POLYCHAETES OF THAILAND. NERIDAE (PART 1): PERINEREIS and PSEUDONEREIS WITH NOTES ON SPECIES OF COMMERCIAL VALUE.

by

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POLYCHAETES OF THAILAND. NERELDAE (PART 1);
PERINEREIS and PSEUDONEREIS, WITH NOTES ON
SPECIES OF COMMERCIAL VALUE

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ABSTRACT

In connection with a study of the Annelida Polychaeta of Thailand, the Thai species of Perinereis and Pseudonereis (Nereidae) are reviewed. Four species of Perinereis (P. aubusitenis, P. quatrofagesi, P. singaporiensis, P. striolata) and two species of Pseudonereis (P. anomala; P. gallapagensis) are described and illustrated. A comparison of Perinereis quatrofagesi from the Gulf of Thailand and from Phuket, Andaman Sea, showed similar intraspecific variation within the two populations. The terminology of nereid parapodia is briefly reviewed.

The distribution of possibly commercial polychaetes P. quatrofagesi, Onuphis sp., Murphysa sp. and a spionid along intertidal beach areas on Phuket Island is reported.

I. INTRODUCTION

Nereid polychaetes are abundant in Thai waters, but only limited information about them is available in the literature, e.g., Fauvel (1953). No taxonomic review of the region like those from Japan (Imajima, 1972) and China (Wu et al., 1981) has been made. Hartman (1974) summarized the occurrence of polychaetes of the Indian Ocean between the Red Sea and the Malay Archipelago and listed 16 genera and 103 species of nereids, many of which can be expected to occur in Thailand. Considering that the areas east of Thailand were not included in Hartman's review the number of Thai nereids can be predicted to be high.

During the first PMBC/DANIDA Workshop on Polychaetes (Phasuk & Hylleberg, 1986) it was decided to start a study of the local nereid fauna. The present paper is a result of this study and redescribes six species of the genera Perinereis and Pseudonereis; it thus deals with but a few of
the approximately 35 species and 11 genera of nereids deposited in the PMBC Reference Collection.

Nereids are among the commercially valuable polychaetes. They are used for bait in, e.g., Japan, USA and Australia, where worm digging in some areas provides a major income for the local fishermen. Nereids are rarely used directly for human consumption, although they are considered a delicacy in some parts of Japan. They make excellent live food for shrimp and fish in aquaculture. In Thailand *Perinereis quatrufagesi* has been used as food in shrimp culture with the result that some beaches on Phuket Island have been overexploited. We have therefore scanned the beaches for polychaetes with a potential for commercial harvesting and made preliminary studies into the prospects of mass culture of *P. quatrufagesi* in tanks.

II. MATERIALS AND METHODS

Most of the material was collected from intertidal areas on Phuket Island, studied alive and subsequently preserved in 4% formalin after notes on colour had been made. If the pharynx was not immediately everted, it was squeezed out by pressing the area behind the head between two fingers, and then held for a short time with a forceps in the preservative to make sure that the pharynx was not withdrawn. This methods works well, and the distorted body region attains normal proportions in the fixative. After fixation 24 hrs, worms were transferred to 70% alcohol. Observations were facilitated by a slight staining of the worms in an aqueous solution of methylene blue. The stain was easily removed in alcohol afterwards.

Identification, description and drawings of two of the species were made by participants in the PMBC/DANIDA Polychaete Workshop (Phasuk & Hyleberg, 1986). Atokous and epitokous *Perinereis quatrufagesi* from the Andaman Sea and the Gulf of Thailand were compared by Piyaapong Chotipan, Kasetsart University; Neena Piamthipmanus, Department of Fisheries; and Chutima Tantikitti, Prince of Songkla University. Material of *Perinereis singaporiensis* was worked up by Somboon Anuntalabhochai, Chiang Mai University; Jompol Sanguansin, Department of Fisheries; and Chamchoi Tanapon, Department of Fisheries.

III. TERMINOLOGY

The eversible pharynx with paragnaths and the parapodia with setae exhibit important characters for identifying nereids. As generally used in the literature the pharynx is divided into 8 areas, viz. I-IV on the maxillary, distal ring just below the jaws, and areas V-VIII on the oral, proximal ring adjacent to the peristomium (Fig. 1). The paragnaths are particularly important in identification of epitokous worms since paragnath distribution is identical in atokous and epitokous individuals (Reish, 1954).

As pointed out by Southern (1921) much information can be gained by viewing parapodia from the tip, and in the present descriptions we have observed and illustrated the parapodia in situ on the right side of the worm, with the head towards the right. Fig. 1 shows this and an anterior view of a typical nereid parapodium with the terminology adopted in this paper. Apart from setigers 1 and 2 where notopodial elements normally are absent, most nereid parapodia are biramous.

Notopodium carries the dorsal cirrus and neuropodium the ventral cirrus. These terms are universally accepted in contrast to those used for the three major lobes. We have for the most part followed the nomenclature of Southern (1921). In comparison, Imajima (1972) and Fauchald (1977) call the dorsal ligule (Fig. 1, no. 2) superior ligule and supra-acicular lobe, respectively; the median ligule (Fig. 1, no. 9) is termed infra-acicular ligule and acicular lobe; and the ventral ligule (Fig. 1, no. 19) is called inferior ligule and subacicular lobe, respectively. Similarly, there is wide variation in the terminology used to describe
the notopodial (Fig. 1, nos. 3-8) and neuropodial acicular areas (Fig. 1, nos. 10-18), referred to as the dorsal and ventral divisions in this text.

Variations in number and position of lobes on the two divisions are covered by the terms shown in Fig. 1. The aciculum of the dorsal division is embedded in the upper part of the median ligule and may emerge directly from the upper side of the ligule, or the point may be marked by a swelling referred to as an acicular papilla. The dorsal collar is often absent, as are the superior and postsetal lobes (Fig. 1 no. 5 & 6).

The ventral division is normally provided with two lobes: one larger inferior lobe (Fig. 1, no. 15) which carries the aciculum (Fig. 1, no. 14) and a smaller superior lobe (Fig. 1, no. 12). Along the body these two lobes often change position relative to the aciculum; e.g. from inferior and superior positions in anterior segments to lateral positions in posterior segments. The ventral division may have additional lobes on the margins of the collar. These lobes are referred to as pre-and postsetal lobes (Fig. 1, nos. 17-18).

IV. RESULTS

(A) TAXONOMIC ACCOUNT

*Perinereis* Kinberg, 1866

Eversible pharynx with paragnaths on oral and maxillary rings; either transverse bars or cones in transverse rows on area VI, and cones on other areas. Four pairs of tentacular cirri; parapodia biramous. Notosetae homogomph spinigers; neurosetae homo- and heterogomph spinigers and heterogomph falcigers.

*Perinereis albuhitensis* Grube, 1878

(Fig.2A-Q)

*Perinereis albuhitensis* Grube, 1878: 89-90, pl. 5, fig. 3.-Horst, 1924: 168, pl.33, figs.4-6.-Monro,
DESCRIPTION: Colour white in alcohol. Prostomium longer than wide, antennae less than half as long as the prostomium, palps as long as prostomium, palpostyle oblong and as long as antennae. Two pairs of spherical eyes with dark pigment and almost the same size. Four pairs of tentacular cirri, the longest reaching setiger 3-9 (Fig.2A). Pharynx with conical paragnaths on both rings. The numbers were counted in 5 specimens: Area I: 1-3 cones, mostly 2; II: cluster of 9-17 cones of different sizes; III: 19-26 small cones in 3-4 rows, with group of 3-5 scattered cones on each side of the main patch; IV: cluster of 12-32 cones; V: 3 cones in a triangle; VI: 2 cones with broad base; VII and VIII: 2 irregular rows, first row with 10-15, second with 22-27 cones (Fig. 2A-B). Jaws dark brown with 5 teeth on cutting edge. (See also Fig. 10).
Setigers 1 and 2 uniramous. Setiger 1 with dorsal cirrus shorter than the rounded, conical, dorsal ligule; collar rounded, inferior lobe larger than superior lobe; ventral and dorsal ligules similar in form, ventral cirrus shorter than ventral ligule (Fig.2C,F,G). Setiger 2 similar to setiger 1, only larger. Setiger 3 and the following biramous. Setiger 10: dorsal cirrus shorter than dorsal ligule, ventral ligule similar to dorsal one. Neuropodium with the conical, rounded, superior lobe slightly shorter than inferior lobe, ventral cirrus half as long as ventral ligule (Fig.2D,H,I). Posterior setigers: dorsal cirrus shorter than dorsal ligule which is not enlarged; median and ventral ligules similar, small, pointed, conical. The inferior and superior lobes elongated, lateral in position (Fig.2E,J,K). Setae of 3 kinds: notopodia only homogomph spinigers, neuropodia with homogomph spinigers, heterogomph spinigers and heterogomph falcigers. Counts from one specimen: see Fig 9.

REMARKS. Our material agrees well with the original description. The character stressed by Grube (1878) and Horst (1924) is that two obtusely conical paragnaths are present in area VI. This character is used to separate P. albuitensis, from the very similar P. vancaurica (Ehlers, 1864) (=P. nancuica, see Monro, 1931), which has two linear bars in area VI.

*Perinereis quatrefagesi* (Grube, 1878)  
(Fig. 3A-L, 4A-J)

*Nereis* (Lycoris) *quatrefagesi* Grube, 1878: 79-80.  
*Nereis* (Perinereis) *rumphi* Horst, 1924: 166-168, pl. 33, figs. 1-3.

*Perinereis munitia*. Gravely, 1927: 68, pl.10, fig.24.  

MATERIAL EXAMINED: 38 specimens.  

DESCRIPTION: Largest specimen, 175 setigers, 270 m long, 7 mm wide, including setae, usual nereid shape, tapering posteriorly. Colour in life: pink dorsum, white ventrum, dark purple median dorsal vessel. Preserved specimens basically white with pale brown pigment at base of palpostyles, at inner edge of palps, at posterior part of peristomium, and at anterior margins of first setigers on dorsum; median dorsal vessel dark brown; glands at base of dorsal cirri visible as greyish dots at posterior segments.

Prostomium pear-shaped (Fig.3A), twice as broad as long; antennae pointed, shorter than prostomium; palps as long as or longer than prostomium; palps with transverse groove on middle of the dorsal side palpostyle distinct, globular; two pairs of small, dark-purple eyes often with very little pigment, in trapezoidal to rectangular position. Four pairs of tentacular cirri, longest reaching setiger 2-8, most often setiger 3.

Paragnaths of two kinds: cones and low bars on oral ring and cones on maxillary ring (Fig.3A-C).  
Area I: 1-3 cones in a line; II: 4-10 cones in a patch; III: central oval patch of 6-11 cones with 1-2 additional cones on each side, latter occasionally absent; IV: 15-28 cones in crescent; V: 2-4 cones; (Area V counts from 25 specimens: 1 with 4 cones, 17 with 3 cones in triangle, 1 with 3 cones in a line, 2 with 2 cones in a line, 3 with 1 large and 1 small cone in oblique line, 1 with 1 cone). Area VI: 4-10 short bars in transverse row, 5-8 most common, the 2 rows do not meet
middorsally, and do not meet laterally with cones of ventral areas; VII-VIII: 21-36 cones in 2 distinct rows, a few cones often forming a third, diffuse, middle row. Distal row longest, normally 14-16 cones, proximal row with 7-12 cones, the diffuse middle row with 4-8 cones. Jaws dark brown to black, with 5-7 teeth on cutting edge, when sometimes abraded edge appears smooth. (See also Fig. 10)

Setigers 1 and 2 uniramous (Fig. 3D-E). Dorsal cirrus conical, rounded, slightly longer than the more rounded dorsal ligule. Superior and inferior lobes of similar length; collar posteriorly produced into low, triangular lobe; setigerous division shorter than dorsal and ventral ligules, which have similar size and shape; ventral cirrus similar to dorsal cirrus.

Setiger 3 and the following biramous, similar to the foregoing but decreasing in size, and with lobes more pointed posteriorly.

Setiger 10 (Fig. 3 F-G) with dorsal cirrus rounded-conical, not projecting beyond rounded dorsal ligule; notopodial collar obscure; median ligule similar to dorsal and ventral ligules; neuropodium with inferior lobe longer and broader than superior lobe, both rounded, collar posteriorly produced into low triangular lobe; ventral cirrus conical, rounded, similar to dorsal cirrus. In most specimens ligules very rounded, almost tongue-shaped in profile, as shown in Fig. 3, but in some specimens triangular lobes are present in anterior setigers; however, the tips of the ligules are always rounded.
Posterior setigers (Fig. 3H-I) with short, rounded, conical dorsal cirrus; base of conical dorsal ligule slightly enlarged with glandular area below cirrus; notopodial collar obscure; median ligule rounded, conical; neuropodial setigerous division much shorter than the surrounding ligules, with superior and inferior lobes elongated and encircling the neurosetae; ventral ligule small; ventral cirrus similar to dorsal cirrus.

Setae of 3 kinds: homogomph spinigers, heterogomph spinigers and heterogomph falcigers (Fig. 3J-L). Setal counts from one specimen: see Fig. 9.

EPITOKOUS STAGE (Fig. 4): Colour of live worms: males creamy white, females green, both with red parapodia. The longest specimen (female) : 165 setigers, 96 mm long, 8 mm wide in pre-epitokous region, and 6.5 mm wide in epitokous region. The pre-epitokous region comprises 25-27 setigers in males, 26-31 in females. Both sexes with dorsal cirri clubshaped in first 6-7 setigers, ventral cirri in first 5-6 setigers. Dorsal cirri of epitokous region with 8 crenulations at lower margin in males; smooth in females.

REMARKS, ATOKOUS STAGE: The present species is troublesome because of many synonyms. Fauvel's (1953) key to perinereids of the Indian Ocean (pp. 212-213) leads to P. nuntia (Savigny), subdivided into 6 varieties. Our species keys out to P. nuntia var. brevicirris (Grube), distinguished from P. nuntia var. typica Savigny on account of the length of the tentacular cirri (reach the 7-8th and 10-16th segment, respectively) and the shape of the paragnaths of area VI (bars and cones, versus cones only). Available literature indicates that most workers have accepted these characters and consider P. brevicirris (Grube) as a subspecies of P. nuntia (Savigny).

The first species description of P. brevicirris (Grube, 1866) (Type locality: St. Pauls Island) was in Latin and not illustrated. The description was repeated in 1868 and provided with remarks in German and illustrations. Further details were given in 1878 (p. 80). P. brevicirris has 3 cones in

Fig. 4. *Perinereis quatrefagesi*, epitokous stages. (A) anterior body; (B,C) paragnath pattern, dorsal and ventral views, respectively; (D) 4th pre-epitokous setiger, male and female; (E) 15th pre-epitokous setiger, male and female; (F,G) 15th epitokous setiger, female, setae omitted and included, respectively; (H,I) 15th epitokous setiger, male as above; (J) modified seta, epitokous region, male and female. Scales: (A) 5 mm; (D-I) 1 mm; (J) 0.1 mm; (B,C) not to scale.
area V, and short tentacular and dorsal cirri. These characters are also present in our material but other characters pointed out by Grube (op.cit.) have not been seen: dark violet pigment dots on anterior dorsum, ventral fillets almost as long as the surrounding ligules, parapaths of area VII-VIII numerous (more than 50 based on his figure) and more numerous in the 2 distal rows than in the proximal vertical rows (2-3 cones on a line), areas VI each with 11-14 parapaths and with the 2 areas united in the middle, forming an unbroken row across the pharynx to the edges of areas VIII.

In contrast, our material fits the description of *P. quatrefagesi* (Grube, 1878) (Type locality: Bohoe, Philippines). This species has remained rather unnoticed in the literature, perhaps because it was not illustrated. We are only aware of two references, viz. Marenzeller (1879) and Gravely (1927). Gravely considered *P. quatrefagesi* synonymous with *P. muntia*. Based on the descriptions and figures in Gravely (op. cit.) our material is identical with Gravely's but on account of the characteristics of *P. muntia* (Fauvel 1953) we disagree as to the synonymy. Grube's single specimen of *P. quatrefagesi* had 1 parapath in area V. Our material also contains a specimen with 1 cone in area V (PMBC 3954), although 3 cones are more common in this area. Grube's specimen had 19 cones forming 2 rows in areas VII-VIII. PMBC 3954 had 21 cones in 2 distinct rows in areas VII-VIII: 14 cones distally, and 7 cones in the proximal row. In particular we emphasize the characteristics of areas VI: each with a short row of bars, the 2 rows do not meet in the middle, no contact is made laterally to cones of areas VIII. The only difference between *P. quatrefagesi* and our material is that Grube (1878) mentions that the tentacular cirri are dark; the tentacular cirri of some of our specimens are tinged with dark at the base but most often the cirri are white.

Our material also agrees with *P. rumpphi* Horst, 1924, and *P. weihoensis* Wu, Sun and Yang, 1981. Both species have 3 cones in area V, the left and right areas VI are not joined middorsally and parapodia and tentacular cirri are within the range of variation in our material. Hence, we consider these species as synonymous with *P. quatrefagesi* which has priority.

*P. quatrefagesi* can be distinguished from *P. muntia* by the presence of short tentacular and dorsal cirri in the first, and very long cirri in the second species; from *P. brevicirris* by the parapath pattern of areas V, VI, VII and VIII, as described above; similarly from *P. heterodonta* by the parapath pattern: *P. heterodonta* lacks parapaths in area V and the short bars of areas VI form a continuous line across the pharynx. *P. vallata* is very close to *P. quatrefagesi* in terms of parapodia but area V of *P. vallata* never carries more than 1 parapath (Knox, 1951) and areas VI form an unbroken line across the pharynx.

Imajima (1972) considers *P. mictodonta* (Marenzeller, 1879) synonymous with *P. brevicirris*. Although the parapodia have features in common the pattern of parapaths of the Japanese material is not in accordance with Grube's (1878) description of *P. brevicirris*. Based on the marked differences in occurrence of parapaths we believe *P. mictodonta* is a valid species. It differs from *P. quatrefagesi* in having a cluster of 2-5 cones in area I, long lateral bars in areas VI, with left and right areas VI nearly joined in the middle and 2-3 times as many conical parapaths in areas II, III and IV.

REMARKS, EPITOKOUS STAGE: In *P. weihoensis* the pre-epitokal/epitokal transition is at setiger 10 in males, and 24 in females (Wu et al., 1981), compared to 25/27 and 26/31, respectively, in the present study. If this difference is species specific the suggested synonymy may be wrong. However, the atokous stages of the Chinese and Thai materials cannot be distinguished. There is good agreement between our species and *P. rumpphi*. Horst (1924) reports the transition of setiger 24 in males and 29 in females, supporting the suggested synonymy based on comparison of the atokous stages.
**Perinereis singaporiensis** (Grube, 1878)

(Fig. 5 A-K)


**MATERIAL EXAMINED:** 17 specimens. PMBC 3942; 15 ind., in front of PMBC, intertidal, in dead coral, 19 Feb. 1985; largest specimen: 149 setigers, 135 mm long, 4 mm wide. PMBC 3953; 2 ind. from the same locality, 19 Oct. 1981, coll. P. Tantichodok, largest specimen: 145 setigers, 116 mm long, 4 mm wide.

**DESCRIPTION:** Body slightly tapering posteriorly. Colour in life: prostormium green with white middorsal longitudinal streak; anterior dorsum dark green with black median stripe, more pale towards posterior end; dorsum of each setiger with transverse white band on anterior margin; ventral side white. Colour faded in formalin; in alcohol, white.

Prostormium inverted T shape (Fig.5A), posterior margin slightly wider than length of prostormium. Two short, pointed, conical antennae about 0.3 as long as the prostormium. Palps large and oblong, about 1.5 times as long as the prostormium, palpotyles globular. Two pairs of distinct, black eyes forming a rectangle on posterior half of prostormium. Four pairs of tentacular cirri, the longest reaching setiger 3-6.

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**Fig. 5.** _Perinereis singaporiensis_ (A) anterior body, dorsal view; (B) pharynx, terminal and ventral view; (C,D) setiger 1; posterior and terminal views, respectively; (E,F) setiger 10, as above; (G,H) posterior setiger (145th), as above; (I,J,K) setae from setiger 10. Scales: (A,B) 1 mm; (C) 0.5 mm below parapodium; (C,E) 0.5 mm; (I,J,K) 0.05mm; (D,F,H) not to scale.
Paranathus of 2 kinds: bar-shaped and cones on oral ring and cones on maxillary ring (Fig. 5 A, B). Counts from 6 specimens: Area I: 2 cones in a longitudinal row; II: a group of 9-12 cones; III: 29-33 cones in 3 clusters: central cluster with 21-24 cones, 2 lateral clusters each with 3-7 cones; IV: 33-34 cones in a triangular patch; V: 0-1 large cone, usually 1; VI: 2 bar-shaped cones, VII-VIII: 34-41 cones in 2-3 irregular, transverse rows. Jaws dark brown, with 6-7 teeth on cutting edge. (See also Fig. 10).

Setigers 1 and 2 uniramous (Fig. 5C, D). Dorsal cirrus pointed, conical; dorsal ligule long, rounded, as long as dorsal cirrus; inferior lobe conical with broad base; superior lobe conical, as long as inferior lobe, collar only slightly projecting at posterior margin; ventral ligule similar to dorsal ligule; ventral cirrus similar to dorsal cirrus.

Setiger 3, and the following with basically the same structure as above, but biramous. At setiger 10 (Fig. 5E, F): dorsal cirrus, dorsal and median ligules, inferior lobes, and ventral ligule all projecting to about the same level. Ventral cirrus half as long as ventral ligule.

Posterior setigers (145th) (Fig. 5G, H): dorsal cirrus small; base of dorsal ligule enlarged, projecting beyond conical median ligule; superior and inferior neuropodial lobes elongated, surrounding the aciculum, neurosetae in a straight line above and below acicula; ventral ligule short, conical; ventral cirrus small.

Setae of 3 kinds (Fig. 5I-K): heterogomph spinigers, homogomph spinigers, heterogomph faligers. Counts from 1 specimen: see Fig. 9.

REMARKS: The characters of P. singaporiensis in our material are in good agreement with the original description (Grube, 1878). There are small differences only; area V in some specimens lacks cones, as also reported by Fauvel (1932).

**Perinereis striolata** (Grube, 1878)  
(Fig. 6A-O)

**Nereis** (Perinereis) *striolata* Grube, 1878: 85-86, pl. 4, fig. 9.-Fauvel, 1911: 395.

**Perinereis striolata.** Pruvot, 1930: 60-62.

**Perinereis cultrifera var. striolata.** Fauvel, 1953: 209.-Wu et al. 1981, 197, fig. 123D.

**Nereis** (Perinereis) *obfusca* Grube, 1878: 86.-Horst 1924: 173, pl. 34, figs. 5-6.-Monro, 1931b: 16-19, text-fig. 10a-d.

**Nereis** (Perinereis) *perspicillata* Grube, 1878: 90-91, pl. 4, fig. 10

**Perinereis cultrifera** var. *perspicillata*. Monro, 1931a: 41-42, figs. 3a, b.

**Nereis nigro-punctata** Horst, 1889; 171-174, pl. 8, figs. 1-3.


**Perinereis nigropunctata.** Wu, 1967: 64-66, Fig. 9

**Perinereis marjorii** Southern, 1921: 595-597, pl. 22, figs. 10A-G, text-fig. 7, 8a-c.

**Perinereis yorkensis** Augener, 1922

**Nereis** (Perinereis) *dongalae* Horst, 1924: 174-175, pl. 33, fig. 8.

MATERIAL EXAMINED: 29 specimens. PMBC 3943; 8 atokous specimens, and PMBC 3944: 1 epitokous specimen, in front of PMBC, from intertidal, slate, 18 Feb. 1985.-PMBC 3945: 20 specimens, in front of PMBC, dead coral, intertidal, 19 Oct. 1981; largest specimen; 75 setigers. 40 mm long, 3 mm wide.

DESCRIPTION: General nereid shape, tapering posteriorly. Colour in life: prostomial dark green with white streak from antennae to the first pair of eyes; first quarter of body deep green; dorsum with a T-shaped dark green marking mid-dorsally and a dark green spot on each side. Ventral side white. In formalin: green colour turns brown. In alcohol: colour faded somewhat but brown pigment on dorsum and prostomial still visible. In some specimens only lateral spots preserved. Colour pattern on prostomial variable. Often dark Y-shaped pigmentation on posterior prostomial.
Prostomium pear-shaped (Fig.6A), as long as wide; antennae conical, half as long as prostomium; palps as long as prostomium; palpostyles small and conical. Two pairs of eyes of similar size, in rectangle. Four pairs of tentacular cirri, longest reaching setiger 2-7, most often 5-6.

Paragnaths of two kinds: cones and bars on oral ring and cones on maxillary ring (Fig.6A,B). Area I: with a patch of 4-16 cones; II: 16-18 cones in oblong cluster; III: 4-5 rows of 33 cones in square pattern; IV: 40 cones in triangular patch; V: 1-4 cones (counts from 20 specimens: 11 with 1 cone, 3 with 2 cones, 5 with 3 cones and 1 with 4 cones); VI: usually with 1 bar, only one specimen had a small additional bar on the right side; VII-VIII with 2 rows of cones, 22 cones in first row, 14 cones in second row. Jaws amber to brown with 8-10 teeth on cutting edge. (See also Fig.10).

Setigers 1 and 2 uniramous (Fig.6D,G,H). Dorsal cirrus slender, pointed, slightly produced beyond the bluntly conical dorsal ligule; superior and inferior lobes projecting to level of dorsal and ventral ligules. Setiger 3 and the following biramous, with basically the same structure. Setiger 10 with dorsal cirrus slender and slightly longer than the bluntly conical dorsal ligule. Notopodial setigerous division with prominent conical notacicular papilla (Fig.6E,I,J). Median ligule tongue-shaped in profile; superior and inferior neuropodial lobes projecting as far as the median and ventral ligules; ventral ligule
tongue-shaped in profile, smaller than the median and dorsal ligules; ventral cirrus shorter than ventral ligule. Posterior setigers with base of dorsal ligule increasing in size (Fig.6F,K,L); all three ligules pointed-conical; dorsal ligule larger than median ligule which is larger than ventral ligule. Noticular papilla strongly reduced, absent in last setigers; superior and inferior neuropodial lobes elongated, encircling vertical line of neurosetae. The bases of the dorsal ligules become greatly elongated in the most posterior setigers where the dorsal ligule may be twice the length of the median ligule.

Setae of 3 kinds: heterogomph spinigers, homogomph spinigers, and heterogomph falcigers. Setal counts from 1 specimen: see Fig. 9.

EPITOKOUS STAGE: The single male (PMBC 3944) has 14 nereid and 61 heteronereid setigers. The first 7 setigers have long club-shaped dorsal cirri, the following 7 cirriform dorsal cirri. Ventral cirri are enlarged on the first 5 setigers. Paragnaths on both rings. Area I: 4 cones; II:15 & 27 cones; III: 35 cones; IV: 24 & 25 cones; V: 1 cone; VI: 1 bar; VII-VIII: 2 rings comprised of 15 and 20 cones, respectively.

REMARKS: Atokous Perinereis cultrifera (Grube 1840) has been considered a highly variable species with a cosmopolitan distribution, although a number of subspecies or principal varieties have been distinguished. The varieties of P. cultrifera have been divided into two groups according to the number of paragnaths in area V (Fauvel, 1953). Varieties with 1 cone include P. floridana Ehlers, P. obfuscata Grube, and P. striolata Grube. Varieties with 3 cones in a triangle include P. perspicillata Grube, P. cultrifera typica Grube, and P. helleri Ehlers.

However, the number of paragnaths in area V could not be used with our material since worms with differing paragnath numbers in this area did not vary systematically in parapodial or setal characters. The other main character used to subdivide the varieties has been the number of paragnaths in area I, which in our material varied from 4 to 16 cones, 5-8 being the most common numbers. Area I usually has 2 (or 1) cones in the following taxa: P. camiguina Grube, P. helleri, P. floridana, P. malayana Horst 1889, and P. cultrifera. Area I has a cluster of 4-8 paragnaths in Area I in the following taxa: P. obfuscata, P. striolata, P. perspicillata, P. nigro-punctata, P. marjorii Southern, 1921, and P. dongalae Horst, 1924.

Pruvot (1930) considered P. obfuscata and P. striolata to be synonyms and used the name P. striolata for the New Caledonian material. Our material is in accordance with this suggested synonymy. It is also identical to P. nigro-punctata, P. perspicillata, P. dongalae, and P. marjorii as regards the distribution and number of paragnaths. All other characters are also within the variation in our material except for the dorsal ligule of the first setiger, which is clavate in the Indian material (Southern 1921) and conical in our specimens.

EPITOKOUS STAGE: P. striolata is close to P. cultrifera but the epitokous stages of the latter species have modified parapodia from setiger 19-20 in males and females. (Monro, 1931b), as opposed to from setiger 15 in our material identified as P. striolata (a male, the only mature specimen collected). Monro (1931a) considered P. striolata synonymous with P. obfuscata, which has epitokous parapodia from setiger 14 in males and 18 in females. In P. perspicillata epitokous parapodia are present from setiger 15-16 in males and 18 in females (Monro, 1931b). In P. nigro-punctata modified parapodia are obvious from setiger 16 in males and 19 in females.

Conclusion: Our material of atokous and epitokous specimens is in excellent agreement with P. nigro-punctata (Horst, 1889 and 1924). However, we believe this species to be identical with P. striolata Grube, 1878, which has priority. Furthermore, we synomize P. striolata with P. perspicillata, P. obfuscata, P. marjoril, and P. yorkensis, and P. dongalae since all five species have been described on the basis of differences in colour pattern, length of tentacular cirri, small differences in size of ligules, and pattern and
number of paragnaths in areas I and V. The characters used to separate the above species are all present in a non-systematic way in our material. We therefore believe that *P. striolata* is a very plastic species which, however, is distinctly different from *P. cultrifera*, and the group of varieties ascribed to *P. cultrifera*, which have only 1 or 2 paragnaths in area I.

*Pseudonereis* Kinberg, 1866

Eversible pharynx with paragnaths on both rings, including cones, transverse smooth bars and pectinate bars. Four pairs of tentacular cirri, parapodia biramous. Notoseate include homogomph spinigers and falcigers; neuroseate homo- and heterogomph spinigers and heterogomph falcigers (Fauchois 1977b:90).

*Pseudonereis anomala* Gravier, 1901

(Fig. 7)


*Nereis* (*Pseudonereis*) anomala Horst, 1924: 187.

MATERIAL EXAMINED: 10 specimens. PMBC 3848: 8 ind., in old coral block (*Acropora* sp.), 4 m depth, Mangrove Bay, Surin Island, Andaman Sea, 9 Feb. 1982; largest specimen: 74 setigers, 32 mm long, 2 mm wide.-PMBC 3849: 1 complete specimen, from old coral block, 1 m depth, Phi Phi Don Island, Andaman Sea, 2 Mar. 1982, 72 setigers, 31 mm long, 2.5 mm wide.-PMBC 3850: 1 specimen, in coral block, 1 m depth, southern part of Bang Tao Bay, Phuket Island; 51 setigers, 15 mm long, 1.5 mm wide.

DESCRIPTION: Width similar throughout body, only tapering at the last 10 setigers. Colour in alcohol uniformly red-brown. Prostomium trapezoidal (Fig.7A), width at base equal to length of prostomium. One pair of antennae; palps as long as prostomium, palpostyles oblong rounded, shorter than palphore. Two pairs of eyes in a rectangle, similar size; anterior pair may be obscure with only pigment spots visible, posterior pair rounded and more distinct; four pairs of tentacular cirri, longest reaching setiger 4-8.

Paragnaths on both rings (seen in dissection) (Fig.7B-C). Counts from 8 specimens: Area I: 1-2 elongated cones; II: 4-5 parallel rows of elongated cones arranged in pectinate pattern: 2 cones in first (most distal) row, 4-5 cones in second row, 5-7 cones in third row, 5-6 in fourth row, and 5-6 in the last row; III: 4-5 parallel rows of cones: 8-11 cones in the first (most distal) row, 15-18 cones in each of the following rows; IV: 4-5 parallel rows of cones and 1 group of 7-8 small cones near base of jaws: 6-8 cones in the first (most distal) row and 8-9 cones in each of the following rows (1 specimen had 2 isolated cones in the second row, in addition to 8 cones in a row); V: with no paragnaths; VI: with variable arrangement: 1-2 short rows or a cluster of 6-10 cones, VII-VIII: 2 rows of 15 cones, the upper row with rounded cones alternating with elongated cones in the lower row. Dark brown and broad jaws with 6 teeth on cutting edge (Fig. 7D) (See also Fig. 10).

First and second setigers uniramous. Setiger 1 (Fig.7E,F,K): dorsal cirrus long, 3-4 as long as dorsal and ventral ligules; ventral cirrus slender, shorter than ventral ligule; inferior lobe conical and fused with smaller superior lobe; posterior margin of the collar projects into a low triangular postsetal lobe. Setiger 3 and following with basically the same structure, biramous. Setiger 10: (Fig.7G,H,L): dorsal cirrus long, slender; dorsal ligule digitiform, about 0.3 as long as dorsal cirrus; dorsal setigerous division with small notacicular papilla, dorsal collar obscure, median ligule rounded; ventral setigerous division as in setiger 1 but with fused anterior and posterior lobes projecting to or just beyond level of median ligule; posterior margin of collar produced into a
low triangular postsetal lobe (Fig. 7L); ventral ligule and ventral cirrus extending to about the same level. Posterior setigers (50th): dorsal cirrus very long and digitate, arising subdistantly; base of dorsal ligule greatly prolonged and foliose (Fig. 7I, J, M).

Setae of 4 kinds: heterogomph spinigers, homogomph spinigers, heterogomph falcigers and homogomph falcigers. Counts from 1 specimen: see Fig. 9. In 7 specimens of similar size the first appearance of notosetae (HOF) ranged from setiger 8 to 17.

REMARKS: Our material agrees well with the original description of specimens from the Red Sea; slight differences were noted: 2 rows of paragnaths in area VI (in agreement with specimens reported by Horst, 1924), versus 1 row reported by Gravier (1901); the Red Sea material also had more rounded ligules in anterior setigers and slightly curved terminal pieces of homogomph falcigers of posterior setigers, versus quite straight terminal pieces in our material. However, these differences are insignificant compared to variation described in Chinese and Australian material (Wu et al., 1981 and Hutchings & Turvey, 1982, respectively).

Pseudonereis gallapagensis Kinberg, 1866
(Fig. 8A-P)

Pseudonereis gallapagensis Kinberg, 1866: 174.-

MATERIAL EXAMINED: 7 specimens. PMBC 3851: 4 ind., lower intertidal in front of PMBC under rock and coral rubble, 18 Feb. 1985; 3 complete specimens: 95-110 setigers, 42-50 mm long, 3-3.5 mm wide including setae.

DESCRIPTION: Body gradually tapering posteriorly, two anal cirri. Colour in life: prostomium with white streaks on the central part between the eyes; palps with dark green area dorsally; peristomium and the following setigers with dark green bands across the dorsal side, intersegmental areas white; entire ventral side white; colour more intense in anterior body.

Prostomium pear-shaped, broader than long with pointed antennae slightly shorter than prostomium. Palps slightly longer than prostomium; palpostyles prominent, globose. Two pairs of eyes, the upper pair larger with distinct lenses and dark purple pigment. Four pairs of tentacular cirri, the longest pair reaching setiger 7-10 (Fig. 8A).

Paragnaths on both maxillary and oral rings (Fig.8B-C). Area I: one large cone, sometimes also 1 small cone; II: 4-5 parallel rows of elongate cones, 4-6 in distal rows and 9-11 in proximal rows; III: similar to area II with 4-5 rows of elongated cones, 5-10 in most distal row, 13-19 in the 2nd row, and 18-22 in the 4th row. One specimen had a 5th row with 17 cones. IV: 5 rows of elongated cones: 1st (most distal) row 6-11, 2nd and 3rd rows 7-13, 4th row 10-13, 5th row 11-13. In addition, a group of about 15 small cones at base of jaws; V: with 1 cone; VI: each with 1 bar. VII and VIII: one row of 22-25 cones; paragnaths with round bases alternate with.

Fig. 8. Pseudonereis gallowagensis. (A) anterior body, dorsal view; (B,C) pharynx, dorsal and ventral views; (D,E) setiger 1, posterior and terminal views, respectively; (F,G) setiger 10, as above; (H,I) posterior setiger (60th) as above; (J) dorsal ligule and cirrus, setiger near tail; (K-L) setae from setiger 1; (N,O) setae from setiger 10; (P) notochaeta, setiger 60. Scales: (A,B,C) 1 mm shown next to figures; (D,F,H,J) 0.5 mm; (K-P) 0.05 mm; (E,G,I) not to scale.
cones having elongated bases. Jaws dark brown with six teeth on cutting edge (See Fig. 10).

Setiger 1 uniramous (Fig. 8D-E). Dorsal cirrus long, slender pointed, 2-3x as long as dorsal ligule; dorsal ligule thick, conical. Inferior and superior lobes fused, presetal upper part shorter than the lower part (Fig. 8E). Posterior collar form a postsetal, thick tongue-shaped lobe. Ventral ligule conical, thick, as long as dorsal ligule. Ventral cirrus long, slender, slightly shorter than dorsal cirrus. Setiger 2 similar to setiger 1 but dorsal ligule somewhat larger. Setiger 3 and the following anterior setigers (Fig. 8F-G) with basically the same structure but more developed than setigers 1-2. Parapodia biramous, notopodium with dorsal cirrus, long and slender, dorsal and median ligules conical and nearly the same size; neuropodium with fused superior and inferior lobes, shorter postsetal lobe, conical ventral ligule and long, slender ventral cirrus. At setiger 60 (Fig. 8H-I) the dorsal cirrus is displaced towards tip of dorsal ligule; this displacement is pronounced after setiger 20; the dorsal cirrus is conical with a pointed tip and is slightly shorter than the dorsal ligule, whose base becomes increasingly enlarged and leaflike towards the posterior end (Fig. 8J); the median ligule is thick and conical. Neuropodia with short, bilobed anterior lobe similar in size to the postsetal lobe; ventral ligule thick and conical ventral cirrus not extending beyond ventral ligule.

Setae are of three kinds (Fig. 8K-P): heterogomph falcigers, homogomph spinigers, heterogomph spinigers. HOS present both in noto- and neuropodia. HEF only in neuropodia. Setal counts from one specimen: see Fig. 9. Aciculum black with pointed tip.

REMARKS: The present species differs in some details from Kinberg’s original description (1866) based on 1 specimen from Indefatigable Island, the Galapagos. Gravier (1909) points out that the figures given by Kinberg do not indicate paragnaths in Area V, and the small groups of cones at the base of the jaws in area IV are apparently not present. Otherwise, Gravier, finds good agreement between his and Kinberg’s specimens. The Thai material is very close to Gravier’s South American (Peru) specimens, but heterogomph falcigers have terminal pieces with curved tips in the Peruvian specimens while the tips are gently curved and pointed in the Thai material. In the latter character our material agrees with specimens from Panama (Fauchald, 1977) but in the Thai material the neuropodal ventral ligule of posterior setigers is longer than the ventral setigerous division indicating that the Asian specimens may differ somewhat from the Central- and South American specimens. Pseudonereis gallapagensis resembles Pseudonereis variegata (Grube, 1857) but can, among others, be distinguished on the paragnaths of area VII-VIII. They form one row in the former and several rows in the latter.

(b) SUMMARY OF TAXONOMIC ACCOUNT

1. Four species of Perinereis: P. aibuhitensis, P. quatrefagesi, P. singaporionis, P. striolata, and two species of Pseudonereis: P. anomalus and P. gallapagensis are described.

2. The number and types of setae were counted in one individual of each species and the data summarized in Fig. 9. Pseudonereis anomalus differs from the other species shown in Fig. 9, in having homogomph falcigers in posterior setigers.

3. When viewed from the terminal aspect the setae in the neuropodia of the 4 species of Perinereis are arranged in a S-shaped pattern (Fig. 2-6) while the setae form a more or less C-shaped pattern in the 2 species of Pseudonereis (Fig. 7-8).

4. Paragnaths on the pharynx areas V & VI display patterns which are characteristic for each of the investigated species. The patterns and variations in paragnath numbers are summarized in Fig. 10. The areas VII-VIII can be used to separate Perinereis from Pseudonereis. Each of the areas VI are different in terms of numbers and types of paragnaths in
the 4 species of *Perinereis*, while area V can be used to separate the 2 species of *Pseudonereis*.

(c) DISTRIBUTION OF POLYCHAETES ATTRACTED BY BAIT; WORMS WITH COMMERCIAL VALUE:

INTRODUCTION: Polychaetes are collected and used for bait by local fishermen. However, there is an increase in demand for polychaetes for use in aquaculture because they make excellent live food for many species (Forbes, 1984). Since 1984 Phuket Brackish Water Fishery Station, Department of Fisheries, has used polychaetes to feed female shrimps (*Penaeus monodon* in experiments aimed at increasing both quality and quantity of egg production. Polychaetes sell for about US$3 per kg live weight in Thailand so there is a potential extra income for local people if they get engaged in worm collecting. Yet, even at the present low rate of exploitation some beaches have become affected by the daily collections, which has resulted in dwindling polychaete populations, e.g., on Rawai Beach. It was consequently decided to study the distribution of species with a potential commercial value around Phuket Island. In addition, the prospects of mass culture under laboratory conditions were considered.

METHODS: We used the classical method of local fishermen: crushed fish mixed with sea water
is sprinkled on the sand near the water line at about midtide level. Polychaetes are attracted by the fish smell and emerge 1-2 cm along the sediment surface where they may be caught by grabbing the head. However, they do have fast reactions.

RESULTS: Three species were encountered by this method (see Fig. 11) *Perinereis quatrefages*, *Onuphis* sp., and a spionid which is small and without bait value. In addition, *Diopatra* sp. (Eunicidae) was observed when the tide was lowest. These worms were observed on account of their tubes sticking out of the sediment. They were not attracted by the sprinkled fish. Our interest in this species is hinged on the fact that a related species dug by hand in Australia is a very valuable creature, selling at A$ 40 per kg (Forbes, 1984).

*Perinereis quatrefages* was the most widespread species, occurring at high density of about 100 individuals m⁻² on somewhat sheltered beaches with coarse sand and shells. The species was not observed in sheltered muddy sediment. It was also absent from highly exposed sandy beaches. Some fluctuation in population density was noted, e.g., in front of PMBC where worms were scarce in 1984 but very abundant in 1985. *Onuphis* sp. was only observed in the northern part of Kata Bay. The environmental conditions of this stretch
of beach are not known. The sand is rather fine and well sorted. The population was observed in both 1984 and 1985. Similarly, the spionid populations seem to be restricted to the northern and southern parts of Patong Bay. The central bay is obviously too exposed. Diopatra sp. is probably more widespread than found in this survey; a good population was present in Phuket Bay (Fig. 9).

(d) NEREIDS IN LABORATORY CULTURE: P. quattrefagesi did not survive in tanks without some water flow through the sediment. Yet, good results were obtained with tanks simulating a tidal flat. A sloping sediment surface of coarse sand resting on a screen raised on PVC tubes above the bottom of the tank was supplied with running sea water at the top. Water was drained through an overflow connected to the bottom of the tank at a level beneath the screen. The worms were regularly fed minced fish and grew quickly (about 3 months) to mature epikokous stages. Males and females swarmed for one day in the tanks; then they died. They spawned in the tanks but larvae did not develop under these conditions, probably because of lack of appropriate food for
the larvae. Natural predators were also present in the unsterilized sand. Special care and more studies are needed before larvae can be raised in mass culture. However, the experiments showed that it is easy to raise a culture of sexually mature adults.

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