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16 January 1981

PROC. BIOL. SOC. WASH.
93(4), 1980, pp. 971–981

SYMETHINAE, NEW SUBFAMILY, AND *SYMETHIS GARTHI*, NEW SPECIES, AND THE TRANSFER OF *RANINOIDES ECUADORENSIS* TO *NOTOSCELES* (RANINIDAE: BRACHYURA: GYMNOPLEURA)

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Abstract.—A new subfamily, Symethinae, of the frog crab family Raninidae proposed for the reception of the genus *Symethis*, is detailed and compared with Ranininae in which *Symethis* formerly had been included. A Pacific species *Symethis garthi* is described and compared with the Gulf of Mexico species *Symethis variolosa*. The spermathecal pits of the genus are compared with other genera of Raninidae and illustrated. The taxonomic status of *Raninoides ecuadorensis* Rathbun is reviewed and it is transferred to *Notosceles* Bourne.

The family Raninidae is a unique group of decapod crustaceans, characterized by exposed thoracic epimera, abdomen incompletely flexed under the cephalothorax and elongate thoracic nerve ganglionic mass. Other morphological features found within this group have recently been reviewed by Stevcic (1974). This family of crabs possesses many specialized adaptations which, combined with a superficial resemblance to albuneid "crabs," has led to a long history of confusion surrounding the systematic position of the group. They have been alternately classified among most of the major taxa of brachyuran crabs. This paper deals with the taxonomic status of 2 frog crabs which occur in the eastern Pacific.

I wish to express my appreciation to Drs. R. B. Manning (National Museum of Natural History, Smithsonian Institution), Gilbert Voss (Rosenstiel School of Marine and Atmospheric Science, University of Miami) and Janet Haig (Allan Hancock Foundation) for the loan of specimens. I am also indebted to Dr. Danièle Guinot (Muséum National d'Histoire Naturelle) for examining specimens of *Cyrtorhina granulosa*. Darryl Felder (University of Southwestern Louisiana), Richard W. Heard (Gulf Coast Research Laboratory), and John S. Garth (Allan Hancock Foundation) kindly reviewed the manuscript and Linda Lutz aided in preparation of the illustrations.

In a recent attempt to arrive at a satisfactory phylogenetic classification of the family, Serène and Umali (1972) recognized 2 subfamilies: Notopinae and Ranininae. Morphological features which define the subfamilies are relative sizes of the first and second male pleopods and the orientation of the

orbital sinuses. The crabs of the genus *Symethis* do not fit into either of the available subfamilies for the reasons enumerated below. A new subfamily, Symethinae, subfam. nov., is proposed for the reception of the Atlantic and Pacific species of *Symethis*.

Symethis is restricted to American waters and until now has contained a single species, *S. variolosa* (Fabricius, 1793), which ranges from North Carolina south to Bahia, Brazil, and through the Gulf of Mexico. This species was listed by Rathbun (1937:18) with a geographic range into the Pacific Ocean along the Panamanian coast. However, examination of specimens collected from that area has shown they represent a previously undescribed species formerly confused with *S. variolosa*.

Symethinae, subfam. nov.

Diagnosis.—Eyes greatly reduced; spermathecal pits widely separated with overarching hoods; 7 pairs of gills; palms of cheliped greatly inflated.

Symethis Weber, 1795

Symethis Weber, 1795:92.—Rathbun, 1937:24.
Zanclifer Henderson, 1888:34.—Bourne, 1922:66.

Symethis garthi, sp. nov.

Figs. 1; 2a, b; 3a–c

Symethis variolosa Rathbun, 1937:26, fig. 10, pl. 5, figs. 7, 8 (in part).—Correa, 1970:10, pl. 5, figs. 38–47, pl. 6, figs. 48–55, pl. 7, figs. 60–61 (in part).

Diagnosis.—Carapace heavily eroded, hepatic spines blunt, well developed; abdominal segments coarsely granulate anteriorly; dactyls of ambulatory legs 1 and 2 with flattened spine at base of lunate curvature; dorsal teeth of carapace blunt.

Description.—Carapace eroded, generally oval in shape, convex front to back and side to side; length of carapace 1.64 times width. Rostrum produced beyond general outline of carapace into trilobed process with diminutive eyes at base; eyestalks retract slightly into cup-shaped socket formed by small lateral and ventral outfoldings of carapace and upper margin of basal antennal article; eyes calcified anteriorly, completely protected and concealed when retracted. Rostrum deeply eroded medially at base, floor of depression with numerous raised tubercles. Eroded depressions of carapace spread posteriorly and laterally, forming symmetric depressions over anterior two-thirds of carapace; floor of depressions occasionally with well-developed tubercles. Fronto-orbital region demarcated by elevated transverse ridge (often interrupted by depressions) which connect hepatic spines;

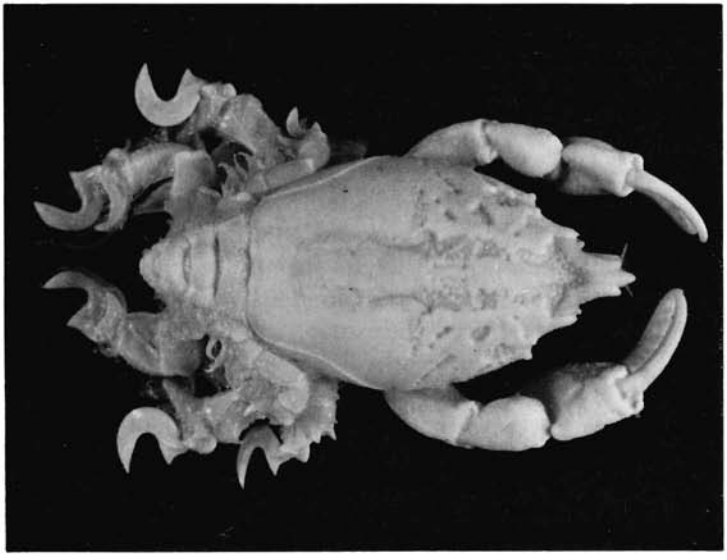

Fig. 1. *Symethis garthi*, holotype ♂, dorsal view.

rostrum lying on lower level than remainder of carapace. Anterolateral margin of carapace with well developed blunt hepatic spines behind which setae become evident laterally. Posterolateral margins of carapace bordered by slight ridge, obvious in dorsal view, terminating posteriorly at base of abdomen. Carapace widest about two-thirds of way from front. Abdomen with 7 segments, only slightly deflexed so that 4 or 5 segments are evident in dorsal view; all segments with very dense setae laterally. First abdominal segment four-fifths as wide as posterior margin of carapace, ornamented with coarse granules anteriorly. Remaining somites of abdomen decreasing in width, all with prominent tubercles; setae forming row dorsally on posterior 5 segments. Penultimate abdominal somite with short, posterolateral extensions, last somite rounded.

Merus of first leg massive with concave inner border, covered with setae proximally. Carpus heavy and minutely eroded with small tubercles; distally with rounded mound of small tubercles forming complex network on bulbous palm of chela; fixed finger slightly deflexed with granules forming parallel longitudinal rows. Broad dorsal carina extending distally on dorsal surface of manus, becoming much broader than base of movable finger. Propodus and fixed finger with numerous large teeth which mesh with tip of propodus interior to fixed finger. Propodus moderately developed, also with parallel rows of granules.

Second leg fringed extensively with setae; carpus tuberculate dorsally

with 2 distal outfoldings to form spatulate processes. Propodus short, with 4 spatulate processes on distal margin; dactyl of second leg flat, lunate, with spine at base. Third leg similar except carpus with 2 small processes and numerous larger rounded spines; propodus with 1 spatulate process and series of spines extending out onto posterior extension of segment; dactyl flat and lunate with spine produced at base. Merus and carpus of fourth leg dorsally tuberculate; propodus with large curved spatulate process on interior margin, dactyl flat, lunate, fringed with setae. Fifth leg greatly reduced, dorsal in position; all segments heavily tuberculate dorsally with serrate margins; posterior margin of propodus with curved spatulate process, dactyl flat, lunate, fringed with setae.

Ischium of third maxilliped greatly elongated, 2.5 times length of merus, paved with low granules; merus short, slightly longer than wide, covered with low tubercles except in central region where floor of depression is clear; palp not evident in ventral view. Exognath of third maxilliped slightly shorter than ischium. Sub-hepatic region of carapace with eroded depressions, floor of depressions with numerous tubercles, produced anteriorly into 2 large mounds, 1 forming lateral margin of pocket surrounding eye. Antennal peduncle massive, produced into 2 lobes, 1 projecting ventrally and 1 extending anteriorly almost to tip of rostrum. Antennule very small and not obvious in ventral aspect.

Material examined.—Holotype: USNM 173452, 31 March 1939, M. S. Stranger, collector, Gulf of California, Espiritu Santo 2, Mexico, 24°26′50″ N, 110°18′W, 11–36 m, male 33.3 mm. Paratypes: USNM 173453, collected with holotype, 10 males, 10 females, 1 carapace, 13.8–35.0 mm. USNM 155089, 14 April 1939, M. S. Stranger, collector, Gulf of California, Puerto Refugio, 29°32′17″N, 113°33′50″W, 18–27 m, 3 males, 1 female, 22.8–25.5 mm. AHF 3513, 6 February 1935, Velero III station No. 458-35; W. L. Schmitt, collector, Secas Isle, Panama, 7°57′55″N, 82°02′W; 9–27 m, 1 male, 13.6 mm.

Etymology.—This species is named in honor of Dr. John S. Garth (Allan Hancock Foundation), whose work has done much to further crustacean knowledge.

Remarks.—*Symethis garthi* and *S. variolosa* are closely related species restricted to American waters. In the Gulf of Mexico, *S. variolosa* occurs only on substrates of shell and shell hash (Goeke, unpublished data). *S. garthi* may also occur most frequently on shell bottoms although specimens from Panama were collected from substrates of mud and sand. Sediment information obtained from original collection tag of the type specimen indicates a sand and shell bottom close inshore. Offshore, coral and rocky bottom is reported; however, it is not known from which bottom type the material was collected. The very few specimens of *S. garthi* available suggest highly restricted populations in the Pacific or the species is not easily collected by usual methods.

The genus *Symethis* has been placed within the subfamily Ranininae by Serène and Umali (1972:25) along with *Ranina* Lamarck, 1801, *Lyreidus* de Haan, 1841, *Notopoides* Henderson, 1888, *Raninoides* H. Milne-Edwards, 1834, *Notosceles* Bourne, 1922 and *Cyrtorhina* Monod, 1956. The characters which define the subfamily are: eye peduncle folded obliquely or longitudinally forward; and male pleopod 2 with elongated, tapering shaft shorter than pleopod 1 (Serène and Umali, 1972:34); apex of male pleopod 2 usually ornamented distally.

Recent work by Hartnoll (1979) has centered on the structure of the spermathecal pits of the raninids and casts some doubt on the validity of the 2 subfamilies. The work has shown no correlation between the subfamilies Ranininae and Notopinae and spermathecal structure of the females. The spermathecal pits of this family have been commonly characterized as a single, unpaired median pit. Gordon (1966) noted the presence in *Ranina* and *Notopoides* of what she thought to be an unpaired spermathecal pit. Hartnoll (1979) has shown that the spermathecal pits of this group are indeed paired but often recessed to the bottom of a pit-like depression present in the anterior part of sternite 7. The depression had mistakenly been described as a single spermathecal pit. The structure of spermathecal pits in this family has been thought to form a continuum, beginning with that characterized by *Lyreidus* through the form exemplified by *Ranilia* to *Raninoides* and *Notosceles* (Hartnoll, 1979:80). However, the spermathecal pits of the genus *Symethis* must be inserted within this grouping. It can be modified so that the progression now proceeds from *Symethis*, through *Lyreidus* and *Ranilia* to the recessed form of *Raninoides* or *Notosceles*.

Of the 10 genera currently recognized within the family Raninidae, the spermathecal pits have been described in 5 by Hartnoll (1979). Gordon (1966) illustrated the spermathecae of *Notopoides* and those of the 4 genera which remain are described here.

The spermathecae of *Ranilia* agree closely with those described for *Ranina*. The sternal shield between pereiopods 3 and 4 is constricted with paired spermathecae obvious upon close examination. The anterior part of sternite 7 contains a median pit with a trough-like depression proceeding posteriorly. The anterior walls of the spermathecal depression are steep-sided with the pits covered by a flexible membrane as in *Ranina*.

Notosceles conforms with that form of spermatheca described for *Raninoides*. The spermathecae are not obvious, but dissection shows them to be located at the bottom of the deep pit-like depression. The pit is circular in ventral view with steep-sided walls on all sides. No trough is evident posteriorly and the median depression occupies most of the area of the sternal shield between pereiopods 3 and 4.

Specimens of the genus *Cyrtorhina* were not available but at the request of the author were examined by Dr. Danièle Guinot (Muséum National d'Histoire Naturelle). She has described a single median pit located on the

anteriormost section of sternite 7. Similar to that found in *Ranina*, the pit is steep-sided anteriorly with indications of a trough-like depression posteriorly.

The spermathecae of *S. garthi* (Fig. 2a) differ greatly from those described for the other genera of frog crabs. The spermathecal openings are situated partly on the suture of sternite 7. There is no indication of a median trough as in *Lyreidus* or *Ranilia* and the spermathecal openings are large and widely separate. Obvious features are the calcified hoods which arch over the spermathecal openings in such a manner as to make them approachable only from the posterior. A decalcified flap is present below the "hood" in *Symethis* as in most of the remaining genera. *Symethis variolosa* from the Gulf of Mexico agrees very closely with this description in the structure of the spermathecal pits. Slight differences in the calcified hood over the opening may be of specific value.

In the Gulf of Mexico, females of *S. variolosa* are often collected with the spermathecal openings completely occluded by an amorphous plug of hardened material. In alcohol, the hardened mass completely occupies the area of the sternal shield between pereiopods 3 and 4 obscuring the spermathecae. This "plug" effectively seals off the pits and may be the result of the packing of the spermathecae with sperm packets by the male after mating. Excess sperm packets transferred during copulation would remain outside the spermathecal openings and may harden on exposure to sea water, effectively preventing the female from mating with a second male. Over 60% of the adult females collected in the Gulf show this condition (Goeke, unpublished data). Eight of the 11 females of the Pacific species examined are also plugged in this manner.

Crabs of the genera *Cyrtorhina* Monod and *Symethis* Weber resemble each other and are considered most closely related by Serène and Umali (1972:49). No evidence was cited by Serène and Umali to support the statement, although the dactyls of the pereiopods and the frontal regions of the carapaces are very similar. Monod (1956:49) states that *Cyrtorhina* is closer to *Ranina* and details how the genera differ. It is my opinion that the resemblance between *Cyrtorhina* and *Symethis* is superficial. Considerable differences are immediately obvious in a comparison of the pleopods and female spermathecae of *Symethis* and *Cyrtorhina*. The first male pleopods of *Cyrtorhina* (Monod, 1956:52) are short and stout, much more closely resembling those of *Ranina* as figured by Barnard (1950:398) than the very broad type of pleopod of *Symethis* (Fig. 3).

The spermathecae of *Cyrtorhina* and *Ranina*, as described previously, are also in close agreement. In both genera, the structure of the spermathecal pits consists of a deep, steep-sided pit in the anterior part of sternite 7. A depression extends posteriorly which becomes increasingly shallower toward the eighth sternal plate. This form of spermatheca lies about midway

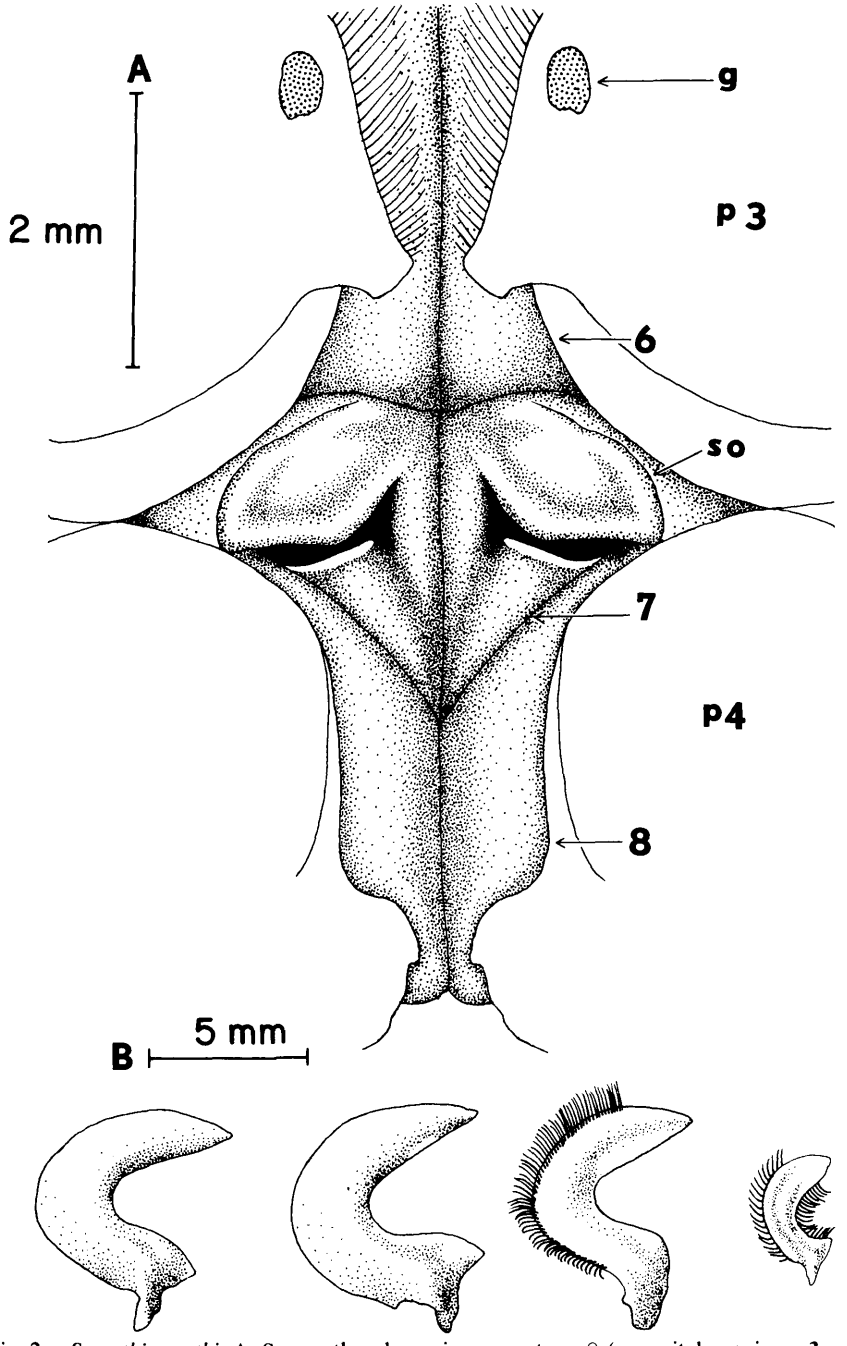

Fig. 2. *Symethis garthi*: **A,** Spermathecal openings, paratype ♀ (**g,** genital opening; **p3, p4,** pereiopods 3 and 4; **so,** spermathecal openings; **6, 7, 8,** sternites 6, 7, and 8); **B,** Dactyls of pereiopods 2–5 (left to right).

in the series of structures found within this family. The spermathecae of *Symethis* are described above and can be considered a basically different form of spermatheca.

As noted by Stevcic (1974) the first male gonopods of the subfamily Raninae are characteristically ornamented distally. This is well documented as the male pleopods of all the genera of the subfamily have been illustrated: *Raninoides* and *Notosceles* by Serène and Umali (1972), *Lyreidus* by Griffin (1970), *Ranina* by Barnard (1950), *Notopoides* by Gordon (1966), *Cyrtorhina* by Monod (1956) and *Symethis* by Correa (1972) and present paper (Fig. 3a, b). In all genera of the subfamily except *Symethis,* the distal part of the first male pleopod is ornamented with either broad spine-like projections or complex folds of tissue. In *Symethis,* however, the first male pleopod has no spines or folds distally. It is highly compressed laterally with the distal portion accuminate. The abundant tufts of setae on the anterior and posterior margins almost obscure the sharply tapering tip. This character supports the separation of the genus *Symethis* from the remaining genera of the subfamily.

Perhaps the most astonishing difference between *Symethis* and the other genera of the family is a difference in the number of gills. In *Symethis* the number of pairs of gills is only 7, all of which lie in the normal vertical position, with the anteriormost pair greatly reduced. In the remaining genera of frog crabs the gills number 8 pairs. *Raninoides louisianensis* Rathbun possesses 8 pairs of gills as does *Lyreidus, Ranilia* and *Notosceles*. In these forms, the anteriormost 2 pairs of gills are reduced in size but are large enough to be easily observed. The anterior 2 pairs are most likely still effective in oxygen exchange.

The reduced number of gills present in the genus *Symethis* represents a major departure from the remaining genera of the family Raninidae. This feature is of considerable taxonomic value and is a conservative character often used in the diagnosis of families. Much importance is attached to the respiratory mechanisms in this family and was stressed by Bourne (1922) in his account of the physiology of this group. Very little information is available on the life histories and ecology of the raninids; however, it is probable that the reduced number of gills is an adaptation to the niche occupied by this genus. Stevcic (1974) stated the reduced number of gills in this and other groups of crabs (i.e., Calappidae, Leucosiidae) is a modification for burrowing.

The differences in the number of gills and the spermathecae are sufficient to warrant the establishment of the proposed subfamily Symethinae. Future research may show that the subfamily deserves elevation to the rank of family. Subsequent work on this group should concentrate on the larval development of *Symethis*. The structure of the nervous system and fossil

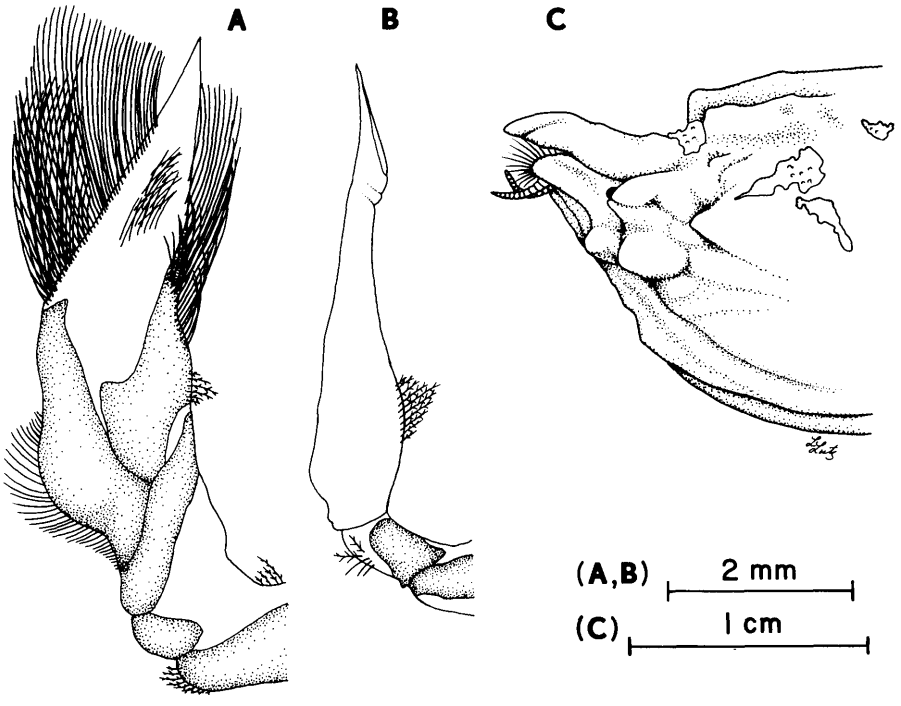

Fig. 3. *Symethis garthi*: **A,** First pleopod; **B,** Second pleopod; **C,** Lateral view of anterior part of carapace of holotype ♂.

history should be examined for support of the separation of this genus from the others within the family.

Notosceles ecuadorensis Rathbun, nov. comb.

The genus *Notosceles* was erected by Bourne (1922) for *N. chimmonis* in his account of the physiology of the family Raninidae. Other species subsequently assigned to the genus are *N. serratifrons* (Henderson, 1893), and *N. viadari* Ward, 1942. In establishing the genus, Bourne (1922) listed many characters which he used to differentiate *Notosceles* from the closely related *Raninoides*. Some features he listed were later questioned by Chopra (1933) who doubted the validity of the genus and suggested that it should be considered a synonym of *Raninoides*. Serène and Umali's (1972) work on the Philippine raninids dealt with this matter and attempted to define characters separating the 2 genera. For this study, *Notosceles ecuadorensis* was compared with 2 species of *Raninoides*: the type-species of the genus,

R. loevis; and *R. louisianensis*. Some of the following characters are those recognized by Bourne (1922) and others were utilized by Serène and Umali (1972). All represent characters that can be of value to separate *Notosceles* from *Raninoides*: 1) anterior end of carapace roughly granulate; 2) eyes of *Notosceles* shorter and stouter; 3) fronto-orbital width half of the extraorbital width of the carapace; 4) eyes slightly longer than rostrum; 5) no spine on ischium of cheliped; 6) truncate third maxilliped in *Notosceles* with shorter ischium to merus length than *Raninoides* (1.58 in *N. ecuadorensis* and 1.33 in *R. loevis*); 7) propodus of cheliped with double crested carina dorsally; 8) sternal shield not produced into acute spine between bases of pereiopods 1 and 2; 9) rostrum pointed with 2 flat lateral teeth at base; 10) first abdominal tergum approximating width of posterior margin of carapace, with second shield about as broad; 11) fifth pereiopod less massive than that of *Raninoides*; and 12) basal segment of the antennular peduncles broader than in *Raninoides*.

Raninoides ecuadorensis was described from material gathered off La Plata Island, Ecuador in 82–101 m. Originally included within the genus *Raninoides* Milne-Edwards, a recent examination of type-material has shown the species would be more properly included in the genus *Notosceles* Bourne, 1922. The material examined consisted of the type male (USNM #69319) and two lots of specimens collected from the type-locality (USNM #69320 and 81933). Supplemental material from the University of Miami (32:3437) was also examined. *Raninoides ecuadorensis* more closely agrees with the generic description of *Notosceles* given by Bourne (1922) and amended by Serène and Umali (1972). It is here designated *Notosceles ecuadorensis* (Rathbun, 1935), nov. comb.

With the transfer of *R. ecuadorensis* to *Notosceles*, 5 species of the genus *Raninoides* are known to occur in American waters. Four of the species are present in the western Atlantic with a single species, *R. benedicti* Rathbun, 1933, in the eastern Pacific. Two additional species, *R. fossor* A. Milne-Edwards and *R. nitidus* A. Milne-Edwards, 1880, have been recently synonymized and removed from species known to occur in American waters. Manning (1975) has shown *R. fossor* to be a junior synonym of *Notosceles chimmonis* Bourne, 1922, and Goeke (1980) removed *R. nitidus* to the genus *Lyreidus* as a synonym of *L. bairdii* Smith, 1881.

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