The shallow-water barnacles (Cirripedia, Balanomorpha) of Bahía de La Paz, Baja California Sur, México, including seven previously unrecorded species and amended descriptions of three species

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Abstract

Characters of the opercular and parietal calcareous plates are commonly used in formulating barnacle descriptions and discussing their taxonomy. However, in some groups these characters have created taxonomic confusion due to a high level of intraspecific variability. We redescribe the shallow-water balanomorph barnacles from Bahía de La Paz in Mexico for which the original descriptions were incomplete or did not include the arthropodal parts. The descriptions present here are based on classical characters derived from calcareous plates (external features) as well as internal characters derived from flexible cuticular body parts such the cirri and parts of the oral cone. The latter character set proved helpful in resolving taxonomic confusion among some of the barnacle species studied. Detailed redescriptions of three species from three genera are presented, along with remarks on their distribution ranges.

Key words: Gulf of California, acorn barnacles, checklist, taxonomy, Thoracica.

Introduction

Balanomorph barnacles are some of the most common invertebrates on rocky shores; the external features (opercular and parietal plates) have been used in almost all taxonomic studies to date and are helpful for the identification of many common species (Newman and Ross, 1976; McLaughlin, 1980). Since Darwin (1854), published descriptions of barnacle species have placed more emphasis on the external calcareous morphology than on detailed description of the arthropodal characters. As a result, the flexible cuticular characters (cirri and mouthparts) of many species have not been

adequately described in the past. This arthropodal morphology provides an excellent means of resolving problems arising from incongruent or ambiguous hard-part designations. The oral cone (mandibles, first and second maxilla, palpi, and labrum) and cirral structures have, in fact, been used in studies on the systematics and phylogeny of many barnacle taxa (Newman and Ross, 1976; Poltaruhka, 1997; Southward and Newman, 2003). This is a continuous process. Descriptions are frequently expanded, hitherto the unrecognized characters thus come to light, and this in turn exposes the need for more complete and/or more detailed descriptions of

the species in question as well as other species.

There have been twelve taxonomic studies of barnacles in the Gulf of California, only three including samples from the western shore (Pilsbry, 1916; Henry, 1960; Steinbeck and Rickets, 1941). Most studies have described new species from particular localities (Zullo, 1961; 1967; Henry and McLaughlin, 1967; Hedgecock, 1979; Laguna, 1990; Van Syoc, 1988, 1992; Van Syoc and Winther, 1999). Since Ross (1962), no one has recorded any new samples from the Gulf of California; published checklists have been based on material contained in various museums or bibliographic compilations (Young and Ross, 2000; Pitombo and Ross, 2002).

In this study we present a checklist of the shallow-water barnacle species found at 18 stations in Bahía de La Paz (Fig. 1) in 1998 and 1999, with diagnoses and descriptions of the species for which the original descriptions were incomplete or in some other way inadequate.

All the specimens are deposited in the Universidad Autónoma de Baja California Sur, Biología Marina, La Paz, B.C.S., México.

Fig. 1 Study area and stations. A, Baja California peninsula. B, Bahía de La Paz. C, Isla Espíritu Santo-La Partida. Numbers and names of stations: 1, Balandra; 2, Pichilingue; 3, Muelle fiscal; 4, Estero Zacatecas; 5, Calerita; 6, La Gallina; 7, El Gallo; 8, La Ballena; 9, Los Islotes; 10, El Embudo; 11, El Cardoncito; 12, El Meztlé; 13, El Candelero; 14, El Morro; 15, El Erizoso; 16, Punta la Raza; 17, Bahía San Gabriel.

Key to shallow-water species of barnacles from Bahía de La Paz

1. Shell with six parietal plates2
- 1'. Shell with four parietal plates (with more than three rows of tubes)*Tetraclita confinis*
2. Rostrum with two ala fused below the lateral plates, mandible with four teeth (Family Chthamalidae) 3
- 2'. Rostrum with radii overlapping the lateral plates (Family Balanidae)4
3. Opercular plates of one side greater than those of the other side, first maxilla without notch in the setose margin*Chthamalus anisopoma*
- 3'. Opercular plates of same size (right and left), first maxilla with a prominent notch in the setose margin.*Chthamalus fissus*
4. Parietes with solid radii5
- 4'. Parietes with tubiferous radii (Subfamily Megabalaninae)9
5. Scutum with a conspicuous adductor ridge (Subfamily Amphibalaninae)6
- 5'. Scutum with a weak adductor ridge (Subfamily Balaninae)8
6. Parietes with broad radii and one row of internal tubes without transverse septa, labrum multidenticulate*Amphibalanus amphitrite*
- 6'. Parietes with narrow radii and one row of internal tubes with transverse septa, labrum simple7
7. Scutum with adductor ridge long and close to articular ridge, cirrus III with complex setae*Amphibalanus inexpectatus*
- 7'. Scutum with adductor muscle ridge short and separated from articular ridge, cirrus III without complex setae*Amphibalanus reticulatus*
8. Parietes ribbed, purple-reddish in color, scutum with one or several rows of pits, cirrus III with a series of prominent spines on anterior margin*Balanus trigonus*
- 8'. Parietes smooth, dark pink in color with white spots, scutum without pits, cirrus III with conical teeth on anterior margin*Balanus poecilus*
9. Parietes rugose with or without tiny spines, reddish or pink in color but radii purple, tergum without crest of depressor muscle*Megabalanus peninsularis*
- 9'. Parietes smooth or finely ribbed, deep red or pink in color, tergum with crest of depressor muscle well developed*Megabalanus coccopoma*

Systematics

Subclass Cirripedia Burmeister, 1834

Superorder Thoracica Darwin, 1854

Order Sessilia Lamarck, 1818

Suborder Balanomorpha Pilsbry, 1916

Family Chthamalidae Darwin, 1854

Subfamily Chthamalinae Darwin, 1854

Genus *Chthamalus* Ranzani, 1817

Chthamalus anisopoma Pilsbry, 1916

(Fig. 2A-I)

Chthamalus anisopoma — Ross, 1962: 8.

Material Examined. Stn 1, 2 specimens UABCS 00225. Stn 2, 4 specimens UABCS 00159. Stn 4, 10 specimens UABCS 00017. Stn 5, 2 specimens UABCS 00402. Stn 6, 5 specimens UABCS 00050. Stn 7, 2 specimens UABCS 00083. Stn 8, 3 specimens UABCS 00112. Stn 10, 2 specimens UABCS 00151. Stn 11, 2 specimens UABCS 00119. Stn 12, 2 specimens UABCS 00086. Stn 13, 2 specimens UABCS 00142. Stn 16, 2 specimens UABCS 00117. Stn 17, 8 specimens UABCS 00198.

Distribution. Gulf of California.

Diagnosis

Shell conical, depressed. Opercular valves asymmetrical, tergum and scutum of one side smaller than contralateral plates. First maxilla with deep notch below first two spines. No conical spines on cirrus I. Cirrus II with basal guards on serrate setae. Penis with basal point.

Description

Parietals (Fig. 2A, C). Shell conical, depressed, with solid plates; rostrum overlapped by adjacent plates; radii narrow; parietal plates undulated. Basis membranous, shell covered with thin, dark-yellow cuticle.

Opercular valves (Fig. 2D, E). Asymmetrical size of opercular valves a principal diagnostic feature of this species, tergum and scutum of one side being bigger than their contralateral partners (either left or right may be bigger). Scutum triangular (higher than wide), growth lines covering 1/3 of valve; articular ridge prominent, depressor and adductor muscle pits oval, shallow. Tergum irregular in form, spur indistinguishable or not. Depressor muscle crests showing ontogenetic variability in each plate: larger, older

Fig. 2 *Chthamalus anisopoma*. A, apical view; B, lateral view of the bent morph, restricted to the northern part of the Gulf (from Lively, 1986); C, lateral view of the conic morph (from Lively, 1986); D, scutum (right) and tergum (left) of the right side; E, tergum (right) and scutum (left) of the left side; F, labrum; G, mandible; H, maxilla I; I, denticulate setae with basal guards of cirrus II. Scale bars: A, 2 mm; B-C, 2.5 mm; D-E, 1 mm; F-H, 150 μ m; I, 70 μ m.

specimens with a few prominent crests, but smaller, younger specimens with numerous small crests. Transverse suture of valves strongly curved, but not in small specimens. In younger, smaller specimens, both pairs of opercular valves alike in size, the main diagnostic character of the species thus not being present in small specimens.

Labrum (Fig. 2F). Very broad with U-shaped cutting edge, lacking notch. Crests with angular ends; either lacking teeth (only covered with small setae) or possessing 9-14 teeth on each side.

Mandibles (Fig. 2G). With four teeth, first prominent, second and third medium-sized, last one small and bifid, followed by row of tiny spines. Posterior angle with prominent spine; inferior margin with long setae covering 2/3 of margin. Below teeth, short setae covering half of mandible.

Maxilla I (Fig. 2H). Upper angle with two prominent spines, followed by deep notch and 10 spines. Inferior angle with 10 or 12 stout setae. Upper and inferior margins with long setae.

Cirri. Cirri I and II with rami unequal in length, posterior ramus being two segments longer than anterior ramus; distal segments with serrate setae with basal guards (Fig. 2I), proximal segment with simple and pectinate setae. Cirrus III generally with rami equal in length, but in some specimens anterior ramus one or two articles longer than posterior ramus. Cirri IV to VI with rami equal in length, distal margins of segments with conical teeth, anterior margin densely covered with stout setae.

Remarks

This species is considered as endemic to Baja California. Pilsbry (1916) described it from Bahía San Luis Gonzaga in the Gulf of California, but the original description was incomplete. Pilsbry described the mandible and maxilla as resembling those of *Chthamalus stellatus*, and the cirri were poorly described.

According to Lively (1986) and Lively *et al.* (2000), *Chthamalus anisopoma* presents two phenotypes, the typical volcano-shaped one that is the most common morph throughout the Gulf of California (Fig. 2A, C) and "bent" morph (Fig. 2B), with a bend in its lateral plates, which is restricted to the northern part of the Gulf. These morphs show the plasticity of the shell as a result of the predator-induced stress (Lively *et al.*, 2000).

This species was recorded from Bahía de La Paz by Steinbeck and Ricketts (1941) and Henry (1943) on the coast of Isla Espíritu Santo attached to *Ostrea mexicana* and rocks. We found specimens in the splash and high intertidal zones, on red mangrove roots (*Rhizophora mangle*), solitarily or in dense aggregations on rocks, on clams, oysters and barnacles including *Megabalanus peninsularis*, *M. coccopoma*, *Balanus trigonus*, *Amphibalanus apmhitrite*, and *Tetraclita confinis*.

Chthamalus fissus Darwin, 1854

(Fig. 3A-C)

Chthamalus fissus Ross, 1962: 36.

Material Examined. Stn 1, 2 specimens UABCS 00181. Stn 4, 5 specimens UABCS 00032. Stn. 5, 2 specimens UABCS 00405. Stn 8, 4 specimens UABCS 00204. Stn. 12, 2 specimens UABCS 00090. Stn 13, 2 specimens UABCS 00140. Stn 15, 2 specimens UABCS 00163. Stn 17, 3 specimens UABCS 00132.

Fig. 3 *Chthamalus fissus*. A, apical view; B, scutum; C, tergum. Scale bars: A, 2 mm; B-C, 1 mm.

Distribution. San Francisco, California, to Bahía de La Paz (Table 1).

Diagnosis

Shell conical, with narrow radii. Labrum with small teeth but lacking setae. First maxilla without notch below second spine. Cirrus II with complex setae with basal guards. Penis without basal point.

Remarks

We found the barnacles attached to rocks, in high densities like a carpet together with *Chthamalus anisopoma*, and also attached to red mangrove roots (*Rhizophora mangle*), oysters, and barnacles (*Megabalanus peninsularis*, *M. coccopoma*, and *Amphibalanus reticulatus*).

Darwin (1854) described *Chthamalus fissus* while emphasizing the difficulty of distinguishing among the species of this genus. Later, Pilsbry (1916) described *C. anisopoma* based on the external characteristics of the plates; he indicated that the unique difference between *C. fissus* and *C. anisopoma* is the unequal size of the opercular plates in *C. anisopoma*, one pair being two or more times bigger than the contralateral plates. However, we observed that barnacles of 3 mm in diameter or less do not display such a size difference, in agreement with Henry's (1943) observations that young barnacles of *C. anisopoma* (1.5 mm in diameter) have smooth parietes and the right and left terga and scuta are similar in shape and size. Henry (1942, 1943) described the mouth parts and cirri of *C. fissus* and suggested that *C. anisopoma* is more closely related to *C. panamensis* than to *C. fissus*. By examining the internal

Table 1. Distribution ranges of the balanomorph barnacles newly recorded herein from the west coast of the Gulf of California.

Species	Distribution in the Eastern Pacific (Young & Ross, 2000; Pitombo & Ross, 2002)	References for the Gulf of California
<i>Chthamalus fissus</i>	San Francisco to Cabo San Lucas	Henry (1943, 1960), Ross (1962), Southward & Newman (1977), Laguna (1990)
<i>Tetraclita confinis</i>	Gulf of California to Acapulco, México	Pilsbry (1916), Henry (1943, 1960), Southward & Newman (1977), Laguna (1990)
<i>Amphibalanus amphitrite</i>	Warm and temperate waters worldwide	Henry (1960), Ross (1962), Henry & McLaughlin (1975), Laguna (1990)
<i>Amphibalanus reticulatus</i>	Gulf of California to Ecuador	Laguna (1990)
<i>Balanus poecilus</i>	Gulf of California, Panama, Colombia, and Ecuador	Henry (1960), Laguna (1985)
<i>Balanus trigonus</i>	Cosmopolitan in warm waters	Pilsbry (1916), Steinbeck & Ricketts (1941), Henry & McLaughlin (1975), Laguna (1990)
<i>Megabalanus peninsularis</i>	Cabo San Lucas to Colombia	Pilsbry (1916), Steinbeck & Ricketts (1941), Henry (1960), Henry & McLaughlin (1986), Laguna (1990)
<i>Megabalanus coccopoma</i>	Mazatlán to Perú	Pilsbry (1916), Southward & Newman (1977), Henry & McLaughlin (1986), Laguna (1990), Zullo (1991)

structures (cirri and oral cone) we were able to find an additional difference in the first maxilla. That of *C. anisopoma* has a deep notch on the spinose margin, in contrast to that of *C. fissus*, which has a straight margin. Apparently, other anatomical structures do not present any stable difference between *C. fissus* and *C. anisopoma* especially in smaller, younger specimens; furthermore, in Bahía de La Paz both species are found together at the same time and place (splash and intertidal zones). We can not discard the possibility that the difference in size of the opercular plates between larger specimens of these two species is merely a matter of morphological or ontogenetic variation. It is necessary to conduct genetic and morphometric studies in order to clarify this problem.

Family Tetraclitidae Gruvel, 1903
 Subfamily Tetraclitinae Gruvel, 1903
 Genus *Tetraclita* Schumacher, 1817
Tetraclita confinis (Pilsbry, 1916)

(Fig. 4A-I)

Tetraclita squamosa stalactifera forma *confinis* Pilsbry, 1916: 255. Henry, 1941: 105; 1943: 369; 1960: 143. Ross, 1962: 34.

Tetraclita stalactifera confinis —Newman and Ross, 1976: 48. Southward and Newman, 1977: 411. Dungan, 1985: 166. Laguna, 1985: 64.

Fig. 4 *Tetraclita confinis*. A, apical view; B, inner view of the parietes; C, scutum; D, tergum; E, labrum; F, mandible; G, maxilla I; H, left cirrus VI; I, serrate setae of cirrus III. Scale bars: A, 1 cm; B, 5.6 mm; C-D, 3 mm; E-G, 100 μ m; H, 3mm; I, 136 μ m.

Material Examined. Stn 5, 4 specimens UABCS 00565. Stn 6, 3 specimens UABCS 00040. Stn 8, 9 specimens UABCS 00100. Stn 10, 2 specimens UABCS 00150. Stn 11, 1 specimen UABCS 00116. Stn 13, 2 specimens UABCS 00139. Stn 15, 2 specimens UABCS 00161.

Distribution. Acapulco to the Gulf of California (Table 1).

Diagnosis.

Shell internally with more than two rows of tubes. Scutum with numerous muscle crests. Tergum with narrow apex. Labrum with two or three teeth on each crest. Cirrus II with unequal rami, distal segments with pectinate and serrated setae.

Description.

Parietals (Fig. 4A, B). Shell wall four-plated, well fused so neither radii or alae distinguishable. Wall with several rows of tubes, rounded. Coloration olive or dark gray, basis membranous.

Opercular Valves (Fig. 4C, D). Opercular orifice small. Scutum dark gray to purple, ocludent margin toothed. Adductor ridge prominent, extending to near base of elongate articular ridge, muscle crests numerous and small. Clusters of small spines present above adductor muscle pit. Tergum with strong transverse growth lines, narrow apex, and prominent depressor muscle crests. Distance between spur and basiscutal margin 1/3 of spur width. Spur broad, triangular, with scutal margin curved.

Labrum (Fig. 4E). Notch poorly developed, expressed as slight curve between crests. Crests straight, covered with short setae, and with or without three or four teeth on each crest.

Mandibles (Fig. 4F). With four teeth, first prominent, fourth bifid with short spines on both sides of its margin, followed by row of nine to 10 tiny spines. Inferior angle with one or two prominent spines. Upper margin covered by short setae. Posterior margin lined with large setae along half its length.

Maxilla I (Fig. 4G). Superior angle with two prominent spines followed by a deep notch, then eight to 12 long spines. Inferior angle with two or four prominent spines. Upper and lower margins lined with stout setae along 1/4 of their length.

Cirri (Fig. 4H, I). Cirri I, II, and III with rami unequal in length, anterior ramus longer than posterior one. Anterior ramus of cirrus I with four more segments than

posterior ramus, all segments covered with long setae on both margins. Cirrus II with segments of longer, anterior ramus covered by long setae, distal segments with pectinate and serrate setae. Cirrus III with three to five long setae on anterior margin of each segment; distal segments densely covered with serrate setae. Cirri IV, V, and VI with rami equal in length, with two stout setae on anterior margin of typical segment, disto-distal margin with an erect spine, and posterior margin covered with stout setae.

Remarks.

This taxon was described by Pilsbry (1916), who determined the taxonomic status as an infrasubspecific "forma" or local race in the Gulf. Records of Henry (1943, 1960) and Ross (1962) demonstrated that its range extends farther southeast to Acapulco. The arthropodal parts of *Tetracilita confinis* have never been figured or adequately described. In this study we found characters such as the presence of three to four teeth on each crest of the labrum and two to six accessory teeth on the fourth tooth of the mandible to be useful in the determination of species. The original description was based on two specimens collected at Saint George Island (northern part of the Gulf), and the description only explained a few differences between *T. stalactifera* forma *floridiana* and *T. stalactifera* forma *confinis*. Nevertheless, while reviewing the organisms we found some features of the parietal plates that did not agree with the original description of Pilsbry (1916). He wrote that these plates are completely fused and covered by ribs; but actually, some do not have fully fused plates and possess radii and alae. In addition, rather than ribs, they have well-defined striae. These kind of variation have not been mentioned by previous workers (Henry, 1941, 1943, 1960; Ross, 1962, 1969), and the intraspecific variation they represent further confuses the diagnosis of this species. *Tetracilita stalactifera* was recordered by Steinbeck and Ricketts (1941) and Henry (1943) from the northern Gulf of California. Differences between *T. stalactifera* (according to Ross, 1968 and Celis, 2003) and *T. confinis* include that the tergum is narrower in *T. confinis* and the spur in *T. stalactifera* projects only a very short distance below the basicutal angle. Also, the mandible in *T. stalactifera* has five teeth and cirrus II has simple setae, while *T. confinis* has four teeth in the mandible and complex setae on cirrus II. Since, Darwin (1854), several authors (e.g.,

Pilsbry, 1916; Ross, 1968) have mentioned the great variability present in the varieties or subspecies of *T. stalactifera*. Careful examination of the types of *Tetracilita stalactifera* and samples from the Atlantic and Pacific populations is a necessary prelude to further taxonomic clarification.

Family Balanidae Leach, 1817

Subfamily Amphibalaninae Pitombo, 2004

***Amphibalanus amphitrite* (Darwin, 1854)**

Balanus amphitrite var. *amphitrite* Darwin, 1854: 240.

Balanus amphitrite var. *comunis* Darwin, 1854: 240.

Balanus amphitrite comunis — Nilsson-Cantell, 1921: 311.

Balanus amphitrite forma *hawaiiensis* Broch, 1922: 314.

Balanus amphitrite var. *denticulata* Broch, 1927: 133.

Balanus amphitrite hawaiiensis — Hiro, 1937: 432;

1938: 304. Nilsson-Cantell, 1938: 40. Henry, 1958: 223; 1960: 142. Ross, 1962: 12. Utinomi, 1964: 52.

Balanus amphitrite cochinchinensis Nilsson-Cantell, 1938: 43.

Balanus amphitrite var. *fulminensis* Oliveira, 1941: 21.

Balanus amphitrite var. *aeratus* Oliveira, 1941: 22.

Balanus amphitrite herzi Rogers, 1949: 8.

Balanus amphitrite franciscanus Rogers, 1949: 9.

Balanus amphitrite denticulata — Henry, 1959: 192.

Balanus amphitrite amphitrite — Harding, 1962: 274.

Zullo, 1963: 8. Stubbings, 1967: 271. Utinomi, 1967: 200; 1970: 355. Henry and McLaughlin, 1975: 30.

Newman, 1976: 415. Newman and Ross, 1976: 62.

Balanus amphitrite — Laguna, 1990: 409. Young and Ross, 2000: 234. Pitombo and Ross, 2002: 101.

Material Examined. Stn 4, 9 specimens UABCS 00001. Stn 9, 2 specimens UABCS 00168. Stn 17, 2 specimens UABCS 00129.

Distribution. Worldwide in temperate waters.

Diagnosis

Parietals smooth with one row of tubes with or without transverse septa. Depressor muscle furrow small, deep, in some specimens inconspicuous. Labrum multidenticulate. Cirrus III without complex setae.

Remarks.

We found all our specimens from the intertidal zone to 40 m deep. They were either attached on red mangrove bark and roots, embedded in gorgonians (*Muricea* sp. and *Lophogorgia* spp.) at 40 m deep, or on

inanimate substrata.

***Amphibalanus inexpectatus* (Pilsbry, 1916)**

Balanus amphitrite inexpectatus — Pilsbry, 1916: 97.

Steinbeck and Ricketts, 1941: 431. Henry, 1942: 126; 1943: 368; 1959: 192; 1960: 142. Ross, 1962: 6.

Balanus inexpectatus — Henry and McLaughlin, 1975: 180. Southward and Newman, 1977: 411. Young and Ross, 2000: 235. Pitombo and Ross, 2002: 101.

Material Examined. Stn 1, 2 specimens UABCS 00179. Stn 4, 7 specimens UABCS 00004. Stn 17, 1 specimen UABCS 00128.

Distribution. Gulf of California to Ecuador.

Diagnosis

Shell smooth with one row of tubes with transverse septa. Tergum with prominent depressor muscle crests. Labrum simple. Cirrus III with complex setae on distal segments.

Remarks

This species was recorded by Steinbeck and Ricketts (1941) from Bahía de La Paz attached to mangrove roots in the Mogote area. We found it in the intertidal zone on red mangrove bark and roots (*Rhizophora mangle*), on barnacles such as *Amphibalanus amphitrite*, and on rocks and other inanimate substrata.

***Amphibalanus reticulatus* (Utinomi, 1967)**

Balanus amphitrite var. *comunis* Darwin, 1854: 240. Stubbings, 1963: 14.

Balanus reticulatus Utinomi, 1967: 216; 1970: 356. Henry and McLaughlin, 1975: 88. Laguna, 1990: 409. Young and Ross, 2000: 235. Pitombo and Ross, 2002: 101.

Material Examined. Stn 2, 2 specimens UABCS 00153. Stn 17, 1 specimen UABCS 00214.

Distribution. Southern part of the Gulf of California (Table 1) to Ecuador.

Diagnosis

Shell conical, white with violet or purple stripes. Parietals with one row of tubes with transverse septa. Depressor crests prominent. Labrum simple. Cirrus II with conical teeth on anterior margin.

Remarks

We found this species attached to rocks and the barnacle *Megabalanus peninsularis* in the intertidal zone.

Genus *Balanus* Da Costa, 1778

***Balanus trigonus* Darwin, 1854**

Balanus trigonus Darwin, 1854: 223. Pilsbry, 1916: 111. Baker, 1967: 47.

Material Examined. Stn 2, 2 specimens UABCS 00157. Stn 5, 1 specimen UABCS 00410. Stn 6, 2 specimens UABCS 00049. Stn 7, 2 specimens UABCS 00075. Stn 8, 6 specimens UABCS 00096. Stn 9, 3 specimens UABCS 00172. Stn 12, 2 specimens UABCS 00093. Stn 14, 16. Stn 17, 2 specimens UABCS 00125.

Distribution. Worldwide in temperate waters (Table 1).

Diagnosis

Shell ribbed, purple-reddish in color. Scutum with one to six longitudinal rows of pits. Labrum simple. Cirrus III with series of prominent spines on anterior margin.

Remarks

We found this species attached to inanimate substrata, stony corals (*Pocillopora* sp.), gorgonians (*Muricea* sp.), and barnacles such as like *Megabalanus peninsularis* and *M. coccopoma*. It lives from the intertidal to 20 m deep.

***Balanus poecilus* Darwin, 1854**

Balanus poecilus — Henry, 1960: 142.

Material Examined. Stn 9, 3 specimens UABCS 00168.

Distribution. Gulf of California (Table 1), Panama, Colombia, and Ecuador.

Diagnosis

Shell boat-shaped, faintly pink with purple to pink stripes. Labrum simple, with three teeth on each crest. Mandible with five teeth, the last one bifid. Cirrus III with conical teeth on anterior margin.

Remarks.

We found these specimens embedded in gorgonians *Lophogorgia* spp. at 20 m depth. Elsewhere it has been recorded as subtidal living from 15m to 40m deep.

Subfamily Megabalaninae Newman, 1979

Genus *Megabalanus* Hoek, 1913

***Megabalanus peninsularis* (Pilsbry, 1916)**

(Fig. 5A-F)

Balanus tintinnabulum peninsularis Pilsbry, 1916: 66. Henry, 1941: 102; 1942: 120; 1960: 146. Ross, 1962: 6.

Fig. 5 *Megabalanus peninsularis*. A, apical view; B, labrum; C, mandible; D, maxilla I; E, cirrus VI; F, median segments of cirrus VI; Scale bars: A, 1.2 cm; B-C, 1 mm; D, F, 190 μ m; E, 3 mm; G, 130 μ m.

Material Examined. Stn 5, 2 specimens UABCS 00406. Stn 6, 10 specimens UABCS 00043. Stn 7, 12 specimens UABCS 00065. Stn 8, 6 specimens UABCS 00103. Stn 9, 3 specimens UABCS 00164. Stn 10, 3 specimens UABCS 00147. Stn 11, 3 specimens UABCS 00118. Stn 12, 8 specimens UABCS 00084. Stn 13, 3 specimens UABCS 00136. Stn 15, 2 specimens UABCS 00160. Stn 16, 3 specimens UABCS 00174. Stn 17, 6 specimens UABCS 00120.

Distribution. Bahía de La Paz (Gulf of California) to Colombia (Table 1).

Diagnosis

Shell ribbed with or without tiny spines, reddish or pink in color. Tergum with closed furrow, long spur. Labrum usually with two or three teeth on each crest, but sometimes unarmed. Cirrus II with stout and serrate setae. Cirri III with single row of spines on disto-distal margin.

Description

Parietals (Fig. 5A). Shell conical to cylindrical, basis porous, parietals smooth, sometimes ribbed with or without tiny spines covering all the plates. Radii broad, porous. Coloration usually light purple to pink with white radii, but some specimens white with dark radii.

Opercular valves. Opercular orifice triangular or

pentagonal. Scutum with strong growth lines, adductor ridge conspicuous but never confluent with articular ridge, depressor muscle furrow broad, and deep, adductor muscle pit indistinguishable. Tergum triangular with fine longitudinal striae, closed furrow, and long spur, distance between basiscutal margin and spur short (as wide as spur). Depressor muscle crests faint, present only in specimens with basal diameter of more than 3 cm.

Labrum (Fig. 5B). Notch narrow, deep, with variable number of teeth on each crest, maximum three and minimum one; however, some specimens lacking teeth. Outer surface covered with fine, short setae.

Mandibles (Fig. 5C). Usually with five prominent teeth, fifth fused with inferior angle, but exceptional specimens with four or six teeth. Upper and inferior margins lined with long setae (1/4 of total margin).

Maxilla I (Fig. 5D). With 12 to 14 long spines, first ones prominent, these followed by row of medium size spines. Both margins lined by short setae (1/4 of total margin).

Cirri (Fig. 5E, F). Cirrus I with rami unequal in length, anterior ramus longer than posterior. Both margins of segments densely covered by short setae. In cirrus II, anterior ramus five to seven segments longer than posterior ramus; segments wider than long, lateral margins lined by stout and serrate setae. Anterior ramus of cirrus III with 12 to 14 segments, posterior ramus with eight to 10 segments; both margins densely covered by short setae, disto-distal margin with single row of conical spines, and distal segments densely lined by serrate setae. Cirri IV, V, and VI, with rami equal in length, segments wider than long, posterior margin of each segment with erect spines, distal margin with series of conical spines.

Remarks

We found the specimens attached to inanimate substrata and stony coral (*Pocillopora* sp.), from the intertidal to 5 m deep.

This species was synonymised by Henry and McLaughlin (1986) with *Megabalanus galapaganus* (Pilsbry, 1916); nevertheless, exhaustive examination of the collected specimens has made it clear that the morphology of this species is unstable throughout its range of distribution. A revisionary study of this species as well as *M. galapaganus* is necessary to define their taxonomic status. Intraspecific variation in

balanomorphs had been documented for some genera, such as *Megabalanus*, in which Henry and McLaughlin (1986) mention intraspecific variation in external morphology, consisting of different color patterns and unstable morphology of the parietal plates.

The specimens of *M. peninsularis* collected in Bahía de la Paz present four types of morphological variation related to 1) the parietal plates, 2) the presence or absence of spines covering all the parietal plates, ranging from the opercular orifice to the base, and 3) color patterns ranging from clear pink to purple, with whitish lines. Furthermore, we found certain variations of internal characters (cirri and oral cone): e.g., number of teeth on the labrum, presence or absence of a bifid tooth in the mandibles, number of spines on the first maxilla, and presence or absence of stout setae on the cirri. These sorts of variation have not been mentioned in any previous work, a fact which again suggests the need for a clarifying revision of the morphologic characters of this species.

Megabalanus coccopoma (Darwin, 1854)

Balanus tintinnabulum var. *coccopoma* Darwin, 1854: 196.

Balanus tintinnabulum coccopoma Pilsbry, 1916: 68. Henry, 1942: 120. Ross, 1962: 6.

Material Examined. Stn 2, 6 specimens UABCS 00206. Stn 3, 2 specimens UABCS 00155. Stn 7, 5 specimens UABCS 00076. Stn 17, 3 specimen UABCS 00238.

Distribution. Bahía de la Paz, Gulf of California to Perú. Rare in California (Table 1).

Diagnosis

Shell globose to conical, color pink to red. Parietes with one row of tubes with incomplete septa. Tergal depressor crests prominent and numerous. Labrum naked or with one to three teeth on each crest. Cirri III with small spines on anterior margin. Cirri VI with four spines on postero-distal angle.

Remarks

According to Henry (1942), the shell is usually deep red, but several color patterns have been described (pale pink, dark pink, or deep red) (Darwin, 1854; Ross, 1962), and we found some specimens displaying a pinkish-purple coloration. Furthermore, some variations in the labrum was found. Henry (1942) described the labrum as having no teeth, but among the specimens we

examined, most present a range of one to three teeth on each crest. Darwin (1854) mentioned that the *Balanus tintinnabulum* group is one of the most variable groups of barnacles. Because they attached so frequently to ships' hulls, it may be that their extreme tendency to vary is caused by their exposure to varying and site-specific conditions.

There is evidence of the presence of this species at higher latitudes after climatic events such as "El Niño" (Newman and McConnaughey, 1987). The Gulf of California is characterized by warmer waters than the Eastern Pacific *per se* (Roden, 1964; Álvarez-Borrego, 1983), which explains the presence of this species in the southern part of the Baja California peninsula, attached to inanimate substrata, stony corals (*Pocillopora* sp. and *Porites* sp.), barnacles (*Megabalanus peninsularis*), and oysters from the intertidal to 3 m deep.

Comments on Distribution

Barnacles have been studied for more than a century, but still present many taxonomic problems and controversies. This stems primarily from lack of clarity in original descriptions and also from a lack of diagnostic characters that would allow a more precise identification of the organisms.

Seven of the species listed herein are new records for the west coast of the Gulf of California (Table 1). *Chthamalus fissus* and *Megabalanus peninsularis* extend their range from that published by Pitombo and Ross (2002) as limited to Cabo San Lucas in Baja California. *M. coccopoma* had been registered only in Mazatlán (Ross, 1962; Pitombo and Ross, 2002). While the subfamily Balaninae is known to be distributed throughout the Eastern Pacific, including the east coast of the Gulf of California (Laguna, 1985), the record of *Amphibalanus reticulatus* constitutes a new record for the Gulf's west coast.

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