

Updated checklist and identification of areas of endemism of benthic amphipods (Caprellidea and Gammaridea) from offshore habitats in the SW Gulf of Mexico*

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SUMMARY: An updated checklist of the benthic amphipods associated with soft bottoms in the SW Gulf of Mexico has been made and the areas of endemism have been identified. Amphipods were collected in a depth interval of 25 to 3700 m during six cruises from 1994 to 1999. A total number of 56 species were identified, 11 belonging to the suborder Caprellidea and 45 to the suborder Gammaridea. Thirteen species extended their geographical distribution within the Gulf of Mexico and four species were considered new records in the Gulf of Mexico. A biogeographic analysis based on the shared species and the parsimony criterion helped identify three areas of endemism in the SW Gulf of Mexico. They were named: area A, a small area on the continental shelf of the Bay of Campeche; area B, the continental slope of the Bay of Campeche; and area C, the lower continental slope of the Mexican ridges extending into the western Sigsbee abyssal plain. These areas are defined in terms of their complex topography that may help isolate habitats that promote endemism.

Keywords: Amphipoda, biogeography, continental shelf, continental slope, abyssal plain.

RESUMEN: LISTADO ACTUALIZADO E IDENTIFICACIÓN DE ÁREAS DE ENDEMISMO DE LOS ANFÍPODOS BENTÓNICOS (CAPRELLIDEA Y GAMMARIDEA) DE HÁBITATS MARINOS EN EL SO DEL GOLFO DE MÉXICO. – Se presenta una lista actualizada de los anfípodos bentónicos asociados a fondos suaves en el SO del Golfo de México y las áreas de endemismo reconocidas. Los anfípodos fueron colectados en un intervalo de profundidad de los 25 a 3700 m en seis cruceros oceanográficos de 1994 a 1999. Un total de 56 especies fueron identificadas, 11 pertenecientes al suborden Caprellidea y 45 al suborden Gammaridea. Trece especies ampliaron su distribución geográfica en el Golfo de México y cuatro especies fueron registros nuevos para el Golfo de México. Un análisis biogeográfico basado sobre las especies compartidas de acuerdo con el criterio de parsimonia ayudó a identificar tres áreas de endemismo en el sector SO del Golfo de México, nombradas como área A, un área pequeña sobre la plataforma continental de la Bahía de Campeche; área B, el talud continental de la Bahía de Campeche; y área C, del talud continental inferior de las Cordilleras Mexicanas hasta el oeste de la planicie abisal de Sigsbee. Estas áreas fueron definidas en términos de su topografía compleja que permite aislar hábitats promoviendo el endemismo.

Palabras clave: Amphipoda, biogeografía, plataforma continental, talud continental, planicie abisal.

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INTRODUCTION

The first reports of amphipods from offshore habitats were documented during the last decades of the 19th century by Sars, Chevreux, and Stebbing (Thurston, 2000). A large number of amphipods have been recorded subsequently in diverse benthic habitats (Barnard, 1961, 1962, 1964). Endemicity to the generic level was analyzed by Barnard and Karaman (1991) and Bellan-Santini (1990) within different biogeographic regions. At a worldwide scale, the surveys by Marquez and Bellan-Santini (1993), Cartes and Sorbe (1999), Bachelet *et al.* (2003), and Guerra-García (2003) have contributed with new species to the checklist, showing the restricted geographic distribution of species of this group.

Our knowledge of the amphipod fauna has significantly increased in the last years; however, it remains limited for offshore habitats in most of the ocean regions. The benthic amphipod fauna of the Gulf of Mexico has been extensively documented in the coastal ecosystems including the continental shelf (Myers, 1981; Ortiz, 1991; Thomas, 1993; LeCroy, 1995, 2000, 2001).

Our objective was to update the checklist of benthic amphipod species (Caprellidea and Gammaridea) occurring between 25 and 3700 m depth, and to recognize areas of endemism of amphipod fauna in the offshore habitats of the south-western region of the Gulf of Mexico.

MATERIAL AND METHODS

The Gulf of Mexico is characterized by a complex geomorphology (Roberts *et al.*, 1999) with various canyons, escarpments, salt diapirs and massive carbonated deposits (Bryant *et al.*, 1991). The semi-enclosed basin is linked with the Caribbean Sea by the Yucatan Channel and with the Western Tropical Atlantic Ocean through the Straits of Florida and the different straits and sills through the Caribbean Sea. The seafloor is an accumulation of terrigenous clastic sediments, the sedimentary regime is the result of the influence of the Mississippi, Panuco, Papaloapan and Grijalva-Usumacinta rivers (McKee and Baskaran, 1999).

The continental shelf represents approximately 30% of the total area (Rabalais *et al.*, 1999) with a variable extension (Bouma, 1972). The continental slope is characterized by the Mexican ridges in the

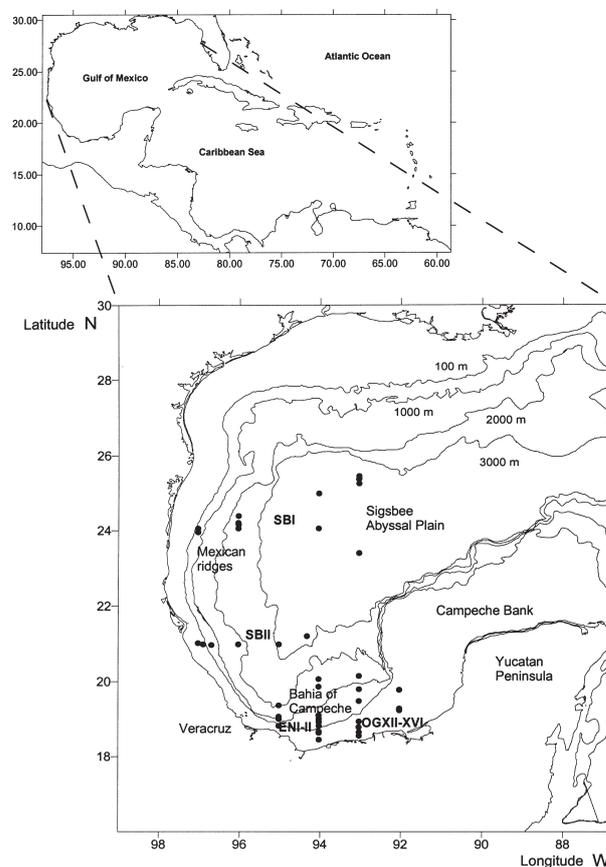


FIG. 1. – Markers show the location of sampling stations of the six cruises where amphipods were sorted for this study. Abbreviations used: SBI: Sigsbee I, SBII: Sigsbee II, ENI-II: ENOS I and II, OGXII-XVI: OGMEX XII and XVI.

western sector of the Gulf, a canyon and knolls in the Bay of Campeche, and an escarpment along the northern edge of the Campeche Bank. The Sigsbee abyssal plain occupies most of the central portion of the basin and is characterized by thin turbidite layers (Bryant *et al.*, 1991). The surface circulation is dominated by the Loop Current and interaction with eddies (Welsh and Inoue, 2000), in general the water column is thermally stratified and displays space and time variability along the continental shelf (Monreal-Gómez and Salas de León, 1997).

The amphipod species were sorted out by sieving, with a 250 μm sieve, superficial sediment samples that were collected with GOMEX (0.06 m²) and USNEL (0.25 m²) boxcorers on six cruises: SIGSBEE.1 (SBI), SIGSBEE.2 (SBII), ENOS.1 (ENI), ENOS.2 (ENII), OGMEX.12 (OGXII), and OGMEX.16 (OGXVI). These cruises were in the south-western (SW) region of the GM in the polygon delimited by 18°38.0' and 25°27.0'N - 92°19.0' and 97°12.0'W on board the

R/V Justo Sierra-UNAM from 1994 to 1999. The bathymetric range (25 to 3700 m) encompassed soft bottom habitats of the continental shelf, continental slope and abyssal plain. Sampling sites were graphically posted with the SURFER V.7 software. Caprellidea and Gammaridea amphipods were preserved in ethanol solution, and identified according to McCain (1968), Myers (1981), Lowry (1984), Barnard and Karaman (1991), Ortiz (1994), Bousfield and Hoover (1997), Lowry and Stoddart (1997), LeCroy (2000, 2001), and Ortiz *et al.* (2002). The classification and the superfamily arrangement followed Bousfield and Shih (1994) and Bousfield (2001). Incomplete or damaged amphipods were identified to the lowest taxonomic level possible. Each species herein reported includes the geographical occurrence, the information for depth and sediment type and the cruises on which they were collected. The specimens were characterized by their frequency and abundance of occurrence in the samples and herein named as dominant, common and rare faunal components. The specimens are deposited at the Colección Nacional de Crustáceos (CNCR-UNAM) and counted with a reference number to the database and collection.

Endemicity in this study was defined as local areas with high survival of species (allochthonous endemics) (Pielou, 1992). The Parsimony Analysis of Endemicity (PAE) was used to identify the areas of endemism in the SW region of GM. This method classifies the study sites according to their shared taxa, following the parsimony criterion (Rosen, 1988; Morrone, 2004). To obtain the cladograms and the strict consensus cladogram WINCLADA V 0.9.99 beta (Nixon, 1999) cladistic software was used. The data matrix (which can be requested from the first author) included 40 species (columns) that were identified as 0 to 39, collected in 15 sites (rows) that were identified as S1 to S15 (between 25 and 3635 m depth). The amphipods used in the data matrix included six caprellids and 34 gammarids. The amphipod information was coded as binary characters; presence of the amphipod was equal to 1 and its absence equal to 0 (Morrone, 1994). A hypothetical area was added (0 in all columns) to root the cladograms. The effects of sampling intensity and spatial autocorrelation were not considered in the findings. The areas of endemism identified were overlapped on the locations sampled.

RESULTS

Order AMPHIPODA Latreille, 1816
 Suborder CAPRELLIDEA Leach, 1814
 Superfamily CAPRELLOIDEA Laubitz, 1993
 Family CAPRELLIDAE White, 1847

1. *Caprella* sp.

This species is a common component, it occurs in soft bottoms of the Mexican ridges (SBI cruise) and the Bay of Campeche (OGXVI cruise) within a depth range of 550 to 2120 m.

2. *Caprella danilevskii* Czerniavski, 1868

This species is a dominant component, it occurs in muddy sediments of the Mexican ridges (SBI cruise) within a depth range of 550 to 2120 m.

3. *Caprella equilibra* Say, 1818

This species is a dominant component, it occurs in muddy sediments of the Mexican ridges and Sigsbee abyssal plain (SBI cruise) within a depth range of 1231 to 3700 m.

4. *Caprella penantis* Leach, 1814

This species is a dominant component, it occurs in muddy sediments of the Sigsbee abyssal plain (SBI cruise) within a depth range of 2200 to 3700 m.

Family PARIAMBIDAE Laubitz, 1993

5. *Deutella* sp.

This species is a rare component, it occurs in soft bottoms of the Bay of Campeche (OGXVI cruise) at 897 m depth.

6. *Deutella incerta* (Mayer, 1903)

This species is a rare component, it occurs in soft bottoms of the Bay of Campeche (OGXVI and ENII cruises) within a depth range of 116 to 1470 m.

7. *Hemiaegina minuta* Mayer, 1890

This species is a rare component, it occurs in soft bottoms of the Bay of Campeche (OGXVI cruise) at 354 m depth.

8. *Paracaprella pusilla* Mayer, 1890

This species is a rare component, it occurs in muddy sediments of the Mexican ridges (SBI cruise) at 498 m depth.

Family PHTISICIDAE Vassilenko, 1968

9. *Hemiproto wigleyi* McCain, 1968

This species is a rare component, it occurs in soft bottoms of the Veracruz continental shelf (SBII cruise) and the Bay of Campeche (OGXVI cruise) within a depth range of 25 to 76 m.

10. *Phtisica* sp.

This species is a rare component, it occurs in soft bottoms of the Veracruz continental shelf (SBII cruise) at 76 m depth.

11. *Phtisica marina* Slabber, 1769

This species is a rare component, it occurs in soft bottoms of the Bay of Campeche (OGXVI and ENII cruises) within a depth range of 76 to 1470 m.

Suborder GAMMARIDEA Latreille, 1803

Superfamily AMPELISCOIDEA Bousfield, 1979

Family AMPELISCIDAE Costa, 1857

12. *Ampelisca* sp.

This species is a dominant component, it occurs in muddy sediments and sandy bottoms of the Veracruz continental shelf (SBII cruise) and Bay of Campeche (OGXII and OGXVI cruises) within a depth range of 25 to 203 m.

13. *Ampelisca agassizi* (Judd, 1896)

This species is a common component, it occurs in sandy bottoms of the Bay of Campeche (OGXVI cruise) at 25 m depth.

14. *Ampelisca bicarinata* Goeke and Heard, 1983

This species is a common component, it occurs in muddy sediments and sandy bottoms of Tamaulipas continental shelf (SBI cruise) and the Bay of Campeche (OGXII and OGXVI cruises) within a depth range of 47 to 203 m.

15. *Ampelisca lobata* Holmes, 1908

This species is a common component, it occurs in soft bottoms of the Tamaulipas continental shelf (OGXVI cruise) within a depth range of 169 to 203 m.

16. *Ampelisca parapacifica* Goeke and Heard, 1984

This species is a common component, it occurs in muddy sediments and sandy bottoms of the Bay of Campeche (OGXII and OGXVI cruises) within a depth range of 26 to 169 m.

17. *Ampelisca vadorum* Mills, 1963

This species is a common component, it occurs in sandy bottoms of the Bay of Campeche (OGXVI cruise) at 25 m depth.

18. *Ampelisca verrilli* Mills, 1967

This species is a common component, it occurs in muddy sediments and sandy bottoms of the Bay of Campeche (OGXVI cruise) within a depth range of 25 to 200 m.

19. *Byblis* sp.

This species is a rare component, it occurs in soft bottoms of the Bay of Campeche (ENII cruise) at 1611 m depth.

Superfamily COROPHIOIDEA Barnard and Barnard, 1983

Family AORIDAE Stebbing, 1899

20. *Lembos* sp. s. s.

This species is a rare component, it occurs in soft bottoms of the Veracruz continental shelf (SBII cruise) and the Bay of Campeche (ENII cruise) within a depth range of 76 to 314 m.

Family COROPHIIDAE Dana, 1849

Subfamily COROPHIINAE Bousfield and Hoover, 1997

21. *Apocorophium acutum* (Chevreux, 1908)

This species is a rare component, it occurs in soft bottoms of the Sigsbee abyssal plain (SBI cruise) at 3600 m depth.

22. *Apocorophium simile* (Shoemaker, 1934)

This species is a rare component, it occurs in soft bottoms of the Mexican ridges (SBI cruise) at 1231 m depth.

23. *Corophium* sp.

This species is a dominant component, it occurs in soft bottoms of the Tamaulipas continental shelf, the Mexican ridges and the Sigsbee abyssal plain (SBI cruise) and sandy sediments of the Bay of Campeche (OGXVI cruise) within a depth range of 25 to 3700 m.

24. *Monocorophium acherusicum* (Costa, 1851)

This species is a rare component, it occurs in soft bottoms of the Sigsbee abyssal plain (SBI cruise) at 2620 m depth.

25. *Monocorophium insidiosum* (Crawford, 1937)

This species is a rare component, it occurs in soft bottoms of the Mexican ridges (SBI cruise) at 1231 m depth.

Family ISAEDIDAE Dana, 1855

26. *Photis* sp.

This species is a rare component, it occurs in sandy sediments of the Bay of Campeche (ENII cruise) at 25 m depth.

Family ISCHYROCERIDAE Stebbing, 1899

27. *Cerapus* sp.

This species is a rare component, it occurs in sandy sediments of the Bay of Campeche (ENII cruise) at 25 m depth.

28. *Erichthonius* sp.

This species is a common component, it occurs in soft bottoms of the Mexican ridges (SBI cruise) within a depth range of 498 to 1698 m.

29. *Erichthonius brasiliensis* (Dana, 1853)

This species is a rare component, it occurs in soft bottoms of the Sigsbee abyssal plain (SBI cruise) at 3690 m depth.

Family PODOCERIDAE Leach, 1814

30. *Podocerus* sp.

This species is a common component, it occurs in soft bottoms of the Mexican ridges and the Sigsbee abyssal plain (SBI cruise) within a depth range of 1231 to 3700 m.

Superfamily EUSIROIDEA Bousfield, 1979

Family BATEIDAE Stebbing, 1906

31. *Carinobatea cuspidata* Shoemaker, 1926

This species is a rare component, it occurs in sandy sediments of the Bay of Campeche (OGXVI cruise) at 52 m depth.

Family EUSIRIDAE Stebbing, 1888

32. *Eusiroides* sp.

This species is a rare component, it occurs in soft bottoms of the Bay of Campeche (OGXVI cruise) at 203 m depth.

Superfamily LEUCOTHOIDEA Bousfield, 1979

Family MAXILLIPIIDAE Ledoyer, 1973

33. *Maxillipius* sp.

This species is a rare component, it occurs in soft bottoms of the Veracruz continental shelf (SBII cruise) at 76 m depth.

Superfamily LILJEBORGIOIDEA Bousfield, 1979

Family LILJEBORGIIDAE Stebbing, 1899

34. *Liljeborgia* sp.

This species is a rare component, it occurs in sandy sediments of the Bay of Campeche (OGXII and OGXVI cruises) within a depth range of 57 to 65 m.

Superfamily LYSIANASSOIDEA Lowry and Stoddart, 1997

Family LYSIANASSIDAE Dana, 1849

Subfamily LYSIANASSINAE Dana, 1849

35. *Concarnes* sp.

This species is a rare component, it occurs in soft bottoms of the Mexican ridges (SBI cruise) at 498 m depth.

36. *Concarnes concavus* (Shoemaker, 1933)

This species is a rare component, it occurs in soft

bottoms of the Bay of Campeche (ENII cruise) at 256 m depth.

Subfamily TRYPHOSINAE Lowry and Stoddart, 1997
37. *Hippomedon* sp.

This species is a rare component, it occurs in soft bottoms of the Bay of Campeche (OGXII and OGXVI cruises) within a depth range of 26 to 203 m.

Superfamily OEDICEROTOIDEA Bousfield, 1979
Family OEDICEROTIDAE Lilljeborg, 1865
38. *Americhelidium* sp.

This species is a rare component, it occurs in sandy sediments soft bottoms of the Bay of Campeche (OGXVI cruise) at 25 m depth.

39. *Americhelidium americanum* (Bousfield, 1973)

This species is a rare component, it occurs in soft bottoms of the Veracruz continental shelf (SBII cruise) at 76 m depth.

40. *Hartmanodes* sp.

This species is a rare component, it occurs in sandy sediments of the Bay of Campeche (OGXII cruise) at 25 m depth.

41. *Perioculodes* sp.

This species is a rare component, it occurs in soft bottoms of the Bay of Campeche (OGXVI cruise) at 61 m depth.

Superfamily PARDALISCOIDEA Bousfield, 1979
Family PARDALISCIDAE Boeck, 1871
42. *Halice* sp.

This species is a rare component, it occurs in soft bottoms of the Bay of Campeche (ENII cruise) at 878 m depth.

Superfamily PHOXOCEPHALOIDEA Bousfield, 1979
Family PHOXOCEPHALIDAE Sars, 1895
Subfamily BROLGINAE Barnard and Drummond, 1978
43. *Eobrolgus* sp.

This species is a common component, it occurs in soft bottoms of the Bay of Campeche (OGXVI,

ENI and ENII cruises) within a depth range of 25 to 1800 m.

44. *Eobrolgus spinosus* (Holmes, 1905)

This species is a common component, it occurs in soft bottoms of the Bay of Campeche (OGXII and ENII cruises) within a depth range of 200 to 1290 m.

Subfamily HARPINIINAE Barnard and Drummond, 1978
45. *Harpinia* sp.

This species is a dominant component, it occurs in soft bottoms of the Bay of Campeche (SBII, OGXII, OGXVI and ENII cruises) within a depth range of 25 to 3360 m.

46. *Pseudharpinia* sp.

This species is a rare component, it occurs in soft bottoms of the Bay of Campeche (SBII, ENI and ENII) within a depth range of 600 to 3360 m.

Subfamily METHARPINIINAE Jarret and Bousfield, 1994
47. *Metharpinia* sp.

This species is a rare component, it occurs in soft bottoms of the Bay of Campeche (ENI and ENII cruises) within a depth range of 200 to 1140 m.

48. *Metharpinia floridana* (Shoemaker, 1933)

This species is a dominant component, it occurs in soft bottoms of the Bay of Campeche (SBII, OGXII, OGXVI, ENI and ENII cruises) within a depth range of 25 to 3360 m.

Superfamily PONTOPOREIOIDEA Bousfield, 1979
Family HAUSTORIIDAE Stebbing, 1906
49. *Haustorius* sp.

This species is a rare component, it occurs in sandy sediments of the Bay of Campeche (OGXII cruise) at 25 m depth.

50. *Parahaustorius holmesi* Bousfield, 1965

This species is a rare component, it occurs in sandy sediments of the Bay of Campeche (OGXVI cruise) at 25 m depth.

51. *Protohaustorius* sp.

This species is a rare component, it occurs in soft bottoms of the Bay of Campeche (ENII cruise) at 1140 m.

Superfamily STENOTHOIDEA Bousfield, 2001
 Family AMPHILOCHIDAE Boeck, 1871
 Subfamily AMPHILOCHINAE Barnard and Karaman, 1991

52. *Hourstonius tortugae* (Shoemaker, 1933)

This species is a rare component, it occurs in soft bottoms of the Bay of Campeche (ENII cruise) at 879 m depth.

Family STENOTHOIDEAE Boeck, 1871
 53. *Stenothoe* sp.

This species is a dominant component, it occurs in soft bottoms of the Mexican ridges and Sigsbee abyssal plain (SBI cruise) within a depth range of 498 to 3700 m.

54. *Stenothoe gallensis* Walker, 1904

This species is a rare component, it occurs in soft bottoms of the Sigsbee abyssal plain (SBI cruise) at 3635 m depth.

Superfamily SYNOPIOIDEA Bousfield, 1979
 Family SYNOPIIDAE Dana, 1855
 55. *Garosyrhoe* sp.

This species is a rare component, it occurs in soft bottoms of the Veracruz continental shelf (SBII cruise) at 76 m depth.

56. *Syrrhoë* sp.

This species is a rare component, it occurs in soft bottoms of the Bay of Campeche (ENI cruise) at 1800 m depth.

Areas of endemism

The Parsimony Analysis of Endemicity provided 20 cladograms. The strict consensus cladogram (SCC) has 51 steps, with 33 sinapomorphies, 16 parallelisms, and two reversals (Fig. 2). Three areas of endemism were identified in the strict consensus cladogram in the SW Gulf of Mexico that were

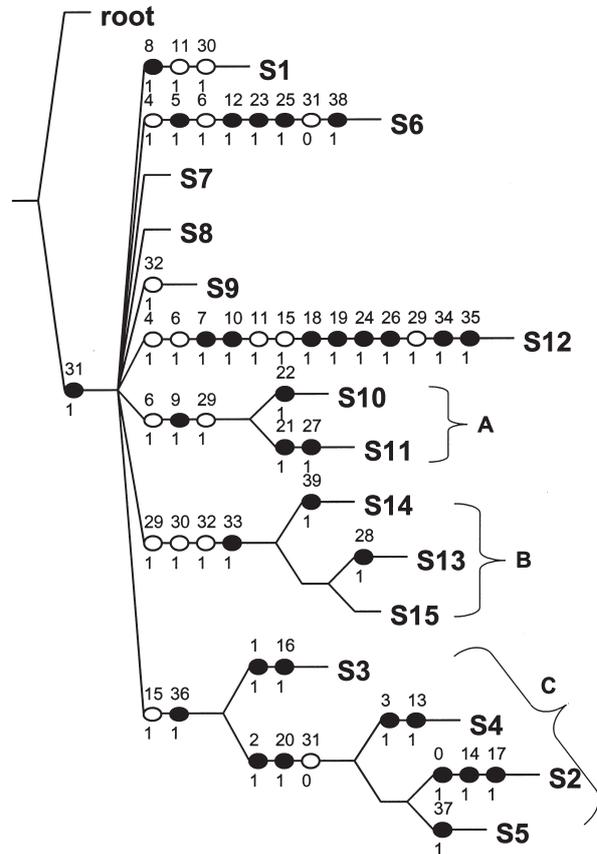


Fig. 2. – Strict consensus cladogram calculated from the Parsimony Analysis of Endemicity (PAE) showing the three areas of endemism. Area A with four sinapomorphies: (9) *Ampelisca parapacifica*, (22) *Hippomedon* sp., (21) *Liljeborgia* sp., and (27) *Perioculodes* sp.; area B with three sinapomorphies: (33) *Metharpinia floridana*, (39) *Syrrhoë* sp., and (28) *Halice* sp.; and area C with 11 sinapomorphies: (36) *Stenothoe* sp., (37) *S. gallensis*., (0) *Caprella* sp., (1) *C. danilevskii*, (2) *C. equilibra*, (3) *C. penantis*, (16) *Monocorophium acherusichum*, (17) *M. insidiosum*, (13) *Apocorophium acutum*, (14) *A. simile*, and (20) *Podocerus* sp.

named as area A, a small area on the continental shelf of the Bay of Campeche, between 26 and 65 m depth (sinapomorphies: *Ampelisca parapacifica*, *Hippomedon* sp., *Liljeborgia* sp., and *Perioculodes* sp.); area B, the continental slope of the Bay of Campeche, between 878 and 1270 m depth (sinapomorphies: *Metharpinia floridana*, *Syrrhoë* sp., and *Halice* sp.); and area C, the lower continental slope of the Mexican ridges extending into the western Sigsbee abyssal plain, between 1231 and 3635 m depth (sinapomorphies: *Stenothoe* sp., *S. gallensis*., *Caprella* sp., *C. danilevskii*, *C. equilibra*, *C. penantis*, *Monocorophium acherusichum*, *M. insidiosum*, *Apocorophium acutum*, *A. simile*, and *Podocerus* sp.) (Fig. 3).

According to PAE and SCC, about 60 % of the difference between groups is accounted for by most species occurring at nine localities. Most of the ben-

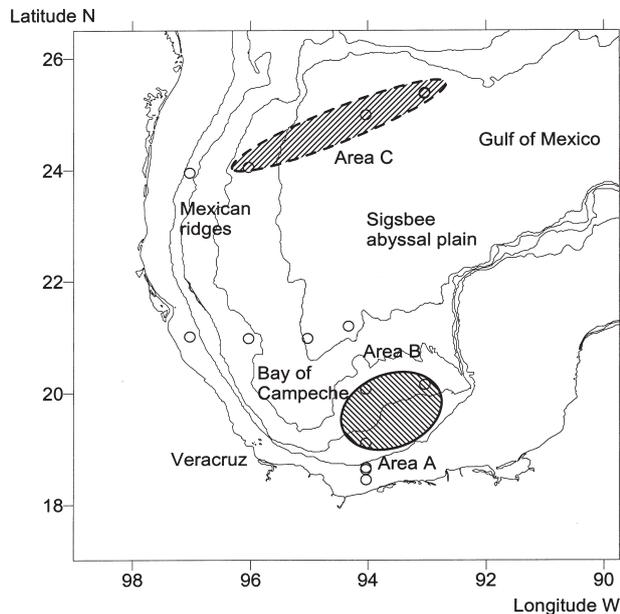


FIG. 3. – Areas of endemism in the SW region of the Gulf of Mexico overlap with the sampling stations used to build the strict consensus cladogram.

thic amphipod species are endemic to the continental slope and abyssal plain (25 %) and in overall, the Gulf of Mexico has 32 % endemism (or 18 species) of the 56 benthic amphipods reported in this study, and 6.5 % of endemic species of the Atlantic Ocean (279 species) (Thurston, 2000).

DISCUSSION

New records and geographical extension

This study contributes with 56 species that are grouped into 21 families and 13 superfamilies of the suborders Caprellidea and Gammaridea in the SW of GM. *Ampelisca* sp., *Corophium* sp., *Cerapus* sp., *Concarnes* sp., *Harpinia* sp., *Maxillipius* sp. and *Stenothoe* sp. will require a future taxonomic analysis once this larger collection of specimens is accounted for. The distribution of 13 amphipod species originally recorded for the northern GM is geographically and bathymetrically extended into the Bay of Campeche (Table 1). The occurrence of *Caprella danilevskii*, *C. penantis* and *Stenothoe gallensis* on the continental slope and the abyssal plain can be explained by sediment transport and turbidity currents. Other species (*Hemiproto wigleyi*, *Carinobatea cuspidata*, *Parahaustorius holmesi*, and *Americhelidium americanum*) extend their geographic distribution southwards. Other

coastal species have also been recorded on the continental shelf (*Ampelisca lobata*, *Houstonius tortuga*, and *Concarnes concavus*) and the continental slope (*Phtisica marina*). The family Corophiidae is one of the cases previously known from coastal habitats (Bousfield, 2000) and extending into the continental slope (*Apocorophium simile* and *Monocorophium insidiosum*), and abyssal plain (*Apocorophium acutum*, *Corophium* sp. and *Monocorophium acherusicum*).

New records of genera not previously recorded in the GM included *Maxillipius* sp. on the continental shelf with sister species *M. rectitelson* Ledoyer, 1973 in Madagascar and *M. commensalis* Lowry, 1984 in Papua New Guinea (Lowry, 1984), *Halice* sp. on the continental slope with 15 sister species (Barnard and Karaman, 1991) in the western sector. The presence of *Syrrhoe* sp. on the continental slope of the Bay of Campeche with 13 sister species, a close relative being *S. papyracea* Stebbing, 1888 from the Caribbean Sea (Barnard and Karaman, 1991) and *Pseudharpinia* sp. on the continental slope as well as the other two records of genera in the GM.

A total number of 101 species of caprellid and gammaridean amphipods, grouped into 26 families, were recorded by Escobar-Briones and Winfield (2003) on the continental shelf and upper continental slope and they recognized that the greatest species richness (ca. 70%) occurred in the N and E Gulf of Mexico regions. These new records, which extend into the lower continental slope and abyssal plain, have increased by 41 species the known number of species and by six the number of known families. A larger effort has been made since 1997 solely in the abyssal plain habitats and may provide in the coming years new unexpected records.

Areas of endemism

Area A is considered controversial in this study owing to its small size and the exclusion of other sampling sites also located on the shelf of the Bay of Campeche. The marked seasonal influence of rivers and the resulting sedimentary texture would suggest that the distribution of the amphipod components could fluctuate from widespread to local over the long term.

The family Phoxocephalidae occurs frequently and in high abundance in area B in the continental slope of the Bay of Campeche, where species of the slope genera *Halice* sp., *Syrrhoe* sp., *Pseudharpinia* sp., *Harpinia* sp. occur.

TABLE 1. – Species of benthic amphipods that extend their geographical range within and into the Gulf of Mexico. Information includes the sector of previous record, the sector of new occurrence, the reported depth range, the new depth interval and the reference.

Species	Sector for the new record	Sector of previous record	New depth interval	Depth of occurrence (m)	Reference
<i>Caprella danilevskii</i>	SW	NE	550-2120	<200	McCain (1968)
<i>Caprella penantis</i>	SW	NE, NW	2200-3700	<200	McCain (1968)
<i>Hemiproto wigleyi</i>	SW	NE	<200	<200	McCain (1968)
<i>Phtisica marina</i>	SW	NE	76-1470	<200	McCain (1968)
<i>Ampelisca lobata</i>	SW	NE	<200	<200	LeCroy (2001)
<i>Hourstonius tortugae</i>	SW	NE	879	<200	LeCroy (2001)
<i>Carinobatea cuspidata</i>	SW	NE	<200	<200	Ortiz (1991)
<i>Apocorophium acutum</i>	SW	NE	3600	<200	Bousfield (2001)
<i>Monocorophium insidiosum</i>	SW	NE	1231	<200	Bousfield (2001)
<i>Parahaustorius holmesi</i>	SW	NE	<200	<200	LeCroy (2001)
<i>Concarnes concavus</i>	SW	NE	256	<200	Lowry and Stoddart (1997)
<i>Americhelidium americanum</i>	SW	NE	>200	<200	LeCroy (2001)
<i>Stenothoe gallensis</i>	SW	NE	3635	<200	Thomas (1993)

Phoxocephalids (a primitive group) radiated successfully in shallower waters and colonized bathyal and abyssal depths before continental drift took place (Bousfield, 1982). Dispersion and speciation models for phoxocephalid amphipods are controversial and widely debated (Barnard and Drummond, 1978; Jarret and Bousfield, 1994); however, there is a coincidence between allopatrid speciation (vicariance) and the dispersion of this group towards the Western Atlantic. The incursion of *Harpinia* and *Metharpinia* into the Western Atlantic and the GM has been explained by the “post-Pangea” general model, with a centre of diversity in bathyal depths of the north-eastern Pacific (Jarret and Bousfield, 1994). Additionally, the presence of *Halice* sp., *Byblis* sp., *Syrrhoë* sp., *Pseudharpinia* sp. (primitive *swimming* forms), and *Lembos* sp. s.s. (primitive *non-swimming* aroid form), characteristic of bathyal and abyssal depths (Myers, 1981; Barnard and Karaman, 1991), fosters a new supposition about the GM and reinforces the hypothesis that the Bay of Campeche is an area with a high degree of endemism and greater biodiversity of natantia forms. Moreover, the broad protection in the marsupium, the fossorial condition, small body size, and direct development might represent endemism evolutionary advantages for benthic amphipods. The patterns of origination and extinction that determine the current results are not biased by possible sampling artifacts (Miller, 2000), as we measured within-habitat rather than cumulative regional species richness and endemism.

Area C has been recognized by the changes in sediment grain size that varies from inshore sandier substrates to offshore silt and clay sediments (Escobar-Briones *et al.*, 1999). In addition to all the species and families (Caprellidae, Corophiidae and Stenothoidae) occurring in the Mexican ridge area

there were frequent and abundant components. Variability (> 90%) in amphipod richness may be explained by habitat heterogeneity with secondary contributions from the net primary productivity exported as biogenic carbon to the seafloor in the area. Habitat heterogeneity relates to the total species richness at the regional level through species turnover. The exported biogenic carbon contribution represents a resource and can be important to species when its main role has an influence on the habitat characteristics e.g. minimum oxygen zone on the slope and high export rates on the continental margin.

Corophids and caprellids have been documented in coastal ecosystems in the northern GM (McCain, 1968; Myers, 1981; Bousfield, 2000; LeCroy, 2000). The distribution of these amphipods in deeper habitats of the northern GM suggests a later incursion of the reptantia species by sediment dumping during the Tertiary (Bouma and Roberts, 1990), or by continuous transport events from shallower waters caused by turbidity currents (Roberts *et al.*, 1999). Similar sediment transport can occur in the Mexican Ridges promoting continuous transport of shallower species to deeper waters.

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