

ON THREE NEW SPECIES OF OCELLATE OCTOPUSES (CEPHALOPODA: OCTOPODA) FROM THAI WATERS

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ABSTRACT

Ocellate octopuses are shallow-water cephalopod species characterized by the presence of a pair of dark false eye-spots (or ocelli) on the arm crown over the bases of second and third arms, one below each eye. Three new species of ocellate octopuses are reported from Thai territorial waters, both in the Gulf of Thailand (Pacific Ocean) and the Andaman Sea (Indian Ocean). The species are *Octopus rex*, *Octopus neglectus* and *Octopus siamensis* spp. nov. Morphological descriptions are provided, along with details of known distributions, life history and commercial exploitation.

INTRODUCTION

Despite the economic importance of octopus fisheries in Thailand, the systematics of the fauna is poor. Apart from Nateewathana (1997), no overview has previously been published on the octopodid fauna of the country. Since this publication, additional material has been collected from both the Gulf of Thailand and the Andaman Sea. This material confirms that the three ocellate octopus species, *Octopus ocellate* sp. A, B and C in Nateewathana (1997), are new to science. These species are described here.

MATERIALS AND METHODS

The majority of the octopodid material used in the present study derives from previous research (Nateewathana 1997). Additional material was collected from the Andaman coast and the Gulf of Thailand. The majority of the material was collected from Gulf waters, between Trat province on the East coast and Narathiwat province in the south.

Procedures for preservation, dissection, measurements, counts and curation are described in Nateewathana (1997). Characters for identification and measurements also follow Nateewathana (1997, Fig. 1A). The primary measurements and indices used here are presented in Table 1. Arms are numbered starting from the dorsal pair: I, dorsal; II dorso-lateral, III, ventro-lateral; IV, ventral. Web sectors are similarly named from the dorsal sector: A, between dorsal arms; B, dorsal to dorso-lateral arms; C, dorso-lateral to ventro-lateral arms; D, ventro-lateral to ventral arms; E, between ventral arms.

Type and other voucher material have been deposited in the Reference Collection of Phuket Marine Biological Center, Phuket, 83000, Thailand. Additional voucher material is lodged in the Fisheries Science Museum (FSM), Department of Fisheries, Bangkok 10900, Thailand.

Table 1. Specification of measurements and indices.

Mantle Length	ML	dorsal mantle length, measured from midpoint between eyes to posterior end of mantle.
Total Length	TL	measured from end of longest arm to posterior end of mantle.
Mantle Width Index	MWI	maximum mantle width as a percentage of mantle length.
Ventral Mantle Length	VML	ventral mantle length measured from anterior border of mantle at ventral midline, to apex of mantle.
Head Width Index	HWI	greatest width of head at level of eyes as a percentage of mantle length.
Mantle Arm Index	MAI	mantle length as a percentage of longest arm.
Arm Length Index	ALI	length of arm measured from beak to tip of arm as percentage of mantle length.
Arm Width Index	AWI	Width of stoutest (right) arm at mid-point of arm length as a percentage of mantle length (measurement exclusive of webs and membranes).
Arm Formula	AF	Comparative length of arms expressed numerically in decreasing order, e.g., II.IV.II.I. etc.
Web Depth Index	WDI M	Measurement of deepest (most extensive) sector of web measured from mouth midpoint of sector between arms as a percentage of longest arm.
Web formula	WF	Comparative depth of each web sector measured from mouth to midpoint of sector between arms expressed alphabetically in decreasing order, e.g., B.C.D = A. E.
Arm Sucker Count	ASC	Total sucker count for intact arm with the highest sucker count.
Hectocotylized Arm Sucker Count	HcASC	Number of suckers on hectocotylized arm.
Hectocotylized Arm Index	HcAI	Length of hectocotylized arm measured from mouth to distal tip as a percentage of mantle length.
Opposite Arm Index	OAI	Length of hectocotylized arm as a percentage of its fellow arm on opposite side.
Ligula Length Index	LLI	Length of ligula measured from distal-most sucker to tip of arm as a percentage of length of hectocotylized arm.
Calamus Length Index	CaLI	Length of calamus measured from last (distal-most) sucker to its distal tip as a percentage of ligula length.
Spermatophore Length Index	SpLI	Length of spermatophore as a percentage of mantle length.
Spermatophore Width Index	SpWI	Greatest width of spermatophore as a percentage of spermatophore length.
Sperm Reservoir Index	SpRI	Length of sperm reservoir as a percentage of total spermatophore length.
Egg Length Index	EgLI	Length of (mature) egg as a percentage of mantle length.
Funnel Length Index	FuLI	The length of the funnel from the anterior funnel opening to the posterior border measured along the ventral midline as a percentage of mantle length.
Free Funnel Index	FFul	The length of the funnel from the anterior opening to the point of dorsal attachment to the head as a percentage of mantle length.

SYSTEMATICS ACCOUNT

Order Octopoda Leach, 1818
Suborder Incirrata Grimpe, 1916
Family Octopodidae d'Orbigny, 1839

Genus *Octopus* Lamarck, 1798

Diagnosis: Benthic octopodids. Mantle saccular, without fins. Eight arms lacking cirri, arms with biserial suckers, third right arm of male hectocotylized with end of arm modified into ligula and calamus. Web well developed. Ink sac present. Mantle aperture wide. Internal shell cartilaginous and vestigial.

Octopus rex sp. nov.

(Figs.1A & B, Table 2 & 3)

Octopus sp.5 -Norman & Hochberg
1994:156-157

Octopus sp.1 -Norman & Sweeney 1997:
figs.4 f-g

Octopus ocellate sp.A -Nateewathana 1997:
figs.9A & B

Octopus sp.A -Norman 1998: 819

MATERIAL EXAMINED:

Holotype: PMBC no.17463, male, 51.4 ML, Ko Kood, Trat province, Gulf of Thailand, R/V Pramong 12, Bottom trawl 19 m, Coll. Pitiporn Nilaphat, 7 April 1999.

Paratypes: PMBC no. 17464, 2 specimens: 1 male, 53.3 ML, 1 female, 54.3 ML, Ko Kood, Trat province, Gulf of Thailand, R/V Pramong 12, Bottom trawl 19 m, Coll. Pitiporn Nilaphat, 7 April 1999.

Other material: see Appendix 1.

DESCRIPTION: Medium-sized animal (ML to 76 mm; TL to 212 mm). Mantle (Fig.1A, a) elongate ovoid (MWI 44.2-81.6). Head wide, slightly narrower than mantle (HWI 21.9-45.1), demarcated from mantle by constriction; eye small, conspicuous,

projecting above surface of head. Funnel moderately large, slender, bluntly tapered (FuLI 27.0-43.2) with moderately long free portion (FFuI 13.8-35.7); funnel organ W-shaped, outer limbs about 95% of medial limbs. Arms moderately long (MAI 32.9-58.8) (2-3 times ML), robust, tapering to narrow tips. Arms unequal, arm order IV.III.II.I. Arm suckers biserial throughout, all suckers in female similarly sized, 3rd and 4th pairs of suckers in mature male enlarged. Third right arm of males hectocotylized somewhat shorter than its opposite arm (OAI 65.5-96.1); ligula moderately elongate (LLI 4.3-9.1) with very shallow groove (Fig.1A, b); calamus short, distinct (CaLI 14.3-15.8); hectocotylized arm with 63-82 suckers. Webs moderately deep (WDI 15.7-32.5), web formula D.E.C.B.A. Upper beak (Fig.1A, c) with moderate hood and slightly curved rostrum, concave on cutting edge. Lower beak (Fig.1A, d) with conical rostrum, narrow hood, long wings and slightly curved lateral wall. Radula with seven teeth and two marginal plates in each transverse row (Fig.1B, f); Rhachidian tooth with 1 lateral cusp on either side of a moderately long medial cone; first lateral teeth small with cusps at lateral edges; second lateral teeth unicuspidate, conical-shaped with curved base; lateral marginal teeth unicuspidate, long and curved; marginal plates rectangular. Ink sac present. Gill lamellae 8-9 (usually 8). Mature female with numerous small eggs (2-3 mm long; 0.9-1.0 mm wide), in female paratype 2.8 mm long and 1.0 mm wide. Male with very long penis and a small coiled diverticulum; spermatophores (Fig.1B, g-i) long (SpLI 44.6-58.2), slender (SpWI 1.8-2.2), with long, coil reservoir (SpRI 42.2-48.5); number of spermatophores low, about 11-16.

Integumental sculpture consists of a pattern of fine, rounded and closely set epidermal tubercles; tubercles cover dorsal and ventral surfaces of arms, head and mantle; a slightly enlarged tubercle present above each eye.

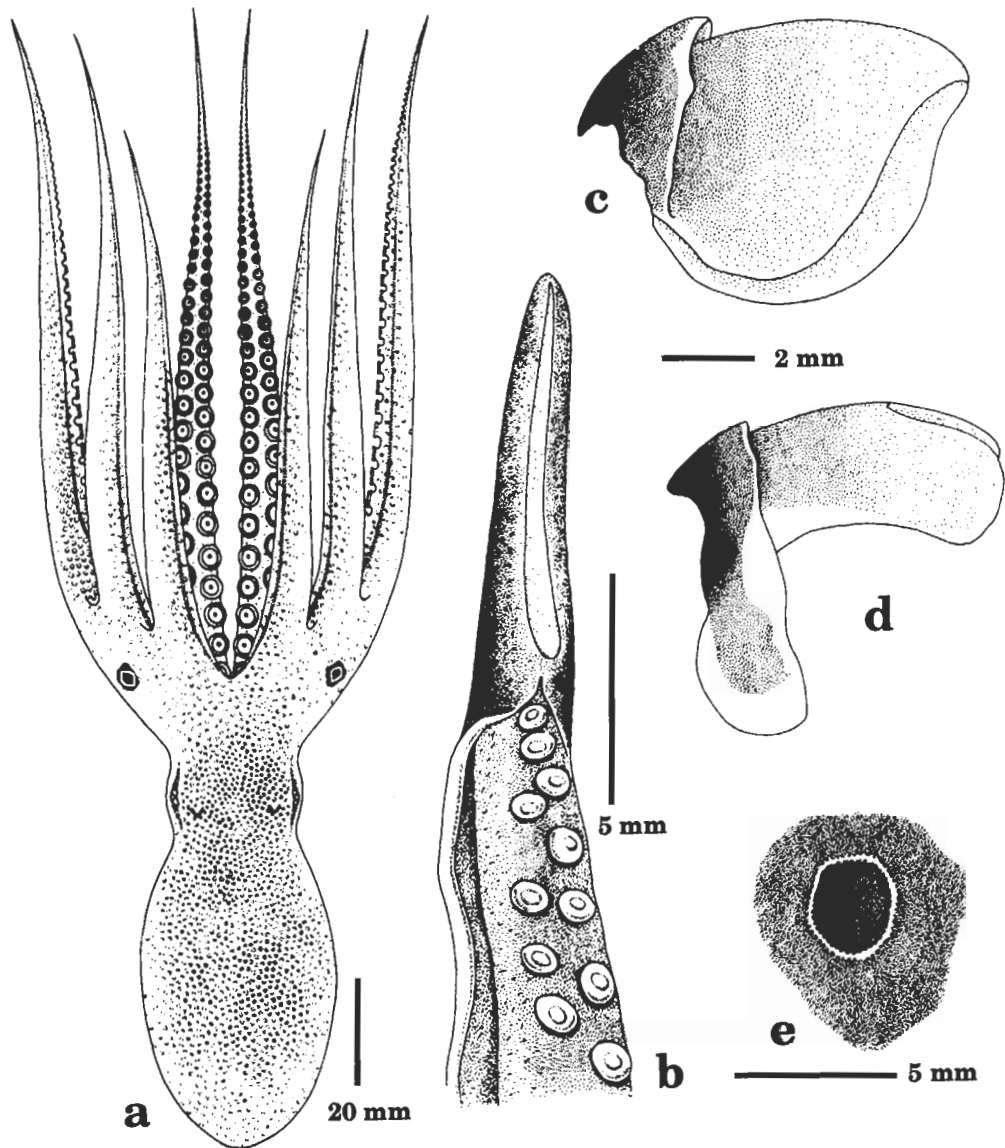


Fig.1A. *Octopus rex* sp. nov. (a), dorsal view of 59.9 mm ML of female. (b), hectocotylus of 62.2 mm ML of male. (c), upper beak of 69.2 mm of female. (d), lower beak of 69.2 mm ML of female. (e), ocellus of 59.9 mm ML of male.

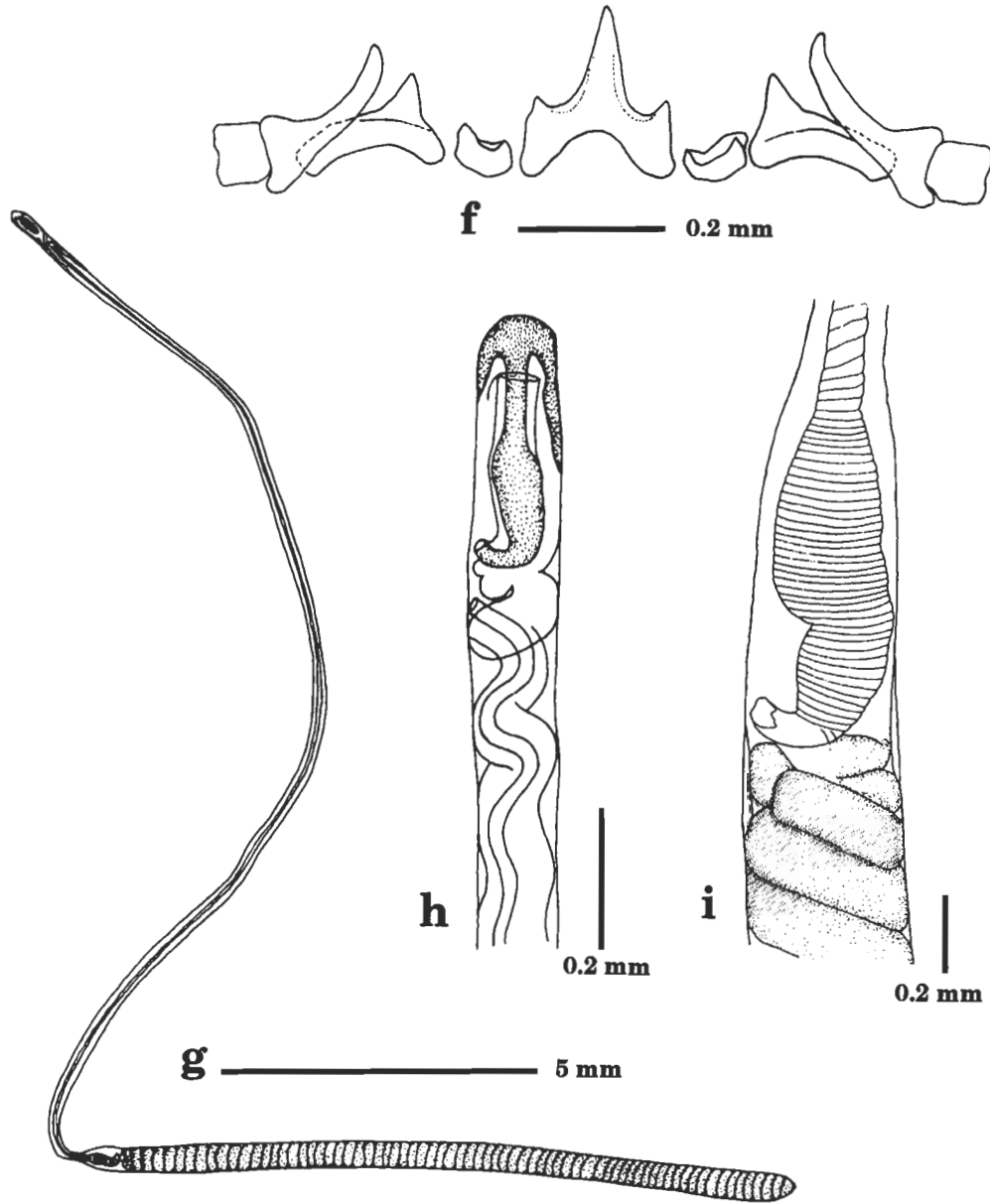


Fig.1B. *Octopus rex* sp. nov. (f), radula of 69.2 mm ML of female. (g), whole spermatophore of 61.0 mm ML of male. (h), enlargement of oral cap. (i), enlargement of cement body.

Colour in ethyl alcohol reddish-brown on dorsal surfaces of head, arms and mantle, white and cream on ventral surfaces; a short longitudinal brownish black bar through eye; narrow dark stripe along dorso-lateral face of arms I-III; ocellus with a small pink/purple iridescent ring (Fig.1A, e) on the base between arms II and II.

DISTRIBUTION: Tropical continental waters of Southeast Asia, from the Andaman Sea and the Gulf of Thailand through Indonesia to Northern Australia.

ETYMOLOGY: The species is named in honor of His Majesty the Thai King's Celebration of the 72nd Birthday (1999). From the Latin, "rex" is mean "ruler, king, prince".

REMARKS: *Octopus rex* is an ocellate octopus which is characterized by a black ocellus containing a fine iridescent blue to purple ring, short longitudinal bar through each eye, and a narrow dark longitudinal line along the dorsal edges of arms I-III. This species is distinguished from other ocellate octopus occurring in the region by distinctive colour patterns, higher suckers counts on normal arms (*O. rex*: males 134-184, females 140-198; *O. neglectus*: males 110-125, females 119-143; *O. siamensis*: males 100-136, females 96) and a shorter ligula (4.3-9.1% arm length in *O. rex*, >9% in two other new species). Spermatophores of this species are proportionally longer than in *O. neglectus* (44.6-58.2% vs 34.8-39.8% ML).

Table 2. Measurements, counts and morphometric indices of the type material of *Octopus rex*.

Index	Holotype (PMBC no. 17463)	Paratype (male) (PMBC no. 17464)	Paratype (female) (PMBC no. 17464)
ML(mm)	51.4	53.3	54.3
TL(mm)	156.7	181.3	173.5
MWI	56.6	54.4	53.6
VML(mm)	43.2	43.7	43.9
HWI	34.6	35.1	30.4
MAI	48.0	41.6	45.6
AL _I I	163.5	180.9	160.2
AL _{II} I	185.0	199.2	168.0
AL _{III} I	216.8	211.1	191.5
AL _{IV} I	228.2	240.1	219.5
AWI	17.5	22.9	15.3
WDI	25.5	25.3	20.1
ASC	166	154	146
HcASC	63	70	-
HcAI	192.2	153.2	-
OAI	77.3	72.6	-
LLI	8.1	6.1	-
CaLI	15.7	15.8	-
FuLI	39.2	36.6	35.9
FFuI	14.6	19.5	19.9

O. rex has been collected from coastal waters on mud and sandy mud substrates, from intertidal shallows to a depth of about 80 m. Females lay small eggs, up to 3 mm long, often in shells or bottles (Norman 1998). It is one of the most important fisheries species in Thai waters. It is harvested in large quantities by trawlers, both in the Andaman Sea and the Gulf of Thailand. The species is

always mixed with other octopus during fishing operations. No information is available on fishery statistics in Thailand since the species is lumped with other ocellate octopus under the name *Octopus membranaceus*. It is also mixed with other octopus, particularly *Octopus aegina* Gray, 1849, in exports to Europe, Australia and the United States.

Table 3. Means, standard deviations and ranges of selected measurements and indices (in percent) of *Octopus rex* from Thailand.

Index	Males				Females			
	n	mean	s.d.(n-1)	Range	n	mean	s.d.(n-1)	Range
ML(mm)	5	50.7	7.6	39.8-61.0	5	55.8	13.7	42.7-76.2
TL(mm)	5	174.5	20.1	147.0-203.0	5	188.7	24.3	149.0-212.0
MWI	5	61.3	15.5	48.6-81.6	5	53.8	6.5	44.2-62.2
VML(mm)	5	38.2	6.1	32.5-45.2	5	44.1	10.7	33.8-60.4
HWI	5	37.8	5.3	32.5-45.1	5	30.8	5.4	21.9-34.9
MAI	5	40.0	3.5	36.6-48.3	5	43.4	9.9	32.9-58.8
ALiI	5	182.3	28.8	157.6-229.4	5	161.1	33.4	131.2-218.2
ALiiI	5	216.5	26.5	186.1-243.9	5	189.3	43.1	139.6-257.7
ALiiiI	5	243.5	25.4	203.1-267.2	5	198.2	21.3	162.7-217.1
ALivI	5	251.2	21.4	220.7-272.9	5	239.6	50.5	170.1-303.9
AWI	5	17.4	5.7	14.1-27.5	5	13.8	2.1	11.6-17.3
WDI	5	27.8	4.1	22.7-32.5	5	21.9	4.9	15.7-29.3
ASC	5	147.0	21.0	134.0-184.0	5	177.0	22.0	140.0-198.0
HcASC	5	73.0	8.0	63.0-82.0	-	-	-	-
HcAI	5	198.7	21.3	164.7-221.3	-	-	-	-
OAI	5	82.2	11.0	65.5-96.1	-	-	-	-
LLI	5	7.0	1.8	4.3-9.1	-	-	-	-
CaLI	5	18.0	5.5	14.3-15.8	-	-	-	-
SpLI	5	51.8	6.8	44.6-58.2	-	-	-	-
SpWI	5	2.0	0.2	1.8-2.2	-	-	-	-
SpRI	5	46.0	3.2	42.2-48.5	-	-	-	-
EgLI	-	-	-	-	5	5.5	0.8	4.3-6.5
EgWI	-	-	-	-	5	1.8	0.2	1.5-2.1
FuLI	5	34.5	5.6	29.9-43.2	5	32.5	3.9	27.0-38.0
FFuI	5	22.1	8.4	14.0-35.7	5	19.3	3.7	13.8-23.4

***Octopus neglectus* sp. nov.**

(Figs.2 A & B, Table 4 & 5)

Octopus ocellate sp.B. -Nateewathana
1997:436-440,figs.10A**MATERIAL EXAMINED:****Holotype:** PMBC no. 17465. male, 52.7 mm ML. Thai-Malaysian Border, Andaman Sea, trawled. Coll. A. Nateewathana. 19 December 1994.**Paratype:** PMBC no. 11959. female, 44.5 mm ML. Off Ko Phuket, Bottom trawled, 88 m. Coll. A. Nateewathana. 18 March 1995.**Other material:** see Appendix 2.**DESCRIPTION:** Medium-sized animals (ML to 64 mm; TL 272 mm); mantle (Fig.2A, a) saccular to elongate ovoid (MWI 64.2-75.7); head small and narrower than mantle (HWI 24.4-40.4), demarcated from mantle by moderate constriction; eye small, not projecting above surface of head. Funnel large, robust (FuLI 34.5-43.7), bluntly tapered with moderately long free portion (FFuI 19.3-30.2); funnel organ W-shaped (Fig.2A, b), limbs thick, outer limbs almost as long as median limbs. Arms long (MAI 30.3-36.4) (2-3 times ML), slender andTable 4. Measurements, counts and morphometric indices of the type material of *Octopus neglectus*.

Index	Holotype (male) (PMBC no 17465)	Paratype (female) (PMBC no 11959)
ML(mm)	52.7	44.5
TL(mm)	199.7	196.5
MWI	68.6	69.3
VML(mm)	44.5	41.0
HWI	38.7	32.6
MAI	35.8	35.7
AL _I	236.0	181.8
AL _{II}	254.9	208.5
AL _{III}	273.9	242.0
AL _{IV}	278.9	281.7
AWI	13.9	13.7
WDI	19.5	18.3
ASC	110	125
HcASC	70	-
HcAI	214.4	-
OAI	95.8	-
LLI	10.3	-
CaLI	12.1	-
FuLI	34.7	35.1
FFuI	24.9	24.0

Table 5. Means, standard deviations and ranges of selected measurements and indices (in percent) of *Octopus neglectus* from Thailand.

Index	Males				Females			
	n	mean	s.d.(n-1)	Range	n	mean	s.d.(n-1)	Range
ML(mm)	5	51.3	6.1	44.4-58.5	5	60.2	7.1	27.8-64.5
TL(mm)	5	211.0	24.3	178.0-238.0	5	251.4	36.7	186.0-272.0
MWI	5	71.9	3.3	68.0-75.7	5	69.6	3.6	64.2-73.8
VML(mm)	5	37.6	2.5	33.1-45.0	5	43.8	4.5	36.0-46.9
HWI	5	35.4	4.1	29.1-40.4	5	28.5	3.4	24.4-32.2
MAI	5	35.0	1.0	33.6-36.4	5	33.6	2.1	30.3-35.9
AL _I	5	238.7	12.4	225.6-257.2	5	211.3	25.5	181.5-249.2
AL _{II}	5	258.7	18.3	230.8-280.4	5	247.1	26.1	206.2-273.8
AL _{III}	5	271.8	25.8	242.7-297.8	5	267.0	21.3	241.0-297.3
AL _{IV}	5	283.3	8.2	274.7-295.6	5	297.1	19.4	278.2-329.5
AWI	5	15.4	1.4	13.5-17.1	5	14.5	1.1	13.0-16.1
WDI	5	20.6	2.1	17.1-22.3	5	19.0	2.0	16.9-22.3
ASC	5	119.0	6.0	110.0-125.0	5	136.0	10.0	119.0-143.0
HcASC	5	58.0	7.0	51.0-70.0	-	-	-	-
HcAI	5	240.6	26.2	209.5-275.0	-	-	-	-
OAI	5	85.0	11.2	73.8-99.3	-	-	-	-
LLI	5	10.0	0.7	9.3-10.8	-	-	-	-
CaLI	5	12.6	3.4	11.4-16.1	-	-	-	-
SpLI	4	37.5	2.0	34.8-39.8	-	-	-	-
SpWI	4	2.6	0.4	2.2-3.2	-	-	-	-
SpRI	4	37.5	11.5	22.4-50.0	-	-	-	-
EgLI	-	-	-	-	1	7.0	-	-
FuLI	5	38.6	3.8	34.5-43.7	5	37.3	1.4	34.9-38.6
FFuI	5	24.1	4.3	19.3-30.2	5	24.5	3.1	20.1-27.3

narrow tips. Arm lengths subequal, arm order IV.III.II.I. Arm suckers biserial, 3rd and 4th pairs of suckers enlarged on arms II and III in males, uniform in females. Third right arm in male hectocotylized (Fig.2A, c), slightly shorter than its opposite arm (OAI 73.8-99.3); ligula slender, long (LLI 9.3-10.8); ligula groove long with incomplete transverse ridges; calamus short, slightly pointed (CaLI 11.4-16.1);

hectocotylized arm with 51-70 suckers. Web moderately deep (WDI 16.9-22.3); web formula D.=E.C.B.A. Upper beak (Fig.2A, e) with long, curved rostrum, concave on cutting edge and short hood. Lower beak (Fig.2A, f) with conical, short rostrum, narrow hood, widely spread wings and long, slightly curved lateral walls. Radula with seven teeth and two marginal plates in a single transverse row (Fig.2B, g); rhachidian

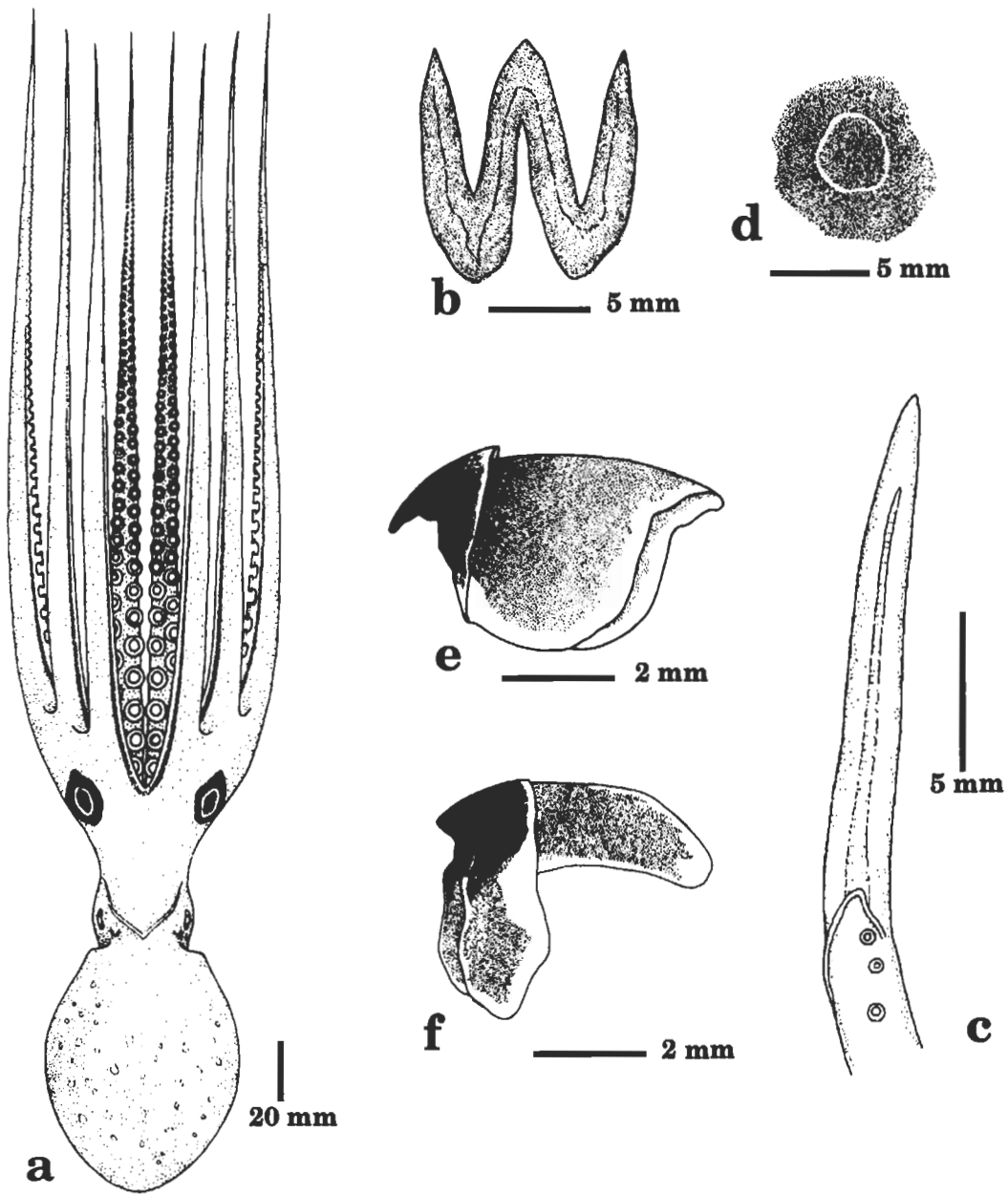


Fig.2A. *Octopus neglectus* sp. nov. (a), dorsal view of 49.7 mm ML of male. (b), funnel organ of 49.7 mm ML of male. (c), hectocotylus of 49.7 mm ML of male. (d), ocellus. (e), upper beak of 49.7 mm ML of male.

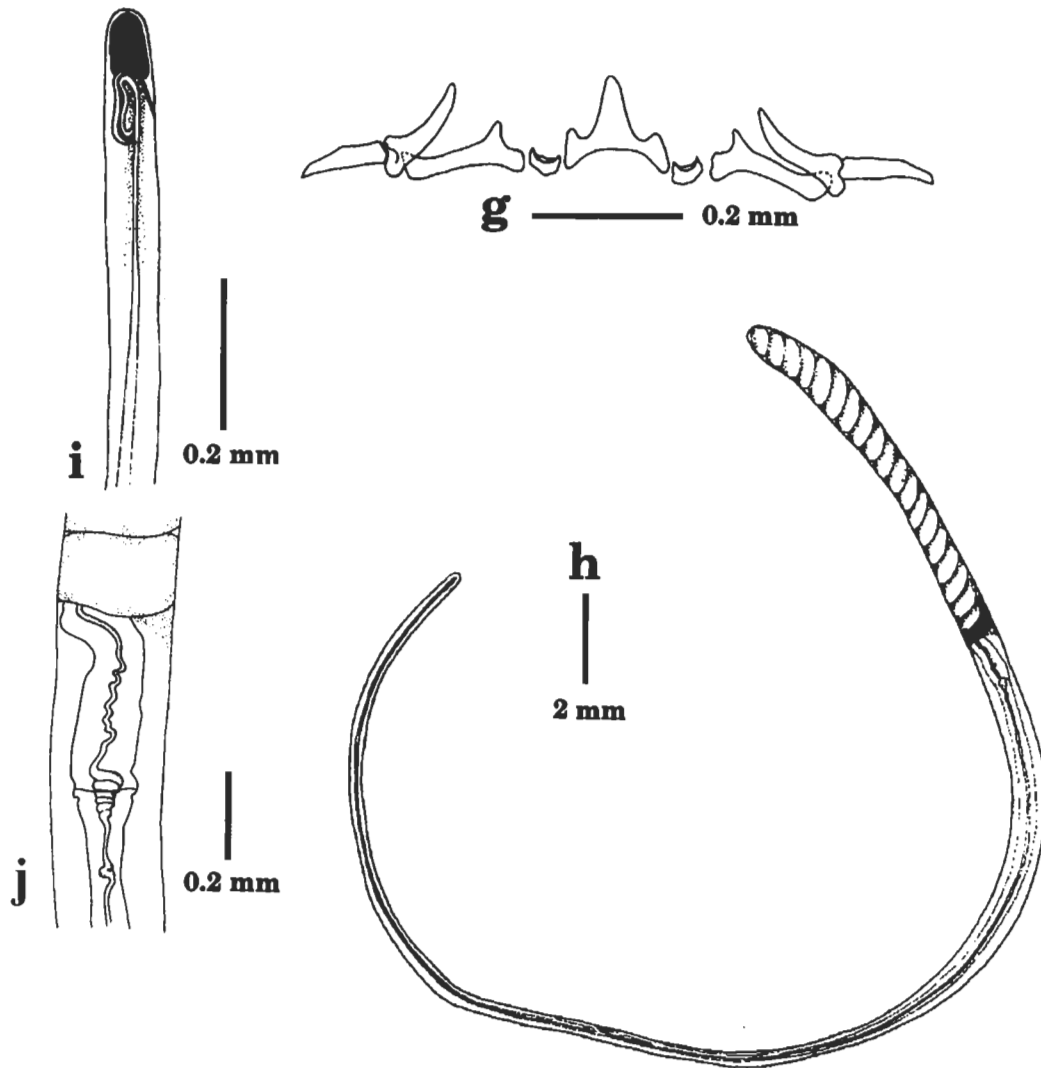


Fig.2B. *Octopus neglectus* sp. nov. (f), lower beak of 49.7 mm ML of male. (g), radula of 49.7 mm ML of male. (h), whole spermatophore of 49.7 mm ML of male, (i), enlargement of oral cap. (j), enlargement of cement body.

tooth with one lateral cusp on either side of a moderate medial cone; first lateral teeth with two small cusps on lateral edges; second lateral teeth unicuspidate and short with long, slightly curved base; lateral marginal teeth long and slender; marginal plates oblong. Ink sac present. Gill lamellae 7-8 (usually 7). Mature female with numerous, small eggs (0.8 mm long in submature paratype, EgLI to 7.0 in other material). Male with long penis and single coiled diverticulum; spermatophores (Fig.2B, h-j) long (SpLI 34.8-39.8), slender (SpWI 2.2-3.2) with relatively short, coiled sperm reservoir (SpRI 22.4-50.0).

Integumental sculpture with small, close-set tubercles over head, mantle and arms; 1-2 cirri over each eye. Live specimens brownish-green colour dorsally and paler white ventrally; numerous small, rounded white spots distributed on dorsal mantle; a narrow, small, slightly u-shaped transverse bar present between eyes. Ocellus with blue/purple iridescent ring (Fig.2A, d). Colour in preserved ethyl alcohol brownish with faint white spots. Transverse narrow bar between eyes sometimes visible.

DISTRIBUTION: The Andaman Sea, Gulf of Thailand, Cambodia, Vietnam and Taiwan (C.C. Lu, pers. comm.)

ETYMOLOGY: This species is one of the most common ocellate octopuses in the country yet it remained undescribed. The species name derives from the Latin, "neglectus", meaning to pay no attention or disregard.

REMARKS: *Octopus neglectus* is characterized by an ocellus of a black spot containing a fine iridescent blue to purple ring. The body and arms are brownish-green in colour with numerous rounded-white spots on dorsal mantle and a narrow curved white bar between the eyes. This species is distinguished from *O. neglectus* in remarks above. It is distinguished from *O. siamensis*

by its distinctive colour pattern.

It is one of the major commercial species in Thailand, usually caught in large quantities by bottom trawls, in depths between 20-80 m. The species is normally mixed with other ocellate octopuses and is recorded as *Octopus membranaceus* Quoy and Gaimard, 1832. No statistics are available on the scale of its commercial harvest.

***Octopus siamensis* sp. nov.**

(Fig.3, Table 6)

Octopus ocellate sp.C -Nateewathana 1997:440-442, fig.11

MATERIAL EXAMINED:

Holotype: PMBC no. 17462, male, 41.5 mm ML, Ranong Fish Landing. Coll. A. Nateewathana. 30 January 1996.

Paratypes: PMBC no. 11979, 1 male, 47.1 mm ML, 1 female, 64.7 mm ML, Ranong Fish Landing. Coll. A. Nateewathana. 30 January 1996.

Other material: 1 male, 56.0 mm ML, Pak Panang Fish Landing, Nakhon Sri Thammarat, Gulf of Thailand, Coll. A. Nateewathana. 5 August 1999

DESCRIPTION: Medium-sized animals (ML to 64 mm; TL to 195 mm); mantle (Fig.3, a) broadly ovoid (MWI 57.8-82.8); head small (HWI 22.3-27.0), demarcated from mantle by prominent constriction; eyes small, not projecting above surface of head. Funnel large, stout, bluntly tapered (FuLI 35.5-40.5) with moderately long free portion (FFuI 22.7-30.1); funnel organ W-shaped (Fig.3, b), outer limbs as long as median limbs. Arms moderately long (MAI 26.1-47.9) (2-3 times ML), stout, tapering to narrow tips. Arm lengths subequal, arm order IV.III.II.I. Arm suckers biserial, 3rd and 4th pairs of suckers enlarged on arm II and III in males, uniform in female. Third right arm of males hectocotylized (Fig. 3, c), shorter than its opposite arm (OAI 75.2, 78.1); ligula of moderate length (LLI 9.3, 10.1); ligula

groove shallow without transverse ridged; calamus very short, conical; hectocotylized arm with 56-61 suckers. Web deep (WDI 19.2-34.8), web formula D.C.B.E.A or D.=C.B.E.A. Upper beak (Fig. 3, f) with sharp, curved rostrum, narrow hood, slightly concave on cutting edge. Lower beak (Fig.3, g) with short, blunt rostrum, narrow hood, widely spread lateral wings and long, slightly curved lateral walls. Radula with seven rows of teeth and two marginal plates on each transverse row (Fig.3, e); rhachidian tooth tricuspidate with a long, conical unicuspid and 1 lateral cusp on either side; first lateral teeth small and unicuspidate; second lateral teeth unicuspidate, conical

and long, curved base; lateral marginal teeth curved and long; marginal plates oblong. Ink sac present. Gill lamellae 7-8. Mature female with numerous small eggs (1.7 mm long; 1.3 mm wide).

Integumental sculpture with small papillae surrounded by circle of very minute reddish brown chromatophores over mantle, head and arm crowns; two to three small tubercles above each eyes and somewhat smaller tubercles on neck. Live specimens with brown base and uniformly spreads, reddish brown chromatophores dorsally, smaller and more dense ventrally; four dark longitudinal stripes on mantle, head, and eyes through

Table 6. Measurements, counts and morphometric indices of the type material of *Octopus siamensis*.

Index	Holotype (male) (PMBC no. 17462)	Paratype (male) (PMBC no. 11979)	Paratype (female) (PMBC no. 11979)
ML(mm)	41.5	47.1	64.7
TL(mm)	190.0	195.0	195.0
MWI	68.4	82.8	57.8
VML(mm)	34.4	35.3	43.3
HWI	22.3	27.0	22.7
MAI	26.1	30.0	47.9
ALII	204.8	250.5	187.8
ALIII	261.1	267.5	208.6
ALIII	320.6	368.7	182.4
ALIVI	333.3	383.1	194.7
AWI	18.5	21.4	11.4
WDI	19.2	22.0	34.8
ASC	100	136	96
HcASC	56	61	-
HcAI	250.5	277.1	-
OAI	75.2	78.1	-
LLI	9.3	10.1	-
EgLI	-	-	2.6
EgWI	-	-	2.0
FuLI	36.5	40.5	35.5
FFuI	23.3	30.1	22.7

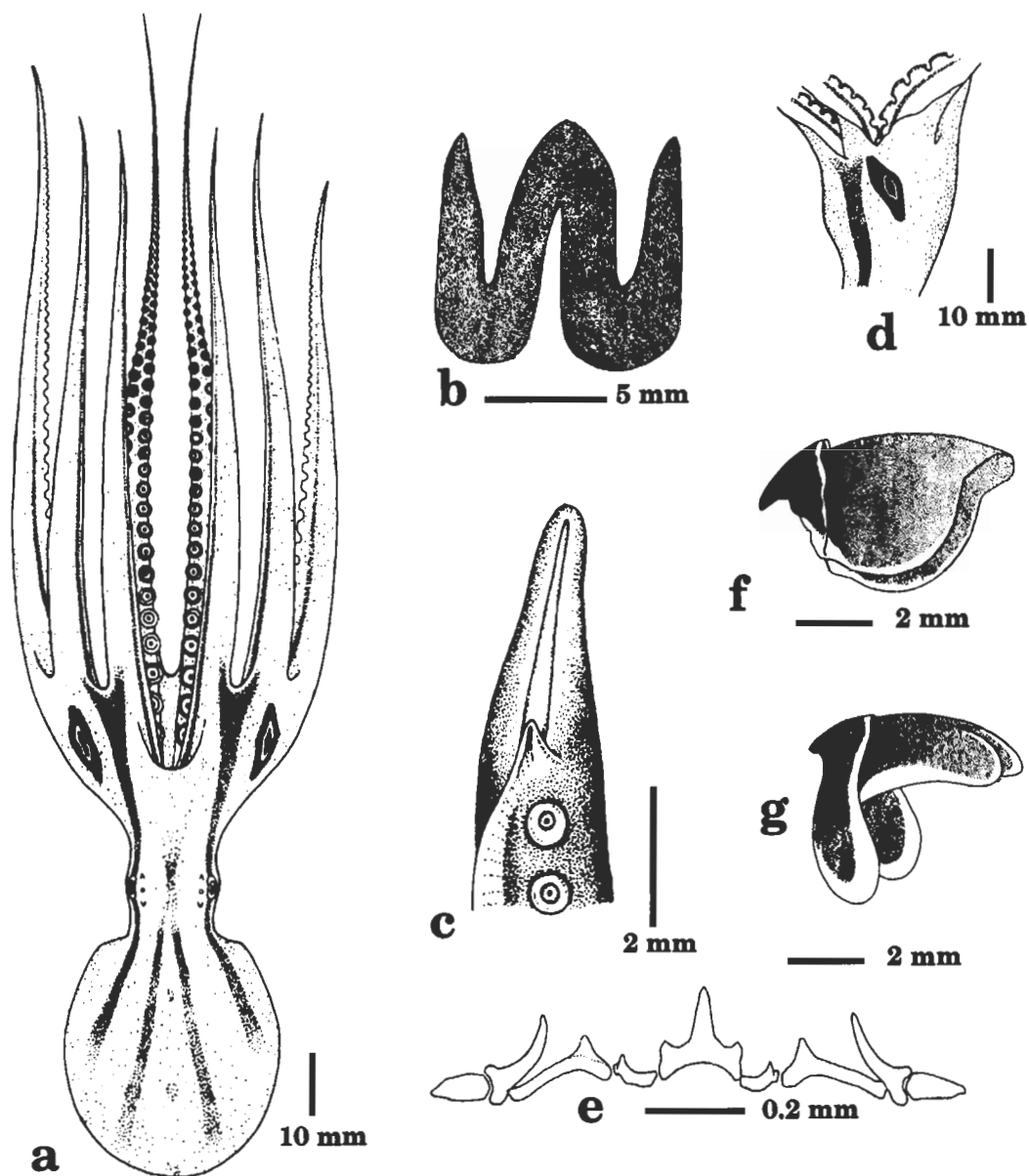


Fig.3. *Octopus siamensis* sp. nov. (a), dorsal view of 48.6 mm ML of male. (b), funnel organ of 48.6 mm ML of male. (c), hectocotylus of 49.3 mm ML of male. (d), ocellus. (e), radula of 48.6 mm ML of male. (f), upper beak of 48.6 mm ML of male. (g), lower beak of 48.6 mm ML of male.

the base of arm lengths. Ocellus (Fig.3, d) with iridescent white ring.

DISTRIBUTION: The Andaman Sea and the Gulf of Thailand.

ETYMOLOGY: The species is named after "Siam =Thailand".

REMARKS: The unique characters of *O. siamensis* are four longitudinal stripes on the mantle, head and lateral borders of the arms, the presence of ocellus with iridescent white ring. It is distinguished from the other two new species above.

O. siamensis resembles ocellate specimens from the Indian Ocean reported by Massy (1916) and Jothinayagam (1987) under the name *O. areolatus* (non de Haan, 1839-1841 in Ferussac and d'Orbigny, 1834-1848). They share the same form of ocellus and integumental sculptures. There was, however, no mention of the four characteristic dark longitudinal stripes on the body.

O. siamensis shares these four body stripes with *O. exannulatus* Norman, 1992 and *O. areolatus* d'Orbigny, 1839. It differs from *O. exannulatus* in that it possesses a distinct iridescent ring within the ocellus. *O. areolatus* is characterized by a large green to gold iridescent ring within each ocellus, a dumbbell-shaped head patch and large eggs (7-10 mm).

DISCUSSION

Nateewathana (1997) recorded five species of ocellate octopuses from the Andaman Sea of Thailand: *O. cyanea* Gray, 1849, *O. exannulatus* Norman, 1993 and *Octopus* ocellate spp. A, B and C. Additional material from the Gulf of Thailand and the Andaman Sea have enabled review of the latter three species. They have been found to be new to science. In the present report, *O. ocellate* sp. A is referred to *O. rex*, *O. ocellate* sp. B to *O. neglectus* and *O. ocellate* sp. C to *O.*

siamensis.

Norman (1992) reported eight ocellate species as occurring in the Indo-West Pacific region: *Octopus areolatus* d'Orbigny, 1834 (junior synonyms: *O. brocki* Ortmann, 1888, *O. fangsiao* d'Orbigny, 1834 and *O. ocellatus* Gray, 1849), *O. cyanea* Gray, 1849, *O. exannulatus* Norman, 1993, *O. mototi* Norman, 1993, *O. ovulum* Sasaki, 1917, *O. polyzenia* Gray, 1849, *O. robsoni* Adam, 1941 and *O. varunae* Oommen, 1971. The present study adds three new species to this list bringing the number of described ocellate species in the region to eleven.

Affinities of the ocellate species have been discussed by Norman (1992). The three new species, *O. rex*, *O. neglectus* and *O. siamensis* fall into the ocellate group which possess an iridescent ring within the ocellus. Two species in the list above lack an iridescent ocellus: *O. cyanea* and *O. exannulatus*. Amongst the species with an iridescent ring, *O. areolatus* and *O. polyzenia* are large-egg species while the remaining taxa are small-egg species. *O. mototi* is characterized by having a circular cluster of dark spots above each eye which forms a floweré pattern. *O. robsoni* and *O. varunae* possess 10 gill lamellae per demibranch while the three new species have fewer gill lamellae (8-9 in *O. rex*, 7-8 in *O. neglectus* and *O. siamensis*). *O. ovulum* is only known from its original description with the type material originating from fish markets in Japan. The status of this nominal species remains unresolved (see discussion in Norman, 1992).

O. rex and *O. neglectus* are important commercial species in Thai waters. Large scale harvests occur using benthic trawls.

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REFERENCES

- Jothinayagam, J.T. 1987. Cephalopoda of the Madras coast. -Zoological Survey of India Technical Monograph no.15:1-85
- Massy, A.L. 1916. Cephalopoda of the Indian Museum. Record of the Indian Museum 12(5):185-247
- Natewathana, A. 1997. The octopod fauna (Cephalopoda : Octopoda) of the Andaman Sea, Thailand. -Phuket Marine Biological Center Special Publication 17(2): 407-452
- Norman, M.D. 1992. Ocellate octopuses (Cephalopoda: Octopodidae) of the Great Barrier Reef, Australia: description of two new species and redescription of *Octopus polyzenia* Gray, 1849. -Memoirs of the Museum of Victoria 53(2): 309-344.
- Norman, M.D. 1998. The living resources of the Western Central Pacific. Vol.2. Cephalopods, crustacean, holothurians and sharks. FAO Rome
- Norman, M.D. & F.G Hochberg. 1994. Shallow-water octopuses (Cephalopoda : Octopodidae) from Hong Kong's Territorial waters. In: B. Morton (ed.), The Malacofauna of Hong Kong and Southern China III. Pp. 141-159. Proceedings of the Third International Workshop on the Malacofauna of Hong Kong and Southern china, Hong Kong 13 April-1 May 1992. Hong Kong: Hong Kong University Press, 1994
- Norman, M.D. & M.J. Sweeney. 1997. The shallow-water octopuses (Cephalopoda : Octopodidae) of the Philippines. -Invertebrate Taxonomy 11: 89-140

Appendix 1. Material examined of *O. rex* from Thai waters.

Catalog no	ind/sex	ML (mm)	Locality	Gear/depth	Collector	Date
PMBC no 11925	1 ♀	61.8	Ko Dam Kwan, Phang-nga Bay	Pramong 10, trawled	K. Yoodee	22 May 1994
PMBC no 11926	5 ♀	15.9-22.3	06°52'3" N 98° 30'5" E	Paknam, trawled, 100 m	A.Nateewa thana	17 March 1989
PMBC no 11927	1 ♀	40.7	07°47'3"N 98°50'1"E	Pramong 10, trawled, 25 m	K. Yoodee	23 June 1989
PMBC no 11928	2 ♀ 1 ♂	36.5-51.5 39.2	06°43.6' N, 98°25.0' E	Paknam, trawled, 76 m	A.Nateewa thana	17 March 1989.
PMBC no 11929	1 ♂	33.4	17°14'37"N 94°21'04"E	Chulabhon trawled, 78 m.	A.Nateewa thana	19 November 1989.
PMBC no 11930	2 ♀ 2 ♂	21.4-31.7 28.5-41.0	06°58'13"N 98°48'52"E	Paknam, trawled, 78 m	A.Nateewa thana	15 March 1989.
PMBC no 11931	4 ♀ 3 ♂	36.5-54.9 33.8-51.0	08°58'72"N 97°43'29"E	Chaktong trawled, 80.7 m	S.Bussara wit	20 April 1996.
PMBC no 11932.	3 ♀ 2 ♂	41.5-75.0 49.8-61.0	09°32'5"N 97°38'0"E	Chaktong trawled, 82.7 m.	S.Bussara wit	19 April 1996
PMBC no 11933	2 ♀ 1 ♂	40.3-43.9 56.3	09°31'32"N 97°37'92"E	Chaktong triangular dredge, 86.7 m	S.Bussara wit	19 April 1996
PMBC no 11934	1 ♀	35.3	07°59'1"N 98°30'0"E	Pramong 10, trawled, 29 m	K. Yoodee	25 June 1989
PMBC no 11935	3 ♀ 6 ♂	23.3-40.0 36.8-37.5	07°04'4"N 98°53'5"E.	Paknam, trawled, 70 m	A.Nateewa thana	15 March 1989
PMBC no 11936	2 ♀ 1 ♂	33.1-41.7 31.0	09°33'7"N 97°49'0"E	Chaktong , triangular dredge, 70 m	S.Bussara wit	18 April 1996
FSM 19990001	1 ♀ 3 ♂	48.6 42.0-48.5	Ko Chang, Trat	Pramong 12, trawled 25 m	P.Nilaphat	5 April 1999
FSM 19990002	4 ♀ 5 ♂	41.4-51.9 29.4-47.7	Rayong Fish market	-	A.Nateewa thana	26 September 1997

Appendix 2. Material examined of *O. neglectus* from the Andaman Sea, Thailand

Catalog no	ind/sex	ML (mm)	Locality	Gear/depth	Collector	Date
PMBC no 11951	15♀ 17♂	51.9-63.7 47.5-59.3	Thai-Malaysian border.	Fishing vessel, trawled, 80-90 m	S. Utsaha	17 December 1994
PMBC no 11952	8♀ 22♂	43.5-61.4 52.8-64.8	Thai-Malaysian border	Fishing vessel, trawled, 80-90 m	S. Utsaha	19 December 1994
PMBC no 11953	7♀ 4♂	46.0-55.2 50.0-53.0	Kantang Fish Landing, Trang	-	A.Nateewathana	15 December 1994
PMBC no 11954	2♀ 11♂	44.8-53.0 53.0-63.3	Ranong Fish Landing	-	A.Nateewathana	30 January 1996
PMBC no 11955	4♀ 4♂	43.8-50.6 58.2-59.9	Trang Fish Market	-	A.Nateewathana	27 January 1996
PMBC no 11956	11♀ 15♂	32.2-54.3 47.5-47.9	Krabi Fish Market	-	A.Nateewathana	14 February 1996
PMBC no 11957	1♀ 5♂	62.5 32.8-51.9	Kantang Fish Landing, Trang	-	A.Nateewathana	3 July 1991
PMBC no 11958	1♂	44.3	La-oon Fish Market, Ranong	-	A.Nateewathana	5 July 1994
PMBC no 11959	1♀	44.5	Off Ko Phuket	R/V Chulabhorn, Trawled, 88 m	A.Nateewathana	18 March 1995
PMBC no 11960	1♂	57.0	Artificial Reef between KoKai Nok & Ko Lipi	R/V Pramong 10. Shrimp trawl	K. Yoodee	20 March 1995