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Taxonomic inventory of the sponges (Porifera) of the Mariana Islands

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Abstract—We review the sponge fauna of the Mariana Islands based on new and existing collections, and literature records. 124 species of siliceous sponges (Class Demospongiae) and 4 species of calcareous sponges (Class Calcarea) have been identified to date, representing 73 genera, 44 families, within 16 orders. Several species are adventive. Approximately 30% (40) of the species encountered are undescribed, but not all are endemics, as the authors know them from other locations. Approximately 30% (38) of the species are known from diverse locations within the Indo West Pacific, but several well-known, widespread species are absent. The actual diversity of sponge fauna of the Marianas is considerably higher, as many species, especially cryptic and encrusting taxa, remain to be collected and studied.

Introduction

Our knowledge of the sponge fauna of the tropical Pacific has increased substantially in recent years, as a result of enhanced collecting effort driven in

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part by pharmaceutical interests, and by the attention of a larger number of systematists working on Pacific sponges than ever before. Nevertheless, with the exception of Micronesia, Hawaii, Papua New Guinea, and New Caledonia, the sponge faunas of most tropical island groups in Oceania are poorly known (Kelly-Borges & Valentine 1995). Prior to the 1950's, records of Pacific sponges were fragmentary and confined to the reports of major scientific expeditions such as that of the H. M. S. *Alert* (Ridley 1884), the H. M. S. *Challenger* (Ridley & Dendy 1886, 1887), and the *Albatross* (Agassiz 1906; Lendenfeld 1910a, b; 1915; Wilson 1925). Our basic knowledge of Micronesian sponges is based largely on the studies of de Laubenfels (1954) and Bergquist (1965), with the former including material from the Mariana Islands. De Laubenfels (1954) recorded 9 species from Guam and 10 from Saipan, with one species in common, based on his own collecting on both islands, as well as on material gathered by Preston Cloud on Saipan. Few taxonomic papers have appeared on sponges from the Marianas since. Hartman & Goreau (1975, 1976) described two coralline sponges, *Acanthochaetetes wellsi* and *Stromatospongia micronesica*, from caves on Guam and Saipan. Smyth (1990) recorded 7 species of boring sponges from gastropod shells on Guam. *Terpios hoshinota* received much attention on Guam due to the threat it poses to reefs because of its rapid, enveloping growth (Bryan 1973; Plucer-Rosario 1987); it was described by Rützler & Muzik in 1993. Quinn & Kojis (1999) described the community structure of coralline sponges from the "Grotto", a well-known marine cavern on Saipan.

The Coral Reef Research Foundation (CRRF) has contributed significantly to our knowledge of the sponge fauna of Saipan, Tinian and Rota Islands in the Commonwealth of the Northern Mariana Islands (CNMI). CRRF is a non-profit organization based in Koror, Palau and engaged in a long-term sponge collection and inventory program in Micronesia and elsewhere in the Indo-West Pacific. Kelly-Borges & Valentine (1995) reviewed knowledge of sponges of the tropical island region of Oceania, including published and unpublished species identified through CRRF research, up to that time. Unfortunately numerous records were inadvertently listed from the Marianas in that paper that did not originate from there. All CRRF records from the Marianas were therefore reevaluated for the present publication and records that we do not list from the Marianas but appear in Kelly-Borges & Valentine (1995) should be disregarded.

Our knowledge of the marine sponges of Guam has increased markedly since the mid-1980's, first as a result of a research program on marine natural products and chemical ecology established by Valerie Paul at the University of Guam. She and her collaborators have published extensively on the ecology and chemistry of local sponges, and solicited numerous identifications from specialists. As a result, marine natural product reports form the bulk of publications on sponges from Guam and the CNMI in recent years (Appendix 1). Much of this research relates to the general use of secondary metabolites in sponges as chemical deterrents to fish and invertebrate predation (Rogers & Paul 1991, Pennings et al. 1994, Becerro et al. 1998), and as allelopathic compounds

in spatial competition in coral reef habitats (Thacker et al. 1998). In particular, the sponges *Hyrtios erecta* (Rogers & Paul 1991), *Luffariella variabilis* and *Dysidea* sp. 4 (Duffy & Paul 1992, Pennings et al. 1994), *Dysidea* sp. 2 (Paul et al. 1997, Thacker et al. 1998), and *Cacospongia* sp. 1 (Becerro et al. 1998) have received considerable attention. Some specialist consumers of sponges have also received attention, including cephalaspideans (Carlson & Hoff 1973; 1974) and nudibranchs (Rogers & Paul 1991; Avila & Paul 1997; Becerro et al. 1998). A short course conducted on Guam in sponge taxonomy in 1996 by Michelle Kelly fostered further interest in sponges. During the 1990's Gustav Paulay's lab was involved in structured as well as unstructured surveys of the marine biodiversity of Guam. New material was collected during three biodiversity surveys carried out for COMNAVMARIANAS (U.S. Department of Defense): at Apra Harbor (Paulay et al. 1997), at the southern Orote – North Agat Bay area (Paulay et al. 2001) and at the Pugua Patchreef – Haputo area (Amesbury et al. 2001). The first survey was partly focused on sponges, while the latter two were general invertebrate surveys, although exposed macro-sponges were routinely documented. A non-indigenous species survey funded by Sea Grant provided additional coverage (Paulay et al. 2002).

The aim of this paper is to provide an inventory of the marine sponges known from the coastal reefs of Guam and the CNMI. The taxa listed represent well known and partially identified sponge species, many of which remain undescribed. The specimens and photo vouchers associated with most of these morphospecies should assist in future identifications, by allowing their recognition through inevitable future nomenclatural and systematic changes. The present list constitutes a working list, from which taxonomic descriptions of new and known taxa may arise. This taxonomic inventory also aims to achieve maximal biological accuracy through examination of actual material by expert taxonomists. All too frequently checklists of this nature are uncritical compilations of species names directly from the literature, resulting in some species being covered under multiple names because of misidentifications or synonymies, and others included erroneously from poor identifications or locality records. Most of the taxonomic identifications have been checked and updated. The exceptions are a few literature records (see Appendix 1) for which specimens were not reexamined.

Methods

This paper is based on collections from Guam made by staff of the University of Guam Marine Laboratory, collections from CNMI made by CRRF, and records from the literature. Several of the species recorded in the literature were also recollected, but some of de Laubenfels' (1954) records and the small boring sponges recorded by Smyth (1990) were not (see Appendix 1). Sponges were collected using SCUBA and snorkeling. All newly collected species were distinguished in the field, characterized by field characters, and photographed *in*

situ. Most species encountered were documented by both vouchers and photos, while a few were documented by only one of these methods (Appendix 1). After collection material was fixed in 80% ethanol and prepared for identification by thin sectioning and through preparation of spicule slides (see Kelly-Borges & Vacelet 1995). Vouchers (see Appendix 1) are deposited at the Natural History Museum, London (NHM), University of Guam, Mangilao (UGI), Queensland Museum, Brisbane (QM), National Institute of Water & Atmospheric Research Institute, New Zealand (NIWA), Smithsonian Institution (USNM), Zoologisch Museum, University of Amsterdam (ZMA), and the collections of the Coral Reef Research Foundation, Republic of Belau (CRRF). Photo vouchers are by Paulay (GP numbers, housed at the Florida Museum of Natural History) and CRRF (0CDN numbers, housed at CRRF). Cited photographs (Appendix 1) are on the WWW at: http://www.flmnh.ufl.edu/reefs; they are also available on the Marine Biodiversity of Guam CD-ROM co-publication (see website for availability).

Results and Discussion

We have documented 128 sponge species from intertidal to ca. 50m depths on coastal reefs and caves of Guam and the CNMI (Appendix 1). These comprise 124 siliceous (Class Demospongiae) and 4 calcareous (Class Calcarea) sponges, representing 73 genera, 44 families, within 16 orders. During the process of this review, several systematic changes were made (see comments to Appendix 1).

The 128 species recorded here represent only part of the sponge diversity of the Marianas, as both collecting and taxonomic efforts remain limited. Over 30 additional species are known to the authors from Guam, but have not received sufficient taxonomic attention to be included here. Although there have been numerous collections made in the Marianas over the years, none have been comprehensive. Rather sponges have been collected opportunistically from diverse locations on Guam and mostly from cave habitats on Saipan, Rota and Tinian. No sponge records are available from the ecologically distinctive, volcanically active islands of the northern arc of the Marianas.

The rich sponge fauna of Apra Harbor on Guam has received the most attention to date, and the exposed macrosponges of that area are relatively well known. The exposed macrosponges of outer reef slope habitats on Guam are next best known, but new taxa are regularly encountered on every new reef area surveyed. The rich sponge fauna of caves on the outer reef slope have been only incidentally sampled on Guam, and only the larger species, preferred for pharmaceutical analysis, were sampled in this habitat in the CNMI. Although the sponge fauna of shallow fringing reefs received the first taxonomic attention (de Laubenfels 1954), this habitat remains poorly known as little recent attention has been devoted to it in the Marianas in recent years. Sponge faunas are renowned for their spatial heterogeneity (Hooper & Lévi 1994, Hooper & Kennedy 2002). There is considerable variation in species composition even among neighboring reefs on an island, with additional differences among habitats and among islands

(e.g. Hooper 1994). This phenomenon is also clearly evident on Guam where many sponge species are known from restricted biotopes or reef areas. We estimate the diversity of exposed macrosponges in the Marianas to be at least twice that recorded here. The unstudied encrusting and cryptic sponges are likely at least as diverse as macrosponges, making the total poriferan diversity of the Marianas at least 500 species.

In contrast to the documented local (alpha scale) heterogeneity in sponge distributions, sponge faunas become more predictable at regional (gamma) scales (Hooper et al. 2002). Consequently, the Mariana Islands' sponge fauna may be expected to contain predictable elements of a broader Micronesian or west central Pacific fauna. However numerous conspicuous and abundant sponge species that are nearly ubiquitous on neighboring archipelagoes as well as in much of the west central Pacific appear to be absent in the Marianas. These include the haplosclerids *Haliclona (Reniera) poseidon* (de Laubenfels), *Gelliodes fibulatus* (Carter), *Oceanapia sagittaria* (Sollas), *Callyspongia aerizusa* Desqueyroux-Faundez, and *Cribrochalina olemda* de Laubenfels, the dictyoceratids *Spongia matamata* de Laubenfels, *Carteriospongia foliascens* (Pallas), and *Phyllospongia papyracea* (Esper), the poecilosclerids *Biemna tubulata* (Dendy), the axinellid *Axinella carteri* (Dendy), species of *Diacarnus*, *Theonella*, and the calcareous sponges *Pericharax heteroraphis* Poléjaeff, and *Leucetta avocada* de Laubenfels. Many of these species have been recorded consistently within various Indo-west Pacific reef systems, from Vanuatu to Thailand, the Great Barrier Reef to Chuuk, and represent some of the 5% of the regional fauna that is hypothesized to be widely distributed (e.g. Hooper et al. 2000). There is a growing body data however to suggest that at least some widespread morphological species are comprised of genetically-divergent, allopatric species complexes (e.g. *Astrosclera willeyana* – Woerheide et al. 2003).

Nevertheless part of the regional fauna is represented in the Marianas: thus approximately 30% (38) of the species recorded are regionally widespread (see Hooper et al. 2000). The absence of numerous regional species is partly a reflection of the lower diversity of sponges in the Marianas than on neighboring island groups. Thus CRRF has recorded 218 species of sponges from Chuuk in the central Carolines and 295 species from Palau (L. Colin pers. comm. 2001). A survey of 6 of the 80 known marine lakes in Palau resulted in more than 140 sponge species (Kelly-Borges & Valentine 1995). Kelly-Borges & Valentine (1995) indicated that there are over 1000 published and undescribed species in the tropical region of Oceania, including Guam, but this is a vast underestimate of the known fauna (JNH, MK, CRRF unpublished information). In comparison, Hooper & Lévi (1994) estimated that there are about 5,000 published and undescribed species in the Australian insular and continental faunas alone.

The relatively low diversity of sponges in the Marianas relative to Palau and the Federated States of Micronesia fits general patterns seen in other marine organisms (e.g. Randall 1995; Myers 1999) and reflects the isolation, location,

and habitat-diversity of the archipelago. First the Marianas lie further removed from the Indo-Malayan diversity center than Palau and neighboring islands. Second, the east-flowing Equatorial Counter Current (ECC) creates a biogeographic corridor (the "Caroline Conduit" – Springer 1982) that flows through and enriches the biodiversity of the islands of Palau, Federated States of Micronesia, and even Marshall Islands. In contrast, the Marianas are isolated from the influence of the ECC and bathed by the west-flowing North Equatorial Current. Finally, lagoons are poorly developed in the Marianas, especially in comparison with the large barrier reef islands and atolls of the Caroline chain. Lagoons host the most diverse and striking sponge faunas in the area. Only one deep lagoon, Apra Harbor, exists in the Marianas; it hosts a specialized sponge fauna, many species of which are not known elsewhere in the archipelago.

Approximately 30% (40) of the species recorded here are new to science, but this is not unusual, as sponge faunas are underdescribed worldwide (e.g. Kelly-Borges & Valentine 1995, Hooper et al. 2000). Many of the new species recognized within the Guam fauna are known by the authors from other locations and few of the 40 species are likely to be endemic to the Marianas.

Adventism

The Marianas were among the first islands settled in Micronesia, with clear evidence for human occupation dating to 3500BP and indications of human presence to 4300BP (Kirch 2000). Magellan's landing on Guam in 1521 was the first western contact in Oceania. Thus Guam has had an especially prolonged opportunity to accumulate a non-indigenous biota (Paulay et al. 2002). Today, commercial shipping traffic to Guam originates mostly from the US mainland via Hawaii, and to a lesser extent from Asia. The two largest freight companies, Matson Shipping and CSX Lines route through Hawaii to Guam, and return to the US via Asia. Smaller shipping lines however also connect Guam with several Asian cities, as well as with islands in Micronesia. The arrival of two dry docks in the 1990's: the *Adept*, from Subic Naval Station in the Philippines in 1992, and the *Machinist*, from Pearl Harbor, Hawaii in 1999 have demonstrated the importance of these structures in transporting fouling organisms. Thus about 20 species of sponges arrived in abundance from Hawaii on the hull of the *Machinist*. Given what we know about the global transport of marine species (Carlton 1996), adventive sponges are to be expected to occur on Guam, although their recognition is difficult.

Recognition of non-indigenous status relies on accurate taxonomic identifications together with a series of criteria established to evaluate evidence for adventism (Chapman & Carlton 1991). Widely disjunct distributions are one of these criteria, and two sponges on Guam, *Clathria mima* and *Hyrtios altum*, are recorded in the literature from the Atlantic as well as the Indo-West Pacific. However Atlantic records of both are poorly documented and likely the artificial result of poor taxonomy, rather than of non-indigenous status. Another criterion is restriction to artificial substrata, including substrata associated with human

transport. At least four sponges (*Callyspongia* aff. *fibrosa, Mycale (Carmia)* sp. 1, *Niphates* sp. 1, and *Tedania* cf. *ignis*) in Apra Harbor have been encountered only on artificial bottoms (buoys, wharfs, ship halls) and are not known to us from extensive sampling in the region or in the Indo-West Pacific. Until these sponges are encountered in a natural habitat their status remains to be accurately established, thus at present they are best regarded as cryptogenic (cf. Carlton 1996). The presence of striking sponge, *Ianthella basta*, in Guam has led to speculation about whether its population on Guam represents an isolated natural occurrence or whether it is adventive (Birkeland pers. comm. 1993). *Ianthella basta* ranges from the Mascarene Islands to Vanuatu, the Philippines and Guam. The absence of the species from all intervening Micronesian Islands, including Palau and the Federated States of Micronesia implies either that it colonized Guam by jump dispersal, or that it became established through anthropogenic transport. On Guam the species is restricted to Apra Harbor, the busiest port in Micronesia, where it appears to be spreading. If adventive, *Ianthella* could have arrived from the Philippines, an area linked to Guam with frequent shipping traffic. The environmental conditions in which the sponge is found in Guam are no different from that in other locations where it is common (Bergquist & Kelly-Borges 1995).

In addition to these sponges, numerous species previously unknown on Guam arrived on the hull of the dry dock *Machinist* in 1999. These sponges are currently under study by Ralph DeFelice (Bishop Museum), and their fate on Guam remains to be seen.

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Appendix 1. Sponges of the Marianas

UGI: catalogue numbers of vouchers housed in Univ. of Guam Invertebrate collections; all specimens from Guam.

Museum: catalogue numbers of vouchers housed at permanent repositories; see methods for codes. Provenance if other than Guam noted paranthetically.

Ref: references: numbered references follow at the end of the Appendix

Photo: photo vouchers; available at: http://www.flmnh.ufl.edu/reefs and in the Marine Biodiversity of Guam CD-ROM copublication. Provenance if other than Guam noted paranthetically.

Notes: numbered notes follow at end of Appendix

ID: identifier: 1: Michelle Kelly, 2: John Hooper, 3: Rob van Soest and Wallie de Weerdt, 4: Patricia Bergquist, 5: Gustav Paulay, 6: literature cited.

Is: island: G = Guam, R = Rota, T = Tinian, S = Saipan

Taxon	UGI	Museum	Ref	Photo	Notes	ID	Is
CLASS CALCAREA							
CLATHRINIDA: LEUCETTIDAE							
Leucetta chagoscnsis Dendy, 1913	6162	0CDN 0988-I(S)	18	GP407-11, 0CDN 0988-I (S)		1	G,S
Leucetta primigenia Haeckel, 1872		USNM Ac.183733 (S)	1		1	6	S
Leucetta sp 1 (n. sp.)		0CDN 1003-(R)		0CDN 1003-Y(R)		1	R
MURRAYONIDA: MURRAYONIDAE							
Murrayona phanolepis Kirkpatrick, 1910	6083	0CDN 0980-X(S)		GP417-2 (S), 0CDN 0980-X (S)		1,5	G,S
CLASS DEMOSPONGIAE							
AGELASIDA: AGELASIIDAE							
Agelas sp. 1	6082	0CDN 0970-N(S)		GP587-6, 0CDN 0970-N (S)		1,4	G,S
Agelas sp. 2	6800	QM G317348		GP863-18		2	G
AGELASIDA: ASTROSCLERIDAE							
Astrosclera willeyana Lister, 1900	6085		22(S)	GP572-37		5	G,S
Stromatospongia micronesica Hartman & Goreau, 1976		Holotype: YPM 9104, YPM 9110(S)	5	GP649-10, 0CDN 0983-A (S)		6	G,S
ASTROPHORIDA: ANCORINIDAE							
Melophlus sarasinorum Thiele, 1899	5943	BMNH 1995.6.22.5	11	GP524-36		1	G
Penares nux (de Laubenfels, 1954)	5940	BMNH 1995.6.22.4		GP274-18		5	G

Appendix 1. Sponges of the Marianas / *(continued)*

Taxon	UGI	Museum	Ref	Photo	Notes	ID	Is
Penares sollasi Thiele, 1903	6095	ZMA 16415		GP380-21		3	G
Rhabdastrella globostellata (Carter, 1883)	6094	BMNH 1995.6.22.2		GP651-14	17	1,5	G
CHONDROSIDA: CHONDRILLIDAE							
Chondrilla australiensis Carter, 1873	6010	BMNH 1995.6.22.37, USNM Ac.183733 (S)	1			1,6	G,S
Chondrilla grandistellata Thiele, 1900		USNM Ac.183733 (S)	1		1	6	S
Chondrosia corticata Thiele, 1900	6707	NIWA 915, QM G317346		GP763-13		1,2	G
DENDROCERATIDA: DARWINELLIDAE							
Chelonaplysilla sp. 1 (grey)	5977	BMNH 1995.6.22.27		GP531-27		1	G
Chelonaplysilla sp. 2 (purple)	5978	BMNH 1995.6.22.28		GP513-10		1	G
DENDROCERATIDA: DICTYODENDRILLIDAE							
Dictyodendrilla nigra (de Laubenfels, 1954)		0CDN 0973-Q		0CDN 0973-Q (S)	19	1	S
DICTYOCERATIDA: DYSIDEIDAE							
Dysidea arenaria? Bergquist, 1965		BMNH 1995.6.22.30				1	G
Dysidea sp. 1A (n. sp. aff. *herbacea* (Keller, 1889) ridged)				GP741-29		1	G
Dysidea sp. 1B (n. sp. aff. *herbacea* (Keller, 1889) smooth)			23	GP573-6		1	G
Dysidea sp. 2 (n. sp.)		BMNH 1997.5.13.1	12, 16	GP389-33		4	G
Dysidea sp. 3 (n. sp., aff. *avara* (Schmidt, 1862))	6048	BMNH 1995.6.22.8		GP869-32	25	1	G
Dysidea sp. 4 (n. sp., aff. *granulosa* Bergquist, 1965)	6009, 6049	BMNH 1995.6.22.7, NIWA 909	14,23 24	GP768-25	11	1	G
Dysidea sp. 5 (n. sp., cave)		NIWA 917		GP740-27		1	G
DICTYOCERATIDA: IRCINIIDAE							
Ircinia sp. 1	6608	NIWA, QM		GP862-28		4	G
Ircinia sp. 2	6614			GP838-25		2	G
Sarcotragus sp. 1 (n. sp)		0CDN 0971-O(R)		0CDN 0971-O (R)		1	R
Sarcotragus sp. 2 (n. sp)		0CDN 1014-M(R)		0CDN 1014-M (R)		1	R
DICTYOCERATIDA: SPONGIIDAE							
Coscinoderma cf. *mathewsi* (Lendenfeld, 1886)		NIWA 924 & 925		GP763-1	3	1	G
Hippospongia metachromia de Laubenfels, 1954	6619	NIWA 921, 0CDN 0996-Q(S)		GP615-27, 0CDN 0996-Q (S)		1	G,S
Strepsichordaia lendenfeldi Bergquist et al., 1988		0CDN 0995-P(R)		0CDN 0995-P (R)		1	R

Appendix 1. Sponges of the Marianas / *(continued)*

Taxon	UGI	Museum	Ref	Photo	Notes	ID	Is
DICTYOCERATIDA: THORECTIDAE							
Aplysinopsis cf. *elegans* Lendenfeld, 1888	6706	NIWA 911		GP649-2		1	G
Cacospongia sp. 1 (n. sp.)	6140	BMNH 1995.6.22.23	9,10	GP530-12	26	1	G
Fascaplysinopsis reticulata (Hentschel, 1912)	6609	NIWA 919, 0CDN 0984-C(S)		GP407-13, 0CDN 0984-C (S)		1	G,S
Hyrtios altum (Poléjaeff, 1884)	6004	BMNH 1995.6.22.24		GP532-9		4	G
Hyrtios erecta (Keller, 1889)		USNM 31754	13	GP644-2	26	4	G
Hyrtios sp. 1		BMNH 1995.6.22.25				4	G
Luffariella geometrica Kirkpatrick, 1910		0CDN 0982-Z(S)		0CDN 0982-Z (S)		1	S
Luffariella variabilis (Poléjaeff, 1884)	6081	BMNH 1995.6.22.26	14,15	GP573-26		1	G
HADROMERIDA: ACANTHOCHAETETIDAE							
Acanthochaetetes wellsi Hartman & Goreau, 1975	6615	Holotype: YPM 9077	4,22(S)	GP649-7		6	G,S
HADROMERIDA: CLIONIDAE							
Alectona sp. 1			2		2	6	G
Cliona ensifera (Sollas, 1888)			2		2	6	G
Cliona sp. 1			2		2	6	G
Cliona vastifica (Hancock, 1849)			2		2	6	G
Cliona viridis Schmidt, 1862			2		2	6	G
Thoosa bulbosa Hancock, 1849			2		2	6	G
HADROMERIDA: HEMIASTERELLIDAE							
Hemiasterella typus Carter, 1871	6709	ZMA 16407		GP261B-23		3	G
HADROMERIDA: SPIRASTRELLIDAE							
Spheciospongia globularis Dendy 1921	?6690	BMNH 1995.6.22.38				1	G
Spheciospongia vagabunda (Ridley, 1884)	6008	BMNH 1995.6.22.39		GP270-36		1	G
Spirastrella potamophera de Laubenfels, 1954		USNM Ac.183733 (S)	1		1	6	S
HADROMERIDA: SUBERITIDAE							
Terpios aploos de Laubenfels, 1954	6612	Holotype: USNM 23141	1		4	6	G
Terpios hoshinota Rützler & Musik, 1993		BMNH 1995.6.22.11	6,7,8	GP362-2		6	G
Terpios sp. 1		NIWA 923		GP761-5		1	G
HADROMERIDA: TETHYIDAE							
Tethya seychellensis Wright, 1881		USNM Ac.183733 (S)	1		16	6	S
Tethya sp(p).	6217			GP400-2	16	5	G

Appendix 1. Sponges of the Marianas / *(continued)*

Taxon	UGI	Museum	Ref	Photo	Notes	ID	Is
HALICHONDRIDA: AXINELLIDAE							
Acanthella cavernosa Dendy, 1922	5975, 5932	BMNH 1995.6.22.12		GP530-31		1	G
Axinella sp. 1 (n. sp.)	6163, 6015	BMNH 1995.6.22.40, QM G317355		GP752-1		2	G
Dragmacidon sp. 1 (n. sp.)	6802	QM G317357 0CDN 0959-Z (S)		GP868-10, 0CDN 0959-Z (S)		1,2	G, S
Stylissa massa (Carter, 1889)	5942	BMNH 1995.6.22.13, 0CDN 0960-A (S)	1,27	GP868-31	5	1	G,S
HALICHONDRIDA: DESMOXYIDAE							
Myrmekioderma granulata (Esper, 1830)	6138	BMNH 1997.5.13.3, 0CDN 0990-K(S)		GP530-15, 0CDN 0990-K (S)		1	G,S
HALICHONDRIDA: DICTYONELLIDAE							
Liosina cf. *granularis* Kelly Borges & Bergquist, 1988	6042	BMNH 1995.6.22.10		GP868-24		1	G
HALICHONDRIDA: HALICHONDRIIDAE							
Amorphinopsis sp. 1			2		2	6	G
Axinyssa aculeata Wilson, 1925		ZMA 16419		GP651-30		3	G
Axinyssa sp. 1 (n. sp.)	6691	QM G317352		GP582-33		2	G
HAPLOSCLERIDA: CALLYSPONGIIDAE							
Callyspongia diffusa (Ridley, 1884)		USNM 23143	1		6	6	G
Callyspongia sp. 1 (aff. carens Pulitzer-Finali, 1982 –RvS 42)	6687	ZMA 16410		GP735-21		3	G
Callyspongia sp. 2 (aff. fibrosa Ridley & Dendy, 1887)	6688	ZMA 16411		GP514-30		3	G
Callyspongia subarmigera Ridley, 1884	6695	ZMA 16409		GP459-28		3	G
Euplacella sp. 1 (n. sp.)		0CDN 0972-P(S)		0CDN 0972-P (S)		1	S
Siphonochalina crassifibra Dendy,1889	6046, 6045	BMNH 1995.6.22.19, ZMA 16404		GP536-15		3	G
HAPLOSCLERIDA: CHALINIDAE							
Adocia neens (Topsent, 1918)		USNM Ac.183733 (S)	1		1	6	S
Haliclona (Gellius) gracilis (Hentschel, 1912)	6705	ZMA 16420		GP458:8		3	G
Haliclona (Reniera) viola (de Laubenfels, 1954)	6616	Holotype: USNM 23142, ZMA 16403	1		13	6	G

Appendix 1. Sponges of the Marianas / *(continued)*

Taxon	UGI	Museum	Ref	Photo	Notes	ID	Is
Haliclona (Soestella) sp. 2 (n. sp., blue aquarium *Haliclona*)	6043, 5983	BMNH 1995.6.22.18, ZMA 16413		GP361-26		3	G
Haliclona ligulata (Whitelegge, 1901)		USNM 23144	1		1,22	6	G
Haliclona osiris (de Laubenfels, 1954)	5974, 5929	BMNH 1995.6.22.14, USNM 31763, ZMA 16422	20	GP288-5		1	G
Haliclona sp. 1 (orange)	5972, 5934	BMNH 1995.6.22.17, ZMA 16423		GP361-30		1	G
Haliclona sp. 4 - (n. sp. coralline sponge)	6692	NIWA 912				1	G
Haliclona streble de Laubenfels, 1954		Holotype: USNM 23139 (S)	1		1	6	S
HAPLOSCLERIDA: NIPHATIDAE							
Amphimedon aff. *viridis* Duchassaing & Michelotti, 1864	6040	ZMA 16406		GP388-16		3	G
Niphates sp. 1 (n. sp.)	6192	NIWA 913, 916		GP536-9		1	G
Niphates sp. 2 (n. sp.)	6807	NIWA 918		GP868-27		1	G
Niphates sp. 3 (with sigmas)	6103	ZMA 16421		GP577-28	6	3	G
HAPLOSCLERIDA: PETROSIIDAE							
Petrosia sp. 1	6698	ZMA 16408		GP781-24		3	G
Petrosia sp. 2 (aff. *aruensis* Hentschel, 1912)	6689	ZMA 16412		GP649-6		3	G
Xestospongia exigua (Kirkpatrick, 1900)	6016	BMNH 1995.6.22.36		GP273-33		1	G
Xestospongia sp. 1	6574	ZMA 16417		GP869-13		3	G
Xestospongia sp. 2 (aff. *carbonaria* (Lamarck, 1814))	5998	BMNH 1995.6.22.22, ZMA 16416	28	GP532-4	21	3	G
HAPLOSCLERIDA: PHLOEODICTYIDAE							
Aka sp. 2 (yellow)	6024			GP407-33		5	G
Aka trachys de Laubenfels, 1954		Holotype: USNM 23146	1		1	6	G
Phloeodictyidae: New genus sp. 1 (n. sp.)		GP824-7, 0CDN 0985-F(S)		0CDN 0985-F (S)	14	1	G,S
Oceanapia? sp. 1 (crevice stick sponge)	6702			GP261B-22		1	G
"Pellina" pulvilla (Thiele, 1903)		USNM 23145	1		1	6	G
HOMOSCLEROPHORIDA: PLAKINIDAE							
Corticium sp. 1 (n. sp.)	6806	NIWA 914	17	GP868-5		1	G
Plakina sp. 1	6078	BMNH 1995.6.22.1		GP288-6		1	G

Appendix 1. Sponges of the Marianas / *(continued)*

Taxon	UGI	Museum	Ref	Photo	Notes	ID	Is
"LITHISTIDA": AZORICIDAE							
Leiodermatium sp. 1			22			6	S
"LITHISTIDA": SCLERITODERMIDAE							
Aciculites papillata Lévi & Lévi, 1983		0CDN 1015-N(R)		0CDN 1015-N (R)		1	R
"LITHISTIDA": THEONELLIDAE							
Theonellidae: new genus sp. 1 (n. sp.)		0CDN 0989-J(S)		0CDN 0989-J (S)	12	1	S
POECILOSCLERIDA: CRAMBIIDAE							
Monanchora clathrata (Carter, 1883)	6809	QM G317344		GP870-17		2	G
POECILOSCLERIDA: CRELLIDAE							
Crella cyathophora (Carter, 1880)	6793	QM G317354, ZMA 16418		GP253-20		3	G
POECILOSCLERIDA: DESMACELLIDAE							
Neofibularia hartmani Hooper & Lévi, 1993		NIWA 922		GP838-26		1	G
POECILOSCLERIDA: MICROCIONIDAE							
Clathria (Clathria) basilana Levi, 1961	6190			GP536-11	10	2	G
Clathria (Microciona) mima (de Laubenfels, 1954)	6710	QM G317343		GP616-9		2	G
Clathria (Thalysias) cf. *hirsuta* Hooper & Levi, 1993	5980	BMNH 1995.6.22.34		GP869-34	10	2	G
Clathria (Thalysias) cf. *reinwardti* Vosmaer, 1880	6696	QM G317353		GP577-35	7	2	G
Clathria (Thalysias) eurypa (de Laubenfels, 1954)				GP868-30		1	G
Clathria (Thalysias) sp. 1 (n. sp., JNAH ref #2431)	6810	QM G317351		GP870-12		2	G
Clathria (Thalysias) vulpina (Lamarck, 1814)		USNM 23149	1,3		7	6	G
Clathria (Wilsonella) sp. 2 (n. sp., JNAH ref #1766)	6711	QM G317365		GP746-12		2	G
POECILOSCLERIDA: MYCALIDAE							
Mycale (Carmia) cecilia de Laubenfels, 1954		0CDN 0964-H		0CDN 0964-H (S)		1	S
Mycale (Carmia) sp. 1 (n. sp., JNAH ref #2199)	6796	QM G317358		GP536-13		2	G
Ulosa spongia de Laubenfels, 1954		NIWA 9910		GP651-36		1	G
POECILOSCLERIDA: MYXILLIDAE							
Iotrochota baculifera Ridley, 1884	6617	BMNH 1995.6.22.16		GP868-17		1	G
Iotrochota ditrochota (de Laubenfels, 1954)				GP288-28		4	G
POECILOSCLERIDA: RASPAILIIDAE							
Ceratopsion sp. 1 (n. sp.)	5938	BMNH 1995.6.22.42, QM G317364		GP651-6		1,2	G

Appendix 1. Sponges of the Marianas / *(continued)*

Taxon	UGI	Museum	Ref	Photo	Notes	ID	Is
Echinodictyum antrodes (de Laubenfels, 1954)		USNM 23148	1		8	6	G
POECILOSCLERIDA: TEDANIIDAE							
Tedania cf. *ignis* (Duchassaing & Michelotti, 1864)	6194	QM G317356		GP536-10		2	G
Tedania meandrica Thiele, 1903	5985	BMNH 1995.6.22.35, ZMA 16425		GP361-29		3	G
Tedania sp. 1 (n. sp.)	6799	BMNH 1995.6.22.9, QM G317347		GP866-14		2	G
SPIROPHORIDA: TETILLIDAE							
Cinachyra porosa (Lendenfeld, 1888)		USNM 23138 (S)	1		9	6	S
Cinachyra sp(p).	5993	BMNH 1995.6.22.6		GP578-27	9	1	G
VERONGIDA: APLYSINELLIDAE							
Aplysinella rhax (de Laubenfels, 1954)	6057	BMNH 1995.6.22.30	21	GP514-12	20	1	G
VERONGIDA: PSEUDOCERATINIDAE							
Pseudoceratina tyroeis (de Laubenfels, 1954)		0CDN 0987-H(S), 0CDN 1011-J(R)		0CDN 0987-H (S), 0CDN 1011-J (R)		1	S,R
Pseudoceratina purpurea (Carter, 1880)	?6694			GP578-14	18	5	G
Pseudoceratina sp. 1 (paper thin yellow)		0CDN 0981-Y(S), 0CDN 1023-V(T)		0CDN 0981-Y (S), 0CDN 1023-V(T), GP869-25(G)	15	1	S,T,G
Pseudoceratina sp. 2 (n. sp.)	6708	NIWA 920		GP736-26		1	G
VERONGIDA: IANTHELLIDAE							
Ianthella basta (Pallas, 1766)	5930	BMNH 1995.6.22.32	19	GP530-25		1	G
VERTICILLIDA: VERTICILLITIDAE							
Vaceletia crypta (Vacelet, 1977)	6610			GP417-33 (S)		5	G

References: 1) de Laubenfels 1954, 2) Smyth 1990, 3) Hooper & Lévi 1993, 4) Hartman & Goreau 1975, 5) Hartman & Goreau 1976, 6) Bryan 1973, 7) Plucer-Rosario 1987, 8) Rützler & Musik 1993, 9) Avila & Paul 1997, 10) Becerro et al. 1998, 11) Lee et al. 2000, 12) Paul et al. 1997, 13) Rogers & Paul 1991, 14) Duffy & Paul 1992, 15) Pennings et al. 1994, 16) Thacker et al. 1998, 17) Lee et al. 2001, 18) Plubrukarn et al. 1997, 19) Pordesimo & Schmitz 1990, 20) Shin et al. 1998, 21) Shin et al. 2000, 22) Quinn & Kojis 1999, 23) Carlson & Hoff 1973, 24) Carlson & Hoff 1974, 25) Davidson 1993, 26) Rogers 1989, 27) Schmitz et al. 1985, 28) Schmitz et al. 1983

Notes:

1) de Laubenfels (1954) records that were not recollected nor taxonomically updated. Vouchers of these records were deposited at the USNM as noted.
2) Smyth (1990) records, not recollected and taxonomy not verified nor updated. Smyth's collections were apparently not deposited anywhere and these records exist solely as listed in her paper (K. Rützler pers. comm. 2000)
3) This species can grow in either a large, exposed, or a small, cryptic growth form; these two growth forms hint at cryptic diversity. Only the latter growth form was encountered on Guam. The cryptic morph has a few, small, surface manifestations with the typical appearance of the species, but its bulk is nestled within the reef matrix, largely concealed by turf and reef sediment, and with pieces of rubble incorporated into its mass.
4) *Terpios aploos* was recollected at the type locality, but has not yet been taxonomically reexamined.
5) As *Stylotella agminata* in de Laubenfels (1954); *Stylotella aurantium* is a junior synonym (see above). Misidentified as *Hymeniacidon aldis* in Schmitz et al. (1985).
6) *Callyspongia diffusa* has not been seen on Guam in recent years, but de Laubenfels' (1954: plate IVb) illustration and *habitus* description of that species from Guam is strikingly similar to *Niphates* sp. 3, a species that is common at Dungas Beach, where de Laubenfels' record came from. Demostration of the potential identity of these two records awaits an examination of de Laubenfels' specimen.
7) The record of *Clathria vulpina* is based on de Laubenfels' (1954) specimen of *Clathria frondifera*, which was reexamined by Hooper & Lévi (1993) and listed under the synonymy of *C. vulpina*. While *C. vulpina* was not encountered on Guam during recent surveys, the very similar *C.* cf. *reinwardti* was, and that species was also found at Dungas Beach, from where de Laubenfels' specimen of *C. frondifera* originated. It is therefore possible that these two records represent the same species.
8) As *Kieplitela antrodes* in de Laubenfels (1954); *Kieplitela* de Laubenfels, 1954 is a junior synonym of *Echinodictyum* Ridley & Duncan, 1881 (Hooper 1991; Hooper & Wiedenmayer 1994). This species was not recollected nor taxonomically reexamined.
9) The identity of the one or more (probably two) species of *Cinachyra* on Guam has not been established; likely one corresponds with de Laubenfels' (1954) interpretation of *Cinachyra porosa* (Lendenfeld, 1888) from Saipan, a species that was not recollected there nor taxonomically reexamined.
10) Identified samples of *Clathria* cf. *hirsuta* have a nestling growth form, with the outer parts of the sponge are flush with the coral (usually *Porites rus*) into which they nestle. One specimen of *C. basilana* appeared identical to *C.* cf. *hirsuta* in the field, the only potential example among sponges on Guam where field appearance was not diagnostic (although further attention may provide useful field characters). Other examples of *C. basilana* had an exposed, massive growth form on buoys.
11) Recorded as *Dysidea* cf. *reticulata* by Carlson & Hoff (1973, 1974), who described the cephalaspid opisthobranchs *Sagaminopteron nigropunctatum* and *S. psychedelicum* from this host.
12) The new genus is the same as that represented by de Laubenfels' (1954) *Plakinalopha mirabilis*. This sponge is a theonellid lithistid with unusual non-articulated desma spicules typical of lithistid sponges, and it has unusual irregular discotriaenes without a rhabd (MK unpublished data), and is closely related to *Siliquariospongia* Hoshino.
13) de Laubenfels' (1954) *Adocia viola* was recollected and reexamined, and is now considered to belong to *Haliclona (Reniera)*.
14) This species has many size categories of toxas. Guam record based on photo only, not verified.

15) This very unusual species encrusts coralline sponges in caves, and has been encountered in Saipan and west Tinian.
16) The identity of the *Tethya* species on Guam have not been established; it is likely that one corresponds with de Laubenfels' (1954) *Tethya diploderma* (now synonymized under *Tethya seychellensis*; see Bergquist & Kelly-Borges 1991) from Saipan, a species that was not recollected there nor taxonomically reexamined.
17) de Laubenfels' (1954) record of *Jaspis tuberculata* (a temperate Australian endemic) from Saipan, not listed here separately, has not been reexamined; it most likely corresponds to *Rhabdastrella globostellata* (see Kennedy 2000 for a review of this complex (often recorded as '*Jaspis stellifera*'), and past confusion surrounding it).
18) The common yellow-green verongid sponge *Psammaplysilla purpurea* Carter, 1880 is now known as *Pseudoceratina purpurea* (Carter, 1880) after the review of Bergquist (1980) which synonymised the former genus with the later.
19) Recollection of *Dendrilla nigra* de Laubenfels, 1954 throughout Micronesia, revealed that the species is a dictyodendrillid, and thus it is now referred to as *Dictyodendrilla nigra* (de Laubenfels, 1954).
20) *Dysidea rhax* de Laubenfels, 1954, is now known as *Aplysinella rhax* (de Laubenfels, 1954) because the sponge experiences an aerophobic discoloration to walnut brown upon death and exposure to air, due to the fleshy texture of the mesohyal, the prominence of hollow detritus-lined golden fibres, and small well spaced choanocyte chambers (Kelly, unpublished).
21) Schmitz et al.'s (1983) record of *Amphimedon* is almost certainly this species; a voucher is available: USNM 31765.
22) *Haliclona ligulata* was described from southern New South Wales (Whitelegge 1901), and thus is likely different than the species so identified on Guam.