

Composition and Zoogeographic Relationships of the Decapod Crustacea Shelf-Fauna of the Northeastern Gulf of Mexico*

*Composición y Relaciones Zoogeográficas de la Carcinofauna de la Plataforma
Continental del Noreste del Golfo de México*

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ABSTRACT

The exploration of the continental shelf of the northeastern Gulf of Mexico conducted onboard the R/V TURSIOPS from 1970 to 1971 yielded an assorted collection of decapod crustaceans composed of 120 species divided into 29 families. They constitute a faunal assemblage with tropical and subtropical affinities. Based on their geographic ranges, they were classed into six groups: Group I consisted of essentially tropical species (43 %), group II encompassed eurythermal species (42%) exhibiting a broad geographic distribution in the tropical Western Atlantic. Group III included transatlantic species (6%). Groups IV, V, and VI represented endemic (5%), deep-water (2%), and circumtropical species (2%), respectively. The decapod shelf-faunas studied is composed of 28 % of coastal species, 28 % of deep-water inhabitants, and 42% of indigeneous shelf species. Their zoogeographic analysis revealed a strong affinity (76%) with the Caribbean Province. Nearly 77% of the species studied are able to establish as permanent residents in the warm-temperate region of the Carolinian Province, but not necessarily displaying a disjunct Floridian distribution. Only 4 % extend their range into the temperate climate of the Virginian Province.

Key word: Zoogeographic composition, decapod crustacea, Gulf of Mexico

RESUMEN

La exploración del ambiente de plataforma continental del noreste del Golfo de México realizada abordo del B/O TURSIOPS durante 1970 y 1971 sirvió para la colecta de una variada carcinofauna compuesta por 120 especies incluídas en 29 familias. Este complejo faunístico incluye elementos con afinidades tropicales y subtropicales. De acuerdo con sus alcances geográficos, éstos fueron divididos en seis grupos: El grupo I representa especies tropicales (43%), en tanto que el grupo II incluye las especies euritérmicas (42%) distribuidas ampliamente en el Atlántico Tropical occidental. El grupo III comprende las especies transatlánticas (6%). Los grupos IV, V, y VI representan respectivamente a las especies endémicas (5%), las típicas de aguas profundas (2%), y las de distribución circuntropical (2%). La fauna decápoda del NE del Golfo de México se encuentra compuesta por un 28 % de elementos costeros, 28 % de habitantes batiales, y 42 % corresponde a las especies autóctonas del ambiente de plataforma. La composición zoogeográfica de este complejo faunístico indica una afinidad significativa con la Provincia Caribeña (76%). Cerca del 73% de estas especies son residentes de la zona cálido-templada perteneciente a la Provincia Carolineana; sin embargo, no todas muestran una distribución discontinua en la Península de la Florida. Sólo 4% de estas especies han sido registradas en la región templada de la Provincia Virginiiana.

Palabras clave: Composición y zoogeografía, decapoda crustacea, Noreste del Golfo de México.

* A través de la presente contribución científica el autor desea rendir homenaje al distinguido científico mexicano Dr. Eucario López-Ochoterena, profesor de muchas generaciones de Biólogos en nuestro país y digno ejemplo de rectitud y constancia académica durante más de 42 años de labor docente y de investigación. Sirvan estas breves líneas para

expresar al Dr. López Ochoterena, la estimación y respeto de su exalumno y amigo, en ocasión de este merecido Jubileo Académico.

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Introduction

The decapod crustacea fauna of the Gulf of Mexico is perhaps one of the best documented biota due to the intensive exploratory efforts conducted by early oceanographic expeditions such as those of the U.S. Coast Survey steamer *BLAKE* (1877-1878), and the U.S. Fish Commission vessels' *ALBATROSS* (1885) and *FISH HAWK* (1901-1902). Soto in 1980 had made a succinct review of the most recent contributions that have enriched our knowledge on this important faunistic group. From the zoogeographic point of view, two renown authors Ekman (1953) and Hedgpeth (1957) have considered the shelf fauna of the northern Gulf of Mexico as warm-temperate with more faunistic affinity with the Carolinian Province, which stretches along the eastern seaboard of the U.S., than with the tropical fauna of the West Indies. However, in light of the most recent studies of the shelf and deep-waters (Pequegnat and Pequegnat, 1971; Powers, 1977) of the Gulf, a different zoogeographic conception may emerge. From a rather intensive sampling of the benthic communities of the northeastern continental shelf of the Gulf of Mexico conducted in 1970 through 1971, this author was able to assemblage an assorted collection of decapod crustaceans composed of 120 species divided into 26 families. A detailed species account of this collection can be found in Soto (1980).

The present contribution attempts to examine the faunal composition of the decapods of the shelf environment of the northeastern Gulf of Mexico, and to analyse their zoogeographic affinities with faunas distributed in the Tropical Western Atlantic region.

Results and discussion

The decapod shelf-fauna of the northeastern Gulf of Mexico is composed of an assemblage of species with both tropical and subtropical affinities. In analysing the distributional pattern of this faunal complex it soon became evident the problem of defining its general composition in accordance with the two major zoogeographic provinces recognized within the Gulf of Mexico (Hedgpeth, 1953; Briggs, 1974). These provinces, the Carolinian and

Caribbean, appear closely related in the northern boundary of the Gulf. However, they seem to attain certain level of distinctness among some of their faunal components in the southern part of Florida (Briggs, 1974; Spivey, 1981). A plausible explanation to this condition is the geological emergence of the Florida Peninsula during the late Pleistocene.

Based on the analysis of the geographic range exhibited by the 120 decapod species included in this study, they have been classed into six groups:

Group I is composed of tropical species distributed from the Caribbean Sea through the Gulf of Mexico, extending northward along the south-eastern coast of the U.S., as far north as Cape Hatteras, N.C.

Group II comprises those species distributed farther north of Cape Hatteras, N.C., as far south as South America.

Group III consists of those species ranging from North Carolina to the northern Gulf of Mexico, from Tampa Bay to Texas.

Group IV includes those species endemic to the Gulf of Mexico.

Group V encompasses the amphiatlantic species.

Group VI contains the cosmopolitan species.

The tropical species included in the group I amount to 51 taxa or 43%. This group is recognized as an essential component of the decapod shelf-fauna in which most of the 26 identified families are represented. It is interesting state at this point, that for most of the tropical species neither the temperature nor the emergence of the Florida Peninsula have been an ecological impediment in their dispersion into the temperate region. As a result of this condition, a considerable number of tropical fauna from the NE Gulf are found as permanent residents within the boundaries of the warm-temperate region as defined by Miller (1969). It is clear that the zoogeography of group I is largely influenced by the circulation pattern that prevails in the Gulf of Mexico and the southeastern coast of the U.S. The two major circulation features in these areas are the Loop and the Florida Currents.

The Caribbean waters that flow into the Gulf of Mexico through the Yucatan Strait extends into the northeastern Gulf in a form of an anti-cyclonic gyre

or eddy known as the Eastern Gulf Loop Current (Nowlin and Mc Lellan, 1967). This current flows toward the northwest coast of Florida then turns east, and in the region of the West Florida Escarpment it flows southwards until it joins with the Florida current. This current flows along the continental shelf northward from the Florida Straits to Diamond Shoals, N.C. (Cerame-Vivas and Gray, 1966), and it is commonly known as the Gulf Stream. This circulation pattern is accountable for the warm surface-water conditions that favors the dispersion and the establishment of tropical species in the northern Gulf of Mexico and the eastern coast of the U.S.

Group II contains 52 species or 42% of the total number. These are ubiquitous species whose eurythermal condition allows them to have a widespread distribution in the tropical Western Atlantic. It is this circumstance that prevents their use as zoogeographic indicators.

Group III contains only 7 species or 6% of the total decapod assemblage. They represent a small portion of the influx of transatlantic species which probably reached the northern Gulf of Mexico prior the geological emergence of the Florida Peninsula. Some of these faunal elements present a disjunct distribution or a faunal break in Southern Florida. This is perhaps the most important zoogeographic attribute of this group. However, the validity of such condition as stated by Hedgpeth (1953), is questionable (Abele, 1970) given the number of taxa (carolinian) that presumably had disjunct distribution, and that are known to inhabit the Florida Bay (Tabb and Manning, 1961) and the Everglades area (Rouse, 1970).

Group IV includes 5 species or 5% of the total. They represent the species confined to the Gulf of Mexico. This low percentage of endemism among decapod crustaceans is essentially a reflection of the wide distribution range exhibited by most of the shelf-fauna assemblage herein studied. The endemic species belonging to this group correspond to benthic forms normally occurring within the boundaries of the outer shelf and the continental upper slope.

Group V encompasses 2 species or 2% of the total number. The group includes common representatives of the deep-water fauna of the Gulf: *Parapenaeus longirostris* and *Homola barbata*.

Group VI includes also 2 species or 2% of the carcinofauna here studied. One species belong to the family Eryonidae (*Polycheles typhlos*), and the other to the Crangonidae (*Pontophilus gracilis*). The members of the former family are normal components archibenthic fauna of the Gulf of Mexico. According to Ekman (1953) the genus *Polycheles* was formerly a littoral form which then became adapted to the deep-sea habitat. The second species, *P. gracilis* is virtually circumtropical in its world distribution, and in the tropical Western Atlantic its range extends as far north as Marthas Vineyard, Mass.

Faunal Composition

From the species assemblage that compose the decapod crustacea shelf-fauna of the northeastern Gulf of Mexico, one may distinguishes two basic components designated hereafter as A and B, respectively.

The first component involves species identified as shallow water forms whose depth range usually extends within the boundaries of the inner shelf (< 50 m). The second component in turn, is made up of the taxa that normally occur on the outer shelf region (100 to 200 m), and the upper continental slope (> 200 m).

In order to establish the degree of faunistic contribution of the above two components to the benthic shelf environment, a comparative regional analysis was conducted of the common species known to inhabit both coastal and deep-waters of the northeastern Gulf of Mexico. To accomplish this task, the information offered by Menzel (1971), Rouse (1970), and Abele (1970) was selected as representative of the decapod coastal fauna. Similarly, for the case of the deep-water representatives it was chosen Pequegnat *et al.* (1970). The Results of this comparative analysis are shown in Table 1. This analysis has been conducted at species level though for space convenience, only the family names appear in the referred table.

According to the compiled information, from a total of 126 species listed by Menzel (1971) 34 or 28% are common inhabitants of the shelf habitat. Rouse (1970), on the other hand, listed 103 decapod

	Continental Shelf of the NE Gulf of Mexico	Apalachee Bay & St. George's Sound	South West Florida	North Western Florida	Slope & Abysal
	Soto, 1980	Menzel, 1971	Rouse, 1970	Abele, 1970	Pequegnat <i>et al.</i> , 1970
No. of spp.	120	126	103	154	135
Penaeidae	18	3	7	7	7
Alpheidae	3	3	2	3	
Hyppolytidae	1	1	1	1	
Processidae	1		1	1	
Pandalidae	3				2
Crangonidae	2				2
Eryonidae	1				1
Nephropsidae	1				
Scyllaridae	4	1	1	2	
Galatheididae	8			6	
Porcellanidae	3	1	1	1	1
Paguridae	9	3	3	1	
Albuneidae	1	1		1	
Raninidae	1				1
Dromiidae	3	2	1	3	
Doroppidae	2				1
Homolidae	1				
Leucosiidae	5	1		1	2
Calappidae	5	1	1	1	3
Portunidae	8	5	3	7	1
Xanthidae	7	3	2	3	1
Goneplacidae	3	1	1	1	
Pinnotheridae	1				
Palicidae	3				1
Majidae	23	7	3	9	4
Parthenopidae	4	1	1	1	1
Common spp		34	28	49	33
Affinity %		28	23	41	27.5

Table 1. Faunal composition of the decapod crustacea shelf-fauna of the Northeastern Gulf of Mexico.

species of which just 28 or 23% occur in the NE continental shelf of the Gulf of Mexico. Abele (1970) reported 154 species of which 41% are also common shelf inhabitants. The average value estimated from the above percentages indicates that the coastal decapod fauna contributes roughly a 31% to the inner shelf species assemblage (component A).

From the total of 135 deep-water species identified by Pequegnat (1970) from the Gulf of Mexico 33 or 28% form part of component B.

Through this comparative analysis it is then possible to recognize the species indigenous to the shelf environment which in this study amount to 42%. Among the most conspicuous family constituents are the following: penaeidae, pandalidae,

scyllaridae, galatheididae, dorippidae, leucosiidae, calappidae, xanthidae, goneplacidae, pinotheridae, palicidae, majidae, and parthenopidae.

Faunistic relationships

Early in this study, it was emphasized the capacity exhibited by many of the faunal components with tropical affinities to colonize the temperate region of the eastern coast of the U.S. Whether these faunal components should be considered as truly tropical or rather warm-temperate forms remains a questionable matter. However, one feasible way to approach this situation, as suggested by Behre (1954), is by establishing the faunal relations among zoogeographic areas with common faunistic elements.

In keeping with Behre (1954), the definition of faunal boundaries for the decapod shelf fauna from the NE Gulf of Mexico requires to review the faunistic similarities that can be recognized along the different zoogeographic provinces in the tropical Western Atlantic, namely: Virginian, Carolinian, Caribbean or Tropical, and Antillean. Geographic regions that can be selected as best representatives of these provinces are, following the same latitudinal gradient: Woods Hole, Mass., North Carolina, and the West Indies.

The information on decapod crustaceans from the area of Woods Hole was compiled from several publications by Rathbun (1881), Sumner *et al.* (1911), Wigley (1960), and Smith (1964). In the case of the region of North Carolina, the comprehensive publications by Williams (1965, and 1984) were consulted. Likewise, the records furnished by Rathbun (1933), and Schmitt (1935) for Puerto Rico and the Virgin Island were a good reference source for the West Indies fauna. These records were supplemented with others provided by authors such as Holthuis (1955), Pequegnat *et al.* (1971), and Lemaitre (1984). The results of this comparative analysis are presented in Table 2.

As it might be expected, the Woods Hoole region shows the lowest affinity with the decapod shelf-fauna of the NE Gulf of Mexico. It was estimated that from approximately 119 species only 5 or 4 % occur in the Gulf; of these species, two belong to the family pandalidae, two are ubiquitous portunids crabs, and the last one is a majid brachyuran crab.

From the region of North Carolina 249 decapods species are known from the shelf margin; of these, 88 or 73% are share with the NE Gulf of Mexico. Interesting enough, most of these species are permanent residents in the middle and outer continental shelf of North Carolina where bottom temperature is warm enough to allow their successful settlement (Cerame-Vivas and Gray, 1966; Williams *et al.*, 1968).

In addition of the 315 species previously known from the West Indies, 49 records were herein included, thus amounting to a total of 364 species of which, 91 or 76% represent normal components of the shelf-fauna here analyzed.

From Table 2, it is interesting to notice, the remarkable similarity in terms of its species composition, exhibited by several families recorded in the NE Gulf of Mexico, North Carolina, and the West Indies. They appear almost equally represented; such is the case of the following families: alpheidae, pandalidae, porcellanidae, albulidae, calappidae, portunidae, xanthidae, goneplacidae, pinotheridae, and parthenopidae.

Other families in turn, display certain differences in their species composition possible due to their respective thermal tolerance. A close examination of such families reveals that they include elements with either northern or southern affinities. Thus one can distinguish in the family penaeidae that *Solenocera necopina* and *Hymenopenaeus aphoticus* present a rather northern distribution. Whilst the species *Solenocera vioscai* and *Trachypenaeus similis* have a southern affinity.

In the family scyllaridae, of the four species identified in the NE Gulf, only *Scyllarus nodifer* is absent in the West Indies.

The members of the family galatheididae are essentially tropical in their distribution. With the exception of *Galathea rostrata* and *Munida forceps*, all the other species are distributed throughout the West Indies. *G. rostrata* clearly exhibited northern affinity, whereas *M. forceps* seems to be confined to the Gulf of Mexico and the northwestern coast of Cuba (Chace, 1942).

In the family paguridae, *Pagurus puncticeps* shows southern affinity, and the species *P. defensus* and *P. impressus* in contrast, are rather northern forms.

From the family xanthidae only *Carposporus papulosos* appears absent from the West Indies.

In the family majidae, the species that display southern affinities are *Aepinus septemspinus*, *Podocheila lamelligera*, and *Mithrax cornutus*; species with northern affinity are *Collodes trispinosus*, *Pyromaia arachna*, and *Stenocionops spinimana*. The species *Libinia dubia* occurs as far south as Cuba, but is essentially a northern form which appears as a common resident in the Woods Hole region.

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	Continental Shelf of the NE Gulf of Mexico	North Carolina	Woods Hole	Puerto Rico & Virgin Islands
	Soto, 1980			
No. of spp.	120	249	119	364
Penaeidae	18	11		14
Alpheidae	3	3		3
Hyppolytidae	1	1		
Processidae	1	1		
Pandalidae	3	1	2	1
Crangonidae	2			
Eryonidae	1			1
Nephropsidae	1			
Scyllaridae	4	4		3
Galatheidae	8	2		7
Porcellanidae	3	3		3
Paguridae	9	8		6
Albuneidae	1	1		1
Raninidae	1			
Dromiidae	3	3		3
Doroppidae	2			
Homolidae	1	1		1
Leucosiidae	5	5		5
Calappidae	5	5		5
Portunidae	8	7	2	7
Xanthidae	7	6		6
Goneplacidae	3	2		2
Pinnotheridae	1	1		1
Palicidae	3	1		1
Majidae	23	17	1	15
Parthenopidae	4	4		4
Common spp		88	5	91
Affinity %		73	4	76

Table 2. Zoogeographic relationships of the decapod shelf-fauna of the Northeastern Gulf of Mexico.

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