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Caridean Shrimps of the Gulf of California. I. New Records, with Some Remarks on Amphiamerican Distribution[1]

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ABSTRACT: Six caridean shrimps are reported from the Gulf of California, Mexico, for the first time: *Ambidexter symmetricus*, *Latreutes parvulus*, and *Salmoneus ortmanni* were not previously reported in the eastern Pacific; northern range extensions are given for *Thor manningi*, *Ambidexter panamensis*, and *Automate dolichognatha*. A brief discussion on amphiamerican species is included with a comparison of brachyuran crabs and caridean shrimps.

RESUMEN: Nuestras investigaciones ecológicas en el Golfo de California, México, han revelado que seis camarones carídeos tienen una distribución más amplia que la previamente conocida. Tres de ellos no habían sido registrados para el Océano Pacífico: *Ambidexter symmetricus*, *Latreutes parvulus*, y *Salmoneus ortmanni*. La distribución de los otros tres, *Thor manningi*, *Ambidexter panamensis*, y *Automate dolichognatha*, se extiende más de 1000 km al norte del límite anteriormente establecido. Se incluye una breve discusión acerca del origen de las llamadas "especies anfiamericanas" y se compara el número de ellas entre los camarones carídeos y entre los cangrejos braquiuros: si se toma como referencia el número de especies de cada grupo en el Golfo de California, más del 20% de los camarones se encuentra también en la costa Atlántica de América, mientras que la proporción en el caso de los cangrejos braquiuros no llega siquiera a un 5%. Se sugiere que, dado que tuvieron un mismo período de aislamiento—desde el Mioceno en este caso—los procesos de especiación han sido mucho más rápidos entre los cangrejos, lo cual está de acuerdo con su explosiva radiación evolutiva, particularmente notable durante el Terciario.

AS A RESULT of our continuous ecological research in the Gulf of California during the last four years, we have found several interesting facts about some groups of crustaceans. In this paper we report range extensions for six species of caridean shrimps. Three of these shrimps had not been previously known from the eastern Pacific.

Thor manningi Chace, 1972

Thor manningi Chace, 1972:137, figs. 59, 60.

PREVIOUS DISTRIBUTION: North Carolina to Tobago and Curazao, and westward of Yucatan; Islas Marias on the west coast of México.

MATERIAL EXAMINED: Laguna Percebú, Baja California: 3 females collected July 1978; 1 ovig. female, 8 August 1979. La Choya: 1 male, 2 ovig. females, 1 June 1979. Bahia Concepción: 1 incomplete specimen, 1 ovig. female, 26 March 1981; 2 males, 1 female, 23 March 1981; 1 ovig. female, 20 March 1981; 1 female, 4 May 1981.

REMARKS: In the original description of this species based on abundant material from the western Atlantic, Chace (1972) stated with reference to the genus *Thor*, "Most of the morphological characters investigated proved to be variable and useless, but the few

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TABLE 1

Thor manningi FROM THE GULF OF CALIFORNIA

LOCATION*	SEX	CARAPACE LENGTH (mm)	SIZE OF EGGS (mm)	ACCESSORY SPINULES, DACTYL OF PEREIOPOD 4	ID PEREIOPOD 5
LC	♂	2.1	—	3/4	4/4
BC	♂	1.4	—	4/4	4/4
BC	♂	1.6	—	4/4	4/4
LP	♀	1.5	—	3/3	3/3
LP	♀	2.2	—	3/3	4/?
BC	♀	1.8	—	4/4	4/4
LP	♀	2.5	—	3/4	?/2
BC	♀	2.3	—	?/4	4/4
BC	?	2.1	—	4/4	4/4
LP	♀ ov.	2.0	0.51	3/4	3/3
LC	♀ ov.	2.9	0.59	4/4	?/4
LC	♀ ov.	3.0	0.64	4/4	4/4
BC	♀ ov.	2.1	0.42	4/4	4/4
BC	♀ ov.	2.4	0.64	4/4	4/4

*LC = La Choya; BC = Bahía Concepción; LP = Laguna Percebú

reasonably stable characters finally found are sufficient to permit identification of most specimens." In the excerpt from the key to Atlantic species below, he distinguishes *Thor floridanus* from *T. manningi*:

3.(2) Dactyls of fourth and fifth pereiopods commonly armed with 4 or 5 (rarely 3 or 6) spinules on flexor margin proximal to distal pair of spines; eggs large and few, increasing in major diameter during development from 0.66 to 1.40 mm .... *T. floridanus.*
Dactyls of fourth and fifth pereiopods commonly armed with 3 (sometimes 2 or 4) spinules on flexor margin proximal to distal pair of spines; eggs not very large, increasing in major diameter during development from 0.36 to 0.75 mm ..... *T. manningi.*

For the Gulf of California, we found that most of the 14 specimens we examined had 4 of the spinules mentioned in the key by Chace (1972), but the size of the eggs (Table 1) was "not very large." We believe the first mentioned character is "reasonably stable" only at the level of populations. As shown in Table 1, the specimens from Laguna Percebu had 3 (sometimes 4 and rarely 2) spinules, while the specimens from Bahia Concepción always had 4, and those from La Choya (situated closer to Laguna Percebú, Figure 1) had 4 and rarely 3. Specimens from this latter population were even larger than the specimens studied by Chace (1972).

On the other hand, the size of eggs should certainly be considered a more specific character because it is obviously related to reproductive processes which indeed are one of the most accepted criteria in defining species.

We did not have the opportunity to examine any material of *T. floridanus*, but the "ventral margin (of rostrum) typically bearing single tooth forming bifid rostral tip, rarely unarmed" (Chace 1972) in *T. manningi* may also be used as another combined character, perhaps less variable, in diagnosis of the species. The original description by Kingsley (1878) and the drawings by Chace (1972)

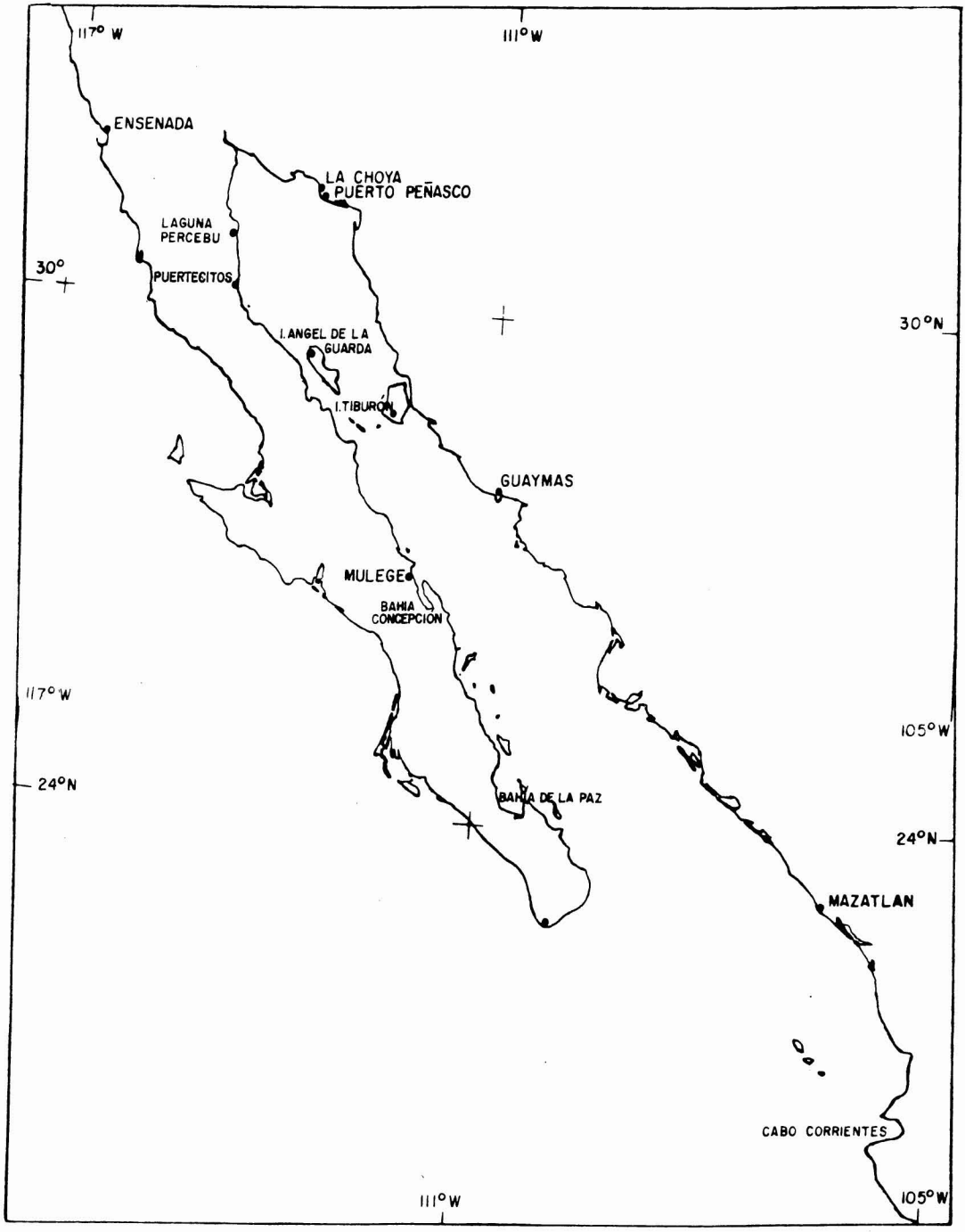

FIGURE 1. Gulf of California, Mexico, showing localities mentioned in the text.

show the rostrum of *T. floridanus* having a single point.

Ambidexter panamensis Abele, 1972

Ambidexter panamensis Abele, 1972:373, figs. 4, 5.

PREVIOUS RECORDS: San Diego, Calif.; Naos and Culebra Island, Pacific coast of Panamá; Mazatlan, Sin.

MATERIAL EXAMINED: Ensenada, Baja California: 1 ovig. female collected July 1978. Laguna Percebú, Baja California: 14 females (9 ovig.), 9 males, 27 August 1979. Bahia Concepción, Baja California Sur: 3 ovig. females, 1 male, 18 June 1980. Bahia de La Paz, Baja California Sur: 2 males, May 1980.

REMARKS: This is the first record of this species from the Gulf of California, although the oceanic limit for the gulf is not the same as the geographic one, which might well extend from Cabo San Lucas in Baja California Sur to Cabo Corrientes in Jalisco (Roden and Groves 1959). Considering the recent record of this species for Mazatlan by Williamson (1980), the range is now extended northwestward more than 1200 km.

Ambidexter symmetricus Manning and Chace, 1971

Ambidexter symmetricus Manning and Chace, 1971:3, figs. 1, 2. Abele 1972: 366.

PREVIOUS RECORDS: Florida; Louisiana; Tamaulipas, México; Puerto Rico; Trinidad; Isla Galeta, Caribbean Coast of Panamá.

MATERIAL EXAMINED: Puertecitos, Baja California: 1 male, 5 February 1978. Laguna Percebú, Baja California: 1 ovig. female, June 1978; 1 ovig. female, July 1978; 5 females (2 ovig.), August 1978.

Automate dolichognatha De Man, 1888

Automate dolichognatha De Man, 1888: 529. Banner and Banner 1973:299 (and synonymy). Wicksten 1981:1104.

PREVIOUS DISTRIBUTION: Indo-Pacific region from the Red Sea to Samoa; western Atlantic from North Carolina to Barbados, and the Yucatan Peninsula; eastern Pacific from Ecuador to Panamá; Galápagos Islands, Cocos Island, Costa Rica; Clarion Island, México.

MATERIAL EXAMINED: Laguna Percebú, Baja California: 1 specimen, March 1978; 2 ovig. females, July 1978.

Latreutes parvulus (Stimpson, 1866)

Rhynchocyclus parvulus Stimpson, 1866: 48.

Latreutes parvulus: Holthuis 1947:59; 1951:131. Carvacho 1979:465 (and synonymy).

PREVIOUS DISTRIBUTION: North Carolina to Rio de Janeiro; Cuba; Puerto Rico; Sierra Leone, West Africa.

MATERIAL EXAMINED: Laguna Percebú, Baja California: 23 females (19 ovig.), 4 males, 9 July 1979.

REMARKS: We have distinguished two other forms of *Latreutes* (Carvacho and Rios 1982). They seem to be *L. antiborealis* Holthuis 1952, which is so closely related to *L. parvulus* that we believe it might become a junior synonym of this species when more material becomes available.

Salmoneus ortmanni (Rankin 1898)

Salmoneus ortmanni: Carvacho 1979:453 (and synonymy).

PREVIOUS RECORDS: Bermudas; Bahamas; Guadalupe; Yucatan peninsula.

MATERIAL EXAMINED: Bahia Concepción, Baja California Sur: 1 ovig. female, 18 June 1980.

REMARKS: Parker (1964) found *Salmoneus* sp. at one station in the assemblage he called "Northern Gulf basins and troughs, 230 to 1500 meters," where "the great tidal exchange through these basins and channels creates virtually uniform temperature, salinity and

oxygen conditions from about 30 to 50 meters close to the surface down to the bottom at 1500 meters." Chace (1972) reported most specimens from turtle grass, but one apparently was taken from much eroded coral standing in 10 feet of water. Our specimen comes from a tide pool as did others mentioned by Chace (1972). The specimen reported by Parker (1964) could possibly belong to this species if we assume it is an eurybaric one.

DISCUSSION

We may now take a closer look at those species with an amphiamerican distribution (Ekman 1953), which may also be considered part of the cognate species so called by Vermeij (1978). We believe these species are good evidence for the dynamic although historic process of speciation.

The origin of the Gulf of California is still not well understood; but considering paleoecological evidence, such as the presence of palm and reef coral fossils along the coast of the state of Washington, Durham and Allison (1960) stated that Baja California must have been subject to climates even more tropical than that of today. Thereafter when the tropical belt was reduced to its present boundaries, the Gulf of California became a tropical refuge because of its geographical limits and the position of its opening in the Pacific Ocean.

A complete fossil record of the Cenozoic coasts of the American continent would be the strongest evidence for what now seems only speculation.

It cannot be told yet at what time amphiamerican species passed from one side of the continent to the other. Nevertheless, based on the fossil record of some Mollusca, Woodring (1974) found that it should have happened not earlier than 5 to 23 million years ago, when the last functional interoceanic passage was still open somewhere in Central America making possible the existence of the Miocene Caribbean Faunal Province.

Once the Miocene Caribbean populations became separated (when the Pacific-Caribbean connections were finally closed during the late Miocene [Olsson 1972]) genetic flow ceased between populations on the Caribbean coast and those on the west coast. The result of this geographic isolation seems to have been unequal among the main groups of Crustacea; while brachyuran crabs have shown a higher degree of speciation, caridean shrimps have behaved as more conservative forms.

We noted a higher percentage of amphiamerican species of caridean shrimps than of brachyuran crabs. We have said elsewhere (Carvacho and Rios 1982) that more than 20% of the species of caridean shrimps found in the Gulf of California are also present on the Atlantic coast of America, while Ekman (1953) reported only 2% of the total number of species of American warm-water crabs found both in Pacific and Atlantic regions. Considering only the species from the Gulf of California, those crabs present also in the Atlantic account for less than 5%.

It is evident in this case that, given the same period of isolation, the speciation processes have been much faster among Brachyura than among Caridea. This consideration is in accord with the explosive radiation of Brachyura, particularly noticeable during the Tertiary period (Figure 2).

We believe that considering only morphological characters is not a reliable way to determine whether two disjunct populations that were isolated for a relatively short geological time belong to the same species.

It might be that once the Central American Isthmus was raised and as a result the Miocene Caribbean Province was split, there still remained some biotopes that had not drastically changed. Now assuming that morphology is primarily an adaptation, significant morphological changes cannot be expected among those populations inhabiting such biotopes, even when the isolation period has been long enough to create incompatible genomes.

Finally, considering the vagueness of estimated time elapsed since splitting of the disjunct populations occurred, we may ask: Are there any general parameters by which to compute the biological time that correspond to a given number of millions of years in each of the species, as different as a shrimp and a crab, discussed?

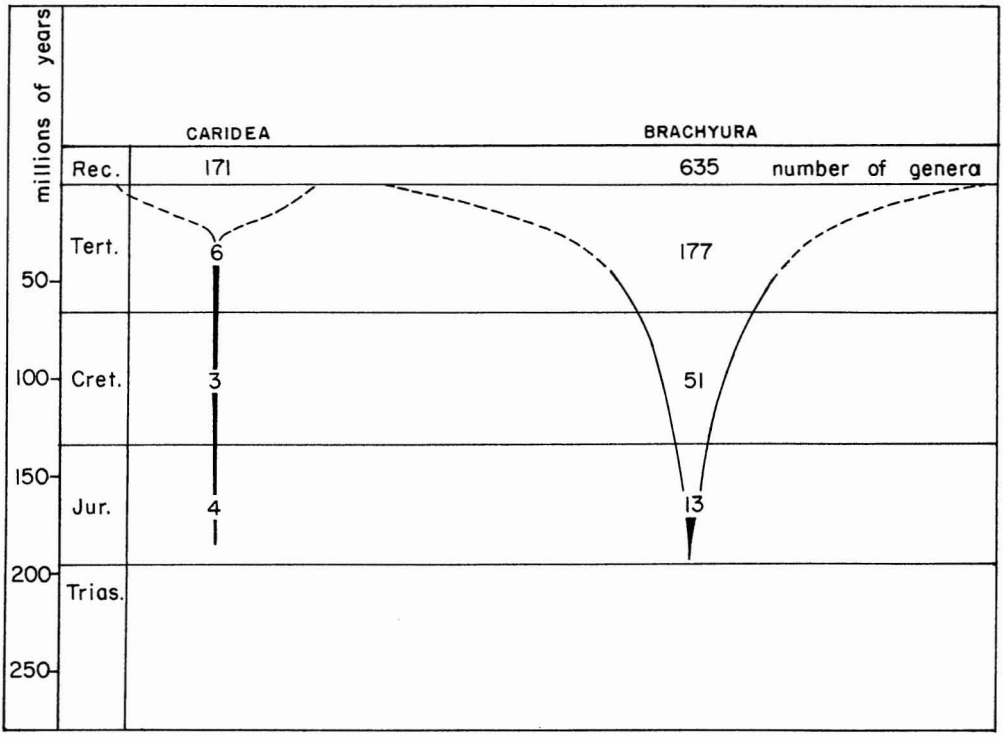

FIGURE 2. Evolution of Caridea and Brachyura (modified from Glaessner 1969).

LITERATURE CITED

ABELE, L. G. 1972. A review of the genus *Ambidexter* in Panama. Bull. Mar. Sci. 22(2):365–380.

BANNER, D. M., and A. H. BANNER. 1973. The Alpheid shrimp of Australia. Part I. The lower genera. Rec. Aust. Mus. 28:291–382.

CARVACHO, A. 1979. Les crevettes carides de la mangrove Guadeloupeenne. Bull. Mus. Natn. Hist. Nat., Paris (4)1, A(2):445–470.

CARVACHO, A., and R. RIOS. 1982. Los camarones carídeos del Golfo de California. II. Catálogo, claves de identificación y discusión biogeográfica. An. Inst. Cienc. del Mar y Limnol. Univ. Nal. Autón. México 9(1):279–294.

CHACE, F. A., Jr. 1972. The shrimps of the Smithsonian-Bredin Caribbean Expeditions with a summary of the West Indian shallow water species (Crustacea: Decapoda: Natantia). Smithsonian Contrib. Zool. 98: 1–179.

DURHAM, J. W., and E. C. ALLISON. 1960. The geologic history of Baja California and its marine faunas. *In* Symposium: The biogeography of Baja California and adjacent seas. Syst. Zool. 9:47–91.

EKMAN, S. 1953. Zoogeography of the sea. Sidgwick and Jackson, London. 417 pp.

GLAESSNER, M. F. 1969. Decapoda. *In* R. C. Moore, ed. Treatise on invertebrate paleontology. The Geological Society of America and University of Kansas. R(4)2:400–532.

HOLTHUIS, L. B. 1947. The Hippolytidae and Rhynchocinetidae collected by the Siboga and Snellius expeditions with remarks on other species. Part IX *in* The Decapoda of the Siboga Expedition. Siboga Exped. Mon. 39A(8):1–100.

———. 1951. The caridean crustacea of tropical West Africa. Atlantide Rep. 2:7–187.

———. 1952. The Crustacea Decapoda Macrura of Chile. Reports of the Lund University Chile Expedition 1948–49. Lund Univ. Arsskr., n. ser. sect. 2, 47(10):1–110.

Man, J. G. De. 1888. Report on the podophtalmous crustacea of the Mergi Archipelago. J. Linn. Soc. Lond. (Zool.) 22:1–312.

Manning, R. B., and F. A. Chace. 1971. Shrimps of the family Processidae (Crustacea: Decapoda: Caridea) from north western Atlantic. Smithsonian Contrib. Zool. 89:1–41.

Olsson, A. A. 1932. Contributions to the Tertiary paleontology of northern Peru: Part 5, the Peruvian Miocene. Bull. Amer. Paleo. 68:1–272.

Parker, R. H. 1964. Zoogeography and ecology of macroinvertebrates of Gulf of California and continental slope of western Mexico. *In* Tjeerd H. Van Andel and George G. Shor, Jr., eds. Marine Geology of the Gulf of California. Memoir 3. Amer. Assoc. of Petroleum Geologists.

Rankin, W. M. 1898. The Northrop collection of Crustacea from the Bahamas. Ann. N. Y. Acad. Sci. 11(12):225–258.

Roden, G. I., and G. W. Groves. 1959. Recent oceanographic investigations in the Gulf of California. J. Mar. Res. 18(1):10–35.

Stimpson, W. 1866. Descriptions of new genera and species of macrurous Crustacea from the coasts of North America. Proc. Chicago Acad. Sci. 1:46–48.

Vermeij, G. J. 1978. Biogeography and adaptation: Patterns of marine life. Harvard Univ. Press, Cambridge, Mass. 332 pp.

Wicksten, M. K. 1981. The species of Automate (Caridea: Alpheidae) in the eastern Pacific Ocean. Proc. Biol. Soc. Wash. 94(4):1104–1109.

Williamson, D. I. 1980. Larval development in a species of *Ambidexter* Manning and Chace (Decapoda: Caridea: Processidae). Crustaceana 39(3):235–246.

Woodring, W. P. 1974. The Miocene Caribbean Faunal Province and its subprovinces. Verh. Naturforsch. Ges. Bas. 84(1):209–213.