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Two new species of pygmy octopuses (Cephalopoda: Octopodidae) from deep water off the Ryukyu Archipelago, southern Japan

NATSUMI KANEKO & TSUNEMI KUBODERA[1]
Department of Zoology, National Museum of Nature and Science, 3-23-1 Hyakunin-cho, Shinjukuku, Tokyo, 169-0073 Japan.
E-mail: kubodera@kahaku.go.jp ([1]corresponding author)

Abstract

Two new species of pygmy octopuses are described from upper bathyal waters (350–370 m) around the Ryukyu Archipelago. *Bathypolypus rubrostictus* n. sp. is characterized by its small body (20 mm ML), short arms (2–2.5×ML), no enlarged suckers, large spoon-shaped ligula with five deep transverse laminae and large round calamus. There are numerous small brownish-red spots on the dorsal surface of the mantle, which is smooth, without papillae, and webs are pale reddish brown. *Octopus diminutus* n. sp. is characterized by its diminutive adult body size (13–17 mm ML), short arms (2–3×ML), enlarged suckers on the arms of the male, very large pointed calamus, pale brown body colour, and elongate compound superocular papillae. The generic placement of the two species and taxonomic definitions of the genera *Octopus* and *Bathypolypus* are discussed.

Key words: *Bathypolypus rubrostictus*, *Octopus diminutus*, bathyal zone.

Introduction

The cephalopod fauna in the East China Sea, including the Ryukyu Archipelago, has been intensively sampled by bottom trawl surveys (Kubodera and Yamada 1998; Kubodera and Horikawa 2005). Fifteen species of the Octopodidae were reported from the continental shelf and slope of this region, of which five were unidentified species. Recent studies on the neritic octopus fauna along the Ryukyu Archipelago clarified a high species diversity of benthic octopuses in the shallow waters off Okinawa and adjacent islands. Two new shallow-water *Octopus* species have previously been described (Kaneko and Kubodera 2005, 2007). In this study, we describe two additional new species of tiny octopuses from the upper bathyal zone (> 300 m) off the Ryukyu Archipelago.

Materials and Methods

Samples were collected during two bottom trawl surveys: October 1997, R/V *Yoko-Maru*, Seikai Fisheries Research Institute; May 2005, R/V *Hakuho-Maru*, Tokyo University. The collection sites are shown in Fig. 1.

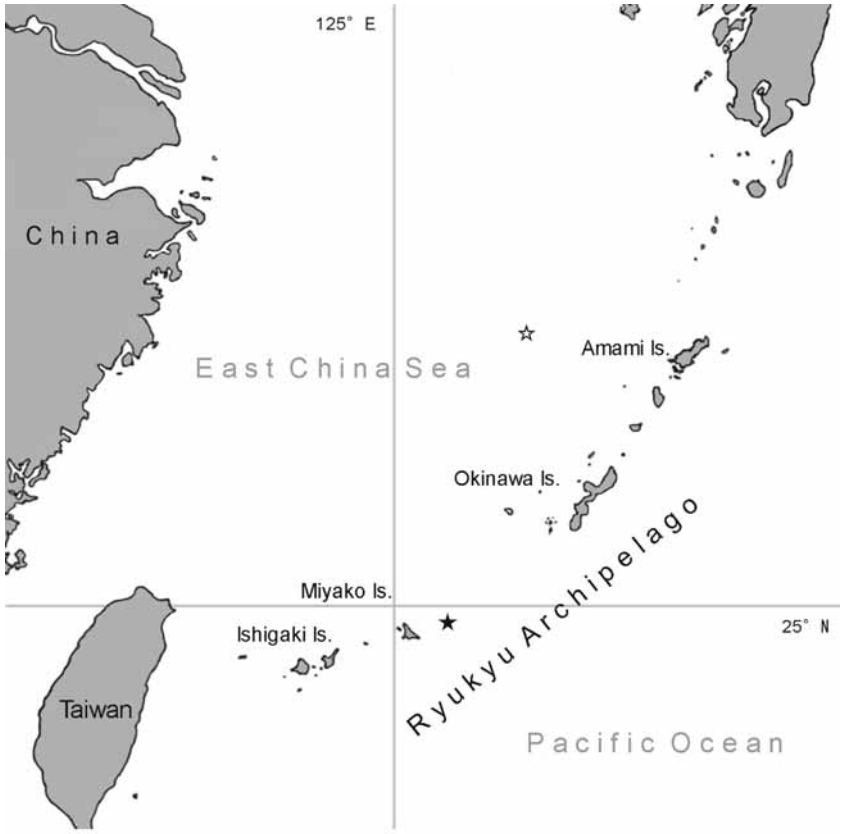

FIGURE 1, Map of the collection sites. ○—*Bathypolypus rubrostictus* n. sp., ●—*Octopus diminutus* n. sp.

All samples were fixed in 10% formalin, and are stored in 40% isopropanol (Roper and Sweeney 1983). Counts and measurements were made from preserved specimens as defined by Roper and Voss (1983), and Norman and Sweeney (1997).

Abbreviations and definitions of indices

AF—arm formula (comparative length of arms expressed numerically in decreasing order); ALI—arm length index (arm length as a percentage of mantle length); ASIe—enlarged arm sucker index (diameter of enlarged sucker as a percentage of mantle length); ASIn—arm sucker index (diameter of normal sucker as a percentage of mantle length); AWI—arm width index (stoutest arm width as a percentage of mantle length); CaLI—calamus length index (calamus length as a percentage of ligula length); EgL—egg length; EgLI—egg length index (length of egg as a percentage of mantle length); EgW—egg width; EgWI—egg width index (greatest width of egg as a perceqntage of mantle length); FFuI—free funnel length index (free funnel length as a percentage of mantle length); FLI—funnel length index (funnel length as a percentage of mantle length); HWI—head width index (head width as a percentage of mantle length); LLI—ligula length index (ligula length as a percentage of length of hectocotylized arm); MAI—mantle arm index (mantle length as a percentage of longest arm); ML—mantle length; MWI—mantle width index (mantle width as a percentage of mantle length); OAI—opposite arm index (length of hectocotylized arm as a percentage of its fellow arm on opposite side); SpL—spermatophore length; SpLI—spermatophore length index (length of spermatophore as a percentage of mantle length); SpRI—sperm reservoir length index (length of sperm reservoir as a percentage of mantle length); SpW—spermatophore width; SpWI—spermatophore width index (greatest width of spermatophore as a percentage of spermatophore length); TL—total length; TOLI—terminal organ length index (length of terminal organ and diverticulum as a percentage of mantle length); TW—total weight; WDI—web depth index (web depth as a percentage of the longest arm).

All specimens are deposited in the National Museum of Nature and Science, Tokyo, Japan (NSMT).

Systematics

Family OCTOPODIDAE

Bathypolypus Grimpe, 1921

Type species: *Bathypolypus arcticus* (Prosch, 1847)

Remarks

Muus (2002) redefined *Bathypolypus* based on Robson's (1932) description and his observations as follows: deep-water octopods of normal octopus-like appearance with stout body; generally with short arms; biserial suckers; hectocotylus with deeply excavated ligula that bears a number of well-defined laminae; crop, if present, typically without diverticulum; ink sac absent; radula with homodont or weakly and irregularly multicuspid rachidians; skin usually with papillae; supraocular cirri often present.

To date, the majority of the known species of *Bathypolypus* are concentrated in the Atlantic Ocean. The new species described below represents the first record of *Bathypolypus* in the Pacific Ocean.

Bathypolypus rubrostictus n. sp.

Figures 2–4, 8A–B, Tables 1–3

Material examined

Holotype. Mature male, 20 mm ML, East China Sea, Japan, Ryukyu Archipelago, west of Amami Island, 28°33.25'N, 126°58.11'E, 350 m, collected by T. Kubodera, R/V Hakuho-Maru, bottom trawl, 13 May 2005 (NSMT–Mo. 75584).

Diagnosis

Body small (20 mm ML). Ink sac absent. Stylets absent. Arms short (2–2.5×ML), subequal. Webs deep (WDI: 30.4–36.5), subequal. Enlarged suckers absent. Right third arm of male hectocotylized; shorter than opposite arm (OAI: 78.4) with 43 suckers. Ligula large (LLI: 15), spoon-shaped with 5 deep transverse laminae; calamus large (CaLI: 53.3). Gills with 4–5 lamellae per demibranch. Funnel organ very large; W-shaped; lateral limbs about half length of medial limbs. Male terminal organ straight; diverticulum well developed. Spermatophores long (SpLI: 118.8). Dorsal surface smooth, without papillae. Numerous small brownish red spots on surface of dorsal mantle and webs.

Description

The following description is based on a single mature male. Body small (TL: 84 mm; TW: 8.5 g; ML: 20 mm); mantle shape almost round (MWI: 96). Head slightly narrower than mantle (HWI: 82.1) (Fig. 2A). Funnel short (FLI: 31.7); free funnel length very short (FFuI: 6.9). Funnel organ very large, W-shaped (Fig. 2B); lateral limbs about half length of medial limbs. Stylets absent.

Arms short (2–2.5×ML); subequal in length (AF: 4>3>1>2); normal arms relatively narrow (AWI: 10.4), hectocotylized arm slightly wider (AWI: 14.9). Arm autotomy absent. Arm suckers in two rows; 69–79 suckers on normal arms; suckers small (ASIn: 5); enlarged suckers absent. Webs thick with deep margin (WDI: 30.4–36.5); depths subequal; web formula D>E>B>C>A.

Right third arm in male hectocotylized; shorter than opposite arm (OAI: 78.4); with 43 suckers. Ligula large (LLI: 15); spoon-shaped, copulatory groove thick and wide with 5 transverse laminae; calamus large, almost half size of ligula (CaLI: 53.3); (Fig. 2C, 8B).

Gills with 4–5 lamellae per demibranch.

Digestive tract (Fig. 3A); buccal mass muscular; anterior salivary glands small; posterior salivary glands small (approximately 80% size of buccal mass); oesophagus short, straight; crop slightly inflated; diverticulum absent;

stomach not bipartite; caecum muscular, small in size, not coiled; intestine muscular and short; anal flaps absent; digestive gland ovoid in shape, about 2 times length of buccal mass; ink sac absent.

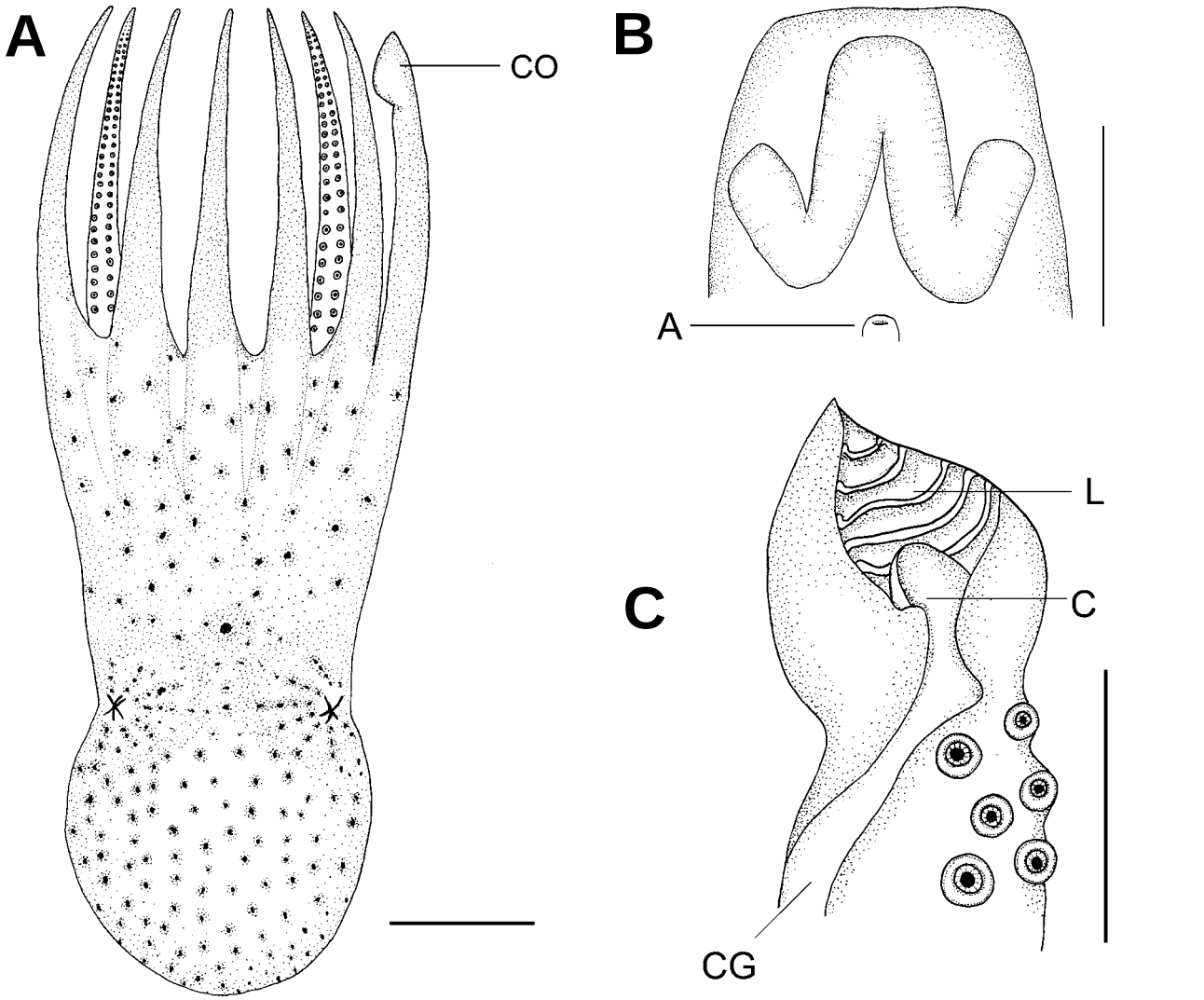

FIGURE 2, *Bathypolypus rubrostictus* n. sp. (Holotype, 20 mm ML male, NSMT–Mo.75584). **A.** Dorsal view (scale bar: 10 mm). **B.** Funnel organ (scale bar: 5 mm). **C.** Hectocotylus (scale bar: 10 mm). Abbreviations: A—anus; C—calamus; CG—copulatory groove; CO—copulatory organ; L—ligula.

Upper beak (Fig. 3B); rostrum sharply hooked; jaw edge rounded; hood medium in size, about one-third of horizontal length of upper beak; crest almost straight, lateral wall broad. Lower beak (Fig. 3C); rostrum short; rostral tip sharp; hood narrow; wings slightly spread; crest gently slope; lateral walls narrow.

Radula with 7 teeth plus 2 marginal plates per transverse row (Fig. 3D). Rachidian tooth with 2 lateral cusps on each side in asymmetrical seriation; first lateral teeth small, sharp; second lateral teeth larger than first, sharp; marginal teeth long, curved, sharply pointed, longer than second lateral teeth; marginal plates flat.

Reproductive tract of mature male (Fig. 4A); testis relatively small; vas deferens duct thin; mucilaginous gland round, robust; spermatophoric gland long, thick; accessory gland thick, long; spermatophore storage sac relatively large; terminal organ short, straight with well-developed diverticulum (TOLI: 24.8).

Spermatophores 4 in number; 1 in spermatophoric gland; 1 in terminal organ; 2 in spermatophore storage sac. Spermatophore (Fig. 4B) long, moderate width (SpL: 24 mm; SpW: 1.8 mm; SpLI: 118.8; SpWI: 8.9); ejaculatory apparatus coiled but not clear; spermatophore reservoir more than half of total spermatophore length (SpRI: 64.5); cap thread long.

Body of specimen when fresh white or reddish white in color; numerous small brownish red spots present on dorsal mantle and webs (Fig. 8A). Fixed specimen pale reddish brown; dorsal surface smooth, without papillae. Numerous small dark brownish red spots on dorsal mantle and webs visible even in preserved specimen.

Etymology

Specific name derived from the Latin *rubro-* and *stictus* meaning “red spotted” in reference to the reddish brown spots on the dorsal mantle surface. Japanese name: Ogura-gunbai-dako.

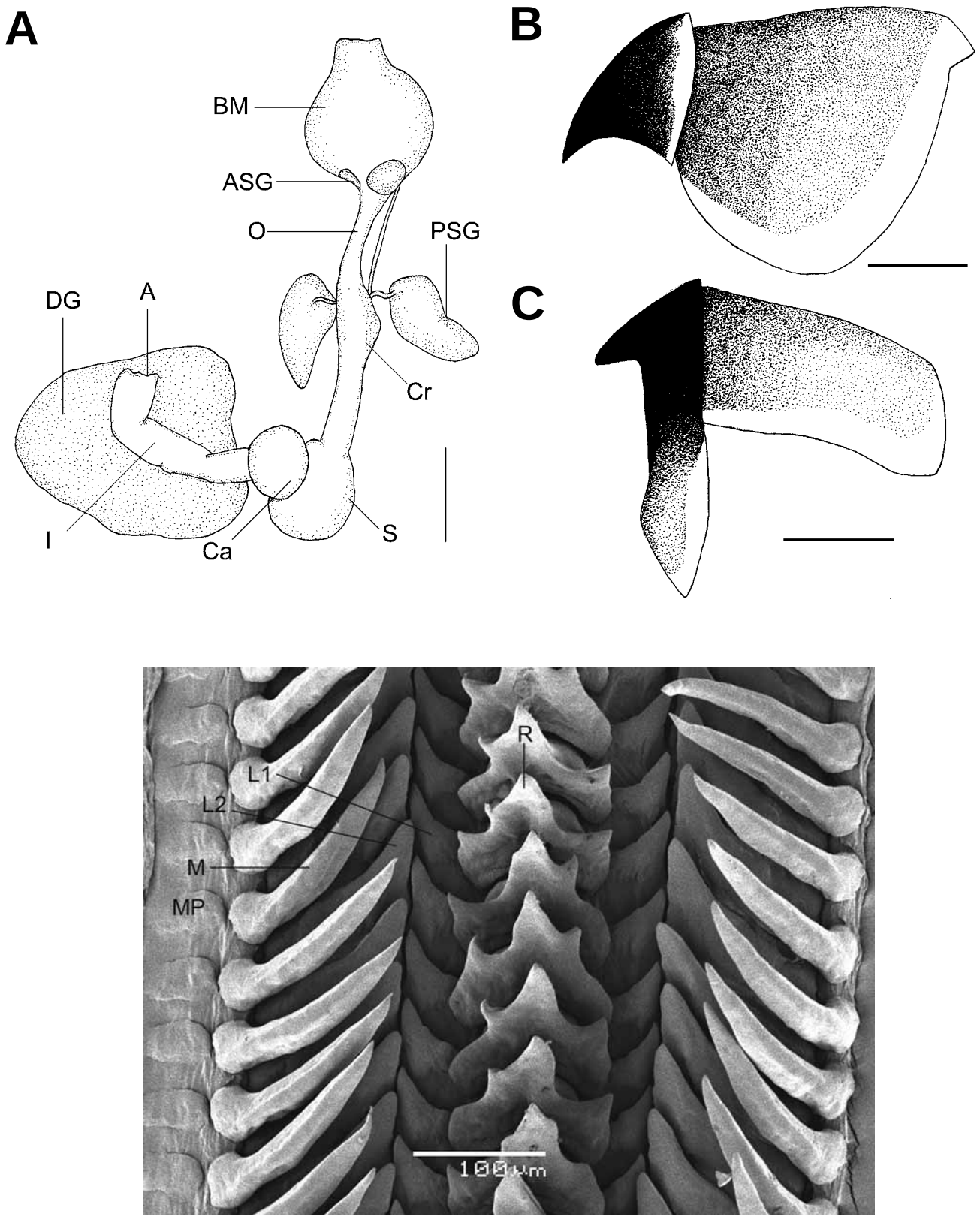

FIGURE 3, *Bathypolypus rubrostictus* n. sp. (Holotype, 20 mm ML male, NSMT–Mo.75584). **A.** Digestive organ (scale bar: 5 mm). **B.** Upper beak. **C.** Lower beak (scale bars: 1 mm). **D.** Radula. Abbreviations: A—anus; ASG—anterior salivary gland; BM—buccal mass; Ca—caecum; Cr—crop; DG—digestive gland; I—intestine; L1—first lateral tooth; L2—second lateral tooth; M—marginal tooth; MP—marginal plate; O—oesophagus; PSG—posterior salivary gland; R—rachidian tooth; S—stomach.

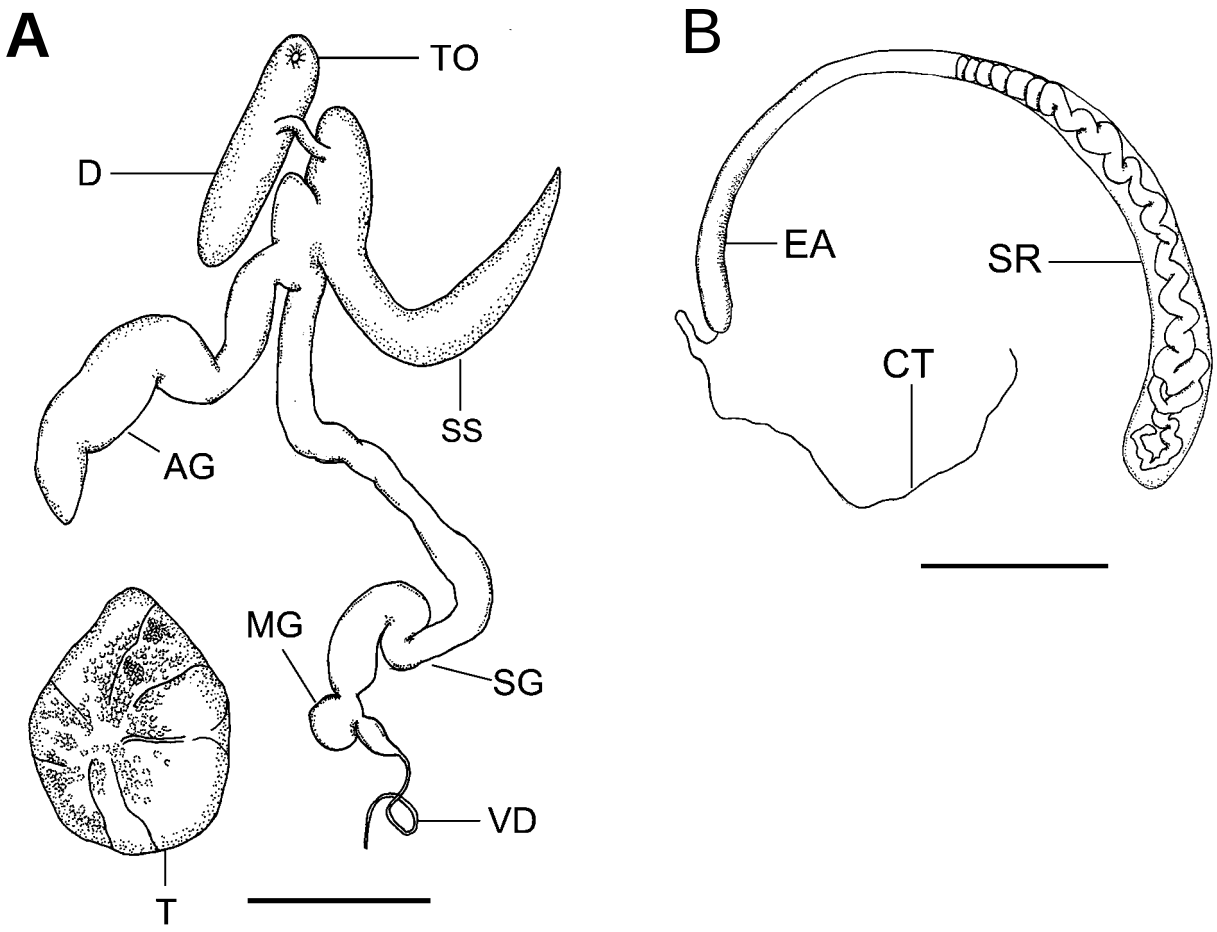

FIGURE 4, *Bathypolypus rubrostictus* n. sp. (Holotype, 20 mm ML male, NSMT–Mo.75584). **A.** Male reproductive tract (scale bar: 10 mm). **B.** Spermatophore (scale bar: 5 mm). Abbreviations: AG—accessory gland; CT—cap thread; D—diverticulum; EA—ejaculatory apparatus; MG—mucilaginous gland; SG—spermatophoric gland; SR—sperm reservoir; SS—spermatophore storage sac; T—testis; TO—terminal organ; VD—vas deferens.

Remarks

Bathypolypus rubrostictus n. sp. is described from a single specimen. Nothing is known about the life history, biology, or distribution of this species. *B. rubrostictus* n. sp. lacks several characters that Muus (2002) used to define the genus *Bathypolypus* and shows some affinities (such as W-shaped funnel organ) with *Benthoctopus salebrosus*, a poorly known species that Muus (2002) removed from the genus *Bathypolypus*. However, the most significant generic characters for *Bathypolypus* are absence of an ink sac and possession of a large, spoon-shaped ligula with distinct laminae. On these grounds we tentatively place this new species in the genus *Bathypolypus*. This genus is reported to contain six valid species (Muus, 2002, Norman and Hochberg, 2005): *Bathypolypus arcticus* (Prosch, 1847), *B. bairdii* (Verrill, 1873), *B. ergasticus* (Fischer & Fischer, 1892), *B. pugniger* Muus, 2002, *B. sponsalis* (Fischer & Fischer, 1892) and *B. valdiviae* (Thiele, in Chun, 1915). The morphology of these species and the new one described here is summarized in Table 3. *B. rubrostictus* is clearly distinguished from the other species based on: much smaller size at maturity; fewer gill lamellae; and W-shaped funnel organ. In addition, the comparatively smooth dorsal surface with a color pattern of reddish spots allows this species to be easily identified.

Genus *Octopus* Cuvier, 1797

Type species: *Octopus vulgaris* Cuvier, 1797

Remarks

Species of the genus *Octopus* are generally characterized by: medium to large body; moderate to long arms (4–7 × ML) with lateral and ventral pair longer than dorsal pair; small ligula (LLI: <3%); diamond pattern of primary papillae on dorsal mantle. Although several species assigned to the genus *Octopus* were moved to new or resurrected genera on the basis of the redefinition of *Octopus sensu stricto* (Norman and Hochberg 2005), many species still exist as ìunplaced *Octopus*î because their characteristics are insufficient to symbolize the characteristics of a new genus.

TABLE 1 Measurements and counts of *Bathypolypus rubrostictus* n. sp. and *Octopus diminutus* n. sp. A–E: web sectors from dorsal to ventral in order. Abbreviations: d—damaged; H—hectocotylus; L—left; R—right; (n)—number of eggs for calculating means.

Species	***B. rubrostictus***	***O. diminutus***			
Status	Holotype	Holotype	Paratype	Paratype	Paratype
NSMT-	Mo. 75584	Mo. 76059	Mo. 76060	Mo. 76061	Mo. 76062
Sex	Male	Male	Male	Male	Female
Total length	84	42	35	44	42
Total weight (g)	8.5	2.2	1.8	1.6	2.6
Dorsal mantle length	20	17	14	13	16
Ventral mantle length	16.9	12.8	11.0	10.0	12.2
Mantle width	19.4	11.1	11.4	10.3	13.2
Head width	16.6	9.8	9.5	9.0	10.5
Funnel length	6.4	6.1	5.1	6.3	6.6
Free funnel length	1.4	3.4	3.6	3.6	4.6
Web depth -A	15.9	8.8	8.8	6.3	7.4
-B L/R	16.4/16.1	8.7/8.8	8.2/7.7	8.5/8.3	7.6/7.2
-C L/R	16.4/15.5	d/8.3	9.4/7.8	8.9/9.1	9.3/8.6
-D L/R	18.6/16.8	7.8/8.8	9.5/8.6	9.0/8.0	7.7/8.5
-E	17.9	7.3	6.0	6.0	7.2
Arm length -1 L/R	48/50	33/37	26/31	30/30	38/43
-2 L/R	48/47	38/38	27/31	30/29	43/41
-3 L/R	51/40	34/32	34/27	30/26	41/d
-4 L/R	51/50	33/30	30/d	28/31	40/39
Arm width	2.1	1.7	1.6	1.5	1.6
Sucker count -1 L/R	70/73	74/79	76/71	73/73	96/86
-2 L/R	75/69	71/80	d/76	78/74	88/80
-3 L/R	70/43H	79/40H	79/39H	69/38H	84/d
-4 L/R	79/73	68/74	69/d	74/74	73/87
Normal sucker diameter	1.0	1.1	0.9	1.0	1.1
Enlarged sucker diameter	-	1.8	1.7	1.6	-
Gill count	4-5	6	5-6	6	6
Ligula length	6.0	3.1	2.7	2.7	-
Calamus length	3.2	1.6	1.8	1.2	-
Terminal organ length	5.0	5.6	2.4	2.5	-
Spermatophore length	24	-	8.5	-	-
Spermatophore width	1.8	-	0.6	-	-
Spermatophore reservoir length	15.5	-	3.4	-	-
Egg length	-	-	-	-	2.3 (10)
Egg width	-	-	-	-	0.8 (10)

TABLE 2 Indices of *Bathypolypus rubrostictus* n. sp. and *Octopus diminutus* n. sp. A–E: web sectors from dorsal to ventral in order. Abbreviations: d—damaged; L—left; R—right.

Species	***B. rubrostictus***	***O. diminutus***			
Status	Holotype	Holotype	Paratype	Paratype	Paratype
NSMT-	Mo. 75584	Mo. 76059	Mo. 76060	Mo 76061	Mo. 76062
Sex	Male	Male	Male	Male	Female
MWI	96.0	66.9	83.2	76.9	81.5
HWI	82.1	59.0	69.3	67.2	64.8
MAI	40.4	48.8	50.7	47.9	41.5
AWI	10.4	10.2	11.7	11.2	9.9
ALI 1 : R/L	247.5/ 247.5	198.8/ 222.9	189.8/ 226.3	223.9/ 223.9	234.6/ 265.4
ALI 2 : R/L	232.6/ 237.6	228.9/ 228.9	197.1/ 226.3	223.9/ 216.4	265.4/ 253.1
ALI 3 : R/L	198.0/ 252.5	204.8/ 192.8	248.2/ 197.1	223.9/ 194.0	253.1/ d
ALI 4 : R/L	247.5/ 252.5	198.8/ 180.7	219.0/ d	209.0/ 231.3	246.9/ 240.7
WDI A	31.2	23.2	25.9	21.0	17.2
WDI B : R/L	31.6/ 32.2	22.9/ 23.2	24.1/ 22.6	28.3/ 27.7	17.7/ 16.7
WDI C : R/L	30.4/ 31.2	d/ 21.8	27.6/ 22.9	29.7/ 30.3	21.6/ 20.0
WDI D : R/L	32.9/ 36.5	20.5/ 23.2	27.9/ 25.3	30.0/ 26.7	17.9/ 19.8
WDI E	35.1	19.2	21.8	20.0	16.7
ASIn	5.0	7.2	6.6	7.5	6.8
ASIe	-	10.8	12.4	11.9	-
FLI	31.7	36.7	37.2	47.0	40.7
FFuI	6.9	20.5	26.3	26.9	28.4
OAI	78.4	84.2	100.0	86.7	-
LLI	15.0	9.7	10.0	10.4	-
CaLI	53.3	51.6	66.7	44.4	-
TOLI	24.8	33.7	17.5	18.7	-
SpLI	118.8	-	62.0	-	-
SpWI	8.9	-	4.3	-	-
SpRI	64.5	-	40.0	-	-
EgLI	-	-	-	-	14.2
EgWI	-	-	-	-	5.0

***Octopus diminutus* n. sp.**

Figures 5–7, 8C–D, Tables 1–2

Material examined

Holotype. Mature male, 17 mm ML, Western Pacific Ocean, Japan, Ryukyu Archipelago, east of Miyako Island,

24×50'N, 125×46'E, 364 m, collected by J. Kosuge, R/V Yoko-Maru, bottom trawl, 26 October 1997 (NSMT–Mo. 76059).

Paratypes. 1 mature male, 14 mm ML, same locality, collector and collection date same as holotype (NSMT–Mo. 76060). 1 mature male, 13 mm ML, same locality, collector and collection date as holotype (NSMT–Mo. 76061). 1 mature female, 16 mm ML, same locality, collector and collection date same as holotype (NSMT–Mo. 76062).

Diagnosis

Body small (13–17 mm ML). Ink sac present. Stylets present. Arms short (2–3×ML), subequal in length. Webs medium in depth (WDI: 16.7–30.3). Enlarged suckers present on arms 1, 2 and 3 of males (ASIe: 10.8–12.4) at level of 6-7th proximal sucker. Right third arm of male hectocotylized; length equal to or slightly shorter than opposite arm (OAI: 84.2–100); with 38–40 suckers. Ligula medium to large (LLI: 9.7–10.4); calamus very large (CaLI: 44.4–66.7). Gills with 5–6 gill lamellae per demibranch. Funnel organ very large; VV-shaped; lateral limbs slightly shorter than medial limbs. Male terminal organ straight; diverticulum well developed. Spermatophore length moderate (SpLI: 62). Dorsal mantle surface rough with numerous small and rounded papillae; dorsal mantle with white spots; pale brown in body colour. Superocular papillae extremely long; compound.

Description

Body small (TL: 35–44 mm; TW: 1.6–2.6 g; ML: 13–17 mm); mantle ovoid (MWI: 66.9–83.2). Head slightly narrower than mantle (HWI: 59.0–69.3); eyes large, pronounced (Fig. 5A). Funnel length short to medium (FLI: 36.7–47.0; FFuI: 20.5–28.4). Funnel organ very large, VV-shaped; lateral limbs slightly shorter than medial limbs (Fig. 5B). Stylets present (length: 4 mm); not mineralized (Fig. 5C).

Arms short (2–3×ML); subequal in length (AF variable); width narrow (AWI: 9.9–11.7). Arm suckers; in 2 rows; normal arms with 68–96 suckers. 2–3 suckers enlarged on arms 1, 2 and 3 of males commencing at level of 6th to 7th proximal sucker (ASIe: 10.8–12.4; ASIn: 6.6–7.5). Webs thin to tip of arms, margin moderate to deep (WDI: 16.7–30.3); web formula typically D>C>A=B > E.

Right third arm in males hectocotylized; equal or slightly shorter than opposite arm (OAI: 84.2–100). Hectocotylized arm with 38–40 suckers. Ligula muscular, large (LLI: 9.7–10.4); calamus very large, distal tip pointed, almost half length of ligula (CaLI: 44.4–66.7). Copulatory groove thick and wide (Fig. 5D, 8D).

Gills with 5–6 lamellae per demibranch.

Digestive tract (Fig. 6A); buccal mass muscular with thick lip; anterior salivary glands small; posterior salivary glands approximately equal in length to buccal mass; oesophagus straight, narrow; crop diverticulum well developed; stomach bipartite; caecum muscular, approximately twice size of stomach, but not coiled; intestine muscular, long; anal flaps inconspicuous; digestive gland ovoid in shape, twice size of buccal mass. Ink sac well developed, not buried in ventral surface of digestive gland.

Upper beak (Fig. 6B); rostrum sharply hooked; jaw edge rounded; hood small, about 25% length of upper beak; crest rounded, lateral wall broad. Lower beak (Fig. 6C); rostrum short; tip rounded; hood narrow; wings spread; crest slightly rounded; lateral walls narrow.

Radula with 7 teeth plus 2 marginal plates per transverse row (Fig. 6D). Rachidian tooth with 1–2 lateral cusps on each side (typically 2 cusps) in asymmetrical seriation; first lateral teeth very small; second lateral teeth larger than first; marginal teeth long, curved, sharply pointed; marginal plates flat, wide, smooth.

Reproductive tract of mature male (Fig. 7A); testis small; vas deferens duct thin, highly coiled; spermatophoric gland long and thick; accessory gland thick and long; spermatophore storage sac relatively large, more than twice length of terminal organ; terminal organ straight, variable in size, enlarged when spermatophore included (TOLI: 17.5, 18.7 in paratypes; 33.7 in holotype); diverticulum well developed.

Spermatophore (Fig. 7B); narrow, moderate length (SpL: 8.5 mm; SpW: 0.6 mm; SpLI: 62; SpWI: 4.3). Two spermatophores present in storage sac. Ejaculatory apparatus tightly coiled but details indistinct in material examined; reservoir about half length of spermatophore (SpRI: 40); cap thread short.

Reproductive tract of mature female (Fig. 7C); ovary large, round; proximal oviducts short; distal oviducts short, about twice length of proximal oviducts; oviducal glands dark in colour with numerous radiating chambers. Mature ovarian eggs (Fig. 7D); numerous, relatively small (EgL: 2.3 mm; EgW: 0.8 mm, EgLI: 14.2, EgWI: 5.0).

Body of preserved specimens pale brown in colour. Dorsal surface rugose with numerous small rounded papillae. Single long compound superocular papilla present above each eye; numerous moderate sized papillae also present around eye with several scattered on dorsal mantle, but not in an obvious diamond-shaped pattern. Dorsal mantle with white spots (*sensu* Packard and Sanders 1971) visible in some specimens (Fig. 5A, 8C).

Etymology

Specific name derived from the Latin word meaning “diminutive” in reference to its tiny size at maturity. Japanese name: Tsunonaga-ko-dako.

Remarks

Octopus diminutus n. sp. is known only from the type locality. Nothing is known about the life history, habitat, or distribution of this tiny octopus. *Octopus diminutus* is distinguished from *Octopus s.s.* based on the following characteristics: (1) short arms (2–3×ML vs. 3–5×ML); and (2) large ligula (LLI: 9.7–10.4 vs. < 4). However, the characteristics of the new species are insufficient at this stage to support placement in a new genus. Following Norman and Hochberg (2005), we designate the generic status of this species as “unplaced *Octopus*”.

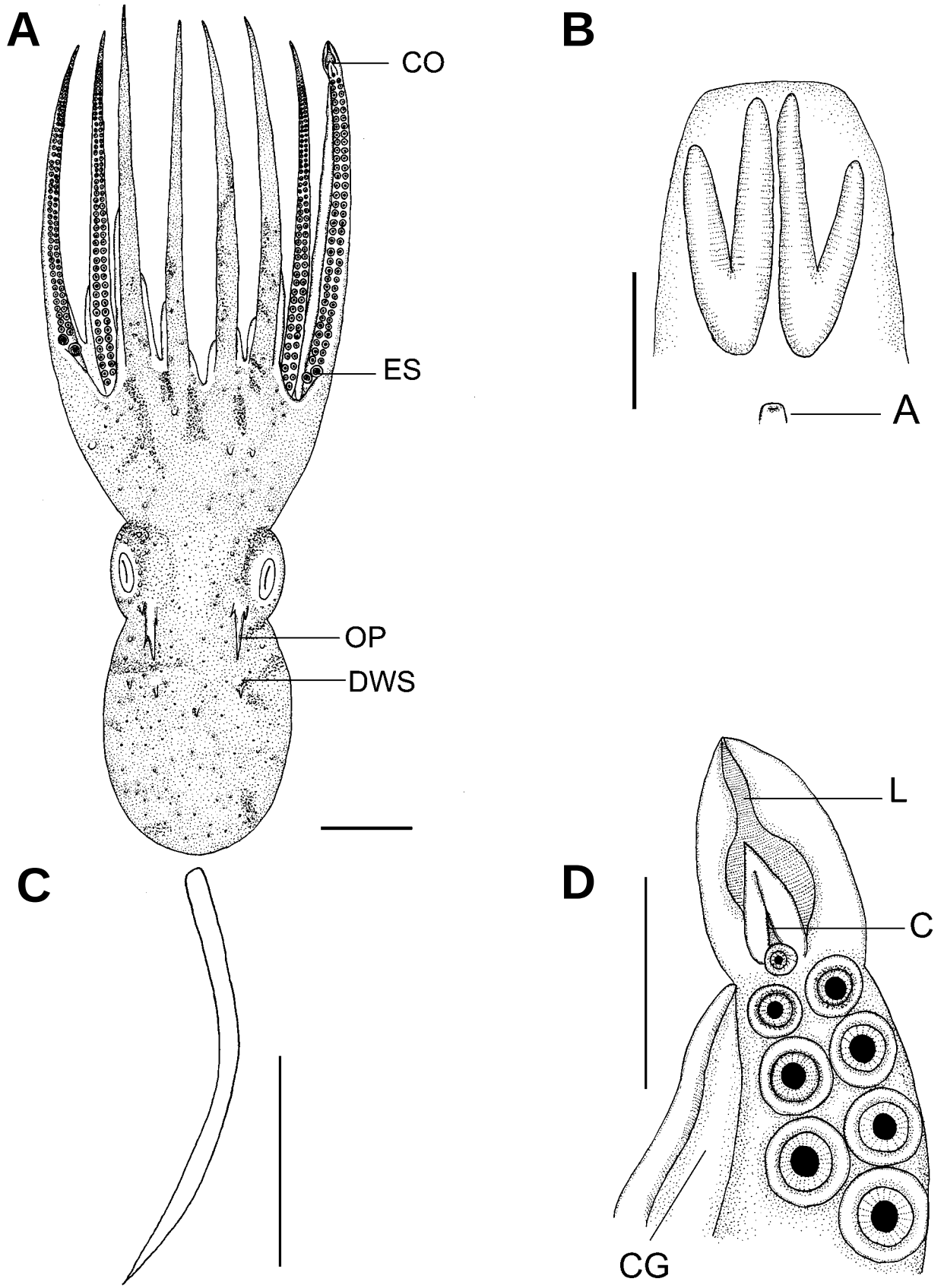

FIGURE 5, *Octopus diminutus* n. sp. (Holotype, 17 mm ML male, NSMT–Mo.76059). **A.** Dorsal view (scale bar: 5 mm), **B.** Funnel organ (scale bar: 3 mm), **C.** Stylet (scale bar: 2 mm) **D.** Hectocotylus (scale bar: 3 mm). Abbreviations: A—anus; C—calamus; CG—copulatory groove; CO—copulatory organ; DWS—dorsal white spots; ES—enlarged sucker; L—ligula; OP—ocular papillae.

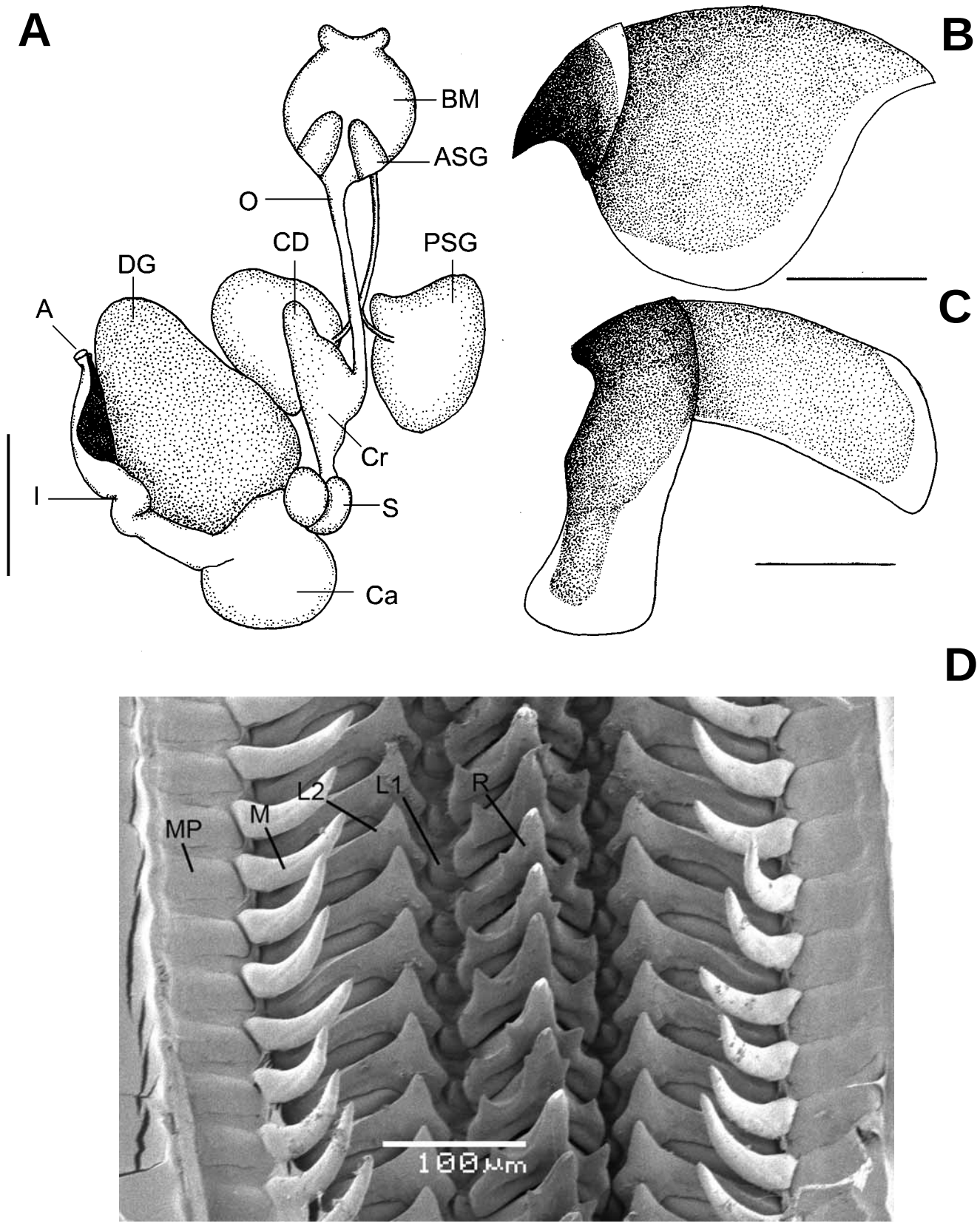

FIGURE 6, *Octopus diminutus* n. sp. **A.** Digestive organ (Holotype, 17 mm ML male, NSMT–Mo.76059, scale bar: 5 mm). **B.** Upper beak. **C.** Lower beak (Paratype, 13 mm ML male, NSMT–Mo.76061, scale bars: 1 mm). **D.** Radula (Holotype, 17 mm ML male, NSMT–Mo.76059). Abbreviations: A—anus; ASG—anterior salivary gland; BM—buccal mass; Ca—caecum; CD—crop diverticulum; Cr—crop; DG—digestive gland; I—intestine; IS—ink sac; L1—first lateral tooth; L2—second lateral tooth; M—marginal tooth; MP—marginal plate; O—oesophagus; PSG—posterior salivary gland; R—rachidian tooth; S—stomach.

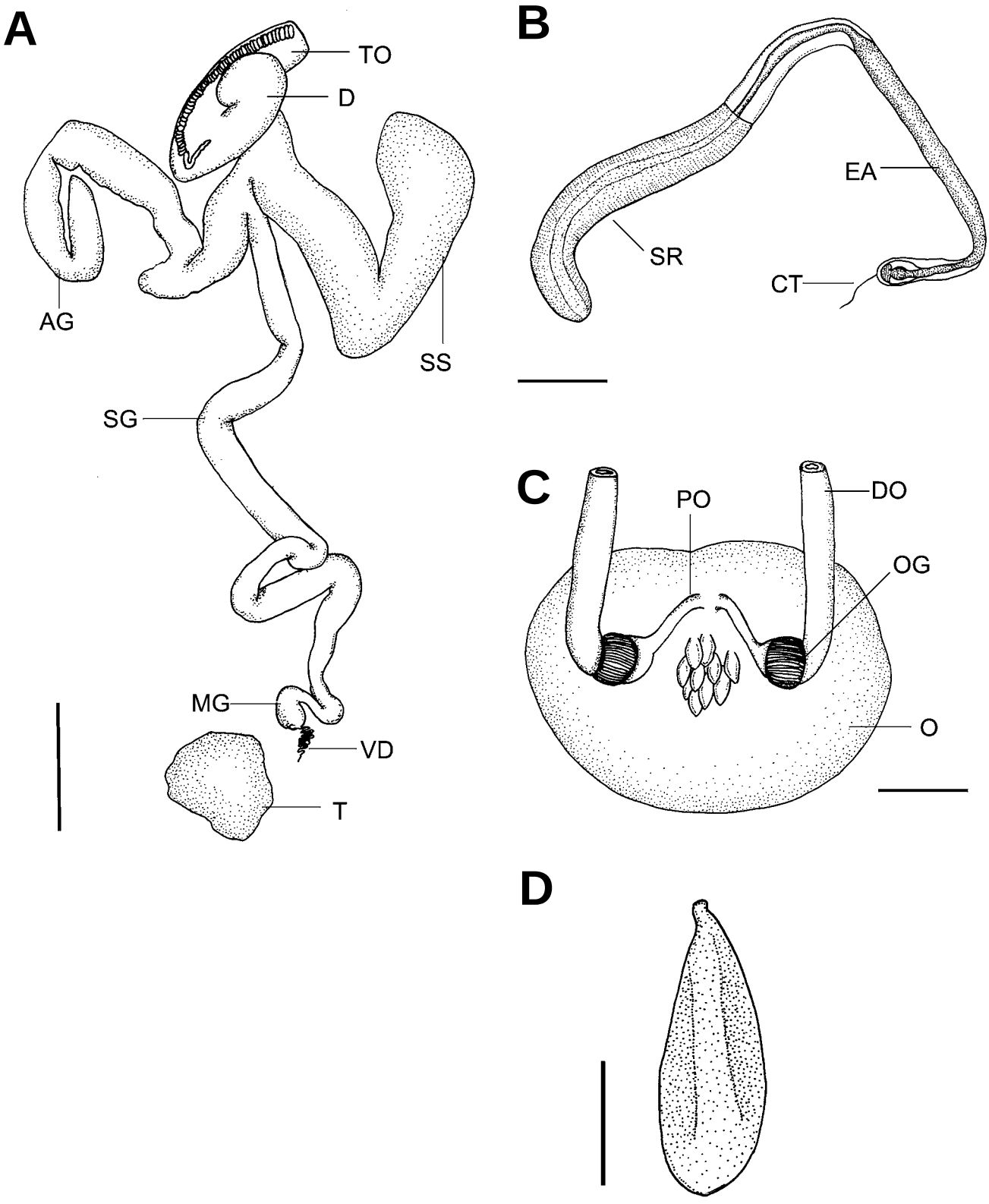

FIGURE 7, *Octopus diminutus* n. sp. **A.** Male reproductive tract (scale bar: 5 mm). **B.** Spermatophore (scale bar: 1 mm) (Holotype, 17 mm ML male, NSMT–Mo.76059). **C.** Female reproductive tract (scale bar: 3 mm). D. Ovarian eggs (scale bar: 1 mm) (Paratype, 16 mm ML female, NSMT–Mo.76062). Abbreviations: AG—accessory gland; CT—cap thread; D—diverticulum; DO—distal oviduct; EA—ejaculatory apparatus; MG—mucilaginous; O—ovary; OG—oviducal gland; PO—proximal oviduct; SG—spermatophoric gland; SR—sperm reservoir; SS—spermatophore storage sac; T—testis; TO—terminal organ; VD—vas deferens.

FIGURE 8, Photograph of holotype specimens. **A, B.** *Bathypolypus rubrostictus* n. sp. (Holotype, 20 mm ML male, NSMT-Mo.75584). **C, D.** *Octopus diminutus* n. sp. (Holotype, 17 mm ML male, NSMT-Mo. 76059).

Octopus diminutus matures at a much smaller size than other *Octopus* species reported from mid-depths to deep waters in the Indo-West Pacific. *O. micros* Norman, 2001 reported from mid-water depths (100–200 m) off the south eastern Australia shows some similarities, but *O. diminutus* is distinguished from *O. micros* by the presence of enlarged suckers on male arms, and by the the shape of the funnel organ (VV vs. W) (Norman 2001).

TABLE 3. Morphological comparison of *Bathypolypus* species. Abbreviations: A—eastern American population; Approx—approximately; NA—North Atlantic population; NS—not stated. Single asterisk: original description. Double asterisks: Data includes type specimen. Triple asterisks: Data based on type specimen of *B. grimpei* (synonym of *B. vairdii*).

Species	***B. rubrostictus* n. sp.**	***B. arcticus* (Prosch, 1847)**	***B. bairdii* (Verrill, 1873)**	***B. ergasticus* (Fischer & Fischer, 1892)**	***B. pungniger* Muus, 2002**	***B. sponsalis* (Fischer & Fischer, 1892)**	***B. valdiviae* (Thiele, in Chun , 1915)**	***B. salebrosus* (Sasaki, 1920)**
Data source	Present paper	Prosch, 1847* Muus, 2002**	Verrill, 1873* Muus, 2002**	Fischer & Fischer, 1892* Robson, 1932** Muus, 2002**	Muus, 2002*	Fischer & Fischer, 1892* Robson, 1932** Muus, 2002**	Robson, 1932***	Sasaki, 1920*
Type locality	Amami Is. (southern Japan)	Greenland	Campo Bello I. (Canada)	Sahara	Iceland (Faroe)	Sahara	Namibia	Kinka-san Okhotsk Sea
Mantle length (mm)	20	to 70	to 60	45	to 50	27–41	30	40 (ventral)
Arm length (×ML)	2–2.5	1.9–2.3	1.7–2	about 3–4	1.5	about 2–3	about 2–3	2–2.5
Web depth (WDI)	30.4–36.5	33–34	27–36	20–28	-	25–33	33–41	about 30
Funnel organ shape	W	VV	VV	VV	VV	VV	V V	W
Gill lamellae	4–5	6–7	6–8	7–8	6–7	7	6	9–10
Number of suckers on Hctocotypus arm	43	40	26–40 (A) 35–49 (NA)	73–83	31–45	44–55	45	-
Ligula length (LLI)	15	9–23	24–44 (A) 18–38 (NA)	7–13	22–34	14–22	13–18	-
Calamus length (CaLI)	53.3	20	Approx. 20	30–40	26–51	57–71	NS	-
Number of transverse laminae	5	13–17	9–-10	7	4–6	6	4–5	-

Discussion

Recent systematic studies on mid-depth to deep water benthic octopuses revealed that some of them possess unique characters that make them separable from hitherto known genera, and several new genera have been erected (Allcock *et al*. 2003; Allcock *et al*., 2004; Gleadall 2004; Gonzalez *et al*. 1998; Norman *et al*. 2004a; Norman *et al*. 2004b; Vecchione *et al*. 2005). Although the two new species described above possess distinct specific characteristics, their generic status needs to be critically re-evaluated. Further investigation on both *Bathypolypus* and *Octopus* is required and a more detailed generic revision is necessary that includes molecular analyses (Guzik *et al*. 2005).

The octopus fauna beyond the continental shelf (> 200 m deep) around the Ryukyu Archipelago, and for that matter, throughout the Indo-West Pacific, is still poorly understood and little is known of the phylogenetic relationships between the deep-sea and shallow-water faunas of the region. Norman *et al*. (1997) reported that the benthic octopus fauna in water depths ranging from 200 to 1000 m in the Banda and Arafura Seas showed no overlap with shallow-water faunas of this area and they proposed that there were no clear phylogenetic affinities between the shallow-water species and species in water deeper than 200 m at the same latitude. This trend may also be true in the faunas off the Ryukyus, and probably other parts of the region, but further investigation is required, as is accumulation of more specimens from this area.

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