuel Pedraza (MZUSP), Karen Reed (USNM) and Jéssica Colavite (Universidade Regional do Cariri, CE) for their kind assistance throughout the execution of this work. The input from two anonymous referees is gratefully acknowledged.

FINANCIAL SUPPORT

This work was supported by the Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq (M.T., grant number 301806/2010–1); PETROBRAS (M.T., grant number 4600224970); and Fundação de Amparo à Pesquisa do Estado de São Paulo – FAPESP (W.S., grant numbers 2008/11280–6, 2013/01201–0 and 2014/15549–0).

REFERENCES

- Abele L.G. and Kim W. (1986) An illustrated guide to the marine decapod crustaceans of Florida. Tallahassee, State of Florida Department of Environmental Regulation, Technical Series 8, 1–760.
- Bullis H.R. and Thompson J.R. (1965) Collection by the exploratory fishing vessels Oregon, Silver Bay, Combat, and Pelican made during 1956–1960 in the southwestern North Atlantic. *United States Fish and Wildlife Service, Special Scientific Report—Fisheries* 510, 1–130.
- Casadio S., Feldmann R.M., Parras A. and Schweitzer C.E. (2005) Miocene fossil Decapoda (Crustacea: Brachyura) from Patagonia, Argentina, and their paleoecological setting. *Annals of Carnegie Museum* 74, 151–188.
- Chace F.A. Jr. (1940) Reports on the scientific results of the Atlantis expeditions to the West Indies, under the joint auspices of the University of Havana and Harvard University. The brachyuran crabs. *Torreia* 4, 3–67.
- Coelho P.A., Almeida A.O. and Bezerra L.E. (2008) Checklist of the marine and estuarine Brachyura (Crustacea: Decapoda) of northern and northeastern Brazil. *Zootaxa* 1956, 1–58.
- Faxon W. (1895) Reports on an exploration off the west coasts of Mexico, Central and South America, and off the Galapagos Islands, in charge of Alexander Agassiz, by the U.S. Fish Commission steamer “Albatross,” during 1891, Lieut.-Commander Z.L. Tanner, U.S.N. commanding. XV. The stalk-eyed Crustacea. *Memoirs of the Museum of Comparative Zoology at Harvard College* 18, 1–292.

- Felder D.L., Álvarez F., Goy J.W. and Lemaitre R. (2009) Decapoda (Crustacea) of the Gulf of Mexico, with comments on the Amphionidacea. Chapter 59. In Tunnell J.W. Jr., Felder D.L. and Earle S.A. (eds) *Gulf of Mexico origin, waters and biota, vol. 1. Biodiversity*. Houston: Texas A&M University Press, College Station, pp. 1019–1104.
- Feres S.J.C., Santos L.A. and Lopes A.T.L. (2008) Primeiro registro de *Rochinia confusa* Tavares, 1991 (Crustacea: Decapoda: Majidae) para o litoral maranhense. *Boletim do Laboratório de Hidrobiologia* 21, 103–106.
- Griffin D.J.G. and Tranter H.A. (1986) The Decapoda Brachyura of the Siboga Expedition. Part VIII: Majidae. *Siboga-Expedition* 39(C4), 1–335, 22 plates.
- Lalana R., Ortiz M., Varela C. and Tariche N. (2004) Compilación sobre los invertebrados colectados en las expediciones del “Atlantis” en el archipiélago cubano. *Revista de Investigaciones Marinas* 25, 3–14.
- McLaughlin P.A., Camp D.K., Angel M.V., Bousfield E.L., Brunel P., Brusca R.C., Cadien D., Cohen A.C., Conlan K., Eldredge L.G., Felder D.L., Goy J.W., Haney T., Hann B., Heard R.W., Hendrycks E.A., Hobbs H.H., Holsinger J.R., Kensley B., Laubitz D.R., LeCroy S.E., Lemaitre R., Maddocks R.F., Martin J.W., Mikkelsen P., Nelson E., Newman W.A., Overstreet R.M., Poly W.J., Price W.W., Reid J.W., Robertson A., Rogers D.C., Ross A., Schotte M., Schram F.R., Shih C-T., Watling L., Wilson G.D.F. and Turgeon D.D. (2005) Common and scientific names of aquatic invertebrates from the United States and Canada: Crustaceans (with CD-ROM). *American Fisheries Society Special Publication* 31, 1–545.
- Melo G.A.S. (1996) *Manual de Identificação dos Brachyura (Caranguejos e Siris) do Litoral Brasileiro*. São Paulo: Plêiade.
- Miers E.J. (1886) Report on the Brachyura collected by H.M.S. Challenger during the years 1873–1876. In Murray J. (ed.) *Zoology. Report on the scientific results of the voyage of H.M.S. Challenger during the years 1873–76 under the command of Captain George S. Nares, R.N., F.R.S. and the Late Captain Frank Tourle Thomson*, Volume 17. Edinburgh: Neill and Company, pp. 1–362, 29 plates.
- Milne-Edwards A. (1873–1880) *Études sur les xiphosures et les crustacés de la région mexicaine. Mission scientifique au Mexique et dans l'Amérique centrale, ouvrage publié par ordre du Ministre de l'Instruction publique. Recherches zoologiques pour servir à l'histoire de la faune de l'Amérique central et du Mexique, publiées sous la direction de M.H. Milne Edwards, membre de l'Institut*. Cinquième partie. Tome premier. Paris: Imprimerie Nationale.
- Milne-Edwards A. (1880a) Reports on the results of dredging, under the supervision of Alexander Agassiz, in the Gulf of Mexico, and in the Caribbean Sea, 1877, 78, 79, by the United States Coast Survey Steamer “Blake,” Lieut.-Commander C.D. Sigsbee, U.S.N., and Commander J.R. Bartlett, U.S.N., commanding. VIII. Études préliminaires sur les crustacés. *Bulletin of the Museum of Comparative Zoology at Harvard College* 8, 1–68, 1–2 plates.
- Milne-Edwards A. (1880b) Compte rendu sommaire d'une exploration zoologique faite dans e golfe de Gascogne à bord du navire de l'Etat le Travailleur. *Comptes Rendus des Séances de l'Académie des Sciences* 91, 355–360.
- Milne-Edwards A. and Bouvier E.L. (1923) Reports on the results of dredging. Under the supervision of Alexander Agassiz, in the Gulf of Mexico (1877–78), in the Caribbean Sea (1878–79), and along the Atlantic coast of the United States (1880), by the U.S. Coast Survey steamer “Blake.” Lieut.-Com. C.D. Sigsbee, U.S.N., and Commander J.R. Bartlett, U.S.N., commanding. XLVII: Les Porcellanides et des Brachyures. *Memoirs of the Museum of Comparative Zoology at Harvard College* 47, 283–395.
- Ng P.K.L. and De Forges B.R. (2007) A new species of deep-water spider crab of the genus *Rochinia* A. Milne-Edwards, 1875, from Guam (Crustacea: Brachyura: Majidae). *Zootaxa* 1610, 61–68.
- Ng P.K.L., Guinot D. and Davie P.J.F. (2008) Systema Brachyorum: Part I. An annotated checklist of extant brachyuran crabs of the world. *Raffles Bulletin of Zoology* 17, 1–286.
- Nizinski M.S. (2003) Annotated checklist of decapod crustaceans of Atlantic coastal and continental shelf waters of the United States. *Proceedings of the Biological Society of Washington* 116, 96–157.
- Paulmier G. (1993) Crustacés profonds capturés aux casiers aux Antilles Françaises. *Rapport IFREMER, Laboratoire du Robert, La Martinique, et Station de l'Houmeau, Neuil/Mer*, 34 pp., 34 pl.
- Pequegnat L.H. (1970) Deep-water Brachyuran crabs. In Pequegnat W.E. and Chace F.A. Jr. (eds) *Contributions on biology of the Gulf of Mexico*. Houston: Texas A&M University Oceanographic Studies, pp. 171–204.
- Poupin J. (1994) *Faune marine profonde des Antilles françaises: récoltes du navire “Polka” faites en 1993*. Paris: ORSTOM Editions (Etudes et Thèses).
- Powers L.W. (1977) A catalogue and bibliography to the crabs (Brachyura) of the Gulf of Mexico. *Contributions in Marine Science* 20, 1–190.
- 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.
- Rathbun M.J. (1925) The spider crabs of America. *Bulletin of the United States National Museum* 129, 1–613.
- Sars G.O. (1885) *Crustacea I. The Norwegian North Atlantic Expedition 1876–1878: Zoology = Den Norske Nordhavns-Expedition 1876–1878: Zoologi*. Christiania: Grøndahl and Søn.
- Serejo C.S., Young P.S., Cardoso I.C., Tavares C., Rodrigues C. and Almeida T.C. (2007) Abundância, diversidade e zonação dos crustáceos no talude da costa central do Brasil (11°–22°S) coletados pelo programa REVIZEE/Score Central: Prospecção pesqueira. In Costa R.A.S., Olavo G. and Martins A.S. (eds) *Biodiversidade da fauna marinha profunda na costa central brasileira*. Rio de Janeiro: Museu Nacional (Série Livros no. 24), pp. 133–162.
- Silva K.C.A., Ramos-Porto M. and Cintra I.H.A. (2001) Caranguejos capturados durante pescarias experimentais para o programa REVIZEE/Norte (Crustacea: Decapoda: Brachyura). *Boletim Técnico-Científico do CEPNOR* 1, 77–102.
- Silva K.C.A., Ramos-Porto M., Cintra I.H.A., Muniz A.P.M. and Silva M.C.N. (2002) Crustáceos capturados durante o Programa REVIZEE na costa norte brasileira. *Boletim Técnico-Científico do CEPNOR* 2, 97–108.
- Silva K.C.A., Ramos-Porto M., Cintra I.H.A. and Viana G.F.S. (1999) Ocorrência de *Rochinia umbonata* (Stimpson, 1871) na plataforma continental dos Estados do Amapá e Pará/REVIZEE-NORTE (Crustacea: Decapoda: Brachyura: Majidae). *Trabalhos Ocenográficos da Universidade Federal de Pernambuco* 27, 169–173.
- Smith S.I. (1885) On some new or little known decapod Crustacea, from recent Fish Commission dredgings off the east coast of the United States. *Proceedings of the United States National Museum* 7, 493–511.
- Smith S. I. (1886) Report on the decapod Crustacea of the “Albatross” dredgings off the East-coast of the United States during the Summer and Autumn of 1884. *Report of the United States Fish Commission* 13, 605–705.
- Soto L.A. (1991) Faunal zonation of the deep-water brachyuran crabs in the Straits of Florida. *Bulletin of Marine Science* 49, 623–637.

- Stimpson W.** (1871) Preliminary report on the Crustacea dredged in the Gulf Stream in the Straits of Florida by L.F. de Pourtales, Assist. U. S. Coast Survey. Part I. Brachyura. *Bulletin of the Museum of Comparative Zoology at Harvard College* 2, 109–160.
- Takeda M.** (1983) Crustaceans. In Takeda M. and Okutani T. (eds) *Crustaceans and Mollusks trawled off Suriname and French Guiana*. Tokyo: Japan Marine Fishery Resource Research Center, pp. 19–180.
- Tavares M.** (1991) The cruise of the “Marion Dufresne” off the Brazilian coast: account of the scientific results and list of stations. *Zoosystema* 21, 597–605.
- Viana G.F.S., Ramos-Porto M., Santos M.C.F., Silva K.C.A., Cintra I.H.A., Cabral E., Torres M.F.A. and Acioli F.D.** (2003) Caranguejos coletados no norte e nordeste do Brasil durante o Programa REVIZEE (Crustacea, Decapoda, Brachyura). *Boletim Técnico-Científico do CEPNOR* 11(1), 117–144.
- Viana G.F.S., Ramos-Porto M., Torres M.F.A., Santos M.C.F., Cabral E. and Acioli F.D.** (2002) Espécies de *Rochinia* A. Milne-Edwards, 1875 (Decapoda: Brachyura: Majidae) coletadas em águas do nordeste brasileiro. *Boletim Técnico-Científico do CEPENE* 10, 85–96.
- Wicksten M.K. and Packard J.M.** (2005) A qualitative zoogeographic analysis of decapod crustaceans of the continental slopes and abyssal plain of the Gulf of Mexico. *Deep-Sea Research I* 52, 1745–1765.
- Williams A.B.** (1984) *Shrimps, lobsters and crabs of the Atlantic Coast of the Eastern United States, Maine to Florida*. Washington, DC: Smithsonian Institution Press.
- and
- Williams A.B., McCloskey L. and Gray J.** (1968) New records of Brachyuran decapod Crustacea from the continental shelf of North Carolina, USA. *Crustaceana* 15, 41–66.

Correspondence should be addressed to:

W. Santana
Laboratório de Sistemática Zoológica,
Pró-Reitoria de Pesquisa e Pós-Graduação,
Universidade Sagrado Coração – USC, Rua Irmã Arminda,
10-50, Jd. Brasil, 17011-160,
Bauru, SP, Brazil
email: william_santana@yahoo.com.br