Polychaete Annelids of an Intertidal Reef Limestone Platform at Tanguisson, Guam

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Abstract—Quantitative analyses of the polychaete fauna in two samples from a low intertidal reef limestone platform at Tanguisson, Guam, revealed close similarities in abundance, family and generic composition, and species diversity with results from prior studies of similar habitats elsewhere in the tropical Indo-West Pacific region. The samples contained 29 species of polychaetes, of which 15 were determined to species, 8 to genus, and 6 only to family. Total polychaete density based on the one complete substratum sample is estimated as 43,500/m^2, also comparable to estimates from other similar habitats. *Syllis* (*Langerhansia*) *cornuta* dominated both samples numerically, accounting for 42% and 43% of all polychaetes. The Syllidae was by far the most abundant family, accounting for 75% and 93% of all polychaetes, as is typical in such habitats. Despite their abundance, however, syllids are so small that they represented only about 1 g/m^2 dry weight. The dominant species by biomass was *Palola siciliensis* (about 16 g/m^2 dry weight).

Despite the proximity of the study site to the heated-water effluent of a power plant, no adverse effect on the polychaete fauna was detected, such as lower than expected diversity or presence of pollution indicator species.

Of the 27 species of polychaetes now identified as occurring at Guam, 24 are widely distributed in the tropical Indo-West Pacific region. *Odontosyllis ctenostoma* was previously known from the Atlantic, Mediterranean and questionably Japan. The new Indo-West Pacific records are *Sphaerosyllis ovigera*, known previously only from the Atlantic, and *Exogone longicornis*, from the Galapagos.

Introduction

Intertidal benches or platforms are common shore features of the limestone coasts of Guam. They are erosional features caused by wave action and dissolution truncating emerged Mariana limestone of Pleistocene age (Tracey et al., 1964; Fairbridge, 1968). Platforms of this type occur throughout the Indo-West Pacific tropics. Despite their simple topography and barren appearance, they support a rich biota of benthic algae and small invertebrates.

Because polychaete annelids are known to be extremely abundant in this type of habitat elsewhere (Kohn and Lloyd, 1973a), because predatory gastropod molluscs that specialize on polychaete annelids for their prey are prominent in this habitat type (Kohn, 1959; Kohn and Leviten, 1976) and because little information exists on the polychaete fauna of Guam (Emery, 1962: 67) we report here on the abundance

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and diversity of polychaetes in two quantitative samples of bench substrate from Tanguisson, Guam.

Study Site, Materials, and Methods

The study site was located at 13°32.3′ N, 144°48.2′ E, approximately midway between Amantes Point and Tanguisson Point on the northeast coast of Guam. This locality is within Sector 2 of Tracey et al. (1964: 79) and Sector IV of Randall and Holloman (1974: 92ff). Two samples of substratum were taken by A. J. K. on 18 January 1975 on the 'outer reef-flat subzone' approximately at the site of Transect C of Randall (1973: figs. 2, 3) and Randall and Holloman (1974: 96, figs. 84, 85). This habitat corresponds most closely to Facies 39 in Cloud's (1959: Table 6) classification and to Structure 57, 'dalle du platier' or 'outer reef flat flagstone', in Battistini's (1975) classification of reef structures. The level of the study site was estimated from observed tidal heights to be very close to (within 0.2 m of) tidal datum, or mean lower low water.

Sample A was a block of limestone of 34 cm^2 and approximately 3 cm deep, chiseled from a section of bench lacking a well developed algal mat. Sample B consisted of 50 cm^2 of algal mat and bound 'sand' (mainly the calcarinid foraminiferan *Baculogypsina sphaerulata* Parker and Jones) scraped from the surface of the underlying limestone. Sample B was fixed in 10% formalin in sea water immediately upon return to the laboratory and later preserved in 70% ethanol until examined for faunal analysis. Sample A was allowed to stand in a bucket of stagnant sea water overnight and periodically examined for emerging polychaetes, which were similarly fixed. The block was fixed in 10% formalin in sea water the following day and later preserved in 70% ethanol. It was subsequently broken apart and the remaining polychaetes isolated and examined.

Because we attempted to identify and count all individuals in the collection, we have used Brillouin's formula,

$$H = \frac{1}{N}\left(\ln N! - \sum_{1}^{s} \ln N_i!\right)$$

as a measure of species diversity (Pielou, 1975). N is the total number of individuals, N_i the number of individuals in the i^{th} species, and there are S species. We have omitted unidentified individuals in families or genera that were represented by identified species. H increases both with increasing number of species and with more even distribution of individuals among species. In order to compare species diversity with results from other studies in which all individuals from measured areas were not counted, we also used Shannon's formula for the estimation of H,

$$H' = -\sum \frac{N_i}{N} \ln \frac{N_i}{N}.$$

As a measure of between-sample similarity that takes into account relative

abundance of species, we have used percentage similarity,

$$PS = 1 - 0.5\left(\sum_{i=1}^{s}\left|\frac{N_{1i}}{N_1} - \frac{N_{2i}}{N_2}\right|\right)$$

where N_{1i} is the number of individuals in the i^{th} species in Sample 1, N_1 is the total number of individuals in Sample 1, and similarly, for Sample 2. Pielou (1975) advocates use of this measure, for which she gives a slightly different but equivalent formula. Its merits are discussed more thoroughly by Whittaker (1952) and Schoener (1968).

A set of specimens of identified species represented by more than one specimen has been deposited in the University of Guam Marine Laboratory. The remaining specimens have been deposited in the National Museum of Natural History, Smithsonian Institution.

Systematic Section

The basic taxonomic reference and systematic arrangement used was the recent synthesis by Day (1967). For species listed by Day, we cite only that work unless other sources were particularly useful for identification. The specimens we analyzed agree with Day's descriptions, except for the discrepancies mentioned. For species not listed by Day, the original description and other sources used in identification, if any, are cited.

AMPHINOMIDAE

Pseudeurythoe sp.

Sample B, 11 specimens; length 2.0–5.0 mm.

The specimens closely resemble those of the unidentified species of *Pseudeurythoe* recorded from Easter Island by Kohn and Lloyd (1973b: 694). Branchiae occur on setigers 3–8. Eyes were visible only on one specimen. A caruncle is absent. Notosetae consist only of smooth capillaries. Neuropodia contain simple capillary setae with minute serrations, as well as long and short serrated forked setae.

PHYLLODOCIDAE

Phyllodoce sp.

Sample A, 1 specimen.

The specimen is poorly preserved, incomplete, and not identifiable to species.

HESIONIDAE

Sample A, 6 specimens; length 2.0–3.3 mm.

The specimens all appear to be of the same species, but the anterior ends are too poorly preserved to permit identification. One specimen has only compound setae. The other five are gravid females with long capillary setae, suggesting epitoky.

SYLLIDAE

Syllis (*Haplosyllis*) *spongicola* Grube

Syllis (*Haplosyllis*) *spongicola.* Day, 1967: 240, fig. 12.1.e–i.
Haplosyllis spongicola. Imajima, 1966a: 220, fig. 38a–h. Westheide, 1974: 35, fig. 14a–e.
Sample A, 5 specimens; length 4.2–5.0 mm.

The dorsal cirri have 4–10 joints (20–30 in specimens about 25 mm long, according to Day), as was characteristic of the small specimens Kohn and Lloyd (1973b: 694) recorded from Easter Island. The length and number of joints in successive segments varies irregularly, rather than alternating long and short (9 and 7, according to Imajima; 3–4 and 5–10, according to Westheide).

Syllis (*Syllis*) *gracilis* Grube

Syllis (*Syllis*) *gracilis.* Day, 1967: 241, fig. 12.1.m–p.
Syllis gracilis. Imajima, 1966a: 248, fig. 49a–k.
Sample A, 1 specimen; length 4.4 mm.

The anterior dorsal cirri have 7–11 joints (about 16, according to Day; 13–18 in a specimen 10 mm long, according to Imajima), and the posterior ones have 6–7 joints. The proventriculus extends between segments 8 and 13 (10–14, according to Day; 10–15, according to Imajima) and has 40 rows of points. The anterior segments lack dark cross-bars.

This is the only species of syllid previously reported from Guam (Emery, 1962).

Syllis (*Langerhansia*) *cornuta* Rathke

Syllis (*Langerhansia*) *cornuta*, Day, 1967: 244, fig. 12.2.s–u.
Langerhansia cornuta. Imajima, 1966b: 256, fig. 51.a–o.
Sample A, 62 specimens; Sample B, 51 specimens; length 2.2–7.8 mm.

This was the most abundant species in both samples, as it was in the samples studied earlier from the eastern Indian Ocean and Easter Island (Kohn and Lloyd, 1973a: 375; 1973b: 695). As in these specimens, the compound spinigers in the Guam specimens have weakly bidentate tips (see also Imajima, 1966b: fig. 51k). The proventriculus has 25–32 rows of points (30–35, in Day) and the dorsal cirri have 4–8 joints (10–18, in Day).

Syllis (*Typosyllis*) *alternata* Moore

Syllis alternata Moore, 1908: 323, figs. a–f.
Typosyllis alternata. Imajima, 1966b: 273, fig. 58,a–l.
Sample A, 20 specimens; Sample B, 10 specimens; length 1.2–5.2 mm.

Our specimens agree with the extensive description in Imajima with respect to the following characteristics: The form and arrangement of palps, prostomium, pharynx and proventriculus are similar. The 1st, 3rd, and 4th dorsal cirri are the longest, but they have fewer joints (averaging 19, 17, and 15, respectively) than in the larger specimen (23 mm) described by Imajima (35 in 1st, 21–28 in 3rd and 4th). The shorter 2nd dorsal cirri have 9–10 joints (17, according to Imajima). Dorsal

cirri of the midbody region are at least as long as the width of the body. The anterior parapodia have 10–12 bidentate, serrate falcigers, with the blades of the upper ones twice the length of the lower ones. In midbody parapodia the upper blades are 1 1/2 times as long as the lower ones. Posterior parapodia have two bifid, minutely serrate, simple setae.

Several of the differences between our specimens and those described by Moore and Imajima may be because of their smaller size. The median antennae are shorter (13–18 joints vs. 22–30, according to Moore in a specimen 30 mm long; 25, according to Imajima), as are the lateral antennae (8–14 joints vs. about 20, according to Moore and 17–18, according to Imajima), the dorsal tentacular cirri (10–18 vs. 20–25, according to Moore), and the ventral tentacular cirri (8–14 vs. 15, according to Moore). In the midbody region, dorsal cirri do not alternate long and short; their number of joints (9–18) is similar to that reported by Imajima.

Moore (1908: 323), Berkeley and Berkeley (1948: 77) and Banse and Hobson (1974: 64) described anterior bidentate falcigers with very long blades and do not mention simple setae in *S.* (*T.*) *alternata* from Alaska, British Columbia, and Washington, respectively. These features are not characteristic of our specimens nor apparently of others described from central or western Pacific regions (Imajima, 1966b: 273; Gibbs, 1971: 142).

The specimens we have assigned to *S.* (*T.*) *alternata* are also quite similar to *S.* (*T.*) *variegata*. The former differs in having fewer joints in the antennae and dorsal cirri, in having two simple bifid setae rather than one in posterior parapodia, in lacking any dorsal pigmentation, and in being generally smaller.

Syllis (*Typosyllis*) *variegata* Grube

Syllis (*Typosyllis*) *variegata*. Augener, 1913: 190. Day, 1967: 248, fig. 12.3.j–l.
Typosyllis variegata. Westheide, 1974: 51, figs. 21–22.
Sample A, 11 specimens; Sample B, 6 specimens; length 2.5–13.3 mm.

The pigment pattern of broken brown transverse bars extends to about the posterior end of the proventriculus; it is lacking in some specimens. The pharynx extends to setiger 8–12 (12, according to Day). The proventriculus extends over 8–12 segments (about 8–10, according to Day). All but two of the specimens have an upper simple bidentate seta in the last 3 setigers. These are not mentioned by Day, but are by Augener. Westheide described *S.* (*T.*) *variegata* with a simple upper seta in the last 20 setigers and a simple lower seta in the last 5 setigers of larger specimens.

Syllis (*Typosyllis*) sp.

Sample B, 3 specimens; length 2.1–8.7 mm.

This species agrees with the description of *Syllis* (*T.*) *cirropunctata* Michel in Day (1967: 250, fig. 12.4.k–l) with respect to the extent of the pharynx and the number of rows of points on the proventriculus. The dorsal cirri have 14–28 joints [30–40 in *S.* (*T.*) *cirropunctata*, according to Day]. Each joint has a pair of dark, reniform internal structures. The setae differ strikingly from *S.* (*T.*) *cirropunctata*

in that they are bidentate with an enlarged secondary tooth and distinctly toothed margin.

Opisthosyllis australis Augener

Opisthosyllis australis Augener, 1913: 218, text fig. 28; pl. 3, fig. 35. Fauvel, 1953: 156, fig. 80g–i.

Sample B, 7 specimens; length 4.5–9 mm.

The specimens agree with the original description and that in Fauvel (1953) with the following exceptions: The anterior and posterior eyes are of the same size (anterior twice as large as posterior, according to Augener). The dorsal cirri do not consistently alternate between long and short; the number of joints ranges from 18 to 32 (38 in the longest in a worm 29 mm long, according to Augener; 38–40 in worms 18–20 mm long, according to Fauvel). There is no large papilla at the shoulder of each dorsal cirrus. Each parapodium contains 8 compound falcigers (about 15 in middle parapodia, according to Augener). The appendage length of anterior falcigers does not differ between upper and lower setae in the same parapodium. Most of the falcigers in the midbody and posterior parapodia are unidentate and strongly curved, but some bidentate falcigers are present (all unidentate and strongly curved, according to Augener).

Augener indicated 22 joints in the dorsal and 16 in the ventral tentacular cirri. In our specimens dorsal tentacular cirri have 17–26 joints and ventral ones 11–21 joints. Our largest specimen has 40 setigers. The pharynx extends to setiger 10, with its tooth between setigers 9 and 10. The proventriculus extends from setiger 10 to 17 and has 40 distinct rows of points. In a specimen with 28 setigers described by Augener, the pharynx extended to setiger 9; the proventriculus extended to setiger 15 and had 40 rows of points.

Odontosyllis ctenostoma Claparéde

Odonotosyllis ctenostoma. Day, 1967: 261, fig. 12.7.g–h. Fauvel, 1923: 277, fig. 104f–l. Fauvel, 1934: 311.

Sample B, 1 specimen; length 4.4 mm incomplete.

The specimen agrees in all respects with the description in Day. It differs from the description in Fauvel in that the posterior eyes are closer to each other than the anterior ones, and the proventriculus is 3 times rather than twice the length of the pharynx.

Pionosyllis sp.

Sample A, 3 specimens; Sample B, 3 specimens; length 0.8–1.3 mm.

This species resembles *Pionosyllis confusa* Hartmann-Schröder (1960: 92) from the Red Sea with respect to the following features: The lateral antennae and palps have the same form and position and are fused basally and bent ventrally. The intersegmental boundaries are more distinct from setiger 7 on. The blades of upper falcigers are twice as long as the lower ones and are shorter posteriorly. The anterior edge of the pharynx is lobed; the dorsal tooth is at the level of setiger

1. The proventriculus extends between setigers 4 and 6 and has about 20 rows of points.

Our specimens differ from the description of *P. confusa* in the following ways: The prostomium is hemispherical rather than quadrangular. The median antenna inserts between the eyes rather than in front of them and is distinctly rather than indistinctly jointed. The palps are broader and longer. Dorsal and ventral tentacular cirri are similar in length. Dorsal cirri are short (about half as long as width of a body segment) and do not alternate in length. The parapodia contain 1 aciculum rather than 2, and 4 falcigers rather than 11; none of them has an elongate blade. A simple upper seta is present from setiger 12 on (rather than 20) and is bidentate.

Brania rhopalophora (Ehlers)

Brania rhopalophora. Day, 1967: 269, fig. 12.9.l–o.

Sample A, 2 specimens; Sample B, 5 specimens; length 1.2–1.5 mm.

The specimens have 22–23 setigers. The narrow distal portions of the antennae, tentacular cirri and dorsal cirri are set apart by a constriction. The pharynx reaches setiger 5 (3, according to Day) and the proventriculus extends to setiger 7 (6, according to Day). Simple setae occur from the middle of the body on; all are serrate, in contrast to the plain setae reported in this species from the eastern Indian Ocean (Kohn and Lloyd, 1973a).

Three of the specimens contained eggs, and one carried embryos affixed to the body wall.

Exogone longicornis Westheide

Exogone longicornis Westheide, 1974: 117, figs. 54, 55.

Sample A, 6 specimens; Sample B, 10 specimens; length 1.0–2.9 mm.

The specimens agree with the original description and figures in all respects except that the median antenna is located posterior to the lateral antennae and between the anterior eyes, the shaft of the compound spiniger lacks denticles, and the tip of the aciculum is slightly bent but not swollen.

This is the second known record of the species, which was described from 24 specimens collected from sandflats at Academy Bay, Santa Cruz Island, Galapagos.

Sphaerosyllis ovigera Langerhans

Sphaerosyllis ovigera Langerhans, 1879: 567, pl. 32, fig. 23. Fauvel, 1923: 302, fig. 116a–d.

Sample B, 2 specimens; length 1.3, 1.5 mm.

The specimens have 14 and 17 setigers (24–28 in specimens about 1.5 mm long, according to Langerhans). The proventriculus has about 12 rows of points (10, according to Langerhans; 10–15, according to Fauvel). The simple upper seta begins on setiger 1 (2, according to Langerhans).

Sphaerosyllis sp.

Sample A, 1 specimen; Sample B, 1 specimen; length 2.2, 2.5 mm.

Our specimens closely resemble *Sphaerosyllis brevicirra*, described by Hartmann-Schröder (1960: 105, figs. 128–130) from a single specimen 1.6 mm long collected near low tide level at Ghardaqa, Egypt. They agree with the original description and figures with respect to the size, shape and papillae of the prostomium and peristomium, presence of few papillae on the dorsal surface, insertion and shape of antennae, presence of dorsal cirri on all setigers, finger-like ventral cirri, form of aciculum, form and number of falcigers per parapodium (4–5; 4 according to Hartmann-Schröder), presence of simple setae from setiger 1 on, position of the pharyngeal tooth, and length of the proventriculus.

Our specimens differ from *S. brevicirra* primarily in that the prostomium is not fused with the peristomium and the other segments are clearly defined; the eyes are not fused; nuchal organs are not present; dorsal cirri become elongate posteriorly (their length is constant according to Hartmann-Schröder); and the proventriculus contains 15 rather than 20 rows of points; it extends from the middle of setiger 4 to the middle of setiger 6, rather than from the beginning of setiger 3 to the end of setiger 5, as in *S. brevicirra*.

SPHAERODORIDAE

Sphaerodoropsis sp.

Sample A, 2 specimens; Sample B, 1 specimen; length 1.0–1.3 mm.

This species keys to *S. capense* Day in Day (1967) and Fauchald (1974). Originally described in the genus *Sphaerodorum* (Day, 1963: 407, fig. 7d–f), *S. capense* was referred to *Sphaerodoridium* by Day (1967: 289), but is now placed in *Sphaerodoropsis* (Fauchald, 1974: 271, 284).

Our specimens differ from the original description of *S. capense* in the following characteristics: they have 4–6 macrotubercles per row rather than 18. The setae are distinctly compound with short simple blades, rather than the indistinctly separated blades of *S. capense*. The head is contractile, as in *S. capense*, but no eyes are apparent.

NEREIDAE

Two poorly preserved specimens of Nereidae are present, one in each sample. They belong to different species but are unidentifiable.

EUNICIDAE

Palola siciliensis (Grube)

Eunice (*Palolo*) *siciliensis*. Day, 1967: 382, fig. 17.2.a–f.

Sample A, 8 specimens; length 21–44 mm.

The specimens agree with the description in Day in all respects, except that the acicula are brown rather than black as Day noted for specimens up to 300 mm long.

The only intact specimen is 21 mm long; the lengths of the others, calculated from the regression given by Kohn and Lloyd (1973a) ranged from 24 to 44 mm. This species was previously recorded from Guam (Emery, 1962).

Lysidice collaris Grube

Lysidice collaris. Day, 1967: 402, fig. 17.8.a–f.
Sample A, 9 specimens; length 3–11 mm.

The specimens differ from the description in Day only in that the eyes are round rather than reniform, and subacicular hooks begin on setigers 15–18 (20, according to Day). In some specimens the margins of the maxillary plates appear worn and their teeth cannot be counted.

This species was previously recorded from Guam (Emery, 1962).

Nematonereis unicornis (Grube)

Nematonereis unicornis. Day, 1967: 403, fig. 17.8.j–n.
Sample A, 4 specimens; Sample B, 3 specimens; length 1–3.5 mm.

The specimens differ from the description in Day only in that the eyes are reniform rather than round, and subacicular hooks begin on setigers 7–9, as reported by Kohn and Lloyd (1973a,b) (20, according to Day).

ARABELLIDAE

Arabella mutans (Chamberlin)

Cenothrix mutans Chamberlin, 1919: 330, pl. 61, figs. 1–9; pl. 62: fig. 1.
Arabella mutans. Day, 1967: 446, fig. 17.18.f–m. Fauvel, 1953: 275, fig. 140i–l, fig. 143g–i. Fauchald, 1970: 128, pl. 21: figs. a–f.
Sample B, 2 specimens; length 3.5, 7.0 mm.

The specimens have 1 pair of eyes (none, according to Chamberlin; 2 pairs, according to Day). The maxillary formulas are compared with those given by Day below:

	3.5-mm specimen	7.0-mm specimen	Day (1967)
Mx. I	(*1*+5)+(*1*+?)	(*1*+5)+(*1*+6)	(*1*+4)+(*1*+4)
Mx. II	(*0*+7)+(*0*+9)	(*0*+8)+(*0*+10)	(*0*+12)+(*0*+12)
Mx. III	(*1*+2)+(?)	(*1*+2)+(?)	(*1*+4)+(*1*+4)
Mx. IV	(*1*+1)+(?)	(*1*+1)+(*1*+1)	(*1*+3)+(*1*+3)
Mx. V	(*1*)+(*1*)	(*1*)+(*1*)	(*1*)+(*1*)

The main difference is in maxilla I, which resembles more closely the figure in Fauvel (1953: fig. 140,1) in that the denticles below the falcate tip are both closer and more similar in size to it. Fauchald (1970) discussed the wide variation of this character in *A. mutans.*

SPIONIDAE

Sample A, 1 specimen.

The specimen consists only of the anterior 12 setigers, precluding determination to genus.

ORBINIIDAE

Naineris sp.

Sample A, 1 specimen.

The specimen is incomplete and too poorly preserved to permit identification.

OPHELIIDAE

Armandia intermedia Fauvel

Armandia intermedia. Day, 1967: 577, fig. 25.2.d–g.

Sample B, 1 specimen; length 3.8 mm.

The body contains 27 setigers; gills occur on setigers 2–24, with those on setigers 23 and 24 reduced. Lateral eyespots occur on setigers 5–19 (7–18, according to Day). There are 10 anal papillae (10–20, according to Day, who described a specimen 12 mm long); an internal ventral anal cirrus is not present.

CAPITELLIDAE

Notomastus sp.

Sample A, 1 specimen; length 11 mm incomplete.

The specimen consists of 11 biannulate thoracic setigers and a number of poorly preserved abdominal segments with no visible branchiae.

TEREBELLIDAE

Sample A, 2 specimens.

The specimens appear to be of the same species but are poorly preserved, incomplete and unidentifiable.

SERPULIDAE

Sample A, 1 specimen.

The specimen probably belongs to the subfamily Serpulinae, but the operculum and branchial crown are absent, precluding further identification.

Discussion: Population Density, Diversity and Zoogeography

POPULATION DENSITY

Although the two samples studied were from the same site, they represent different microhabitats and were collected in different ways. Sample A, from a relatively bare region of limestone bench covered by a very thin layer of sand, included the substratum to a depth of about 3 cm. It contained 148 polychaetes of 21 species, equivalent to about 43,500 polychaetes/m^2 (Table 1). Sample B, from an area of bench with an algal mat binding sand, consisted only of the algal-sand mat, not the underlying limestone. It contained 107 individuals of 17 species, equivalent to 21,400 polychaetes/m^2 (Table 1); the underlying reef limestone may well have harbored as many more polychaetes. Because our samples were small

Table 1. Polychaete annelids known from Guam, their geographic distribution, and estimates of population density and species diversity on the intertidal bench at Tanguisson. Sample A: Truncated reef limestone bench covered with thin layer of sand (34 cm^2); Sample B: Algal-sand mat overlying truncated reef limestone bench (50 cm^2).

Polychaete Species	Intertidal bench at Tanguisson		Intertidal Rimmed Terraces (Emery, 1962)	Recovered from *Conus* Alimentary Tracts	Geographic Distribution	Reference
	Sample A	Sample B				
CHRYSOPETALIDAE						
Chrysopetalum ehlersi Gravier (=*Paleanotus debilis* (Grube) according to Day, 1967)			×		Indian Ocean, Atlantic, Mediterranean	Day (1967)
AMPHINOMIDAE						
Eurythoe complanata (Pallas)				×	All tropical seas	Day (1967)
Pseudeurythoe sp.		11				
PHYLLODOCIDAE						
Phyllodoce sp.	1					
HESIONIDAE						
Unidentified Hesionidae	6					
SYLLIDAE						
Syllis (*Haplosyllis*) *spongicola* Grube	5				All temperate and tropical seas	Day (1967)
Syllis (*Syllis*) *gracilis* Grube	1		×		All temperate and tropical seas	Day (1967)
Syllis (*Langerhansia*) *cornuta* Rathke	62	51			All temperate and tropical seas	Hartman (1966)
Syllis (*Typosyllis*) *alternata* Moore	20	10			Solomon Is., Japan, Eastern Pacific	Rioja (1941), Imajima (1966b), Gibbs (1971)
Syllis (*Typosyllis*) *variegata* Grube	11	6			All temperate and tropical seas	Day (1967)
Syllis (*Typosyllis*) sp.		3				
Optisthosyllis australis Augener		7			Tropical Indo-West Pacific	Imajima & Hartman (1964)
Odontosyllis ctenostoma Claparède		1			Atlantic, Mediterranean, Japan	Fauvel (1934) Imajima & Hartman (1964)
Pionosyllis sp.	3	3				

Table 1. (continued)

Polychaete Species	Intertidal bench at Tanguisson		Intertidal Rimmed Terraces (Emery, 1962)	Recovered from *Conus* Alimentary Tracts	Geographic Distribution	Reference
	Sample A	Sample B				
Brania rhopalophora Ehlers	2	5			Tropical Indian Ocean, South West Africa, Chile	Day (1967), Kohn & Lloyd (1973a)
Exogone longicornis Westheide	6	10			Galapagos	Westheide (1974)
Sphaerosyllis ovigera Langerhans		2			Atlantic, Mediterranean	Fauvel (1923), Hamilton (1970)
Sphaerosyllis sp.	1	1				
SPHAERODORIDAE						
Sphaerodoropsis sp.	2	1				
NEREIDAE						
Platynereis dumerilii (Audouin & Milne Edwards)			×		All temperate and tropical seas	Day (1967)
Nereis (Nereis) persica Fauvel				×	Tropical Indo-West Pacific	Day (1967)
Perinereis nigropunctata (Horst)				×	Tropical Indo-West Pacific	Day (1967)
Perinereis obfuscata Grube (=*P. cultrifera* (Grube) according to Fauvel, 1953)			×		Tropical Indo-West Pacific, Atlantic, Mediterranean	Day (1967)
Pseudonereis gallapagensis Kinberg (=*P. variegata* (Grube) according to Day, 1967)			×		Circumtropical	Day (1967)
Unidentified Nereidae (2 species)	1	1				
EUNICIDAE						
Palola siciliensis (Grube)	8		×	×	Tropical Indo-West Pacific, Atlantic, Mediterranean	Day (1967)
Lysidice collaris Grube	9		×	×	Tropical Indo-West Pacific, Japan	Day (1967)
Nematonereis unicornis (Grube)	4	3		×	Tropical Indo-West Pacific, Atlantic, Mediterranean	Day (1967)
Eunice afra Peters			×	×	Tropical Indo-West Pacific, Atlantic	Day (1967), Birkeland et al. (1976)

ARABELLIDAE						
Arabella mutans (Chamberlin)		2		×	Eastern Pacific, Indian Ocean, Atlantic	Fauvel (1953), Day (1967), Fauchald (1970), Birkeland et al. (1976)
SPIONIDAE						
unidentified Spionidae	1					
ORBINIIDAE						
Naineris sp.	1					
OPHELIIDAE						
Armandia intermedia Fauvel		1			Tropical Indo-West Pacific, Japan, Atlantic	Day (1967)
Polyophthalmus pictus Dujardin			×		All temperate and tropical seas	Fauvel (1953)
CAPITELLIDAE						
Dasybranchus caducus (Grube)				×	Tropical Indian Ocean, Mediterranean	Day (1967)
Notomastus sp.	1					
TEREBELLIDAE						
Terebella ehrenbergi Grube				×	Tropical Indo-West Pacific	Day (1967)
Terebella sp.			×			
Loimia medusa (Savigny)			×		Tropical Indo-West Pacific, Eastern Pacific, Atlantic	Day (1967)
unidentified Terebellidae	2					
SERPULIDAE						
Spirorbis sp.			×			
unidentified Serpulinae	1					
Total number of species	21	17	12	10		
Total number of individuals	148	118	—	—		
Estimated population density (no./m^2)	43,500	23,600	—	—		
Species diversity (H)	1.96	1.87	—	—		
Species diversity (H′)	2.13	1.98	—	—		
Percentage similarity (PS)		0.69				

and were not replicated, the extrapolated estimates of population density are very rough. However, we justify them on the grounds that 1) comparable samples from very similar habitats elsewhere had similar species compositions, species diversities, and population densities, and 2) three replicate samples from one such habitat in the Eastern Indian Ocean were almost identical in species composition and relative abundance (Kohn and Lloyd, 1973a, PS values ranged from 0.79 to 0.88). In 7 Eastern Indian Ocean samples from similar habitats, estimates of density ranged from 16,000 to 92,000 polychaetes/m^2 (Kohn and Lloyd, 1973a).

As expected, Sample A contained more sedentary polychaetes than B, but the difference was not significant (χ^2 test, $p > 0.1$). However, if the 3 species of Eunicinae (which live in burrows in reef limestone) are added to the sedentary species list, and *Armandia intermedia* (which moves actively in sand) is subtracted from it, significantly more individuals (24) of species expected to be associated with a solid substratum occur in Sample A than in Sample B (χ^2 test; $P < 0.001$).

Only 9 of the 29 species (31%) occurred in both samples. The relatively high between-sample similarity value (PS=0.69) is because of the predominance of *Syllis* (*Langerhansia*) *cornuta* in both, accounting for 42% of all polychaetes by number in Sample A and 43% in B. The Syllidae was by far the most abundant family, accounting for 75% of Sample A and 93% of Sample B by number. This is typical in other Indo-West Pacific tropical regions as well as elsewhere (Kohn and Lloyd, 1973a: Table 4; 1973b).

Despite their abundance, syllids typically are small. Use of the conversion factors for dry weight worked out by Kohn and Lloyd (1973a) leads to an estimate of about 1 g dry weight/m^2 of syllids in Sample A and about 0.6 g/m^2 in Sample B. Individuals of the largest species present, *Palola siciliensis*, ranged in estimated dry weight from 0.6 mg to 22.3 mg; the estimated dry weight of all 8 specimens is 56.9 mg, equivalent to 16.7 g/m^2. We lack comparable dry weight regressions for the two other eunicids present. Crude calculations based on the generalized relationships for polychaetes: wet weight=1.07×volume (Nicol, 1960: Table 9.4), and dry weight=0.28×wet weight (Holme, 1953), gave estimates of the mean dry weight of *Lysidice collaris* of 1.2 mg (equivalent to 3.1 g/m^2) and of *Nematonereis unicornis*, 0.02 mg (<0.1 g/m^2). Thus although the syllids dominated numerically, *Palola siciliensis* accounted for most of the biomass of polychaetes in the sample that included its microhabitat.

DIVERSITY

Table 2 presents comparisons of species diversity and family, genus, and species richness between the Guam sample that included the reefrock substratum (Sample A) and samples from similar habitats in the eastern Indian Ocean analyzed by Kohn and Lloyd (1973a). The resemblances of family, genus, and species number as well as the H measure of species diversity are close. In addition, high proportions of families and genera were common to samples from both regions. Although within-habitat, between-sample similarity is high (Guam PS=0.69; Indian Ocean

Table 2. Comparisons of richness of identified families, genera, and species of polychaetes from low intertidal reef limestone substratum, Tanguisson, Guam, and eastern Indian Ocean fringing reefs.

Location	Number of Families	Number of Genera	Number of Species	Number of Individuals	H	H′
Tanguisson, Guam (Sample A)	11	15	21	148	1.96	2.13
Number in common	7	5–9	4–6			
Eastern Indian Ocean (Ranges of 7 samples)	9–13	13–27	16–32	174–657	1.89–2.46	2.00–2.55

Sta. 108 mean PS=0.83), comparison of Guam Sample A with the 3 samples from Sta. 108 gave PS values of 0.24–0.29. This is caused mainly by the absence from Guam of the single most abundant species at Sta. 108, *Phyllochaetopterus arabicus*, to the relatively small number of species in common (Table 2), and to the fact that although the dominant species at Guam, *Syllis* (*Langerhansia*) *cornuta* (43%), ranked 2nd in 5 of the 7 Indian Ocean samples, it represented at most 19% of the total in the latter.

PROXIMITY TO TANGUISSON POWER PLANT

Although the heated effluent of the oil-fired Tanguisson electric power plant empties on the reef-flat shoreline only about 470 m NNE of the study site (Randall, 1973: fig. 3; Randall and Holloman, 1974: figs. 84, 85), the samples examined gave no indication of adverse effect on the polychaete fauna. Diversity, abundance and faunal composition are comparable to similar reef limestone habitats fringing islands remote from such man-induced impacts (Kohn and Lloyd, 1973a). Moreover, no individuals of species indicative of pollution, e.g., *Capitella capitata* (Grassle and Grassle, 1976) were present. Of course in the absence of any comparative data from the same site prior to installation of the power plant, these statements must be regarded as speculative.

ZOOGEOGRAPHY

In addition to the 29 species of polychaetes mentioned above, Table 1 lists 12 species identified by O. Hartman from intertidal rimmed terraces on Guam, a habitat very similar to the Tanguisson site (Emery, 1962), and 10 species recovered from alimentary tracts of predatory gastropods of the genus *Conus* from Guam (unpublished data; determined by M. C. Lloyd). The total number of polychaete species known from Guam is now at least 39, of which 27 have been identified to species (Table 1).

Of the 27 identified species, 24 were previously known to occur throughout the tropical Indo-West Pacific region. *Sphaerosyllis ovigera* was known previously only from the Atlantic (Fauvel, 1923), and *Odonotosyllis ctenostoma*, from the Atlantic, Mediterranean and questionably from Japan (Fauvel, 1934; Imajima and Hartman, 1964), despite its citation in Day (1967). *Exogone longicornis*, recently

described from the Galapagos by Westheide (1974), was to our knowledge not previously known to occur elsewhere.

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