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NOTES ON BARNACLES (CIRRIPEDIA: THORACICA) FROM THE GULF OF MEXICO

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ABSTRACT Examination of several collections of barnacles from the northern and western Gulf of Mexico made over the last 30 years has improved our knowledge of the distributions of several taxa previously considered to be absent or rare in those regions. *Conchoderma auritum* (Linnaeus) and *Heteralepas* sp. aff. *cornuta* (Darwin) are recorded for the first time from the Gulf of Mexico. *Conchoderma auritum*, *Conchoderma virgatum* (Spengler), *Heteralepas cornuta* (Darwin), *Balanus trigonus* (Darwin), *Balanus venustus* Darwin, and *Balanus amphitrite amphitrite* Darwin have broad distributions outside the Gulf of Mexico. *Tetraclita stalactifera stalactifera* (Lamarck) is abundant in the intertidal zones of the southwestern Gulf, but rare elsewhere in the Gulf of Mexico outside the Florida Keys. Spatial segregation of *Octolasmis hoeki* (Stebbing) and *Octolasmis lowei* (Darwin) on a host crab is discussed.

INTRODUCTION

The purpose of this paper is to present information on the distribution of nine barnacle species in the Gulf of Mexico, based on an examination of the barnacles from regional museum collections. Two new records of barnacles for the Gulf of Mexico are presented: the lepadomorphs, *Conchoderma auritum* (Linnaeus), a pedunculate barnacle often attached to whales, and *Heteralepas* sp. aff. *cornuta* (Darwin). *Heteralepas cornuta* has been found attached to the stems of gorgonians and to other organisms below 90 m depth (Weisbord 1979). Species not previously known from the western Gulf of Mexico include *Conchoderma virgatum* (Spengler), a widely distributed, pelagic lepadomorph attached to various organisms and floating objects, *Tetraclita stalactifera stalactifera* (Lamarck), an intertidal balanomorph (often called "acorn" barnacles), and *Balanus trigonus* (Darwin), a subtidal balanomorph with a wide distribution. A review of the literature suggests that two intertidal and subtidal balanids documented herein from the northwestern Gulf, *Balanus amphitrite amphitrite* Darwin and *Balanus venustus* Darwin, may have been long overlooked or misidentified in the past. Finally, an examination of specimens of two crab-dwelling barnacles, *Octolasmis hoeki* (Stebbing) and *Octolasmis lowei* (Darwin), on *Calappa sulcata* Rathbun (Brachyura: Oxystomata) indicates the two species are spatially segregated on the body of this host.

The Gulf of Mexico is a semi-enclosed oceanic basin extending from approximately 18°N to 30°N and 81°W to 97°W on the western side of the Atlantic Ocean. Water enters the Gulf through the Yucatan Channel (176 km wide) and exits through the Florida Straits (144 km wide). The Loop Current, which directs this flow, is restricted to the eastern Gulf. The northward extent of the Loop Current varies considerably, typically ranging further north during the summer (Ichiye et al. 1973; Figure 1).

There are several important differences that distinguish the western Gulf of Mexico from the eastern Gulf. First, with respect to circulation, the tropical waters of the Loop Current influence the western Gulf of Mexico much less than they do the Gulf east of the Mississippi River delta. Second, though the continental shelves off Florida and the Yucatan peninsula consist of carbonate sediments, the shelf in the northwestern Gulf consists of terrigenous sediments, which results in much higher turbidity (Rezak et al. 1983; Figure 1). Third, the influence of winter cold fronts on nearshore surface water temperature is most pronounced in the northwestern portion of the Gulf of Mexico (Rezak et al. 1983). Nearshore surface temperatures off Louisiana may be as low as 6°C for short periods in winter. Fourth, salinity in these same waters is strongly influenced by variability in the Mississippi/Atchafalaya discharge system and other rivers draining into the northwestern Gulf (Rezak et al. 1983). Most of the Mississippi River discharge flows west along the coast of Louisiana (Figure 1). Thus, the hydrography of the western Gulf of Mexico is very different from that of the eastern Gulf, especially in the northwestern region, where terrigenous sediments and highly variable salinity and temperature regimes predominate. Of the nine species discussed herein, *Tetraclita stalactifera stalactifera*, *Balanus trigonus* and *B. a. amphitrite* show regional differences in distribution and abundance that appear to be related to the above parameters.

Few barnacle collections made in the western Gulf of Mexico had been analyzed until recently. This was, in part, due to the lack of cirriped specialists in the region. Additionally, the lack of natural hard substrates has limited the number of cirriped collections in the northwestern Gulf of Mexico. It has been only in the last several decades that man-made hard substrates (e.g., jetties, oil rigs) have allowed the development of any substantial intertidal and subtidal fouling communities. Comparisons of present day biofouling community species composition with that from two to three decades ago suggest the region is still undergoing successional changes (Gunter and Geyer 1955, George and Thomas 1979).

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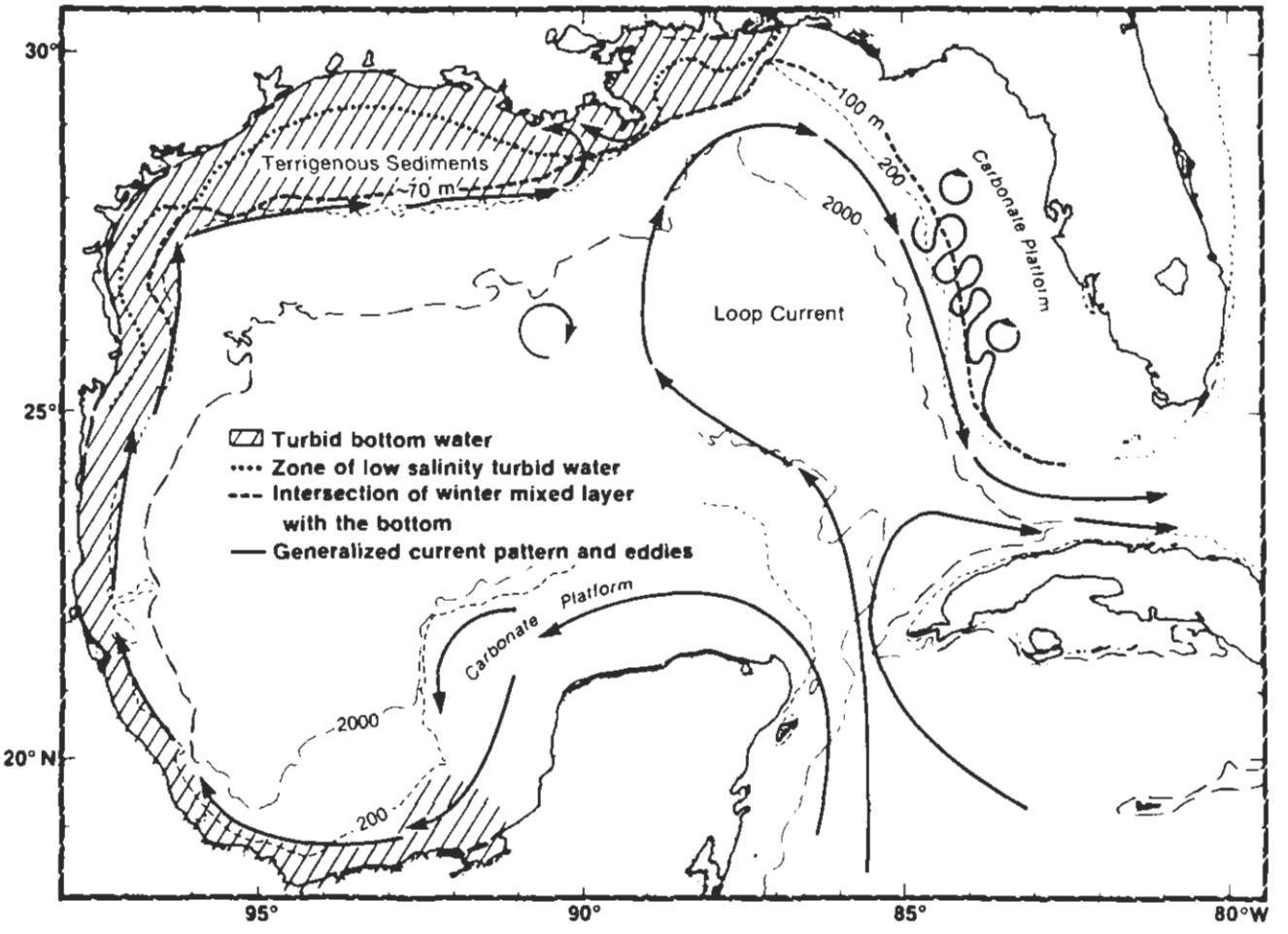

Figure 1. Map of the Gulf of Mexico summarizing circulation patterns, continental shelf bottom types, and turbid water regions. Arrows representing Loop Current show range of variability in flow pattern. Nearshore circulation patterns are not illustrated. Spin-off eddies represent mechanisms for dispersal of tropical organisms to continental shelf regions in both the eastern and western Gulf of Mexico. (Modified, with permission, from Rezak et al. 1983).

Most other collections from the western Gulf of Mexico included either deep-sea species or those epizooic on organisms collected for other studies. These collections include primarily trawl samples made by the M/V OREGON (1961–1968), the R/V OREGON II (1967–1977), the R/V ALAMINOS (1963–1973), and the R/V GYRE (1974 to present).

Spivey (1981) summarized the available information on the zoogeography of the Cirripedia of the Gulf of Mexico and provided a list of species occurring in the region. Based in part on the relatively low endemism of cirripeds (14%) and other invertebrate groups, and the wide overlap of temperate and tropical species, he determined that the Gulf of Mexico is a transition zone between tropical and warm temperate shelf faunas.

Abbreviations for collections reported herein are as follows: CCSU - personal collection of Dr. J. W. Tunnell, College of Science and Technology, Corpus Christi State University, 6300 Ocean Drive, Corpus Christi, Texas 78412; GCRL - Gulf Coast Research Laboratory, Ocean Springs, Mississippi 39564; TAMU - Texas A&M University Systematics Collection, Dept. of Oceanography, College Station, Texas 77843; TAIU - Texas A&I University, Biology Dept., Kingsville, Texas 78363; UTMSI - University of Texas Marine Science Institute, Port Aransas, Texas 78373.

SYSTEMATICS

Order THORACICA Darwin, 1854

Suborder LEPADOMORPHA Pilsbry, 1916

Family LEPADIDAE Darwin, 1851

Conchoderma auritum (Linnaeus, 1767)

Gulf of Mexico – GCRL77:1075: from plastic band on head of dusky shark, *Carcharinus obscurus* (Lesueur); about 16 km south of Pensacola, Florida; 21 July 1977; coll. T. Mattis; det. W. A. Newman.

Remarks – This record represents the only account of this species in the Gulf of Mexico. This occurrence was first presented, without collection data, by Overstreet (1978). Zullo (1979) considered *C. auritum* to be a cosmopolitan species, often found attached to whale barnacles and, occasionally, to ships. This species has also been found attached to the teeth, baleen, palate, and penis of whales (Dr. H. R. Spivey, Florida State University at Tallahassee, pers. comm.). The nearest record to the Gulf of Mexico is from Cape Hatteras, North Carolina, on an iron buoy (Weisbord 1979).

***Conchoderma virgatum* (Spengler, 1790)**

Northwest Gulf of Mexico – Attached to gray triggerfish, *Balistes capriscus* Gmelim, found in sediment trap; south of Mobil oil platform (lease block HI-389), near East Flower Garden Bank, 27°54′N, 93°36′W; 5 February 1983; coll. L. S. Baggett.

Remarks – Published records (Wells 1966, Pequegnat and Pequegnat 1968, Dawson 1969) and unpublished records (GCRL68:811, GCRL72:1055) suggest that this species is common in the eastern Gulf of Mexico on floating objects and various marine organisms (also see Spivey 1981). *Conchoderma virgatum* is a cosmopolitan species found attached to ships, buoys, fish, parasitic copepods, etc. (Zullo 1979). Its occurrence off the northwestern Gulf coast, therefore, is not surprising.

Family HETERALEPADIDAE Nilsson-Cantell, 1921

***Heteralepas* sp. aff. *cornuta* (Darwin, 1851)**
(Figure 2a)

Gulf of Mexico – GCRL67:750: 20 specimens on antipatharian; 29°15′N, 88°11′30″W, Offshore project Station 6; 92 m; 15 March 1967; coll. R/V GULF RESEARCHER.

Remarks – Dr. Victor Zullo (University of North Carolina at Wilmington, pers. comm.) found *H. cornuta* in the mid-1960's to be abundant on settling plates (several hundred individuals) from off Fort Lauderdale, Florida. Elsewhere in waters adjacent to the Gulf of Mexico, the species is known from off Cape Lookout, North Carolina (91 m depth, Ross 1964). It has also been found at several locations in the eastern Atlantic (Weisbord 1979), in the Indian Ocean (Nilsson-Cantell 1938), and at one location in the eastern Pacific (Ross 1975). Ross (1975), however, suggested that those reported from the Indian Ocean may be referable to *H. japonica* (Aurivillius), a closely related species. Collection depths range from 90 m to 4315 m. The above record represents the only report of this genus and species from the Gulf.

The specimens examined differ somewhat from *H. cornuta,* described originally by Darwin (1851) from St. Vincents, West Indies, and from those examined by Ross (1975) from the eastern Pacific, in the number of segments comprising the rami of the 5th and 6th cirri and the caudal appendages. The posterior (rudimentary) rami of the Gulf of Mexico specimens have between 8 and 11 segments and the anterior rami have 42–46 segments. Caudal appendages contain 6 segments. For this species, Darwin indicated between 11 and 13 segments for the posterior rami, although a ramus of 8 segments is illustrated (his Plate X, Figure 28), 63 segments for the anterior rami of the 6th cirri and 8 for the caudal appendages. Ross (1975) indicated 12 to 15 segments for the posterior rami, 52 to 53 segments for the anterior rami, and 9 segments for the caudal appendages. Without comparisons to other material, I chose not to assign the present specimens to *H. cornuta.* It is, however, likely that segment number varies in *H. cornuta,* based on comparisons of descriptions by Darwin (1851), Broch (1927) and Ross (1975). Segment number is known to vary considerably in a closely related and better known species, *H. japonica* (Aurivillius 1894, Foster 1978).

Family POECILASMATIDAE Nilsson-Cantell, 1921

***Octolasmis hoeki* (Stebbing, 1895)**
(Figure 2b)

***Octolasmis lowei* (Darwin, 1851)**
(Figure 2c)

Synonymy of local occurrence for Octolasmis lowei:

Octolasmis mulleri (Coker): Pilsbry 1907, pp. 95–96, fig. 32c; Pearse 1952, p. 238; Hulings 1961, p. 216.

Western Gulf of Mexico – *O. hoeki:* TAMU-2-6487: 12 on epipods of 3rd maxillipeds of *Calappa sulcata* Rathbun; 28°19′N, 95°23.8′W; 38 m; 4 June 1971; coll. R. M. Darnell.

– *O. hoeki:* TAMU-2-6489: 19 on epipods of 3rd maxillipeds of *Calappa sulcata,* with *Octolasmis lowei;* 23°58.4′N, 97°29.5′W; 37 m; 24 September 1971; coll. R. M. Darnell.

– *O. lowei:* TAMU-2-6488: 23 inside gill chamber of *Calappa sulcata;* 28°40.7′N, 94°47.7′W; 22–27 m, 7 July 1972; coll. W. E. Pequegnat.

– *O. lowei:* TAMU-2-6490: inside gill chamber of *Calappa sulcata,* with *Octolasmis hoeki;* 23°58.4′N, 97°29.5′W; 37 m; 24 September 1971; coll. R. M. Darnell.

Remarks – *Octolasmis lowei* is known to occur in the gill chambers of several crab species (Pilsbry 1907, Pearse 1952, Wells 1966, Jeffries et al. 1984) and is considered to be a cosmopolitan species (Causey 1961). It has not, however, been reported from the eastern Pacific (Weisbord 1979). *Octolasmis hoeki,* a tropical to north temperate Atlantic species (Spivey 1981), has been found "on the subbranchial region of *Calappa flammea*" (Hulings 1961) and on the mouthparts of palinurids (Stebbing 1895, Gruvel 1905). Wells (1966) incorrectly paraphrased Hulings (1961), saying *O. hoeki* was found "in" the branchial chamber of *C. flammea.* Co-occurrence of these species on the same host has been noted by Causey (1961). I have found both species on several large specimens of *C. sulcata* from the

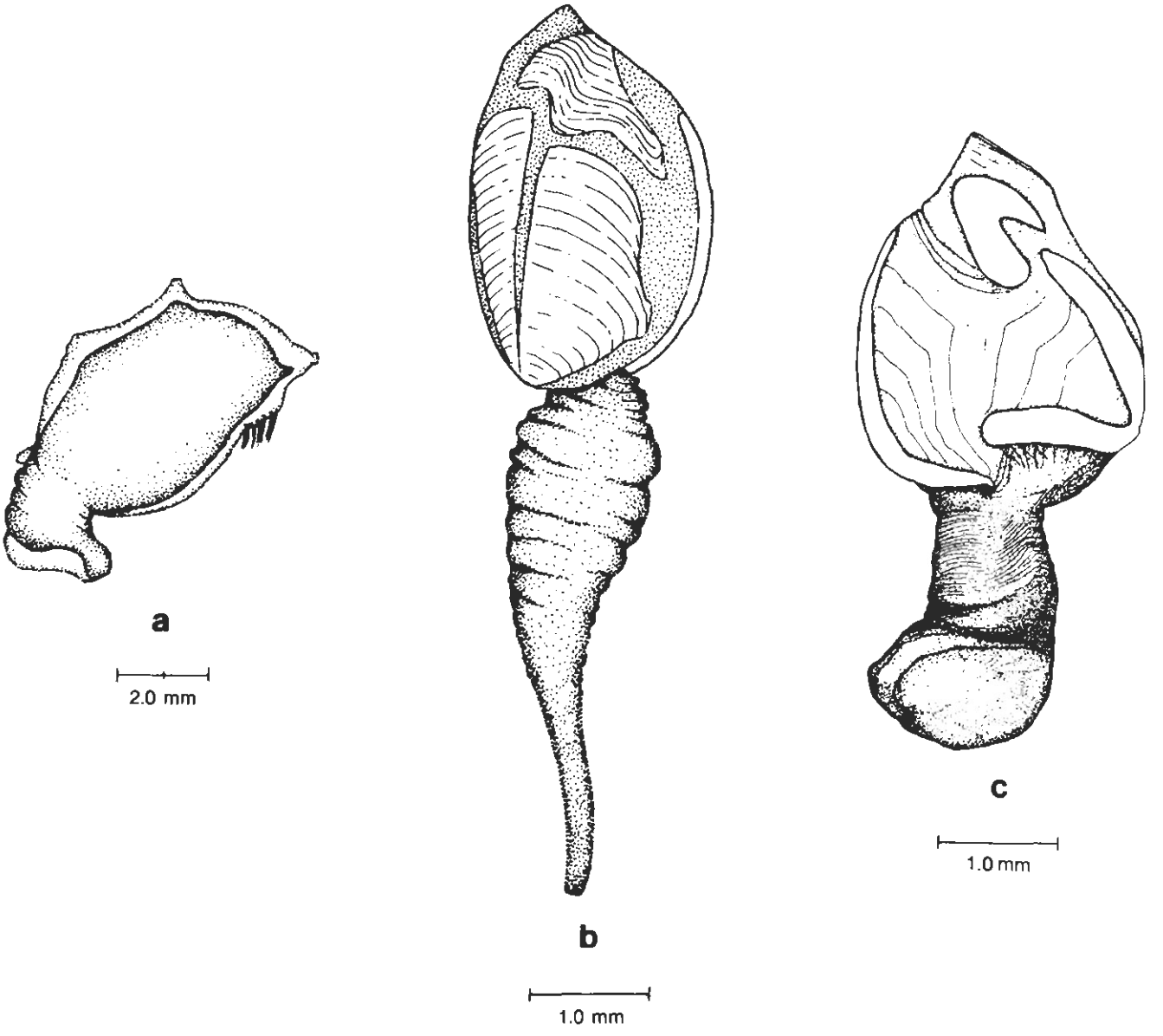

Figure 2. Lateral views of: (a) *Heteralepas* sp. aff. *cornuta* (Darwin); (b) *Octolasmis hoeki* (Stebbing); (c) *Octolasmis lowei* (Darwin).

western Gulf of Mexico. Data from one crab are given above (TAMU-2-6489 and TAMU-2-6490). Never were both species found to occur together on the same body region of a crab. There is a clear spatial segregation between *O. lowei* within the branchial chambers of *C. sulcata* (on the gills and in the gill chambers) and *O. hoeki* outside the chambers (on the mouthparts, the carapace near the gills, and on the exoskeleton of the first walking legs near the branchial chamber). These spatial preferences are evident even in cases where only one species is present.

Suborder BALANOMORPHA Pilsbry, 1916

Family TETRACLITIDAE Gruvel, 1903

***Tetraclita stalactifera stalactifera* (Lamarck, 1818)**

Synonymy of local occurrence:

Tetraclita squamosa stalactifera Lamarck: Stephenson and Stephenson 1950, p. 388; Henry, 1954, p. 444.

Western Gulf of Mexico – UTMSI: 1 individual from jetty, Tuxpan, Mexico, 21°00′N, 97°15′W; intertidal, with *Chthamalus fragilis* Darwin; 24 December 1954; coll. H. H. Hildebrand.

– UTMSI: from Boca Andrea, Veracruz, Mexico, 19°15′N, 96°08′W; no date; coll. H. H. Hildebrand.

– CCSU: 6 individuals; Isla de Lobos, Mexico, 21°27′N, 97°15′W; station I-7-4; 7 June 1973; coll. J. W. Tunnell.

– CCSU: 1 individual; Isla de Lobos, Mexico, 21°27′N, 97°15′W; windward reef, south side, *Acropora* zone, 1.5 to 4.5 m; station 76-14-1; 14 June 1976; coll. J. W. Tunnell.

– CCSU: 13 individuals; Isla de Lobos, 21°27′N, 97°15′W; *Acropora* zone, west of boulder ridge on leeward

side of island, 1 to 3 m; station 76-14-2; 14 June 1976; coll. J. W. Tunnell.

– TAMU, uncataloged: 4 individuals, the largest 3.5 cm carino-rostral length, with *Balanus reticulatus* Utinomi and *Megabalanus antillensis* (Pilsbry); Mobil oil platform (lease block HI-389), 2 km southeast of East Flower Garden Bank, 27°54′N, 93°36′W; near surface; 26 March 1984, R/V GYRE cruise 84-G-3; coll. G. D. Dennis.

Remarks – *Tetraclita stalactifera stalactifera* is found intertidally in the western Atlantic from Florida to Brazil (Southward 1975). Newman and Ross (1976) also list the species from Bermuda, the Gulf of California south to Acapulco, Mexico, the Arabian Sea, and South Africa.

These are the only records of this species in the Gulf of Mexico outside the Florida Keys (see Stephenson and Stephenson 1950, Henry 1954), and the Yucatan peninsula (Spivey, pers. comm.), and support, in general, Southward's (1975) conclusion that the distribution of *T. s. stalactifera* is intertidal in relatively clear waters. This species has not been found on any natural or man-made structures in the turbid nearshore waters of the northern Gulf of Mexico. It is apparently common in Mexican waters north to at least Cabo Rojo. It is not known from north of Cabo Rojo in the Gulf, except from the oil platform near the East Flower Garden Bank, approximately 177 km SSE of Galveston, Texas. The water near this shelf-edge bank is very clear and temperatures are always above 18°C. In the southwestern Gulf, *T. s. stalactifera* has been found attached to both artificial and natural substrates, including the dead portions of storm-tossed *Acropora palmata* (Lamarck) branches and coral heads on the crests of coral reefs (Dr. J. W. Tunnell, Corpus Christi State University, pers. comm.).

Family BALANIDAE Leach, 1817

Balanus trigonus Darwin, 1854

Northwest Gulf of Mexico – TAMU, uncataloged: on plastic recruitment floats; 10 km south of Holly Beach, Louisiana; settled between June and August 1982 and September to October 1983 (Gittings 1984 and unpublished data, respectively), with *Balanus reticulatus, B. improvisus* Darwin and *B. eburneus* Gould; 8–10 m; coll. S. R. Gittings.

– UTMSI: 22 live, 9 dead, on *Busycon,* 17 live, 5 dead, on another *Busycon,* in trawl; Redfish Bay, near Port Aransas, Texas; 3 m; 22 April 1984; coll. R. D. Kalke.

– TAMU, uncataloged: on *Crassostrea virginica* (Gmelin), with *B. eburneus;* Aransas Bay, Texas, near causeway from Port Aransas to Aransas Pass; salinity 31 ppt; 27°C; 0.6 m; 21 September 1984; coll. S. R. Gittings.

– TAMU, uncataloged: abundant on seaward end of rock jetty, subtidal to 6 m depth, with *Megabalanus antillensis, Chthamalus fragilis,* and *Balanus amphitrite amphitrite;* also on gorgonians; Port Mansfield, Texas; 13 August 1984; coll. S. R. Gittings.

– TAMU, uncataloged: on bay scallop, *Argopecten irradians* (Lamarck); Laguna Madre, Texas, near spoil island just south of Mansfield Channel; 0.5 m; 13 August 1984; coll. S. R. Gittings.

– TAMU, uncataloged: on terra cotta recruitment plates and PVC support structure 1 m above live coral reef (Mr. L. S. Baggett, Texas A&M University, pers. comm.), settled 1982–1983; East Flower Garden Bank (27°54′N, 93°36′W); 21 m; coll. L. S. Baggett.

Remarks – Is is surprising that *B. trigonus* has not been reported until now from the western Gulf of Mexico, since it is cosmopolitan in warm seas and its distribution, for the most part, is natural (i.e., unaltered by man's activities; Newman and Ross 1976). I have found it to be quite abundant and widespread in both turbid and clear waters off Texas and Louisiana, although it is seldom a principal fouler of stationary structures. Perhaps, as suggested by Wells (1966), *B. trigonus* has within the last several decades been extending its range. Hedgpeth (in Whitten et al. 1950) thought "*B. amphitrite niveus* . . . is probably the species seen covering rocks below the *Chthamalus fragilis* zone at the end of the [Port Aransas, Texas] jetty" (p. 76). The balanid material of Whitten et al., although not available for study, may be referable to *B. trigonus,* which I have seen occupying an identical position on the Port Mansfield (Texas) jetty.

The distribution of *B. trigonus* in Texas bays may be limited by high water temperatures during the summer. Ritz and Foster (1968) found that cirral activity for *B. trigonus* living in an area with a temperature range of 11–21°C increased to a temperature optimum of 27°C, with cessation of activity at 31°C. In Texas bays, summer water temperatures may exceed 32°C.

Balanus amphitrite amphitrite Darwin, 1854

Northwest Gulf of Mexico – CCSU: Corpus Christi Bay, Texas, north beach under harbor bridge; with *Balanus eburneus;* salinity 27 ppt; 16°C; 7 February 1980; coll. J. W. Tunnell.

– TAMU, uncataloged: 3 on Scotch Bonnet shell, *Phalium granulatum* (Born), with *Balanus eburneus;* Redfish Bay, Texas; <1 m depth; February 1984; coll. T. J. Bright.

– TAMU, uncataloged: 6 live, 30 dead, from public boat ramp; Port Mansfield, Texas, mainland side of Laguna Madre; intertidal; 24 February 1984; coll. T. J. Bright.

– UTMSI: abundant on samples of serpulid reef from Baffin Bay, Texas; approximately 1 m depth; no date.

– TAMU, uncataloged: 11 live, 5 dead, on oysters, *Crassostrea virginica;* Redfish Bay, Texas, oyster reef near causeway from Port Aransas to Aransas Pass, Texas; with *Balanus reticulatus* (dead) and *Balanus eburneus;* 23 March 1985; coll. M. K. Wicksten.

Remarks – *Balanus amphitrite amphitrite* has a cosmopolitan distribution in warm seas (Newman and Ross 1976). The occurrence of this species intertidally on pilings and rocks at Corpus Christi Bay Beach, Corpus Christi, Texas,

was noted in 1971 by Spivey (pers. comm.). Wells (1966) and Henry and McLaughlin (1975) reported its presence to the east, off Panama City, Florida, and to the south, off Veracruz, Mexico, but cited no localities in the northwestern Gulf of Mexico. Though Hedgpeth (in Whitten et al. 1950) reported *B. a. niveus* from the Port Aransas, Texas, jetties, and Gunter and Geyer (1955) reported *B. amphitrite* from platforms off Texas and Louisiana, it is not clear whether their specimens were *B. a. amphitrite, B. reticulatus, B. venustus* (with which *B. a. niveus* was later synonymized; Harding 1962), or, perhaps, even *B. trigonus,* as discussed previously.

Thomas (1975) suggested that *B. a. niveus* reported by Whitten et al. (1950) was *B. venustus.* Though *B. venustus* occurs in the western Gulf of Mexico, it is not common, and it is doubtful that it occurs at any time on jetties in abundances seen by Whitten et al. (1950). *Balanus trigonus* is the only species I have seen to occur in abundances reported by Whitten et al. (1950) on the ends of (south) Texas coast jetties.

Analysis of recent collections suggests that *B. a. amphitrite* is a common species, though not in high abundance, on man-made structures in shallow south Texas bays. It is less frequently observed in the more northern bays. Personal collections have not confirmed *B. a. amphitrite* on any offshore oil structures or artificial settling substrates in the northwestern Gulf of Mexico. These are occupied predominantly by *B. reticulatus* nearshore in the northern Gulf (Thomas 1975) and by *Megabalanus antillensis, B. trigonus,* and *B. reticulatus* on offshore and south Texas structures.

Balanus venustus Darwin, 1854

Northwest Gulf of Mexico – TAIU: approximately 24 on shell dredged from 7½ Fathom Reef, 26°51′N, 97°18′W, north of Port Mansfield, Texas; 27 July 1973.

– TAMU, uncataloged: about 25 on moon snail, *Polinices duplicatus* (Say); in Laguna Madre, Texas, near Mansfield Channel marker 15, 26°33.5′N, 97°20′W; salinity 42 ppt; 29.5°C; 13 August 1984; coll. S. R. Gittings.

– TAMU, uncataloged: numerous, on oysters attached to dead gorgonian (*Leptogorgia*?); north side of north jetty at Mansfield cut, Texas; salinity 35 ppt; 29.5°C; 13 August 1984; coll. T. J. Bright.

Remarks – Henry and McLaughlin (1975) documented *B. venustus* from Heald Bank, off Texas (approximately 29°04′N, 94°17′W), the only published record of the species west of Panama City, Florida, and north of Campeche Bay, Mexico. This species is represented in a collection returned by the R/V ALAMINOS from 22 m at location 28°41′N, 94°48′W, according to Spivey (pers. comm.).

Balanus venustus occurs in the eastern Atlantic, the tropical to north temperate western Atlantic, and the Indo-Pacific (Spivey 1981). It occurs in highest abundances on mollusc shells rather than on artificial surfaces. A notable exception was that reported by Pequegnat and Pequegnat (1968), who found it to occur in abundance on plastic fouling recruitment floats off Panama City, Florida. Aside from the report by Hedgpeth (in Whitten et al. 1950) of *B. amphitrite niveus* seen (but not examined) on the Port Aransas (Texas) jetties (discussed earlier in the sections on *B. trigonus* and *B. a. amphitrite*), no unquestioned reports exist for *B. venustus* on artificial substrates in the northwestern Gulf of Mexico.

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