

NEW RECORD OF OCEANIC SQUIDS FROM THAI WATERS, THE ANDAMAN SEA.

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ABSTRACT

During a bottom trawl survey off the Andaman Sea coast of Thailand in 1989 by M.V. Paknam (Southeast Asian Fisheries Development Center), cephalopods were collected from the depth between 300-500 m. Of these, six genera and seven species have never been reported in Thai waters. They are: *Abralia* (*Asteroteuthis*) *andamanica* Goodrich, 1986; *A.* (*Stenabralia*) *lucens* Voss, 1962; *Histioteuthis celetaria pacifica* (Voss, 1962); *Nototodarus hawaiiensis* (Berry, 1912); *Chiroteuthis* (*Chirotauma*) *imperator* Chun, 1908; *Liocranchia reinhardti* (Steenstrup, 1856) and *Alloposus mollis* Verrill, 1880. The species are described and illustrated in the present report.

INTRODUCTION

Cephalopoda living in oceanic water include the *Nautilus* and some members in the order Sepiida, Teuthida and Octopoda. The living Sepiida consists of one oceanic species, *Spirula spirula*. The Teuthida comprises the entirely neritic Myopsida and the oceanic Oegopsida. A number of octopod species are found living in the bottom of the deep oceans.

There are about 200 species of oceanic squids belonging to 28 families known to occur in the world oceans (Worms, 1983). Of these, the Oegopsida constitutes a majority of the oceanic squids and has recently been divided into twenty six families (Clarke and Trueman, 1988). These are oceanic squids seldom found over the shelf or near coasts. All oceanic squids spend their entire life span in the open ocean.

Several species of the oceanic squids support the major cephalopod fisheries to the world (Roper *et al.*, 1984). Eventhough the oceanic squids are commercially exploited elsewhere, the knowledge of these resources in Thailand are poorly known. Only five species of cephalopods living in the open sea in Thai waters have been recorded, *i.e.* *Spirula spirula* (L., 1758); (Sithigornkul, 1974); *Thysanoteuthis rhombus* Troschel, 1857 (Nateewathana & Hylleberg, 1989); *Abralia armata* (Quoy & Gaimard, 1832) and *Stenoteuthis oualaniensis* (Lesson, 1830) (Chotiyaputta *et al.*, 1992) and *Nautilus pompilius* L., 1758 (Sawata and

Phongsuwan, 1994). An intensive investigation of the oceanic cephalopods in Thai waters, especially in the Thai Exclusive Economic Zone and contiguous areas is needed in order to increase the knowledge on valuable fisheries resources in the country.

MATERIALS AND METHODS

The materials examined were obtained from the training vessel, M.V. Paknam of the Southeast Asian Fishery Development Center operated off the Andaman Sea coast of Thailand during March, 1989. A deep sea bottom trawl was launched to the sea bed at depth 300-500 m. between Latitude $06^{\circ} 45.7' N$, $-07^{\circ} 34.4' N$, and Longitude $97^{\circ} 44.4' E$ - $98^{\circ} 11.2' E$ (Fig.1).

The collected material was fixed in 10% formalin and transferred to 75% ethyl alcohol for permanent storage. Fixation, preservation, and curation of cephalopods were done as described by Roper and Sweeney (1983).

Species description, measurements, counts, indices and abbreviations are in accordance with Roper & Voss (1983). Measurements and abbreviations are summarized and given in Table 1. Indices are expressed as percentage of dorsal mantle length and are denoted by the final initial I, *e.g.* HWI = HW/MLx100. The described specimens are deposited in the Reference Collection of Phuket Marine Biological Center, P.O. Box 60, Phuket 83000, Thailand.

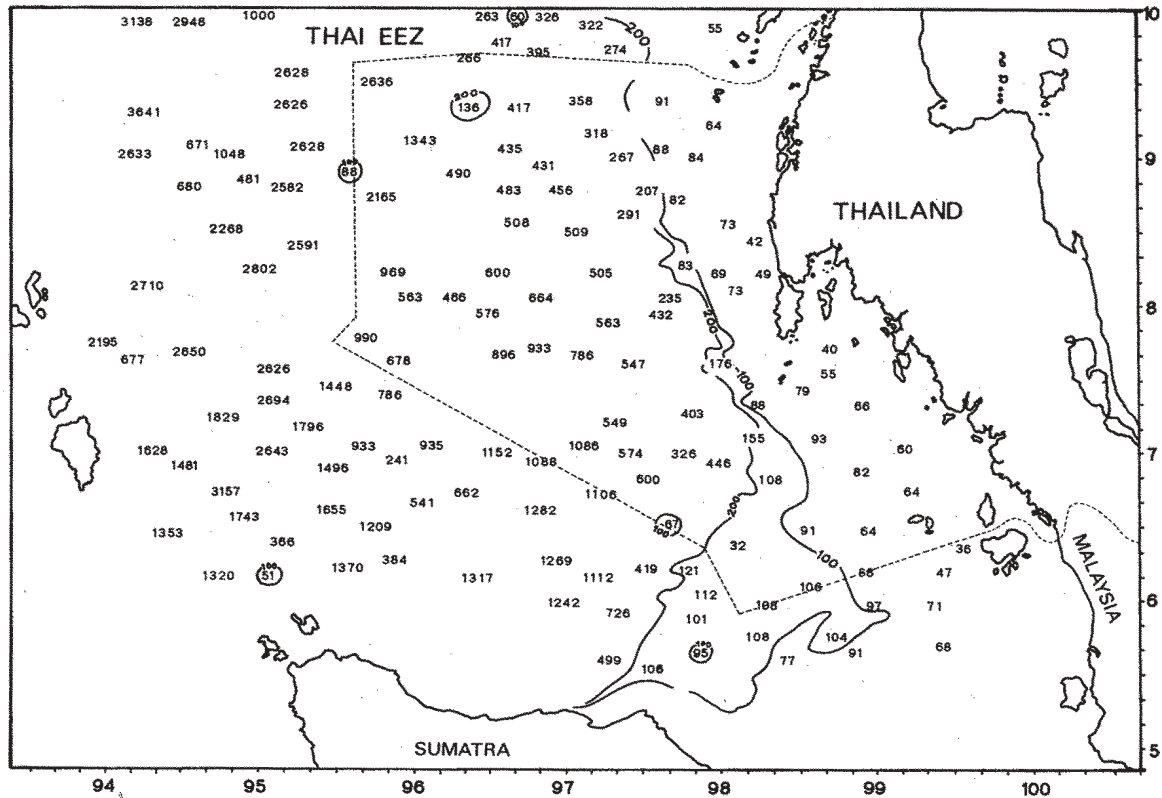


Figure 1. Map of the Thai Exclusive Economic Zone (EEZ) in the Andaman Sea.

Table 1. Specification of measurements and indices.

ML	<i>Mantle Length:</i>	dorsal mantle length, measured from the anteriormost point of the mantle to the posterior tip.
MW	<i>Mantle Width:</i>	greatest mantle width
HL	<i>Head Length:</i>	measured from the junction of the first pair of arms to the anterior end of the nuchal cartilage.
HW	<i>Head Width:</i>	greatest head width, measured across the eyes.
FL	<i>Fin Length:</i>	greatest length of fins, measured in the midline.
FW	<i>Fin Width:</i>	greatest width across both fins.
AL	<i>Arm Length:</i>	(AL _{I,II,III,IV}) arm length, of each right arm measured from the base of the first proximal sucker to tip of arm.
TtL	<i>Tentacle Length:</i>	total length of tentacular stalk and club.
CIL	<i>Club Length:</i>	length of right tentacular club from the proximal most carpal sucker to the club tip.

RESULTS

A total of 8 species of the oceanic cephalopods were collected during the present study but a species, *Sthenoteuthis oualaniensis*, has been recorded in Thai waters (Chotiyaputta *et al.*, 1992). Therefore, the present report will describe only 7 species of the oceanic cephalopods.

Subclass Coleoidea Bather, 1888
Order Teuthida Naef, 1916
Suborder Oegopsida Orbigny, 1845

Family Enoploteuthidae Pfeffer, 1912
sensu Young *et al.*, 1992.

Family characters: Straight locking apparatus, biserial armature on arms with hooks and/or suckers, tetraserial armature on the tentacular club sometimes with hooks on manus, photophores, eight buccal lappets, buccal connectives attached to the dorsal margins of Arm IV.

Genus *Abralia* Gray, 1849

Generic characters: Fins extend to posterior end of mantle; club with 1 row of hook and 2 rows of suckers; ocular photophores of various sizes; enlarged photophores absent at tips of arm IV.

Abralia (Asteroteuthis) andamanica Goodrich,
1896
(Fig. 2, a-g; Table 2)

Abralia andamanica -Goodrich, 1896:9, pl.2, figs. 38-45; -Massy, 1916:239-241; -Sasaki, 1929:242-245, pl. xxi, figs. 6-8; textfig.123.

Asteroteuthis andamanica -Pfeffer, 1912:137

Abralia (Asteroteuthis) andamanica G. Voss,
1963:99-105, figs. 20 & 21.

MATERIAL EXAMINED:

PMBC no.11593. 1 female. Lat. 07° 03'.7 N, Long. 98° 11'.2 E. Bottom trawled. Depth 240 m. M.V. Paknam. 17 March 1989.

PMBC no.11591. 1 female. Lat. 06° 45'.7 N, Long. 97° 57'.8 E, Bottom trawled. Depth 342 m. M.V. Paknam. 20 March 1989.

PMBC no.11592. 1 female. Lat. 06° 41'.7 N, Long. 97° 58'.2 E. Bottom trawled. Depth 342 m. M.V. Paknam. 20 March 1989.

DESCRIPTION:

Colour in alcohol yellow; dorsal and ventral surface of mantle, head and arms evenly covered with small, numerous brown to dark maroon photophores; fins devoid of photophores; the gladius shows through the mantle dorsally as a dark line.

Mantle (Fig.2,a-b) slender; widest at anterior margin, tapering gradually to a point posteriorly; median antero-dorsal lobe slightly pronounced; ventral anterior margin emarginated.

Fins large, FLI = 50-64, FWI = 74-90; anterior margin convex; lateral lobes rather sharply pointed; posterior margin concave, united posteriorly to a long slender pointed tip.

Head short, slightly wider than long, dorsoventrally flattened. Eyes large and prominent, covered with eyelids; five photophores present ventrally on eyeball, the anterior and posterior ones large and conspicuous, the other three in the middle smaller and rounded (Fig. 2, d).

Funnel stout, bluntly tapered anteriorly; funnel organs with prominent inverted v-shaped dorsal pad and stout oval ventral pads; funnel and mantle locking cartilage simple, straight groove and ridge.

Arms moderately long, unequal, in the order of II,IV,III,I. Arm I and II squarish, stout, slender tip, with prominent keeled on distal two-thirds. Arm III stout flattened, slender tip, and with a distinct aboral keel for its entire length. Arms I-III with well-developed protective membranes. Arm IV trapezoidal in section, and no keel. Two rows of strong, compact hooks, numbering 12-15 hooks on each arm, present proximally two-thirds on all arms (Fig.2, c), and one-third distally followed by 12 to 14 small oval and rounded suckers (Fig.2, g).

Hectocotyliised arms could not be examined since no male specimens were available.

Tentacles long and slender, slightly flattened (Fig.2, e) with small expanded club. Club dactylus considerably longer than manus. Dactylus with three long, slender curved hooks and two irregularly rows of suckers. Manus with four rows of small suckers. Suckers with two rows of small conical teeth (Fig.2, f)

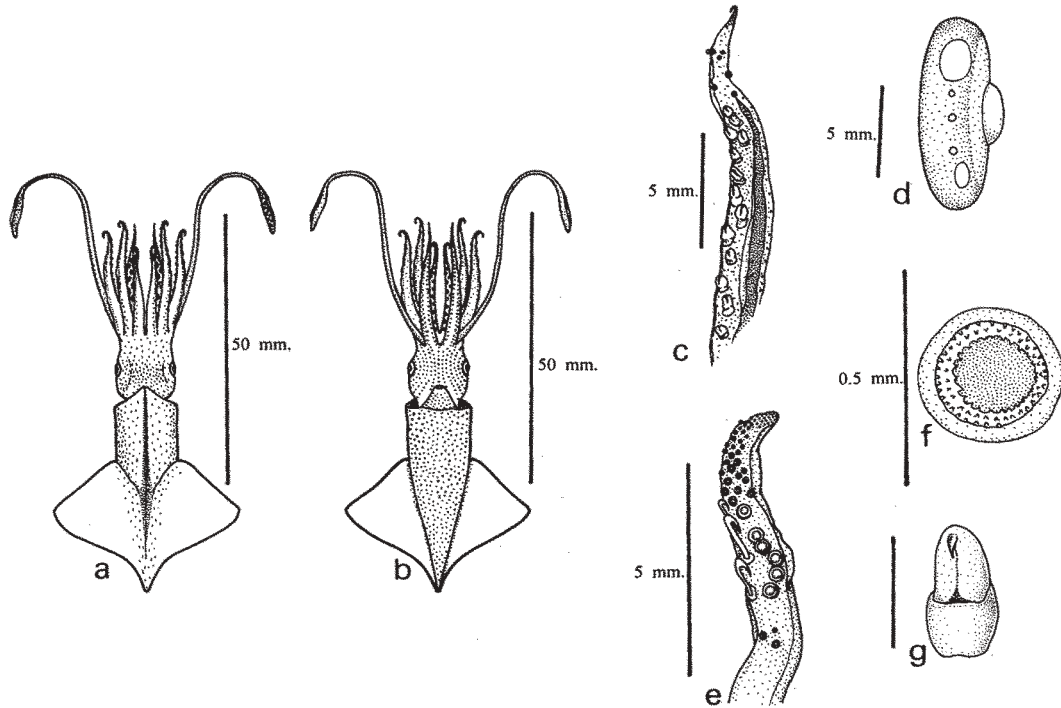


Figure 2. *Abralia (Asteroteuthis) andamanica*. a, dorsal view. b, ventral view. c, right ventral arm. d, eye. e, tentacular club. f, club sucker. g, arm hook.

Table 2. Means, standard deviations and ranges of selected measurements and indices (in percent) of *A. (Asteroteuthis) andamanica* from the Andaman Sea, Thailand.

Index	n	mean	s.d.(n-1)	Range
ML(mm)	3	37.2	5.2	32.0-43.0
MWI	3	30.8	6.5	24.8-37.7
HLI	3	27.0	2.6	24.2-29.4
HWI	3	26.5	7.8	18.2-33.9
FLI	3	56.3	6.7	50.4-63.6
FWI	3	83.9	8.4	74.3-90.2
AL _I I	3	46.1	2.9	43.7-49.3
AL _{II} I	3	52.4	2.7	49.3-54.3
AL _{III} I	3	48.1	1.5	46.5-49.4
AL _{IV} I	3	51.9	5.2	47.9-57.8
TtLI	3	118.1	22.8	97.0-142.3
CILI	3	14.4	4.3	11.0-19.2

GEOGRAPHICAL DISTRIBUTION: Tropical Indo-Pacific from the Arabian Sea and the Seachelles to southern Japan, the Hawaiian

Islands, and eastern Australia. The species lives in the midwater (epipelagic and mesopelagic) of the open ocean and near slopes, including bathyal.

New record of oceanic squids from Thai waters

REMARKS: The description of *Abralia (Astero-teuthis) andamanica* from the Andaman Sea coast of Thailand agrees well with the earlier descriptions. However, Voss (1963) stated that this species may be separable into several subspecies throughout its range. It has been attempted to investigate some morphometrical variabilities and other biological characters of the species (Kubota, *et al.*, 1982).

According to Nesis (1987), the species can be split into several indistinctly isolated forms, two of which have been formally described: *A. andamanica* f. *andamanica* and *A. andamanica* f. *robsoni*. The first is characterized by having photophores on ventral side of head arranged in longitudinal rows and a longitudinal stripe free of photophores is usually conspicuous in center of ventral side of mantle. The latter comprises of photophores on ventral side of head arranged diffusely, usually no stripe free of photophores in center of ventral side of mantle. The present specimens is similar to the latter species.

Abralia (Stenabralia) lucens G. Voss, 1963
(Fig.3,a-g; Table 3)

Abralia (Stenabralia) lucens -G. Voss, 1963:105-111, figs.22 & 23

MATERIAL EXAMINED:

PMBC no.11595. 4 specimens, 1 male and 3 females. Lat. 07° 03'7 N, Long. 98° 11'2 E. Bottom trawled. Depth 240 m. M.V. Paknam. 17 March 1989.

DESCRIPTION:

Colour in alcohol yellow creamed; dorsal mantle with sparse photophores, more dense along the midline between gladius. Ventral mantle with numerous and conspicuous photophores arranged somewhat in longitudinal rows; head covered with dense photophores dorsally and five distinct longitudinal rows of photophores ventrally; funnel with sparse photophores; arms covered with a few scattered photophores dorsally and three longitudinal rows along the edge of the ventral arms; a cirlet of photophores present around each eye.

Mantle (Fig.3, a-b) long and slender, tubular anteriorly and about 1/3 posteriorly, slightly tapering to a blunt tip at posterior end; median anterodorsal lobe low and rounded; ventral mantle margin slightly emarginated.

Fins short and fairly narrow, occupies about 46% of ML; anterior margins convex; lateral lobes pronounced and free; posterior margins slightly concave, continuous around apex of mantle.

Head moderately broad, wider than long, dorsoventrally flattened. Eyes small; eyelids very narrow. Eyeball with a row of eight photophores (Fig.3, c); from anterior to posterior end, the first photophore large, oval and white, the second to the fifth small, round, yellowish and of about equal size, the posteriormost similar to the first one. One minute round photophore present between the first and second, and one between the third and the fourth photophore.

Funnel strong, conical, tapering anteriorly and deeply set into the ventral surface of the head; funnel valve strong and well-developed; funnel organ inverted V shaped with broad lateral limbs, ventral pads large and oval; funnel and mantle locking cartilage simple, straight groove and ridge.

Arms long, order II.IV.III.I. Arm I shortest, slender with aboral keel on 2/3 of its entire length. Arm II dorsoventrally compressed, a ridge present on distal half of its length. Arm III dorsoventrally compressed, broad and well-developed swimming membrane present along the entire length. Arm IV strongly angled on ventromedian side and without keel. Arms bear eight to twelve pairs of hooks (Fig.3, f-g), arranged in two irregular rows terminating distally in two rows of about six pairs of small suckers and four rows of minute suckers at the tip.

Hectocotylised arm not presented in the present male specimen.

Tentacles short; stalks flattened, rectangular with moderately expanded clubs (Fig.3, d). Club with a group of 4-5 suckers on carpus, 6-7 hooks arranged in a row with 2 irregular rows of suckers on manus, 4 rows of minute suckers (Fig.3, e) on dactylus.

GEOGRAPHICAL DISTRIBUTION: The Philippines, Polynesia (Line Islands) and the Andaman Sea.

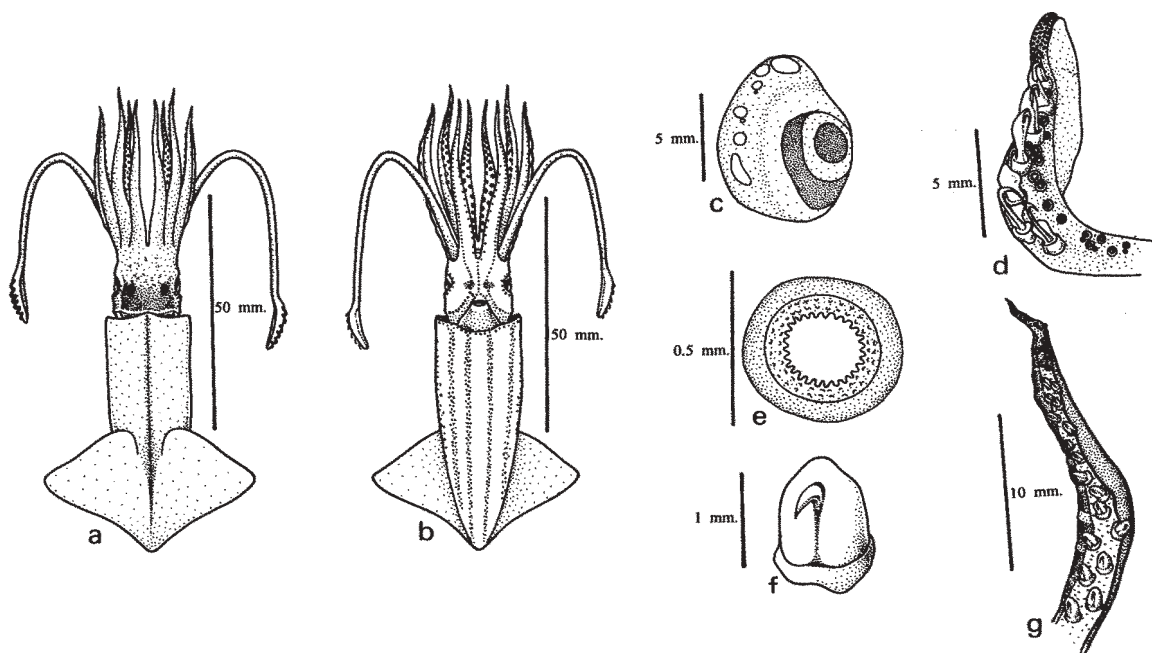


Figure 3. *Abralia (Stenabralia) lucens*. a, dorsal view. b, ventral view. c, eye. d, tentacular club. e, club sucker. f, arm hook. g, right ventral arm.

Table 3. Means, standard deviations and ranges of selected measurements and indices (in percent) of *A. (Stenabralia) lucens* from the Andaman Sea, Thailand.

Index	n	mean	s.d. (n-1)	Range
ML (mm)	4	44.1	5.9	36.5-50.4
MWI	4	40.1	7.2	30.7-46.5
HLI	4	31.1	3.9	25.5-34.1
HWI	4	21.2	2.7	17.5-23.6
FLI	4	46.5	6.9	36.2-50.6
FWI	4	73.3	11.7	56.2-82.1
AL _I	4	54.5	16.1	33.7-70.8
AL _{II}	4	67.2	15.3	44.6-78.1
AL _{III}	4	64.1	16.6	39.8-76.4
AL _{IV}	4	65.9	18.0	40.3-81.2
TILI	4	115.2	44.6	48.9-143.1
CILI	4	26.5	4.5	21.1-30.4

REMARKS: The material of *S. (Stenabralia) lucens* from the Andaman Sea coast of Thailand correspond with the original description (G. Voss, 1963). The species is only known from the Pacific

Ocean, the Philippines and Oceania. This is the first record of the species outside the type locality and the first record from the Indian Ocean.

Family Histiototeuthidae Verrill, 1881
sensu N. Voss et al., 1992.

Medium to large squid; mantle usually thick-walled, short and conical; head large with asymmetrical developed eyes, left eye usually much the larger; fins terminal, medium to large, transversely oval in combined outline, united posteriorly with median notch; fins may extend slightly posterior to free tip of mantle; photophores anteriorly directed, numerous, small, arranged roughly in diagonal rows on mantle, head, and aboral surfaces of arms, more concentrated on ventral surfaces; inner web connecting arms vestigial to in excess of 60% of length of arms; six- or seven-parted buccal membrane; suckers arranged in two rows on arms and usually 5-8 rows on tentacular club; tentacles long, carpal adhesive apparatus extends two to three club lengths down oral surface of stalk; both arms I usually hectocotylyzed in male.

The family is composed of one genus and 13 currently recognized species.

Genus *Histiototeuthis* Orbigny, 1841

Family is monotypic; generic diagnosis are as given for family.

Histiototeuthis celetaria pacifica (G. Voss, 1962)
 (Fig.4,a-b; Table 4)

Calloteuthis celetaria pacifica -G. Voss, 1962: 174;
 -1963: 199, fig. 26; - Clarke, 1966:197

Histiototeuthis celetaria pacifica -N. Voss, 1969:767-
 773, figs, 4 h-i; 5 d; 7 e; 16; 17; -N. Voss *et al.* 192:80

MATERIAL EXAMINED:

PMBC no. 11186. 14 specimens. Lat. 06° 49'.7 N,
 Long. 97° 53'.8 E. Bottom trawled. Depth
 317 m. M.V. Paknam. 20 March 1989.

PMBC no. 11185. 11 specimens. Lat. 07° 01'.79
 N, Long. 97° 53'.89 E. Bottom trawled.
 Depth 340 m. M.V. Paknam. 19 March
 1989.

PMBC no. 11184. 13 specimens. Lat. 06° 41'.7 N,
 Long. 97° 58'.2 E. Bottom trawled. Depth
 342 m. M.V. Paknam. 20 March 1989.

PMBC no. 11183. 2 specimens. Lat. 07° 34'.4 N,
 Long. 97° 44'.4 E. Bottom trawled. Depth
 400 m. M.V. Paknam. 19 March 1989.

DESCRIPTION:

Colour in alcohol brownish with purple-red photophores distributed over mantle, head and arms. Numerous large photophores arranged in seven diagonal rows on ventral surface of mantle, and smaller photophores on dorsal mantle and head. Two rows of photophores on arms I, II and III. Arm IV with three rows of large photophores with only median row extending to tip.

Mantle (Fig.4, a-b) conical, moderately elongate, cylindrical anteriorly about 1/3 of ML and slightly tapering to blunt posterior tip; median antero-dorsal lobe slightly pronounced; ventro-lateral lobes blunt; ventral mantle margin slightly emarginated.

Fins large, oval in outline, occupy 35-46% of mantle length, width greater than length (FWI=39-58, Table 4); posterior border slightly extended beyond the mantle tip, with shallow median notch.

Head large, slightly narrower than mantle width. Eyes asymmetrical, with left eye about twice as large as right; two strong nuchal folds on either side of head; olfactory crest strongly curved dorsally.

Funnel strong, conical anteriorly; funnel valve large and semicircular; dorsal funnel organ, inverted v-shaped, ventral pads ovoid and stout; funnel locking cartilage broad with deep median groove.

Arms unequal, in the order of II.III.IV. Arms I and II with low, aboral keels on terminal third. Arm III with swimming keel originates proximally and reduces to ridges at about midarm to distal tip. Low protective membranes present orally along the margins in all arms. Biserial suckers in all arms. Suckers approximately uniform in size on proximal 2/3 and abruptly reduces to minute to distal tip. Suckers on Arm IV, about 1/3 smaller than on other arms. No sign of hectocotylyzation on dorsal arms of mature male.

Tentacles long, slender with expanded club. Swimming keel arises posteriorly on the aboral angle of the club at about 1/2 of the club length. Low protective membrane present along its margin. Club with 6-7 rows of large suckers on

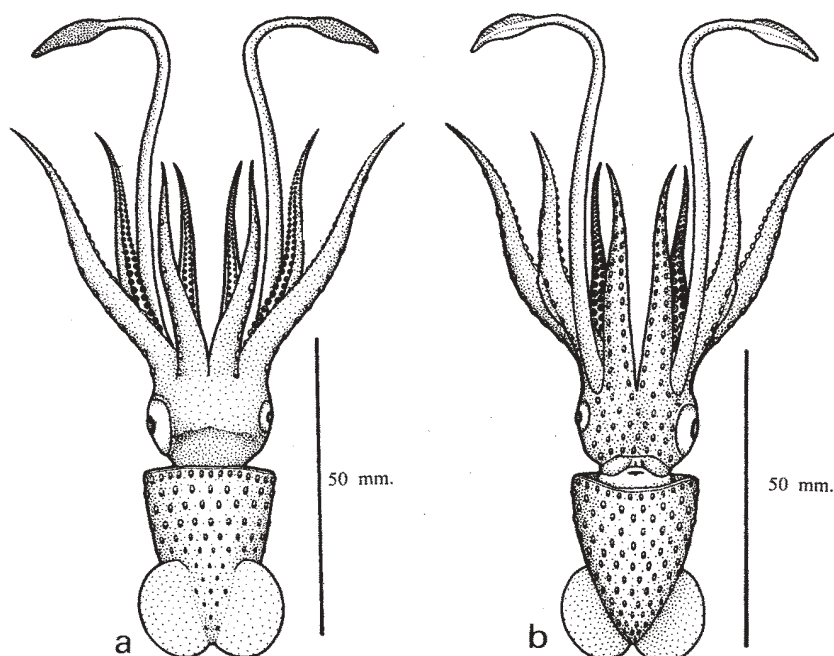


Figure 4. *Histioteutis celetaria pacifica*. a, dorsal view. b, ventral view.

Table 4. Means, standard deviations and ranges of selected measurements and indices (in percent) of *H. celetaria pacifica* from the Andaman Sea, Thailand.

Index	n	mean	s.d. (n-1)	Range
ML (mm)	10	75.8	20.9	38.7-108.3
MWI	10	51.6	7.7	42.1-65.6
HLI	10	41.5	7.4	29.7-51.9
HWI	10	36.0	3.0	32.0-40.4
FLI	10	39.9	3.9	35.0-46.4
FWI	10	53.1	7.1	39.4-58.2
AL _I I	10	126.2	20.9	93.5-162.1
AL _{II} I	10	135.2	25.3	105.3-164.8
AL _{III} I	10	128.9	21.9	97.4-172.4
AL _{IV} I	10	122.0	21.2	87.0-165.5
TtLI	3	301.1	41.6	255.4-336.7
CILI	3	33.0	5.4	29.4-39.2

manus and small suckers on dactylus; large median suckers with about 28-32 pointed teeth on horny ring; carpal suckers present in a row on oral surface of stalk.

GEOGRAPHICAL DISTRIBUTION: In Pacific, widespread in equatorial and both tropical regions, from Hawaii, and Indo-Pacific. In Indian Ocean

known from off Northwestern Australia (abundant) and off Madagascar (N. Voss *et al.*, 1992).

REMARKS: Family Histioteuthidae has been revised by G. Voss (1963). A complete synonymy, full description and discussion of the species affinities of the genus are given.

Family Ommastrephidae Steenstrup, 1857
sensu Wormuth *et al.*, 1992.

Family characters: Inverted -T funnel locking cartilage; lateral funnel adductor; 2 rows of suckers on arms; 4 rows of suckers on tentacular club (except *Illex* with 8 rows on dactylus); photophores in some genera; fusion of funnel and mantle locking apparatus in some species.

Subfamily Todarodinae

Genus *Nototodarus* Pfeffer, 1912

Generic characters: Both arms IV of males hectocotylyzed; funnel groove with foveola only; side pockets and light organs absent.

Nototodarus hawaiiensis (Berry, 1912)

(Fig. 5, a-d; Table 5)

Nototodarus hawaiiensis -Berry, 1912:434,437;
 Wormuth, 1976:2,17-21, fig.3; -Dunning,
 1988:159-168.

MATERIAL EXAMINED:

PMBC no.11189. 5 specimens, 1 male, 4 females.
 Lat. 06° 49'.7 N, Long. 97° 53'.8 E.
 Bottom trawled. Depth 317 m. M.V.
 Paknam. 20 March 1989.

PMBC no.11188. 5 specimens, 5 females. Lat. 07°
 01'.79 N, Long. 97° 53'.89 E. Bottom
 trawled. Depth 340 m. M.V. Paknam. 19
 March 1989.

PMBC no. 11190. 3 specimens, 1 male, 2 females.
 Lat. 06° 45'.7' N, Long. 97° 57'.8 E,
 Bottom trawled. Depth 342 m. M.V.
 Paknam. 20 March 1989.

PMBC no.11187. 6 specimens, 2 males, 4 females.
 Lat. 07° 34'.4 N, Long. 97° 44'.4 E.
 Bottom trawled, Depth 400 m. M.V
 Paknam. 19 March 1989.

DESCRIPTION:

Colour in alcohol yellow cream; dorsal surface of mantle, head, and arms covered with scattered dark gray chromatophores; skin rough.

Mantle (Fig.5, a-b) moderately long, cylindrical anteriorly about 2/3 and tapering at about the level of fins to a conical tip; median antero-dorsal lobe long, round; ventral mantle margin excavated.

Fins small, wider than long, occupy about 35% of ML; anterior margins convex; lateral lobes pointed; posterior margins slightly concaved to a narrow posterior point.

Head stout, as broad as mantle; dorsoventrally flattened; three large olfactory crests present on posterior margin. Eyelid large, with a deep distinct sinus on the anteroventral border.

Funnel stout, tapering anteriorly; funnel valve subterminal, rectangular and well-developed; dorsal funnel organ sharply inverted v-shaped with oval ventral pads. Funnel groove with foveola (Fig.5, d), no longitudinal ridges. Locking apparatus inverted T-shaped (Fig.5, c), with a deep median pit and longitudinal groove.

Arms moderately long, unequal, in order of III.II.IV or II.III.IV. Arm I long and slender, low keel present on basal. Arm II slightly dorsoventrally flattened, with low keel. Arm III stout, with keel and with a deep triangular swimming membrane. Arm IV trapezoidal in section, keel present. Biserial suckers in all arms. Arm sucker rings toothed with about 20 teeth all around; proximally, teeth are flattened broad platelets that grade distally into sharp, pointed teeth, the distal central tooth much enlarged, pointed and curved.

Both Arms IV in males hectocotylysed basally by protective membranes and trabeculae modified into thick, saw-like processes; right arm further modified to tip by greatly reduced suckers and stalks enlarged, closely set, comblike.

Tentacles short and stout (Fig.5, e). Tentacular club long, occupy about 60% of ML; carpal area indistinct; about 12 median manal suckers 3 or 4 times larger than marginal suckers, with 14 to 18 large, sharp teeth, the central one enlarged.

GEOGRAPHICAL DISTRIBUTION: Hawaiian Islands to Midway Island (Berry, 1912; Wormuth, 1976), South China Sea (Dong, 1963), northern Australia (Dunning, 1988) and the Andaman Sea.

REMARKS: The genus *Nototodarus* Pfeffer, 1912 is characterized by having the simple foveola in the funnel groove, absence of light organs and hectocotylyzation of both ventral arms in males. Six nominal forms of the genus *Nototodarus* have

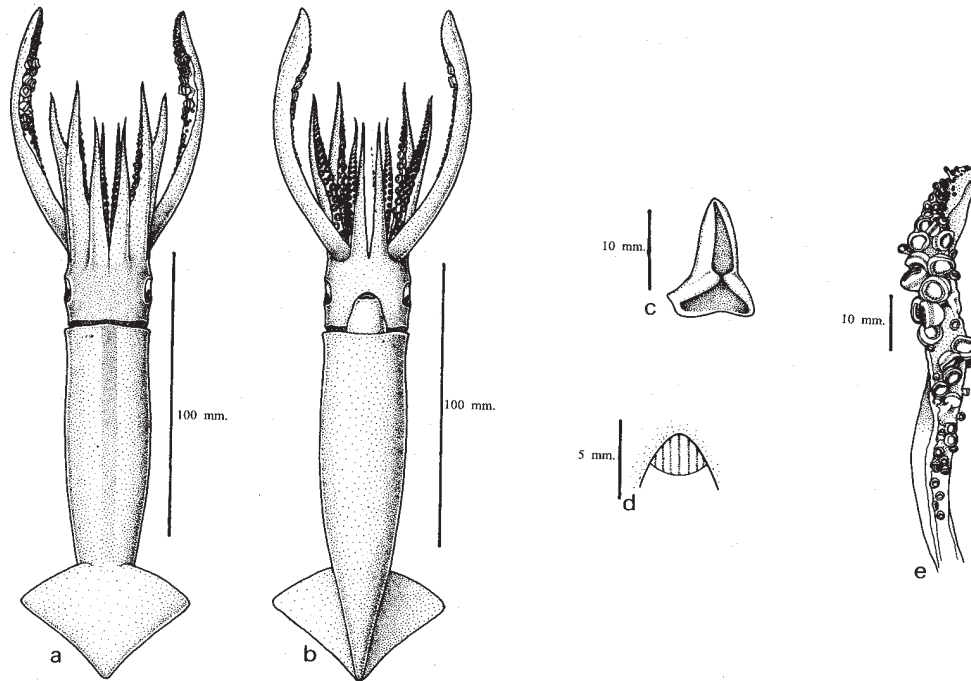


Figure 5. *Nototodarus hawaiiensis*. a, dorsal view. b, ventral view. c, funnel locking cartilage. d, foveola. e, tentacular club.

Table 5. Means, standard deviations and ranges of selected measurements and indices (in percent) of *N. hawaiiensis*, from the Andaman Sea, Thailand.

Index	n	mean	s.d. (n-1)	Range
ML (mm)	10	85.5	21.0	61.9-115.9
MWI	10	34.2	5.4	26.5-39.8
HLI	10	28.3	4.3	24.9-33.6
HWI	10	22.0	1.5	19.9-24.4
FLI	10	34.8	5.0	27.0-41.2
FWI	10	56.8	6.0	50.6-67.7
AL _I I	10	51.2	11.7	30.0-66.9
AL _{II} I	10	60.7	8.9	47.0-75.7
AL _{III} I	10	61.5	7.8	50.9-74.1
AL _{IV} I	10	47.3	8.1	34.8-58.6
TtLI	10	95.2	8.7	85.0-110.1
CILI	10	63.3	5.3	56.4-71.1

been described from continental shelf and slope waters of the Indo-Pacific region (Dunning, 1988), i.e. *N. gouldi* (McCoy, 1888), *N. hawaiiensis* (Berry, 1912), *N. nipponicus* Okutani and Uemura, 1973, *N. insignis* (Gould, 1852), *N. sloanii* (Gray,

1849) and *N. philippinensis* Voss, 1962. The species identity of *Nototodarus* have been revised in some areas, especially in New Zealand and Australian waters (Kawakami and Okutani, 1981; Smith *et al.*, 1987; Dunning, 1988). In 1985,

Okutani and Koroïwa considered *N. nipponicus* to be a junior synonym of *N. philippinensis*. Smith, *et al.*, (1987) considered *N. sloanii* and *N. gouldi* to be distinct species, as well as *N. hawaiiensis* and *N. philippinensis* (Dunning, 1988).

Two species of *Nototodarus*, *N. sloanii* and *N. gouldi*, are reported in the Indian Ocean (Silas, *et al.*, 1986). The present species, *N. hawaiiensis* is a new record in the Indian Ocean. The specimens have been compared with the specimens from the Australian waters by Dr C.C. Lu of the Victorian Museum (pers comm.).

**Family Chiroteuthidae Gray, 1849
sensu Roper and Sweeney, 1992.**

Family characters: Funnel locking-cartilage oval with one or two inward projecting knobs (ventral tragus and posterior antitragus); arms with 2 rows of suckers; tentacles very long, slender with suckers in 4 rows; buccal connectives attach to ventral borders of arms IV; photophores usually present (may be on eyes, ventral arms, tentacles, viscera); fins together round or oval; secondary fin may be present.

Genus *Chiroteuthis* Orbigny, 1839

Generic characters: Fins together approximately circle-shape, not lobed posteriorly; arms IV usually much thicker than arms II and III; funnel valve present; distinct tragus present on funnel locking-apparatus.

Chiroteuthis (Chirotauma) imperator Chun, 1908
(Fig. 6,a-b; Table 6)

Chiroteuthis (Chirotauma) imperator -Massy, 1916:243-244; -Sasaki, 1929: 305-308, pl. 24, figs.9,10, textfig.142; -Voss 1963:136-140, fig.30,a.

MATERIAL EXAMINED:

PMBC no. 11179. 13 specimens. Lat. 06° 49'.7 N, Long. 97° 53'.8 E. Bottom trawled. Depth 317 m. M.V. Paknam. 20 March 1989.

PMBC no. 11181. 3 specimens. Lat. 07° 01'.79 N, Long. 97° 53'.89 E. Bottom trawled.

Depth 340 m. M.V. Paknam. 19 March 1989.

PMBC no. 11182. 16 specimens. Lat. 06° 41'.7 N, Long. 97° 58'.2 E. Bottom trawled. Depth 342 m. M.V. Paknam. 20 March 1989.

PMBC no. 11180. 4 specimens. Lat. 07° 34'.4 N, Long. 97° 44'.4 E. Bottom trawled. Depth 400 m. M.V. Paknam. 19 March 1989.

DESCRIPTION:

Colour yellow, gelatinous and translucent. Mantle (Fig.6,a-b) thick, slender, cylindrical at about anterior one-fourth, tapering at the anterior margin of fins to a tubular and spindle shape at posterior end; median antero-dorsal lobe markedly pronounced; ventral mantle margin slightly emarginated.

Fins circular in shape, thick, fleshy and joined together along the mid-dorsal line, length from 37-50% of ML, slightly longer than wide.

Head long, narrow, about one-third of ML, deeply convex ventrally; neck long and slender; funnel groove absent. Eyes large. Eyeball oval with three longitudinal rows of photophores or light organs, 6 organs on the ventralmost, 9-10 on the middle and 7-8 on the dorsal row.

Funnel small, inconspicuous and opening on the ventral side; dorsal funnel organ inverted v shaped; ventral pads oblong; nuchal cartilage oval, about twice as long as wide, provided with small triangular tragus and conspicuous round-headed conical antitragus.

Arms unequal, in order of IV.III.II.I. Arm I somewhat squarish in cross-section, with narrow protective membrane and distinct only in its distal part. Arm II equilateral triangle in cross-section, with rounded lateral surfaces and more developed protective membrane. Arm III squarish in cross-section, equipped with a low thick fleshy keel and well developed protective membranes. Arm IV quadragular in cross-section, flattened on the outer surface, sharp-edged on the ventrolateral margin, protective membranes distinct and well developed. All arms possess biserial suckers. Suckers subglobular, gradually decreasing in size to distal tips. Ring suckers with entire on the proximal half and 9-16 squarish teeth on the distal half.

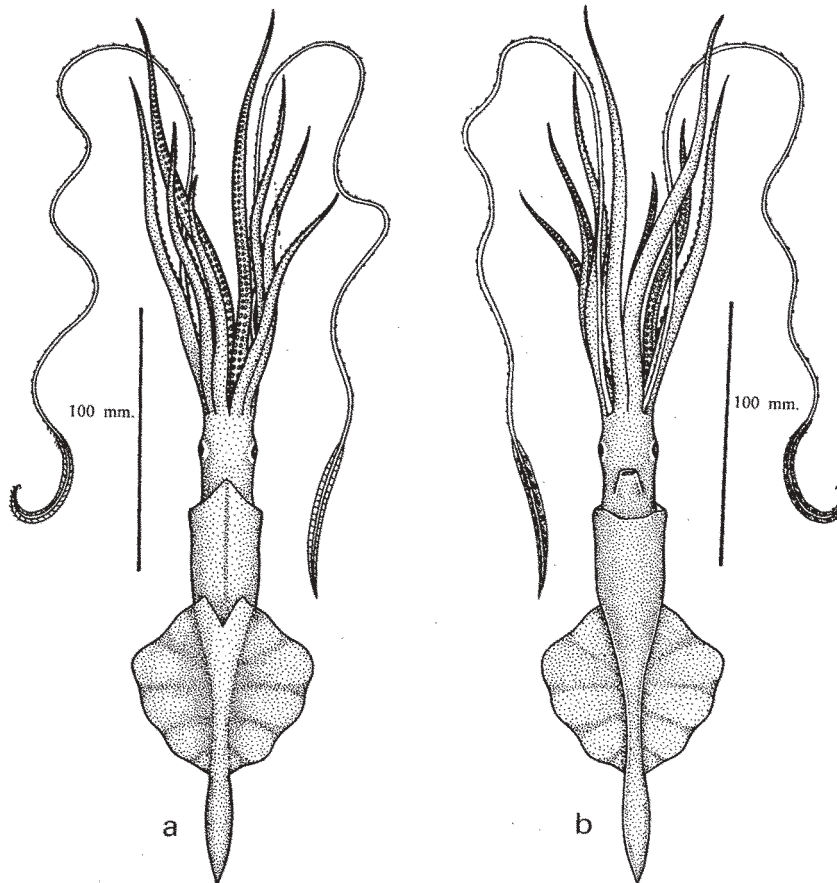


Figure 6. *Chiroteuthis (Chirotauma) imperator*. a, dorsal view. b, ventral view.

Table 6. Means, standard deviations and ranges of selected measurements and indices (in percent) of *Chiroteuthis imperator* from the Andaman Sea, Thailand.

Index	n	mean	s.d. (n-1)	Range
ML (mm)	10	135.7	29.6	76.5-170.0
MWI	10	15.3	1.0	14.4-17.1
HLI	10	34.9	9.1	27.6-55.4
HWI	10	8.8	1.3	7.2-11.5
FLI	10	44.4	3.9	37.4-50.4
FWI	10	40.9	5.1	33.1-48.7
AL _I I	10	55.8	9.3	40.6-67.6
AL _{II} I	10	71.3	9.1	58.4-82.5
AL _{III} I	10	81.8	8.9	72.0-94.1
AL _{IV} I	10	131.4	26.3	97.1-173.6
TtLI	10	273.1	162.0	133.7-522.9
CILI	2	104.3	5.8	100.2-108.5

New record of oceanic squids from Thai waters

Tentacles long, cylindrical, about twice as long as mantle; stalks slender, attenuated distally, with narrow club. A broad protective membrane bordered the club for its entire length. Club suckers arranged in four rows, gradually decreasing in size distally. Ring suckers with entire proximally, and about 10 teeth distally of which the median one is very large. About 39-49 oval photophores present on the aboral surface of the tentacular stalk.

GEOGRAPHICAL DISTRIBUTION: Tropical Indo-West Pacific from the Gulf of Aden to southern Honshu, Indonesia and Hawaii. Mesopelagic and bathyal.

REMARKS: As pointed out by many authors, there is strong possibility that *C. imperator* and *C. macrosoma* Goodrich, 1896 are synonyms of *C. picteti* Joubin, 1894 (Voss, 1963; Clarke, 1966; Kubota, *et al.* 1981). However, no conclusive comments have not yet been made public up to this date. Only Nesis (1987) has given the synonyms of these three species in the species identification key (p. 249). The present report, therefore, is still remain the original name.

Family Cranchiidae Prosch, 1849
sensu N. Voss *et al.*, 1992

Family characters: Mantle thin-walled, fused to head at nuchal region and to funnel at posterolateral corners; fins vary from separate, small, paddle-shaped, subterminal, to medium-large, round, terminal, to ovate or lanceolate, terminal or terminal-lateral; funnel moderately large to very large; head short; eyes small to large with photophores; arms short to medium length, with suckers in two rows, except on portions of secondarily modified arms of males; tentacles with 2 rows (except in *Teuthowenia*, with 4 rows) of carpal suckers on major portion of stalk; tentacular club suckers in 4 rows, hooks appear with growth in *Caliteuthis* and *Mesonychoteuthis*.

Genus *Liocranchia* Pfeffer, 1884

Generic characters: Stout, spindle shape mantle; inverted v shape, moderately long, tubercular

cartilaginous strips at each funnel-mantle fusion point. 4-14 photophores, fins oval.

Liocranchia reinhardti (Steenstrup, 1856)
(Fig. 7 a-c; Table 7)

Liocranchia reinhardti -Pfeffer, 1912:667-673, pl.48, figs.1-3; -G. Voss, 1963:145-150, fig.32.

MATERIAL EXAMINED:

PMBC no.11175. 20 specimens. Lat. 06° 49' .7 N, Long. 97° 53' .8 E. Bottom trawled. Depth 317 m. M.V. Paknam. 20 March 1989.

PMBC no. 11176. 1 specimens. Lat. 07° 01' .79 N, Long. 97° 53' .89 E. Bottom trawled. Depth 340 m. M.V. Paknam. 19 March 1989.

PMBC no.11177. 13 specimen. Lat. 06° 45.7' N, Long. 97° 57' .8 E, Bottom trawled. Depth 342 m. M.V. Paknam. 20 March 1989.

PMBC no. 11178. 8 specimens. Lat. 07° 34' .4 N, Long. 97° 44' .4 E. Bottom Trawled. Depth 400 m. M.V. Parknam. 19 March 1989.

DESCRIPTION:

Colour in alcohol white and translucent. Mantle (Fig.7, a-b) elliptical, spindle-shaped, tapers posteriorly to narrow point; wall thin and leathery; a row of small tubercles present on dorsal mantle along the midline of gladius; ventral mantle with two moderately long cartilaginous strips diverge from apex of funnel-mantle fusion in inverted v-shape.

Fins large, oval, almost circular in combined outline unite posterior to end of gladius, with slight indentation in the midline.

Head broad and round. Eyes prominent, with about 14 irregularly round to oval photophores around the eyeball; eyelids very small and round.

Funnel large, broad base, tapered anteriorly and reaching to beyond anterior margin of the eyeballs; free in its anterior third; funnel valve medium to large size. Dorsal funnel organ inverted v-shaped with three longitudinal, broad, triangular flaps; ventral pads large, stout, crescent shaped.

Arms short, unequal in the order of III.IV.III.I. Arms I-III connected basally by medium depth

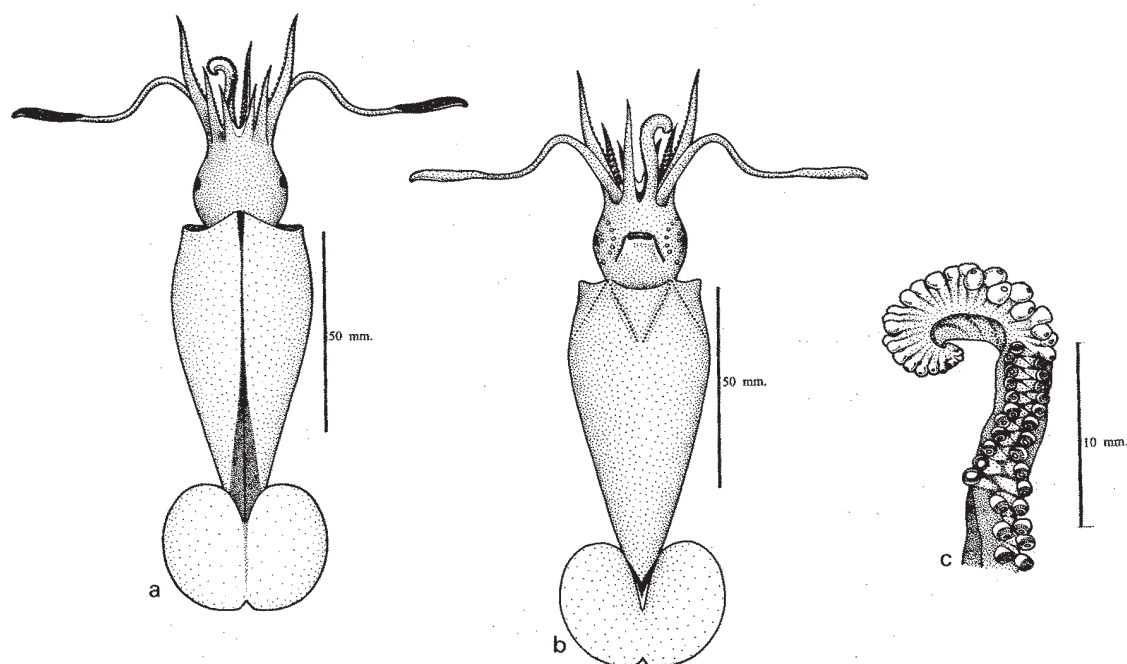


Figure 7. *Liocranchia reinhardti*. a, dorsal view. b, ventral view. c, left ventral arm.

Table 7. Means, standard deviations and ranges of selected measurements and indices (in percent) of *L. reinhardti* from the Andaman Sea, Thailand.

Index	n	mean	s.d. (n-1)	Range
ML (mm)	10	81.5	14.2	64.3-102.8
MWI	10	41.9	5.9	35.6-52.7
HLI	10	17.6	3.6	13.8-26.0
HWI	10	10.9	3.3	7.8-19.4
FLI	10	31.2	5.1	26.9-44.6
FWI	10	36.5	4.9	30.7-48.1
AL _I	10	10.1	2.7	8.1-16.2
AL _{II}	10	16.5	4.4	11.5-26.7
AL _{III}	10	27.0	11.3	19.3-44.3
AL _{IV}	10	22.3	7.2	14.7-33.3
TtLI	10	78.5	10.0	64.1-90.0
CILI	10	13.1	0.9	12.4-14.3

web. Aboral keel absent on Arm I and II, present on Arm III; lateral keel present on IV; well developed trabeculate protective membrane present on both margins of all arms. Biserial suckers present in all arms and cover nearly the entire length of the arm; sucker rings smooth to

slight pointed teeth on distal margin. Right or left arm IV (Fig. 7, c) modified into hectocotylus. Arm enlarged and elongate, with two rows of suckers basally, followed by single ventral row of enlarged fleshy suckers on laterally curved end.

New record of oceanic squids from Thai waters

Tentacles short, rounded stalk, with slightly expanded club. Carpal suckers in two rows alternating in pairs or singly with pads extending 1/2 to 2/3 length of stalk; carpal group present; on club, suckers largest on mid manus, rings with sharp, conical teeth around entire margin. Well developed trabeculate protective membrane on both margins, more highly developed ventrally; dorsal keel present on distal 1/2 to 2/3 of club.

GEOGRAPHICAL DISTRIBUTION: Circum-global tropical and subtropical waters. Surface to about 1,200 m.

REMARKS: *L. reinhardti* is a well defined species. The present specimens are in accordance with the earlier descriptions. A generic revision of the Cranchiidae has been made by N. Voss (1980).

Order Octopoda Leach, 1818
Suborder Incirrata Grimp, 1916
Family Alloposidae Verrill, 1880
sensu Hochberg et al., 1992

Family characters: Suckers uniserial proximally, biserial distal to edge of web; web deep between

all arms; body short, gelatinous, densely pigmented; mantle opening wide; funnel embedded in gelatinous tissue; radula heterodont; eyes large, diameter about 40% ML, hemispherical; entire right arm III hectocotylized, develops in pouch in front of eye, detachable; mantle locking-apparatus distinct, well developed; funnel organ w-shape; shell vestige absent. Monotypic.

Genus *Alloposus* Verrill, 1880

Generic characters: the same as family characters.

Alloposus mollis Verrill, 1880
 (Fig. 8, a-b)

Alloposus mollis -Robson, 1932: 215-217; -Thore, 1949:66-72, figs. 61-68

MATERIAL EXAMINED:

PMBC no. 11174. 1 specimen. Lat. 07° 01' .79 N, Long. 97° 53' .89 E. Bottom trawled. Depth 340 m. M.V. Paknam. 19 March 1989.

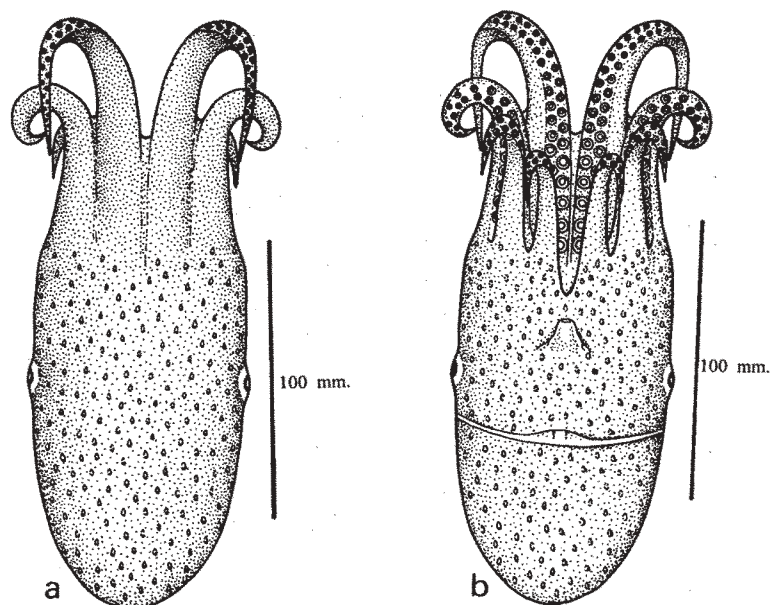


Figure 8. *Alloposus mollis*. a, dorsal view. b, ventral view.

DESCRIPTION:

Body is soft and very gelatinous, and as a result it is very easily torn and damaged. The present specimen, therefore, is not a good condition. Description of the species is tentatively given. However, the systematics, morphology and development has been described by Thore (1949).

Mantle (Fig.8, a-b) short, stout, and about as wide as long. Head broad, and the width about equal to the mantle width. Eyes large and prominent. Mantle aperture wide and the funnel organ w shaped. Arms rather long, subequal, in order of I.II.III.IV. All arms united by a deep web. Suckers arranged in a single row within the web, biserial at the border of the web and becoming uniserial near the distal tips of the arms.

GEOGRAPHICAL DISTRIBUTION: Cosmopolitan in tropical and subtropical waters.

DISCUSSION

The oceanic cephalopods in Thai waters are mainly restricted to the Andaman Sea. The water depth in the Gulf of Thailand is below 95 m. However, the Gulf of Thailand is connected to the deeper South China Sea. Records of oceanic cephalopods on the Pacific coast of Thailand, e.g. *Abralia armata* and *Thysanoteuthis rhombus* (Chotiyaputta *et al.*, 1992) might have occurred by chance. The first species was collected in a juvenile stage and might have been distributed to the Gulf by currents. *T. rhombus* is a pelagic species and can sometimes move to shallow water close to the shore. After recording *T. rhombus* in Thai waters (Nateewathana and Hylleberg, 1989), further specimens added to the PMBC Reference collection were mainly collected in the neritic zone.

As pointed out in the introduction, our knowledge of the oceanic cephalopods in Thai waters is limited. However, it may be useful to compare information from adjacent waters to the present study. The knowledge about the oceanic cephalopods of the Indian Ocean has been summarized and reported by Silas *et al.* (1986). They mentioned that 69 species of oceanic squids representing 43 genera of 13 families are reported from this region. From all the areas explored in the

Indian Ocean, the highest abundance of cephalopod larvae and juveniles were recorded in the Bay of Bengal area, in the Wadge Bank off Cape Comorin and between Quinlon and Cochin. Although a number of species occur in oceanic waters, their small size and unfavorable consistency make them unsuitable for human consumption but are important as forage to tunas, billfishes and toothed whales. Only a few species of oceanic squids are commercially and potentially important. They belong to the families Ommastrephidae, Enoploteuthidae, Thysanoteuthidae, Octopoteuthidae, Histioteuthidae, Veranyi-dae, Lepidoteuthidae, Onychoteuthidae, Gonatidae and Cranchiidae (Voss, 1973; Roper *et al.*, 1984). The following genera are important to the world fisheries: *Ommastrephes*, *Illex*, *Todarodes*, *Nototodarus*, *Sthenoteuthis*, *Thysanoteuthis* and *Onychoteuthis*. All of these genera, except *Illex*, are distributed in the Indian Ocean and species of these genera are dominant and approach the surface at night. According to Clarke (1966), a large majority of oegopsid species (about 90%) live shallower than 1,500 m and most extend into the photic zone at some time and, more than is generally supposed, enter water between the surface and 100 m. He also emphasized that all the ommastrephid squids which is the most important commercially family are found in the upper 100 m.

The Thai EEZ in the Indian Ocean includes a vast deep area reaching down to 2,000 m (Fig.1). The average depth is about 500-600 m. Eventhough only few species of the oceanic cephalopods has been recorded in Thai EEZ, some of these species have been reported to be exploited in other countries e.g. *Nototodarus hawaiiensis* (Australia), *Thysanoteuthis rhombus* (Japan), *Sthenoteuthis oualaniensis* (many countries in the Indo-Pacific region). It should be noted that *S. oualaniensis* were also collected in the present study but has not been included in this report, since it has already been recorded in Thai waters (Chotiyaputta *et al.*, 1992). Should the consumption of squid in Thailand increase to the point where other species must be utilized, the most productive species would be the oceanic squids. Intensive surveys and investigations combined with the development of new fisheries techniques should be carried out in the future.

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