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NOTE
Range Extensions of Echinoderms (Asteroidea, Echinoidea and Holothuroidea) to Guam, Mariana Islands

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Abstract—We report range extensions to Guam for fourteen echinoderm species and provide notes on their ecology: *Pentaceraster alveolatus* Perrier, *Valvaster striatus* (Lamarck), *Chondrocidaris gigantea* A. Agassiz, *Pseudoboletia maculata* Troschel, *Maretia planulata* (Lamarck), *Metalia dicrana* H. L. Clark, *Parasalenia gratiosa* A. Agassiz, *Actinopyga obesa* (Selenka), *Holothuria* (*Mertensiothuria*) *fuscocinerea* Jaeger, *H.* (*Microthele*) *fuscogilva* Cherbonnier, *H.* (*Semperothuria*) *flavomaculata* Semper, *H.* (*Platyperona*) *excellens* (Ludwig), *H.* (*Theelothuria*) *turriscelsa* Cherbonnier and *Stichopus noctivagus* Cherbonnier. Surveys were conducted primarily at night on coral reefs from 1 to 43 m in depth.

Introduction

Echinoderms are important components of coral-reef ecosystems and have been extensively studied. However, surveys in Micronesia have generally been conducted during the day in shallow water (e.g., Grosenbough 1981, Cutress & Rowe 1986), so that species inhabiting the reef slope, particularly nocturnal and infaunal forms, are little known. Knowledge of the distribution and ecology of these echinoderms could contribute to an understanding of reefal processes and regional biogeography. This paper records range extensions for fourteen echinoderms to the Micronesian island of Guam, the southernmost island in the Mariana archipelago.

There are several recent accounts of Guam's echinoderms. Yamaguchi (1975) listed 26 asteroids from Guam. Three additional species were described in Pope & Rowe (1977) and in Rowe & Nichols (1980). Five echinoids from Guam were reported by A. H. Clark (1954). Rowe & Doty (1977) found 30 holothuroids in the shallow waters around Guam. Several technical reports list echinoderms from Guam and give information on their distributions and habitats (e.g., Dickinson & Tsuda 1975, Stojkovich 1977, Zolan 1981).

Collections for this study were made on several reefs on Guam (Fig. 1). Names of the collection sites were taken from USGS topographic maps. Guam (13° N, 145° E) is a small (≈540 km²), volcanic and uplifted-limestone island with a narrow fringing reef in the western Pacific Ocean. We examined reef flats, sinkholes on the reef flat, lagoons and reef slopes, primarily at night, with the aid of SCUBA to depths of 43 m. We found twelve previously unreported echinoderms from the classes Asteroidea, Echinoidea and Holothuroidea. Two additional unreported echinoderms collected by others are also included in this account.

Annotated Species List

The echinoderms are listed below in taxonomic order. Information on each specimen's habitat, locality and behavior are given. Asteroids and echinoids were determined by the senior author or the authority indicated. The holothuroids were identified by the authors (A.M.K. and D.R.H.) using the listed references. Other works listing synonomies and with information on biology are provided. Collection numbers for voucher specimens are from the University of Guam Invertebrate Collection (UGI) unless indicated otherwise.

Class Asteroidea

Family Oreasteridae

Pentaceraster alveolatus Perrier 1875

Fisher 1919: 348–350, pl. 101 fig. 1; Jangoux 1986: 126–127.

Voucher specimen: J20234 (Australian Museum), one specimen, Piti reef flat, early 1986, collected by L. G. Eldredge early 1989 (date not recorded), determined by F. W. Rowe.

Remarks: *P. alveolatus* is reported from western Polynesia, Philippines, New Caledonia and Hawaii (Fisher 1906, Jangoux 1986).

Family Valvasteridae

Valvaster striatus (Lamarck 1816)

Plate 1b

Fisher 1906: 1092–1094, pl. 38 fig. 4–4a; Jangoux 1986: 146–147.

Voucher specimen: UGI 5718, one specimen, northern Piti Bay in sinkholes on reef flat at night; at 7 m depth on sand at base of dead *Porites* sp., collected by K. D and L. S. Meyer 9 March 1991, determined by L. M. Marsh.

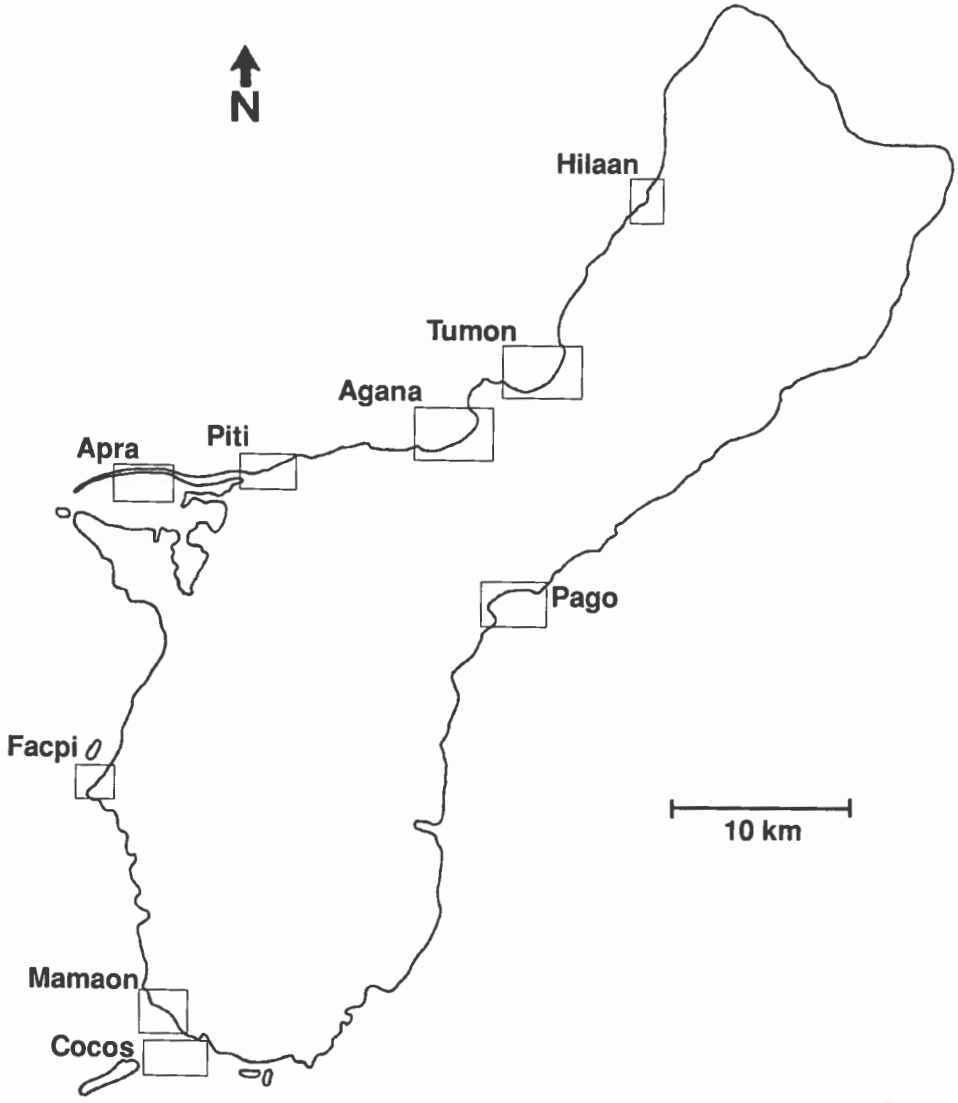

Figure 1. Map of Guam, Mariana Islands, showing the sites mentioned in the text.

Remarks: This specimen had four orange and greenish-grey banded arms. Two uncollected specimens from the same location had five arms. All observed specimens were found at the base of dead coral on sand and/or rubble. *V. striatus* is capable of producing considerable amounts of mucopolysaccharides, a trait also reported from the Pterasteriidae (Kozloff 1987). One specimen of *V. striatus* converted a liter of water to thick mucus in about 30 min. It has also been reported from 20 to 30 m depth on the reef slope between Agana Bay and Tumon Bay and at a similar depth on the reef slope at Pago Bay (B. Smith pers. comm.). *V.*

striatus has been found in the Gulf of Bengal, Mauritius (Fisher 1906), New Caledonia, Philippines and the Hawaiian Islands (Jangoux 1986).

Class Echinoidea
Family Cidaridae
Chondrocidaris gigantea A. Agassiz 1863

Aggasiz & Clark 1907: 11–12; Chantel de Ridder 1986; 30–31.

Voucher specimen: UGI 5717, one specimen, Sumay Channel, mouth of Sumay river, west side of channel, under rocks and rubble on a shelf at 10 m depth, collected by M. Rogers 6 March 1990, determined by C. E. Birkeland.

Remarks: The large primary spines were colonized by several epibiotic organisms: coralline algae, sponges, hipponicid gastropods, the bivalve *Pinctada* sp., and spirorbid polycheates. This species has previously been reported from the Hawaiian, Maurice, and Loyalty islands in the Pacific (Chantel de Ridder 1986).

Family Toxopneustidae
Pseudoboletia maculata Troschel 1869
Figure 2

Clark & Rowe 1971: 142–143, 156.

Voucher specimen: CASIZ 081252 (California Academy of Sciences Invertebrate Zoology Collection), one specimen, southern Piti reef flat ("U.S.O. Beach") at <1 m depth during the day, collected by R. K. Sakamoto early March 1992, determined by R. Mooi.

Remarks: Living specimen was a light cream with dark brown patches (Fig. 2). One uncollected specimen was seen on the reef slope at 7 m depth during the day north of Hilaan Point (C. Birkeland photorecord). This species is known from Ceylon, East Indies, northern Australia, Philippines, China and southern Japan (Clark & Rowe 1971).

Family Parasalenidae
Parasalenia gratiosa A. Agassiz 1863

H. L. Clark 1912: 369; H. L. Clark 1938: 407–408; Clark & Rowe 1971: 142–143, 157, fig. 70a.

Voucher specimens: UGI 5728, seven juvenile specimens, patch reef ("Dog-leg Reef") in north Apra Harbor, among branches of *Porites cylindrica* with adults at night at 3 m depth, collected by A. M. Kerr 28 January 1992. UGI 5740, one

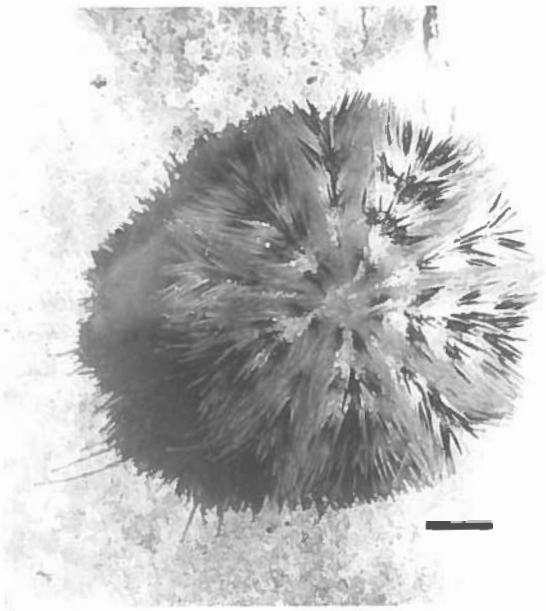

Figure 2. *Pseudoboletia maculata* Troschel, CASIZ 081252 (Calif. Acad. Sci.), live specimen not *in situ*, scale bar = 3 cm.

specimen, patch reef ("Dogleg Reef") in north Apra Harbor at night at 3 m depth on live *Porites rus*, collected by P. J. Schupp 28 January 1992.

Remarks: The spines were dark brown in large specimens and banded with grey in juveniles. The spines of all specimens had a characteristic white ring at the base. The maximum test diameters of a random sample collected in north Apra Harbor was 26.3 ± 3.6 mm (n = 12, range = 19–32 mm). This species has been found on patch reefs ("Dogleg" and Western Shoals) in Apra Harbor and in the sinkholes at Piti Bay, primarily at night. Only juveniles were found parasitized by the eulimid gastropod *Viteobalcis* sp., although both young and adults were collected in the same habitat. This species has been reported from the western IndoPacific (de Ridder 1986).

Family Spatangidae

Maretia planulata (Lamarck 1816)

Plate 1a

Mortensen 1951: 21–39; Clark & Rowe 1971; 146–147, 165, fig. 82a; Norris 1991: 89–95, fig. 3.

Voucher specimen: UGI 5725, Glass Breakwater, north Apra Harbor, found 5–10 cm deep in unconsolidated sediment at 15 m depth, collected by D. R. Norris 21 May 1991, determined by M. Tsuchiya.

Remarks: Individuals generally have white to light grey spines and test, with larger individuals possessing two dark bands around the perimeter of the test. A single population of *Maretia* has been found off the Glass Breakwater in north Apra Harbor, Guam. *Maretia* is found in average densities of 4 individuals per 0.5 m^2 at 6 m in depth to a maximum of >25 individuals per 0.5 m^2 at 30 m in depth. Mean maximum test diameter of *Maretia* ranged from 12 mm at 12 m in depth to 15.5 mm at 23 m in depth. *Maretia* is a non-selective deposit feeder and moves through the sediment using modified spines on the oral surfaces (Norris 1991). Individuals were often found with one to three parasitic eulimid gastropods attached to their tests. Other organisms which have been observed in the sediment with *Maretia* include *Metalia dicrana*, tube-dwelling polychaetes, bivalves and gastropods. *Maretia* is distributed from east Africa and the Red Sea to Fiji and New Caledonia eastward to the Gilbert Islands (Mortensen 1951).

Family Brissidae

Metalia dicrana H. L. Clark 1917

Mortensen 1951: 546; Clark & Rowe 1971: 146–147, 166; Tsuchiya et al. 1989: 241–255; Norris 1991: 89–95, fig. 3.

Voucher specimen: UGI 5729, one specimen, Glass Breakwater, north Apra Harbor, found 5–10 cm deep within unconsolidated sediment at 4 m in depth, collected by D. R. Norris 21 May 1991, determined by M. Tsuchiya.

Remarks: A single population of *Metalia dicrana* was found in Apra Harbor, Guam. *M. dicrana* was found at lower densities than *Maretia planulata*, an infaunal urchin found in the same habitat (Norris 1991). *M. dicrana* is found in Malaysia, Fiji, Philippines and Samoa (Mortensen 1951).

Class Holothuroidea

Family Holothuriidae

Actinopyga obesa (Selenka 1867)

Figure 3a

Panning 1944: 56–57, fig. 25; Clark & Rowe 1971: 176–177; Cherbonnier 1988: 20, fig. 3a–k.

Material examined: UGI 5713, one specimen, northern Piti Bay on reef flat at night, feeding at 1 m depth on rubble and sand, collected by A. M. Kerr 29 January 1991.

Remarks: This specimen is entirely dark brown. We have also seen, but not collected, this species in Cocos lagoon on sand and rubble in stands of the seagrass *Enhalus acoroides* at 1.5 m depth, on the inner reef flat of Tumon Bay and northern Agana Bay, and on a patch reef ("Double Reef") north of Hilaan at 7 m

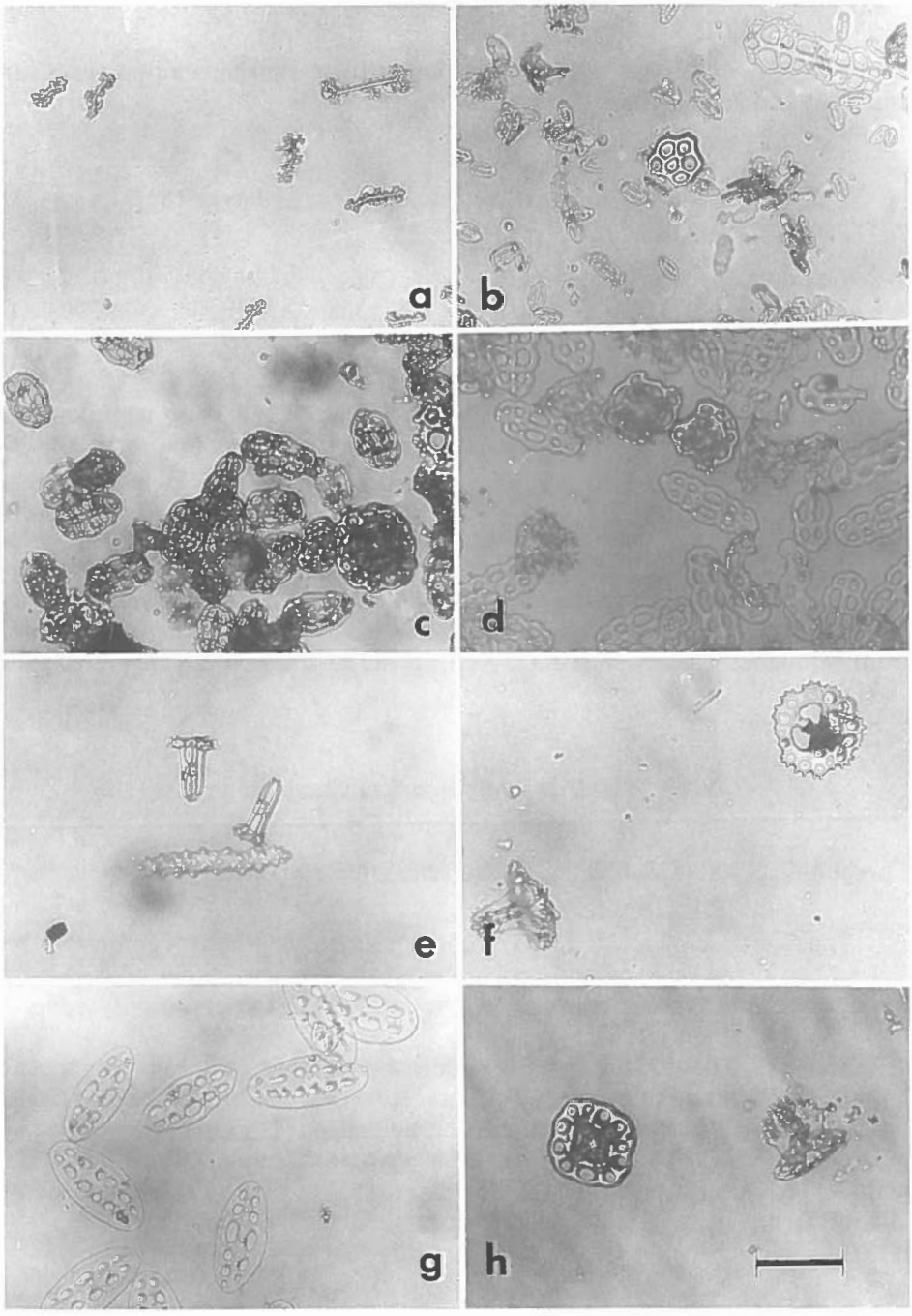

Figure 3. Photomicrographs of holothuroid spicules. Ossicles are from mid-dorsal body wall, unless indicated otherwise. Scale bar = 100 μm. (a) *Actinopyga obesa* (Selenka), UGI 5713. (b) *Holothuria* (*Mertensiothuria*) *fuscocinerea* Jaeger, UGI 5726. (c) *H.* (*Microthele*) *fuscogilva* Cherbonnier, UGI 5712. (d) *H.* (*M.*) *fuscogilva* Cherbonnier, UGI 5712, mid-ventral body wall. (e) *H.* (*Semperothuria*) *flavomaculata* Semper, UGI 5722. (f) *H.* (*Theelothuria*) *turriscelsa* Cherbonnier, UGI 5720. (g) *H.* (*Platyperona*) *excellens* (Ludwig), UGI 5723, buttons. (h) *H.* (*P.*) *excellens* (Ludwig), UGI 5723, tables.

depth. *A. obesa* has been recorded previously from Hawaii, Philippines, China and Southern Japan (Clark & Rowe 1971).

Holothuria (*Mertensiothuria*) *fuscocinerea* Jaeger 1833
Figure 3b

Deichmann 1958: 300–301, pl. 3 figs. 13–23; Clark & Rowe 1971: 176–177; Chao & Chang 1989: 120, 122–123, figs. 23a–e, 31b, 35a; Cherbonnier 1988: 108–110, figs. 44a–o.

Voucher specimen: UGI 5726, one specimen, Hilaan Point in sinkhole on reef flat at night, at 1 m depth on sand in crevice under coralline rock, collected by A. M. Kerr 25 January 1992.

Remarks: The dorsum is greyish brown with large patches of dark brown. The podia are greyish and ringed at the base with dark brown. The specimens ejected a few very long, thick, translucent cuvierian tubules when first disturbed. Uncollected specimens were seen at Piti and Mamaon Channel on sand in crevices on the reef flat, reef-flat sinkholes or channel slope. *H. fuscocinerea* is reported from throughout the tropical Indo-west Pacific to the Red Sea (Clark & Rowe 1971).

Holothuria (*Microthele*) *fuscogilva* Cherbonnier 1980
Plate 1h, Figure 3c–d, 4d

Cherbonnier 1980: 628–630, fig. 7a–l; Féral & Cherbonnier 1986: 88–89.

Voucher specimen: UGI 5712, one specimen, southern Tumon-Bay reef slope 11 m depth on sand and rubble during the day, ca. 30 cm relaxed length when caught, but experienced considerable degrowth in 1 yr of captivity, collected by D. R. Hopper July 1989.

Remarks: The dorsum is brown while the sides are light tan with spots of brown. The bottom is uniformly light tan. It has several brown "teats," conical bumps, arranged in ventrolateral rows on both sides. The area around the anus is also dark brown. This species has been reported from New Caledonia, Tahiti and the Tuamotu Islands (Féral & Cherbonnier 1986). The single sighting from Guam extends its range considerably northward.

Holothuria (*Semperothuria*) *flavomaculata* Semper 1868
Plate 1g, Figure 3e

Clark & Rowe 1971: 178–179, pl. 27, fig. 15; Cherbonnier 1980: 634–635, fig. 10a–f; Féral & Cherbonnier 1986: 90–91.

Voucher specimen: UGI 5722, one specimen, northern Piti Bay in sinkholes on reef flat at night, at 7 m depth in base of live *Porites cylindrica*, collected by A. M. Kerr 7 July 1991.

Remarks: The specimens are greyish brown with yellow-tipped papillae and tentacles. This species extended its anterior end from crevices to feed at night. This species was also found, but not collected, on a patch reef ("Dogleg Reef") in northern Apra Harbor and Mamaon Channel at 1 to 4 m depth amongst plates and columns of live *Porites rus*. *H. flavomaculata* is found from the Red Sea to the South Pacific (Clark & Rowe 1971). In Micronesia it has been reported from Yap (Grosenbough 1981) and Palau (Panning 1944).

Holothuria (*Theelothuria*) *turriscelsa* Cherbonnier 1980
Plate 1d, Figure 3f

Cherbonnier 1980: 644–646, fig. 15a–l, pl. 1e; Féral & Cherbonnier 1986: 92–93.

Voucher specimen: UGI 5720, one specimen, northern Piti Bay in sinkholes on reef flat at night, at 7 m depth at base of live *Porites cylindrica* on rubble and sand, collected by A. M. Kerr 7 July 1991.

Remarks: The enlarged bases of the papillae on the dorsal tegument are characteristic. Most specimens seen were grey with dark brown papilliar bases; one uncollected animal, though, had a uniformly dark brown dorsum and beige flanks. Most specimens ejected many long, thick cuvierian tubules when handled. An uncollected specimen at Piti was parasitized by the eulimid gastropod *Melanella* sp. We have seen this species in the sinkholes at Piti, on the reef slope between Apra and Facpi (Agat) at about 3 m depth, the reef slope at north Tumon from 15 to 21 m depth and Pago on the reef slope at 43 m depth. *H. turriscelsa* has been found as much as 1.5 m below the surface of loose rubble on the reef slope at Piti (B. Smith pers. comm.). By comparison, *H.* (*Mertensiothuria*) *pervicax* Selenka at the same site was only found to 0.5 m deep (B. Smith pers. comm.). This species has previously been reported only from New Caledonia (Cherbonnier 1980).

Holothuria (*Platyperona*) *excellens* (Ludwig 1875)
Plate 1e–f, Figures 3g–h, 4a–c, 5a–e

Ludwig 1875: 98, fig. 32a–c; Théel 1886: 199; Cherbonnier 1988: 94–95, fig. 37a–n.

Voucher specimens: UGI 5723 and UGI 5724, one specimen each, northern Piti Bay in sinkholes on reef flat at night, at 7 m depth on base of live *Porites cylindrica*, collected by A. M. Kerr 7 July 1991.

Description: Body slightly flattened ventrally, convex dorsally. Uniformly purplish black in life, completely black in alcohol. Handling live animals stains

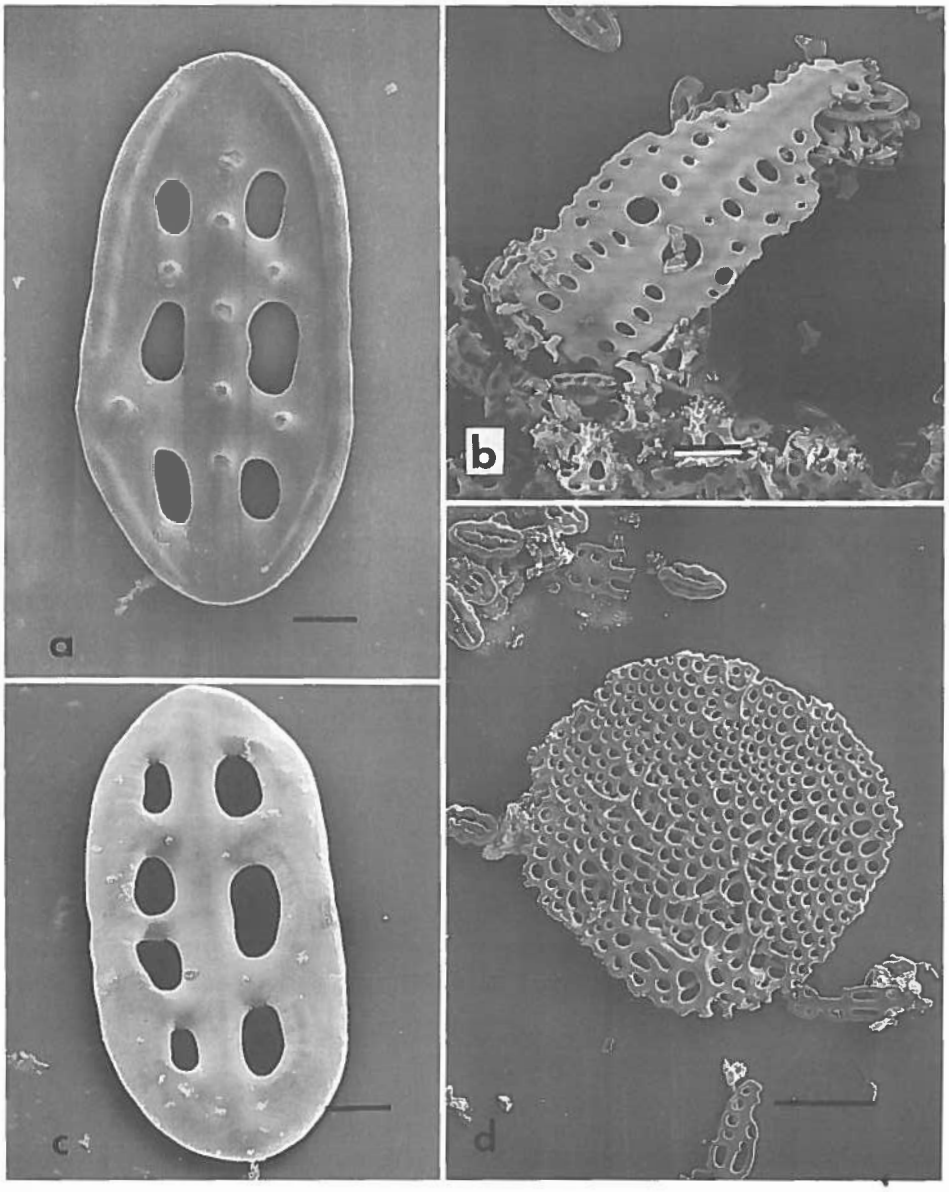

Figure 4. Electron micrographs of holothuroid spicules. (a) *Holothuria* (*Platyperona*) *excellens* (Ludwig), UGI 5723, knobbed and rimmed button, mid-dorsal body wall, scale bar = 10 μm. (b) *H.* (*P.*) *excellens* (Ludwig), UGI 5723, plaque from ventral podia, scale bar = 50 μm. (c) *H.* (*P.*) *excellens* (Ludwig), UGI 5723, smooth button, mid-dorsal body wall, scale bar = 10 μm. (d) *H.* (*Microthele*) *fuscogilva* Cherbonnier, UGI 5712, plaque from ventral podia, scale bar = 100 μm.

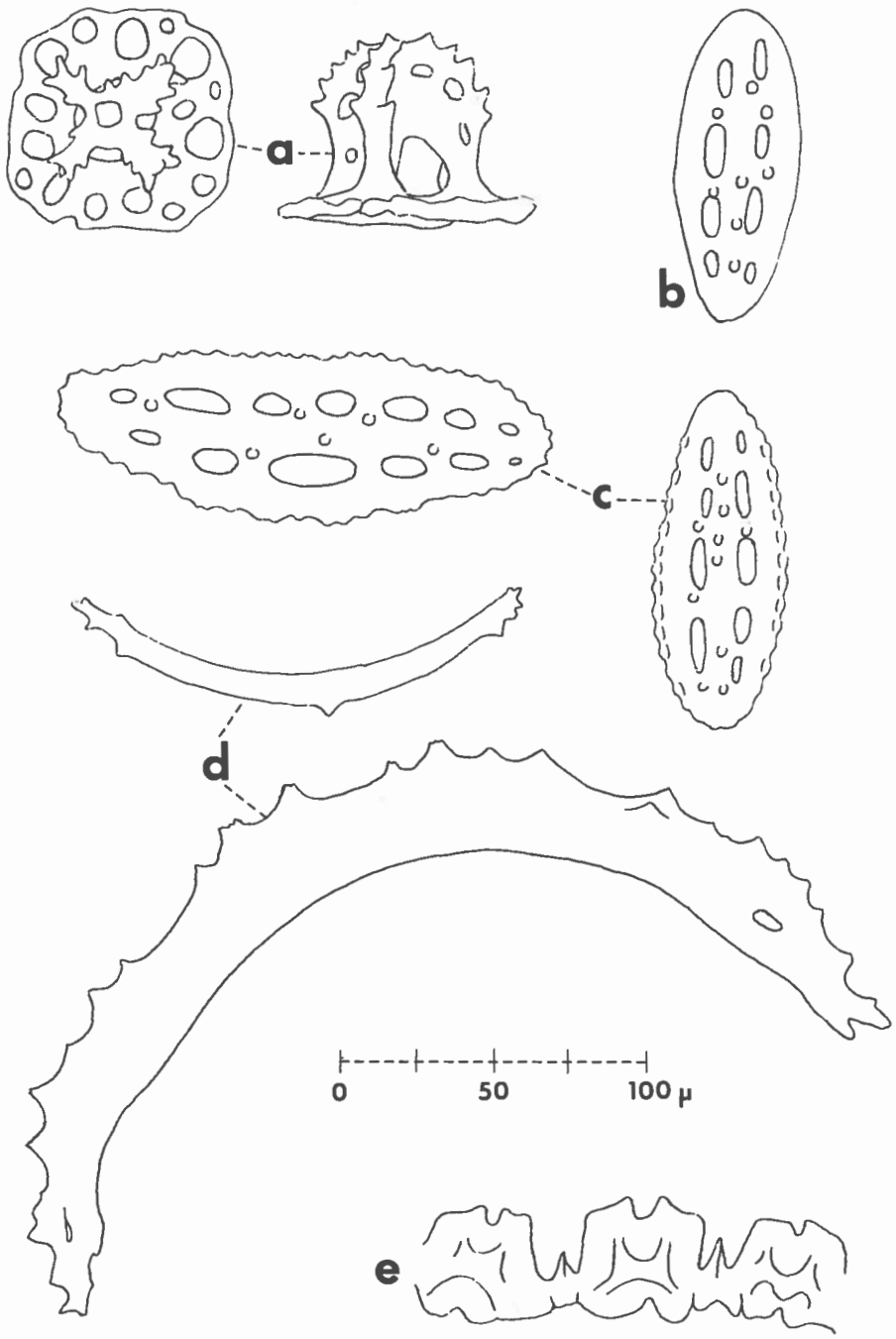

Figure 5. *Holothuria* (*Platyperona*) *excellens* (Ludwig). Scale bar applies to a–d. (a) Body wall tables. (b) Smooth rimmed button from dorsum. (c) Knobby rimmed and large notched buttons from ventrum. (d) Tentacle rods. (e) Calcareous ring.

the hands purplish black. The dark epidermis peels off, revealing white and light brown mottled dermis below. Undisturbed lengths of live animals in the field averaged 187.7 ± 45.5 mm (n = 30, range = 110 to 290 mm). Width usually between 30–40 mm. Body wall hard and about 4 mm thick middorsally. Dorsal papillae short, scattered, 1–2 cm^{-2}. Podia dark purplish black, arranged ventrally in three long bands at densities of 8–10 cm^{-2}. Oral tentacles 20, 120–150 mm long, dark purple in life, greyish black in alcohol, surrounded by an even collar of flattened triangular papillae.

Interior of body cavity white. Radial longitudinal muscles to 15 mm wide, thin, white, depressed along center. Gonads of a 23-cm female collected in early February numerous, in one tuft, light blue, sometimes branched once or twice, to 70 mm long, 5 mm wide, with a few mature ova, the germinal vesicle and nucleolus plainly visible. Polian vesicle 50 mm long, clear with small irregular black blotches, proximal section ovoid, distal portion elongate and pointed. Tentacle ampules clear, elongate, pointed, length to 40 mm. Respiratory trees paired, yellowish. Cuvierian tubules numerous, very thin, white, ejected in short pieces. Wet weight of ejected cuvierian tubules of a 23-cm specimen 30.9 g; mean dried weight of tubules 2.79 ± 1.00 g (n = 4, range = 1.92 to 4.03 g). Calcareous ring stout, well developed, radial plates little less than twice as long as interradial plates and three to four times wider (Fig. 3e). Radial plates squarish about 7 to 8 mm long, with small anterior and posterior notches. Interradial plates, narrow, weakly notched posteriorly, pointed anteriorly, about 4 mm long.

Body wall spicules are tables and buttons (Fig. 3g–h, 4a–c, 5a–d). Base of tables 60–80 μm in diameter, squarish with smooth or slightly undulating rim, 10–12 large holes and occasionally two to three smaller holes near to or opening onto the rim. Spire short, four columned, terminating in a spiny crown. Buttons flattened, 90–110 μm long, broadly ovoid to elliptical, 6–13 circular to ovate holes arranged in two rows on either side of the slightly raised longitudinal axis, often with numerous knobs 2–3 μm high concentrated along median, margin smooth or with knobs along raised outer rim or notched in larger buttons. Plaques from podia are 200–500 μm long and perforated. Tentacle rods curved, with scattered spines on convex side, usually with spiny, knobbed ends.

Remarks: Though the specimen pictured in Plate 1e–f was photographed during daylight, this species is strictly nocturnal. *H. (P.) excellens* was seen active only at night among live colonies of *Porites cylindrica* and *P. rus* between 2–10 m in depth. It was usually seen feeding on the calcareous- and filamentous-algal encrusted dead branches immediately below the living coral. However, it was

Plate 1. Previously unrecorded echinoderms from Guam. No specimens are *in situ*. (a) *Maretia planulata* (Lamarck). (b) *Valvaster striatus* (Lamarck), UGI 5717. (c) *Stichopus noctivagus* Cherbonnier. (d) *Holothuria (Theelothuria) turriscelsa* Cherbonnier with cuvierian tubules extending from anus. (e) *H. (Platyperona) excellens* (Ludwig), UGI 5723. (f) *H. (P.) excellens* (Ludwig), UGI 5723. (g) *H. (Semperothuria) flavomaculata* Semper, UGI 5722. (h) *H. (Microthele) fuscogilva* Cherbonnier, UGI 5712, preserved specimen.

occasionally seen on live coral with its tentacles extended onto the corallites. The population in the sinkholes at Piti was over 100 individuals at an estimated maximum density of 3–4 m^2. Smaller, less dense populations were seen at several locations on the leeward coast of Guam: Mamaon Channel, Hilaan Point and a patch reef ("Dog-leg") in north Apra Harbor.

This species was synonomized under *H.* (*P.*) *difficilis* by Deichmann (1958). The specimens found on Guam, however, lend support to Cherbonnier's (1988) view that *H.* (*P.*) *excellens* is a valid species. *H.* (*P.*) *excellens* differs from other holothuroids in the subgenus *Platyperona* by its much larger size (to at least 290 mm), dark purple color and its habitat amongst live coral. The rimmed and knobbed buttons most resemble those of a subtropical Atlantic *Platyperona*, *H.* (*P.*) *rowei* Pawson 1981. Among sympatric holothuroids, its spicules resemble those of *H.* (*P.*) *difficilis*, except for the presence of knobbed and rimmed buttons (Fig. 4a). Knobbed buttons are reported occasionally from platyperonids (e.g., *H.* (*P.*) *sanctori* Delle Chiaje 1823), where they appear more frequently in larger animals (Pawson 1978). However, small individuals of *H.* (*P.*) *excellens* (110–120 mm) found in this study which overlap in size the largest specimens of *H.* (*P.*) *difficilis* found on Guam (A. M. Kerr unpublished data), are distinct in spicule form, as well as coloration and habitat. Additionally, the holotypes of *excellens* and *difficilis* described in Ludwig (1875) and Semper (1868), respectively, also differ in spicule form and color, yet are both quite small (75 and 70 mm long, respectively) and recorded from Samoa. Therefore, it is very unlikely that the aforementioned features are related to ontogenetic changes or geographic variation. *H.* (*P.*) *excellens* has been reported from Samoa (Ludwig 1875) and Madagascar (Cherbonnier 1988)

Family Stichopodidae

Stichopus noctivagus Cherbonnier 1980

Plate 1c

Cherbonnier 1980: 654–656, fig. 19a–p; Féral & Cherbonnier 1986: 96–97.

Voucher specimen: UGI 5721, one specimen, northern Piti Bay in sinkholes on reef flat at night, at 7 m depth on coralline rock and sand, collected by A. M. Kerr 4 January 1992.

Remarks: The specimen is white with numerous small, irregular patches of red. The papillae are few, prominent, pointed and emerge from a dark reddish-brown base. This species is nocturnal and has only been found at Piti where only two specimens have been seen to date. *S. noctivagus* has previously been reported only from New Caledonia (Cherbonnier 1980).

Discussion

There are now 28 asteroids, 22 echinoids and 37 holothuroids reported from Guam. The asteroids and echinoids reported here are found in the tropical western

Indo-Pacific. The holothuroids, *Actinopyga obesa*, *Holothuria* (*Mertensiothuria*) *fuscocinerea*, *H.* (*Platyperona*) *excellens* and *H.* (*Semperothuria*) *flavomaculata*, are also widely distributed. The other holothuroid records are of poorly known species. *H.* (*Theelothuria*) *turriscelsa*, and *Stichopus noctivagus* were recently described (Cherbonnier 1980) and are reported outside their type locality, New Caledonia, for the first time. They probably have a wide distribution in at least the western Pacific. We report *H.* (*Microthele*) *fuscogilva* based on a single specimen collected from Tumon. However, this holothuroid is common at depths of >30 m on the neighboring island of Rota (A. M. Kerr pers. obs.), and likely occurs at other localities on Guam.

The communities of little-known echinoderms reported in this paper could provide an opportunity to study their ecology in detail. The parasitic eulimid gastropods from *Parasalenia gratiosa* and *H.* (*T.*) *turriscelsa* are undescribed (A. Warén pers. comm.). Norris (1991) examined depth and particle-size partitioning between the echinoids *Maretia planulata* and *Metalia dicrana*. We noted several novel attributes of other species as well (see *Annotated species list*).

Most of the species were found at night below depths of 3 m. Surveys using SCUBA at moderate depths have turned up many new species of echinoderms in recent years (e.g., Cherbonnier 1980, Lambert 1986, Massin & Lane 1991). Our surveys on the relatively well-sampled island of Guam uncovered no new species. However, collecting time totalled less than 100 hours on a few reefs, yet disclosed 12 range extensions. Many areas of the tropical Pacific, including Micronesia, have not been thoroughly sampled beyond snorkeling depth. Surveys in deeper water, particularly at night, will undoubtably continue to provide researchers with many new finds, reminding us of our meager knowledge about the remarkable diversity of life on coral reefs.

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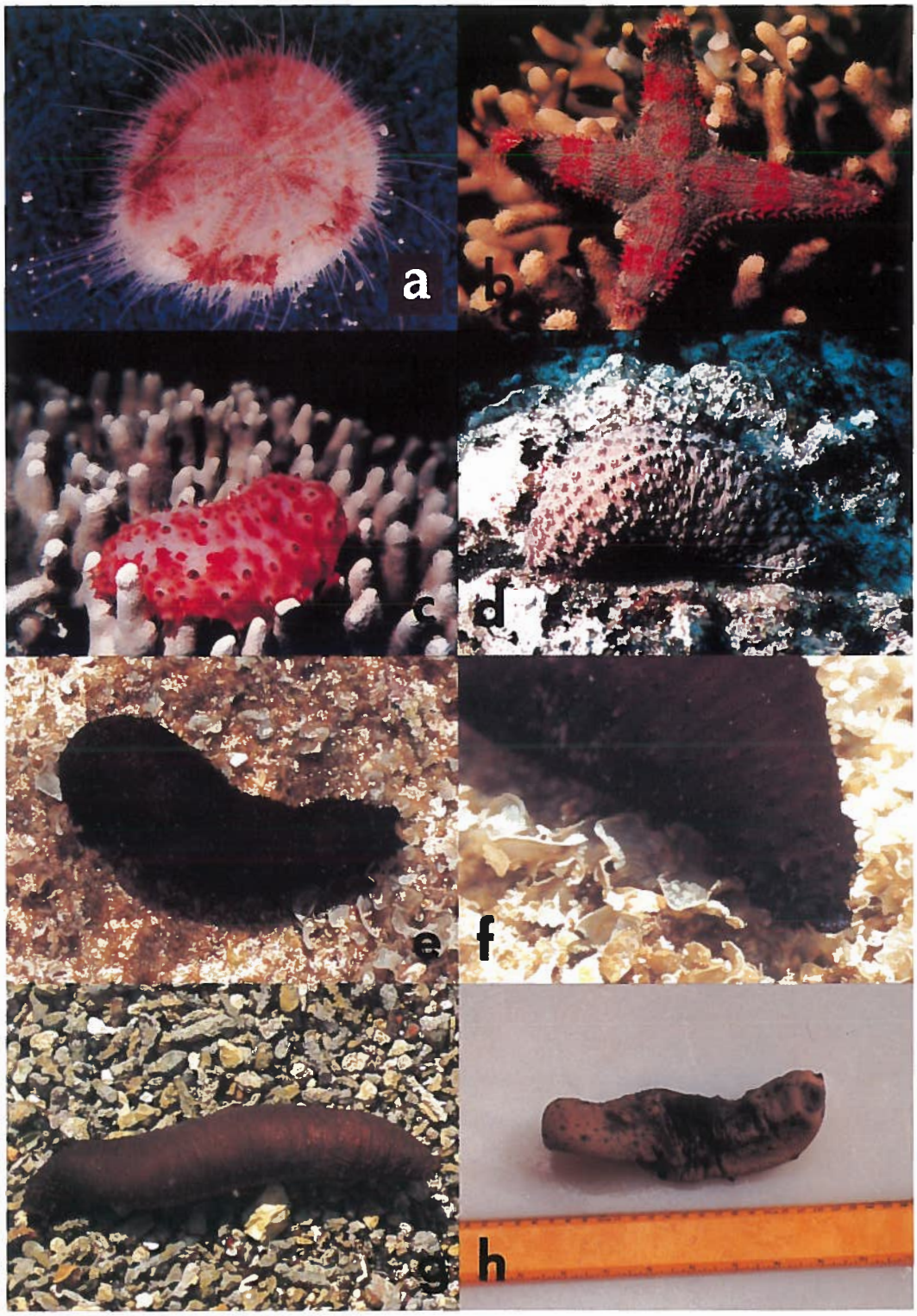
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