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An annotated checklist of the shallow water Cirripedia of Guam

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Abstract—Twenty-four species of barnacles are recorded from Guam and two additional species from neighboring Saipan in the Mariana Islands. Shore barnacles (12 species) and coral barnacles (9 species) dominate the known fauna. Numerous species remain to be documented, especially subtidally.

Introduction

The barnacle fauna of the Mariana Islands in general or Guam in particular, has not been the focus of any one study, although several species have been reported from this area (Hiro 1937; Smyth 1986, Foster & Newman 1987, Foster 1990, Southward et al. 1998, Asami & Yamaguchi 2001). Nearby island groups, such as Palau (Hiro 1937, 1938, 1939a, Newman & Ross 1977, Ogawa 2000) and Chuuk (Newman 1960, 1972, Newman & Ross 1977), have fared poorly or slightly better.

The annotated list that follows contains only 26 species, including 3 acrothoracicans, 12 shore barnacles, 9 coral barnacles, and 2 other species from the fore reef. Only one pedunculate is listed; the balance is largely balanomorphs. A relatively large proportion of the recorded fauna is comprised of coral-inhabiting barnacles, as a result of two recent visits focusing on the group by Kiyo Asami (Asami & Yamaguchi 2001). Pyrgomatids however have relatively low diversity on Guam. Although additional species certainly remain to be recorded, relatively few species of corals are infested, and no coral-eating barnacles are known (Ross & Newman 1995, Ross 2000). Foster & Newman (1987) and Foster (1990) previously recorded 7 species of shore barnacles, 6 of these collected at Ypao Point incidentally on *Euraphia hembeli*. Even with nearly

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twice as many species now known from intertidal habitats, this assemblage remains poorly studied, and additional species likely remain to be discovered. The three acrothoracicans listed were all collected during a study on bioerosion of gastropod shells (Smyth 1986, 1989, 1990); additional, as yet unidentified species occur in corals and probably other substrata. Other than the pyrgomatids, the barnacle fauna of the fore reef and deeper waters remains poorly collected and studied. Only two species (*Tetrapachylasma ornatum* and *Conopea folliculus*) are here recorded, although several others have been collected and are awaiting study. Thus the species here recorded represent but a modest fraction of the cirriped fauna of the Mariana Islands. Four of the species known from the area were described from the Marianas.

There is an extensive body of literature on the Cirripedia. During the past 25 years or so there have been numerous studies on morphology, systematics and ecology, the most recent general reviews being those of Newman & Ross (1976), Anderson (1994) and Newman (1996). More specialized reviews by Barnes include egg production (1989), reproduction (1992) and mortality (1999) whereas cirral activity patterns were reviewed by Anderson & Southward (1987), male morphology by Klepal (1987), and larval setation sequencing by Newman & Ross (2001). The checklist of Cirripedia for the western Pacific by Jones et al. (2000) is by far the most comprehensive, with 315 species belonging to 76 genera and 21 families having been cited, and their list is only complete probably through late 1997.

List of Species

The classification below follows Newman (1996). General comments and references about each genus and species are given first, followed by specific comments pertaining to the species on Guam. Documentation of each record is given in Table 1.

Subclass Cirripedia Burmeister, 1834
Superorder Acrothoracica Gruvel, 1905
Order Pygophora Berndt, 1907
Family Lithoglyptidae Aurivillius, 1882
Lithoglyptes Aurivillius, 1882
Lithoglyptes mitis Tomlinson, 1969

General: Tomlinson 1969, Smyth 1989, 1990, Kolbasov & Høeg 2000; boring in gastropods, bivalves, and corals.

This species is very common in both living and hermited gastropod shells on Guam, on reef flat as well as fore reef habitats. It and a much rarer, as yet unidentified lithoglyptid, have been recorded in shells of *Bursa, Cantharus, Cerithium, Chicoreus, Conus, Coralliophila, Drupa, Lambis, Latirus, Morula, Nassa, Purpura, Thais, Trochus, Turbo,* and *Vasum* on Guam (Smyth, 1990).

Table 1. Barnacles of Guam

Voucher: All records from Guam unless otherwise stated. Voucher specimens in: USNM: US National Museum of Natural History; UF: Florida Museum of Natural History, University of Florida, Gainesville; NSMT: National Science Museum, Tokyo; SIO: Scripps Institution of Oceanography.

Ref: references documenting occurrence on Guam or Saipan (S): 1) Foster 1990, 2) Southward et al. 1998, 3) Foster & Newman 1987, 4) Jones 2000, 5) B. Foster in litt., 6) Hiro 1937, 7) K. Asami pers. comm., 8) Asami & Yamaguchi 2001, 9) Smyth 1986, 10) Smyth 1989, 11) Smyth 1990.

Photo: Cited photographs by GP are housed at UF, are on the WWW at: http://www.flmnh.ufl.edu /reefs and also available on the Marine Biodiversity of Guam CD-ROM co-publication.

Taxon	Voucher	Ref	Photo
Lithotrya nicobarica Reinhardt 1850	SIO		
Verruca cookei Pilsbry 1928	USNM	1	
Chthamalus malayensis Pilsbry 1916	USNM, SIO	1	
Chthamalus proteus Dando & Southward 1980	UF 264, SIO	2	
Euraphia hembeli Conrad 1837	USNM	1, 3	
Pseudoeuraphia montgomeryi (Foster 1990)	Holotype: USNM 237820	1	
Nesochthamalus intertextus (Darwin 1854)	UF 222	3	
Tetrapachylasma ornatum Jones 2000	Holotype: YPM 9303 (Saipan); UF 480	4 (S)	
Balanus amphitrite Darwin 1854	UF 336		
Balanus eburneus Gould 1841	UF 223		
Tetraclitella divisa (Nilsson-Cantell 1921)	USNM	1	
Tesseropora pacifica Pilsbry 1928	USNM	1	GP420-21
Tesseropora sp. 1		5	
Conopea folliculus Hiro 1937		6	
Cantellius euspinulosum (Broch 1931)		7	
Cantellius pallidus (Broch 1931)		7 (S)	
Cantellius septimus (Hiro 1938)		7	
Savignium crenatum (Sowerby 1823)		7	
Trevathana orientale (Ren 1986)		7	GP270-37
Trevathana dentata (Darwin 1854)		8	GP263-2
Trevathana paulayi Asami & Yamaguchi 2001	Holotype: NSMT-Cr13681	8	GP263-6
Wanella milleporae (Darwin 1854)		7	GP263-9
Neotrevathana elongata (Hiro 1931)		7	
Cryptophialus coronophorus Smyth 1986	Holotype: USNM 222986	9, 10	
Cryptophialus cf. *zulloi* Tomlinson 1973		10, 11	
Lithoglyptes mitis Tomlinson 1969		10, 11	

Family Cryptophialidae Gerstaecher, 1866
Cryptophialus Darwin, 1854
Cryptophialus coronophorus Smyth, 1986

This species was described from Guam, and is common around the island on reef flats; it has also been collected on the offshore Pugua Patch Reef (Double Reef). It commonly bores into gastropod shells, including species of *Bursa, Cantharus, Cerithium, Chicoreus*, *Cymatium, Drupa, Lambis, Latirus, Morula,*

Thais, Trochus, *Turbo,* and *Vasum,* as well as into reef limestones (Smyth 1986, 1989, 1990).

Cryptophialus sp. cf. *C. zulloi* Tomlinson, 1973

General: Tomlinson 1973; boring in gastropods.

Common on Guam in reef flat habitats; also known from Pugua Patch Reef. On Guam this species has been encountered boring into shells of the gastropods *Bursa, Cantharus, Cellana, Cerithium, Chicoreus, Drupa, Morula, Purpura, Thais, Trochus, Turbo,* and *Vasum*, as well as into the reef matrix (Smyth 1989, 1990).

Superorder Thoracica Darwin, 1854
Order Pedunculata Lamarck, 1818
Family Lithotryidae Gruvel, 1905
Lithotrya Sowerby, 1822
Lithotrya nicobarica Reinhardt, 1850

General: Henry 1957, Rosell 1972, Dineen 1988, 1990; boring in calcareous substrates, dia. to 18 mm.

Lithotrya is a common borer in intertidal karst faces on Guam and is also common on the walls of surge channels that cut into the fore reef, to at least 5 m depth. In the latter habitat it feeds actively at night.

Order Sessilia Lamarck, 1818
Suborder Verrucomorpha Pilsbry, 1916
Family Verrucidae Darwin, 1854
Verruca Schumacher, 1817
Verruca cookei Pilsbry, 1928

General: see Henry 1957; intertidal, wall asymmetrical, dia. to 3 mm.

Recorded on *Euraphia hembeli* at Ypao Point on Guam (Foster 1990).

Suborder Balanomorpha Pilsbry, 1916
Superfamily Pachylasmatoidea Utinomi, 1968
Family Pachylasmatidae Utinomi, 1968
Subfamily Pachylasmatinae Utinomi, 1968
Tetrapachylasma Foster, 1988
Tetrapachylasma ornatum Jones, 2000

General: Foster 1988, Jones 2000.

Tetrapachylasma ornatum is a commensal of the coralline sponge *Astrosclera "willeyana"* (a species complex; see Wörheide et al. 2002), and gets partially covered by the aragonitic skeleton of the host in a manner reminiscent

of pyrgomatids. The host and barnacle are restricted to dim microhabitats on the fore reef such as caverns, crevices, and the undersides of large overhangs. Only a small proportion (<10%) of these sponges on Guam are infected. The species was recently described from similar habitats on neighboring Saipan.

Superfamily Chthamaloidea Darwin, 1854
Family Chthamalidae Darwin, 1854
Subfamily Euraphinae Newman & Ross, 1976
Euraphia Conrad, 1837
Euraphia hembeli Conrad, 1837

General: Newman 1961, Foster & Newman 1987; intertidal to subtidal in surge channels and caves, dia. to 75 mm.

Although this large barnacle is relatively common around much of the coast of Guam, it is rarely seen, because of its restriction to dark, cavernous areas of the reef front. It is especially common in areas exposed to strong wave action, from the low intertidal to a few meters depth.

Pseudoeuraphia Poltarukha, 2000
Pseudoeuraphia montgomeryi (Foster, 1990)

General: Foster 1990; wall vinaceous red, dia. to 2.8 mm.

Described from specimens collected on *Euraphia hembeli* in the intertidal zone of Ypao Point on Guam.

Subfamily Notochthamalinae Foster & Newman, 1987
Nesochthamalus Foster & Newman, 1987
Nesochthamalus intertextus Darwin, 1854

General: Pope 1965, Foster & Newman 1987; intertidal, interior of wall violet, dia. to 14 mm.

Relatively widespread around Guam, but not as common as *Chthamalus malayensis*.

Subfamily Chthamalinae Darwin, 1854
Chthamalus Ranzani, 1817
Chthamalus malayensis Pilsbry, 1916

General: Pope 1965, Southward et al. 1998; intertidal on rocks, mangrove roots, dia. to 17 mm.

This is the most common shore barnacle on Guam, although it is by no means ubiquitous around the island.

Chthamalus proteus Dando & Southward, 1980

General: Southward et al. 1998; intertidal on rocks and marine structures, introduced from Caribbean to Hawaii and Guam.

This Caribbean barnacle was first encountered on Guam in October 1997 by Yoshi Hisatsune. It was already common in Apra Harbor at that time, but not encountered at other locations on island. It was likely introduced to Guam via Hawaii.

Superfamily Tetraclitoidea Gruvel, 1903
Family Tetraclitidae Gruvel, 1903
Subfamily Tetraclitellinae Newman & Ross, 1976
Tetraclitella Hiro, 1939
Tetraclitella divisa (Nilsson-Cantell, 1921)

General: Hiro 1939b, Ross 1971, Foster 1974; low intertidal, in crevices and beneath overhangs; considered a circumtropical species but likely a species complex.

Common but inconspicuous in shaded, low intertidal habitats around Guam.

Subfamily Tetraclitinae Gruvel, 1903
Tesseropora Pilsbry, 1916
Tesseropora pacifica Pilsbry, 1928

General: Henry 1957, Newman & Ross 1977; intertidal, dia. to 40 mm.

These are the most conspicuous intertidal barnacles on Guam because of their large size, ribbing, and exposed habit. They are locally common on the outer parts of reef flats and benches.

Tesseropora sp. 1

General: Newman & Ross 1977, Jones 1993; intertidal, wall ribbed, dia. to about 7 mm.

A second, small species of *Tesseropora* was collected on Guam by Frost (in litt.) and has not been further studied.

Superfamily Balanoidea Leach, 1817
Family Archaeobalanidae Newman & Ross, 1976
Subfamily Archaeobalaninae Newman & Ross, 1976
Conopea Say, 1822
Conopea folliculus Hiro, 1937

Described from Saipan, Mariana Islands from an unidentified antipatharian (Hiro 1937); not recorded from Guam.

Family Pyrgomatidae Gray, 1825
Subfamily Pyrgomatinae Gray, 1825
Tribe Pyrgomatini Gray, 1825
Cantellius Ross & Newman, 1973
Cantellius euspinulosum (Broch, 1931)

General: Foster 1974, Anderson 1992; host corals *Goniopora*, *Madrepora* [=?*Acropora*], *Pachyseris*, *Pavona*, and *Porites*.

On Guam this species is found in *Porites* on the fore reef, at relatively low levels of infestation.

Cantellius pallidus (Broch, 1931)

General: Ross & Newman 1973, Foster 1982, Ren 1986; host corals *Montipora*, *Pavona*, *Pocillopora*, *Cyphastrea*, and *Merulina*.

Cantellius pallidus was collected John Starmer on Saipan, near the Grotto, on *Pocillopora* (K. Asami pers. comm.). The species has not been recorded on Guam to date.

Cantellius septimus (Hiro, 1938)

General: Hiro 1938, Ross & Newman 1973, Ren 1986, Anderson 1992; host coral *Montipora* spp.

Common in *Montipora verrucosa* on the fore reef on Guam.

Savignium Leach, 1825
Savignium crenatum (Sowerby, 1823)

General: Ross & Newman 1973; host coral *Goniastrea* spp.

Occasionally infests *Goniastrea pectinata* on Guam.

Trevathana Pilsbry, 1916
Trevathana dentata (Darwin, 1854)

General: Asami & Yamaguchi 2001; host coral *"Favites" russelli, Goniastrea* spp.

This is by far the most common pyrgomatid on Guam. Most colonies of *Goniastrea retiformis*, an abundant coral on Guam, are heavily infested. Interestingly, the morphologically similar *Goniastrea edwardsi* are very rarely infested, and thus barnacle infestation can aid in the field identification of the two corals. *Trevathana dentata* is also found in *"Favites" russelli* on Guam.

Trevathana paulayi Asami & Yamaguchi, 2001

General: Asami & Yamaguchi 2001; wall red-purple, ribs white, host coral *Acanthastrea echinata*.

This species infests most colonies of *Acanthastrea echinata* on Guam, typically with numerous barnacles per colony.

Trevathana orientale (Ren, 1986)

General: Ren 1986, Asami & Yamaguchi 2001; wall red-purple, host coral *Favia stelligera*.

On Guam this species is moderately common in the faviid corals *Favia stelligera* and *Cyphastrea serailia*.

Neotrevathana Ross, 1999
Neotrevathana elongata (Hiro, 1931)

General: Hiro 1931, Ross 1999, Ogawa 2000; host corals *Favia mathaii*, *Goniastrea aspera* (Ryukyu's), and *Echinopora lamellosa* (Palau).

Neotrevathana elongata was moderately common in *Favia mathaii* or *F. pallida* near the mouth of Apra Harbor on Guam (K. Asami pers. comm.). These corals have not yet been seen with barnacles elsewhere on the island.

Wanella Anderson in Ross, 1999
Wanella milleporae (Darwin, 1854)

General: Ross & Newman 1973, Anderson 1992, Ross 1999, Ogawa 2000; only on fire coral *Millepora* spp.

This species infests *Millepora platyphylla* at relatively low levels around Guam.

Family Balanidae Leach, 1817
Subfamily Balaninae Leach, 1817
Balanus DaCosta, 1778
Balanus eburneus Gould, 1841

General: Henry & McLaughlin 1975; wall white, fouling species, intertidal to 37 m, dia. to 40 mm.

This species was encountered in three quite different habitats on Guam, but all characterized by waters of lower than fully marine salinity. It was abundant in a fish pond in an aquaculture facility, on woody vegetation in the Pago River estuary, and in a freshwater seep along the shoreline in the Haputo area. The latter population is comprised of barnacles of a low, mound-like growth form, appropriate for their interstitial habit among boulders in the seep discharge. *Balanus eburneus* is endemic to the Western Atlantic and introduced to the

tropical Pacific. As noted above it has invaded a few natural communities on Guam.

Balanus amphitrite Darwin, 1854

General: Henry & McLaughlin 1975; wall white with lavender or purple stripes, intertidal, fouling species, dia. to 30 mm.

Known only in Apra Harbor on Guam, where it is common on buoys, revetments, and other artificial substrata. The abundance of *Balanus amphitrite* on artificial substrata, including the undersides of vessels, together with its cosmopolitan distribution is highly suggestive of non-indigenous status on Guam. However Pleistocene(?) fossils of what appear to be this species are common in deposits underlying inner Apra Harbor indicating that this species is likely indigenous to Guam.

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