

An annotated checklist and key to the Crinoidea of Guam and the Commonwealth of the Northern Marianas Islands

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Abstract—Twenty-one species of crinoids in six families are now known from the Marianas Islands, 17 species from Guam and 10 from the Commonwealth of the Northern Marianas Islands (CNMI). This paper adds nine previously unreported crinoid species each to Guam and the CNMI. The nomenclature of all 21 species is reviewed and updated following Rowe et al. (1986), Hoggett and Rowe (1986) and Messing (1995, 1998a). One apparently juvenile comasterid does not fit comfortably in any known genus and may represent a new taxon. A simple key to the shallow-water species of Guam is included. Crinoid faunal diversity on Guam is compared with that known elsewhere in the Indo-West Pacific.

Introduction

Although general reviews of the shallow-water Indo-Pacific echinoderm fauna have encompassed both Guam and the Commonwealth of the Northern Marianas Islands (CNMI) (e.g., A. M. Clark & Rowe 1971), only two papers specifically documented the crinoid fauna of these islands. A. H. Clark (1954) listed one species from Guam and one from Rota, CNMI, and Meyer & Macurda (1980) recorded 7 additional species from Guam. Since then, the known fauna has more than doubled, and several taxonomic revisions have warranted re-identification of earlier records (Rowe et al. 1986, Hoggett & Rowe 1986, Messing 1995, 1998a, Rankin 2000). These are discussed below.

Species richness is now 21 species in six families. One apparently juvenile comasterid does not completely conform to any current generic diagnosis and may represent a new taxon.

Annotated List of Guam Crinoids

We follow the ordinal classification of Rasmussen & Sieverts-Doreck (1978) for simplicity, recognizing that phylogenetic hypotheses at familial and higher levels are in need of revision (e.g., Simms 1988, Roux 1997). Abbreviations are as follows: United States National Museum, Smithsonian Institution (USNM), University of Guam Invertebrates Collection (UGI), and Florida Museum of Natural History (UF). In the distribution sections, Indo-Malaya includes the islands of Malaysia, Indonesia, Papua New Guinea and the Philippines. Unless noted otherwise, L.K. collected all specimens, C.G.M. identified all photographs, and Gustav Paulay provided numbered photo records in the material examined sections (three-digit film roll followed by one- or two-digit photo number). If more than one specimen is included under a given catalogue number, the number is given in parentheses.

Order Comatulida A. H. Clark, 1908

Family Comasteridae A. H. Clark, 1908

Subfamily Phanogeniinae White & Messing (in White et al. 2001)

Phanogenia Lovén, 1866

Phanogenia gracilis (Hartlaub, 1890)

Material examined: GUAM: UGI 2918 (2), “Mounds” N. of Tanguisson Pt., in coral pockets, 10 m, 28 Aug 1977, [with galatheid] D.L. Meyer coll.; UGI 6110 (5), Gun Beach, East Tumon, exposed on coral heads at night, 15 m, 4 Aug 1997 [with polynoid], G. Paulay coll.; UGI 6679, Luminao Reef, under rubble, 5 m, 19 Oct 1998, [with galatheid]; UF 1 Gun Beach, East Tumon, fore reef under crevices at night, 10-20 m, 22 Jun 2000; UF 2, Gun Beach, East Tumon, fore reef under crevices at night, 12 m, 8 Oct 1995, G. Paulay coll.; UF 3 (2), Cocos I., rubble on outer W side of lagoon, 18 m, 23 Apr 1999, G. Paulay coll., photo GP582:27, 28; UF 4, Cocos I., W. Barrier reef, groove on fore reef under rubble, 12-14 m, 23 Feb 1999, C. Meyer coll.; UF 5, South of Ritidian, partly exposed under coral overhang, 35 m, 7 May 1999, [with alpheid], photo GP587:17; UF 6, Gun Beach, East Tumon, fore reef under crevices at night, 10 m, 12 Jul 2000; UF 7, north of Haputo fore reef, under coral overhangs, ~15 m, night, 9 Jun 2000, G. Paulay coll., photo GP830:18 [with commensals], 37; UF 8, Glass Breakwater, directly offshore of small grove of trees, Luminao fore reef, under overhang, 20-30 m, 12 Oct 1999, G. Paulay coll.; [photo(s) only] NW Orote Pt., 15-20 m, 27 April 2000, night, photo GP812:3,6; Orote Pt., 13° 25.13 N, 144° 38.51 E, 35-40 m, 20 Jan 2000, photo GP746:8. NORTHERN CNMI: UF 9, Maug I., R. Randall coll.

Additional records: GUAM: USNM E32078, Gab-Gab Beach, Apra Harbor, 3 km E of Orote Pt., 13° 26'30"N, 144° 38'30"E, 6.1 m, 10 Dec 1983, R. F. Bolland coll. & D. L. Meyer det.

Notes: This species was formerly called either *Comaster multifidus* or *C. gracilis*. Although several papers have recognized the two as separate species throughout the western Pacific (e.g., A. H. Clark 1931, Zmarzly 1985, Messing 1994, 1998b, Kogo 1998), no morphological feature has yet been found that consistently distinguishes them (Messing 1998a). Messing (1998a) also recognized that *Comaster multifidus*, the type of the genus *Comaster*, was identical and senior to *Comanthina variabilis* (Bell), an Australian endemic. He transferred all species of *Comanthina* to *Comaster* and removed the remaining species previously placed in *Comaster* to the next most senior available genus, *Phanogenia* (Lovén). As a result, specimens from Guam identified by Meyer & Macurda (1980) as *C. multifidus* have been re-identified as *Phanogenia gracilis*. Yet, because multiple authors have recognized two similar taxa, they are enumerated as separate in the discussion and table below.

This is the only Guamanian comatulid in which the centrodorsal is small, star-shaped and completely lacks cirri. *Phanogenia gracilis* is largely cryptic during the day under rubble, coral heads or overhangs. At night, its disk remains concealed, but it extends most of its arms in a multiradial orientation with pinnules oriented in four directions, or tetrads (see Meyer & Macurda 1980). Despite its relatively small local size (arm length <10 cm), *P. gracilis* houses the most diverse assemblage of symbionts so far observed on any host crinoid on Guam. A brittlestar, a polynoid scale worm, a pair of alpheid shrimp, a pontoniine shrimp, myzostomid worms and a squat lobster, probably *Allogalatea*, are commonly observed on specimens of *P. gracilis* at night in 10-40 m at Gun Beach in Tumon Bay, and Haputo Point, further north along the same coastline.

Distribution: From the Maldives to Fiji, Kwajalein and Onotoa Is. including tropical Australia, Indo-Malaya, Taiwan, Palau, Guam and Okinawa (A. H. Clark 1931, 1954, Meyer & Macurda 1980, Zmarzly 1984, 1985, Chen et al. 1988, Messing 1994, 1998b, Rowe & Gates 1995, Kogo 1998). Depth range: chiefly 10 to 50 m, but also shallower in some locales (6.1 m at Gab-Gab, see additional records section above) with a few questionable dredging records from as deep as 216 m (A. H. Clark 1931, Messing unpublished).

Phanogenia cf. *distincta* (Carpenter, 1888)

Material examined: GUAM: UF 10, W coast of Guam, Agana/Tumon Bay area, 17-125 m, 1 Aug 1997, dredge #3, G. Paulay & B. Smith coll.; UF 46, Mangilao, 13°25.15'N, 144°48.03'E, 95-130 m, 31 Jul 1997, dredge, T. Leberer & G. Paulay, colls. (4).

Notes: These specimens fit the published description of *Phanogenia distincta* (formerly *Comaster distinctus*, see under *P. gracilis*, above): a cirrus-bearing *Phanogenia* with 35 or fewer arms. The four specimens from UF 46 range from a ray length of 35 mm with 18 arms to 57 mm with 28 arms. However, the diagnostic features of several cirrus-bearing *Phanogenia* form an apparent

growth series [e.g., *P. distincta*: ≤ 35 arms up to 60 mm long; *P. fruticosa*: 37-63 arms to 90 mm long, and *P. multibrachiata*: 140-160 arms to 150 mm long (A. H. Clark 1931)]. Although *P. distincta* and *P. multibrachiata* exhibit distinctly different color patterns at New Caledonia (Meyer 1986), it remains unclear whether they are separate taxa or growth stages of a single species.

Distribution: [Including a likely synonym, *Comaster brevicirrus* (Bell)] Madagascar to New Caledonia including the Andaman Islands, W and NW tropical Australia, Indo-Malaya, the South China Sea, Guam and Japan (A.H. Clark 1931, Marshall & Rowe 1981, Meyer 1986, Messing 1998b, Rowe & Gates 1995, Kogo 1998). *P. multibrachiata* has a similar range; it has not been recorded from Madagascar, but has been recorded from the Great Barrier Reef (Stevens 1989). This is only the second record of a cirrus-bearing *Phanogenia* from Oceania (after that from New Caledonia). Depth range: rarely < 30 to at least 55 m; some older dredging records exceed 100 m (possibly 290 m), but the latter are not precise so the maximum depth of this species is unknown. *P. multibrachiata* has a similar depth range.

Alloeocomatella Messing, 1995

Alloeocomatella pectinifera (A. H. Clark, 1911)

Material examined: GUAM: UF 11, Gun Beach, East Tumon, underneath overhang, 30 m, 21 Oct 1999, night [with eulimid gastropod parasites]; UF 12, Cocos Island, W Barrier Reef, groove on fore reef under rubble, 12-14 m, 23 Feb 1999, G. Paulay coll.; UF 13 (3), Cocos Island, W side of outer fore reef, in rubble, 18 m, 23 Apr 1999, photo GP582:21-22,29; UF 14, Orote Pt., rubble field, 18 m, 22 May 1998; [photo(s) only] NW Orote Pt., 15-20 m, 24 April 2000, night, photo GP812:5,7,10.

Notes: A combination of bright red, orange or maroon coloration and only ten arms, some of which are much longer than the others, make this abundant crinoid one of the most conspicuous species on Guam. It is cryptic during the day and extends several of its longer arms at night. The pinnules typically orient in a single plane (like barbs on a feather), unlike the tetrad arrangement in *Phanogenia gracilis*. *Alloeocomatella pectinifera* was the most abundant crinoid in an intensive recent survey along the Orote Peninsula (Paulay et al. 2001). It has been found island-wide, but appears reliably at night off Gun Beach, Tumon Bay, together with *P. gracilis*. This species was previously referred to as *Comissia pectinifera*.

Distribution: Maldive Islands to New Caledonia and Kwajalein, including the Great Barrier Reef, Indo-Malaya, Palau, Guam and Chuuk (Zmarzly 1985, Meyer 1986, Messing 1995, 1998b). Depth range: 3-23 m (Messing 1995). Two specimens recorded by Kogo (1998) as *Comissia magnifica* from a depth of 6.1-6.2 m off Okinawa most likely represent *A. pectinifera*.

Alloeocomatella polycladia Messing, 1995

Material examined: GUAM: UGI 2919, SW of Achae Pt., hidden beneath dead coral, 21 m, 28 Aug 1977, D. L. Meyer coll.; UF 15, Cocos Island, W side of outer fore reef in rubble, 18 m, 23 Apr 1999; UF 16, Gun Beach, East Tumon, night, partially concealed under rock overhang, 30 m, 16 Aug 1998; UF 41, Luminao fore reef, in rubble, 10 m, 9 Sep 1997, G. Paulay coll. SOUTHERN CNMI: UF 17, Saipan, off Agingan Pt., under large flat rock, ~20 m, 10 Aug 2001 [with ~20 myzostomes]; UF 18, Saipan, off Agingan Pt., under large rubble/rock, 30 m, 11 Aug 2001.

Notes: This is the first record of this species from Guam. A few records of *Comatella maculata* (Carpenter) actually refer to *A. polycladia*: Meyer & Macurda (1980) from Palau and Meyer (1986) from New Caledonia (cited in Messing 1995). Juvenile *A. polycladia* with only ten arms may be confused with *A. pectinifera* although the former usually bears arms of similar length, while the latter typically bears much longer anterior arms (Messing 1995). The small specimen reported here from Cocos I. may thus possibly be *A. pectinifera*.

A. polycladia hides during the day under corals, overhangs, rubble or in crevices and often occurs with *A. pectinifera*. At night, it may remain partly concealed, or perch completely in the open. It is dark red or purplish red, sometimes with pinnules beaded with pink or tipped with yellow, orange or pink (Messing 1995). The color forms observed on Guam are dark red to orange and correspond to the above description.

Distribution: Indonesia to Fiji and Chuuk, including the Great Barrier Reef, Indo-Malaya, Palau, CNMI and Okinawa (Messing 1995, Pilcher & Messing 2001). Because Messing (1998b) recorded both *A. polycladia* and true *Comatella maculata* (which he treated as a synonym of *Comatella stelligera*) from Chuuk Atoll, it is not possible to determine if some other records of *C. maculata* from this region, unaccompanied by descriptive information, are correctly identified or not [e.g., Mortlock I. (Hartlaub 1891)]. However, solid dark purple specimens from Kwajalein that were cryptic during the day, exposed at night and identified as *C. maculata* (Zmarzly 1985), likely represent *A. polycladia*. Depth range: 3 to 30 m.

Comatella A. H. Clark, 1908*Comatella stelligera* (Carpenter, 1888)

Material examined: SOUTHERN CNMI: USNM E7726, Rota I. 12 Nov 1945, D. G. Frey, coll., C. G. Messing, det.

Notes: Members of the genera *Comatella* and *Alloeocomatella* are often confused because both share the same ray branching pattern (i.e., brachitaxes of two ossicles each united by synarthrial articulations and first pair of brachial ossicles on interior arms united by syzygy). However, *Comatella* has distinctive pinnules with a rounded keel on each of the basal two segments and combs that, unlike that of any other Pacific comasterid, arise from the side of the pinnule

closest to the arm that bears it (Messing 2001). The Rota I. specimen was originally identified by A. H. Clark (1954) as *Comatella maculata* (Carpenter, 1888). However, Messing (2001) recognized this species as a younger stage of *C. stelligera*. The specimen has 22 arms and its rays orient in a single plane, unlike the rays of *Comatella nigra*, which are distinctly twisted (and which has not yet been recorded from the Marianas Chain).

C. stelligera typically occurs under ledges, coral rubble or among branching corals with at least some of its arms extended. Colors include black, maroon, brown or greenish-brown; the latter three usually mottled, flecked or spotted with yellow or pale green; pinnules are often yellow-tipped. Small specimens formerly identified as *C. maculata* are often dark red-brown with numerous yellow spots. It is not yet clear if red-purple specimens with blue stripes or mottling are *C. stelligera* or *C. nigra*.

Distribution: Indo-Malaya to Chuuk, CNMI and southern Japan (Messing 1998b, Pilcher & Messing 2001); probably also the Great Barrier Reef and Nicobar Islands (Messing unpublished).

Subfamily Comasterinae A. H. Clark, 1909

Comaster Agassiz, 1836

Comaster schlegelii (Carpenter, 1881)

Material examined: GUAM: UGI 2909 (2), 2910, 2913 [with alpheids], 2914 [with *Harrovia* sp.], north of Tanguisson Point, on "exposed mounds", 10 m, 28 Aug 1977, D. L. Meyer & C. Birkeland coll., D. L. Meyer & D. B. Macurda det.; UGI 2103, Orote Pt., on pavement, 10 m, 17 Jul 1968, R. Tsuda coll.; UGI 2104, NW coast, outside of Pugua patch reef, 42 m, 19 Jul 1968, [with alpheids, pontoniines, and a galatheid] R. Randall coll.; UF 19, W coast, Hospital Point, under overhangs, 30-35 m, 7 Jun 1999; UF 20, Cocos Island, W side of lagoon, under rubble, ~18 m, 23 Apr 1999; UF 21, Orote Pt. on coral rock, 34-35 m, 1969, R. Chesher coll., C. G. Messing det., RHCG62; UF 22, NW coast, Pugua patch reef, exposed, ~13° 35.98'N, 144° 49.83'E, 15-25 m, 3 Aug 2000 [with alpheids and pontoniines]; [photos only] Orote Peninsula, 0.5 km NW of Blue Hole, 30 m, 25 May 1988, R. Myers photo 216b; Orote Pt., 13° 26.96' N, 144° 37.15' E, 10-20 m, 16 Feb 2000, photo GP649:32; NORTHERN CNMI: UF 24, Maug I., R. Randall, coll. SOUTHERN CNMI: Saipan, inside Grotto, 8 m, 21 Feb 1988, R. Myers photo 214S; UF 25 (1 spec.), UF 26 (2), Saipan, off Agingan Pt., exposed on boulder, 15-20 m, 11 Aug 2001 [with *Allogalatea* sp., alpheids, pontoniines & myzostomes].

Additional records: GUAM: USNM E35079, Orote Pt., on top of rock, 30.5 m, 5 Feb 1976, D. L. Meyer coll. & det.

Notes: This is the most common large, bushy crinoid of the Guamanian fore reef [although the Cocos I. specimen is the smallest *Comaster schlegelii* ever observed by one of us (C.G.M.)]. It occurs widely along the west side of Guam (where the majority of the diving occurs) and often hosts crustacean symbionts.

Rarely encountered smaller animals are often partially hidden; larger animals are fully exposed during the day (see Meyer & Macurda 1980, as *Comanthina schlegelii*, for feeding behavior and field characters). Messing (1998b) has suggested that *C. schlegelii* from Micronesia may be a distinct taxon: it develops more arms, retains more cirri at a larger size and perches in the open to a greater degree than *C. schlegelii* from Australia and Papua New Guinea. Specimens from Guam are similar to those from Micronesia.

Local specimens are completely yellow; dark green to dark brown/black; yellow with black banding on arms and pinnules; black with black and white pinnules tipped with yellow; banded orange, brown and white; brown arms with yellow pinnules and cirri, or black with a yellowish disk. Two photographed specimens (R. Myers 216b, G. Paulay 649-32) with different color patterns are tentatively included here. Both have brownish-yellow arms (also partly white in the Myers photo) and either mostly black or mostly white pinnules with yellow tips. These patterns resemble that of one *Comaster schlegelii* from Enewetak: division series and arms orange to orange-brown with random white variegations; pinnules “black with yellow tips except for variegations where pinnules are white with yellow tips” (Zmarzly 1984:111). Other color patterns from other areas include green, often mixed with black, orange and white (Rowe et al. 1986), and orange or orange brown arms variegated with white, and with brown, orange-brown or white pinnules tipped with yellow or white (Zmarzly 1984).

Distribution: Indo-Malaya to Fiji and Kwajalein, including tropical Australia (Western Australia to Port Molle, Queensland), Taiwan, Palau, Guam, Saipan and southern Japan (Meyer & Macurda 1980, Zmarzly 1984, 1985, Rowe et al. 1986, Chen et al. 1988, Rowe & Gates 1995, Messing 1998b, Kogo 1998). Records from the Maldive Is., Sri Lanka and the Andaman Is. that pre-date the generic revision of Rowe et al. (1986) may refer to *C. schlegelii* or *C. nobilis*. Depth range: 10-42 m locally; it has been collected in as little as 1.5 m at Madang, Papua New Guinea (Messing unpublished). The specimens listed above from Maug I. and Saipan are the first records of *C. schlegelii* from the CNMI.

Clarkcomanthus Rowe et al., 1986

Clarkcomanthus littoralis (Carpenter, 1888)

Material examined: SOUTHERN CNMI: UF 27 (2), Saipan, off Agingan Pt., partly hidden under overhang, 10-13 m, 10 Aug 2001 [with *Harrovia* sp.]; UF 40, Saipan, off Agingan Pt., under overhang, ~15-20 m, 11 Aug 2001 [with *Harrovia* sp.].

Notes: This is the first record of this species from the Marianas Chain. Members of the genus *Clarkcomanthus* differ from *Comanthus* in having pinnule combs only as far as the second pinnule on the undivided arm (P_2) and in lacking an initial transversely oriented comb tooth. *C. littoralis* differs from *C. luteofuscum* (below) in having a small centrodorsal that does not obscure the radial ossicles (and usually fewer than 12 cirri). The Saipan specimens are

yellow-green aborally with a black disk and ambulacra; in one, the arms become yellow distally. Other color patterns recorded elsewhere include green or brown proximal rays becoming pale green distally; pale gray or white with articulations and soft parts ginger brown, or green with yellow spots; pinnules may have yellow tips (Rowe et al. 1986, Messing unpublished).

Distribution: Northern Australia (from Lancelin, W.A., to Lady Elliot I., Queensland), Indo-Malaya, southern Japan, Fiji, New Caledonia, Tonga, Saipan and Chuuk Atoll. Depth range: 1-144 m (Rowe et al. 1986).

Clarkcomanthus luteofuscum (H. L. Clark, 1915)

Material examined: SOUTHERN CNMI: UF 44, Saipan, off Agingan Pt., in coral thicket, 10-13 m, 10 Aug 2001 [with pontoniines].

Notes: This is the first record of this species from the Marianas Chain. It differs from *C. littoralis* in having a large centrodorsal that covers the radial ossicles and rarely bears fewer than 15 cirri. The single specimen has a “starry night” color pattern: uniformly black with numerous tiny yellow spots. Elsewhere, the species is recorded as being dull brown or green; rays greenish-brown proximally with brown articulations and small yellow spots, becoming yellowish or light green distally, and with pinnules green or brown and spotted or beaded with yellow or green; and rays very dark brown with small green spots on articulations, centrodorsal, cirri and pinnules (Rowe et al. 1986, Messing unpublished). Meyer & Macurda (1980) recorded this species from Palau as *Comanthus samoana*.

Distribution: Northern Australia (from NW Cape, W.A., to Swain Reefs, Queensland), southern Japan, Indo-Malaya, Solomon Is., New Caledonia, Tonga, Palau, Saipan, Chuuk Atoll (Rowe et al. 1986, Messing 1998b [the record from Chuuk incorrectly omitted from his Table 1], Kogo 1998). Depth range: 0-18 m.

Comanthus A. H. Clark, 1908

Comanthus alternans (Carpenter, 1881)

Material examined: GUAM: UF 42, Orote Pt., on coral/rock, 13 m, 2 Aug 1969, RHCG54; UF 43, Pati Pt., exposed, 24 m, 25 July 2001, V. Bonito, coll.

Notes: This large, bushy comatulid may have even more arms than *Comaster schlegelii* (i.e., up to about 125), but it differs in having a small stellate centrodorsal without cirri (at least in specimens with more than 40 arms), and well-separated rays without any pavement of small plates between them. Individuals use some of their arms to cling to prominent perches in exposed positions, with the centrodorsal raised above the substrate. Both specimens are dried and uniformly dark brown (almost black). Other color patterns recorded elsewhere include black or deep mahogany with green or white pinnule tips, and sometimes with a white aboral arm stripe; dark brown with a dusting of tiny white or yellow spots; rays greenish yellow with groups of pinnules alternating

between black with white tips and white with a middle black band; and pale gray or white with few to many pinnules black or brown with white tips (Meyer & Macurda 1980, Zmarzly 1985, Rowe et al. 1986, Messing unpublished observations). Meyer & Macurda (1980) reported this species from Palau as *Comantheria briareus* and *Comantheria* sp. cf. *C. briareus*. Zmarzly (1985) reported it from Kwajalein as *Comantheria briareus*.

Distribution: Northern Australia (Carnarvon, W.A., to One Tree Reef, Queensland), Indo-Malaya, southern Japan, Palau, Guam, Chuuk and Kwajalein Atolls and New Caledonia. Depth range: 0-90 m (Rowe et al. 1986).

Comanthus parvicirrus (Müller, 1841)

Material examined: GUAM: UGI 2920, SW of Achae Pt., 21 m, 28 Aug 1977 [with two alpheids], D.L. Meyer coll. & det. SOUTHERN CNMI: Saipan, USNM E18210, lagoon, in clump of *Montipora verrucosa*, 3.4 m, 4 Oct 1949, P. E. Cloud coll.; UF 39, Saipan, off Agingan Pt., under rubble & overhangs, ~15-20 m, 11 Aug 2001 [with two alpheids].

Notes: Unlike *Comaster schlegelii* and *Oxycomanthus bennetti*, this species usually has 20-40 arms and is more slender with fewer, smaller cirri, characters that it shares with *Clarkcomanthus littoralis* and *Comanthus wahlbergii*. It differs from *C. wahlbergii* in having the radial ossicles visible beyond the small centrodorsal, and from *C. littoralis* in having pinnule combs at intervals along the entire arm length and a transversely oriented first comb tooth. Older records of *C. parvicirrus* (before Rowe et al. 1986) may be referable to *Comanthus briareus*, *C. gisleni*, *C. suavia* or *Clarkcomanthus littoralis*. For example, the specimen identified as *C. parvicirrus* in figure 6g of Meyer & Macurda (1980) from Palau is almost identical to *C. suavia* from Papua New Guinea (Messing unpublished); both have greenish rays with distinctly darker articulations, a paler centrodorsal with at most one cirrus, and reddish pinnules.

Distribution: Thailand to Fiji and Tonga, including Indo-Malaya, northern Australia (Cockburn Sound, Western Australia to Julian Rocks, New South Wales), the Coral Sea, Taiwan, Palau, Chuuk, Guam, CNMI and Okinawa (Rowe et al. 1986, Chen et al. 1988, Kogo 1998, Messing 1998b). Records from Madagascar (Marshall & Rowe 1981), Enewetak and Kwajalein (Zmarzly 1984, 1985) may or may not represent this species. Depth range: shoreline to 28 m (Rowe et al. 1986). A specimen in the Smithsonian Institution extends the range of this species to Saipan.

Comanthus wahlbergii (Müller, 1843)

Material examined: GUAM: UF 29, Orote Pt., cryptic under rock, 27-34 m, 4 Nov 1998, H.T. Conley coll.; UF 30, Ritidian fore reef, 7-9 m, 4 May 2000, night, G. Paulay coll., photos GP815:18, 818:2.

Notes: This is a new record for Guam. The white and reddish (photo 815:18) and white, pale brown and darker brown (photo 818:2) concentric banded color patterns are similar to the pale and dark brown concentric banding previously recorded for this species elsewhere, although other colors have also been recorded (Rowe et al. 1986). This species differs from both *Comanthus parvicirrus* and *Clarkcomanthus littoralis* in having usually at least 20 cirri on a larger centrodorsal that covers the radial ossicles.

Distribution: False Bay, South Africa, to Samoa, including Indo-Malaya, northern Australia (Garden Island near Perth to Mooloolaba, Queensland), Lord Howe Island, New Zealand, Admiralty Islands, New Caledonia, Guam and southern Japan (Rowe et al. 1986, Messing 1998b, Kogo 1998). Messing (1998b) tentatively identified this species from the Sulu Sea. Marshall & Rowe (1981) recorded this species as *Comanthus* sp. aff. *C. samoanus* from Madagascar and Meyer & Macurda (1980) recorded it as *C. samoanus* from Palau. Depth range: 1-103 m (Rowe et al. 1986).

Oxycomanthus Rowe et al., 1986

Oxycomanthus bennetti (Müller, 1841)

Material examined: GUAM: UGI 2911, Southwest side of Achae Pt., exposed, 21 m, 28 Aug 1977, D. L. Meyer, C. Birkeland & J. Eads coll., D. L. Meyer det.; UF 31, Uruno Point, exposed on coral head, 20 m, 7 Nov 1999; [photo only] Anae Island, 18-24 m, 25 Aug 1999, photo GP762:16. SOUTHERN CNMI: Saipan, inside the Grotto, 27 July 1985, 18 m, R. Myers photo S-10; UF 32, Saipan, off Agingan Pt., exposed on coral head, ~15-20 m, 11 Aug 2001 [with *Allogalatea* sp.].

Notes: As with *Comaster schlegelii*, this is a large (usually >50 arms), bushy, diurnally-active and rheophilic species. However, the cirri of *O. bennetti* are usually 3.0-4.5 cm long and elevate the animal above its perch, whereas in *C. schlegelii*, the cirri are rarely as much as 2.0 cm long, weaker and more strongly curled. These anatomical differences result in postural differences that are observable in the field, and are useful in distinguishing these otherwise similar species on Guam (see Meyer & Macurda 1980, as *Comanthus bennetti*, for further field characters). The UF 32 specimen from Saipan was black with yellow-tipped distal pinnules and with a greenish-yellow tinge around the cirri and mouth.

Distribution: Andaman Islands to Fiji and Arno Atoll, including Indo-Malaya, tropical Australia (Ashmore Reef to Elliot Island), Lord Howe I., Taiwan, Palau, Guam, Saipan and Okinawa (Meyer & Macurda 1980, Zmarzly 1984, Rowe et al. 1986, Chen et al. 1988, Rowe & Gates 1995, Messing 1998b, Kogo 1998). Although Rowe et al. (1986) give the depth range as 8-25 m, *O. bennetti* is common in <10 m and may be found in as little as 1 m. A less common, differently colored, deeper water form, which may have fewer longer arms, occurs in 15-46 m (Meyer & Macurda 1980, Messing unpublished). The

photo-identified animal from Saipan listed above has attributes consistent with the deep-water form.

Oxycomanthus exilis Rowe et al., 1986

Material examined: none.

Additional records: GUAM: USNM E33982, Gab-Gab Beach, Apra Harbor, 3 km E of Orote Pt., 13° 26'30"N, 144° 38'30"E, 3.1 m, 20 Nov 1983, R. F. Bolland coll. & F. W. E. Rowe det.

Notes: This record, the only one for this species from Guam, is based on a specimen not seen by us, but identified by one of the describers of the species.

Distribution: Indo-Malaya to New Caledonia and Fiji, including tropical Australia (Ashmore Reef to Moreton Bay, Queensland), Solomon Is., Guam, Chuuk and possibly southern Japan (Rowe et al. 1986, Rowe & Gates 1995, Messing 1998b, Kogo 1998). Depth range: 3-25 m.

Oxycomanthus cf. *mirus* Rowe et al., 1986

Material examined: GUAM: UF 717, Luminao fore reef, in rubble, 10 m, 9 Sep 1997, G. Paulay coll.

Notes: This specimen most closely approaches *Oxycomanthus mirus* although it exhibits several features in common with closely similar *O. comanthipinna* (Gislén). As in *O. mirus*, the oral pinnule combs bear straight, blade-like primary teeth set in from the edge of the segments that bear them, the distal teeth are fused to each other and taper to form a sharp pinnule tip, and most tooth-bearing segments also bear a secondary peg-like tooth. Unlike *O. mirus*, all second brachitaxes consist of two segments rather than all or mostly four, and seven functional cirri are present. Described specimens of *O. mirus* have at most one rudimentary cirrus and three cirrus scars (Rowe et al. 1986). *O. comanthipinna* bears 8-15 functional cirri, no secondary comb teeth, and its second brachitaxes may consist either of two or four segments. The larger number of cirri in the Guam specimen (relative to described *O. mirus*) may be accounted for by its small size: 20 arms, ray length 70 mm and centrodorsal diameter 2.1 mm. The holotype of *O. mirus* has 38 arms, ray length 140 mm and a centrodorsal 2.5 mm across. A larger specimen collected off Palawan I., Philippines, has 41 arms, ray length 170 mm and four rudimentary cirrus scars on a centrodorsal 3.1 mm across (Messing unpublished). Several other comasterids lose cirri as they increase in size (e.g., *Comaster nobilis*) and others vary in the proportions of brachitaxes of two versus four segments (*Comanthus gisleni*, *Clarkcomanthus albinotus*).

Distribution: Great Barrier Reef, Australia; Palawan, Philippines; New Caledonia and Guam. Depth range: 3-18 m (Rowe et al. 1986, Messing unpublished).

Subfamily incertae sedis
Genus incertae sedis
Comasterid sp. A

Material examined: SOUTHERN CNMI: UF 33, SW Aguijan I., Tow 27, 140-420 m, 9 Apr 1983, Eldredge et al. colls. (1984).

Notes: This specimen shares with *Rowemissia scitulus* similar small size (centrodorsal diameter 2.6 mm; estimated ray length ~50 mm), ten arms, a roughly central mouth, and distinctive pinnule combs tapering to a sharp tip with the initial and distal 1-2 teeth single and nonconfluent, and middle teeth paired separated and peglike (Messing 2001). However, unlike *R. scitulus*, it bears no gonads, lacks P₃ and P_c on at least two rays and thus appears to be a juvenile. It also differs in having more cirri composed of more segments that are much shorter than in *R. scitulus* (20 cirri of +17 segments with a maximum length/width ratio of 1.3 versus 11 cirri of 10-11 segments with a maximum ratio of 3.4); U-shaped aboral ridges on the distal cirrus segments instead of weak spines; proportionally larger comb teeth, and a distal syzygial interval of 4-10 instead of 2-4. Finally, numerous calcareous nodules cover the aboral interradial areas and are scattered on the oral surface of the Aguijan specimen whereas both surfaces in *R. scitulus* bear thin calcareous scales.

The distinctive comb form distinguishes the Aguijan specimen from *Comissia* spp. but approaches that of both *Comaster* spp. and *Oxycomanthus mirus*. However, similarly sized specimens of, e.g., *Comaster schlegelii* (ray length 60 mm) already have as many as 38 arms and well developed diagnostic aboral interradial plating. In *O. mirus*, the larger of the paired comb teeth is bladelike rather than peglike, and in both *Oxycomanthus* and *Comaster* the mouth is excentric rather than central or subcentral. We treat the specimen as unidentified because it is apparently juvenile and has not developed all features diagnostic of its genus, whichever that may be. We include it in the species list because it clearly differs from all other crinoids known from this area.

Family Mariametridae A. H. Clark, 1909

Stephanometra A. H. Clark, 1909

Stephanometra indica (Smith, 1876)

Material examined: none.

Additional records: GUAM: USNM E7727, tide pools, 25 Nov 1945, D. G. Frey coll. & A.H. Clark det.

Notes: Rowe & Gates (1995) formally synonymized *S. spicata* under *S. indica*. Rankin (2000) added *S. spinipinna* and *S. oxyacantha* as junior synonyms of *S. indica*. Of the 103 specimens she examined, which ranged from the Red Sea to Fiji and the South China Sea, over 20% were intermediates that could not be satisfactorily assigned to species.

Both *Stephanometra* and *Lamprometra* (below) are usually cryptic under rubble and within the reef framework during the day. At dusk, they crawl to

exposed perches and spread their arms in a biplanar posture. For further behavioral and postural details, see Meyer & Macurda (1980) and Messing (1994).

Distribution: (*S. indica* plus synonyms) Red Sea, Tanzania and Madagascar to Guam and the Tonga Islands, including Indo-Malaya, tropical Australia as far south as the Capricorn Channel, Queensland, Palau and Okinawa. Previously published records extending the distribution as far east as Jaluit and Arno (Zmarzly 1984) may be based on incorrect identifications (Rankin 2000). Depth range: 1 to at least 15 m; a few older dredging records from substantially deeper than about 30 m (50-73 m) may not be accurate (A.H. Clark 1941, Rankin 2000, Messing unpublished).

Lamprometra A. H. Clark, 1913

Lamprometra palmata (Müller, 1841)

Material examined: GUAM: UF 34, Facpi Point, on rock substrate with algal and sand covering, 23-27 m, 20 Mar 1993, F. Thomas coll., donated by H.T. Conley; NORTHERN CNMI: Alamagan, UF 35, reef slope, on rock, 20 m, 19 May 1992, P. Schupp coll.

Notes: This single specimen is a new record for Guam. See *Stephanometra*, above, for posture and behavior. Rankin (2000) considered *L. klunzingeri* from the Red Sea and northwestern Indian Ocean as a synonym of *L. palmata* and noted that some previously published records of *L. palmata* may represent *Stephanometra indica*, *Liparometra* spp. or *Dichrometra* spp.

Distribution: Red Sea and Mauritius (possibly Zanzibar and Tanzania) to Tonga, Marshall Islands and possibly Hawai'i, including tropical Australia and Indo-Malaya north to southern Japan (Utinomi & Kogo 1965, Kogo 1998, Rankin 2000). The only record from Hawai'i (Hartlaub 1912) refers to a single broken specimen supposedly from Oahu in the Museum of Comparative Zoology, Harvard; no catalogue number has been published. Depth range: shoreline to 35 m (plus a few questionable deeper old dredging records)(A. H. Clark 1941, Rankin 2000).

Family Colobometridae A. H. Clark, 1909

Cenometra A. H. Clark, 1909

Cenometra bella (Hartlaub, 1890)

Material examined: GUAM: UGI 2921, SW of Achae Point, on wire coral, 45 m, 28 Aug 1977, D. L. Meyer coll. & det.; UGI 2915, "Blue Hole", Orote Pt., attached to antipatharian, 48 m, 30 Aug 1977, J. Eads coll. & D. L. Meyer det.; UF 36, Orote Pt., near Blue Hole, on cliff, 67 m, 29 Dec 1971, N. Vag coll.; UF 28, Haputo, reef flat under rock, 4 Aug 2000, V. Bonito coll.

Notes: This species typically clings to gorgonian and antipatharian sea whips, usually arranging its arms in an irregular radial fan. Specimens usually

bear 25-30 (sometimes up to 40) arms and exhibit a wide range of colors, often with cirri of a sharply contrasting color. In addition to the material examined above, G. Paulay (personal communications) has observed this species off Hospital Point (on *Cirrhopathes* sp.) and ~2 km north of the University of Guam Marine Lab/Pago Bay (on a gorgonian) in 30-40 m.

Distribution: Burma to New Caledonia, Kwajalein and Jaluit, including Indo-Malaya, tropical Australia (Ashmore Reef to the Great Barrier Reef), Taiwan, Palau, Guam, Chuuk and Japan (A.H. Clark 1947, A. M. Clark & Rowe 1971, Meyer & Macurda 1980, Zmarzly 1985, Chen et al. 1988, Rowe & Gates 1995, Messing 1998b). Inclusion of *Cenometra herdmani* A.H. Clark and *C. cornuta* A.H. Clark within *C. bella* following A. M. Clark & Rowe (1971) extends the range eastward at least to Sri Lanka [although Rowe & Gates (1995) maintain *C. cornuta* as distinct]. Depth range: chiefly 10-55 m, with a few records from shallower water (A. H. Clark 1947, Meyer & Macurda 1980, Messing unpublished).

Family Charitometridae A. H. Clark, 1909

Monachometra A. H. Clark, 1916

Monachometra cf. *patula* (Carpenter, 1888)

Material examined: GUAM: UF 37, Eleven Mile Bank, 73-110 m, 1997, F. Cushing coll.

Notes. According to the most recent treatment of the Charitometridae, this specimen most closely approaches *Monachometra* in that “the genital pinnules taper evenly from the usually more or less broadened earlier segments to a delicate and slender tip, the portion beyond the gonads being much longer than the gonads themselves; the outer portion of the arms is rounded dorsally [=aborally], sometimes with a slightly raised broad median line;...the IIBr series are 2;...and the cirri have 17-31 segments with the opposing spine often bifurcate” (A. H. Clark 1950:208). The specimen also bears distinct synarthrial tubercles although they are not as prominent as those described for *Monachometra*. It differs from the generic diagnosis in having oral pinnules somewhat longer than genital pinnules (rather than shorter or about the same length), 28 arms (rather than 10-21), and cirrus sockets irregularly crowded rather than arranged in 10-15 columns.

Within the genus, the specimen most closely approaches *M. patula* (Carpenter) in having proximal brachials with prominently raised distal margins and exteriorly developed IIBr series. Although it differs significantly in having cirrus sockets crowded irregularly around the centrodorsal rather than in 10-12 columns separated midradially, the difference may be due to size. The Guam specimen bears 28 arms and 39 cirri composed of up to 24 segments while previously recorded specimens have at most 21 arms and 30 cirri with 22 segments. The brachitaxis ossicles of the Guam specimen also bear irregularly crenulate margins, a feature not previously recorded in *M. patula*.

Distribution: *M. patula* has previously been recorded from the Philippines, eastern Indonesia (Kai Is.) and Sahul Shelf (Timor Sea) in 104-385 m (A. H. Clark 1941). The current record, if conspecific, extends the range to Guam in 73-110 m.

Family Antedonidae Norman, 1865

Dorometra A. H. Clark, 1917

Dorometra nana (Hartlaub, 1890)

Material examined: GUAM: UGI 6209, Pati Pt., outer reef slope, under rock, 10 m, 27 May 1997, T. Leberer coll.; UF 38, Orote Pt., under rock, 20 m, May 2000, V. Bonito coll.

Notes: These are the first records of *Dorometra nana* from Guam. Both specimens are small, delicate and mottled. The Orote Pt. specimen is brown, beige and white; the Pati Pt. specimen is maroon and mauve.

Distribution: Andaman and Nicobar Islands to Tonga, Jaluit and Ebon atolls, including Australia (W coast to New South Wales), Indo-Malaya, Palau, Guam and Chuuk (A. H. Clark & A. M. Clark 1967, Meyer & Macurda 1980, Zmarzly 1984, Messing 1998b). Utinomi & Kogo (1968) list it as a member of the Japanese crinoid fauna, but Kogo (1998) does not.

Order Isocrinida Sieverts-Doreck, 1952

Family Isocrinidae Gislén, 1924

Subfamily Metacrininae Roux, 1981

Saracrinus A. H. Clark, 1923

Saracrinus nobilis (Carpenter, 1884)

Material examined: GUAM: UGI 6812, Thompson-Cromwell Cruise 84-02/04 Sta.08, off Hospital Pt., on outside of shrimp trap, haul #15, ~366 m, 10 May 1984, R. Strong coll.

Additional records: NORTHERN CNMI: UGI 6680, SW Aguijan, Tow 27, 4 Sep 1983, D. Meyer det.

Notes: Roux (1981) transferred this species from *Metacrinus* to *Saracrinus*. This is the only stalked crinoid reported from the Marianas chain so far. The Aguijan specimen retains 38 cm of stalk and was reported to be tan to brown in life (Meyer & Macurda 1980).

Distribution: Western Sumatra to New Caledonia, the Kermadec Islands and New Zealand, and as far north as southern Japan and the Bonin Islands (Carpenter 1884, A.H. Clark 1923, Meyer & Macurda 1980, Roux 1981, Bourseau et al. 1991).

Artificial key to the shallow-water (<50 m) crinoids of Guam and the Commonwealth of the Northern Marianas Islands

This key to adult specimens includes only the most easily recognizable features. Small ten-armed juveniles of species that normally develop more than ten arms have not been included. For additional details, see the following sources identified by superscript numbers accompanying each species: 1) Messing (1998a), 2) A. H. Clark (1931), 3) Rowe et al. (1986), 4) A. M. Clark & Rowe (1971), 5) Messing (1995).

- 1a. More than ten arms..... 2
 1b. Ten arms only..... 17
- 2a. (1a) Cirri absent..... 3
 2b. (1a) Cirri present..... 5
- 3a. (2a) Exposed on prominent perches; anchors with curved lower arms that raise the central body above the substrate..... *Comanthus alternans*³
 3b. (2a) Central body hidden within reef framework or under ledges; only arms exposed..... 4
- 4a. (3b) Usually 40-125 fragile and extremely Velcro-like arms; rays well separated basally, longest 11-20 cm (specimens with fewer than 40 arms have ray lengths 5-9 cm); pinnule combs coiled into tiny fists or spirals; usually gold, orange or brown with darker aboral arm stripe.....
 *Phanogenia gracilis*^{1,2}
 4b. (3b) Usually 30-48 robust arms, not extremely Velcro-like; rays crowded basally (except in small specimens), longest usually 14-17 cm; pinnule combs taper to a point; yellow or green with green or black articulations....
 *Oxycomanthus mirus*³
- 5a. (2b) A few (usually <15) short cirri scattered around the margin of a small, thin, discoidal or pentagonal centrodorsal..... 6
 5b. (2b) Numerous (usually ≥20) cirri completely encircle centrodorsal, which may be thin or thick..... 8
- 6a. (5a) Usually 10-20 arms with longest rays <7 cm; hidden during the day; arms exposed at night, often banded white and red, lavender or brown; combs taper to a point, present only on first pinnule.. *Oxycomanthus exilis*³
 6b. (5a) Usually 25-40 arms with longest rays usually >10 cm; arms extend from crevices and branching corals during the day; sometimes more exposed at night..... 7

- 7a. (6b) Color variable, but most often brown or greenish with bluish pinnules and cirri; combs coiled, present on several proximal pinnules and at intervals along arm..... *Comanthus parvicirrus*³
- 7b. (6b) Color usually greenish or yellow-green, never with bluish pinnules or cirri; combs not coiled, present only as far as second pinnule on undivided arm..... *Clarkcomanthus littoralis*³
- 8a. (5b) Robust with more than 50 arms..... 9
- 8b. (5b) Slender with fewer than 40 arms..... 10
- 9a. (8a) Completely exposed; cirri 3-4 cm long, robust and elevating body above substrate; bases of rays well separated; arms resemble feathers (i.e., with pinnules arranged in single plane); colors variable: green, black, orange or yellow, often with differently colored pinnule tips.. *Oxycomanthus bennetti*³
- 9b. (8a) Completely exposed or with body partly hidden; cirri usually 2 cm long, not elevating body above substrate; underside of body appears solid due to pavement of small plates between bases of rays; successive pinnules offset (not in single featherlike plane); usually black, brown, yellow or a combination..... *Comaster schlegelii*³
- 10a. (8b) Comb teeth present on at least proximal pinnules..... 11
- 10b. (8b) Proximal pinnules without comb teeth..... 15
- 11a. (10a) Pinnules lacking Velcro-like texture; color dark red or purplish; pinnule combs usually of >20 tall narrow teeth; large specimens form fans on exposed perches at night; small specimens extend arms from crevices...
..... *Alloeocomatella polycladia*⁵
- 11b. (10a) Pinnules with Velcro-like texture; color never uniform dark red or purplish; pinnule combs of <15 teeth; arms may be visible during the day; sometimes completely exposed at night, but not forming fans on exposed perches..... 12
- 12a. (11b) Arms slender and fragile; cirri fine and delicate; rays orange or orange and white; rarely found shallower than 30 m..... *Phanogenia cf. distincta*^{1,2}
- 12b. (11b) Arms and cirri stout; color variable; found as shallow as 1 m..... 13
- 13a. (12b) Color usually white with reddish or brown bands; pinnule combs present at intervals to at least halfway out arm..... *Comanthus wahlbergii*³
- 13b. (12b) Color black, maroon, green or brown, sometimes yellow distally, and often with green or yellow mottling, flecks or spots; pinnule combs present only on proximal two or few pinnules on undivided arm..... 14
- 14a. (13b) Pinnule comb only as far as second pinnule on undivided arm; two or four ossicles between ray branches..... *Clarkcomanthus luteofusum*³

- 14b. (13b) Pinnule combs on first three to five pinnules; only two ossicles between ray branches.....*Comatella stelligera*²
- 15a. (10b) Usually clings to unbranched or sparsely branched antipatharians and gorgonians; color variable, often with rays and cirri of contrasting color....
.....*Cenometra bella*⁴
- 15b. (10b) Hidden during the day; forming arc-shaped or radial fans on exposed perches at night; usually concentrically banded with cream, brown and/or orange (sometimes green) 16
- 16a. (15b) One to several pinnules near arm bases rigid and spike-like, its component segments longer than wide.....*Stephanometra indica*⁴
- 16b. (15b) Second pinnule larger than others but not rigid and spike-like, its component segments squarish.....*Lamprometra palmata*⁴
- 17a. (1b) Rays reddish or orange, up to 50 cm long; 4-7 arms extend upward from a crevice only at night; withdraws rapidly when illuminated; central body almost never visible; centrodorsal discoidal with marginal ring of cirri.....*Alloeocomatella pectinifera*⁵
- 17b. (1b) Rays purplish, mauve, or pale tan and white, 3-4 cm long; cryptic under rubble; capable of swimming via rapid arm flexing; up to 30 extremely delicate cirri more or less cover a low hemispheric centrodorsal.....
.....*Dorometra nana*⁴

Discussion

We report 21 species of crinoids from Guam and the CNMI distributed among six families and thirteen genera; 20 are unstalked crinoids, or comatulids, of which all but the unidentified juvenile comasterid sp. A and the charitometrid, *Monachometra* cf. *patula*, are known from <50 m. This total adds twelve new records to earlier reports (Clark 1954, Meyer & Macurda 1980), as follows: *Alloeocomatella pectinifera*, *Clarkcomanthus littoralis*, *Clarkcomanthus luteofuscum*, *Comanthus alternans*, *Comanthus wahlbergii*, *Oxycomanthus exilis*, *Oxycomanthus* cf. *mirus*, *Phanogenia* cf. *distincta*, comasterid sp. A (Comasteridae), *Lamprometra palmata* (Mariametridae), *Monachometra* cf. *patula* (Charitometridae) and *Dorometra nana* (Antedonidae). Nine new records are added for Guam and the total fauna there is now at least 17 species. Eight new records are added for the CNMI (chiefly due to recent collecting by one of us at Saipan [L.K.]) and the known fauna there is now at least 10 species. Most of the 21 species reported here are well recognized and widely distributed across the Indo-Malayan archipelago and islands of the western Pacific, a pattern that also applies to the crinoid faunas of other Micronesian islands (A. M. Clark & Rowe 1971, Meyer & Macurda 1980, Zmarzly 1984, 1985, Messing 1998b). Species richness of these islands reflect well known declines among most groups

of benthic macrofauna from the rich central Indo-Malayan archipelago to the north, east and west (Table 1).

Although the marine fauna of Guam has been intensively surveyed during the last several years and is now among the most thoroughly investigated in Oceania (Amesbury et al. 2001, Paulay et al. 1997, Paulay et al. 2001, 2001, 2002), the current faunal list is probably incomplete. Gislén (1922) listed an additional seven shallow-water species (converted to current nomenclature) that occur in both Indo-Malaya to the southwest and Ogasawara-Gunto (Bonin Is.) to the north that have not yet been found in the Marianas Chain. Also, *Comatella stelligera* found at Rota I, CNMI, and the two species of *Clarkcomanthus* reported from Saipan herein have not yet been found at Guam. Although these absences may be real, it is also plausible that these taxa inhabit areas that are visited infrequently, or have never been sampled on Guam. Areas of strong currents not often visited by divers (e.g., Pati Point at the northern tip of Guam) may support rheophilic species such as *Colobometra perspinosa*, which has been reported anecdotally, but has not yet been photographed or collected. Soft bottom habitats (e.g., Apra Harbor) have not been explored as thoroughly as have reefs and hard-bottoms, and little deep-water dredging has taken place.

Table 1. Number of shallow-water (<50 m) species recorded from areas in the Indo-West Pacific region.

Island/Island Group	No. species	Source
Jolo Archipelago, Tubbataha Reefs & central Palawan (Sulu Sea)	58	A.H. Clark 1941, 1947, A.H. & A. M. Clark 1967, Messing 1998b
Lizard I., Great Barrier Reef	54	Hoggett & Vail, pers. commun. in Messing 1998b
Papua New Guinea	44	Messing 1998b
Chuuk	21*	Messing 1998b
Palau	19	Meyer & Macurda 1980
Madagascar	~20	Marshall & Rowe 1981
Taiwan	20	Chen et al. 1988
Guam	17	Meyer & Macurda 1980; this paper
CNMI	10	Meyer & Macurda 1980; this paper
Marshall Islands	14	Zmarzly 1984, 1985

Differing collecting methods, efforts, investigators and taxonomies among sites render the following records imperfectly comparable although numbers have been modified to reflect current taxonomy. *Messing's (1998b) list of species from Chuuk totaled 22 species, but only 19 were actually checked off. He omitted *Clarkcomanthus luteofuscum*, *Liparometra articulata* and *Comanthus ?wahlbergii* and treated *Stephanometra indica* and *S. oxyacantha* as separate.

Shallow-water species richness supposedly declines with distance to the north, west and east of the Indo-Malayan archipelago. However, Palau, which sits much closer to Indo-Malaya, supports only about four more nominal species than Guam (given taxonomic changes made since Meyer & Macurda 1980).

Although Chuuk atoll lies east of Guam, Messing (1998b) found 22 species there during only 14 dives, a greater richness than Guam. Finally, the Marshall Islands (Enewetak and Kwajalein), which lie twice as far from Indo-Malaya, support about the same number of species as Guam (Zmarzly 1984, 1985)(Table 1). Variable survey effort among sites notwithstanding, factors other than distance from the Indo-Malayan archipelago must thus contribute to crinoid faunal patterns among central western Pacific islands [although limited sampling in the CNMI almost certainly underestimates that fauna].

First of all, recorded Palauan richness is probably artificially low. Though reduced by taxonomic changes [e.g., synonymy of *Stephanometra spicata* and *S. oxyacantha* under *S. indica* (Rowe & Gates 1995; Rankin 2000)], the fauna likely includes several cryptic species distinguished since Meyer & Macurda (1980) surveyed those islands (e.g., *Comanthus suavia*, *C. gisleni* and *Clarkcomanthus littoralis* have all been confused with *Comanthus parvicirrus*), as well as others recorded from Guam, Chuuk and Indo-Malaya (e.g., *Alloeocomatella pectinifera*, *Oxycomanthus exilis*). Also, Meyer & Macurda dove at night at only one of more than 20 survey sites. Secondly, Guam is a single pinnacle surrounded by a narrow fringing reef. Chuuk, Enewetak and Kwajalein are atolls with broad lagoons and Palau is an archipelago surrounded by extensive shallow banks. All have substantially greater shallow-water area and habitat diversity than Guam. Also, while Palau, Chuuk and the Marshall Islands lie along a chain of island and bank stepping-stones that connect to the Indo-Malayan center of richness, about 450 km of open ocean separates Guam from its nearest potential shallow-water source of larvae to the south.

Finally, Guam lies within the North Equatorial Current, so its most direct source of larval recruitment might be Enewetak, almost 2000 km due east. Although nothing is known about the longevity or dispersal capabilities of tropical Pacific crinoid larvae, modern circulation patterns may not have generated current faunas. For example, Benzie & Williams (1997) have shown that the genetic structure of *Tridacna* spp. does not agree with modern current patterns; they suggest that changes in circulation associated with Quaternary climate changes and sea level fluctuations may have shaped faunal affinities observed today. A more detailed understanding of crinoid faunal patterns must await information about larval longevity, reproductive patterns and fecundity, and evolutionary and biogeographic history, about which nothing is currently known.

Little endemism exists among the shallow-water crinoids of Oceania and no examples currently exist for Guam or CNMI. *Eudiocrinus tenuissimus* is known only from Jaluit Atoll (Gislén 1940), *Euantedon tahitiensis* and *Mastigometra pacifica* are known only from Tahiti (A. H. Clark & A. M. Clark 1967), and several species are currently known only from Ogasawara-Gunto (A. H. Clark 1947, 1950), which, like the Marianas Chain (Guam + CNMI), is separated from adjacent island groups by similarly broad deep-water gaps. However, given the recent discovery of such morphologically cryptic taxa as the *Comanthus gisleni*-

C. suavia-*C. parvicirrus* complex, endemism may be simply unrecognized in the Marianas Chain. For example, the local *C. schlegelii*, which as outlined above seems to be a heavier, robust morphotype exclusive to Micronesia, may at least be restricted to this region. Given their demonstrated success with other difficult groups of marine invertebrates, molecular techniques will likely prove extremely useful in solving many of these systematic problems.

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