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Coral reef polychaetes of Guam and Saipan, Mariana Islands

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Abstract – Polychaetes are important food resources of reef fishes and invertebrates. Some are indicators of environmental perturbation and reef condition. Species inventory recognizing native and alien species is important to regulatory agencies. Polychaetes collected from coastal habitats of Guam and Saipan, with published records, raise the known number of species from Guam to 104 and from Saipan to 51. The number from Saipan is an underestimate based on collections in many shallow reef habitats identified by Hartman, two short visits by the author and a few specimens sent by a resident. Infaunal polychaetes in sand, rock crevices, and those removed from the digestive tracts of gastropods (*Conus* spp.), belong to 30 families, 25 known from Guam, 20 from Saipan with five of these only recorded from Saipan. Polychaetes are listed by family with collection site(s). Authors of published records are given for each species. Comparisons of community structure based on species richness, common taxa, and trophic guilds with those of West Pacific, Hawai'ian and East Indian Ocean locations are made. Using published records and quantitative data available only for some islands, reef polychaete communities of Guam are similar to those of Hawai'i, Enewetak, and Indonesia in species composition and density. More collections and taxonomic studies would add more species to presently under-represented families in Guam e.g. the Spionidae, Phyllodocidae, Eunicidae and Polynoidae. Families common on Guam reefs and in the Indo-West Pacific are the Syllidae, Serpulidae and Spirorbidae. Recently introduced polychaetes include, *Oenone fulgida*, *Timarete caribous*, *Thelepus setosus* and *Sabellastarte spectabilis* collected from the floating dry dock facility 'Machinist' one week after arriving in Apra Harbor from Hawai'i. The serpulid, *Salmacina dysteri*, was also on the dry dock, but had been recorded earlier from Guam. This species most likely reached Guam on the hull of a vessel in transit across the Pacific Ocean.

Introduction

Islands in the tropical central and western Pacific region have species-rich polychaete communities that are mostly cryptic, endolithic or infaunal. A few are conspicuously colored and occur in live corals, others have venomous chaetae and jaws, some are caught on baited hooks (Glasby & Bailey-Brock 2001) while others are used for bait or fish feed. Swarming Palolo worms are seasonally collected for food in Fiji and Samoa.

Tropical polychaete ecology is often based on distribution records in taxonomic works (Fauvel 1953, Day 1967) or restricted to a few quantitative studies from specific habitats and reviews (Kohn & White 1977, Bailey-Brock et al. 1980, Bailey-Brock 1995). The importance of polychaetes to the trophic dynamics of coral reefs is often overlooked. Polychaetes are consumed by many reef fishes (Dee & Parrish 1994), predatory invertebrates and corals (Porter 1974). Prey gut studies often fail to establish identifications due to the effects of digestion on these soft-bodied worms. The diets of conid gastropods (Kohn 1959, Leviten 1978) provide the best examples of prey identification from predator digestive tracts using "hard" structures such as chaetae and jaws that are relatively unaffected by digestion. Analysis of polychaetes in the diet, and those in the feeding range habitat of each *Conus* spp., reveal the specialist or generalist nature of prey selection and the polychaete species eaten. These studies are the basis of an overall ecological perspective of reef polychaete assemblages that can be compared in different habitats and locations.

Researchers also compare polychaete communities at different geographic locations by assigning each species to a trophic and motility guild based on their diet and tubicolous or motile life style. Habitats with complex polychaete assemblages include intertidal rock benches, sand and coral rubble sediments, coral rock, reef flats, boat harbors, and estuaries (Bailey-Brock 1976, 1999, Bailey-Brock et al. 2001). At Enewetak four habitats were defined for an intertidal limestone bench; water filled pools with sand bottom, bench with algal turf, bare rock bench and the most seaward exposed reef crest. All except the bare rock bench provided refuge to non-boring polychaetes, and all were exposed at the lowest tides (Bailey-Brock, et al. 1980). Similar intertidal and shallow subtidal habitats, as well as some different ones were sampled on Guam and Saipan (Bailey-Brock 1999). These records and those collected by others since then are included here to give a complete listing of species records to date.

Polychaetes of the Mariana Islands have been compiled from three studies. The most extensive species record for Guam (Kohn & White 1977) includes species recorded by Emery (1962). They list 39 species, 27 of which were collected from intertidal bench habitats and the digestive tracts of conid gastropods, and 10 were listed in Emery's geological paper. Additional collections from Guam and Saipan (1981, 1986) added more species to these records, and the coastal polychaete assemblages of Guam and those of other West Pacific islands and Hawai‘i were compared (Bailey-Brock 1999). A collection from Saipan, identified by Hartman, included 37 polychaetes belonging to 20 families (Cloud 1959). New records and some recently introduced polychaetes are added here.

Methods

Hard substrata (coral rock, shells, stranded debris) with attached tubeworms and cryptic species were collected using SCUBA, snorkeling and wading. Attached and cryptic polychaetes were scraped and picked from coral rock (Brock & Brock 1977), preserved in 10% formalin, stored in 70% ethanol, and later identified to the lowest taxon possible.

Sampling sites and Habitats

Collections from sites on Guam and Saipan, Southern Marianas (Figure 1), were made in 1981 and 1986, and more recently by Dr. Gustav Paulay and colleagues at Guam from 1995-1999. Dr. Richard Brock collected at Saipan in 1989, and 1990. Ray Roberts and Alan Davis (Marianas High School) collected in 1999 and 2000. Collections from Saipan listed by Cloud (1959) were made between October 1948 and July 1949.

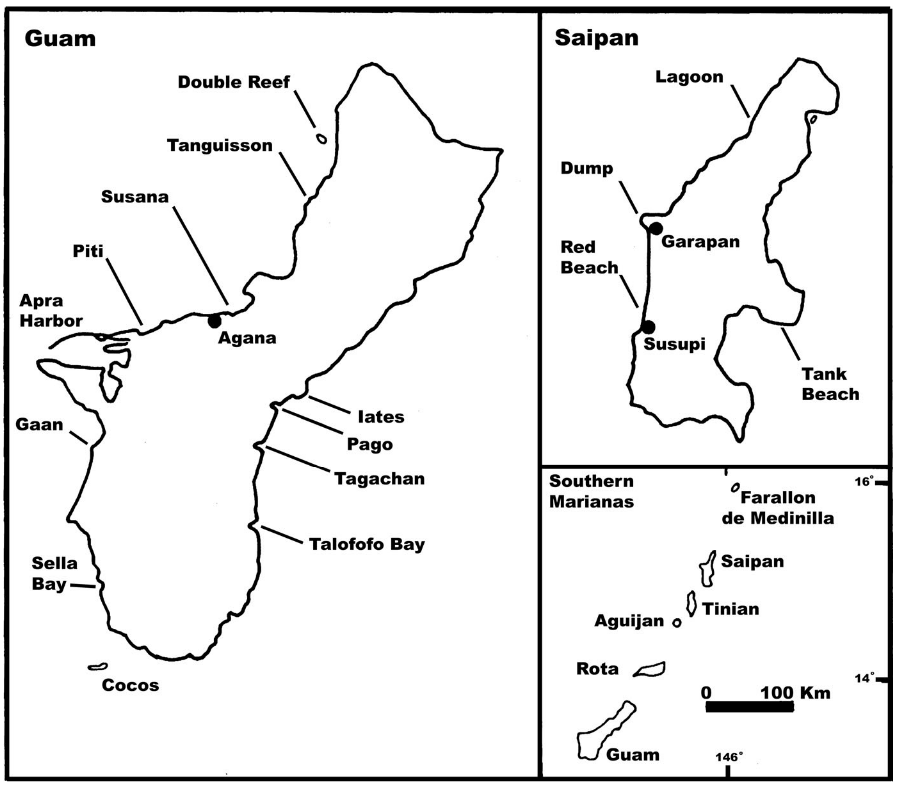

Figure 1. Map of Southern Mariana Islands, Guam, and Saipan, showing main collecting localities.

Guam collection localities given in Bailey-Brock (1999), and shown in Figure 1 of this study, include reference to the detailed reef and coastline maps drawn by Randall & Eldredge (1976). These give more site information than the current USGS maps and should be used if available.

Iates Point (1981, 1986) - An exposed rocky coast and erosion bench with a prominent headland that extends north from the University of Guam Marine Laboratory to Taogam Point (Randall & Eldredge 1976: map 61). The erosion bench has a dense cover of algae on the seaward side, pits inhabited by cryptic alpheids (*Alpheus idiocheles*) and tide pools. Phyllodocids (GUM 240-A) were collected from alpheid pits.

Pago Bay (1981, 1988) - Reef and beach sites at Pago Bay include near and offshore habitats between Pago River and the University of Guam Marine Laboratory (Randall & Eldredge 1976: map 60). A broad intertidal fringing reef with sand, silt, and coral rubble, and boulders near the reef crest fronts the beach. A solid limestone platform with eroded channels forms the seaward reef. Polychaetes were collected from the fore reef under rocks, among algae at 7m depth, under rocks 20 m shoreward of the reef crest, in extensive sea grass beds, *Enhalus acoroides* and *Halodule uninervis*, and among algae, *Halimeda* and *Padina* spp.

Tagachan (1981) - Crustose algae (*Porolithon gardineri*), and rocks chipped from the southern end of an intertidal bench near Tagachan beach park and shallow pools (approx. 29-40 cm deep) at the seaward edge of the bench contained vermetids (*Dendropoma meroclista*), sipunculans, corals and polychaetes (Randall & Eldredge 1976: map 59).

Talafofo Bay (1981) - Supratidal terraced, rimmed pools on the rock bench near Paicpouc Cove were sampled. These unique supratidal features have rock-like rims of vermetid gastropods, serpulid tubes, and coralline algal crusts that have built up over a long time. Polychaetes and tide pool invertebrates, *Alpheus pacificus* Dana and *A. strenuus strenuus* Dana, portunid crabs, holothurians, and fish, *Istiblennius* sp., *Acanthurus triostegus* and *Sargocentron punctatissimum*, and algae were collected.

Talafofo bench (1981) - A flat limestone pavement forms a narrow fringing reef below the rocky coast landward of the terraced pools in Talafofo Bay (Randall & Eldredge 1976: map 54). Channels cross the reef perpendicular to the shoreline. Short, turf-forming algae (*Padina* spp.) containing fireworms, (*Eurythoe complanata*) covered the seaward section.

Double reef (2000) - Collections from rocks at 3-5m depths and the base of a soft coral colony from 13-20m on Double reef, a patch reef off NW Guam were made by G. Paulay (Randall & Eldredge 1976: maps 90-92).

Tanguisson - A. J. Kohn collected substratum samples from the outer reef flat and bench (Randall & Eldredge 1976: map 94) near Tanguisson Power Plant on 18 January 1975, and removed the polychaetes (Kohn & White 1977). Polychaete remains in the digestive tracts of conid gastropods collected from the same bench were identified and included in their paper.

Agana Bay - Paseo de Susana Park (1981) - Polychaetes were collected from coral rubble and beach deposits 30 m from shore at 30-70 cm depths, at the southern extremity of Paseo de Susana Park. The park is bordered by Agana boat harbor, a broad reef flat, and the Agana River (Randall & Eldredge 1976: map 7). R. K. Sakamoto collected a 127cm long eunicid under a rock in March 1995.

Cabras Island - Piti Power plant (1981) - Polychaetes were collected from coral rubble and algae (*Padina* spp.) on an extensive, shallow reef flat fronting Piti Power plant on the NW coast of Guam (Randall & Eldredge 1976: maps 12, 95). Burrowing and tubicolous species were found in the receiving waters of the plant and in an adjacent harbor.

Apra Harbor (1995-1997, 1999) – The main port of Guam, Apra Harbor is in an embayment on the west coast (Randall & Eldredge 1976: maps 13-21). G. Paulay collected polychaetes from harbor structures, the hull of a dry dock "Machinist"(in 1999) and the reef outside the harbor.

Gaan Point, near Agat (1986) – A beach with rocky outcrops to the south of Apra harbor on the west coast of Guam (Randall & Eldredge 1976: maps 25, 26). Polychaetes were scarce in the coral - rich habitat, but tubeworms on large boulders, live coral colonies, submerged debris, dead coral and shell fragments at 3-5m were scraped off and preserved.

Cocos Island and lagoon (1986) – Polychaetes were collected from sea grass beds, sediment-filled boat channels, and coral rubble on the W. Cocos barrier reef. Sea grass was scraped for calcareous tubeworms (Randall & Eldredge 1976: maps 34-44).

Saipan lagoon (1989, 1990) - Sea grass blades (*Halodule* and *Halophila* spp.) from the lagoon (less than 1 m deep) near the Hotel Nikko had spirorbid tubeworms, syllids, dorvilleids and capitellids.

Saipan bench (1989) - Calcareous tubeworms and errant polychaetes were removed from rocks and debris collected at a meter depth from the rock bench north of Garapan.

Saipan - Tank beach (2, Oct 1999) - Reef site on the east coast of the island with algal turf had two large specimens of the phyllodocid, *Phyllodoce violacea*, one was collected by Alan Davis and Ray Roberto.

Saipan - Red beach (8, Nov.1999) - A 60 watt night light attracted large numbers of a spawning nereidid that were collected by Alan Davis on the west coast of the island, just north of Susupi.

Saipan - (1948-1949) – The extensive geological and biological study of Saipan in Cloud (1959) included habitats on fringing and barrier reefs and sands in the lagoon.

Results

Thirty polychaete families are known from Guam and Saipan (Appendix 1). Twenty families are known from Saipan (Hartman 1954, Bailey-Brock 1999, and this study) and 25 from Guam. Five families from Saipan (Sigalionidae, Euphrosinidae, Pilargidae, Onuphidae, Poecilochaetidae) were not found on Guam. Guam has a diverse polychaete fauna at the family level (Table 1), similar to Enewetak (35 families), the Solomons (34 families), Saipan (29 families) and Fiji (27 families) (Devaney & Bailey-Brock 1987, Bailey-Brock 1985, Corless 1995). Fewer families have been recorded from Tonga (19 families) (Bailey-Brock 1987a) and the Cook Islands (16 families) (Gibbs 1972).

Guam has approximately 76 polychaete genera and over a hundred species known to date (Table 1). Island groups ranked with the most genera to the fewest are Hawai‘i (197 genera, includes unpublished records), the Solomons (117 genera), Enewetak (101 genera), Guam (76 genera), Fiji (53 genera), Tonga (48 genera), the Cook Islands (33 genera) and Saipan (46 genera). These records reflect extremely different sampling efforts and methods used by relatively few polychaete researchers who have been able to organize visits to these remote islands. They do not infer that Saipan has a depauperate polychaete fauna.

Polychaetes with an Indo-West Pacific and Hawai‘i distribution include two fireworms, *Notopygos albiseta* and *Eurythoe complanata* (the latter are 2-3 times larger from Guam than in Hawai‘i), five eunicids *Lysidice ninetta*, *Nematonereis unicornis*, *Palola siciliensis*, *E. afra* and *E. aphroditois*, a spionid, *Dipolydora armata* and a cirratulid, *Dodecaceria laddi* (Appendix 1). Calcareous tubeworms (Serpulidae) widespread in tropical Indo-West Pacific (ten Hove 1994) harbors and reefs are *Salmacina dysteri,* which was scraped from a mooring buoy in Apra Harbor and rocks at Gaan, but was otherwise sparsely represented in these collections. There were few *Hydroides* spp., except for *Hydroides perezi* which was abundant on Pago reef.

Syllids are the most species-rich family in Guam (Kohn & White 1977) on eastern Indian Ocean reefs (Kohn & Lloyd 1973) and in tropical and temperate localities (Licher 1999). They are small, usually cryptic worms rarely seen with the naked eye. A new species of *Haplosyllis* from Guam is conspicuous and abundant on the surface of sponges (Sardà et al. 2002). There are eleven genera in this study compared to 12 in Bailey-Brock (1999) due to revision of *Langerhansia cornuta* to *Typosyllis cornuta* (Licher 1999).

Sediment-dwelling polychaetes include opheliids, spionids (except for *Dipolydora armata*), hesionids, some syllids, glycerids, orbiniids, capitellids, maldanids and chaetopterids. Some of these polychaetes live in fine sands, others in coarse sands with rubble fragments, and a few burrow or form tubes in mud. *Capitella* “*capitata”* collected with sea grass in the lagoon fronting Hotel Nikko, Saipan, thrives on organic detritus and is regarded as a pollution indicator. This polychaete has a worldwide distribution as a complex of sibling species.

Calcareous tubeworms (Serpulidae and Spirorbidae) were found on coral reefs and in harbors. Spirorbids were abundant and species-rich in shallow, calm habitats growing attached to rocks, glass debris, dead coral, sea grass blades and algae. Six of the nine species were found at Pago Bay, and seven were collected on Saipan. Two serpulids, *Salmacina dysteri,* a pseudoclonal species (Nishi & Nishihara 1994) and *Josephella marenzellerii*, a solitary species, are widely distributed.

Table 1. Number of genera in common polychaete families on Pacific Islands G=Guam, S=Saipan, H=Hawai‘i, F=Fiji, T=Tonga, SI=Solomon Islands, CI=Cook Islands, and E=Enewetak.

Family	G	S	H	F	T	SI	CI	E
Chrysopetalidae	1		2			2	1	3
Polynoidae	2	6	8	4	1	8	2	5
Sigalionidae		2	2	1	1	5		
Amphinomidae	4	1	8	1	1	7	1	2
Phyllodocidae	1	1	6	1	1	5	3	5
Pilargidae		1	2	1				
Hesionidae	1	1	6	1		3	3	3
Syllidae	11	3	18	1	3	10	1	15
Sphaerodoridae	1		1			1		1
Nereididae	6	4	9	3	4	8	3	8
Glyceridae	1	1	1	1	1	1	1	1
Eunicidae	4	5	5	4		5	2	5
Dorvilleidae	1	1	5			1		2
Lumbrineridae	1		1	2		1		1
Oenonidae	1	1	1	1				
Arabellidae	1		1	1	1	2		2
Onuphidae		1	3	1		1		
Spionidae	2	2	21	7	1	9	5	10
Magelonidae			1	1				
Orbiniidae	1		3	2		3	2	2
Paraonidae			3	1				
Opheliidae	2		3		2	3	2	2
Oweniidae			1			2	1	
Cirratulidae	3		8	1	2	3		3
Maldanidae	1		3		1	4		2
Cossuridae			1	1				
Scalibregmatidae			1	1				
Chaetopteridae	3		4	1	3	4	3	3
Capitellidae	3	2	4	3	2	6	1	7
Arenicolidae			1			1		1
Sabellariidae			4	1		1		
Terebellidae	7	2	9	1	4	9		4
Sabellidae	4		17		5	6	2	4
Serpulidae	6	3	14	5	7	6		7
Spirorbidae	5	5	10	5	8			3
No. genera	73	42	187	53	48	117	33	101

Reef -associated eunicid worms included the Palolo worm (*Palola siciliensis*) that forms burrows in coral rock and reproduces by epitoky, spawning at the sea surface on a lunar cue. *Eunice afra* was found boring in the base of a soft coral and other *Eunice* spp. were collected among crusts and turf algae, or in rock burrows. The genus *Eunice* includes more than 205 species (Fauchald 1992). Nine *Eunice* spp. are known from Hawai‘i, so the five *Eunice* spp. from Guam is likely an artifact of limited collection efforts.

Terebellids and sabellids build strong tubes attached to the undersides of rocks and harbor structures, or emerging among coral rubble. Terebellids attach shell fragments to the tubes, sabellid tubes are sediment covered and often small and inconspicuous. The identification of *Thelepus setosus* is being studied. *T. setosus* is a N. European species previously recorded from Hawai‘i (Kohn 1959, Hartman 1966).

Tanguisson reef rock and algal mat samples contained 21 and 17 polychaete species with estimated polychaete densities of 43,500 and 21,400/m^2 respectively (Kohn & White 1977). The Tanguisson material yielded 16 families with 42 species (Kohn & White 1977) and Pago Bay had 20 families with 47 species (Bailey-Brock 1999). Composition of trophic and motility categories (modified from Fauchald & Jumars 1979) based on diversity at these sites is given in Figure 2. Omnivorous species were dominant at both sites (56% of species at Tanguisson, 28% at Pago Bay), detritivores were the next (26% of species at Pago Bay and 23% at Tanguisson), then carnivores comprised 18% at Pago Bay and 15% at Tanguisson. Suspension feeding species comprised 28% of the polychaetes at Pago Bay, but only 5% at Tanguisson (Bailey-Brock 1999). This is most likely a sampling bias of the author and a reflection of habitat scale. Fifty species from the 14 locations in Guam in the 1999 study are motile worms, 36 are sessile, and 14 are discretely motile (burrowers or facultative tube dwellers).

The proportions of species assigned to these trophic and motility categories are broadly similar for Hawai‘ian communities at 70m depths off O’ahu (Swartz et al. 1998), and on Indo-West Pacific reefs (Kohn & Lloyd 1973). It is likely that their abundance is also similar, as motile dertritivores are numerically the most abundant guild in Hawai‘ian coral reef habitats. This trophic structure indicates that a good cross-section of the Guam reef fauna has been collected, but small (0.5mm length), sand dwelling polychaetes were not sampled for this study.

Discussion

The polychaete fauna as reported in the references includes species that may be new and unrecorded in the literature. The widely distributed species examined in detail may be found to contain a mixture of undescribed species. This study presents a compiled species list to aid the taxonomist but does not attempt to review groups of closely related species or “contentious” nomenclature that requires review. It is not intended as a reference for biomonitoring programs, but suggests ways that polychaete taxonomy and ecology may be useful to applied fields. The polychaete fauna of West Pacific islands based on number of families present (Bailey-Brock 1999) follows a descending order with Enewetak and the Solomons having more families than Guam, and fewer known from Fiji, Saipan, Tonga, and the Cooks. This reflects the remote position of these islands from other island groups and continental regions, and that more collecting and identification work has been done for reef habitats of the former island group than for the latter. Some polychaetes have most likely reached remote islands among the invertebrate fouling community attached to ship's hulls and in ballast water. Some recently introduced species are documented for the dry dock "Machinist" in Apra Harbor; others possibly arrived during or before World War II.

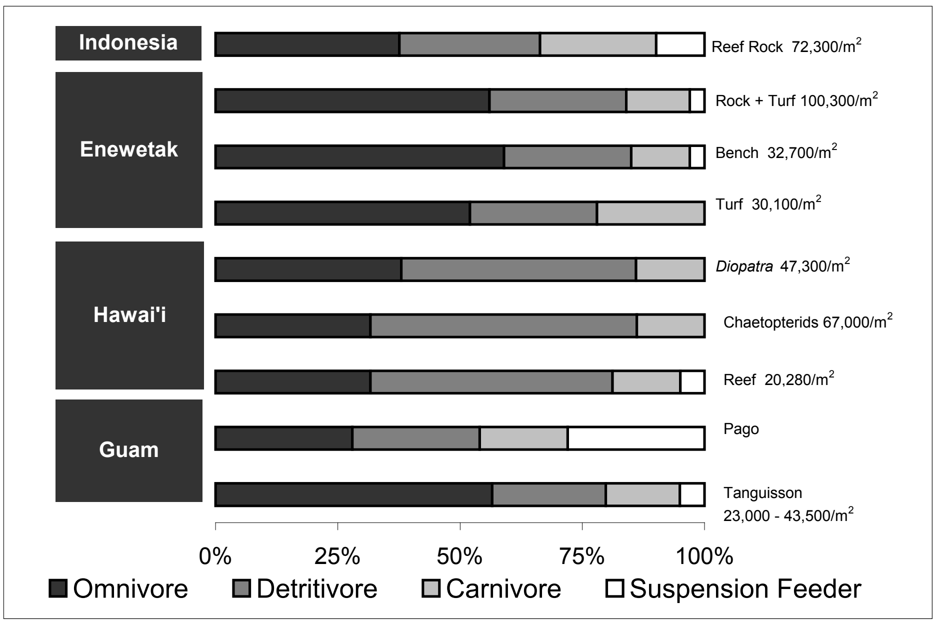

Figure 2. Trophic composition of Pacific polychaete assemblages. Polychaete abundance / m^2 from distinct habitats within Guam and Pacific and Indian ocean islands. Indonesia (Kohn & Lloyd 1973), Enewetak (Bailey-Brock et al. 1980), Hawaii *Diopatra* (Bailey-Brock 1984), chaetopterids and reef (Bailey-Brock 1979), Guam, Pago (Bailey-Brock 1999), Tanguisson (Kohn & White 1979).

Infaunal polychaetes were not been adequately sampled because hard substrates with attached tubeworms were easier to collect and are families of greatest interest to the author. The sediment characteristics e.g. grain size, degree of sorting, organic content; porosity and oxygen levels in pore water define the habitat for infaunal invertebrates. Sediment contains an organic food source for deposit feeders and provides habitat structure for burrowers. Estimates for Guam are similar to Hawai'ian sand habitats (Figure 2) with 23,800/m^2 on an intertidal reef flat (Kohn & White 1977) and 47,300/m^2 in *Diopatra* tubeworm mounds adjacent to the beach (Bailey-Brock 1979, 1984).

Calcareous tubeworms, the serpulids and spirorbids, have been studied by many specialists including P. & E.W. Knight-Jones (1973, 1974), ten Hove (1984), and Nishi & Nishihara (1994). Some species identifications in both tubeworm families remain problematic due to the geographic variation exhibited in diagnostic features. *Hydroides* and *Spirobranchus* spp. show numerous variants of opercular crowns and tube ornamentation. Spirorbids are small (1.5-5 mm tube diameter), hermaphroditic, have 3 to 5 incomplete thoracic setigers and distinct juvenile/adult opercular structures in many species. Numbers of thoracic setigers, types of chaetae and opercular characters are useful for identification.

The densities of polychaetes (Figure 2) at Tanguisson (Kohn & White 1977) are similar to 49,000 worms/m^2 for coral reef limestone from Indian Ocean reefs (Kohn & Lloyd 1973). The algal turf on the seaward section of Enewetak bench had 32,700/m^2. These estimates are well below 82,000-100,300/m^2 for the limestone rock with overlying turf sample (a three dimensional habitat) collected in the similar bench habitat at Enewetak (Bailey-Brock et al. 1980). Forty-two sand samples collected at 70m depth off the S. shore of O'ahu, Hawai'i contained 107 polychaete species (specimens retained on 0.5mm sieve) belonging to 31 families with densities from 21,235/m^2-64,478/m^2 (Swartz et al. 1999). Different methods were used for extracting polychaetes from the substrata. Kohn's Guam and Indian Ocean samples were processed by carefully chipping the rock and removing the polychaetes from rock burrows and among algal turf, while acid dissolution and picking through algal turf was done for the Hawai'ian reef and Enewetak material. The results are broadly comparable from an ecological perspective because they have similar densities and species represented as those of other shallow tropical regions (Bailey-Brock 1979, 1984, Kohn & Lloyd 1973). The two samples from Tanguisson provide the only quantitative polychaete assessments for Guam (Kohn & White 1977). Many of the species represented are known from other tropical regions and cited in many publications including – Bailey-Brock 1979, 1984, 1985, 1987a, b; Devaney and Bailey-Brock 1987, Gibbs 1971, 1972 and Rullier 1972.

Mixed sand and coral rubble samples contained more species and higher total polychaete abundances than sand alone. Coral rubble provides three-dimensional living space for cryptic and boring polychaetes that are also enhanced by detrital food resources. Hard and soft-bottom benthos in mixed sand and rubble sediments appears to yield more complex communities than sand or rock alone (Brock & Smith 1983). The Enewetak, Guam and Hawai'i studies all support this hypothesis that heterogeneous sediments with coral rubble provide more habitat space for cryptic and burrowing species, leading to higher species numbers and more diverse communities.

Syllids are the most species-rich and abundant polychaetes on shallow tropical reefs in the eastern Indian and West - Pacific region. Species richness at shallow depths ranges from 16 – 36, and densities average 40,000 polychaetes/m^2 (Kohn & Lloyd 1973, Kohn & White 1977, Bailey-Brock 1999, Bailey-Brock et al. 1980). Intensive within site collecting would increase species and family richness at e.g. Pago Bay and Tanguisson. A new nereidid, *Ceratonereis brockorum* (Hartmann-Schröder 1985) from Pago Bay, is the only new species record for the Marianas in these collections. Morphological differences exist in some species at different parts of their geographic range, and more complex ecotypic differences may be true for spirorbids, *Hydroides* and *Spirobranchus* spp (P. Knight-Jones, Ben Eliahu and ten Hove, pers. comm. respectively) at a given location. Motile polychaetes are dominant in an assemblage, far fewer are tubicolous unless gregarious species are locally present e.g. spionids, chaetopterids. Dominant feeding guilds tend to be omnivores (includes syllids) and detritivores.

Life history information is lacking for many reef polychaetes, but some assumptions can be made. Asexual reproduction is known for many syllids, sabellids and serpulids. Spirorbids are hermaphroditic brooders (Bailey 1969), and some dorvilleids may reproduce continuously when food is plentiful. Lastly, complex habitat structure (three dimensions e.g., on and within coral rock, among thalli in algal turf) has greater polychaete species richness and density than less topographically complex habitats (e.g. scoured rock bench without algae or sand).

Researchers gain an ecological perspective of polychaete communities from different reef habitats and locations from replicated samples of hard substrates, lagoon sands, sea grass blades etc. which may be quantified and analyzed (species diversity, similarity indices, trophic and motility guilds etc.). This gives a picture of species richness, density and dominance rankings at one point in time from a specific location and habitat. Sampling can be done with a temporal scale, or according to functional guilds for a variety of habitats and ecological niches. If some of these approaches are adopted by researchers in future studies a better understanding of polychaete ecology, trophic dynamics, predator/prey interactions, and substrate effects on community structure will emerge.

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Appendix 1 - Distribution of polychaetes from Guam and Saipan

Is.: island: G = Guam; S = Saipan

Locality: specific collecting localities and sources (noted parenthatically: collectors as letters, references as numbers, see below) from Guam (1-22) and Saipan (22-31) as follows: 1: Iates (B), 2: Pago outer reef (B), 3: Pago inner reef (B), 4: Tagachan (B), 5: Talafofo (B), 6: Cocos (B), 7: Cocos (P), 8: Sella (P), 9: Gaan (2), 10: Gaan (B), 11: Apra Harbor (4), 12: Apra Harbor, Drydock "Machinist" (P), 13: Piti (P), 14: Piti (B), 15: Piti Harbor (B), 16: Piti outer reef (B), 17: Agana (B), 18: Agana bay reef (P), 19: Susana (B), 20: Tanguisson (B), 21: Tanguisson (3), 22: Double reef (P), 23: Saipan, general (B), 24: Saipan, general (2), 25: Saipan, general (1), 26: Saipan, general (D), 27: Saipan, general (3), 28: Lagoon (3), 29: Lagoon (B), 30: Lagoon, dump (B), 31: Tank beach (D). Collectors: B: Brocks, D: Alan Davis, P: G. Paulay and colleagues

Ref.: references: 1) Hartman 1954; 2) Hartman in Cloud 1959; 3) Kohn and White 1977; 4) Sardá et al. 2002

Note: taxonomic and other notes; see end of table.

Taxon	Is.	Locality	Ref	Note
CHRYSOPETALIDAE				
Chrysopetalum ehlersi Gravier, 1901.	G	2, 10, 21	3	
POLYNOIDAE				
Allmaniella ptycholepis (Grube, 1878)	S		2	
Iphione muricata (Savigny,1818)	G, S	8, 24	2	
Lagisca cornuta Potts, 1910	S	24	2	
Perolepis regularis Ehlers 1908	S	24	2	
Scalisetosus pellucidus (Ehlers,1908)	S	24	2	
Thormora atrata (Treadwell,1940)	G	1, 2, 4		
Thormora jukesii Baird 1865	S	24	2	
Polynoid (with holothurian)	G	14		
Polynoid	G	2, 19		
SIGALIONIDAE				
Sthenelais variabilis Potts, 1910	S	24	2	
Thalenessa tropica Hartman, 1954	S	24, 28	2, 3	
AMPHINOMIDAE				
Eurythoe complanata (Pallas,1766)	G, S	2, 5, 13, 17, 19, 24	2	
Linopherus sp. (as *Pseudeurythoe*)	G	2, 21	3	
Notopygos albiseta Holly, 1939	G	13		
Pherecardia striata Kinberg, 1857	G	7		
EUPHROSINIDAE				
Euphrosine myrtosa Savigny 1818	S	24	2	
PHYLLODOCIDAE				
Phyllodoce madeirensis (Langerhans, 1880)	S	24	2	1
Phyllodoce violacea Treadwell, 1926	G, S	1, 31		
Phyllodoce sp.	G	2, 21	3	
PILARGIDAE				
Synelmis albini (Langerhans, 1881)	S	24	2	2
HESIONIDAE				
Hesione genetta Grube 1867	S	24	2	
Hesione splendida Lamarck, 1818	G	17, 19		
unidentified Hesionidae	G	21	3	

Appendix 1 - Distribution of polychaetes from Guam and Saipan / *(continued)*

Taxon	Is.	Locality	Ref	Note
SYLLIDAE				
Branchiosyllis exilis Gravier, 1900	G	2		
Brania rhopalophora (Ehlers, 1897)	G	21	3	
Exogone longicornis Westheide, 1974	G	6, 21	3	
Exogone sp.	S	30		
Haplosyllis spongicola (Grube, 1855)	G, S	6, 21, 24	2, 3	
Haplosyllis sp.	G	6		
Haplosyllis basticola (Sardá, Avila & Paul 2002)	G	11	4	
Odontosyllis ctenostoma Claparède, 1868	G	21	3	
Opisthosyllis australis Augener, 1913	G	21	3	
Opisthosyllis brunnea Langerhans, 1879	G	2		
Pionosyllis sp.	G	21	3	
Sphaerosyllis ovigera Langerhans,1879	G	21	3	
Sphaerosyllis sp.	G	21	3	
Syllis gracilis Grube,1840	G	21	3	
Trypanosyllis sp.	G	2		
Typosyllis alternata Moore,1908	G	21	3	3
Typosyllis cornuta Rathke, 1843	G	2, 21	3	
Typosyllis hyalina (Grube, 1863)	G	2		
Typosyllis prolifera Krohn, 1852	G, S	2, 12, 21, 23	3	
Typosyllis variegata (Grube, 1860)	G	2, 21	3	
Typosyllis sp.	G, S	20, 27	3	
SPHAERODORIDAE				
Sphaerodoropsis sp.	G	21	3	
NEREIDIDAE				
Ceratonereis brockorum Hartmann-Schröder, 1985	G	2		
Ceratonereis singularis Treadwell, 1929	G	2		
Ceratonereis tentaculata Kinberg, 1866	S	24	2	4
Neanthes unifasciata Willey, 1905	G	2		
Nereis macropis Ehlers, 1920	S	24	2	
Nereis persica Fauvel, 1911	G	2		
Perinereis nigropunctata (Horst, 1889)	G	21	3	
Perinereis obfuscata Grube, 1878	G	21	3	5
Platynereis abnormis (Horst, 1924)	S	26		
Platynereis dumerillii (Audouin & Milne- Edwards, 1833)	G	2, 21	3	
Platynereis pulchella Gravier,1901	G	2		
Pseudonereis gallapagensis Kinberg, 1866	G, S	21, 24	2, 3	
Pseudonereis variegata (Grube, 1857)	G	2, 4		
GLYCERIDAE				
Glycera tesselata Grube, 1863	G, S	14, 24	2	
ONUPHIDAE				
Onuphis sp.	S	24	2	
EUNICIDAE				
Eunice afra Peters, 1854	G, S	22, 24	2	
Eunice antennata (Lamarck, 1818)	S	24	2	
Eunice aphroditois (Pallas, 1788)	G	18		
Eunice coccinea Grube, 1878	S	24	2	
Eunice havaica Kinberg, 1865	G	1, 2, 4		
Eunice (Leodice) sp. n.?	G	4		
Eunice petersi Fauchald, 1992	G	2, 5, 21	3	

Appendix 1 - Distribution of polychaetes from Guam and Saipan / *(continued)*

Taxon	Is.	Locality	Ref	Note
Lysidice ninetta Audouin & Milne-Edwards, 1833	G, S	2, 6, 21, 24	2, 3	6
Marphysa mossambica (Peters 1854)	S	23		
Nematonereis unicornis (Grube, 1840)	G, S	6, 14, 24	2	
Palola siciliensis (Grube, 1840)	G, S	2, 14, 21, 24	2, 3	
Paramarphysa ? sp.	S	24	2	
ARABELLIDAE				
Arabella iricolor (Montagu, 1804)	G	2, 4		
Arabella mutans (Chamberlin, 1919)	G	21	3	
Arabella sp.	G	6		
OENONIDAE				
Oenone fulgida (Savigny, 1818)	G, S	12, 24	2	7, 8
LUMBRINERIDAE				
Lumbrineris tetraura (Schmarda, 1861)	G	2		
DORVILLEIDAE				
Dorvillea gardineri (Crossland, 1924)	S	24	2	
Dorvillea rubrovittata (Grube, 1855)	G, S	2, 10, 23		
Dorvillea sp.	S	24	2	
SPIONIDAE				
Dipolydora armata (Langerhans, 1880)	G	2		
Nerine cirratulus saipanensis Hartman, 1954	S	25	1	
Pseudopolydora corallicola Woodwick, 1964	G	14		
Scolelepis squamata saipanensis Hartman in Emery, 1962	S	25	1	
POECILOCHAETIDAE				
Poecilochaetus tropicus Okuda, 1935	S	24	2	
ORBINIIDAE				
Naineris sp.	G	21	3	
OPHELIIDAE				
Armandia intermedia Fauvel, 1902	G	14, 21	3	
Polyophthalmus pictus (Dujardin, 1839)	G	2, 21, 24	2, 3	
CAPITELLIDAE				
Capitella capitata (Fabricius, 1780)	S	29		
Dasybranchus caducus (Grube, 1846)	G	21, 24	2, 3	
Notomastus sp.	G	2, 21	3	
Scyphoproctus sp.	G	6		
MALDANIDAE				
Euclymene sp.	G	3		
CHAETOPTERIDAE				
Mesochaetopterus sagittarius (Claparède, 1870)	G	2, 3, 14		
Phyllochaetopterus elioti Crossland, 1903	G	2, 3, 6, 14		
Spiochaetopterus vitrarius (Ehlers, 1908)	G	3, 15		
CIRRATULIDAE				
Chaetozone sp.	G	4		
Dodecaceria laddi Hartman, 1954	G	16		
Timarete caribous (Grube, 1859)	G	12		8
TEREBELLIDAE				
Eupolymnia nebulosa (Montagu, 1818)	G	14		
Euthelepus kinsemboensis Augener, 1918	G	2		
Loimia medusa (Savigny, 1820)	G, S	21, 24	2, 3	
Neoamphitrite sp.	G	2, 21	3	
Pista brevibranchia Caullery, 1915	G	6, 10, 14, 19		

Appendix 1 - Distribution of polychaetes from Guam and Saipan / *(continued)*

Taxon	Is.	Locality	Ref	Note
Pista macrolobata Hessle, 1917	G	6		
Terebella ehrenbergi Grube, 1870	G	2, 21	3	
Terebella sp. unident.	G	21	3	
Thelepus setosus (Quatrefages, 1865)	G, S	12, 24	2	8
SABELLIDAE				
Augeneriella dubia Hartmann-Schröder, 1965	G	2		
Megalomma bioculatum (Ehlers, 1887)	G	2		
Megalomma quadrioculatum (Willey, 1905)	G	2		
Perkinsiana ?socialis (Langerhans, 1884)	G	6		
Sabellastarte spectabilis (Grube, 1878)	G	12		8
SERPULIDAE				
Hydroides perezi Fauvel, 1918	G	2, 6		
Hydroides sp.	G	6		
Josephella marenzelleri Caullery & Mesnil, 1896	G	2, 10		
Protula sp.	G	6, 19		
Salmacina dysteri (Huxley, 1855)	G	10, 12		
Serpula watsoni Willey, 1905	S	24	2	
Spirobranchus decoratus Imajima,1982	G	10		
Spirobranchus paumotanus (Chamberlin, 1919)	G, S	2, 6, 10, 29		
Spirobranchus corniculatus (Grube, 1862)	G	2, 9, 19, 24	2	9
Spirobranchus tetraceros (Schmarda, 1861)	G	10		
Vermiliopsis infundibulum/ glandigera group	G, S	2, 6, 14, 23		
Vermiliopsis sp.	G	6, 19		
unidentified Serpulinae	G	21	3	
SPIRORBIDAE				10
Janua pagenstecheri Quatrefages, 1865	G	2		
Leodora knightjonesi (de Silva, 1965)	G, S	2, 3, 23		
Neodexiospira nipponica Okuda, 1934	G, S	3, 23		
Neodexiospira preacuta Vine, 1972	G, S	19, 23		
Neodexiospira steueri (Sterzinger, 1909)	G, S	2, 3, 6, 14, 19, 23		
Pileolaria militaris Claparède, 1868	S	23		
Pileolaria polyoperculatus Straughan, 1969	G, S	2, 23		
Pileolaria pseudoclavus Vine, 1972	G	6		
Spirorbis sp.	S	24	2	
Vinearia koehleri Caullery & Mesnil, 1897	G, S	2, 14, 19, 23		

Notes:
1) as *Anaitides*
2) as *Ancistrosyllis rigida* Fauvel
3) incertae sedis
4) as *C. mirabilis* Kinberg 1866
5) as *P. cultrifera* (Grube) in Fauvel, 1953
6) as *L. collaris,* Grube
7) as *Aglaurides fulgida* (Savigny)
8) Introduced on the "Machinist" dry dock.
9) as *S. giganteus* (Pallas)
10) Family status used for Spirobidae