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# FOUR NEW OCTOPUS SPECIES OF THE *OCTOPUS MACROPUS* GROUP (CEPHALOPODA: OCTOPODIDAE) FROM THE GREAT BARRIER REEF, AUSTRALIA

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**Abstract**

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Four new species of shallow-water octopuses are described from tropical waters of the Great Barrier Reef, Australia. All four are members of the "*Octopus macropus* group" (Robson, 1929), characterised by arms of unequal length with the dorsal pair longest (AF 1.2.3.4), moderate to high gill lamellae counts (10–14 per demibranch) and a robust conical copulatory organ. All are nocturnally active. Two species, *O. alpheus* and *O. aspilosomatis* spp. nov., occur in clear waters foraging predominantly on intertidal coral reefs and offshore islands. *O. dierythraeus* sp. nov. forages intertidally and subtidally on muddy substrates in coastal waters. *Octopus graptus* occurs in more open waters, on sandy and mud substrata in the channels and flat bottoms between islands. Full morphological descriptions are provided, along with details of known distributions, life history and commercial exploitation. Delineation of each species from related taxa is discussed.

## Introduction

A number of workers have recognised the distinctive group of octopus species often referred to as the "*Octopus macropus* group" (Robson, 1929; Adam, 1941; Taki, 1944, 1964; Voss, 1981). Members of this species group are found in most tropical and temperate waters of the world and are characterised primarily by elongate arms with the dorsal pair longest (AF 1.2.3.4), moderate to high gill counts (10–14 per demibranch), a moderately large cylindrical copulatory organ with deep grooved ligula, and nocturnal activity patterns.

The species from which this group derives its name, *Octopus macropus* Risso, 1826, was described from the Mediterranean Sea. This species appears limited to the Mediterranean Sea and temperate eastern Atlantic (Hochberg, Mangold and Norman, in prep.). A number of species from Indo-West Pacific waters show close morphological and behavioural similarities with *O. macropus*. As a consequence, many of these species have regularly, and inappropriately, been assigned the name *O. macropus*, both within Australian waters [Girard, 1890; Brazier, 1892; Odhner, 1917; Nesis, 1982 (plate in 1987 abridged translation); Lu and Phillips, 1985], as well as elsewhere in the Indo-West Pacific region (Joubin, 1894, 1898; Goodrich, 1896; Hoyle, 1904; Berry, 1912, 1914; Wülker, 1913, 1920; Massy, 1916; Sasaki, 1920; Robson, 1926, 1929, 1932; Boone, 1938; Adam, 1939, 1942, 1946, 1954, 1959, 1960, 1973; Rees and Stuckey, 1954; Voss, 1963; Roper et al., 1984).

Sasaki (1920) was the first to question the supposed wide distribution of *O. macropus*, when tentatively assigning the name to a Japanese species: "(there is) much doubt whether the species extends as far as the Japanese waters from its home; that is, the Mediterranean Sea". Significant physical and temperature boundaries separate the distribution of the Indo-West Pacific species from that of *O. macropus* and there is no doubt that the Indo-West Pacific species are distinct taxa. A major review of the Indo-West Pacific members of the *O. macropus* group is required, including re-examination of species names from these waters previously synonymised under *O. macropus* (Robson, 1929; Roper et al., 1984).

Recent research into the shallow-water octopuses of the Great Barrier Reef and northern Australia has uncovered a surprisingly rich octopodan fauna (Norman, 1991, 1992a, 1992b, in prep.). At least 25 species have been recognised from these waters, of which only five can be assigned to previously described taxa. Amongst this rich fauna are five members of the *O. macropus* group. *Octopus ornatus* Gould, 1852 is a large species widely distributed throughout the tropical Indo-West Pacific. Norman (in prep.) describes the morphology of this species and its occurrence in Australian waters. The remaining four taxa are described here as new species: *O.*

*alpheus*, *O. aspilosomatis*, *O. dierythraeus* and *O. graptus* spp. nov.

A diagnostic key to the *O. macropus* group in Great Barrier Reef waters is provided along with full species accounts for the four new species. A diagnosis and distribution for *O. ornatus* is presented for comparison.

## Material and methods

Field collection on the Great Barrier Reef was carried out between May and November in 1989 and 1990. Totals of 82 individuals of *O. alpheus*, 26 of *O. aspilosomatis* and 24 of *O. dierythraeus* were encountered live in the field, primarily at night on intertidal reef walks. Active lairs also were found intertidally on daylight reef walks, and subtidally through day and night snorkel and SCUBA dives. The occupants of these lairs were flushed using a weak solution of copper sulphate in sea water (<0.5 M) and captured in hand nets. Individuals were observed and photographed *in situ* and, where facilities were available, within aquaria.

Representative specimens were retained and narcotised in fresh water, and fixed and preserved according to the techniques of Roper and Sweeney (1983). These specimens are now housed in the Museum of Victoria (NMV). Additional specimens of all four new species were found in the collections of the Australian Museum, Sydney (AM), Queensland Museum, Brisbane (QM), National Museum of Natural History, Washington, (USNM) and Muséum National d'Histoire Naturelle, Paris (MNHN).

In the description and tables, measurements and indices follow Roper and Voss (1983). The terms "terminal organ" and "copulatory organ" are used to replace "penis" and "hectocotylus" respectively. These changes follow Hochberg and Mangold (in prep.). The structure historically known as the "penis" is not an intromittent organ and hence should not be referred to by this term. Terminal organ is a more appropriate term for this element of the male reproductive tract. The term "hectocotylus" refers to the entire modified arm and not the modified distal tip. This tip functions as the intromittent organ during copulation and is more appropriately named the copulatory organ.

The following additional or modified indices are also employed:

Stage of Maturity (StM): Immature (Imm: sex indeterminate or reproductive organs minute), Submature (S: reproductive organs distinct but poorly developed) and Mature (M: developed spermatophores or eggs distinct); Head Mantle Width Index (HMWI): head width as per cent of mantle width; Arm Mantle Index (AMI): arm length as per cent of ML; Arm Width Index (AWI): arm width at widest point on stoutest arm, as per cent of ML; Sucker Count (SC): total sucker count for intact arm with the highest sucker count; Gill Count (GC): number of gill lamellae per demibranch not including the medial terminal lamella; Hectocotylized Arm Mantle Index (HAMI): length of hectocotylized arm as per cent of ML; Hectocotylized Arm Sucker Count (HASC): number of suckers on hectocotylized arm; Terminal Organ Limb Index (TOLI): length of terminal organ as per cent of ML; Diverticulum Length Index (DLI): diverticulum length as per cent of length of terminal organ; Spermatophore number (SpN): number of spermatophores in Needham's Sac; Sperm Cord Whorls (SpCW): number of whorls in which sperm cord is coiled; Funnel Length Index (FLI): funnel length as per cent of ML; Free Funnel Index (FFI): length of free funnel portion as per cent of funnel length: Funnel Organ Index (FOI): length of outer limb of funnel organ as per cent of median limb length; Funnel Organ Length Index (FOLI): length of medial limb as per cent of funnel length.

In the descriptions, indices are presented for both sexes combined, except where significant differences were found between the sexes (one way ANOVA, $p = 0.05$). In these indices, range and mean for each sex are presented. Where ranges significantly overlap, standard deviations around the mean are also presented.

Table 1 summarises the key differences between Great Barrier Reef members of the *Octopus macropus* group.

**Key to species of the "*Octopus macropus* group" from Great Barrier Reef waters**

1. Distinctly elongate species with almost cylindrical arms and shallow webs, deepest web always less than 15% of length of longest arm, typically 10% ..... 2
— Robust, moderately elongate species with deep webs, deepest web always greater than 15% of length of longest arm, typically 20% ..... 3
2. Large species (to 130 mm ML, 1.2 m TL and 1 kg) with high gill counts

Table 1. Comparison of Great Barrier Reef species of the *Octopus macropus* group.

| Species: | *O. alpheus* | *O. aspilosomatis* | *O. dierythraeus* | *O. graptus* | *O. ornatus* |
|---|---|---|---|---|---|
| Size: ML (mm) | 80 | 80 | 135 | 190 | 130 |
| TL (mm) | 430 | 440 | 810 | 1300 | 1200 |
| Weight (g) | 340 | 120 | 1500 | 4200 | 1000 |
| Arm length (AMI) | 316.1–*421.0*–507.5 | 438.4–*537.6*–639.8 | 365.7–*477.5*–574.0 | 446.9–*537.9*–706.8 | 544.6–*688.1*–836.6 |
| Web depth (WDI) | 16.3–*21.8*–25.0 | 9.1–*11.6*–14.6 | 17.6–*20.3*–27.8 | 16.4–*20.0*–22.0 | 5.3–*8.7*–11.3 |
| Sucker Count (SC) | 192–*209*–228 | 206–*235*–267 | 234–*259*–280 | 194–*240*–280 | 324–*342*–382 |
| Hectocotylised Arm SC | 82–*91*–97 | 78–*85*–95 | 103–*112*–125 | 86–*87*–88 | 152–*164*–172 |
| Gill Count | 10–12 | 10–11 | 12–14 | 13–14 | 13–14 |
| Funnel organ shape | typically W | W | UU | VV | W |
| Egg size | large | small | large | very large | small |
| Egg number | ~100 | ~30 000 | ~350 | ~700 | >30 000 |
| Colour pattern | red, white spots | plain mantle | white, red spots | pale, scribbles | red, white bars |

(13–14 lamellae per demibranch), high sucker counts (SC 324–*342*–382, HASC 152–*164*–172) and distinctive colour pattern of wide longitudinal white stripes on dorsal mantle and paired white spots on dorsal arm crown and arms, over brown to deep maroon base colour ..... *Octopus ornatus* Gould, 1852

— Medium sized species (to 80 mm ML, 440 mm TL and 120 g) with moderate gill counts (10–11 lamellae per demibranch) and moderate sucker counts (SC 206–*235*–267, HASC 78–*85*–95). Colour pattern of plain red or white dorsal mantle lacking spots, arm crown and dorsal arms covered with regular paired white spots over red base colour ..... *Octopus aspilosomatis* sp. nov.

3. Colour patterns consisting of red base colour with large white spots or the negative pattern of white base colour with red spots; W- or UU-shaped funnel organs ..... 4

— Colour pattern simple, consisting of pale cream to pink base colour with dark brown "scribbling" (spots and short irregular lines) over dorsal mantle and arm crown (fig. 13a), VV-shaped funnel organ with outer limbs much shorter than medial limbs; very large robust species (to 190 mm ML, 1.3 m TL, 4.2 kg), gill counts high (13–14 per demibranch) ..... *Octopus graptus* sp. nov.

4. Large robust species (to 120 mm ML, 715 mm TL, 1.2 kg), with high gill counts (12–14 lamellae per demibranch) and moderate sucker counts (SC 234–*259*–280, HASC 103–*112*–125), funnel organ always UU-shaped, alarm display of large red spots over white base colour on dorsal mantle, arm crown and arms (figs 9a, 12c–d) ..... *Octopus dierythraeus* sp. nov.

— Medium sized species (to 80 mm ML, 430 mm TL, 340 g), with moderate gill counts (11–12 lamellae per demibranch) and moderate sucker counts (SC 192–*209*–228, HASC 82–*91*–97), funnel organ typically W-shaped, largest specimens with slight separation of medial limbs, alarm display of large white spots over red base colour on dorsal mantle, arm crown and arms (figs 1a, 4a–c) ..... *Octopus alpheus* sp. nov.

**Octopodidae** d'Orbigny, 1839

Subfamily **Octopodinae** d'Orbigny, 1839

**Octopus ornatus** Gould, 1852

Figure 17a

*Diagnosis.* Large muscular and elongate species with unequal arms, dorsal arms longest and most robust (AF 1.2.3.4), dorsal arms typically 6 to 7.5 times mantle length. Webs shallow, approximately 9% of length of longest arms. Sucker counts, 320–380 per arm in submature and mature animals, 150–170 suckers on hectocotylized arm of submature and mature males. Gill lamellae, 13–14 per demibranch, typically 14. Funnel organ W-shaped. Eggs small (to 3.5 mm long) produced in large numbers (>30 000). Alarm colouration of white longitudinal stripes on mantle and paired spots along aboral arm surfaces over maroon red base colour.

*Distribution. Octopus ornatus* is recorded from offshore islands of the southern Great Barrier Reef and several individuals from the warm-temperate waters of the New South Wales coast. This species is widely distributed throughout the tropical Indo-West Pacific region, from Hawaii to East Africa. Figure 17a presents the distribution of this species based on examined material and published records that clearly refer to this distinctive species.

*Remarks.* See Norman (in prep.) for full morphological description, annotated synonymy and details of life history based on Australian material. *Callistoctopus arakawai* Taki, 1964, described from southern Japan, is a junior synonym.

**Octopus alpheus** sp. nov.

Figs 1–4, 17b

*Octopus macropus.* — Nesis, 1982 (1987 abridged English translation): plate on p. 74. (non Risso, 1826)

*Material examined.* 82 individuals were encountered live in the field on the islands of the Capricorn Bunker Group at the southern end of the Great Barrier Reef.

18 were retained and are now in the Museum of Victoria. Six additional preserved specimens were found and examined in Australian museums and the National Museum of Natural History, Washington.

Holotype: Qld: 1♂: 74.2 mm ML, NMV F57930, Tryon I., Capricorn Bunker Group, 23°15′S, 151°47′E, 0.1–0.2 m, M. Norman, 2 Nov 1989 (active at 0435–0515 hr).

Paratypes: Qld: 1♂: 61.9; 1♀: 70.1 mm ML, NMV F60100, Tryon I., 23°15′S, 151°47′E, 0.1–0.2 m, M. Norman, 1 Nov 1989 (active at 0415–0530 hr); 1♀: 78.2 mm ML, NMV F65660, Tryon I., 23°15′S, 151°47′E, 0.1–0.2 m, M. Norman, 2 Nov 1989 (active at 0435–0515 hr).

Other material: Qld: 1♂: 19.7 mm ML, NMV F57928, One Tree I., 23°30′S, 152°05′E, 0.2 m, S. Jackson, 16 Oct 1989 (active at 1830 hr); 2♀: 20.2, 25.6 mm ML, NMV F57926, Tryon I., 23°15′S, 151°47′E, 0.1–0.2 m, M. Norman, 2 Nov 1989 (active at 0435–0500 hr, retreated into lair, flushed with $CuSO_4$); 1♀: 20.9 mm ML, AM C31668, Masthead I., 23°32′S, 151°45′E, D.B. Fry, no date; 1♀: 30.8 mm ML, AM C159263, North West I., 23°18′S, 151°42′E, M. Ward and W. Boardman, "Dec 1929–Jan 1931"; 1♀: 32.3 mm ML, QM Mo35762, Wilson I., 23°18′S, 151°55′E, 18 Sep 1972; 3♂, 4♀: 36.1–77.0 mm ML, NMV F65662, Tryon I., 23°15′S, 151°47′E, 0.1–0.2 m, M. Norman, 1 Nov 1989 (active at 0415–0530 hr); 1♂: 38.6 mm ML, NMV F57925, One Tree I., 23°30′S, 152°05′E, 0.2 m, R. Fenwick and M. Norman, 7 Sep 1990 (active at 1840 hr); 1♀: 40.2 mm ML, NMV F57929, Tryon I., 23°15′S, 151°47′E, 0.1 m, M. Norman, 31 Oct 1989 (active at 0520 hr); 1♂: 44.0 mm ML, NMV F57927, One Tree I., 23°30′S, 152°05′E, R. Fenwick and M. Norman, 7 Sep 1990 (active at 1910 hr); 1♂: 45.0 mm ML, AM C159262, Heron I., 23°26′S, 151°57′E, Dec 1964; 2♂, 1♀: 45.0–63.9 mm ML, NMV F60099, One Tree I., 23°30′S, 152°05′E, <0.3 m, M. Norman, 17 Oct 1989 (active at 1925–2100 hr); 1♂: 49.0 mm ML, USNM 817786, One Tree I., 23°30′S, 152°05′E, 0–2 ft (0–0.7 m), 22 Nov 1969 (rotenone station); 1♀: 65.8 mm ML, AM C159265, North West I., 23°18′S, 151°42′E, A.A. Livingstone and W. Boardman, "Dec 1930 to Jan 1931".

*Diagnosis.* Large muscular species with unequal arms, dorsal arms longest and most robust (AF 1.2.3.4), typically 3 to 4.5 times mantle length. Webs moderately deep, approximately 20% of length of longest arm. Sucker counts, 200–230 per arm in submature and mature animals, 80–100 suckers on hectocotylized arm of submature and mature males. Gill lamellae, 10–12 per demibranch, typically 11 on the outer demibranch and 12 on the inner demibranch. Funnel organ typically W-shaped. No mature females encountered, submature females with large-type eggs, produced in low numbers. Alarm colour pattern of large white spots over deep red base on dorsal surfaces of mantle, arm crown and arms.

*Description.* The following description is based on 2 submature and 3 mature males, and 7 submature females. Counts and indices for this material are presented in Tables 2 and 3, with data on 5 immature males and 3 immature females.

Moderate to large robust species (fig. 1a): no mature females found in this study, ML of submature females and mature males to at least 80 mm, TL to at least 430 mm; weight to at least 340 g. Mantle variable from round to elongate (MWI 39.7–*71.6*–89.2), mantle walls moderately muscular. Stylets present. Pallial aperture of moderate width, approximately half mantle width. Funnel long, muscular and broad based (FLI 48.0–*58.1*–69.2) with free portion approximately half funnel length (FFI 30.1–*46.7*–74.2). Funnel organ well developed (fig. 1b), typically W-shaped, except in 2 largest specimens (1♀: 78.2 mm ML and 1♂: 74.2 mm ML, NMV F57930 exhibited slight separation of the medial limbs approaching a UU-type funnel organ). Outer limbs of funnel organ slightly shorter than median limbs (FOI 75.0–*79.7*–83.6). Funnel organ approximately 50% of funnel length (FOLI 48.2–*53.3*–61.7).

Head of moderate width (HWI 43.0–*58.5*–74.6), typically narrower than mantle (HMWI 69.0–*82.5*–108.3). Neck distinct, slightly narrower than head. Eyes large and slightly pronounced.

Arms of moderate length, typically 3 to 5 times mantle length (AMI 316.1–*421.0*–507.5). Arms robust (AWI 14.7–*20.7*–25.9), roughly square in cross section and tapering evenly along length. Arms unequal in length, dorsal pair longest, ventral pair shortest (AF typically 1.2.3.4). Suckers of moderate to large size (SDI 11.9–*14.3*–17.4), deep with distinct radial cushions and scalloped outer rim. Scalloping exaggerated on small distal suckers to form ring of small digits of skin around rim of sucker. Suckers largest on dorsal arms, none especially enlarged in either sex. Approximately 200 suckers per intact normal arm, with slightly higher counts in females (SC♂ 192–*203* ± *9.98*–216, n = 4♂; ♀ 208–*217* ± *8.32*–228, n = 5♀). Webs of moderate depth (WDI 16.3–*21.8*–25.0), deepest dorsally evenly decreasing in depth to shortest ventral web (WF typically A.B.C.D.E). Web margins extended on ventral edges of arms for majority of length.

Right third arm in males hectocotylized, slightly shorter than opposite arm (OAI: 68.5–*70.3*–72.1; HAMI: 197.8–*225.9*–274.6). Copulatory organ (fig. 1c) of moderate size [LLI(mat)

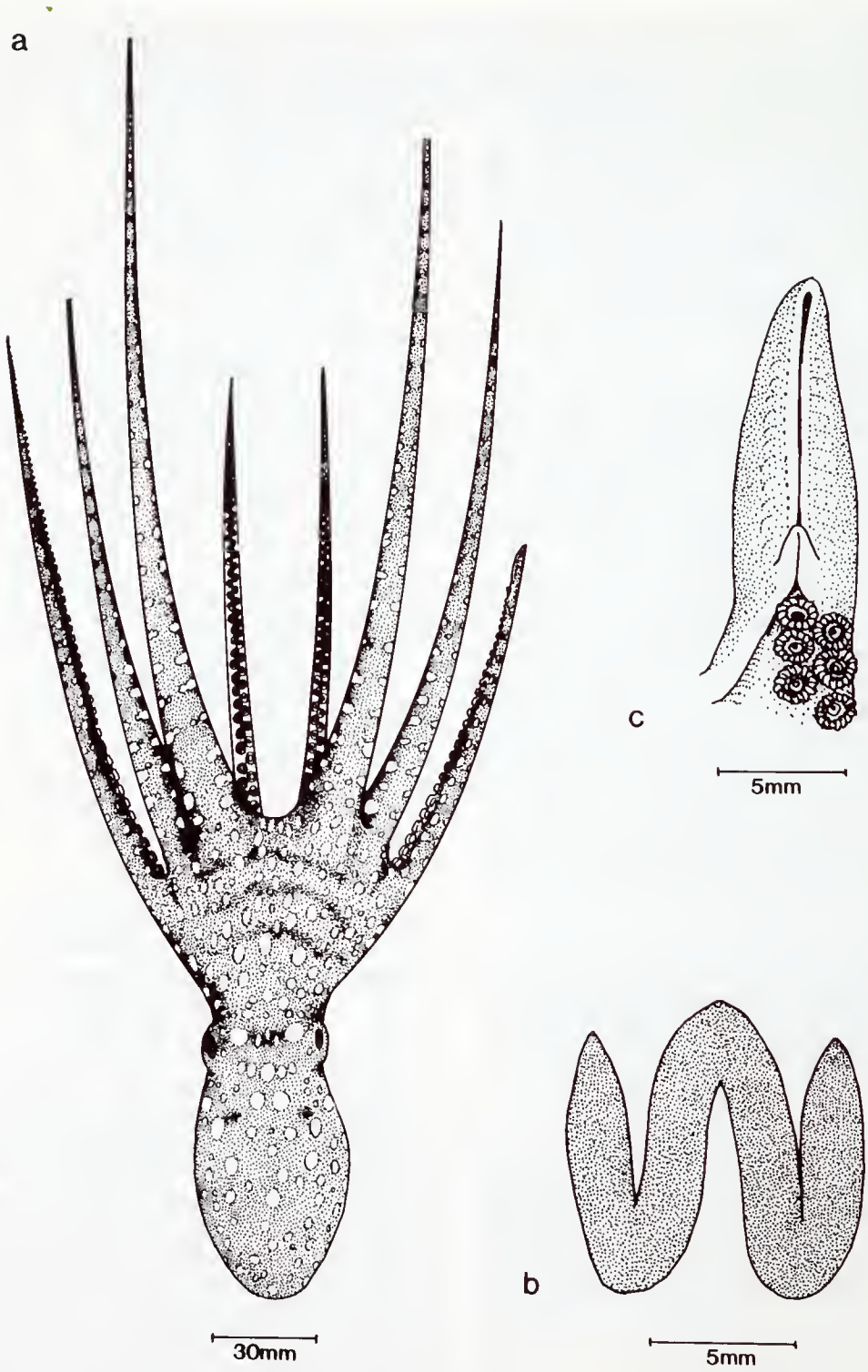



Figure 1. *Octopus alpheus* sp. nov. a, dorsal view of 74.2 mm ML male (holotype, NMV F57930). b, funnel organ of 41.0 mm ML male (NMV F65662). c, copulatory organ of 74.2 mm ML male (holotype, NMV F57930).

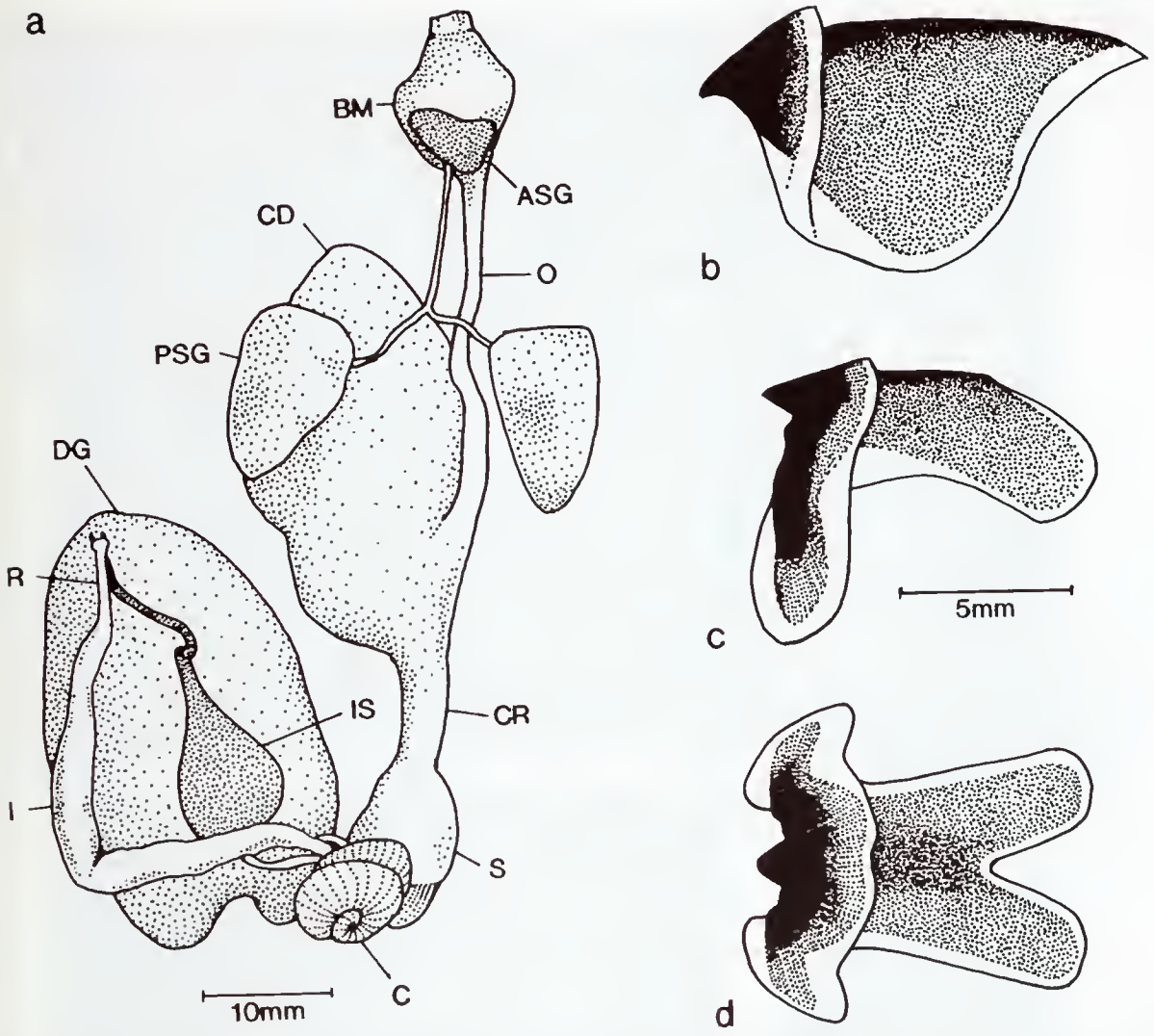



Figure 2. *Octopus alpheus* sp. nov. a, digestive tract of 43.3 mm ML male (NMV F65662). ASG = anterior salivary glands; BM = buccal mass; C = caecum; CD = crop diverticulum; CR = crop; DG = digestive gland; I = intestine; IS = ink sac; O = oesophagus; PSG = posterior salivary gland; R = rectum; S = stomach. b–d, beaks of 77.0 mm ML female (NMV F65662). b, upper beak, lateral view. c, lower beak, lateral view. d, lower beak, ventral view.

5.3–*7.2*–9.1], roughly cylindrical with deep ligula groove and moderate calamus [CLl(mat) 20.9–*23.9*–28.9]. Ligula groove contains >20 fine transverse grooves. Spermatophore groove well developed and wide with fine transverse grooves. Spermatophore guide distinct with moderately deep notch and flattened ridge topped with square papillae. Approximately 90 suckers on hectocotylized arm (HASC 82–*91*–97).

Gills with 10–12 lamellae on each demibranch, typically 11 on outer and 12 on inner demibranch. Terminal lamella small.

Digestive tract illustrated in figure 2a. Anterior salivary glands approximately one-third of buccal mass length. Posterior salivary glands slightly longer than buccal mass. Crop diverticulum large in the 2 specimens dissected, almost as large as digestive gland but possibly distended by contents. Stomach bipartite. Caecum clearly striated, coiled in 1.5 to 2 whorls. Intestine thin walled and reflexed in proximal third. Rectum straight and muscular. Ink sac well developed, embedded in ventral surface of digestive gland. Ink red when released by live animals. Fleshy anal flaps present.

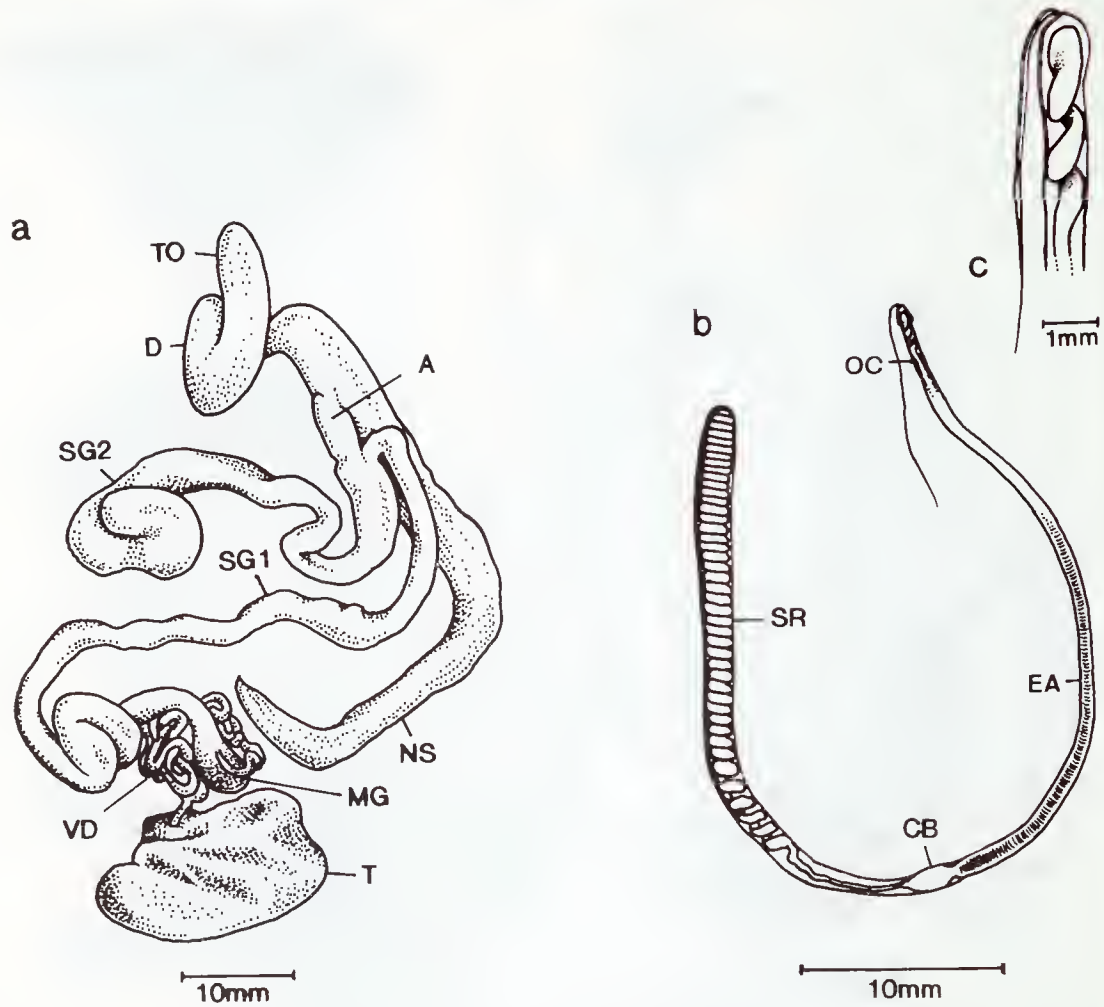



Figure 3. *Octopus alpheus* sp. nov. a, reproductive tract of 74.2 mm ML male (holotype, NMV F57930). A = appendix; D = diverticulum; MG = mucilaginous gland; NS = Needham's Sac; SG1 = spermatophoric gland I; SG2 = spermatophoric gland II; T = testes; TO = terminal organ; VD = vas deferens. b–c, spermatophore of same specimen. b, whole spermatophore. CB = cement body; EA = ejaculatory apparatus; OC = oral cap; SR = sperm reservoir. c, detail of oral cap.

Upper beak (fig. 2b) with small hood and weakly hooked rostrum. Lower beak (figs 2c–d) with moderately sharp rostrum, narrow hood, widely spread wings and flared lateral walls. Ventral view of posterior margin of lateral walls deeply concave. Radula with 7 transverse rows of teeth and marginal plates (figs 4e–f). Rhachidian tooth has 2–3 lateral cusps, typically 3, on each side of large curved medial cusp. Lateral cusps in asymmetrical seriation, migrating from lateral to medial position over 8–9 rows. First lateral teeth small and unicuspidate; second lateral teeth unicuspidate, of moderate length and robust; lateral marginal teeth relativcly straight, short and robust; marginal plates oblong and plain.

Male reproductive tract illustrated in figure 3a. Terminal organ in mature males of moderate length and very robust (TOLI 19.2, 24.8, 32.4) with robust diverticulum (DLI 53.8, 57.5, 58.1). Genital aperture subterminal. Mucilaginous gland enlarged at point of attachment to vas deferens. Spermatophoric gland I narrow with large recurved coil approximately 80% along length. Spermatophoric gland II robust and moderately short with reflexed tip. Spermatophores (figs 3b–c) almost as long as mantle length (SpLI 92.3, 93.7, 95.1), of moderate width (SpWI 2.6, 2.9,

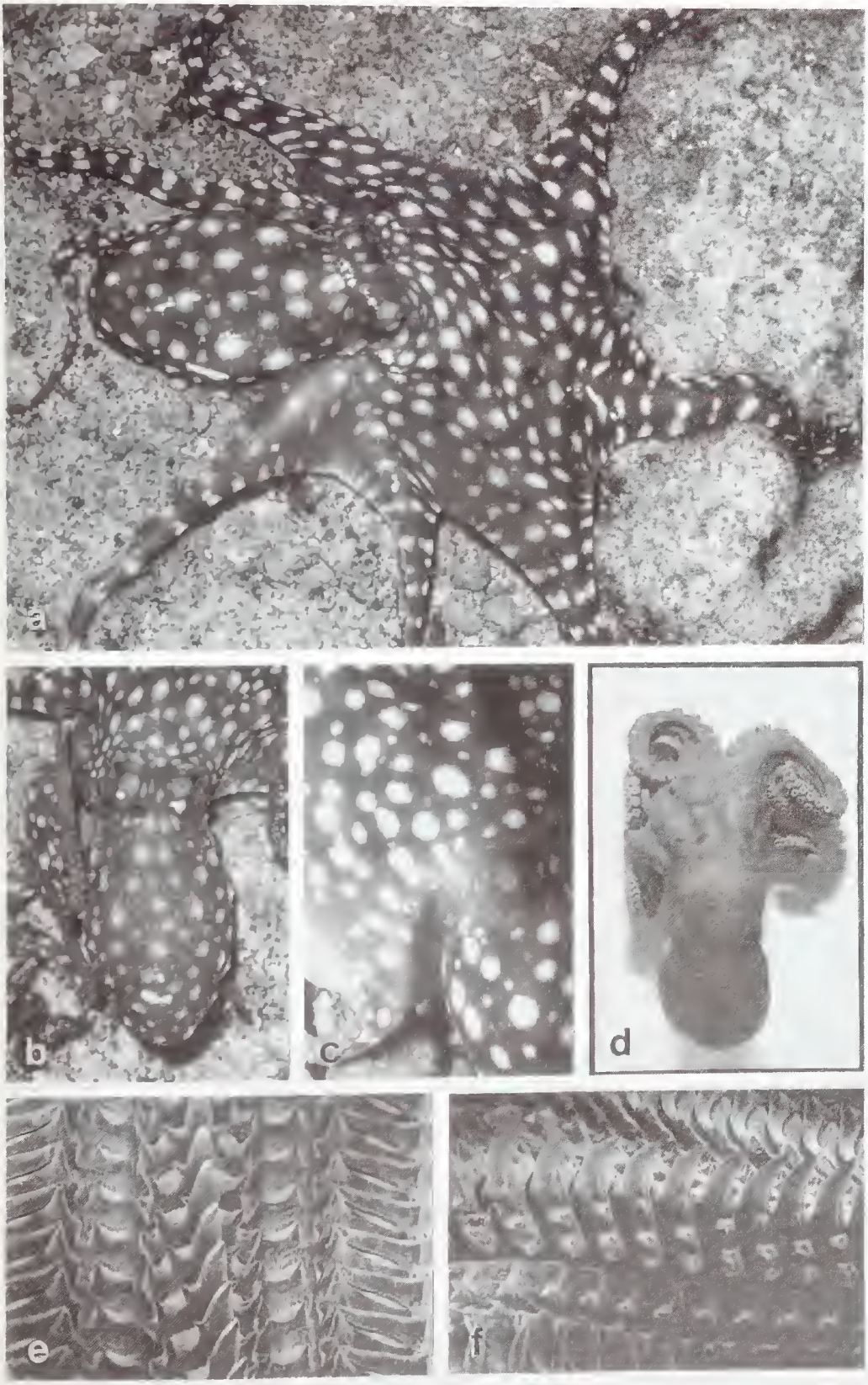



Figure 4. *Octopus alpheus* sp. nov. a–c, active individuals on reef flats at night on Tryon I. d, dorsal view of preserved 74.2 mm ML male (holotype, NMV F57930), showing wavy transverse lines on dorsal arm crown. e–f, radula of 77.0 mm ML female (NMV F65662). e, dorsal view. f, lateral view.

Table 2. Counts and indices for male *Octopus alpheus* sp. nov.
(D = damaged; Imm = immature; InD = indistinct; M = mature; S = submature).

| Museum Reg. No. | NMV F57928 | NMV F57925 | NMV F65662 | NMV F57927 | AM C159262 | NMV F60099 | NMV F65662 | NMV F60100 (Paratype) | NMV F60099 | NMV F57930 (Holotype) |
|---|---|---|---|---|---|---|---|---|---|---|
| ML | 19.7 | 38.6 | 41.0 | 44.0 | 45.0 | 45.0 | 45.6 | 61.9 | 63.9 | 74.2 |
| StM | Imm | Imm | Imm | Imm | S | S | Imm | M | M | M |
| TL | 83 | 198 | 222 | 217 | 227 | 257 | 211 | 372 | >338 | 361 |
| MWI | 74.1 | 74.6 | 57.3 | 73.2 | 71.3 | 82.4 | 55.5 | 79.0 | 84.5 | 60.4 |
| HWI | 60.9 | 56.7 | 49.5 | 57.7 | 55.1 | 66.4 | 46.5 | 74.6 | 67.9 | 51.6 |
| HMWI | 82.2 | 76.0 | 86.4 | 78.8 | 77.3 | 80.6 | 83.8 | 94.4 | 80.4 | 85.4 |
| AMI: 1 | 304.6 | 399.0 | 419.5 | 372.7 | 373.3 | 448.9 | 339.9 | 487.9 | D | 361.2 |
| 2 | 294.4 | 352.3 | 361.0 | 343.2 | 322.2 | 371.1 | 333.3 | 415.2 | 394.4 | 308.6 |
| 3 | 258.9 | 285.0 | 319.5 | D | 288.9 | D | 296.1 | D | D | 274.9 |
| H | 213.2 | 207.3 | 209.8 | 218.2 | 197.8 | 224.4 | 208.3 | 274.6 | 234.7 | 198.1 |
| 4 | 243.7 | 287.6 | 307.3 | 261.4 | 262.2 | 328.9 | 285.1 | 378.0 | 317.7 | D |
| AWI | 18.3 | 18.7 | 15.6 | 19.5 | 19.8 | 22.0 | 14.3 | 14.7 | 25.8 | 21.6 |
| SDI | 12.2 | 13.7 | 12.7 | 16.4 | 12.9 | 15.8 | 11.8 | 14.1 | 17.4 | 14.4 |
| WDI | 24.2 | 19.5 | 20.3 | 19.0 | 24.4 | 16.3 | 20.0 | 21.9 | 23.8 | 18.7 |
| GC | 11/12 | 11 | 11/10 | 11 | 11/12 | 11/12 | 12 | 11/12 | 11/12 | 12/12 |
| SC | | | | | | 200 | 193 | 216 | 203 | 192 |
| HAMI | 213.2 | 207.3 | 209.8 | 218.2 | 197.8 | 224.4 | 208.3 | 274.6 | 234.7 | 198.1 |
| OAI | 82.4 | 72.7 | 65.6 | D | 68.5 | D | 70.4 | D | D | 72.1 |
| HASC | 97 | 92 | 88 | 101 | 84 | 96 | 87 | 98 | 97 | 82 |
| LLI | InD | 3.0 | 2.9 | 4.3 | 3.9 | 3.3 | 3.2 | 5.3 | 7.3 | 9.1 |
| CLI | InD | 25.0 | 40.0 | 36.6 | 34.3 | 30.3 | 40.0 | 28.9 | 22.0 | 20.9 |
| TOLI | 6.6 | 5.7 | 4.4 | InD | InD | InD | 5.3 | 19.2 | 32.4 | 24.8 |
| DLI | InD | 59.1 | InD | InD | InD | InD | InD | 57.5 | 53.8 | 58.1 |
| SpLI | | | | | | | | 93.7 | 95.1 | 92.3 |
| SpWI | | | | | | | | 2.6 | 3.1 | 2.9 |
| SpRI | | | | | | | | 55.3 | 47.7 | 45.1 |
| SpN | | | | | | | | | 2 | 3 |
| FLI | 54.8 | 55.4 | 59.5 | 48.0 | 59.1 | 54.0 | 61.0 | 55.7 | 59.8 | 52.8 |
| FFI | 39.8 | 57.0 | 41.8 | 72.5 | 30.1 | 46.5 | 50.0 | 52.8 | 74.2 | 31.4 |
| FOI | 83.1 | 71.7 | 81.3 | InD | 76.3 | 75.0 | 77.4 | 82.2 | 79.6 | 82.2 |
| FOLI | 54.6 | 56.1 | 45.9 | InD | 57.1 | 57.6 | 44.6 | 61.7 | 53.9 | 50.3 |

Table 3. Counts and indices for female *Octopus alpheus* sp. nov.
(D = damaged; Imm = immature; InD = indistinct; S = submature; * = measurements from immature ovarian eggs).

| Museum Reg. No. | NMV F57926 | NMV F57926 | NMV F65662 | AM C57929 | NMV F65662 | NMV F60099 | AM C159265 | NMV F60100 (Paratype) | NMV F65662 | NMV F65660 (Paratype) |
|---|---|---|---|---|---|---|---|---|---|---|
| ML | 20.2 | 25.6 | 36.1 | 40.2 | 47.7 | 57.5 | 65.8 | 70.1 | 77.0 | 78.2 |
| StM | Imm | Imm | Imm | S | S | S | S | S | S | S |
| TL | 82 | 110 | 173 | 260 | 293 | 320 | 288 | 378 | 399 | 434.0 |
| MWI | 60.9 | 65.2 | 54.6 | 79.6 | 79.0 | 89.2 | 39.7 | 68.8 | 60.4 | 65.1 |
| HWI | 61.9 | 57.8 | 43.2 | 67.2 | 62.9 | 69.4 | 43.0 | 49.6 | 41.7 | 52.3 |
| HMWI | 101.6 | 88.7 | 79.1 | 84.4 | 79.6 | 77.8 | 108.3 | 72.1 | 69.0 | 80.3 |
| AMI: 1 | D | 304.7 | 360.1 | 507.5 | 473.8 | 427.8 | 316.1 | 406.6 | 392.2 | 436.1 |
| 2 | 267.3 | 277.3 | 326.9 | 460.2 | 381.6 | 391.3 | 278.1 | 375.2 | 363.6 | D |
| 3 | 257.4 | 250.0 | 296.4 | 410.4 | 377.4 | 368.7 | 250.8 | 333.8 | 322.1 | 347.8 |
| 4 | 242.6 | 238.3 | 243.8 | 415.4 | 327.0 | 365.2 | 244.7 | 332.4 | 280.5 | 317.1 |
| AWI | 17.3 | 18.0 | 12.5 | 23.1 | 18.2 | 25.9 | 18.4 | 19.5 | 17.4 | 22.4 |
| SDI | 12.4 | 11.7 | 10.0 | 11.9 | 15.1 | 17.4 | 12.3 | 13.0 | 11.9 | 15.1 |
| WDI | 24.8 | 21.9 | 20.0 | 20.1 | 22.6 | 23.6 | 25.0 | 22.5 | 19.9 | 23.2 |
| GC | 11 | 11/12 | 11/12 | 11/12 | 11/12 | 11/12 | 11/11 | 11/12 | I2 | 11 |
| SC | | | | | | 222 | 208 | 228 | 210 | 218 |
| ELI | | | | | | | | 5.7* | | 6.9* |
| EWI | | | | | | | | | 1.3* | |
| EN | | | | ~100 | | <100 | <100 | <100 | <100 | <100 |
| FLI | 54.5 | 48.8 | 48.5 | D | 69.2 | 61.0 | 53.0 | 55.9 | 61.7 | 56.8 |
| FFI | 48.1 | 39.1 | 43.5 | D | 53.9 | 49.3 | 35.8 | 44.2 | 60.6 | 34.7 |
| FOI | 70.7 | 83.6 | InD | InD | 79.8 | 79.6 | 79.1 | 79.5 | InD | 83.6 |
| FOLI | 52.7 | 53.6 | InD | InD | 52.4 | 51.1 | 49.3 | 51.0 | InD | 48.2 |

3.1) and produced in low numbers (2 and 3 in Needham Sacs of 2 specimens). Oral cap simple bearing long cap thread. Sperm reservoir approximately half of spermatophore length (SpRI 45.1, 47.7, 55.3), sperm cord coiled in approximately 40 regular whorls.

No mature females were encountered in this study. Immature ovaries were visible in submature females, poorly developed in even the largest female. Large type eggs in low numbers clearly visible in undeveloped ovaries. Very small ovary of 1 female (78.2 mm ML: NMV F57930) contained approximately 130 long thin immature eggs up to 5.4 mm long. Approximately 22 follicular folds visible on immature eggs. Mature eggs would be very large and produced in low numbers.

Colour in life orange (to deep red in alarm display) covered in circular white spots over dorsal body, arm crown, webs and arms (figs 1a, 4a–e). Spots on arms paired and evenly spaced. Additional spots on dorsolateral faces of arms including 1 on the base of each sucker on at least arms 1 and 2. Pairs of slightly darker markings on dorsal mantle. Iridescent tissue layer present in skin, giving iridescent green sheen in torchlight at night.

Skin sculpture simple, consisting of scattered low papillae located in the centre of white spots, especially on dorsal and lateral mantle. Transverse pair of large papilla in largest white spots on dorsal mantle. Small punctae scattered between papillae on dorsal surfaces. Single slightly larger supraocular papilla directly above each eye, surrounded by low papillae. Pigmentation and sculpture do not extend to oral surface of webs.

Preserved specimens tend to lose dark red colour and definition of spots, base colour fading to cream. Pale spots containing central papilla sometimes visible on mantle, especially on lateral faces. Two to three dark wavy transverse lines across dorsal arm crown often visible.

There appears to be little sexual dimorphism in this species. Sucker counts were slightly lower for males in material examined.

*Distribution.* Offshore islands of the Capricorn Bunker group at the southern end of the Great Barrier Reef, Queensland (fig. 17b). Specimens have been collected from Tryon (23°15′S, 151°47′E), Northwest (23°18′S, 151°42′E), Wilson (23°18′S, 151°55′E), Heron (23°26′S, 151°57′E), One Tree (23°30′S, 152°05′E) and Masthead Islands (23°32′S, 151°45′E).

*Life history.* Nocturnally-active species which forages on exposed intertidal coral reef flats on offshore islands. Preys on small crabs and other crustaceans by probing crevices and burrows with arm tips. This species occupies lairs within coral bedrock and under living coral, closing entrance during the day with pieces of dead coral. It is unclear whether lairs are permanent or temporary refuges. Animals only emerge after dark.

A total of 82 individuals was encountered actively foraging, always in less than 0.3 m on exposed reef flats. Individuals were only encountered at night between 1840 and 0600 hr. No specimens were encountered subtidally, either during the day or at night.

This species often emerges from pools and traverses areas of exposed reef whilst foraging. Water was not retained within the mantle cavity while animals traversed exposed sections of reef. Individuals were often heard making whistling or squeaking noises when in very shallow pools or traversing dry ground as they drew air in and out of the mantle cavity.

This species also tolerates low salinities, being difficult to narcotise in freshwater. This tolerance may relate to the intertidal habits of this species where rain can cause locally low salinities in closed and shallow pools.

Foraging individuals often were captured carrying small crabs on suckers close to the mouth. Several were caught carrying much larger crabs (up to 100 mm carapace width). Examination of stomach contents revealed only crustacean remains.

Foraging individuals of *O. alpheus* appeared tolerant of conspecifics, often crawling over each other whilst seeking prey without any observed aggression. This tolerance was not observed by congeneric octopuses which appear to be a predator of at least smaller members of this species. One small individual of *O. alpheus* was attacked and partially devoured by a large individual of *O. ornatus* Gould, 1852 when released into an aquarium containing the latter species. The stomach contents of *O. ornatus* has been found to contain the beaks of smaller octopuses (Norman, in prep.).

Large eggs indicate young adopt a benthic habit on hatching.

*Etymology.* From the Latin "*alphus*" meaning white spots on the skin, referring to the white spots generated in the alarm display of this species (fig. 4a).

*Remarks.* The colour plates in the 1987 abridged English translation of Nesis (1982) show an indi-

vidual of *O. alpheus* at Heron I., under the heading *O. macropus*. The distinctive colour pattern and locality of this specimen clearly identify it as an individual of *O. alpheus*.

**Octopus aspilosomatis** sp. nov.

Figs 5–8, 17c

*Octopus ornatus*. — Roper and Hochberg, 1987: 16, 18. — 1988: 161. (non Gould, 1852).

*Material examined.* 25 individuals were encountered live in the field on Lizard and Russell islands and on the mainland coast at Cape Tribulation. 21 were retained and are now in the Museum of Victoria. 4 additional preserved specimens were found and examined in the collections of the Australian Museum and the National Museum of Natural History, Washington.

Holotype: Qld: 1♂: 42.1 mm ML, NMV F67001, Russell I., Frankland Group, 17°14′S, 146°06′E, <0.1 m, M. Norman and S. Troy, 19 Oct 1990 (active at 0255 hr).

Paratypes: Qld: 1♂: 42.2 mm ML, NMV F60148, Casuarina Beach, Lizard I., 14°41′S, 145°27′E, 0.1 m, M. Norman, 14 Nov 1989 (active at 0440–0530 hr); 1♂: 44.7 mm ML, NMV F60149, Coconut Beach, Lizard I., Tryon I., 14°40′S, 145°28′E, <0.1 m, M. Norman, C. Davies and J. Martin, 15 Nov 1989 (active at 0450 hr); 1♀: 56.8 mm ML, NMV F60147, Russell I., Frankland Group, 17°14′S, 146°06′E, <0.1 m, M. Norman, S. Troy, 19 Oct 1990 (active at 0335–0350 hr); 1♀: 67.1 mm ML, NMV F60145, Casuarina Beach, Lizard I., 14°41′S, 145°27′E, 0.1 m, M. Norman, 13 Nov 1989 (active at 0330–0515 hr).

Other material: Qld: 4♂: 25.4–34.4, 1♀: 36.4 mm ML, NMV F67002, Coconut Beach, Cape Tribulation National Park, 16°05′S, 145°29′E, <0.2 m, M. Norman, S. Troy, 16 Oct 1990 (active at 0020–0145 hr); 1♀: 27.5 mm ML, USNM 817667, off Coconut Beach, Lizard I., 14°40′S, 145°28′E, 3 m, in open water 25–30 m deep, Larval Fish Survey, 27 Dec 1986 (in floating night light trap); 3♂: 30.5–51.8, 1♀: 50.7 mm ML, NMV F60144, Coconut Beach, Lizard I., 14°40′S, 145°28′E, <0.1 m, M. Norman, C. Davies and J. Martin, 15 Nov 1989 (active at 0450 hr); 1♂: 37.3 mm ML, NMV F65659, Casuarina Beach, Lizard I., 14°41′S, 145°27′E, 0.1 m, M. Norman, 14 Nov 1989 (active at 0440–0530 hr); 3♀: 39.0–45.9 mm ML, NMV F65664, Casuarina Beach, Lizard I., 14°41′S, 145°27′E, 0.1 m, M. Norman, 13 Nov 1989 (active at 0330–0515 hr); 1♂: 39.3, 1♀: 39.8 mm ML, NMV F65661, Russell I., Frankland Group, 17°14′S, 146°06′E, <0.1 m, M. Norman, S. Troy, 19 Oct 1990 (active at 0335–0350 hr); 2♂: 49.3, 83.2 mm ML, AM C159275, Casuarina Beach, Lizard I., 14°41′S, 145°27′E, W.F. Ponder, P.H. Colman, I. Loch, 29 Nov 1974 (active at night); 1♂: 67.9 mm ML, NMV F60146, Casuarina Beach, Lizard I., 14°40′S, 145°28′E, 0.2 m, M. Norman, 13 Nov 1989 (active at 0325 hr).

*Diagnosis.* Moderate sized, elongate species with unequal arms, dorsal pairs longest (AF 1.2.3.4), typically 4.5–6 times mantle length. Webs shallow, approximately 10% of length of longest arm. Sucker counts, 200–260 per arm in submature and mature animals, 78–95 suckers on hectocotylized arm of submature and mature males. Gill lamellae, 10–11 per demibranch, typically 10 on outer demibranch and 11 on inner demibranch. Funnel organ W-shaped. No mature females encountered, submature females with small-type eggs, produced in large numbers (about 30 000 in 1 specimen). Alarm colour pattern of red dorsal mantle and arms, and paired white spots on arm crown and aboral surface of arms only.

*Description.* The following description is based on 4 submature and 6 mature males, and 10 submature females. Counts and indices for this material are presented in Tables 4 and 5.

A number of specimens of *O. aspilosomatis* possess greatly elongated mantles where the mantle becomes almost cylindrical (fig. 8d). Voss (1981) reported such variation in mantle shape in *O. ornatus*, variation also witnessed in Australian material of *O. ornatus* (Norman, in prep.). Certain indices are presented separately for normal and elongate material in the description below.

Moderate sized, elongate species (fig. 5a): no mature females found in this study, ML of submature females and mature males to at least 80 mm, TL to at least 440 mm; weight to at least 120 g. As in *Octopus ornatus*, mantle is highly variable from ovoid to extremely elongate in some preserved specimens (fig. 8d: MWI 27.5–*52.5*–72.9), mantle walls moderately muscular. Stylets present. Pallial aperture of moderate width, slightly greater than half mantle width. Funnel long, muscular and broad based (FLI 30.9–*48.1*–61.1) with free portion variable in length, typically around half funnel length (FFI 28.6–*51.2*–86.8). Funnel organ well developed (fig. 5b), W-shaped with broad limbs. Outer limbs clearly shorter than median limbs (FOI 58.4–*66.9*–84.0). Funnel organ approximately 50% of funnel length (FOLI 44.6–*52.5*–61.7).

Head of moderate width (HWI 26.8–*46.3*–55.3), generally narrower than mantle (HMWI 73.4–*90*–109.8). Neck distinct, slightly narrower than head. Eyes large and pronounced, especially in elongate form.

Arms long, typically 4.5 to 6 times mantle length (AMI 438.4–*537.6*–639.8, n = 13, 314.9–*391.4*–411.2 in elongate forms, n = 4). Arms robust (AWI 9.9–*14*–19.9), square in cross section and tapering evenly along length. Arms

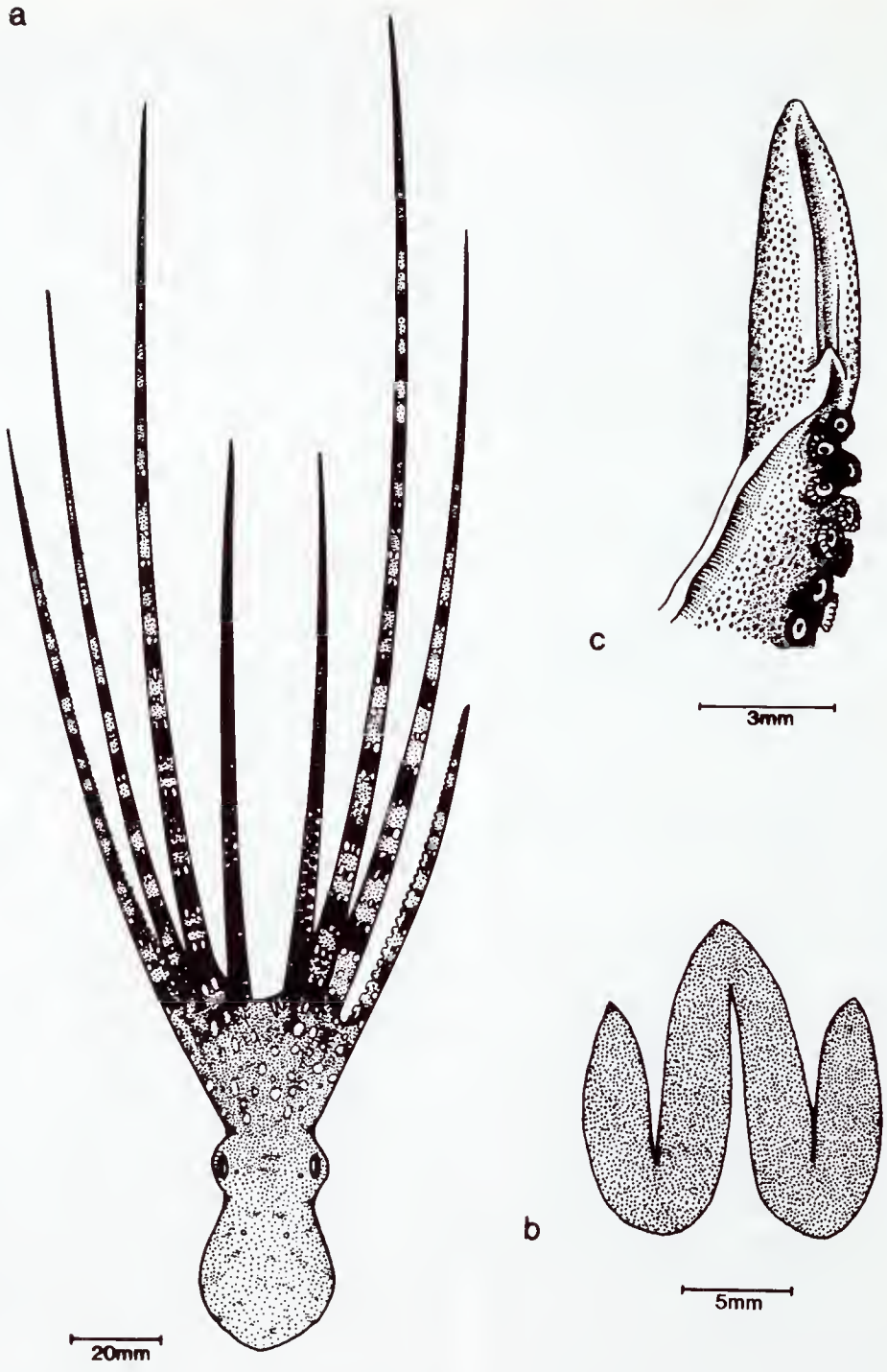



Figure 5. *Octopus aspilosomatis* sp. nov. a, dorsal view of 42.1 mm ML male (holotype, NMV F67001). b, funnel organ of same specimen. c, copulatory organ of same specimen.

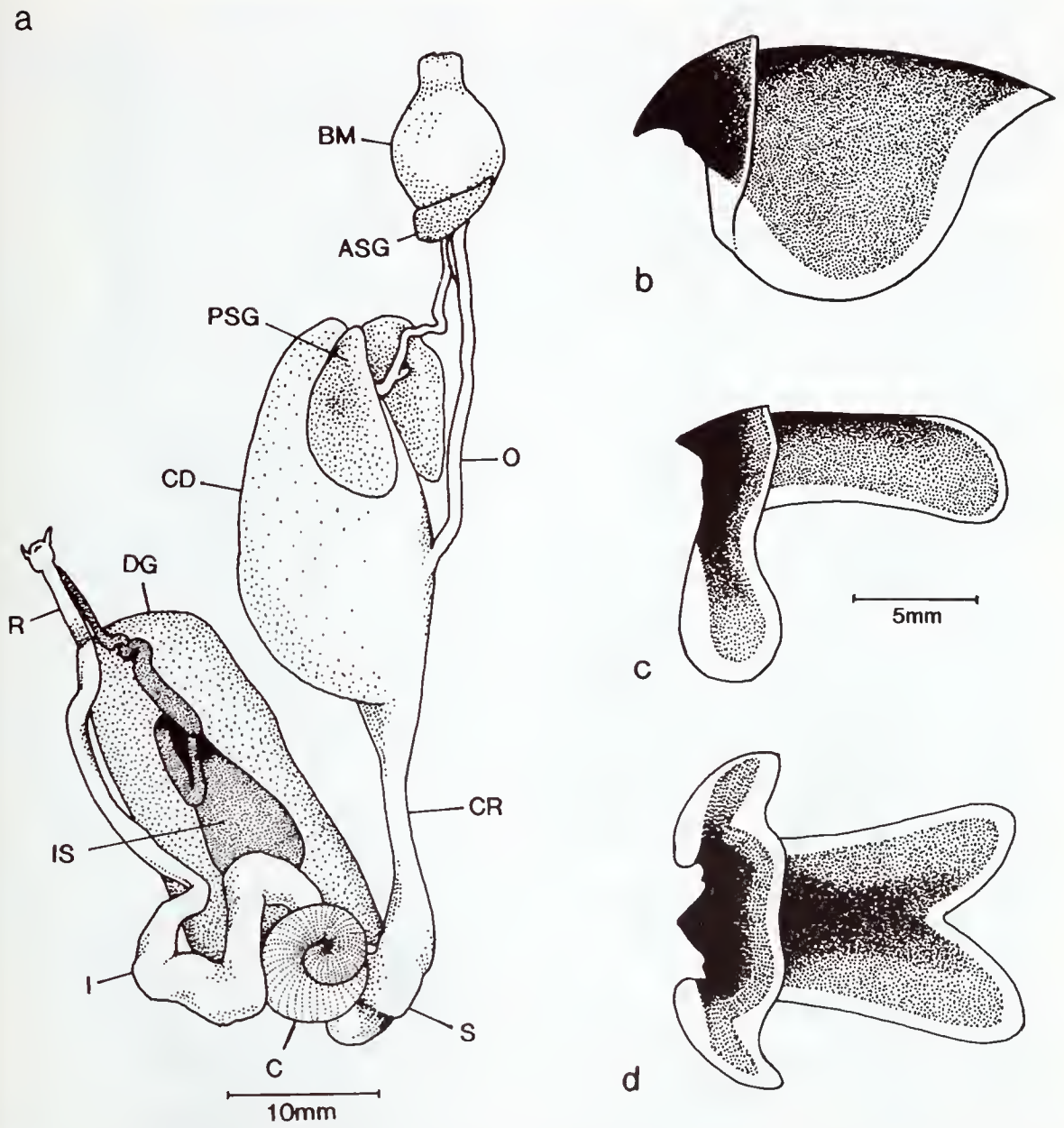



Figure 6. *Octopus aspilosomatis* sp. nov. a, digestive traet of 50.7 mm ML female (NMV F60144) [abbreviations as in fig. 2a]. b–d, beaks of 46.7 mm ML male (paratype, NMV F60149). b, upper beak, lateral view. e, lower beak, lateral view. d, lower beak, ventral view.

unequal in length, dorsal pair longest, ventral pair shortest (AF typically 1.2.3.4). Suekers biserial, of moderate size and slightly larger in males [SDI♂ (normal) 11.4–*12.4*–13.2, SDI♂ (elongate forms) 6.4–*8.2*–9.8; SDI♀ 6.7–*8.5*–9.6]. Suckers deep with fine radial eushions and scallopcd outer rim. Suckers largest on dorsal arms, none especially enlarged in either sex. Approximately 230 suckers per intact normal arm in both sexes (SC 206–*235*–267). Webs shallow (WDI 9.1–*11.6*–14.6), shortest ventrally, remaining webs subequal (WF typically A=B=C=D.E). Web margins extended on ventral edges of arms for majority of length.

Right third arm in males heetocotylized, slightly shorter than opposite arm (OAI: 55.0–*60.5*–65.9; HAMI: 134.6–*210.4*–279.6). Copulatory organ (fig. 5c) of moderate size [LLI(mat)

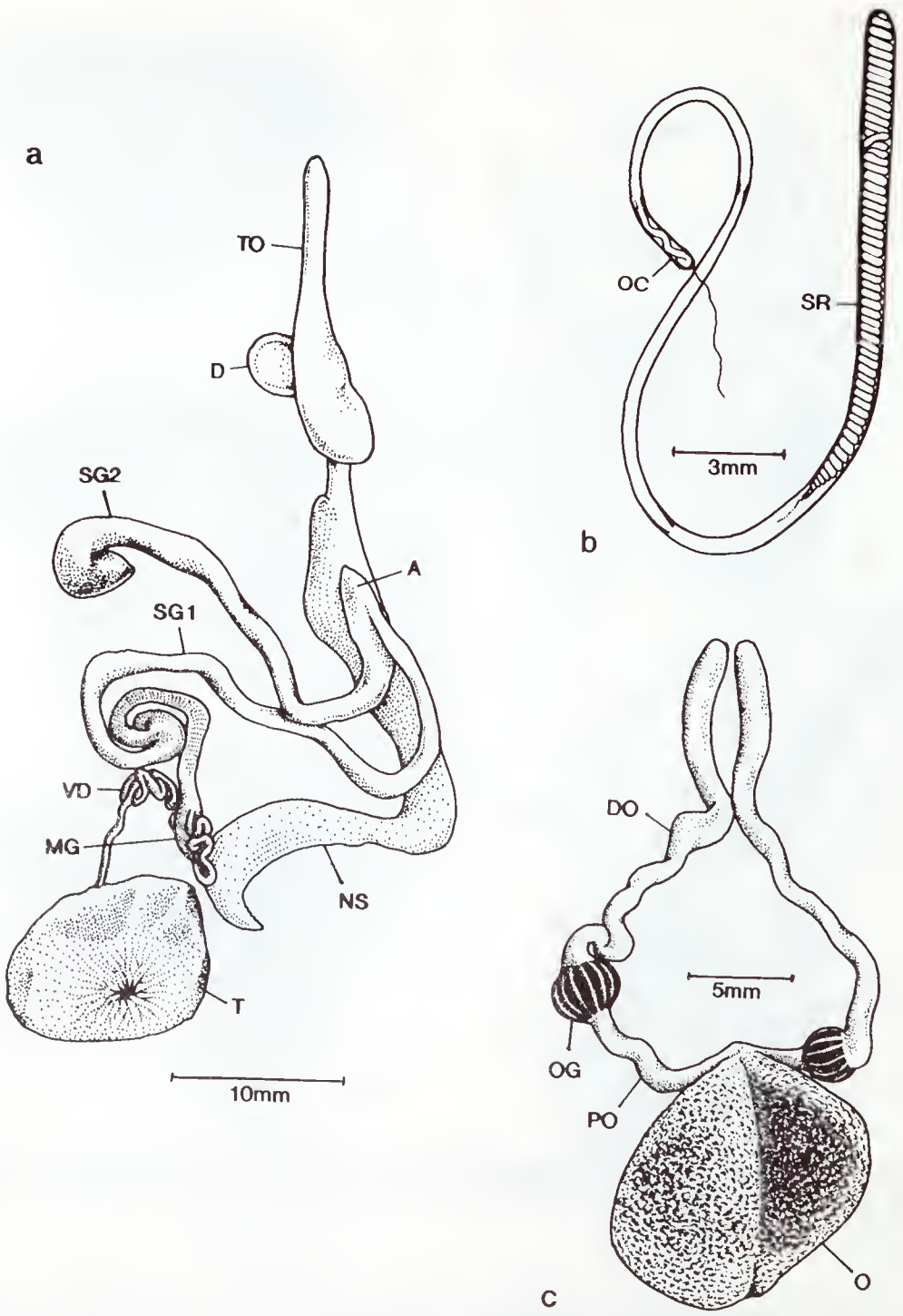



Figure 7. *Octopus aspilosomatis* sp. nov. a, reproductive tract of 67.9 mm ML male (NMV F60146) [abbreviations as in fig. 3a]. b, spermatophore of 83.2 mm ML male (AM C159275). OC = oral cap; SR = sperm reservoir. c, immature ovary of 67.1 mm ML female (paratype, NMV F60145). DO = distal oviduct; O = ovary; OG = oviducal gland; PO = proximal oviduct.

6.1–7.5–8.8, n = 6], roughly cylindrical with deep ligular groove and moderate calamus [CLI(mat) 15.5–*21.1*–29.3]. Ligula groove deep and typically closed. Spermatophore groove well developed and wide with fine transverse grooves. Spermatophore guide distinct with moderately deep notch and flattened ridge topped with square papillae. Approximately 85 suckers on hectocotylized arm (HASC 78–*85*–95).

Gills with 10–11 lamellae on each demibranch, typically 10 on outer and 11 on inner demibranch. Terminal lamella small.

Digestive tract illustrated in figure 6a. Anterior salivary glands approximately one-third of buccal mass length. Posterior salivary glands approximately equal in length with buccal mass. Crop diverticulum large in the specimen dissected, larger than digestive gland but distended by contents. Stomach bipartite. Caecum clearly striated, coiled in 1.5–2 whorls. Intestine thin walled, reflexed in proximal third. Rectum muscular and straight. Ink sac well developed and elongate, ink duct long. Ink red when released by live animals. Fine elongate anal flaps present. Membrane on dorsal surface of visceral mass pigmented with large dark chromatophores, presumably remnants of larval or founder chromatophores.

Upper beak (fig. 6b) with small hood and weakly hooked rostrum. Lower beak (figs 6c–d) with moderately sharp rostrum, narrow hood, widely spread wings and flared lateral walls. Ventral view of posterior margin of lateral walls deeply concave. Radula with 7 transverse rows of teeth and marginal plates (figs 8g–h). Rhachidian tooth has 2–3 lateral cusps on each side of large curved medial cusp. Lateral cusps in asymmetrical seriation, migrating from lateral to medial position over 8–9 rows. First lateral teeth small and unicuspidate; second lateral teeth unicuspidate, of moderate length and robust; lateral marginal teeth curved and relatively fine; marginal plates oblong and plain.

Male reproductive tract illustrated in figure 7a. Terminal organ in mature males of moderate length and robust [TOLI(mat) 21.4–*26.2*–33.6] with robust diverticulum (DLI 48.5–*55.4*–61.3). Genital aperture subterminal. Mucilaginous gland enlarged at point of attachment to short and robust vas deferens. Spermatophoric gland I narrow with large recurved coil approximately 80% along length. Spermatophoric gland II narrow and moderately long with reflexed tip. Spermatophores (fig. 7b) approximately 80% of mantle length, proportionally shorter in elongate forms [SpLI (normal) 75.1, 82.9, SpLI (elongate) 47.8], of moderate width (SpWI 2.5–2.6) and produced in low numbers (1–3 in Needham Sacs of 3 specimens). Oral cap simple bearing long cap thread. Sperm reservoir approximately half of spermatophore length (SpRI 46.2, 54.3), sperm cord coiled in approximately 55 regular whorls.

No mature females encountered. Immature ovaries were visible in submature females. Small type eggs in high numbers were clearly visible in undeveloped ovaries. Largest female (67.1 mm ML paratype, NMV F60145) possessed an immature ovary 14 mm in diameter with elongate narrow oviducts and oviducal glands containing approximately 15 braiding chambers (fig. 7c). This ovary contained about 30 000 immature eggs up to 1.1 mm long. 6 follicular folds were visible in these undeveloped eggs. Mature eggs would be small and produced in large numbers.

Colour in life orange to deep red on the mantle, arm crown and aboral surfaces of all arms. White spots on arm crown and arms in most colour patterns (figs 8a, c–f). Spots on arms paired and evenly spaced. Transverse pair of small dorsal white spots visible on dorsal mantle in some colour patterns (fig. 8a). White spots as found on arm crown never present on dorsal mantle. Distinct, but faint, patch and groove trellis present (fig. 8,b c) on dorsal and lateral mantle. Dorsal mantle often mottled with irregular darker markings. Alarm colour pattern of white mantle, dark eye bars and red arm crown and arms with prominent white spots observed in several specimens.

Skin sculpture simple, consisting of scattered low papillae evenly distributed over dorsal surfaces. Small punctae scattered between papillae on dorsal surfaces. Single slightly larger supraocular papilla directly above each eye, surrounded by low papillae. Pigmentation and sculpture do not extend to oral surface of webs.

Preserved specimens tend to lose dark red colour and definition of spots, base colour fading to cream. Pale spots containing central papilla sometimes visible on arm crown and dorsal arms. Two to three dark wavy transverse lines across dorsal arm crown often visible.

Sexual dimorphism was not marked in the material examined.

*Distribution.* Moderately clear waters of northern Queensland (fig. 17c). Specimens have been collected from intertidal reef flats at Lizard I.

Figure 8. *Octopus aspilosomatis* sp. nov. a, active individual on reef flats at night on Lizard I. (photograph courtesy of C.F.E. Roper). b–c, live aquarium photographs of Lizard I. specimens. d, dorsal view of preserved 67.9 mm ML male (NMV F60146), showing greatly elongated mantle. e, active individual on reef flats at night on Lizard I. f, live photograph of 42.1 mm ML male (holotype, NMV F67001). g–h, radula of 46.7 mm ML male (NMV F60144). g, dorsal view. h, lateral view.

→

(14°41′S, 145°27′E), Russell I. (17°14′S, 146°06′E) and Cape Tribulation (16°05′S, 145°29′E). One specimen was collected swimming on the surface in open water at night off Lizard I. in 25–30 m.

The distribution of this species may prove to be considerably wider, since eggs are small and hatchlings are presumably planktonic.

*Life history*. Nocturnally active species which forages on exposed intertidal coral reef flats in moderately clear water of the offshore islands and mainland coast of northern Queensland where coral reefs are well developed. This species occupies lairs within coral bedrock and under living coral, blocking entrance during the day with pieces of dead coral. It is unclear whether lairs are permanent or temporary refuges. No prey remains were found surrounding lairs. Animals only emerge after dark.

A total of 25 actively foraging individuals was encountered, always in less than 0.3 m on exposed reef flats. Individuals were only encountered at night between 0020 and 0535 hr, which corresponded with low tides at time of collection. No specimens were encountered subtidally, either during the day or at night.

This species preys on small crabs and other crustaceans by probing crevices and burrows with arm tips. Foraging individuals were captured carrying small crabs on suckers close to the mouth. Cannibalism is also likely to occur in the wild as several larger individuals readily attacked and commenced devouring smaller conspecifics when placed in the same container.

This species tolerates low salinities, being difficult to narcotise in freshwater. As was noted with *O. alpheus*, this tolerance may relate to the intertidal habits of this species where rain can result in temporary low salinities in closed and shallow pools at low tide.

Small eggs indicate young adopt a planktonic habit on hatching.

Several specimens contained large numbers of nematodes in the connective tissue membranes surrounding the visceral mass.

*Etymology*. From the Greek "*aspilos*" meaning without spots and "*soma*" meaning body, referring to the absence of red or white spots on the dorsal mantle in all colour patterns.

*Remarks*. Roper and Hoehberg (1987, 1988) reported *O. ornatus* Gould, 1852 from Lizard I. Examination of photographs of live material forming the basis of this record, Roper and Hoehberg's reference to large numbers on the reef flats adjacent to the research station, and the low heptocotylized arm sucker count (about 90, R. Toll. pers. comm.), all clearly indicate that these reports refer to *O. aspilosomatis* and not *O. ornatus*.

### **Octopus dierythraeus** sp. nov.

Figs 9–12, 17d

*Material examined*. 24 individuals were encountered live at 6 sites along the Queensland coast from Lizard I. (14°40′S, 145°28′E) in the north, to Sarina Beach (21°24′S, 149°19′E) in the south. 21 were retained and are now in the Museum of Victoria. 10 additional preserved specimens were found and examined in the collections of the Museum of Victoria, Australian Museum, National Museum of Natural History, Washington, and Muséum National d'Histoire Naturelle, Paris.

Holotype: Qld: 1♂: 135.0 mm ML, NMV F67007, off W coast of Cape Yorke, Gulf of Carpentaria, 10°51′S, 140°27′E, 57 m, C.C. LU, "Susan Wright", 14 Sep 1982 (trawl, 1940–2040 hr).

Paratypes: Qld: 1♂: 59.8 mm ML, NMV F60129, Orpheus I., Cattle Bay, 18°34′S, 146°29′E, 1.5 m, M. Norman, 11 Oct 1990 (1630 hr, flushed from lair with $CuSO_4$); 1♂: 89.1 mm ML, NMV F60127, Lizard I., Watsons Bay, Coby Hole (14°40′S, 145°28′E), 16 m, M. Norman, C. Davies, 23 Nov 1989 (1100 hr, flushed from lair with $CuSO_4$); 1♀: 118.8 mm ML, NMV F60128, Sarina Beach, 21°24′S, 149°19′E., 0.3 m, M. Norman, 16 Sep 1990 (active at 0330 hr, handnet).

Other material: Qld: 2?: 13.8, 19.4 mm ML, AM C50580, Hayman I., 20°03′S, 148°53′E, E.H. Rainford (on reef); 1♀: 20.3 mm ML, AM C159268, "near Townsville", near 19°16′S, 146°50′E, E. Worrell, Mar 1956 (in estuary); 5♂, 3♀: 25.7–80.7 mm ML, NMV F60133, Alexandra Reef (near 16°35′S, 145°30′E), 0.1–0.2 m, M. Norman, S. Troy, 17 Oct 1990 (active on reef flats between 0100–0200 hr, handnet); 2♂: 31.1, 61.1 mm ML, AM C159267, Torres Strait,

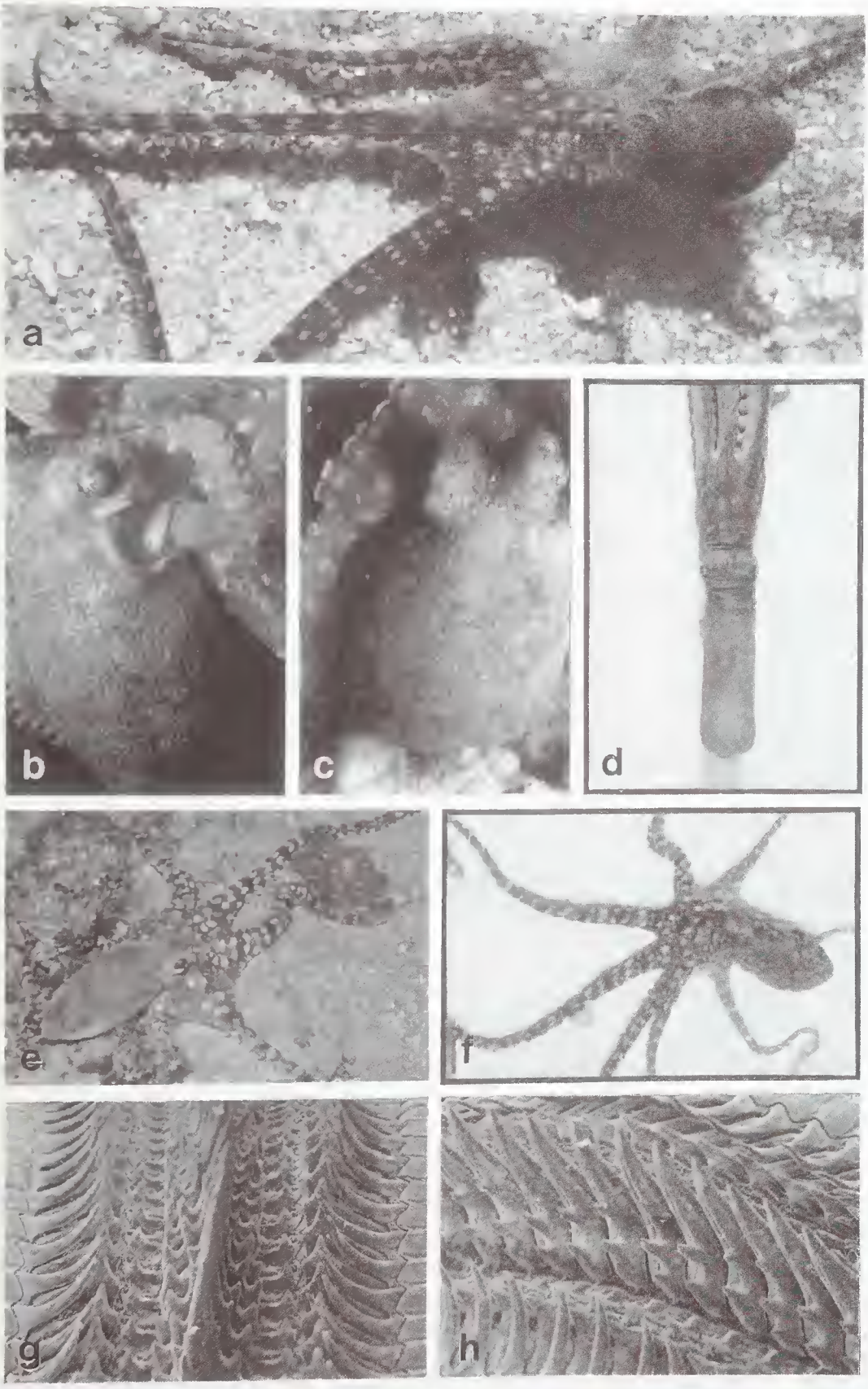

a
b
c
d
e
f
g
h

Table 4. Counts and indices for male *Octopus aspilosomatis* sp. nov.
(E = mantle considerably elongated; D = damaged; InD = indistinct; M = mature; S = submature).

| Museum Reg. No. | NMV F67002 | NMV F65659 | NMV F67001 (Holotype) | NMV F60148 (Paratype) | NMV F60149 (Paratype) | AM C159275 | NMV F60144 | NMV F60146 | AM C159275 |
|---|---|---|---|---|---|---|---|---|---|
| ML | 34.4 | 37.3 | 42.1 | 42.2 | 44.7 | 50.1E | 51.8E | 67.9E | 83.2E |
| StM | S | M | M | M | M | S | S | M | M |
| TL | 250 | 282 | 310 | 321 | 277 | 269 | 296 | 349 | 357 |
| MWI | 72.4 | 72.9 | 73.2 | 75.8 | 63.5 | 50.3 | 39.0 | 30.0 | 27.5 |
| HWI | 59.9 | 57.4 | 65.3 | 55.7 | 58.8 | 44.1 | 36.3 | 33.0 | 26.8 |
| HMWI | 82.7 | 78.7 | 89.3 | 73.4 | 92.6 | 87.7 | 93.1 | 109.8 | 97.4 |
| AMI: 1 | 595.9 | 630.0 | 603.3 | 639.8 | 492.2 | 411.2 | 453.7 | 385.9 | 314.9 |
| 2 | 500.0 | 522.8 | 491.7 | 575.8 | 407.2 | 383.2 | 345.6 | 331.4 | 245.2 |
| 3 | 407.0 | 404.8 | 403.8 | 462.1 | D | 299.4 | 332.0 | 278.4 | 204.3 |
| H | 247.1 | 254.7 | 239.9 | 279.6 | 208.1 | 181.6 | 195.0 | 153.2 | 134.6 |
| 4 | 372.1 | 437.0 | 370.5 | 440.8 | 302.0 | 257.5 | 301.2 | 254.8 | 191.1 |
| AWI | 17.7 | 17.7 | 19.0 | 14.2 | 19.9 | 15.0 | 10.8 | 10.8 | 9.9 |
| SDI | 12.5 | 13.1 | 11.9 | 11.4 | 13.2 | 9.8 | 8.9 | 7.8 | 6.4 |
| WDI | 11.2 | 11.1 | 10.6 | 11.5 | 13.1 | 14.6 | 10.2 | 12.2 | 13.0 |
| GC | 10 | 11 | 11 | 10/11 | 10 | 10 | 10/11 | 10 | 10/11 |
| SC | 227 | 219 | 250 | 236 | 251 | 239 | 206 | 238 | 234 |
| HAMI | 247.1 | 254.7 | 239.9 | 279.6 | 208.1 | 181.6 | 195.0 | 153.2 | 134.6 |
| OAI | 60.7 | 62.9 | 59.4 | 60.5 | D | 60.7 | 58.7 | 55.0 | 65.9 |
| HASC | 84 | 78 | 84 | 81 | 95 | 92 | 86 | 80 | 88 |
| LLI | 5.3 | 6.1 | 6.8 | 7.9 | 7.8 | 4.8 | 4.2 | 8.8 | 7.5 |
| CLI | 24.4 | 29.3 | 20.3 | 20.4 | 19.2 | 20.5 | 23.8 | 22.0 | 15.5 |
| TOLI | 12.5 | 21.4 | 24.2 | 33.6 | 30.0 | 11.0 | 9.5 | 26.8 | 21.5 |
| DLI | 51.2 | 57.5 | 60.8 | 61.3 | 48.5 | 54.5 | 44.9 | 54.9 | 49.2 |
| SpLI | | 75.1 | | 82.9 | | | | | 47.8 |
| SpWI | | 2.5 | | 2.6 | | | | | 2.5 |
| SpRI | | | | 54.3 | | | | | 46.2 |
| SpN | | 1 | 3 | 2 | 3 | | | | 3 |
| FLI | 58.1 | 61.1 | 60.3 | 57.1 | 48.8 | 44.3 | 43.1 | 30.9 | 33.7 |
| FFI | 56.0 | 60.1 | 46.1 | 60.6 | 47.2 | 53.6 | 57.4 | 49.5 | 33.9 |
| FOI | 69.4 | 73.2 | 68.1 | 74.3 | 84.0 | 77.7 | InD | 80.6 | InD |
| FOLI | 49.0 | 68.9 | 64.2 | 56.4 | 54.6 | 54.5 | InD | 66.2 | InD |

Table 5. Counts and measurements for female *Octopus aspilosomatis* sp. nov.
(S = submature; E = mantle considerably elongated; D = damaged; * = immature ovarian eggs; InD = indistinct).

| Museum Reg. No. | NMV F67002 | NMV F65664 | NMV F65661 | NMV F65664 | NMV F65664 | NMV F60144 | NMV F60147 (Paratype) | NMV F60145 (Paratype) |
|---|---|---|---|---|---|---|---|---|
| ML | 36.4 | 39.0 | 39.8 | 43.2 | 45.9 | 50.7E | 56.8 | 67.1 |
| StM | S | S | S | S | S | S | S | S |
| TL | 243 | 256 | 219 | 283 | 318 | 301 | 314 | 439 |
| MWI | 51.9 | 52.1 | 45.2 | 48.4 | 45.8 | 43.2 | 50.9 | 49.8 |
| HWI | 51.9 | 41.8 | 47.5 | 39.1 | 41.2 | 41.8 | 47.2 | 39.6 |
| HMWI | 100.0 | 80.3 | 105.0 | 80.9 | 90.0 | 96.8 | 92.7 | 79.6 |
| AMI: 1 | 535.7 | 530.8 | 424.6 | 532.4 | 568.6 | 469.4 | 438.4 | 527.6 |
| 2 | 428.6 | 397.4 | 361.8 | D | 481.5 | 410.3 | 345.1 | D |
| 3 | 368.1 | 346.2 | 304.0 | D | 372.5 | 359.0 | 283.5 | 427.7 |
| 4 | 326.9 | 305.1 | 238.7 | 331.0 | 372.5 | 335.3 | 267.6 | 357.7 |
| AWI | 16.2 | 11.3 | 13.6 | 12.0 | 11.5 | 11.8 | 13.0 | 13.6 |
| SDI | 9.6 | 7.7 | 8.0 | 6.7 | 8.7 | 9.3 | 8.8 | 9.4 |
| WDI | 11.3 | 10.1 | 12.4 | 9.1 | 10.0 | 11.8 | 14.5 | 10.5 |
| GC | 11 | 11 | 10 | 11 | 10/11 | 11 | 10 | 10 |
| SC | 234 | 217 | 228 | 230 | 236 | 243 | 246 | 267 |
| ELI | | | | | | | | 1.6* |
| EWI | | | | | | | | |
| EN | | | | | | | | ~30 000 |
| FLI | 51.6 | 45.1 | 44.0 | 50.0 | 54.5 | 49.3 | 36.8 | 48.7 |
| FFI | 54.3 | 43.2 | 28.6 | 41.2 | 86.8 | 51.6 | 41.6 | 58.1 |
| FOI | 61.9 | InD | 72.2 | 66.1 | 58.4 | 64.8 | InD | 78.5 |
| FOLI | 51.6 | InD | 51.4 | 53.2 | 45.2 | 51.2 | InD | 67.0 |

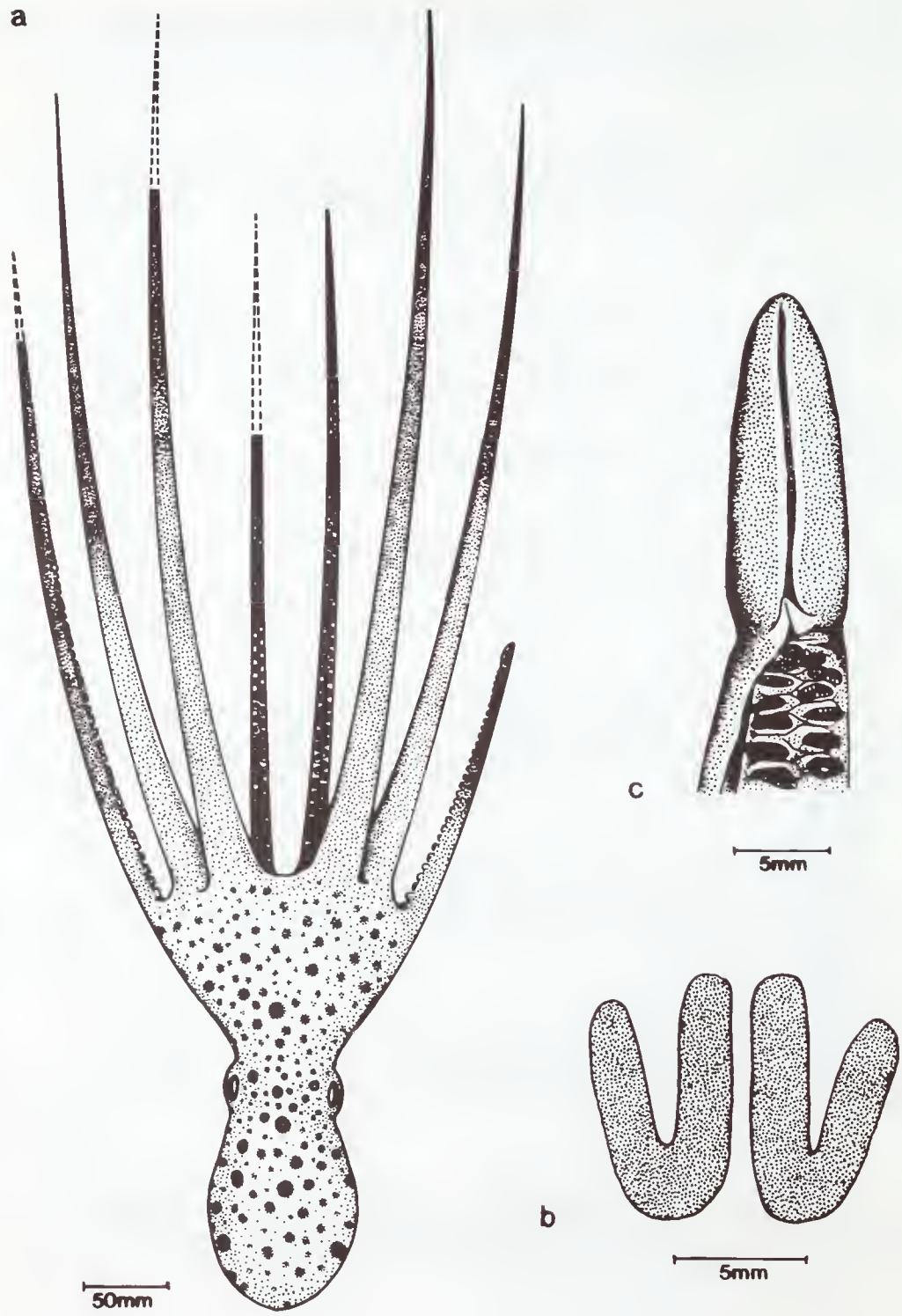



Figure 9. *Octopus dierythraeus* sp. nov. a, dorsal view of 135.0 mm ML male (holotype, NMV F67007). b, funnel organ of 37.5 mm ML male (NMV F60134). c, copulatory organ of 135.0 mm ML male (holotype, NMV F67007).

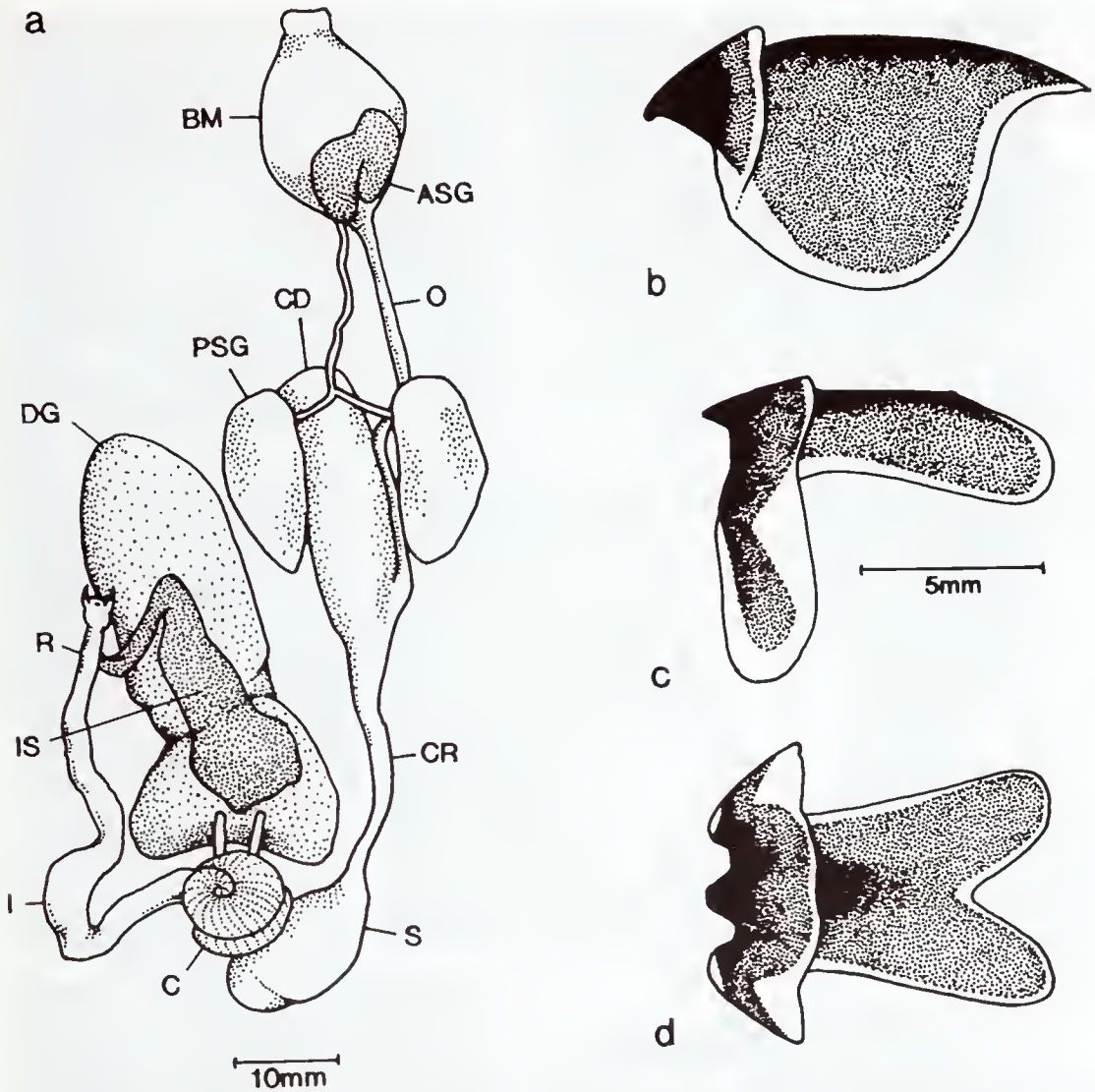



Figure 10. *Octopus dierythraeus* sp. nov. a, digestive tract of 60.7 mm ML male (paratype, NMV F60133) [abbreviations as in fig. 2a]. b–d, beaks of same specimen. b, upper beak, lateral view. c, lower beak, lateral view. d, lower beak, ventral view.

Thursday I., 10°35′S, 142°13′E, G.P. Whitley, 1928; 1♂: 35.5 mm ML, NMV F60132, Orpheus I., Pioneer Bay, 18°36′S, 146°29′E, 0.1 m, M. Norman, 6 Oct 1990 (active at 0410 hr, handnet); 1♂: 36.5 mm ML, AM C164181, Lindeman I., 20°27′S, 149°02′E, G.P. Whitley, 1935; 2♂: 37.5, 48.6 mm ML, NMV F60134, Sarina Beach, 21°24′S, 149°19′E, 0.1–0.2 m, M. Norman, 16 Sep 1990 (active between 0305–0315 hr, handnet); 1♂: 43.2 mm ML, NMV F60131, Orpheus I., Pioneer Bay, 18°36′S, 146°29′E, 1 m, M. Norman, 8 Oct 1990 (active at 2005 hr, retreated to lair, flushed with $CuSO_4$); 1♀: 43.2 mm ML, NMV F60138, Cape Hillsborough, 20°55′S, 149°05′E, 0.1 m, M. Norman, 18 Sep 1990 (in mouth of lair at 0430 hr, flushed with $CuSO_4$); 1♀: 45.3 mm ML, NMV F60136, Bowen, Cape Edgecombe, 20°01′S, 148°15′E, 0.1 m, M. Norman, 20 Sep 1990 (active at 0400 hr, handnet); 2♀: 50.5, 52.5 mm ML, NMV F60137, Magnetic I., Geoffrey Bay, 19°09′S, 146°52′E, 0.1–0.3 m, M. Norman, S. Troy, 4 Oct 1990 (active between 0230–0330 hr, handnet); 1♂: 53.1, 1♀: 77.1 mm ML, USNM 817785, Gulf of Carpentaria, off Weipa, 12°35.4′S, 141°36.2′E, 2 m, G. Hendler, "Alpha Helix" stn M-18, 4 Jun 1979; 1♀: 54.6 mm ML, NMV F60135, Magnetic I., Horseshoe Bay, 19°07′S, 146°51′E, <0.1 m, M. Norman, J. Martin, 9 Nov 1989 (within lair at 1200 hr, flushed with $CuSO_4$); 1♂: 66.6 mm ML, NMV F60130, Orpheus I., Cattle Bay, 18°34′S, 146°29′E, 1.5 m, M. Norman, 9 Oct 1990 (within lair at 1600 hr, flushed with $CuSO_4$); 1♂: 90.5 mm ML, MNHN 4.2.853, Torres Strait, Thursday I., 10°35′S, 142°13′E, M. Lix, No. 27, 1891.

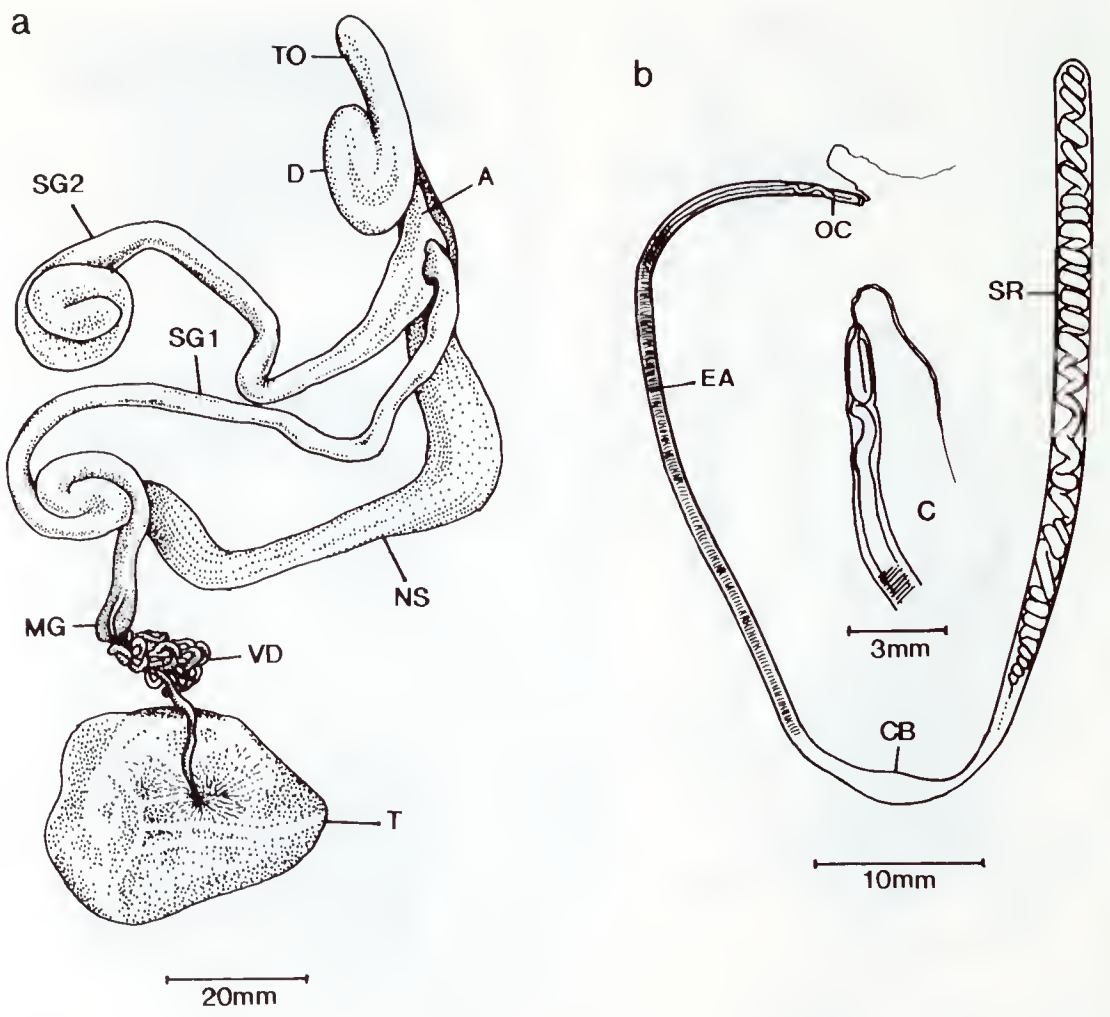
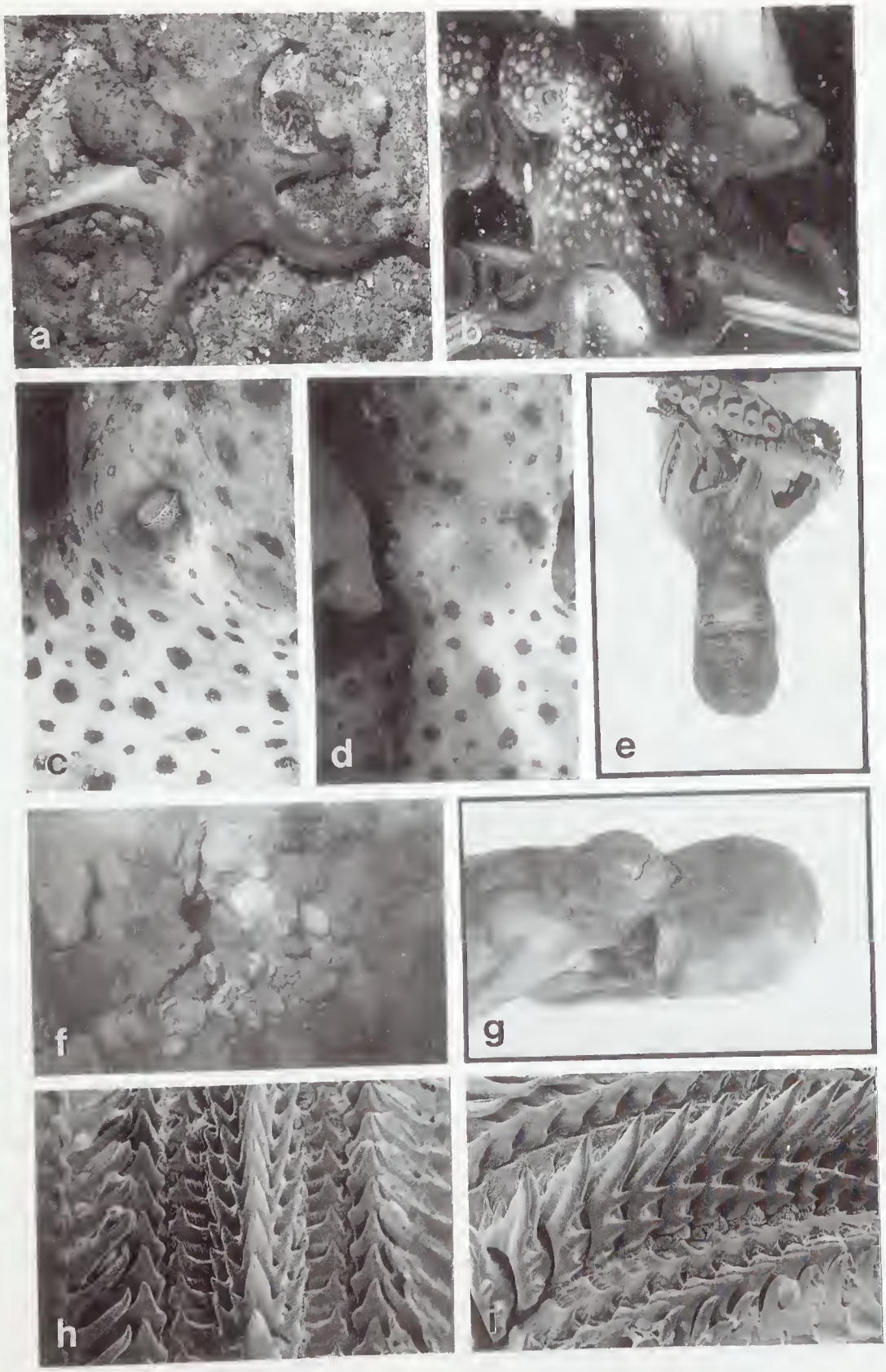



Figure 11. *Octopus dierythraeus* sp. nov. a, reproductive tract of 135.0 mm ML male (holotype, F67007) [abbreviations as in fig. 3a]. b–e, spermatophore from same specimen. b, whole spermatophore. CB = cement body; EA = ejaculatory apparatus; OC = oral cap; SR = sperm reservoir. c, detail of oral cap.

Figure 12. *Octopus dierythraeus* sp. nov. a, active individual at night on reef flat on Magnetic I., showing resting/foraging colour pattern. b, intermediate colour pattern of 54.6 mm ML female (NMV F60135), showing first signs of red spots within white spots. c, alarm colour pattern of same specimen. d, alarm colour pattern of 66.6 mm ML male (NMV F60130). e, dorsal view of preserved 59.8 mm ML male (NMV F60129). f, lair of 66.6 mm ML male (NMV F60130). g, lateral view of preserved 60.7 mm ML male (NMV F60133), showing pale spots each containing a central papilla. h–i, radula of 80.7 mm ML female (NMV F60133). h, dorsal view. i, lateral view.


a
b
c
d
e
f
g
h
i

WA: 1♂: 71.6 mm ML, NMV F67013, off Kimberley coast, 13°12′S, 125°03′E, 77–78 m, C.C. Lu, FV "Hai Kung", 30 March 1981 (on sand).

*Diagnosis.* Large muscular species with unequal arms, dorsal arms longest and most robust (AF 1.2.3.4), typically 4 to 5 times mantle length. Webs moderately deep, approximately 20% of length of longest arms. Sucker counts, 200–280 per arm in submature and mature animals, 100–125 suckers on intact hectocotylized arm of submature and mature males. Gill lamellae, 12–14 per demibranch, typically 13. Funnel organ UU-shaped. No mature females encountered, submature females with large-type eggs, produced in low numbers. Alarm colouration of white base colour and red circular spots on dorsal body, arm crown and arms.

*Description.* The following description is based on 1 mature and 5 submature males, and 1 submature/mature female and 4 submature females. Counts and indices for material examined presented in Tables 6 and 7, with data for immature specimens (4♂, 3♀).

Moderate to large robust species (fig. 9a): ML to at least 135 mm for males and 120 mm for females, TL to at least 810 mm; weight to at least 1.5 kg. Mantle from round to ovoid, never greatly elongated (MWI 62.2–*69.7*–80.3), mantle walls moderately muscular. Stylets present, poorly developed. Pallial aperture of moderate width, approximately half mantle width. Funnel long, muscular and broad based (FLI 43.6–*60.9*–72.8) with free portion usually greater than half funnel length (FFI 36.9–*56.8*–64.8). Funnel organ well developed (fig. 9b), always UU-shaped with broad limbs, outer limbs slightly shorter than median limbs (FOI 76.2–*83.6*–92.7). Funnel organ approximately 50% of funnel length (FOLI 42.2–*51.8*–62.9).

Head of moderate width (HWI 46.8–*58.6*–71.1), typically narrower than mantle (HMWI 69.3–*84.2*–107.1). Neck distinct, slightly narrower than head. Eyes large and slightly pronounced.

Arms moderate to long, dorsal pair longest and typically 4 to 5 times mantle length (AMI 365.7–*477.5*–574.0) and robust (AWI 11.3–*19.3*–25.3), roughly square in cross section and tapering evenly along length. Arms unequal in length, dorsal pair longest, ventral pair shortest (AF typically 1.2.3.4). Suckers of moderate to large size (SDI 13.0–*15.5*–20.2), deep with distinct radial cushions and scalloped outer rim, scalloping pronounced on small distal suckers. Suckers largest on dorsal arms, none especially enlarged in either sex. 200–280 suckers on intact normal arms of larger specimens (SC 234–*259*–280, n = 5♂, 3♀). Webs of moderate depth (WDI 17.6–*20.3*–27.8), deepest dorsally receding ventrally to shortest ventral web (WF typically A.B.C.D.E). Web margins extended on ventral edges of arms for most of length.

Only 1 mature male (135.0 mm ML holotype) encountered. Hectocotylized arm of holotype almost fully regenerated, opposite arm damaged. Right third arm hectocotylized and slightly shorter than opposite arm in submature specimens [OAI(submature) 69.2–*73.9*–77.0, n = 4; HAMI(submature) 234.6–*264.9*–298.2]. Copulatory organ of mature male large [fig. 9c: LLI(holotype) 6.4 on regenerating arm], roughly cylindrical with deep ligula groove and small sharp calamus [CLI(holotype) 16.6]. Spermatophore groove well developed with fine transverse ridges. Regenerating hectocotylized arm of holotype with 93 suckers, approximately 112 suckers in submature males [HASC(submature) 103–*112*–125].

Gills with 12–14 lamellae, typically 13 on each demibranch, plus small terminal lamella.

Digestive tract illustrated in figure 10a. Anterior salivary glands approximately 40% of buccal mass length. Posterior salivary glands approximately equal in length with buccal mass. Crop diverticulum well developed, approximately 70% of length of digestive gland. Stomach bipartite. Caecum clearly striated, coiled in 1.5–2 whorls. Intestine thin walled and reflexed approximately one-third from proximal end. Rectum straight and muscular. Ink sac well developed, embedded in ventral surface of digestive gland. Ink red when released by live individuals. Anal flaps present.

Upper beak (fig. 10b) with small hood and slightly hooked rostrum. Lower beak (figs 10c–d) with moderately blunt rostrum, narrow hood, widely spread wings and flared lateral walls. Ventral view of posterior margin of lateral walls deeply concave. Radula with 7 transverse rows of teeth and marginal plates (figs 12h–i). Rhachidian tooth has 2–3 lateral cusps, typically 3, on each side of large curved medial cusp. Lateral cusps typically in symmetrical seriation, although seriation asymmetrical in 1 specimen (52.5 mm ML ♀, NMV F60137). This specimen differs from other material in no other character. The symmetry of seriation does not appear fixed. In all specimens, lateral cusps migrate from lateral to medial position over 9–10 rows. First lateral teeth small and unicuspidate; second lateral teeth unicuspidate, of moderate

Table 6. Counts and indices for male *Octopus dierythraeus* sp. nov.
(D = damaged; Imm = immature; InD = indistinct; M = mature; R = regenerating; S = submature).

| Museum Reg. No. | NMV F60132 | AM C164181 | NMV F60134 | NMV F60133 | NMV F60134 | NMV F60129 (Paratype) | NMV F60133 (Paratype) | NMV F60130 | NMV F60127 | NMV F67007 (Holotype) |
|---|---|---|---|---|---|---|---|---|---|---|
| ML | 35.5 | 36.5 | 37.5 | 40.9 | 48.6 | 59.8 | 60.7 | 66.6 | 89.1 | 135.0 |
| StM | Imm | Imm | Imm | Imm | S | S | S | S | S | M |
| TL | 212 | 175 | 192 | 253 | 250 | 419 | 351 | 388 | 568 | 810 |
| MWI | 70.4 | 51.8 | 80.0 | 79.0 | 67.5 | 80.3 | 67.1 | 63.5 | 66.8 | 62.2 |
| HWI | 56.3 | 56.2 | 60.3 | 62.3 | 50.4 | 68.9 | 62.6 | 54.2 | 53.8 | 50.7 |
| HMWI | 80.0 | 108.5 | 75.4 | 78.9 | 74.7 | 85.8 | 93.3 | 85.4 | 80.5 | 81.4 |
| AMI: 1 | 439.4 | 361.6 | 384.0 | 491.4 | 397.1 | 561.9 | 489.3 | 453.5 | 512.9 | 477.8 |
| 2 | 388.7 | 274.0 | 336.0 | 401.0 | 347.7 | 469.9 | D | 391.9 | 431.0 | 448.1 |
| 3 | 332.4 | 238.4 | 314.7 | 354.5 | 304.5 | 382.9 | D | 324.3 | 382.7 | D |
| H | 276.1 | 200.0 | 250.7 | 254.3 | 234.6 | 275.9 | 298.2 | 250.8 | 264.9 | 203.7R |
| 4 | 388.0 | 241.1 | 296.0 | 330.1 | 271.6 | 372.9 | 375.6 | 294.3 | 334.5 | 382.2 |
| AWI | 19.2 | 15.1 | 18.7 | 19.6 | 16.7 | 25.3 | 24.9 | 19.5 | 21.5 | 23.6 |
| SDI | 14.1 | 11.0 | 12.3 | 15.6 | 13.2 | 20.2 | 15.3 | 15.0 | 13.0 | 14.4 |
| WDI | 17.3 | 19.5 | 22.2 | 20.4 | 22.3 | 20.8 | >16.8D | 19.2 | 17.7 | 19.2 |
| GC | 12/13 | 12/13 | 13/14 | 12/13 | 12/13 | D | 13 | 13 | 13 | 13/14 |
| SC | | | | | | 242 | 254 | 264 | 272 | 280 |
| HAMI | 276.1 | 200.0 | 250.7 | 254.3 | 234.6 | 275.9 | 298.2 | 250.8 | 264.9 | 203.7R |
| OAI | 83.1 | 83.9 | 79.7 | 71.7 | 77.0 | 72.1 | D | 77.3 | 69.2 | D |
| HASC | 108 | 103 | 105 | 121 | 105 | 108 | 125 | 123 | 117 | 93R |
| LLI | 1.8 | InD | 1.4 | 1.3 | 2.1 | 3.1 | 2.7 | 2.7 | 2.9 | 6.4R |
| CLI | 27.8 | InD | InD | InD | 33.3 | 33.3 | 25.0 | 37.8 | 33.8 | 16.6 |
| TOLI | InD | 5.5 | InD | InD | 7.8 | 14.4 | InD | 8.6 | 9.7 | 24.7 |
| DLI | InD | InD | InD | InD | 57.9 | 47.7 | InD | 63.2 | 58.1 | 59.8 |
| SpLI | | | | | | | | | | 74.8, 75.6 |
| SpWI | | | | | | | | | | 1.3, 1.5 |
| SpRI | | | | | | | | | | 39.6, 41.2 |
| SpN | | | | | | | | | | 4 |
| FLI | 59.2 | D | 56.5 | 63.1 | 59.1 | 67.6 | 69.9 | 60.4 | 61.3 | 45.3 |
| FFI | 65.2 | D | 51.5 | 66.2 | 60.9 | 57.7 | 51.1 | 44.5 | 57.9 | 70.1 |
| FOI | 88.1 | D | 88.3 | 75.0 | 82.8 | 76.2 | 89.9 | InD | InD | 92.7 |
| FOLI | 51.9 | D | 44.3 | 41.9 | 50.5 | 45.8 | 42.2 | InD | InD | 62.9 |

Table 7. Counts and indices for female *Octopus dierythraeus* sp. nov.
(D = damaged; Imm = immature; InD = indistinct; S/M = submature/mature; * = measurements of immature ovarian eggs).

| Museum Reg. No. | AM C159268 | NMV F60138 | NMV F60136 | NMV F60137 | NMV F60137 | NMV F60135 | NMV F60133 | NMV F60128 (Paratype) |
|---|---|---|---|---|---|---|---|---|
| ML | 20.3 | 43.2 | 45.3 | 50.5 | 52.5 | 54.6 | 64.6 | 118.8 |
| StM | Imm | S | S | Imm | Imm | S | S | S/M |
| TL | 131 | 219 | 324 | 277 | 286 | 343 | 365 | 715 |
| MWI | 95.1 | 64.6 | 75.9 | 69.9 | 68.4 | 77.7 | 73.4 | 67.5 |
| HWI | 87.2 | 69.2 | 71.1 | 51.5 | 49.7 | 62.5 | 54.8 | 46.8 |
| HMWI | 91.7 | 107.1 | 93.7 | 73.7 | 72.7 | 80.4 | 74.7 | 69.3 |
| AMI: 1 | 492.6 | 365.7 | 574.0 | 425.7 | 417.1 | 498.2 | 439.6 | 482.3 |
| 2 | 403.9 | 305.6 | 479.0 | 362.4 | 358.1 | 443.2 | 370.0 | D |
| 3 | 335.0 | 263.9 | 419.4 | 322.8 | 314.3 | 362.6 | 371.5 | 353.5 |
| 4 | 305.4 | 250.0 | 401.8 | 308.9 | 310.5 | 357.1 | 331.3 | 340.1 |
| AWI | 21.7 | 24.3 | 11.5 | 18.4 | 17.0 | 14.1 | 11.3 | 19.1 |
| SDI | 15.8 | 15.3 | 17.4 | 13.5 | 12.6 | 17.2 | 14.2 | 15.7 |
| WDI | 24.0 | 27.8 | 18.1 | 18.1 | 18.7 | 18.4 | 21.5 | 17.6 |
| GC | 12/13 | 13 | 13 | 13 | 13/14 | 13/12 | 13 | 13 |
| SC | 234 | 234 | 250 | 276 | | | | |
| ELI | | | | | | | | 11.9* |
| EWI | | | | | | | | 1.9* |
| EN | | | | | | | | <200 |
| FLI | 67.0 | 54.2 | 72.8 | 59.6 | 62.5 | 68.1 | 67.6 | 43.6 |
| FFI | 33.1 | 60.7 | 61.0 | 49.5 | 46.4 | 59.2 | 64.8 | 36.9 |
| FOI | 76.9 | 80.8 | 83.1 | 91.9 | 90.3 | InD | 84.4 | 78.9 |
| FOLI | 57.4 | 53.4 | 50.3 | 49.2 | 40.9 | InD | 51.5 | 57.5 |

length and robust; lateral marginal teeth relatively straight, short and robust; marginal plates oblong and plain.

Male reproductive tract illustrated in figure 11a. Terminal organ in mature male of moderate length and robust [TOLI(holotype) 24.7] with robust diverticulum (DLI(holotype) 59.8). Genital aperture subterminal. Mucilaginous gland enlarged at point of attachment to vas deferens. Spermatophoric gland I narrow with large recurved coil approximately 80% along length. Spermatophoric gland II elongate and narrow with coiled tip. Spermatophores (fig. 11b–c) approximately three-quarters of mantle length (SpLI 74.8, 75.6), narrow (SpWI 1.3, 1.5) and produced in low numbers (4 in Needham's Sac of holotype). Oral cap simple bearing long cap thread. Sperm reservoir approximately 40% of spermatophore length (SpRI 39.6, 41.2), sperm cord coiled in approximately 30 whorls in best condition spermatophore.

No mature females encountered. Immature ovaries were visible in submature females, positioned on the right hand side of the septum midway along visceral mass. The ovary of the largest female (118.8 mm ML, NMV F60128) occupied approximately 20% of visceral mass and contained approximately 350 long thin immature eggs up to 14.1 mm long [ELI(1mm) to 11.9; EWI(1mm) to 1.9]. Approximately 20 follicular folds visible on immature eggs. This species clearly produces large type eggs in moderately low numbers.

Colour in life variable, 3 distinct colour patterns displayed most frequently. Foraging animals have orange base colour with mottled cream and red/brown patches (fig. 12a). Disturbed animals have red brown base colour with white circles each containing a central papilla (fig. 12b). This pattern is similar to that of *O. alpheus* (fig. 4a–c) displaying the same large transverse pair of white spots on dorsal body. This pattern is an intermediate stage in attaining the full alarm display. Alarm display of the negative pattern: white base colour and circular red spots over dorsal body, arm crown, webs and arms (figs 9a, 12c–d). Iridescent tissue layer in the skin produces an iridescent green sheen in torchlight at night.

Skin sculpture simple, consisting of scattered low papillae with smooth tips, located in the centre of white spots in intermediate colour pattern and centre of red spots in alarm pattern (figs 9a, 12c–d). Smaller punctae occur over dorsal surfaces between papillae. Single slightly larger supraocular papilla directly above each eye, surrounded by low punctae. Oral surfaces of all webs smooth and unpigmented.

Preserved specimens lose darker red colours and definition of spots, base colour fading to pink or cream. Ventral surfaces smooth and scattered with small fine chromatophores. 2–3 dark wavy transverse lines often visible across dorsal arm crown. Pale spots containing central papilla sometimes visible on mantle, especially on lateral faces (fig. 12g).

Sexual dimorphism was not marked in the material examined.

*Distribution.* Coastal waters and inshore islands of the Great Barrier Reef and northern Australia, from Sarina Beach (21°24′S, 149°19′E) in the south, north to Thursday I. (10°35′S, 142°13′E) and west to the Kimberley coast, northern Western Australia (13°12′S, 125°03′E) (fig. 17d). Specimens were collected from exposed intertidal reefs and subtidally to 78 m.

*Life history. Octopus dierythraeus* is a nocturnally active species which forages on intertidal rock and mud flats, and shallow subtidal habitats in coastal muddy waters and round inshore islands.

This species is an active predator, observed probing amongst crevices and rubble mainly with arms 1 and 2 on exposed reef flats at night. Active animals were encountered carrying fresh bivalves, crabs, a large polychaete worm and in one case a decapitated fresh octopus of indeterminate identity. Active lairs were surrounded by clean bivalve shells and carapaces of small crabs. Large strombs were also found at two lairs. One specimen flushed from a lair at Orpheus I. (66.6 mm ML male: NMV F60130) had accumulated the remains of over 100 bivalves. Only one small crab carapace was found amongst this midden. *Octopus dierythraeus* has had a significant influence on James Cook University's Giant Clam (*Tridacna* spp.) mariculture project on Orpheus I. (18°36′S, 146°29′E). The empty shells of young clams were regularly found around lairs of this species (P. Lee, pers. comm.). Captive individuals readily take frozen fish (J. Hoey, Reef Wonderland Aquarium, Townsville, pers. comm.).

*Octopus dierythraeus* occupies lairs amongst rocks on muddy substrates and within coral bedrock, closing the entrance during the day with pieces of dead coral. Lairs are permanent or at least long term, judging by the large number of prey remains (primarily bivalve shells) surrounding lair entrances. Animals only emerge after dark.

The large eggs of this species indicate benthic hatchlings.

*Etymology.* From the Greek "*dierythros*" meaning spotted with red, referring to the red spots generated in the alarm display of this species (fig. 9a, 12c–d).

**Octopus graptus** sp. nov.

Figs 13–16, 17e

*Material examined.* None encountered live in the field. 17 specimens obtained from commercial prawn trawl operators, now in the Museum of Victoria. 10 preserved specimens were found and examined in the collections of the Australian Museum, Northern Territory Museum of Arts and Sciences, and Museum of Victoria.

Holotype: Qld: 1♀: 88.8 mm ML, NMV F67006, Cleveland Bay, Townsville (19°11′S, 147°01′E), A. Cabanban, 12 Jan 1990 (trawl).

Paratypes: Qld: 1♀: 107.0 mm ML, NMV F67008, Gulf of Carpentaria, 16°09′S, 138°51′E, 32 m, QDPI, grid 6188, port stn. 8, shot 3, 12 Apr 1983 (at 0210 hr); 1♂: 111.6 mm ML, NMV F67009, 0.3 mile (0.6 km) south of Lucinda wharf (~18°32′S, 146°22′E), 15–17 m, D. Sutton, 12–18 Nov 1989 (prawn trawl on sand).

NT: 1♀: 116.1 mm ML, NTM P1478. W of Orontes Reef, off Cobourg Peninsula, 11°06.0′S, 132°04.3′E, C. Johnson, 10 Aug 1990 (trawl).

Other material: Qld: 2♂: 68.2, 76.9 mm ML, 8♀: 57.3–86.9 mm ML, NMV F67009, 0.3 mile (0.6 km) south of Lucinda wharf (near 18°32′S, 146°22′E), 15–17 m, D. Sutton, 12–18 Nov 1989 (prawn trawl on sand); 1♀: 75.6 mm ML, 1♂: 92.0 mm ML, AM C170702, W of Fitzmaurice Point, SE Gulf of Carpentaria, 17°10.5′S, 140°30.7′E, 13 m, I. Loch, Dec 1976 (trawl); 1♂: 85.4 mm ML, NMV F67012, Gulf of Carpentaria, 10°59′S, 140°29′E, stn 058, SS05/91, 29 Nov 1991 (trawl, 0400 hr); 1♀: 87.8 mm ML, NMV F67003, 50 km west of Port Musgrave, Gulf of Carpentaria, 12°07′S, 141°27′E, 36 m, C.C. Lu, FV "Susan Wright", 16 Jun 1982 (prawn trawl, 1930–2030 hr); 2♂: 23.6, 157.9 mm ML, 4♀: 104.8–190.8 mm ML, NMV F67011, East side of Cape Yorke, somewhere N of Cairns (no exact locality data), commercial prawn trawler, 1989 (purchased from Rosslyn Bay Fisherman's Co-operative); 1♂: 111.3 mm ML, AM C170701, W of Fitzmaurice Point, SE Gulf of Carpentaria, 17°12′S, 140°37.8′E, 11 m, I. Loch, Dec 1976 (trawl).

NT: 1♂: 76.3 mm ML, NMV F67004, Off Groote Eylandt, (about 14°00′S, 137°00′E), 29 Nov 1980 (prawn shot, 2400 hr).

WA: 1♀: 40.6 mm ML, NTM P015795, Joseph Bonaparte Gulf, 13°09′70″S, 128°08′50″E, 27 Jun 1990.

*Diagnosis.* Large muscular species with unequal arms, dorsal pairs longest (AF 1.2.3.4), typically 4.5–7 times mantle length. Webs moderately deep, approximately 20% of length of longest arm. Sucker counts, 200–280 per arm in submature and mature animals, 86–88 on heterocotylized arm of submature and mature males. Gill lamellae, 13–14 per demibranch, typically 13 on outer demibranch and 14 on inner demibranch. Funnel organ VV-shaped. Eggs large (to 28 mm long), produced in moderately low numbers (680 in mature female). Colour pattern of pale cream to pink base colour with dark pink brown irregular seribbling over dorsal mantle and arm crown.

*Description.* The following description based on 2 submature, 1 submature/mature and 1 mature males, and 1 mature and 4 submature females. Counts and indices presented in Tables 8 and 9.

Large robust species (fig. 13a): ML to at least 190 mm, TL to at least 1300 mm; weight to at least 4.2 kg. Mantle round to ovoid (MWI 47.4–*59.5*–76.8), mantle walls thick and muscular. Stylets well developed. Pallial aperture of moderate width, slightly greater than half mantle width. Funnel long, muscular and broad based (FLI 40.9–*50.1*–66.6) with free portion variable in length, typically around half funnel length (FFI 20.9–*51.2*–60.1). Funnel organ moderately developed (fig. 13b), VV-shaped with narrow to medium width limbs. Outer limbs considerably shorter than median limbs (FOI 56.3–*62.1*–70.4). Funnel organ approximately 40% of funnel length (FOLI 39.2–*40.8*–44.7).

Head of moderate width (HWI 33.1–*42.9*–60.2), typically narrower than mantle (HMWI 55.5–*72.2*–92.6). Neck distinct, slightly narrower than head. Eyes large and pronounced.

Arms long, typically 4.5–7 times mantle length (AMI 446.9–*537.9*–706.8). Arms robust (AWI 15.1–*19.6*–26.2), roughly circular in cross section and tapering evenly along length. Arms unequal in length, dorsal pair longest, ventral pair shortest (AF typically 1.2.3.4). Suckers large [SDI(females and submature males): 13.1–*14.5*–16.3], larger in mature male [SDI(mature male): 21.5], but no individual suckers specially enlarged. Suckers deep with moderate flared rims, fine radial cushions and scalloped outer rim. Suckers largest on dorsal arms, none especially enlarged in either sex. Approximately 240 suckers per intact normal arm in both sexes (SC 194–*240*–280). Webs moderately deep (WDI 16.4–*20.0*–22.0), deepest dorsally

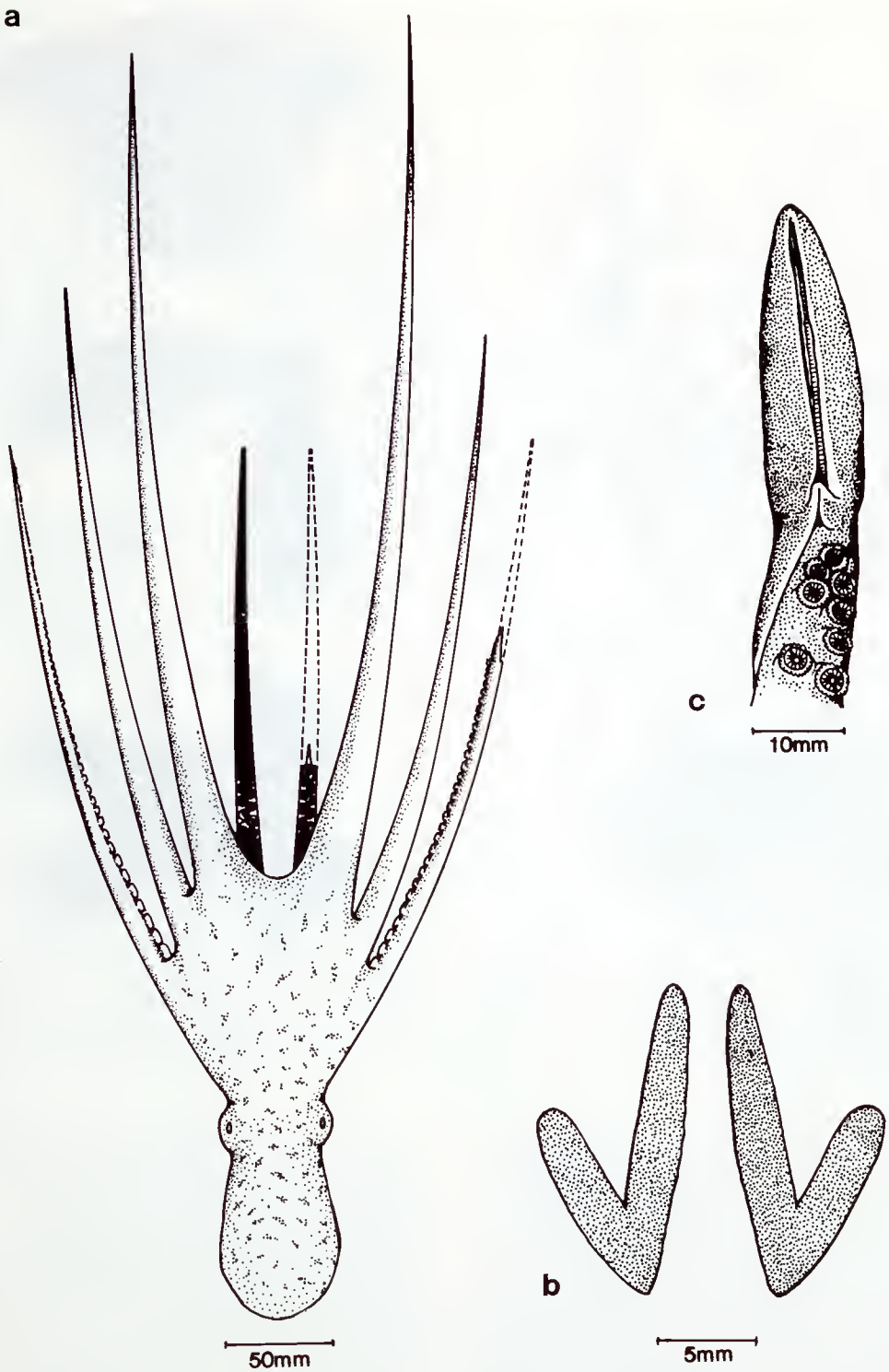



Figure 13. *Octopus graptus* sp. nov. a, dorsal view of 88.8 mm ML female (holotype, NMV F67006). b, funnel organ of 87.8 mm ML female (NMV F67003). c, copulatory organ of 157.9 mm ML male (NMV F67011).

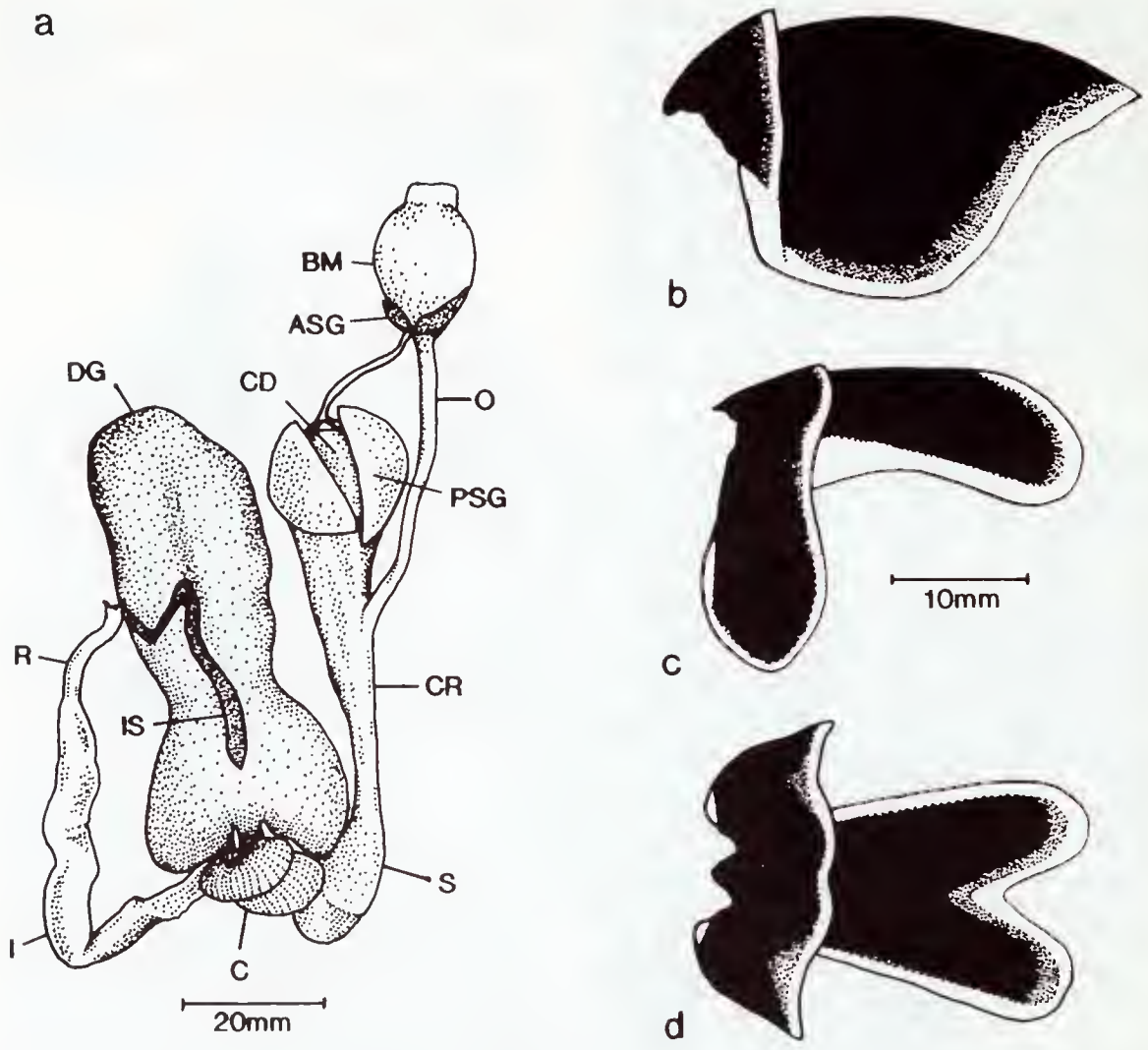



Figure 14. *Octopus graptus* sp. nov. a, digestive tract of 87.8 mm ML female (NMV F67003) [abbreviations as in fig. 2a]. b–d, beaks of 157.9 mm ML male (NMV F67011). b, upper beak, lateral view. c, lower beak, lateral view. d, lower beak, ventral view.

decreasing evenly in depth to ventral web (WF typically A.B.C.D.E). Web margins extended on ventral edges of arms for majority of length.

Right third arm in males hectocotylized, slightly shorter than opposite arm (OAI: 59.2–*68.4*–73.0; HAMI: 187.4–*265.7*–365.4). Copulatory organ (fig. 13c) of moderate size [LLI(mat) 6.5], roughly cylindrical with ligular groove deep and closed. Calamus of modcrate size [CLI(mat) 19.9]. Spermatophore groove well developed and wide with fine transverse grooves. Spermatophore guide not distinct in frozen mature male. Approximately 87 suckers on hectocotylized arm (HASC 86–*87*–88).

Gills with 13–14 lamellae on each demibranch, typically 13 on outer and 14 on inner demibranch. Terminal lamella small.

Digestivc tract illustrated in figure 14a. Anterior salivary glands approximately one-third of buccal mass length. Posterior salivary glands approximately equal in length with buccal mass. Crop diverticulum well developed in the specimen dissected. Stomach bipartite. Caecum clearly striated, coiled in 1.5–2 whorls. Intestinc thin walled, reflexed in proximal third. Rectum muscular and straight. Ink sac poorly developcd and elongate, ink duct long. Fine elongate anal flaps prcsent.

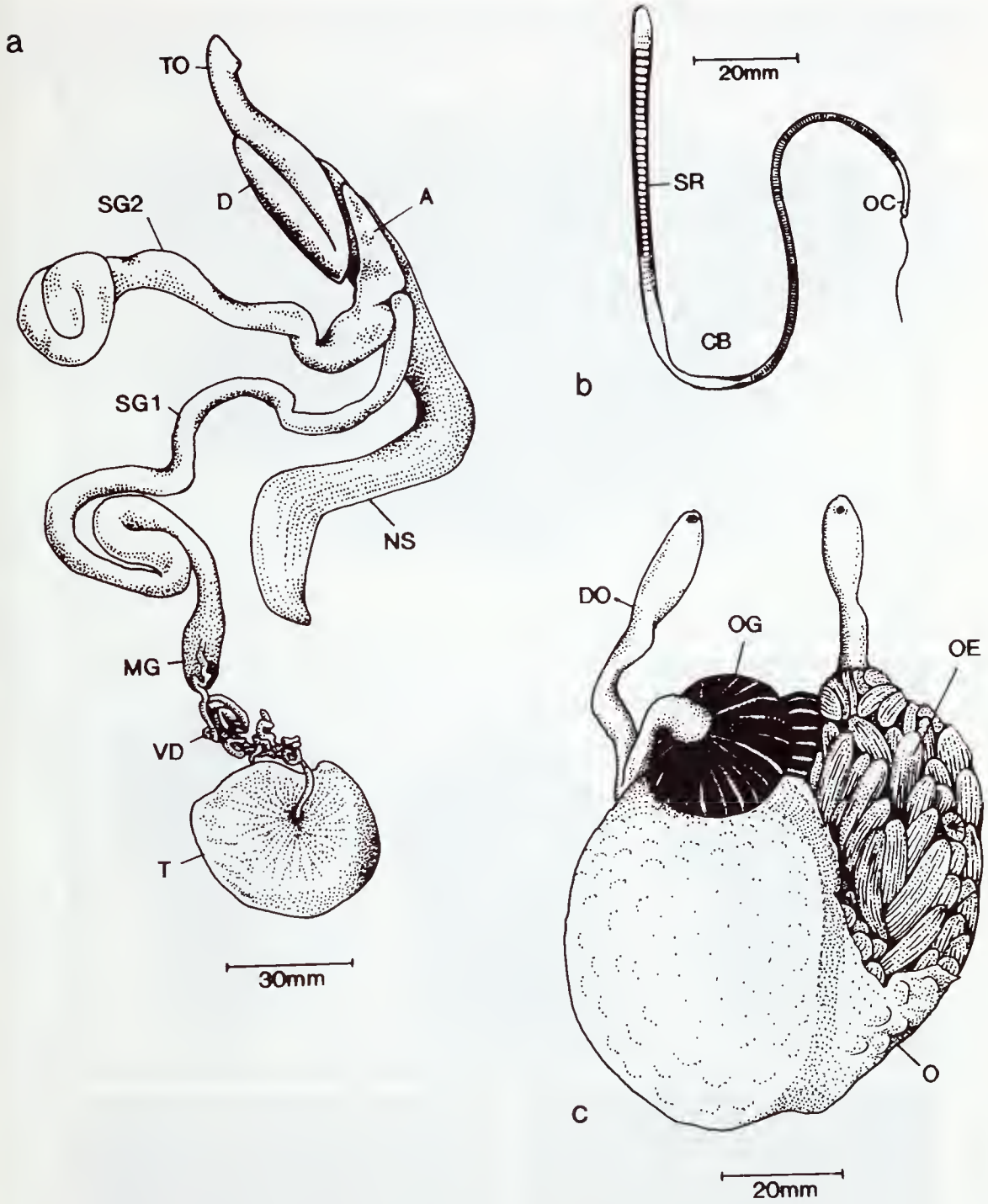



Figure 15. *Octopus graptus* sp. nov. a, reproductive tract of 157.9 mm ML male (NMV F67011) [abbreviations as in fig. 3a]. b, spermatophore from same specimen. CB = cement body; EA = ejaculatory apparatus; OC = oral cap; SR = sperm reservoir. c, ovary of 190.8 mm ML female (NMV F67011). DO = distal oviduct; O = ovary; OE = mature ovarian egg; OG = oviducal gland.

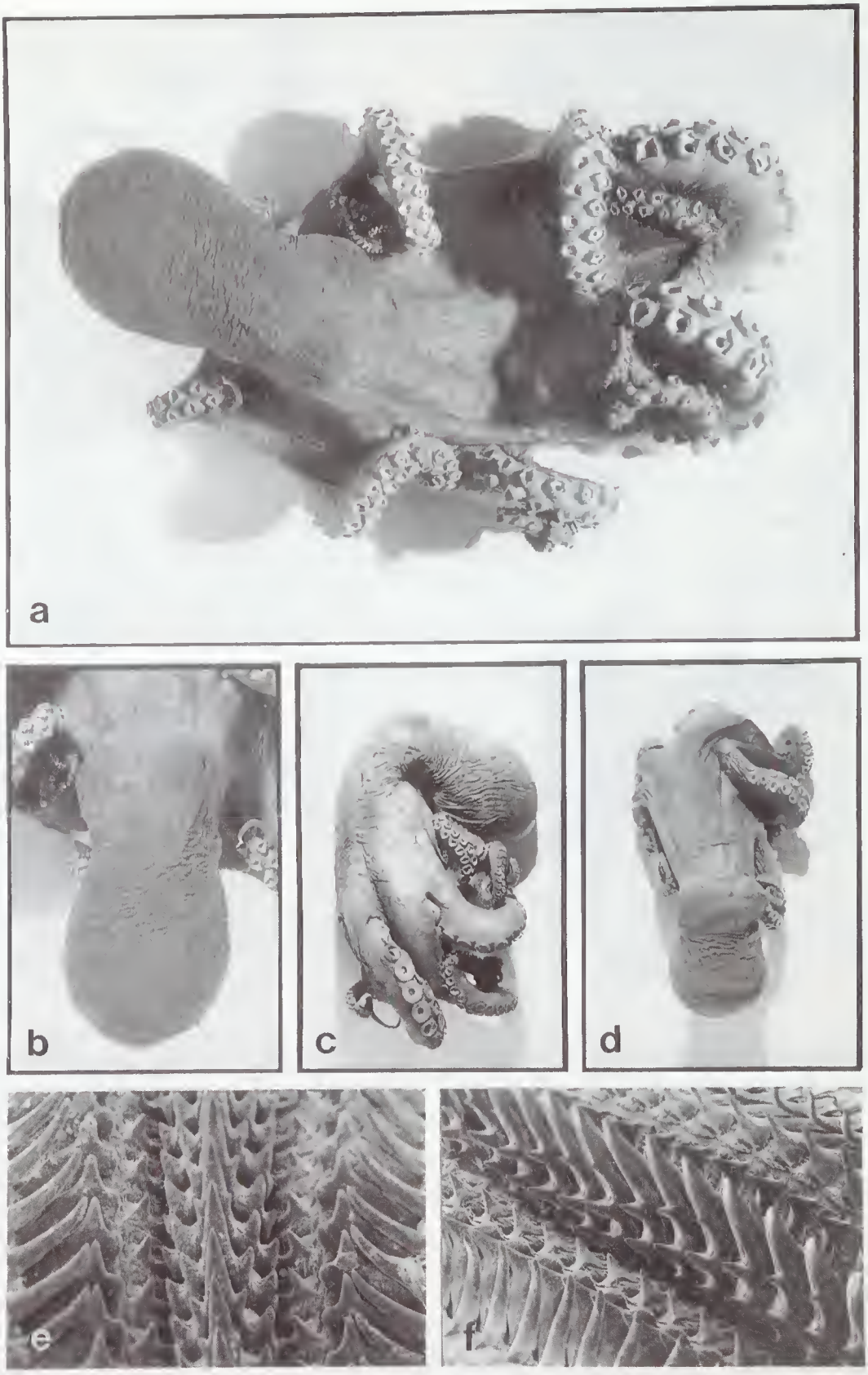

a
b
c
d
e
f

Figure 16. *Octopus graptus* sp. nov. a, dorsal view of preserved 88.8 mm ML female (holotype, NMV F67006). b, dorsal mantle of same specimen. c, lateral view of preserved 116.1 mm ML female (NTM P1478). d, dorsal view of preserved 40.6 mm ML female (NTM P015795). e–f, radula of 57.3 mm ML female (NMV F67009). e, dorsal view. f, lateral view.

←

Upper beak (fig. 14b) with weakly hooked rostrum, small hood and large lateral walls. Lower beak (figs 14c–d) with sharp rostrum, narrow hood, widely spread wings and flared lateral walls. Ventral view of posterior margin of lateral walls deeply concave. Radula with 7 transverse rows of teeth and marginal plates (figs 16e–f). Rhachidian tooth has 2–3 lateral cusps, typically 3, on each side of large curved medial cusp. Lateral cusps in symmetrical seriation, migrating from lateral to medial position over 9–10 rows. First lateral teeth small and unicuspidate; second lateral teeth unicuspidate, of moderate length and robust; lateral marginal teeth curved and relatively fine; marginal plates oblong and plain.

Male reproductive tract illustrated in figure 15a. Terminal organ in mature male large and

Table 8. Counts and indices for male *Octopus graptus* sp. nov. (D = damaged; InD = indistinct; M = mature; S = submature).

| Museum Reg. No. | NMV F67004 | NMV F67009 (Paratype) | NMV F67011 | NMV F67005 |
|---|---|---|---|---|
| ML | 76.3 | 111.6 | 123.6 | 157.9 |
| StM | S | S | S/M | M |
| TL | 420 | 778 | 749 | 1286 |
| MWI | 47.7 | 65.9 | 61.0 | 76.8 |
| HWI | 35.9 | 36.6 | 35.0 | 60.2 |
| HMWI | 75.3 | 55.5 | 57.3 | 78.4 |
| AMI: 1 | 446.9 | 562.7 | D | 706.8 |
| 2 | 327.7 | 465.9 | 484.6 | 589.6 |
| 3 | 256.9 | 337.8 | 449.8 | 526.9 |
| H | 187.4 | 243.7 | 266.2 | 365.4 |
| 4 | 249.0 | 330.6 | 368.9 | 499.7 |
| AWI | 15.1 | 17.6 | 20.2 | 26.2 |
| SDI | 13.1 | 14.3 | 16.3 | 21.5 |
| WDI | 22.0 | 19.1 | D | D |
| GC | 13/14 | 13/14 | 13 | 14 |
| SC | 194 | 220 | 230 | 280 |
| HAMI | 187.4 | 243.7 | 266.2 | 365.4 |
| OAI | 73.0 | 72.1 | 59.2 | 69.4 |
| HASC | 86 | 86 | 86 | 88 |
| LLI | 1.5 | 6.1 | 10.3 | 6.5 |
| CLI | InD | 29.4 | 26.0 | 19.9 |
| TOLI | 6.0 | 10.7 | 12.1 | 31.2 |
| DLI | 37.0 | 67.2 | 56.4 | 82.4 |
| SpLI | | | | 85.5 |
| SpWI | | | | 1.9 |
| SpRI | | | | 38.5 |
| SpN | | | | 5 |
| FLI | 41.7 | 55.2 | 52.0 | 66.6 |
| FFI | 44.3 | 60.1 | 34.8 | 32.8 |
| FOI | 70.4 | InD | InD | InD |
| FOLI | 39.3 | InD | InD | InD |

Table 9. Counts and indices for female *Octopus graptus* sp. nov. (D = damaged; InD = indistinct; M = mature; S = submature).

| Museum Reg. No. | NMV F67003 | NMV F67006 (Holotype) | NMV F67008 (Paratype) | NTM P1478 (Paratype) | NMV F67011 |
|---|---|---|---|---|---|
| ML | 87.8 | 88.8 | 107.0 | 116.1 | 190.8 |
| StM | S | S | S | S | M |
| TL | 510 | 587 | 764 | 679 | 1229 |
| MWI | 59.3 | 58.2 | 56.9 | 60.0 | 49.7 |
| HWI | 47.4 | 53.9 | 41.5 | 42.6 | 33.1 |
| HMWI | 79.8 | 92.6 | 72.9 | 71.0 | 66.6 |
| AMI: 1 | 479.5 | 542.8 | 574.8 | 455.6 | 534.1 |
| 2 | 381.5 | 412.2 | 474.8 | 386.7 | 410.4 |
| 3 | 325.7 | 346.8 | 396.3 | 288.5 | 370.0 |
| 4 | 289.3 | 316.4 | 356.1 | 282.5 | D |
| AWI | 15.5 | 18.9 | 21.6 | 21.8 | 19.5 |
| SDI | 13.2 | 14.4 | 15.0 | 14.4 | 15.1 |
| WDI | 21.4 | 19.4 | 16.4 | 21.6 | D |
| GC | 13/14 | 13 | 13/14 | 13/14 | 13/14 |
| SC | 237 | 225 | 265 | 258 | 249 |
| ELI | | | | | 14.7 |
| EWI | | | | | 17.8 |
| EN | | | | | 680 |
| FLI | 45.9 | 49.5 | 46.8 | 52.0 | 40.9 |
| FFI | 25.1 | 24.8 | 20.9 | 25.4 | 33.5 |
| FOI | 62.7 | 56.3 | 63.5 | 57.4 | InD |
| FOLI | 39.2 | 41.6 | 39.3 | 44.7 | InD |

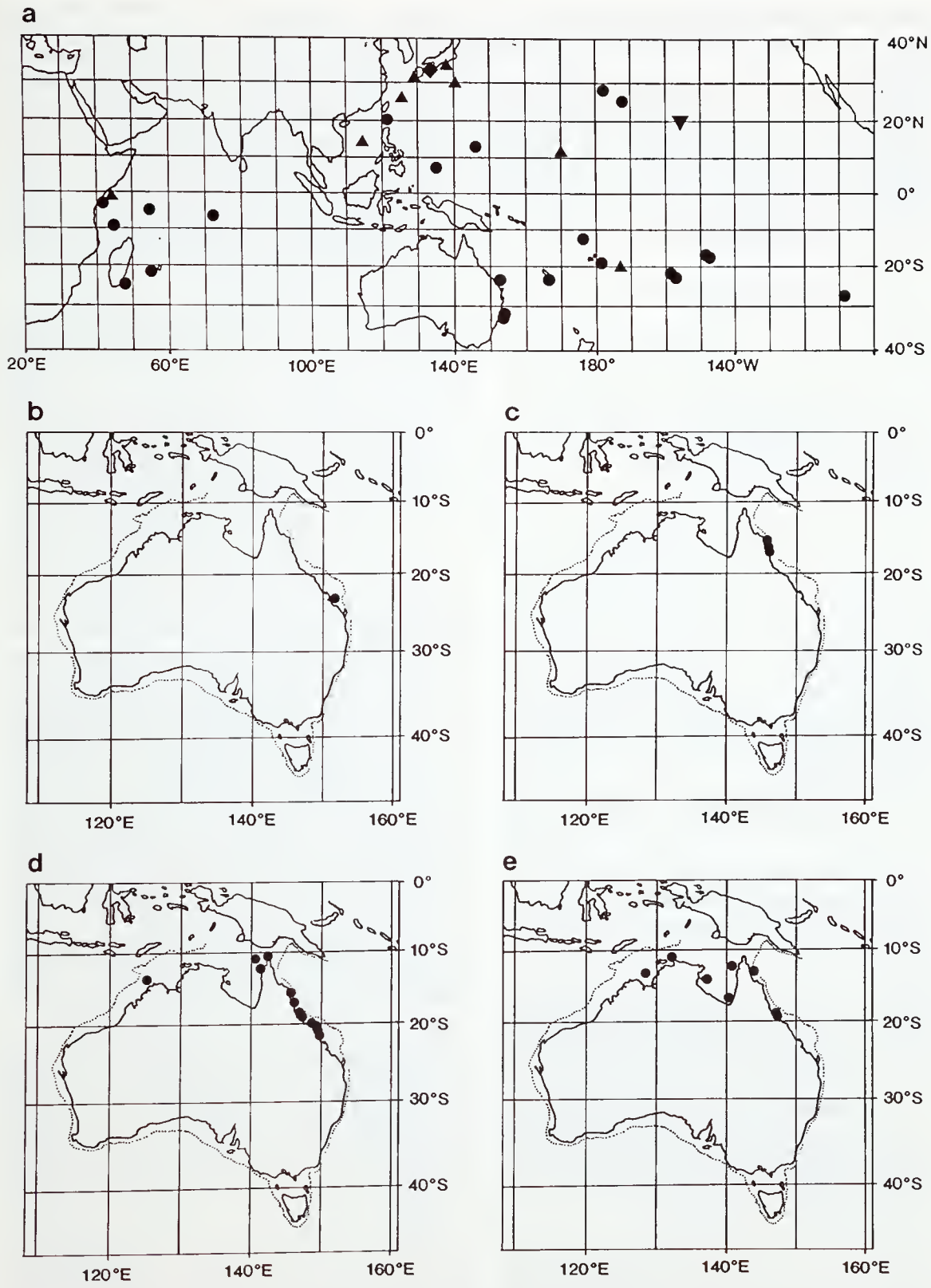
robust [TOLI(mat) 31.2] with robust diverticulum (DLI 82.4). Genital aperture subterminal. Mucilaginous gland enlarged at point of attachment to short and robust vas deferens. Spermatophoric gland I narrow and elongate with large recurved coil approximately 80% along length. Spermatophoric gland II narrow and elongate with reflexed tip. Spermatophores (fig. 15b) approximately 80% of mantle length in mature male (SpLI 85.5), of moderate width (SpWI 1.9) and produced in low numbers (5 in Needham's Sac of mature male). Oral cap simple bearing long cap thread. Sperm reservoir approximately 40% of spermatophore length (SpRI 38.5). Sperm cord deteriorated in spermatophores examined, appears regularly coiled in approximately 30 whorls in best condition spermatophore.

1 mature female specimen encountered (NMV F67011, 190.8 mm ML). Ovary contained approximately 680 almost mature ovarian eggs up to 28.0 mm long (ELI 14.7) (fig. 15c). Eggs exhibited approximately 16 follicular folds. Mature ovary bore 2 large oviducal glands with around 26 braiding chambers. Oviducts robust and relatively short.

Colour in life unknown. Preserved specimens exhibited a fixed colour pattern of cream to pink base colour with irregular fine "scribbling" over dorsal mantle and arm crown (fig. 13a, 16a, c).

→

Figure 17. Distributions of Great Barrier Reef members of the *Octopus macropus* group. a, *Octopus ornatus* Gould, 1852: ▼ = type locality; ◆ = type locality of synonym *Callistoctopus arakawai* Taki, 1964; ● = other material examined; ▲ = additional published records. b, *Octopus alpheus* sp. nov. c, *Octopus aspilosomatis* sp. nov. d, *Octopus dierythraeus* sp. nov. e, *Octopus graptus* sp. nov.


a
40°N
20°N
0°
20°S
40°S
20°E
60°E
100°E
140°E
180°
140°W
b
0°
10°S
20°S
30°S
40°S
120°E
140°E
160°E
c
0°
10°S
20°S
30°S
40°S
120°E
140°E
160°E
d
0°
10°S
20°S
30°S
40°S
120°E
140°E
160°E
e
0°
10°S
20°S
30°S
40°S
120°E
140°E
160°E

In several specimens base colour had become pink brown, darkest in distal portions of arms (fig. 16a).

Skin sculpture simple, consisting of scattered low papillae evenly distributed over dorsal surfaces. Small punctae scattered between papillae on dorsal surfaces. Single slightly larger supraocular papilla directly above each eye, surrounded by low papillae. Pigmentation and sculpture do not extend to oral surface of webs.

Sexual dimorphism was not marked in the limited material examined.

*Distribution.* Open substrata in the coastal waters of northern Australia (fig. 17e), from 11 to 36 m. Collected primarily in prawn trawls from Joseph Bonaparte Gulf, Western Australia (13°09'70"S, 128°08'50"E) east and south to Cleveland Bay, Townsville (19°11'S, 147°01'E).

*Life history.* Little is known of the life history of this species. Where time of capture information was available, all specimens were captured at night indicating that animals were emerged from lairs. This species probably has nocturnal activity patterns.

Stomach contents were examined in several specimens and were found to contain soft tissue remains, suggesting a diet of soft bodied animals such as shellfish. No crustacean or polychaete remains were found.

The large eggs produced by this species indicate that young adopt a benthic habit on hatching.

*Etymology.* From the Greek "*graptos*" meaning inscribed or marked, referring to the irregular "scribbled" dark markings visible on the dorsal mantle and arm crown in preserved material (fig. 13a).

*Remarks.* Commercial prawn trawl operators report catches of this species when trawling at night over sandy substrata. This species is figured in Queensland Department of Primary Industries posters promoting bycatch species for human consumption. Annual catch figures are not available, however it is likely that this large species makes up the bulk of the annual catch of octopuses in Queensland waters.

## Discussion

These new species with other members of the *Octopus macropus* group form a distinct assembly of shallow-water octopus species exhibiting many similarities in morphology and behaviour. Shared characters include elongate arms (typically 4–7 times mantle length), dorsal arms considerably longer than ventral pair (AF 1.2.3.4), moderate to high gill lamellae counts (10–14 per demibranch), a multicuspid radula (rhachidian tooth typically bears three lateral cusps on either side of a medial cone), a moderately large cylindrical copulatory organ with deep ligula groove, forked lateral walls on the lower beak (deeply concave in ventral view), absence of enlarged suckers in both sexes, and nocturnal activity patterns.

In describing four new members of the "*Octopus macropus* group" from the tropical Indo-West Pacific, it is necessary to compare these taxa with related species already described from these waters. Table 10 lists ten nominal taxa from the tropical Indo-West Pacific which share these characters and hence are considered members of the *O. macropus* group. Except for *O. ornatus*, little has been published on these taxa, most of which are known only from their original descriptions. Based on examination of type material for seven of the nominal taxa, and counts and measurements provided in original descriptions, the new species described here can be clearly delineated.

Three of the new species (*O. alpheus*, *O. dierythraeus* and *O. graptus*) lay large eggs (to 28 mm long) in low numbers. This egg size and number indicate that hatchlings adopt benthic habits on hatching. This feature clearly distinguishes these three species from *O. lechenaultii* d'Orbigny, 1826 (and its synonym *O. cuvieri* d'Orbigny, 1826) and *O. luteus* Sasaki, 1929 which both lay small eggs in large numbers. The limited dispersal of the large-egg Australian species also reduces the probability of these species being synonymous with other Indo-West Pacific members of the *O. macropus* group, especially species such as *O. rapanui* from Easter I.

*Octopus ornatus* and *O. aspilosomatis* are small-egg species whose planktonic hatchlings would be capable of wider dispersal. *O. ornatus* is delineated from the other taxa listed in Table 10, primarily on the grounds of high sucker counts, high gill count (13–14 per demibranch) and its distinctive colour pattern (see Norman, in prep.).

*Octopus lechenaultii* (and its synonym *O. cuvieri*) is known only from the original type material. This species shows some similarities with *O. aspilosomatis* including small eggs and short webs. *O. aspilosomatis* appears distinct, however, in possessing shorter arms (AMI to

Table 10. Nominal taxa described from tropical Indo-West Pacific waters belonging to the *Octopus macropus* group.

| Species | Type locality | Nature of type material |
|---|---|---|
| Valid taxa: | | |
| * *O. lechenaultii* d'Orbigny, 1826 | Pondicherry, Southern India | Reasonable condition (MNHN). |
| Synonym: * *O. cuvieri* d'Orbigny, 1826 | Pondicherry, Southern India | Reasonable condition (MNHN). |
| * *O. ornatus* Gould, 1852 | Hawaii | Good condition neotype (USNM). |
| Synonym: *Callistoctopus arakawai* Taki, 1964 | Japan | Taki's personal collection. |
| * *O. rapanui* Voss, 1979 | Easter Island | Good condition (USNM). |
| Nomen dubium: | | |
| *O. machikii* Broek, 1887 | Amboina, Indonesia | Very poor condition (ZMUG). |
| Uncertain: | | |
| *O. luteus* Sasaki, 1929 | Taiwan | Hokkaido Imperial Museum. |
| *O. nanhaiensis* Dong, 1976 | China | Inst. Oceanol. Acad. Sin. |
| * *O. taprobanensis* Robson, 1926 | Sri Lanka | Juvenile specimen (BMNH). |
| * *O. teuthoides* Robson, 1929 | New Hebrides (Vanuatu) | Juvenile specimen (BMNH). |
| * *Eledonenta filholiana* Rochebrune, 1884 | Fiji | Poorly preserved (MNHN). |

* = type material examined by author

639.8 vs 669.0 for *O. lechenaultii*), slightly lower gill lamellae counts (10 vs 12 on outer demibranch) and slightly more suckers on intact normal arms (206–*235*–267 vs 168, 210). Additional material from southern India would be required to confirm this separation.

*Octopus luteus* has a similar morphology to *O. aspilosomatis* sharing production of small eggs. *Octopus aspilosomatis* appears distinct in having longer arms (AMI 438.3–*537.6*–639.8 vs 400, 410 for *O. luteus*), fewer gill lamellae (10 vs 12 on outer demibranch) and slightly shallower webs (WDI 9.1–*11.6*–14.6 vs 14.0, 17.7).

*Octopus rapanui* Voss, 1979 is described from Easter I. The type and additional specimens of *O. rapanui* were examined in the collections of NMNH and MNHN. *Octopus rapanui* is characterised by deep webs (WDI 18–23 (Voss, 1979)); about 105 suckers on hectocotylized arm; medium sized spermatophores [SpLI 66–75 (Voss, 1979)]; 11–12 gill lamellae; and distinct colour pattern of white base colour with fine purple brown chromatophores on dorsal surfaces. These characters clearly delineate this species from species occurring in Great Barrier Reef waters.

The status of some species of the *Octopus macropus* group cannot be resolved until additional material becomes available. *Octopus nanhaiensis* Dong, 1976 is known only from the brief original description based on a single male from Quangdong Province, China. The type has not been examined.

Two species are only known from juvenile specimens. *Octopus taprobanensis* Robson, 1926 was described from the pearl banks off Sri Lanka. It is known only from the type, a 14.4 mm ML specimen of indeterminate sex, which shows the characteristic arm formula (1.2.3.4) and high gill count (13). *Octopus teuthoides* Robson, 1929 was described from Vanuatu. It is known only from the type, a 15.8 mm ML specimen also of indeterminate sex, which shows the same arm formula (1.2.3.4) and slightly fewer gill lamellae (11). Until the juvenile stages of all Indo-West Pacific members of the *O. macropus* group are determined, a process commenced by Young et al. (1989) and Hochberg et al. (1992), it will not be possible to determine the status of these species.

*Octopus machikii* Brock, 1887 is only known from a single female type specimen. This specimen is still extant in the University Museum, Göttingen. It is in very poor condition and was considered by Pickford (unpublished MS) as being a nomen dubium. Robson (1929) described this specimen as having dorsal arms longer than ventral ones, and dorsal webs deeper than ventral ones, suggesting affinities of this species with *O. macropus*.

Rochebrune (1884) proposed a new genus and species, *Eledonenta filholiana*, on the basis of a single poorly-preserved specimen from Fiji. This genus was proposed as a new member of the Eledonidae, reported as possessing the single rows of suckers typical of the family. The type specimen of this species was examined in the MNHN and is a poorly fixed elongate specimen. The elongation of the arms has probably resulted from poor fixation or deterioration prior to fixation. The suckers are arranged in two rows but elongation of the arms has spaced suckers sufficiently for Rochebrune to interpret them as forming a zig-zag single row. *Eledonenta filholiana* belongs in the Octopodinae and is clearly a poorly preserved member of the *Octopus macropus* group. It has the characteristic arm formula of 1,2,3,4, 10 gill lamellae and a copulatory organ typical of the group. Additional, well-preserved material of this species from the type locality will be required to resolve the status of this species.

*Octopus macropus* has been reported a number of times from Australian waters. Girard (1890) recorded it based on a single specimen donated by Baron de Mueller, providing the locality simply as "Australia". Inadequate locality information and the absence of the original specimen leave this record unresolved. Odhner (1917) reported *Octopus cuvieri* from the tropical waters of north-west Western Australia, as "*Octopus cuvieri* d'Orbigny = *macropus* Risso, 45 miles WSW of Pearl Banks off Cape Jaubert, Western Australia". At this stage, insufficient material has emerged from the tropical waters of Western Australia to identify the octopodan fauna of this region. Hence, this record is also unresolved. Temperate Australian waters also contain members of the *Octopus macropus* group. *Octopus maorum* Hutton, 1880 (and its synonym, *O. flindersi* Cotton, 1932) from southern Australia and New Zealand waters belongs in the *O. macropus* group (for full treatment of *O. maorum*, see Stranks, 1988). An additional, undescribed species, reported as *O. macropus* by Lu and Phillips (1985), occurs in the warm temperate waters of southern Queensland and New South Wales. This species is probably the same as that reported by Brazier (1892) from Port Jackson, New South Wales under the name *O. macropus*.

The phylogenetic affinities and taxonomic status of the *Octopus macropus* group is the subject of ongoing research (Hochberg, Mangold and Norman, in prep.).

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