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Identification and Distribution Analysis of Leucothoid Amphipods (Gammaridea) from the Hourglass Cruises

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SHORT PAPERS AND NOTES

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IDENTIFICATION AND DISTRIBUTION ANALYSIS OF LEUCOTHOID AMPHIPODS (GAMMARIDEA) FROM THE HOURGLASS CRUISES—The 28-month-long systematic sampling used in Project Hourglass (1965–1967) provided the first extensive collection of organisms from Florida's offshore benthic ecosystem. The cruises were motivated by the need to document the biology and ecology of the benthic flora and fauna across the West Florida Shelf. Results from this extensive collection include the description of species previously unknown to science (Markham, 1985; Lowry and Stoddart, 1997) and a better understanding of the abundance and distribution of numerous taxa (Dawes and Van Breedveld, 1969; Darovek, 1995). The geographic scope of the sampling efforts of the Hourglass cruises also provided a unique opportunity to analyze differences in species distribution and assemblage composition with depth and bottom type in the northwestern Gulf of Mexico (Serafy, 1979; Myers, 1981; Bullock and Smith, 1991).

Amphipods are numerically dominant in a wide variety of marine systems, from mangrove forests to coral reefs to deep-sea hydrothermal vents (Thomas, 1993a; Sancho et al., 2005). The scope of the ecological importance of these crustaceans is not fully known, however; amphipods have been found to play a key role in the breakdown of detritus and the consumption of microbiota (Zimmerman et al., 1979). This feeding strategy facilitates the transfer of nitrogen and carbon up the food chain (Morrison and White, 1980; Robertson and Lenanton, 1984; Vetter, 1995) as they are a major portion of the diet of fishes, larger crustaceans, and birds (Linke et al., 2001; Platell and Potter, 2001; Sancho et al., 2005; Sa et al., 2006).

The evolution of specific mouthpart morphologies and associating feeding strategies in amphipods have generated high niche specificities (Dias and Hassall, 2005) and is one of the reasons for their success in tropical marine systems (Thomas, 1993a). Many of these features are diagnostic for species identification. This research utilized recent descriptions and taxonomic clarification of leucothoid species (Thomas, 1993b, 1995; Thomas and Klebba, 2006, 2007) to examine a collection of amphipods from the Hourglass cruises across Florida's western continental shelf (1965–1967). The addition of such collections to a taxonomic database furthers the understanding of the distribution of *Leucothoe* across the western Caribbean and Gulf of Mexico.

Leucothoid amphipods are endocommensal peracarid crustaceans that often inhabit sessile benthos such as tunicates, sponges, and bivalves (Thomas and Klebba, 2007). The Leucothoidae is currently composed of 138 species in six genera. Members of the genus *Leucothoe* occur in tropical and subtropical coastal waters around the world and are characterized by a compact, laterally flattened and fusiform body with greatly enlarged second gnathopods. Sexual dimorphism is moderate in the leucothoid group, however; males are generally larger and exhibit more highly developed attributes on the appendages. The size of mature males of described species ranges from 2.5 mm to 10.5 mm. All leucothoid species are exclusively gonochoric. As in other amphipods, females carry fertilized eggs in a thoracic brood pouch (marsupium) formed by setose brood plates (oostegites). Eggs hatch directly into a subadult phase and remain in the brood pouch until they are released as juveniles (Dick et al., 2002). With no distinct larval stage, the offspring settle in relative proximity.

Methods.—The Florida Department of Natural Resources, Division of Marine Resources, conducted 54 Hourglass cruises (R/V *Hernan Cortez*) across the West Florida Shelf from 1965 to 1967. This research is based on the samples collected along four transects from these cruises (Fig. 1). A variety of techniques, including trawl, dredge, and scuba, was used for sampling (Joyce and Williams, 1969). The original researcher, Dr. Bousfield (National Museum of Natural History), grouped and provided a cursory identification of ~1,500 *Leucothoe* specimens.

Epibenthic trawl samples were only taken at stations A–E and I–M and were the only stations where leucothoid amphipods were recorded. The assumptions of sufficient and balanced replication of sampling and homogeneity of variance were not met with this collection, which excluded use of ANOVA to test for assemblage differences between groups of samples (Clarke and Gorley, 2006).

Species composition and relative abundances at each collection station were analyzed for geographic distribution patterns on the basis of depth and bottom type. Bottom type as described in Joyce and Williams (1969) is designated here

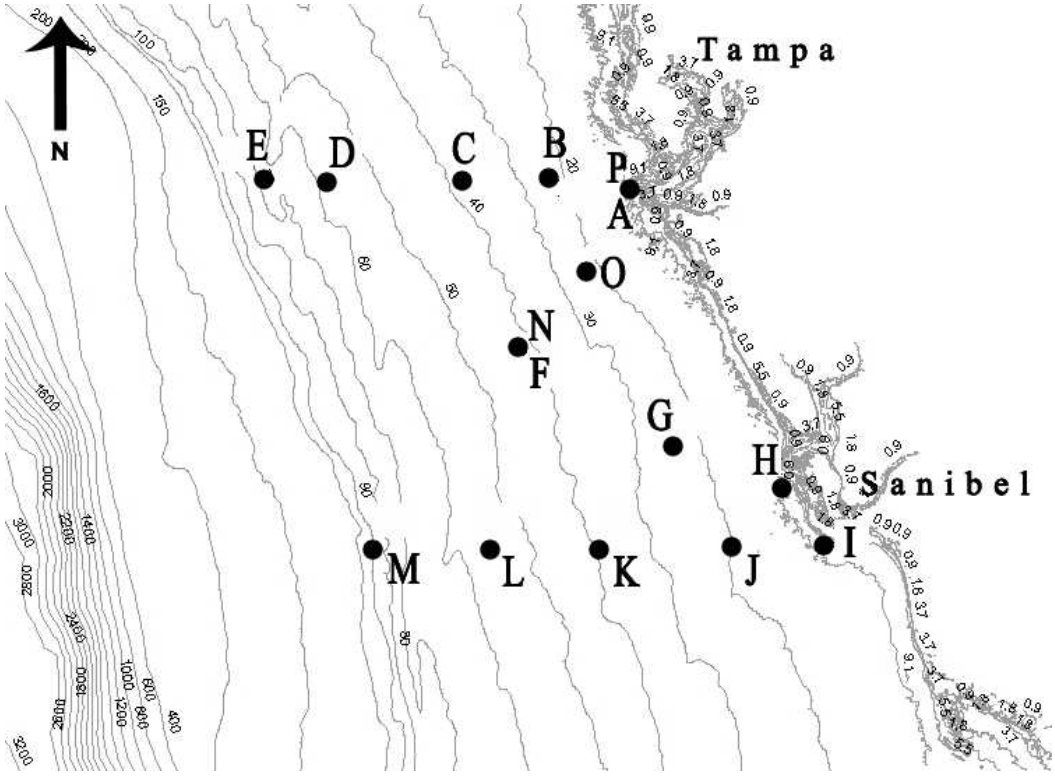

Fig. 1. Collection stations labeled A–P of the R/V *Hernan Cortez* (Hourglass) cruises, 1965, 1966, and 1967 (isobaths are labeled in meters).

as types I–IV. Type I consisted of quartz sand and crushed shell covered by a layer of brown silt, with limited to no hard substrate. Type II was comprised of abundant limestone outcroppings inhabited by numerous sponges, stony corals, and green algae. Type III consisted of less prominent limestone outcroppings inhabited by large sponges and brown algae, alternating with areas of crushed shell covered with fine calcareous silt. Type IV is described as having a smooth bottom consisting of crushed shell covered with fine brown silt and inhabited by numerous small sponges.

Simpson's Index of Diversity values (1-D) were calculated for each station and geographic information system charts, produced with ARCview 9.1 software, were created to illustrate the distribution of species across all stations (Table 1, Fig. 1). Taxonomic examination of specimens in this study concentrated on previously established diagnostic characteristics to identify to species. Leucothoid amphipods have minor yet distinct sexual dimorphism, with males being larger and possessing modified appendages that exhibit a greater number of characters, and are preferred for identification (Thomas, 1993b). Therefore, examination of specimens in this collection was limited to mature males whenever possible. Males, recognized by their penile processes and lack of oostegites, were separated from females and identified to species. A total of 481 male specimens were recorded in an abundance matrix according to species and collection station (Table 1). All taxonomic illustrations were prepared with a Wacom© Intus 3 digital tablet and Adobe Illustrator 3 software as described by Coleman (2003) from digital images captured on dissecting and compound microscopes.

Results.—Leucothoid amphipod species identified in the Hourglass cruise collection include *Leucothoe ashleyae* Thomas and Klebba, 2006, *Leucothoe kensleyi* Thomas and Klebba, 2006, *Leucothoe laurensi* Thomas and Ortiz, 1995, *Leucothoe urospinosa* Serejo, 1998, and *Leucothoe barana* Thomas and Klebba, 2007. An undescribed species is referred to herein as *Leucothoe* A. This collection documents a northern range expansion for each of these species (Table 2). Leucothoid amphipods were found to be most abundant at stations D, E, L, and M, with depths between 55 m and 75 m on the West Florida Shelf

TABLE 1. Abundance of leucothoids in the Hourglass cruise collection by species and sampling station. BT, (1-D) indicate bottom type and Simpson's Index of Diversity values for each station.

Station	BT	(1-D)	*Leucothoe* A (%)	*Leucothoe ashleyea* (%)	*Leucothoe barana* (%)	*Leucothoe kensleyi* (%)	*Leucothoe laurensi* (%)	*Leucothoe urispinosa* (%)
A	I	0.00	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
B	II	0.44	23 (70)	0 (0)	0 (0)	10 (30)	0 (0)	0 (0)
C	III	0.26	41 (85)	0 (0)	1 (2)	5 (10)	0 (0)	1 (2)
D	IV	0.33	75 (81)	0 (0)	2 (2)	10 (11)	4 (4)	1 (2)
E	IV	0.52	35 (54)	1 (2)	0 (0)	29 (45)	0 (0)	0 (0)
I	I	0.00	13 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
J	II	0.00	2 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
K	III	0.52	11 (48)	0 (0)	0 (0)	12 (52)	0 (0)	0 (0)
L	IV	0.55	55 (52)	0 (0)	2 (2)	45 (43)	0 (0)	3 (3)
M	IV	0.48	35 (36)	1 (1)	0 (0)	62 (63)	0 (0)	0 (0)
Total (%)			60.6	0.4	1.1	36.0	0.8	1.2

(Fig. 1). This depth corresponds to the sampling stations where the benthic substrate was recorded as type IV and grab samples contained numerous small sponges (Joyce and Williams, 1969).

The undescribed *Leucothoe* A was the most abundant species at 8 of 10 sampling stations (Table 1) and with the exception of station B, *Leucothoe* assemblage diversity was highest at those collection sites with depths greater than 35 m (Fig. 1).

Diagnosis: Leucothoe A (Fig. 2)

Gnathopod 1, propodus ventral margin finely serrate with seven to nine submarginal setae; gnathopod 2, carpus expanded distally, serrate; propodus, palm scalloped with three to four major projections at distal margin; mandibular palp, article 1, setae lacking; pereiopod 7, basis broad, posterior margin subquadrate; head, anterior margin rounded; mid-ventral keel; anteroventral margin convex.

Discussion.—The Hourglass cruises provided taxonomists, biologists, and ecologists with an extensive collection of marine fauna from a broad range of habitats across the western continental shelf of Florida. The volume of abundance and distribution data of marine flora and fauna generated from this extensive sampling effort resulted in an exponential leap forward in the understanding of the assemblages of fishes, invertebrates, and algae present in the northeastern Gulf of Mexico. Part of the motivation for this work was to avoid wasting the effort of the original Hourglass researchers by examining this carefully preserved collection of leucothoid amphipods. Additionally, the identification of the species present in this collection is an important contribution to the current understanding of leucothoid distribution. As with other species reported from the Hourglass cruise collection (Dawes and Breedveld, 1969; Serafy, 1979; Bullock and Smith, 1991), the documentation of *Leucothoe* A and the five previously described leucothoids in this collection is an extension of the northern range limit of each species (Table 2).

The significantly higher numbers of amphipods collected at stations D, E, L, and M may be indirectly correlated with the bottom type (IV), which seemed to be the preferred habitat for ''numerous small sponges'' that were only reported in high abundance at these locations. Although a direct association between these commensal amphipods and their specific hosts was not recorded at the time of collection, all leucothoid species found in this collection are known to inhabit various species of sponges (Thomas and Klebba, 2006, 2007; J.D. Thomas, personal communication; Serejo, 1998). Larger sponges were reported at those stations with

TABLE 2. Leucothoid amphipod species identified in the Hourglass collection and their previously known ranges.

Species	Previously known range
Leucothoe ashleyae	South Florida, Florida Keys, Belize, Roatan, Bahamas, Puerto Rico
Leucothoe barana	Belize, Florida Keys
Leucothoe kensleyi	South Florida, Florida Keys, Belize
Leucothoe laurensi	Brazil, Cuba, South Florida
Leucothoe urospinosa	Belize, Brazil, South Florida
Leucothoe A (yet to be described)	Belize, Florida Keys

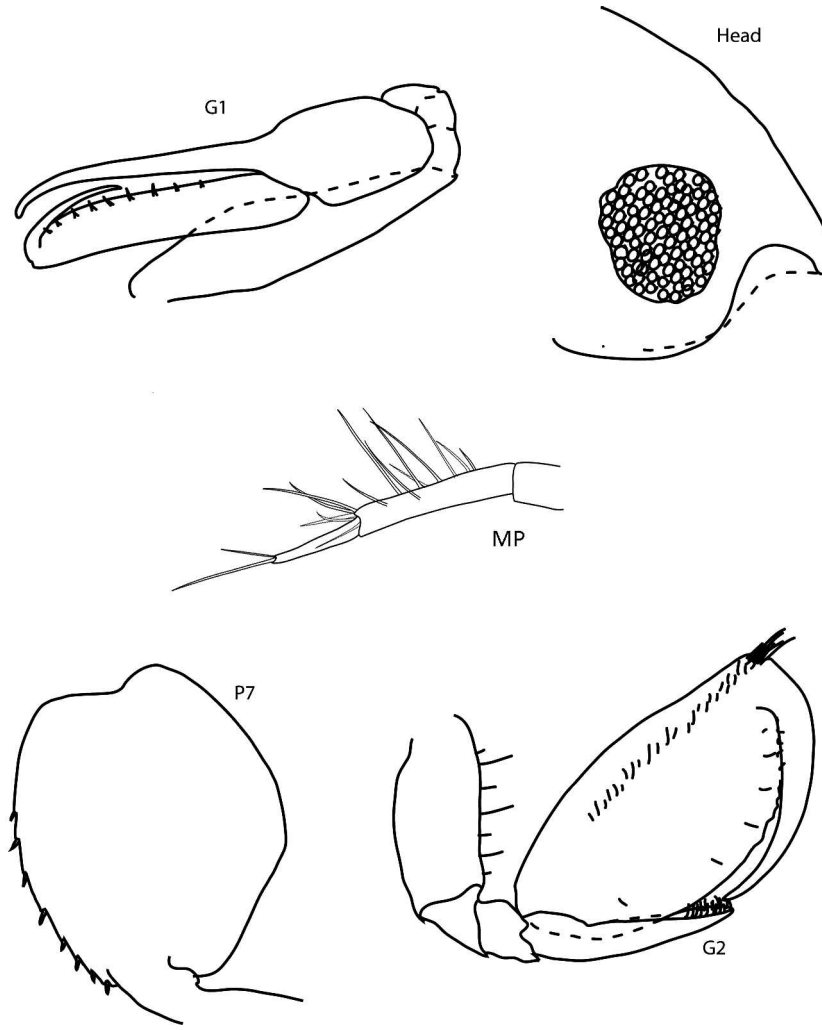

Fig. 2. Gnathopod 1 (G1); gnathopod 2 (G2); periopod 7 (P7); mandibular palp (MP).

bottom types II and III; however, numerous small sponges were only reported at those stations where leucothoid abundance was highest, which would indicate that at least some of the small sponges consisted of preferred host species.

The original Hourglass cruise researchers chose the north and south parallels for sampling stations (A–E and I–M) in part to test if community composition on the West Florida Shelf is affected more by latitude or by depth. As no discernable pattern in leucothoid assemblage composition corresponding to the north or south transect was evident (Fig. 1, Table 1), the distribution analysis presented here is consistent with biogeographic analysis of other taxa from the Hourglass cruises in that depth was more influential on community composition than latitude (Joyce and Williams, 1969; Lowry and Stoddart, 1997). Although there is no obvious pattern in leucothoid assemblage diversity, the Simpson's (1-D) values support the conclusion that habitat preference occurred between 35 and 90 m.

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