Dear Ladies and Gentlemen,

Jørgen Hylleberg was born on October 28, 1935. After school he completed his education as teacher at the training college in Ranum, Denmark. Despite outstanding pedagogic talents, he did have such a burning interest for biology that he started to study biology at University of Aarhus and completed the studies with a M.Sc. degree from University of Copenhagen. The research area of the thesis was marine biology and the famous Professor Gunnar Thorson was his supervisor. One year of the M.Sc. studies was spent at Kristineberg Marine Biological Station in Sweden, a field station he often returned to during the following years. In 1970 Jørgen Hylleberg was invited to University of Aarhus by Professor Tom Fenchel in order to participate in the work of building up marine biology in Jutland, and he was employed as Associate Professor in 1972. He has been teaching and writing several text books in marine biology since this date. Jørgen Hylleberg was on research sabbatical at University of Washington, USA, in 1973–74, and defended his doctoral degree at University of Gothenburg in 1995.

Jørgen Hylleberg’s scientific output comprises more than 150 scientific papers and five books. He has also been the supervisor of a large number of M.Sc. and Ph.D. students at the University of Aarhus. Furthermore, he has been a diligent debater in spoken and written media as well as disseminating marine biology in the form of a large number of popular science articles. He has also been a member of a large number of commissions and been the organizer of more than 25 symposia and workshops within the area of marine biology.

At the end of 1979 Jørgen Hylleberg was stationed as DANIDA advisor during a period of 3 years at the Phuket Marine Biological Center in Thailand. His research and teaching has since this period been very much centred on Thailand and other parts of Southeast Asia. During the period 1983–94 he was engaged by DANIDA and stationed in Thailand for 3 months per year. Since 1991 he was the leader of a large research and development project financed by DANIDA, the Tropical Marine Mollusc Programme – TMMP. A goal of this project was to study the biology of selected tropical molluscs in Southeast Asia and develop aquaculture methods for them.

Jørgen Hylleberg’s work in Southeast Asia can be divided in two parts, teaching and research. During all the years he has given high-class teaching to the Thai students and foreign guests at the Phuket Marine Biological Center, but he also took the initiative to develop International M.Sc. & Ph.D. Programmes in Marine Sciences at University of Aarhus supported by DANIDA. He was the course director of this program from 1990 to 1999. Altogether, 67 students from Southeast Asian countries have passed a two-year education in modern marine biology, crowned by an M.Sc.
degree. Most of them have continued with Ph.D. studies at many universities all over the world. Jørgen Hylleberg’s enthusiasm and deep knowledge about Southeast Asia, biological as well as cultural, has been a crucial condition for the great success of the programme and the following cooperation between scientists in Denmark and Southeast Asian countries. We must not forget the importance of the entire Hylleberg family here, particularly Mrs. Karen Hylleberg, for the unequalled hospitality and care of the foreign students and scientists. The programme could not have been the same success without this grand achievement. The programme was consolidated enough to continue successfully when Jørgen Hylleberg left his position as course director in 1999 in order to concentrate on other tasks, primarily TMMP.

An important part of Jørgen Hylleberg’s research has been to build and develop the reference collection at Phuket Marine Biological Center. For this work he did, in 1990, receive the mark of honour Royal Thai Order: Commander (3rd Class) of the Most Noble Order of the Crown of Thailand. The reference collection is, for example, an important resource during studies of the biodiversity of the marine environments in this tropical area and is very much visited and utilized during research projects in the region. Jørgen Hylleberg has been a member of the editorial committee since 1981, and between 1990–1994 was the editor of Phuket Marine Biological Center Research Bulletin. He has spent much effort and energy in creating a scientific journal that is of great importance for the research in the region.

The enthusiastic work and great knowledge of Jørgen Hylleberg has been of crucial importance for the scientific cooperation in marine biology between Denmark and the Southeast Asian countries. For all this, he was, in 2002 decorated by the Royal Order Ridder af Dannebrogordenen (Knight of the Order of Dannebrog) [Dannebrog is the formal name of the flag of Denmark].

I have known Jørgen Hylleberg since we started our studies at the University of Aarhus in 1963. Together we continued our studies at the University of Copenhagen in 1965 after we had passed the examination in Aarhus. Our colleagues Mogens Gissel Nielsen and Jørgen Mørup Jørgensen also continued their studies the same way. Jørgen Hylleberg was a little older than us, and had the teacher education as his background, which was beneficial, particularly at the examination. In particular I remember how he got the question “explain the life cycle of the medusae” during the lottery draw at the examination. Professor Harald Thamdrup was the examiner and Professor Karl-Georg Wingstrand from Copenhagen was external examiner. Jørgen Hylleberg overwhelmed them with a storm of enthusiasm. With a stentorian voice he explained about the fascinating life cycle of these organisms without being interrupted at all. It resulted in the top mark and we, the other students, were immensely impressed. The talent to tell stories and keep the audience spellbound has also later been valuable during teaching, and many students have much enjoyed his great knowledge and enthusiasm. Jørgen Hylleberg has also been a diligent teacher and supervisor during subsequent biological studies which has resulted in 10 Ph.D. and about 80 M.Sc. students.

I can’t resist the temptation to include a few details about Jørgen Hylleberg as a political actor. His burning engagement has given us many brilliant results but he has sometimes exceeded the limit in his eagerness to reach a goal that for him was the only right one. I remember, for example, some cases where he got a clear no (!) from me being his superordinated department head, which only motivated him to go one step higher in the hierarchy, to the institute leader, and if this did not help, to our dean and finally to the rector. It was very irritating for some of us, and luckily for us, seldom led to any results for Jørgen Hylleberg.

As a summary I must say that Jørgen Hylleberg has all reasons to be proud of his career. He has been diligent, put his footprints on many fronts, and in particular educated a large number of persons in marine biology. The marine biologists as well as the Institute of Biological Sciences would like to express their sincere thanks for the one-man-work to keep marine biology alive for
many years. Today we have a strong group of marine biologists and many students. It is possible that without the effort of Jørgen Hylleberg we could have been completely without marine biology at the Institute of Biological Sciences today. It is our hope that Jørgen Hylleberg, after retirement, would like to continue with research at the Department of Marine Ecology.

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MEGANTHIAS FILIFERUS, A NEW SPECIES OF ANTHIINE FISH (PERCIFORMES: SERRANIDAE), FROM THE ANDAMAN SEA OFF SOUTHWESTERN THAILAND

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ABSTRACT: Meganthias filiferus is described as a new species of fish of the serranid subfamily Anthiinae from one 293-mm specimen collected from 150 m in the Andaman Sea off the southwestern coast of Thailand. Three other species are known in the genus: M. natalensis (Fowler) from the western Indian Ocean, M. kingyo (Kon, Yoshino and Sakurai) from Okinawa, and M. carpenteri Anderson from West Africa. M. filiferus is most closely related to M. natalensis, differing in having a larger head, more angular corner of the preopercle, crenulate instead of serrate lower margin of the preopercle, a longer soft dorsal filament, and in life color.

INTRODUCTION

The colorful fishes of the serranid subfamily Anthiinae are mostly found on deep reefs, hence are not often caught by trawls. Most are too small to be taken by hook and line by fishermen seeking food fishes, such as groupers of the genus Epinephelus and snappers of the genera Etelis and Pristipomoides. Meganthias is among the few anthiine genera with species large enough to be caught by fishermen. This genus was described by Randall and Heemstra (2006) for two unusually large anthiine fishes, M. natalensis (Fowler, 1925) from the western Indian Ocean and M. kingyo (Kon, Yoshino and Sakurai, 2000) from Okinawa. A third species from off West Africa was described as M. carpenteri Anderson, 2006.

Randall and Heemstra (2006) discussed a large undescribed species of Meganthias similar to M. natalensis that is represented by one specimen taken by bottom long line in 150 m off the southwest coast of Thailand. They declined to describe the species in the hope of finding additional material. The specimen was first reported by Sirimontraporn and Bussarawit (1993) as Holanthias chrysostictus (Günther, 1872); they noted differences in color from what is now Odontanthias chrysostictus. They published an excellent color photograph of the fish, which we reproduce here (Fig. 1). Because no more specimens have been found, we provide here the description of the species. It is not unusual for anthiine fishes to be named from single specimens. Dactylanthias aplodactylus was described by Bleeker (1858) from one specimen 255 mm in total length taken off Ambon, Indonesia, and it is still known only from this one fish. Randall (1980) noted that eight of the 30 species then known in the genus Plectranthias were described from single specimens.

MATERIALS AND METHODS

The specimen of the new species is deposited in the fish collection of the Phuket Marine Biological Center (PMBC). Methods of counts and measurements follow Randall and Heemstra (2006). Data in the table of measurements are given as percentages of the standard length (SL). Proportional measurements in the text are rounded to the nearest 0.05.
as a very long filament, the ray length 1.5 in SL; caudal fin lunate with extremely long filamentous lobes, the fin length 1.1 in SL; third anal spine longer than second, 2.95 in head length; color when fresh pink and yellow, as shown in Figure 1.

Meganthias filiferus, new species
(Figs. 1 and 2, Table 1)

Holanthias chrysostictus (non Günther, 1871): Sirimontraporn and Bussarawit, 1993: 93, Plate 8, Fig. 26.

Holotype: PMBC 10034, male, 293 mm SL, Andaman Sea, off southwest coast of Thailand, 150 m, bottom long line, Weera Pokapunt, January, 1993.

Diagnosis: Dorsal rays X, 18; anal rays III, 8; pectoral rays 17; lateral-line scales 44; gill rakers 12 + 25; body depth 2.05 in SL; head length 2.5 in SL; orbit diameter 4.5 in head length; accessory scales present, dense on head and nape; scales dorsally on snout extending forward to upper lip; mandible covered with small scales; lips rugose from dense papillae, those on front of lower lip enlarged; maxilla nearly reaching a vertical at rear edge of eye, its posterior end and corners slightly rounded; six, short, stout, conical teeth on each side at front of upper jaw, projecting slightly upward and fully exposed (along with most of the villiform teeth) when mouth closed; no teeth on tongue; corner of preopercle strongly angular, without a spine, the upper margin finely serrate, the lower margin crenulate; dorsal spines progressively longer, the tenth 3.2 in head length; second and third soft rays of dorsal fin prolonged as a very long filament, the ray length 1.5 in SL; caudal fin lunate with extremely long filamentous lobes, the fin length 1.1 in SL; third anal spine longer than second, 2.95 in head length; color when fresh pink and yellow, as shown in Figure 1.
Description: Dorsal rays X, 18; anal rays III, 8; dorsal and anal rays all branched, the last to base; pectoral rays 17, branched except upper 2; pelvic rays 1, 5; lateral-line scales 44; scales above lateral line to middle dorsal spines 3; scales below lateral line to origin of anal fin 16; circumpeduncular scales 24; gill rakers 12 + 25; pseudobranchial lamellae 33; vertebrae 26 (10 + 16); supraneural (predorsal) bones 2, set in the Ahlstrom et al. (1976) formula /00/2/1+1/1/1/1/. 

Body deep, compressed, the depth 2.05 in SL, the width 2.5 in body depth; head large, the length 2.5 in SL; orbit diameter 4.5 in head length; snout length 3.7 in head length; interorbital space convex, the least width 3.0 in head length; caudal-peduncle depth 3.1 in head length; caudal-peduncle length 2.25 in head length.

Mouth moderately large, the maxilla nearly reaching a vertical at rear edge of orbit; upper-jaw length 2.0 in head length; mouth oblique, forming an angle of about 55° to horizontal axis of head and body, the lower jaw strongly projecting; upper jaw with a band of villiform teeth anteriorly, nearly one-third orbit diameter in width, in about 10 rows, the inner row a little enlarged; edentate gap at symphysis of upper jaw nearly a pupil diameter in width (measured anteriorly); band of villiform teeth on side of jaw narrowing to two rows posteriorly; each side of front of upper jaw with a row of six stout conical teeth smaller than largest sensory pore on head, that project forward and slightly upward, the teeth to the side also inclined laterally; teeth at front of upper exposed when mouth closed; lower jaw with a slightly narrower band of villiform teeth, a narrower symphysial gap, and only one stout conical tooth on each side, not directed forward, and separated by a gap equal to pupil diameter; no outer row of slender conical teeth along side of lower jaw, only two or three outer teeth slightly enlarged about one-third distance to end of jaw; a chevron-shaped patch of villiform teeth on vomer with concave sides; palatines with a slender curved band of small villiform teeth in about five rows; no teeth on endopterygoids.

Nostrils anterior to middle of eye, the posterior a large oval fossa, its greatest diameter one-third orbit diameter, its ventroposterior third divided from rest of nostril by a fleshy partition; anterior nostril ventroanterior to posterior nostril, smaller than nearby sensory pores, with a very slight posterior rim; a large sensory pore medial to upper part of posterior nostril, and another half way between anterior nostril and edge of upper lip.

Opercle with 3 flat spines, the middle one (upcurved on left side) largest and closer to lower than blunt upper spine; posterior margin of preopercle with about 40 minute serrae; corner of preopercle without a spine, forming a distinct angle of about 110°; ventral edge of preopercle bony
and crenulate; margin of subopercle with about 10 small serrae; interopercle of left side with 3 minute serrae hidden by skin, right interopercle smooth; posttemporal with a few small poorly defined serrae.

Scales ctenoid, with accessory scales that are dense on head and nape; head fully scaled, the scales very small on snout, interorbital, space above and below eye, and on mandible; no scales between nostrils and orbit; small scales basally on membranes and spines of dorsal fin posterior to third spine; soft portion of fin with a broad band of scales on about basal third of fin that are progressively smaller distally; even smaller scales extending farther out on rays; anal fin similar, but scales on about basal fourth; caudal fin with progressively smaller scales extending nearly to posterior margin. Lips finely papillate, the papillae enlarged at front of lower lip. Lateral line continuous, ascending obliquely upward to below fifth dorsal spine then following contour of body to straight peduncular part, ending at base of caudal fin.

Origin of dorsal fin above emergent posttemporal, the predorsal length 2.85 in SL; first dorsal spine 7.35, second spine 4.9 in head length; third to tenth dorsal spines progressively longer, the tenth 3.2 in head length; second and third soft rays of dorsal fin prolonged as a very long filament, the ray length 1.5 in SL; origin of anal fin below base of first dorsal soft ray, the preanal length 1.5 in SL; first anal spine short, 5.85 in head length; third anal spine longer than second, 2.95 in head length; third and fourth anal soft rays longest, 1.85 in head length; caudal fin lunate with extremely long, filamentous lobes, the fin length 1.1 in SL; caudal concavity 1.4 in SL; ninth and tenth pectoral rays longest, 1.4 in head length; base of pelvic fins anterior to pectoral-fin base, the prepelvic length 2.55 in SL; pelvic fins just reaching anus, the third ray longest, 1.3 in head length.

Color of holotype in alcohol pale yellowish; membranes of fins translucent; edge of membranes of spinous portion of dorsal fin posterior to fifth spine narrowly black.

Color when fresh (from color photograph of holotype): body bright pink, suffused with yellow ventrally; a broad yellow band above lateral line extending anteriorly onto nape from below base of fifth dorsal spine; head pink with broad yellow bands extending ventrally from yellow nape, one on edge of opercle to upper opercular flap, one along margin of preopercle, and one narrowly encircling posterior part of eye except for a pink rim; all of snout and suborbital region yellow, curving around maxilla to join yellow of mandible and weaker yellow band ventrally on preopercle; lips deep pink; maxilla pink with yellow margins; iris pale yellow; first four dorsal spines and membranes yellow, the remainder of spinous portion of fin pink with outer edge on last five membranes deep red; soft portion of dorsal fin pink, the elongate anterior fourth of fin yellow distal to length of last dorsal spine; several small red spots surrounded by yellow in distal middle part of fin; anal fin pink basally, broadly yellow anteriorly and distally; caudal fin a mixture of pink and yellow, more yellow on lobes, and more pink centrally in fin; pectoral fins yellow, becoming more red distally, especially in middle of fin; pelvic fins pink and yellow.

**Etymology:** This species of *Meganthias* is named *filiferus* from the Latin *filum* for thread or filament, and the Latin suffix –*fer*, meaning “to bear”, in reference to the very long dorsal- and caudal-fin filaments.

**Remarks:** On seeing the photograph and report of this specimen by Sirimontraporn and Bussarawit (1993), we expected that this large Andaman Sea fish would be merely an eastern range extension of *Meganthias natalensis* (Fowler) from the western Indian Ocean, especially because of its large size, shape of the head, and the similar meristic data. Although differences in fresh coloration were noted, these were discounted in view of the variable coloration of *M. natalensis*. However, direct comparison of the holotype of *filiferus* with specimens of *natalensis*, including one of similar size obtained by the first author in the Seychelles (BPBM 35462, 276 mm), revealed species-level differences: the head is much larger in *filiferus*, 2.5 in SL, compared to 2.7–2.9 for *natalensis*; the corner of the preopercle is strongly angular, compared to rounded in *natalensis*, and
MEGANTHIAS FILIFERUS, A NEW SPECIES OF ANTHIINE FISH

the lower margin is crenulate instead of serrate; the upper posterior corner of the maxilla is slightly rounded, compared to strongly rounded in natalensis; the long soft dorsal filament is from a merging of the second and third rays, compared to just the second ray in natalenesis, and it is longer in filiferus, 1.5 in the standard length, compared to 2.0 or more in natalensis.

ACKNOWLEDGEMENTS

We thank foremost Somchai Bussarawit for the loan of the holotype of this new species and Ukkrit Satapoomin for providing the color photograph of Figure 1. Thanks are also due Loreen R. O’Hara for taking an x-ray, Arnold Y. Suzumoto for curatorial assistance, and Elaine Heemstra for her drawing of the head of the holotype.

REFERENCES


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ABSTRACT: A new species of *Schizammina* is described from the mid-shelf of the Andaman Sea at depths between 60 and 85 m. The test is agglutinating, up to about 30 mm high, and consists of dichotomously branching tubes. Tube diameter varies between 0.8 and 1.2 mm. The most closely related species are *S. atlantideae*, *S. furcata*, and *S. galatheae*. *Schizammina andamana* n. sp. was the dominant macrofauna organism at some stations and its cytoplasm contained centric diatoms, indicating that it is a filter feeder on sedimenting primary production.

INTRODUCTION

The Thai-Danish BIOSHELF project 1996–2000 in the Thai Economic Exclusive Zone of the Andaman Sea comprised 12 transects perpendicular to the coast. Sampling in these was carried out during a number of cruises with the ‘R/V Chakratong Tongyai’, using different kinds of gear at depths from 40 to 900 m (Aungtonya et al. 2000, Tendal et al. unpubl.).

During the last two cruises in 2000 it was noticed, when sorting some of the samples on deck, that a schizamminid foraminiferan lives in the mid-shelf area. Inspection of the literature and comparison with specimens in the collection of the Zoological Museum in Copenhagen of all earlier described members of the family indicated that the BIOSHELF specimens represent a new species of the genus *Schizammina*.

The species is here formally described as *Schizammina andamana* n. sp. and its occurrence is discussed and compared to the distribution patterns of other species of the family.

MATERIALS AND METHODS

See Aungtonya et al. (2000) for the list of sampling stations. The samples were immediately fixed in formalin (c. 4%) in seawater with an addition of disodium tetraborate (borax). They were later transferred to 80% alcohol.

Individuals intended for histology were first transferred to distilled water through a falling alcohol series, then to a 5% aqueous solution of hydrochloric acid (HCl) for 1 h in order to remove calcareous particles, and finally to 30% hydrofluoric acid (HF) for 24 h in order to remove siliceous mineral grains. The individuals were washed in distilled water, brought through a series of increasing alcohol concentrations (30, 50, 70, 80%) and finally stored in 80% alcohol. They were embedded in Epon. Sections, 3 µm thick, were made using a Jung microtome fitted with a glass knife. They were stained with toluidine blue for about 2 min and differentiated in 96% alcohol and the coverslips were mounted with Gurr.

Individuals used for scanning electron microscopy were transferred from alcohol to acetone and dehydrated by the use of an Electron Microscopy Sciences 850 critical point drier. The individuals were mounted, broken or entire, on stubs and coated with gold-palladium in an Edwards S150B sputter coater for 5 minutes, and studied in a scanning electron microscope (CamScan MaXim 2040 S) at the University of Aarhus, Denmark.
Some individuals were dried in order to allow the extraction of DNA, but this method failed.

**FAMILY SCHIZAMMINIDAE NØRVANG, 1961**

**Diagnosis:** Test free, large (2–10 cm maximum dimension) and either plate-like or forming dichotomously branching tubes. Agglutinated wall thick and firmly cemented. Interior non-septate, consisting of large, flattened space or lumen of tube system. Aperture simple, oval or circular. (After Lee et al. 2000, abbreviation of the original diagnosis by Nørvang, 1961).

**Scope:** Schizamminidae comprises two genera, *Schizammina* Heron-Allen and Earland, 1929 with seven species and *Jullienella* Schlumberger, 1890 with three species. A third genus, *Astrotrizinella* with one species, *A. planata*, was described by Saidova in 1970 and placed in the family, a position kept in her monograph on Pacific benthic Foraminifera (1975) and other papers, and by Beljaev (1983, 1989). *A. planata* has the characteristics of a xenophyophore and was transferred to the genus *Psammina* by Tendal (1996), a view confirmed in a reinvestigation of the original material by Kamenskaya and Saidova (1998).

**History and present status of genera and species:** The first genus of the family (as understood nowadays) to be described was *Jullienella* Schlumberger, 1890 with the type species *J. foetida* by monotypy. It was found by a French expedition off West Africa and first believed by the bryozoan specialist Jules Jullien to be a bryozoan. Next came *Schizammina* Heron-Allen and Earland, 1929 with type species *S. labyrinthica* and one other species, *S. furcata*, based on material taken by the British ‘Discovery’, off West Africa as well. Meanwhile, Pearcy (1908) had described *Botellina pinnata* from material provided by the South African ‘Pieter Faure’ in the Indian Ocean off South Africa. The species had a remarkable fate, being divided by Nørvang (1961) into two species, *Jullienella pearcyi* Nørvang, 1961 and *Schizammina pinnata* (Pearcy, 1908). Buchanan (1958; 1960), during a survey of the fauna off Ghana, found some of the earlier named species, and described *S. arborescens*. Nørvang (1961) investigated a rich material partly taken by the Danish ‘Atlantide’ (1945–1946) and ‘Galanthea’ (1950–1952) expeditions, partly collected by the Danish zoologist Th. Mortensen in South Africa in 1929, comprising all the species, and added three new ones, *S. atlantideae, S. galatheae* and *S. reticulum*. A third species of *Jullienella, J. zealandica*, was described from New Zealand by Hayward and Gordon (1984).

**RESULTS**

*Schizammina andamana* n. sp.  
(Figs. 1–5)

**Material examined:**
St. C-2. 1 February 2000. 9°00' N, 97°55' E. 60 m. Rectangular dredge. Few specimens/fragments. Alcohol.
St. L-3. 29 February 2000. 6°45' N, 98°43' E– 6°46' N, 98°42' E. 76 m. Hundreds of specimens/fragments. Alcohol.

**Description of holotype:**
The holotype is reddish brown and about 15 mm high. It branches dichotomously four times with good distance between branching points, and a pronounced thickening of the branches just
below these. Large mineral grains are conspicuous on the test surface (Fig. 2A).

**Deposition of type specimens:**

The holotype is deposited at the Phuket Marine Biological Center, Reference Collection (PMBC No. 24587). Six paratypes are deposited in the collection of the Zoological Museum, SNM, Copenhagen (ZMUC PRO 11 to ZMUC PRO 16).

**General description:**

Largest specimens 2–3 cm in length, consisting of a repeatedly dichotomously divided tube system with 5 or 6 dividing points, and 2–6 mm between them. Tubes between points slightly conical with thickest part distally, and 0.8–1.2 mm in outer diameter, mostly just around 1 mm (Fig. 1A–Z).

The branching pattern is characteristic in a way most clearly seen in large specimens (>1.5 cm). The first dichotomy is at a large angle, close to 90°, the following at the same or a smaller angle. The first two branches curve slightly outwards and branch again, but the following pairs of branches are unequally developed, one of them prolonging the original branch in a gentle curve, the other not dividing, but ending blindly, plugged with loose sand grains and fine particles. After 4–5 divisions repeating the pattern of prolongation and curving, the ‘main branch’ almost forms a circle. The branching pattern is not always this strict; the other or both branches in a division may develop, resulting in a more straight part of the test, which itself can be dichotomously divided several times. The branching is essentially in one plane, but slight twisting of single branches out of that plane is seen now and then.

The tube wall consists of quartz grains, up to c. 500 µm in diameter, but mostly 200–250 µm, set in a matrix of organic cement. The large mineral grains extend all the way through the wall. The outer test surface consists of minute mineral grains which often form a rim or smooth surface around the margin of the larger grains (Fig. 3A). Channels for the cytoplasm are found between some of the larger mineral grains. Such channels often expand into larger hollow structures just below the test surface, but do not seem to penetrate the surface itself.

The test colour is red-orange-brown, except at the tips of the branches where it is white (Fig. 2A, D). The colour changed when individuals were put in a weak hydrochloric acid (HCl) solution. A greenish or yellow-greenish substance was given off to the liquid. The test turned whitish with some greenish cement remaining between the mineral grains (Fig. 2B). This treatment made it easier to observe the distribution of the mineral grains on the outer test surface.

The test lumen is a longitudinal channel along the centre of the test axis (Fig. 3B, D). An organic lining was observed in the light microscopic sections. It is often seen on one side only, but in some sections it was found all the way around the cytoplasm (Fig. 5A, B). The differences are probably fixation artifacts.

The cytoplasm is not a uniform cell body as in many other foraminiferans, but a kind of compressed network of numerous compacted granuloreticulopodia. Consequently, this cell organisation resembles to some extent the outer part of the cytoplasm in *Toxisarcon synsucidica* Cedhagen and Pawlowski, 2002 (Fig. 2J). The cytoplasm surface towards the mineral grains is therefore not smooth but has numerous irregular holes and cavities (Fig. 3C).

The cytoplasm is full of stercomata (Fig. 3C) and also contains several centric diatoms. The older (lower) parts of the test lumen are entirely filled with stercomata and the active cell parts seem to be located at the tips of the branches (Fig. 2B, D).

The nucleus is up to 100 µm in diameter (Fig. 5A). Its margin can be irregular and on some of the slides it is located in a structure resembling a vacuole. However, this is probably a fixation artifact. The nucleus contains numerous nucleoli and most of them are concentrated towards its periphery, as in many other species (*e.g.*, Cedhagen and Pawlowski 2002).

Free granuloreticulopodia of the shape typical for foraminiferans were found at the tip of
a branch (Fig. 4).

The test is usually free from other organisms but a few species have been observed on it, primarily on the older parts. An undescribed cirriped (Cedhagen and Høeg, unpubl.) and bryozoan colonies are frequently found. Rare epizoans are gastropod egg cases, hydroids, and other agglutinating foraminiferans.

**Distribution:**

The species has so far been recorded between 6°45’N and 9°N, and can probably be found as scattered fragments also in samples from the two more northern transects. The bathymetric distribution is, for the time being, established as the depths between 60 and 85 m, on sandy mud with shell fragments. It can be the dominant macrofauna organism in some localities (Fig. 2C).

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**Figure 1.** *Schizammina andamana* n.sp. Specimens collected at the type locality (Andaman Sea, BIOSHELF station J-48). Scale bar = 5 mm.
**Figure 2.** *Schizammina andamana* n.sp. A. Holotype, from BIOSHELF station J-48. B. Part of test where sediment particles have been dissolved and the cement connecting them is stained with toluidine blue. C. Small part of sledge sample J-48 as it appeared on the deck immediately following collection. D. Tip of branch where sediment particles have been dissolved. The lighter branch tip contains the active cytoplasm and the brown interior consists of stercomata. Scale bars: A = 5 mm; B & D = 500 µm.

**Figure 3.** *Schizammina andamana* n.sp. SEM photos. A. Side view of branch with larger mineral particles surrounded by a matrix of finer particles. The upper part is broken and a part of the cytoplasm filling the test lumen is exposed. B. Transverse view of broken branch showing the test lumen (TL). C. Cytoplasm surface that was attached to a mineral particle. Its structure is ‘spongy’, like a compressed network of reticulopodia. The round structures are stercomata. D. Enlargement of B showing test lumen (TL) and mineral particle covered by cement (Cm). The central cytoplasm has fallen out but extensions of the cytoplasm (Cp) project between the mineral grains and spread out just under the outer surface of the test. Scale bars: A & B = 100 µm; C = 10 µm; D = 50 µm.
Figure 4. *Schizammina andamana* n.sp. SEM photo of granuloreticulopodia at branch tip. Masses of detritus and finer particles are gathered at the surface. Scale bar = 100 µm.

Figure 5. *Schizammina andamana* n.sp. Light microscopic images of ‘soft parts’. A. N = nucleus with numerous nucleoli; S = hole after dissolved sand grain; OL = organic lining. B. Transverse section of branch showing the general organisation of the organism; S = hole after dissolved sand grains; OL = organic lining; Cm = cement with finer mineral particles; Cp = cytoplasm. Scale bars = 100 µm.
**SCHIZAMMINA ANDAMANA N. SP., FROM THE SHELF WEST OF THAILAND**

**DISCUSSION**

**Systematics**

*Schizammina andamana* agrees with the diagnosis of the genus as given and discussed by Nørvang (1961). The differences to four of the other seven species of the genus, *S. arborescens* Buchanan, 1958, *S. labyrinthica* Heron-Allen & Earland 1929, *S. pinnata* (Pearcy, 1908) and *S. reticulum* Nørvang, 1961, are very obvious, being found in dimensions, branch form or branching pattern.

Distinguishing between *S. andamana* and the last three species, *S. atlantideae* Nørvang, 1961, *S. furcata* Heron-Allen & Earland, 1929 and *S. galatheae* Nørvang, 1961, is more subtle since the dimensions and branch form are much the same, and the branching patterns vary in a less pronounced way. It might even be that with more geographic regions represented by samples and a better knowledge of variation, the four species may in the future be united under the name of *S. furcata*, a point of view mentioned by Nørvang (1961) in discussing relationships between *S. furcata* and *S. galatheae*. For the time being these slightly morphologically different but geographic well separated populations are considered valid species.

The worst problem for the comparison of samples comes from the fragmentation caused by the mechanical handling during sampling, washing and sorting. It obscures the branching pattern, and older and younger parts are not easily distinguished. Likewise, it can make it difficult to clarify whether one or more species are represented in the catch.

The main difference compared to *S. atlantideae* is that the latter is a smaller (< 20 mm maximum length) species. The branching pattern is furthermore more zig-zag-like because some branches to both sides remain short and unbranched. The branch diameter in *S. atlantideae* is 1.0–1.2 mm. The tube wall has several layers, is about 250 μm thick, and the material is silty (20–50 μm grains), with only few finer grains in the interstices.

Likewise, *S. furcata* seems to be a smaller species (rarely > 20 mm maximum length). The branching pattern is dichotomous with a rather long distance (ab. 10 mm) between the first two branching points and smaller but constant distances between the later ones. Branchings are few and predominantly on one of the sides, the branches often curving slightly outwards, although not to the degree seen in *S. andamana*. The branches are coarser than in *S. andamana*, the branch diameter, although varying from 0.8–1.2 mm, mostly being over 1 mm and rarely reaching 1.5 mm. The tube wall is single layered, 250–350 μm thick, and the material is sandy (250–350 μm grains), with a filling of silty particles in the interstices on the outside.

*S. galatheae* is poorly known, the original material being scanty and fragmented. It is of a special importance because it, being found off Tranquebar, southeast India, is so far the geographically nearest species to the Andaman Sea. The branching pattern is regularly dichotomous with short distances between branching points. The branch diameter is 1.2–1.6 mm. The tube wall is single layered, 200–250 μm thick, and the material is sandy (200–250 μm grains), with the interstices between grains filled with large amounts of organic cement.

**Geographic distribution**

Hayward and Gordon (1984), Nørvang (1961) emphasize that the species of Schizaminidae all have regional, restricted distribution areas. The best examples, supported by numerous records, are *Jullienella foetida* found off West Africa, *Schizammina pinnata* and *J. pearcyi* known from eastern South Africa, and *J. zealandica* from off New Zealand.

In the case of *S. andamana* this restricted regional distribution is the eastern shelf of the Andaman Sea. A qualified guess is that the species occurs at mid-shelf depths in the area of seasonal upwelling. The northern limit of distribution could be in the Gulf of Martaban, influenced by freshwater and particle outflow from the Irrawaddy delta. To the south the special hydrographical conditions of the Malacca Strait (strong currents, effects of breaking internal waves, change in sediment composition and structure) might be limiting.
ACKNOWLEDGEMENTS

We thank DANIDA for supporting the BIOSHELF project well. Somchai Bussarawit, Charatsee Aungtonya and their colleagues at the Reference Collection of the Phuket Marine Biological Center are thanked for their indefatigable and extended help. Likewise, the crew of R/V ‘Chakratong Tongyai’ are heartily thanked for their patience, helpfulness and good spirits during our stays onboard. Susanne Petersen, University of Aarhus, helped sectioning and light microscopic preparations specimen preparation for SEM.

REFERENCES

SCHIZAMMINA ANDAMANA N. SP., FROM THE SHELF WEST OF THAILAND


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THE OPISTHOBRANCH MOLLUSCS COLLECTED DURING THE THAI-DANISH BIOSHELF PROJECT IN THE ANDAMAN SEA, THAILAND

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ABSTRACT: Six species of opisthobranch molluscs collected during the Thai-Danish BIOSHELF project are described. The material consisted of 25 specimens from eighteen samples. One specimen was too damaged to be identified. Opisthobranchs were only found in 4% of the samples. Four species were found at depths greater than 300 m. All of the species have been described previously from shallower water, mostly less than 100 m. All specimens were longer than 10 mm, and with the exception of four specimens, all were longer than 30 mm. A comparison with nudibranchs collected during the BIOFAR1 project from the NE Atlantic around the Faroe Islands clearly indicates the importance of using appropriate gear for collecting soft-bodied invertebrates from deep water.

INTRODUCTION

The Thai-Danish BIOSHELF project collected benthic samples in the Andaman Sea during the period 1996–2000, using several types of gear (Aungtonya et al., 2000). Eighteen out of a total of 442 samples contained opisthobranch molluscs. Most of them were preserved in rather poor condition and were difficult to identify; one was too damaged to be identified. Only the 24 specimens that could be identified are included in the present study.

More than 70 species of shallow water opisthobranchs have been described previously from the Andaman Sea (Jensen, 1998) and from the Gulf of Thailand (Bergh, 1902; Swennen et al., 2001). In addition a number of species have been photographed and listed on the Sea Slug Forum (http://www.seaslugforum.net/), and the total number of species occurring in Thailand may well be of the same magnitude as in other Indo-West Pacific localities, i.e. around 300 species (Rudman and Darvell, 1990; Gosliner, 1992).

SYSTEMATICS

**Philine cf. orientalis** A. Adams, 1854

*Synonyms: Philine quadripartita* Ascanius var. *siamensis* Bergh, 1902.

Four specimens of this species were included in the material. One specimen was collected at almost 700 m (Table 1), whereas the others were collected in shallow water (20–24 m). The specimen from deep water (Fig. 1) was also the largest specimen (45 mm long, 25 mm wide and 10 mm high). A specimen from station E 20m collected on 22 April 1996 was dissected. The specimen was 28 mm long, 18 mm wide and 3–4 mm high. The penis and the pharynx were partly everted. The shell and gizzard plates (Fig. 2) were very fragile and partly broke during dissection. The radula had the formula 17 x 1.0.1. The teeth had a denticulate inner margin with some composite denticles characteristic of *P. orientalis* (Rudman, 1998). The penial complex had a long, convoluted prostate, a thin incurrent sperm duct, a long vas deferens and a two-pronged penis (Fig. 3).

The dissected specimen was compared with a specimen of *Philine cf. orientalis* collected during the TMMP workshop in Nha Trang, Vietnam in August 2001. This specimen was 30 mm long, 19 mm wide and 6 mm high. Shell and gizzard plates were almost identical to the BIOSHELF specimen. The radula had the formula 20 x 1.0.1, and the shape of the teeth was also identical. The Vietnamese specimen had the gizzard full of foraminiferans whereas the Andaman Sea...
specimen had an empty gizzard, but had fine calcareous powder in the intestine. It was also compared to a specimen of *P. aperta* from northern Kattegat, Denmark. This specimen was 35 mm long, 24 mm wide and 11 mm high. Shell and gizzard plates were very similar to the SE Asian specimens, but the radular teeth did not have composite denticles; the radular formula was 28 x 1.0.1. The intestine and gizzard were empty.

Remarks: Bergh (1902) described *Philine aperta* from the Gulf of Thailand (as *P. quadripartita* var. *siamensis*). Otherwise *P. aperta* is an Atlantic Ocean species occurring from northern Europe to South Africa (Thompson, 1976). *Philine orientalis* has been described from the South China Sea (Morton and Chiu, 1990), where it feeds on bivalves. Shells and gizzard plates are almost identical in the two species and also resemble those of the other large species of *Philine*, *P. angasi* and *P. auriformis* (Rudman, 1972). However, the radular teeth and also the penial complex differ. The present study has shown that the species found in Thailand is *P. orientalis* rather than *P. aperta*. The specimen from station K10 is no doubt a depth record for the species and possibly even for the genus *Philine*.

**Pleurobranchaea brockii** Bergh, 1897

This was the most common species in the BIOSHELF material. A total of 10 specimens were collected of which four were from depths greater than 480 m (Tables 1–2). The shallow water specimens had retained at least some of the reticulate pigment on the dorsal surface (Fig. 4). The deep-water specimens were generally very badly mangled and could only be identified from radular and jaw morphology, and to some extent on penial morphology (Fig. 5). The radula of the specimen from station K10 had 72–76 teeth in each half row and the teeth were distinctly bicuspid.

Remarks: The anatomy of this species has been described in detail elsewhere (Marcus and Gosliner, 1984; Tsubokawa *et al.*, 1992; Jensen, 1994). This species has a very wide geographical distribution, covering almost the entire Indo-West Pacific Region, i.e. from South Africa to Japan (Marcus and Gosliner, 1984). In 1925 Thiele described *Pleurobranchella nicobarica* from relatively deep water (approx. 300 m) in the Indian Ocean near the Nicobar Islands (Thiele, 1925). This species has unicuspid radular teeth and a widely overhanging mantle. The deep water specimens of the present material also had rather wide and overhanging mantles, but the radular teeth were distinctly bicuspid. Also, these specimens had a caudal spur as found in some species of *Pleurobranchaea*. The dissected specimens of the present material did not have any recognizable material in the stomach or intestine. *P. brockii* is a predator of other opisthobranchs and has been shown to be cannibalistic in some cases (Jensen, 1997).

**Euselenops luniceps** (Cuvier, 1817)

Three specimens of this species were collected from fairly shallow water (Table 1). The specimens varied between 30 and 40 mm in preserved length. These specimens had retained most of their natural pigment (Fig. 6).

Remarks: This species has been thoroughly described by several authors (Bergh, 1897; Willan, 1987; Jensen, 1994) and is easily recognized. It is a fairly common species distributed from South Africa and possibly the Red Sea to Hawaii, and from Japan to Queensland, Australia.

**Kalinga ornata** Alder and Hancock, 1864

Five specimens are included in the present material. Four of these had been collected in rather shallow water (28–34 m), whereas the fifth specimen had been collected at almost 500 m depth (Table 1). The specimens ranged from about 50 to about 75 mm in length preserved. The gut contents of the deep-water specimen consisted of skeletal parts of brittle stars. Other specimens had lots of sponge spicules or polychaete setae on the surface, but this was probably due to the rough collection method. The preserved specimen from station PB4 is shown in Fig. 7. Two specimens had the genitalia everted, at least in part (Fig. 8).

Remarks: The species seems to be fairly common in trawl samples (Rudman and Darvell, 1990; Jensen, 2000). This is probably because of its considerable size and hardy structure. Very little is
known about the biology of this species. For description of anatomy see Alder and Hancock (1864) and Jensen (2000).

**Platydoris annulata** Dorgan, Valdès and Gosliner, 2002

Only one specimen was collected. It was approximately 40 mm long (somewhat curled up), 25 mm wide and 10 mm high; the foot sole was about 7 mm wide with the edges rolled up. The preserved specimen had a pale beige ground colour and several dark purple-brown rings on the dorsal surface. The dorsal surface was densely covered with caryophyllidia (Fig. 9). A small, probably ectoparasitic, isopod was found on the dorsal surface, near the retracted gills.

Remarks: This species was recently described from a single specimen collected from the Philippines. The present specimen extends the distribution to the Andaman Sea and depth from 166–172 m to 303–313 m. The holotype was 46 mm preserved; the present specimen is approximately 40 mm long preserved. The dorsal colour and pattern of rings exactly matches the original description. Dorgan *et al.* (2002) described the ventral colour as uniformly cream. In the present specimen there is a little pigment at the base of genital papillae and also a few indistinct spots on the ventral side of the mantle, close to the foot above the oral tentacles and along the anterior foot margin.

**Ceratosoma sinuata** (van Hasselt, 1824)

For synonyms and description of anatomy see Valdès and Gosliner (1999). Only one specimen of this species was collected from a depth of 40 m. The specimen was about 50 mm long preserved, and all coloration had disappeared (Fig. 10). The four paired lateral lobes are somewhat irregular, but still recognizable by the transverse ridges extending from the middorsal ridge to the tip of each lobe. Valdès and Gosliner (1999) mention a large tubercle middorsally behind the gill. In the present specimen this tubercle is located in front of the withdrawn gills, and looking at the figures in Valdès and Gosliner (1999), it also appears that this is the position in their specimens. Defensive glands are distinct on the posterior lobe, behind the gills.

Remarks: For many years this species was known as *Miamira sinuata* until phylogenetic analysis showed that it could be included in the genus *Ceratosoma* (Valdès and Gosliner 1999). In life it has a very distinct though variable colour pattern.

**Figure 1.** *Philine* cf. *orientalis*. A. Preserved specimen from station K10, dorsal view. B. Ventral view of the same specimen.
Figure 2. *Philine* cf. *orientalis*. A. Shell of specimen from station E20 m. B. Gizzard plates of the same specimen.

Figure 3. *Philine* cf. *orientalis*. Penial complex.

Figure 4. *Pleurobranchaea brockii*. A. Dorsal view of preserved specimen from station G2. B. Lateral view of the same specimen.
Figure 5. Pleurobranchaea brockii. Partly everted penis of specimen from station K10.

Figure 6. Euselenops luniceps. Dorsal view of preserved specimen from station E20 m.

Figure 7. Kalinga ornata. A. Dorsal view of preserved specimen from station PB4. B. Ventral view of the same specimen.
Figure 8. *Kalinga ornata*. A. Partly everted genitalia of specimen from station PB7. B. Everted genitalia of specimen from station PB3.

Figure 9. *Platydoris annulata*. A. Dorsal view of preserved specimen. B. Ventral view of the same specimen.

Figure 10. *Ceratosoma sinuata*. A. Dorsal view of preserved specimen. B. Ventral view of the same specimen.
Table 1. Collecting data for opisthobranchs of the BIOSHELF project. Gear: TD – triangular dredge; OS – Ockelmann sledge; AT – Agassiz trawl; T – otter trawl. An * indicates that sediment type was identified from a different sample (and usually different gear) at the same station.

<table>
<thead>
<tr>
<th>Species</th>
<th>Station</th>
<th>Sediment</th>
<th>Lat &amp; Long</th>
<th>Date</th>
<th>Depth (m)</th>
<th>Gear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philine cf. orientalis</td>
<td>E 20m</td>
<td>muddy sand*</td>
<td>8°29' N; 98°12' E</td>
<td>22 Apr 1996</td>
<td>20</td>
<td>TD</td>
</tr>
<tr>
<td>(2 specimens)</td>
<td>PB3</td>
<td>sand w. shell fragments</td>
<td>7°48' N; 98°31' E</td>
<td>27 Feb 1998</td>
<td>24</td>
<td>OS</td>
</tr>
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<td>Philine cf. orientalis</td>
<td>K10</td>
<td>mud*</td>
<td>7°01' N; 97°20' E</td>
<td>17 Nov 1999</td>
<td>690–684</td>
<td>AT</td>
</tr>
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<td>NA</td>
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<td>78</td>
<td>TD</td>
</tr>
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<td>49</td>
<td>TD</td>
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<td>muddy sand*</td>
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<td>20 Feb 1998</td>
<td>68</td>
<td>TD</td>
</tr>
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<td>H2</td>
<td>soft mud*</td>
<td>7°46' N; 98°14' E</td>
<td>20 Feb 1998</td>
<td>57</td>
<td>TD</td>
</tr>
<tr>
<td>Pleurobranchaea brockii</td>
<td>PB6</td>
<td>sand w. shell fragments*</td>
<td>7°44' N; 98°33' E</td>
<td>21 Feb 1998</td>
<td>34</td>
<td>TD</td>
</tr>
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<td>PB6</td>
<td>sand w. shell fragments*</td>
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<td>T</td>
</tr>
<tr>
<td>Pleurobranchaea brockii</td>
<td>E8</td>
<td>sand*</td>
<td>8°32' N; 96°04' E</td>
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<td>488–478</td>
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<td>sand</td>
<td>9°11' N; 96°12' E</td>
<td>11 Feb 1999</td>
<td>689–504</td>
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<td>K10</td>
<td>mud*</td>
<td>7°01' N; 97°20' E</td>
<td>17 Nov 1999</td>
<td>690–684</td>
<td>AT</td>
</tr>
<tr>
<td>Euselenops luniceps</td>
<td>E 20m</td>
<td>muddy sand*</td>
<td>8°29' N; 98°12' E</td>
<td>22 Apr 1996</td>
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<td>TD</td>
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<tr>
<td>Euselenops luniceps</td>
<td>PB3</td>
<td>sand w. shell fragments*</td>
<td>7°52' N; 98°31' E</td>
<td>23 Apr 1997</td>
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<td>TD</td>
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<td>Euselenops luniceps</td>
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<td>sand w. shell fragments*</td>
<td>7°44' N; 98°33' E</td>
<td>21 Feb 1998</td>
<td>34</td>
<td>TD</td>
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<td>Kalinga ornata</td>
<td>PB3</td>
<td>sand w. shell fragments*</td>
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<td>fragments*</td>
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<td>28</td>
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<td>Kalinga ornata</td>
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<td>sand w. shell fragments*</td>
<td>7°44' N; 98°33' E</td>
<td>21 Feb 1998</td>
<td>34</td>
<td>TD</td>
</tr>
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<td>Kalinga ornata</td>
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<td>sand w. shell fragments*</td>
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<td>32</td>
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<td>Kalinga ornata</td>
<td>G8</td>
<td>muddy sand*</td>
<td>8°00' N; 97°11' E</td>
<td>9 Feb 2000</td>
<td>495–488</td>
<td>AT</td>
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<tr>
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<td>L6</td>
<td>sand w. shell fragments*</td>
<td>6°45' N; 98°06' E</td>
<td>23 Feb 2000</td>
<td>303–313</td>
<td>AT</td>
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<td>Ceratosoma sinuata</td>
<td>C1</td>
<td>muddy sand*</td>
<td>9°02' N; 98°03' E</td>
<td>20 Apr 1996</td>
<td>40</td>
<td>T</td>
</tr>
</tbody>
</table>
Table 2. Size measurements of *Pleurobranchaea brockii* from the BIOSHELF project. The 2 specimens from St. E8 were too badly mangled to be measured.

<table>
<thead>
<tr>
<th>Station/Date</th>
<th>Length (mm)</th>
<th>Width (mm)</th>
<th>Height (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PB6 (21 Feb 1998)</td>
<td>40</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>PB6 (27 Feb 1998)</td>
<td>35</td>
<td>25</td>
<td>11</td>
</tr>
<tr>
<td>A1 (18 Feb 1998)</td>
<td>40</td>
<td>30</td>
<td>10</td>
</tr>
<tr>
<td>G2 (20 Feb 1998)</td>
<td>40</td>
<td>17</td>
<td>12</td>
</tr>
<tr>
<td>H2 (20 Feb 1998)</td>
<td>45</td>
<td>25</td>
<td>13</td>
</tr>
<tr>
<td>F3 (16 Feb 1998)</td>
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<td>12</td>
</tr>
<tr>
<td>B10 (11 Feb 1999)</td>
<td>25</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>K10 (17 Nov 1999)</td>
<td>40</td>
<td>30</td>
<td>10</td>
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</tbody>
</table>

DISCUSSION

The present opisthobranchs material is very small, but in one way it is also unique. It contains a number of species that have been collected from deep water. Only in recent years have thorough surveys of deep-water localities yielded a large number of opisthobranchs (Valdés, 2001a,b). This author found almost all new, undescribed species whereas the present material consists of species that have been described from shallower water previously.

Most samples contained only one specimen of one species, three samples contained 2 specimens of the same or different species, and two samples contained 3 specimens, one of which was the unidentified one. This does not necessarily mean that opisthobranchs are rare; it just indicates that the sampling gears were inadequate. By-catch from shrimp-trawling in several Asian countries (India, Vietnam, Hong Kong and Cambodia) often contains many specimens of some opisthobranch species, including several of the species found in the present material (Taylor and Jensen, 1991; Leung and Morton, 1997; Jensen pers. obs.). The most common species in these shrimp-trawl samples appear to be *Armina* spp., which were not present in the BIOSHELF material.

The poor condition of most of the specimens shows how important it is to use sampling gear that is suitable for soft-bodied invertebrates. Only the large and tough species remain in a recognizable shape after being hauled in a full trawl-net from 400–700 m depth. Notaspideans and dorid nudibranchs are among the hardest opisthobranchs and these groups also dominate the present material even from shallow water stations. Only 4% of the BIOSHELF samples contained opisthobranchs, and no specimen was less than 10 mm long. In the BIOFAR1 project from the Faroe Islands, which also contained many deep water stations, nudibranchs were found in 7% of the samples (Jensen, 2005), and many of the specimens were only a few mm long. In the BIOFAR1 project the most successful sampling gear was the modified Pearcy-Rothlisberg epibenthic sledge (25% of the samples contained nudibranchs), whereas this gear was only used for 13 samples, none of which contained nudibranchs, in the BIOSHELF project. In the BIOFAR1 project only 3.3% of the samples collected by triangular dredge contained nudibranchs, whereas 7.9% of the triangular dredge samples of the BIOSHELF project contained opisthobranchs. Unfortunately Valdés (2001a,b) did not mention the type of gear used for sampling in the New Caledonia deep water expeditions.

ACKNOWLEDGEMENTS

I am grateful to Dr. Somchai Bussarawit, Dr. Charatsee Aungtonya and the staff of the PMBC Reference Collection for placing the valuable BIOSHELF material at my disposal.
REFERENCES


NEW PHOTOGRAPHIC RECORD OF MIMIC OCTOPUS IN THE GULF OF THAILAND

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INTRODUCTION

The mimic octopus was discovered in the mid 1980’s by underwater photographers and later received this nickname (Norman and Hochberg, 2005) due to its ability to impersonate the shape and behaviour of numerous venomous or dangerous animals co-occurring in its habitat. It was reported in the tropical Indo-Pacific region from the Red Sea and Indo-Malayan Archipelago from New Caledonia across Papua New Guinea and Indonesia, to Malaysia and the Philippines.

Norman and Hochberg (2005) described the Mimic Octopus as a new genus and species, Thaumoctopus mimicus, based on specimens dated back to 1905 and 1994. The maximum mantle length is 58 mm. Arms with cream to white bands against dark brown base colour. Arm span is up to 600 mm (Norman et al., 2001). The unique morphological characters includes: absence of a calamus on the copulatory organ, absence of enlarged suckers in either sex; long narrow arms and distinctive colour patterns including a white teardrop ring on the mid-dorsal mantle and white ‘U’ patch on the posterior-dorsal mantle. T. mimicus inhabits exposed bottom of sand or mud at depths of 0.5–37 metres. It occupies the vacated burrows of other animals as its lair (Norman and Hochberg, 2005). It is diurnal active, feeding on small fish and crustaceans that burrow in soft sediment. Burrowing is also observed in this species.

Norman et al. (2001) reported the dynamic mimicry behaviour of T. mimicus impersonating a flatfish, lionfish and sea snake. Other reports on mimicry show that it mimics crocodile snake eels, sea anemones, stingrays, mantis shrimps, brittle stars and jelly fish (Norman, 2000). On exposed soft sediment there are few inanimate objects or sessile organisms to impersonate. The mimic octopus occupies this niche and shifts into day foraging by visually masking its presence from diurnal visual predators and impersonating dangerous animals. Norman and Hochberg (2005) suggested that its lifestyle and habitat preference may have evolved through one of two scenarios: a habitat shift by a day-active ancestor, or as an activity pattern shift from a crepuscular or night-active ancestor occurring in the soft sediment habitat.

RESULTS AND DISCUSSION

Eight underwater digital photographs of a mimic octopus were sent from a tourist diver, Lawrence Neal, to the junior author in August 2005. All photographs were taken from coastal waters of Koh Sark, Pattaya, Chonburi province in the eastern part of the Gulf of Thailand (12º 56’N and 100º 47’E) at a depth of about 10 metres. The serial photographs present daytime (about 3 p.m.) foraging behaviour of the octopus with comparatively long brown arms with white bands on exposed silty sand substrates similar to characters and behaviour of T. mimicus reported by Norman et al. (2001).

Figures 1 and 2 present external morphological characters enabling the identification of the octopus as a Thaumoctopus. The first character is the irregular longitudinal white bars observed on the dorsal mantle indicating that it is not ‘wunderpus’ (Octopus sp. 20 (Norman, 2000)). The wunderpus has distinct white bars and spots on a brown mantle.
Figure 1. *Thaumoctopus mimicus* from Norman and Hochberg, (2005) (left) and the mimic octopus of this study (right).

Figure 2. External morphological characters on dorsum of the mimic octopus in this study (left) compared to *Thaumoctopus mimicus* Norman and Hochberg (2005) (right).
Figure 3. The mimic octopus on sand showing supraocular papillae.

Figure 4. Foraging colour pattern (left) and in camouflaged mode (right).

Figure 5. Swimming displaying flatfish mimicry.
The second character is a distinct white ‘U’ patch with large lower-part of ‘U’ on the posterior-dorsal mantle in the same manner of *T. mimicus*. However, a white teardrop ring on the mid-dorsal mantle could not be observed which might mean that the octopus is a species other than *T. mimicus*. Norman (2000) suggested that a number of undescribed species from Indo-Malayan region might represent additional members of the genus. Norman and Hochberg (2005) considered that probably 1–4 species belong to the genus *Thaumoctopus*.

Supraocular papillae can be seen in Figure 3. Figure 4 (left) shows the colour pattern similar to the normal foraging colour pattern shown in Norman *et al.* (2001) and probably represents brittle star mimicry. The colour pattern of this posture camouflages well with sand and is seen in Figure 4 (right). The last photograph shows the octopus swimming above the substrate displaying flatfish mimicry (Fig. 5).

Specimens could not be collected when the location was re-investigated again by the junior author in October 2005. The location, the rarity of the octopus and popularity as a target species for photographers and tourist divers might drive this species to become endangered. Norman and Hochberg (2005) noted that specimens of this species were difficult to obtain and it was more than a decade between images emerging from Indonesia and actual specimens being obtained.

**References**

