

An Unusual Squid from the Sea of Japan, *Enigmocranchia nipponica*, New Genus and New Species (Cephalopoda: Decembrachiata: Cranchiidae)

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Abstract: Three unusual squids fished in the western Sea of Japan, off Hamasaka, Shinonsen-machi, Hyogo Prefecture, are described here as *Enigmocranchia nipponica*, a new genus and a new species of the family Cranchiidae. It is characterized by having a barrel-shaped mantle that is densely beset by cutaneous tubercles over the entire surface, and black-pigmented end-organs on all arms.

Key words: Cranchiidae, new genus, new species, cutaneous tubercles, end-organs.

Introduction

Two unusual squid were caught by bottom trawl fisheries in the western Sea of Japan in 2004, off Hamasaka, Shinonsen-machi, Hyogo Prefecture. The specimens, preserved in ca. 4% formaldehyde solution were brought to us by Dr. H. Ikezawa of Ibaraki Nature Museum. We were initially reminded of a member of the genus *Cranchia* because of the rough skin on the globose mantle. However, closer observation led us to conclude that the specimens could not be placed within any of the nominal genera of the family Cranchiidae.

In recent a study of the cephalopod fauna found off the southwestern Sea of Japan along San'in district, Wada and Masuda (2013) reported 53 species from 18 families among which one squid individual was reported as an undescribed Cranchiidae sp. Judging by the short description and several photos provided by them, it was apparent that their undescribed Cranchiidae sp. was the same species as ours. We borrowed the specimen and close examination confirmed this was indeed the case.

In this study, we describe a new species of the family Cranchiidae based on three individuals and establish a new genus to accommodate this species.

Taxonomy

Family **Cranchiidae** Prosch, 1849

Enigmocranchia n. gen.

Diagnosis. Cranchiidae having barrel-shaped mantle, which is densely beset over its entire surface by cutaneous tubercles, and black-pigmented, leaf-shaped end-organs on all arms. Photophores on eyeball round and well spaced.

Type species. *Enigmocranchia nipponica* n. sp.

Remarks. The mantle tubercles, unlike those in *Cranchia*, are not cartilaginous, but they are cutaneous and round. Inverted V-shaped cartilaginous streaks are present in the position of the mantle-funnel fusion but there are no funnel stellate tubercles. Black-pigmented, lobe-like end-organs on the arms are common within some cranchiid genera; for example, they are found on all arms in *Cranchia*, and arm III in *Leachia* (Voss, 1980). This genus may be placed in the subfamily Cranchiinae, as it has cutaneous ornamentation and round photophores spaced around the eyeball, unlike the crescent or sigmoid ones seen in the subfamily Taoniinae. But, it is unique among the subfamily in lacking cartilaginous tubercles at the position of mantle-funnel fusion, which is common in *Cranchia*, *Liocranchia* and *Leachia*.

Etymology. *Enigmo* is prefixed to *Cranchia*, because of enigmatic appearance of this taxon among subfamily Cranchiinae.

***Enigmocranchia nipponica* n. sp.**

(Figs. 2–4, Table 1)

Materials examined. Holotype specimen (NSMT-Mo85531: ex-INM-1-048302): gladius length 122.4 mm, female. Trawled by fishing boat, *Kohriki-Marui*, by Mr A. Uno, on March 7, 2004, in the western sector of the Japan Sea, off Hamasaka, Shinonsen-machi, Hyogo Prefecture, at a depth around 100–200 m. No accurate latitudinal and longitudinal data available. Approximate location is shown in Fig. 1. Paratype #1 specimen (NSMT-Mo 85532: ex-INM-1-048301): gladius length 155.3 mm, female. Trawled by the same boat and same fisherman at the same locality as above on March 15, 2004. Paratype #2 specimen (HCA-Mo-906): Mantle length 157 mm, female. Trawled by the same boat and same fisherman at the same locality as above on March 6, 2002.

Description. Mantle plump, barrel-shaped, rather leathery, entirely ornamented by densely beset minute cutaneous tubercles, which are mostly round, but occasionally polygonal or irregularly-shaped, each with several acute cartilaginous spines distally (Fig. 2A–D). Gladius visible along mid-dorsum. Lanceola occupy posterior quarter of gladius. Anterior mid-dorsal end of mantle pointed, fused with head. Ventral excavation shallow with blunt apex on each side where fused with base of funnel. Inverted V-shaped lines of short rami visible at position of mantle-funnel fusion, but neither cartilaginous streaks nor tubercles present (Fig. 3A).

Fins small, thin, squarish oval in outline. Both lobes united, with median cleft posterior to end of gladius; posterior margin extends beyond posterior tip of mantle. Cutaneous tubercles beset dorsal surface of fin, but ventral side free from tubercles (Fig. 2A–B).

Funnel strong, broad basally, conical, reaching to midpoint of eyes. Funnel elements not well preserved, but dorsal element of funnel organ seemingly inverted V-shaped with low crest, but ventral elements indiscernible.

Head small, sub-cubic, skin smooth. Eyes huge, with at least 14 round, photophores of variable sizes arranged in two rows (8–9 inner row, 6–7 outer row) on ventral surface of eyeball (Fig. 3A). Their arrangement may be somewhat modified by fixation and handling.

Buccal connectives DDVV-type.

Arms muscular, with biserial suckers. Aboral keel and oral protective membrane absent. Interbranchial webs A, B and C, narrow and thin, 8–10% of arm lengths. Black-pigmented leaf-shaped end-organ present on tips of all arms (Fig. 2E). Arm formula III>II>IV>I. Arms I shortest, with about 28 suckers; distal suckers extremely minute, primarily biserial, but appear as if in

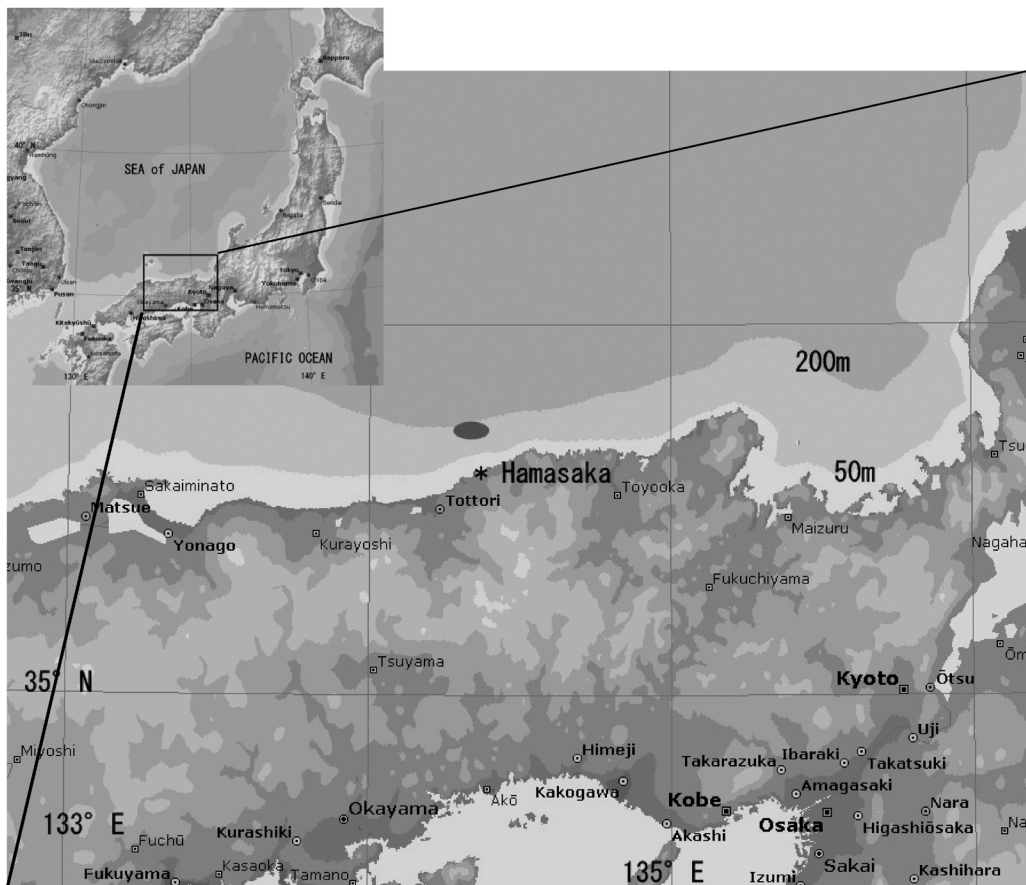


Fig. 1. Map showing approximate collection locality of type specimens (oval).

single zigzag row. Arms II twice as long as arms I, with approximately 35 suckers in zigzag to biserial arrangement. End-organs on arms I and II composed of semi-circular crests attached laterally on arm tips. Aboral surfaces of crests with narrow, white, longitudinal keels, otherwise totally black. Central part on oral side flattened, non-pigmented, smooth. Arms III nearly twice as long as arms II, robust, with about 45 suckers in zigzag or biserial rows. End-organs on arms III differ from those on remaining arms, long, thick, about one-third as long as arm itself, flat, spatulate, non-pigmented (both oral and aboral sides), but margined by black skin; never folded, unlike those on other arms (Fig. 2F). Arms IV second weakest of all, morphologically similar to arms I and II, with about 45 suckers and end organ. Large arm sucker rings carry several blunt teeth along distal margin. Proximal margin undulating or wavy. Hooks absent.

Tentacles missing in holotype and paratype #1, only short remnants present between arms III and IV (Fig. 2E). Paratype #2 has both tentacles, long and thin, length equal to mantle length, with slightly expanded club at distal end (Fig. 4A). Club about 1/6 of tentacle length. Oral surface of club ornamented with about 100 suckers in four rows. About 15 suckers at middle portion are largest, suckers decreasing in size on each side (Fig. 4B). Sucker rings of large suckers bear 16–18 teeth (Fig. 4C). Suckers on dactyls are minute, arranged in four rows. Several carpal suckers and pads appear in proximal portion of club. Small suckers scattered in single row along ten-

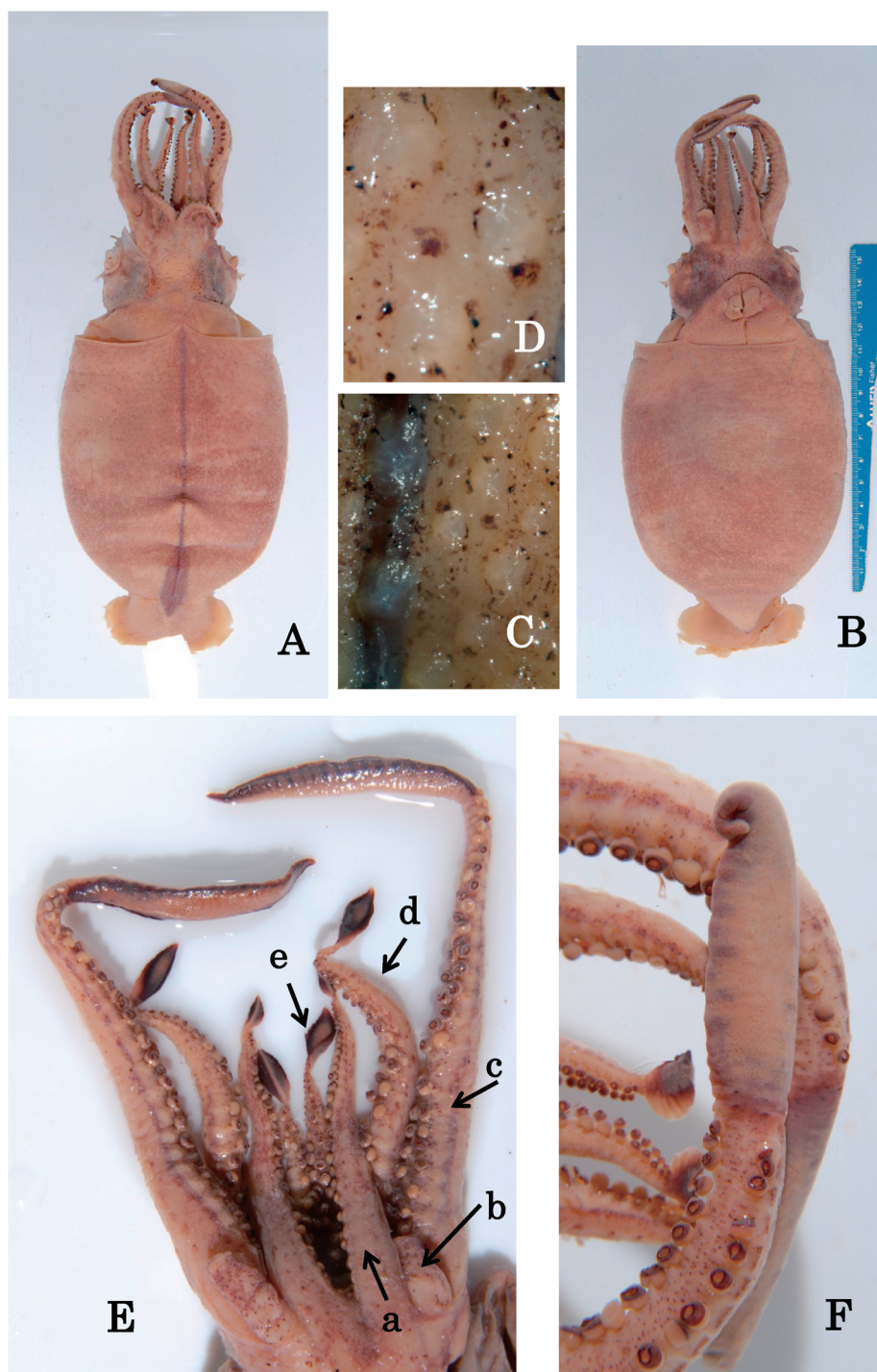


Fig. 2. Holotype. A, dorsal view; B, ventral view; C, D, close-up view of cutaneous tubercles at middle portion of dorsal mantle; E, ventral view of arms (a, arm IV; b, short remnant of tentacle; c, arm III; d, arm II; e, arm I); F, oral surface of arm III.

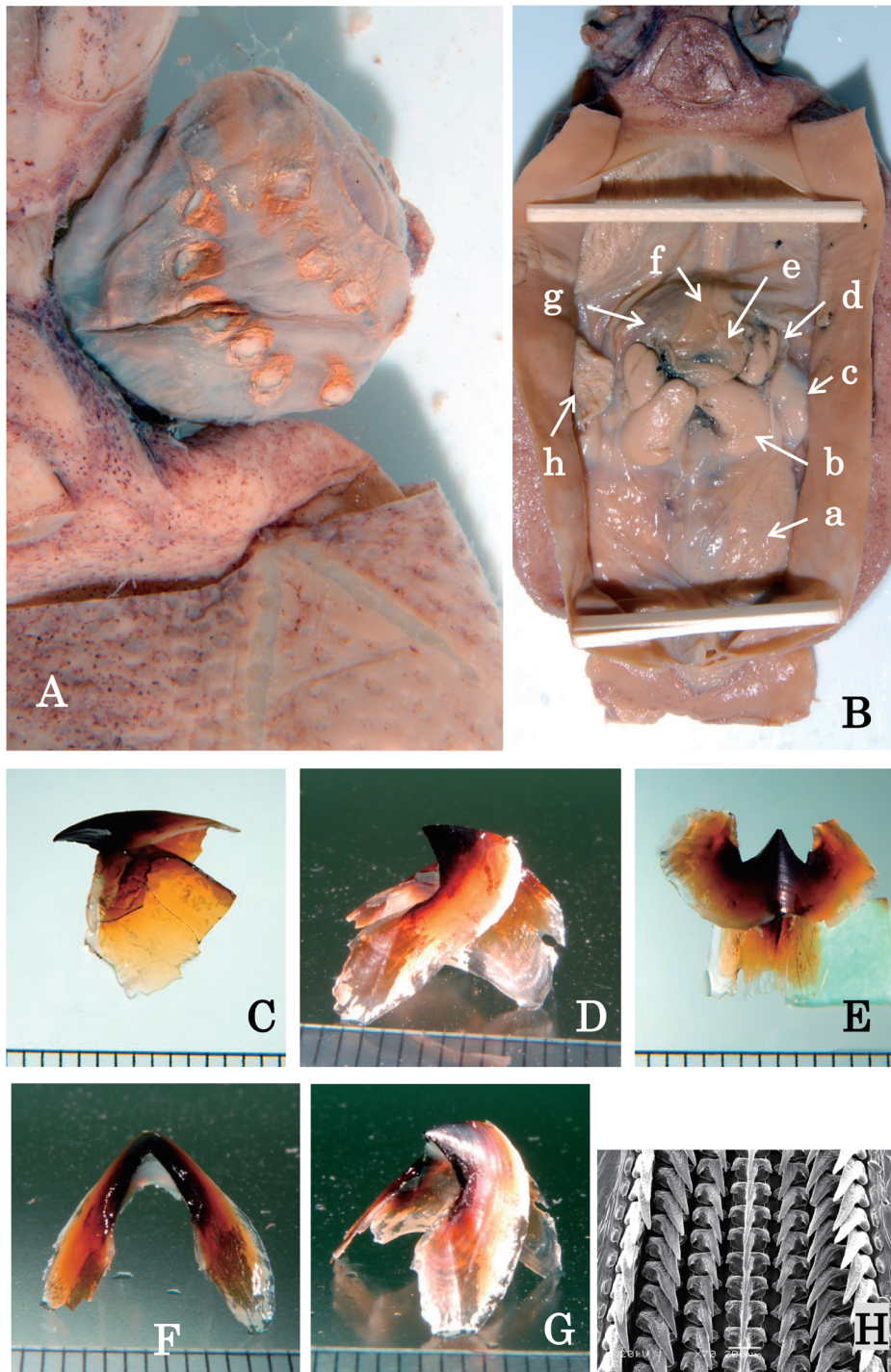


Fig. 3. Paratype #1. A, left eyeball and inverted V-shaped lines of short rami at funnel fusion; B, ventral view of internal organs (a, ovary; b, nidamental gland; c, oviduct; d, oviducal gland; e, intestine; f, anus; g, gill, h, liver); C, lateral view of upper beak; D, lateral view of lower beak; E, ventral view of lower beak; F, posterior view of lower beak; G, oblique view showing jaw edge; H, radula.

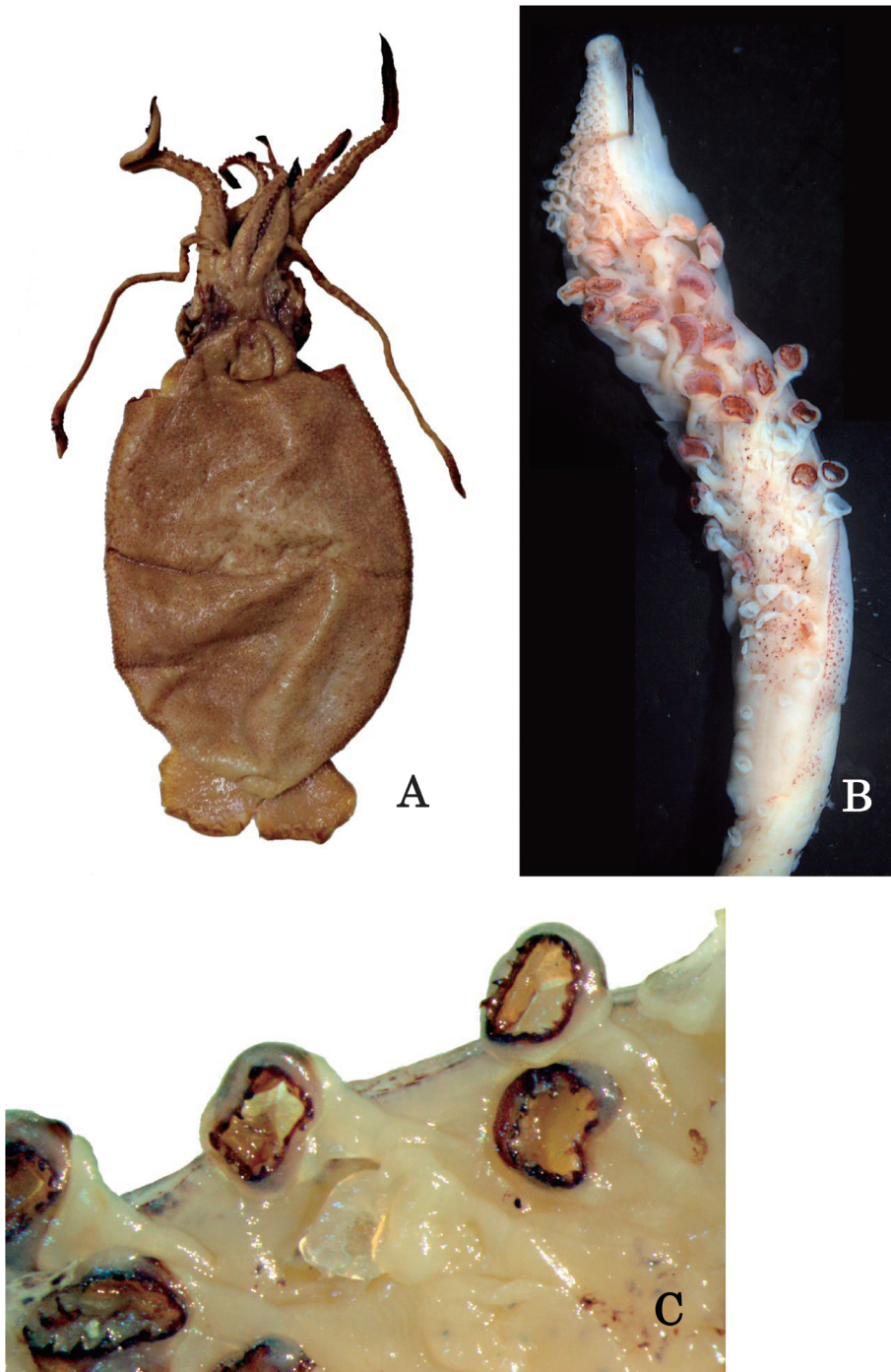


Fig. 4. Paratype #2. A, ventral view; B, right tentacular club; C, closed up view of suckers at middle portion of club. Photos A and C from Wada and Masuda (2013).

tacular stem.

All three individuals are immature females. Paratype #1 has large submature ovary in posterior portion of visceral mass, pair of large nidamental glands medially. Oviducts dorso-lateral to

Table 1. Measurements of type specimens of *Enigmocranchia nipponica* n. sp. (in mm).

	Holotype	Paratype #1	Paratype #2
Mantle length (= gladius length)	122.4	155.3	157.0
Mantle width	93.7	109.3	115.0
Fin length	30.6	30.0	32.0
Fin width	52.4	58.2	74.5
Head length	34.4	29.8	33.4
Head width	52.5	58.1	47.0
Eye diameter	25.2	25.0	27.6
Funnel length	29.6	19.8	28.3
Funnel base width	55.5	68.3	58.0
Right arm I length (end-organ length)	20.0 (5.5)	31.6 (9.2)	61.0 (12)
Right arm II length (end-organ length)	57.6 (5.6)	60.7 (9.5)	79.0 (12)
Right arm III length (end-organ length)	90.7 (21.4)	105.0 (33.1)	113.0 (35)
Right arm IV length (end-organ length)	55.1 (3.0)	45.1 (2.9)	66.0 (6)
Tentacle remnant length	15.1	16.1	—
Tentacle length (club length)	—	—	157.0 (26.0)

nidamental glands with round oviducal glands connecting anteriorly. Liver lies between oviducal glands; short intestine and ink sack present (Fig. 3B).

Beaks and radula were removed from paratype #1.

Upper beak with gently curved rostrum and pointed tip. Upper rostral length ca. 4.0 mm. Jaw angle slightly obtuse. Rostrum and shoulder region darkly pigmented. Hood large, merging into narrow wings laterally. Cutting edge almost straight. Lateral wall damaged during handling. Hood, wings and lateral walls lightly pigmented, periphery transparent (Fig. 3C).

Lower beak with short rostrum and pointed tip. Jaw edge gently curved to jaw angle. Lower rostral length ca. 3.2 mm. Jaw angle obscure, continuing to wing shoulder. Hood broad, merging into broad round wings. Wing fold rises along jaw angle and forms deep shoulder groove. Profile of lateral wall nearly parallel without apparent fold. Rostrum, jaw edge and shoulder regions darkly pigmented. Wings and lateral walls lightly pigmented, periphery narrow, transparent (Fig. 3D–G).

Radula with seven transverse rows of teeth. Rhachidian teeth squarish in shape with sharp pointed central cusp and small blunt cusps at both upper corners. First lateral teeth almost same height as rhachidian teeth, scalene triangular with small round-top cusp on outer side. Second lateral teeth twice as long as first lateral teeth, also scalene triangular. Third lateral teeth long, saber-like in shape, curved inwardly and little taller than second lateral teeth. Tiny round peg on outer margin (Fig. 3H).

Etymology. The species name is derived from the name of the type locality, Nippon (=Japan).

Remarks. At first glance, this taxon resembles *Cranchia scabra* Leach, 1817, which is the only member of the genus *Cranchia* (e.g. Clark, 1966; Voss, 1980; Nesis, 1987). However, the tubercles covering the mantle surface of the present new species are not cartilaginous and polygonal, but low, round, oval or irregular-shaped and cutaneous, thus differing from the stellate or polygonal tubercles of *C. scabra*.

There is no linear (as in *Leachia*) or inverted V-shaped (as in *Cranchia* and *Liocranchia*) cartilaginous streaks at the position of the mantle-funnel fusion. In that position, only inverted V-shaped lines are barely visible. These characters may indicate that the present specimens are appropriately allocated within the Cranchiinae. Voss (1980) defined the subfamily Cranchiinae, stating that, "... modification of arm tips into brachial end-organ present on III or on all

pairs . . .”, in spite of the fact that specimens of *C. scabra* having end-organs on all arms have never been reported so far we are aware. Also, none of the mature specimens of *C. scabra* that we have examined have end-organs.

The cephalopod fauna around Japan has been continuously studied since the early nineteenth century and more than 200 species are recognized as occurring in this region (Sasaki, 1929; Kubodera, 2002; Okutani, 2005; Wada and Masuda, 2013). Despite such extensive survey, the present new species with its obvious and unique morphological characters has not been found until now. It is also very strange that all the type specimens were caught at the same locality, by the same fishermen using the same fishing gear and almost same month of the year. The fact that all are immature females, indicates they are reproductively active in this region. Further research on mature males and the early life of *E. nipponica* is needed.

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