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REVIEW OF THE *OCTOPUS AUSTRALIS* COMPLEX FROM AUSTRALIA AND NEW ZEALAND, WITH DESCRIPTION OF A NEW SPECIES (MOLLUSCA: CEPHALOPODA)

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Abstract

Stranks, T.N. and Norman, M.D., 1992. Review of the *Octopus australis* complex from Australia and New Zealand, with descriptions of a new species (Mollusca: Cephalopoda). *Memoirs of the Museum of Victoria* 53: 345–373.

Four species of shallow water octopuses belonging to the *Octopus australis* complex are reported from Australia and New Zealand. *O. australis* Hoyle, 1885, is redescribed based on the type material and other specimens from subtropical waters of eastern Australia. Three other species are distinguished and characterised: *O. berrima* sp. nov., is diagnosed from temperate waters of south-eastern Australia; and *O. warringa* Stranks, 1990, from temperate waters of Australia and New Zealand, and *O. campbelli* (Smith, 1902) from subantarctic waters off New Zealand, are redescribed.

Introduction

The inshore and deepwater octopodid fauna of Australia is slowly becoming better known. Stranks (1988) revised the inshore octopuses of south-eastern Australia, and together we continue research into the systematics of octopuses of temperate, subtropical and tropical waters of Australia. Stranks (1988: 1990; in press) mentioned problems involving a complex of shallow water species previously attributed to *Octopus australis* Hoyle, 1885. The species within the complex are small to medium sized octopuses with broadly ovoid mantles, long arms, fine and rounded tubercles on the skin, and sometimes a fold or ridge of skin on the ventro-lateral mantle.

The application of the specific name *australis* to Australian and New Zealand taxa is confused. As Tait (1982: 19) stated, "the confusion relating to the identity of *Octopus australis* Hoyle is due largely to the lack of a mature male type specimen." The brief original description of the immature and submature type specimens, and lack of a detailed comparative study of the types, have resulted in the name *O. australis* being applied to several similar taxa from different biogeographic regions.

Three taxa confused with *O. australis*, but now known to constitute separate species, are herein listed as: *O. berrima* sp. nov., *O. campbelli* (Smith, 1902) and *O. warringa* Stranks, 1990. Recent publications dealing with the *O. australis* complex are by Tait (1982), Stranks (1988, 1990), O'Shea (1990) and Toll (1991).

This paper resolves the confusion concerning the four species. Detailed diagnoses, based on type materials plus a comprehensive series of specimens, are provided for two of the taxa (*O. australis* and *O. berrima*). The few available specimens of *O. campbelli* were examined to diagnose this species. Stranks (1988, 1990) provided detailed descriptions of *O. warringa* and the reader is referred to those accounts for information.

Where there is sufficient material, counts and measurements are included for 10 representative females and 10 males. Localities for all specimen lots are mapped. Counts, measurements and indices were defined by Roper and Voss (1983). Measurements and indices are listed throughout as ranges with the mean italicized. Other abbreviations used are: F–female, M–male, ML–mantle length and TL–total length. Material is lodged in collections of: Auckland Institute and Museum, Auckland (AIM); The Australian Museum, Sydney (AM); The Natural History Museum, London (BMNH); Museum of Victoria, Melbourne (NMV); Queensland Museum, Brisbane (QM); Queen Victoria Museum and Art Gallery, Launceston (QVM); South Australian Museum, Adelaide (SAM); and Tasmanian Museum and Art Gallery, Hobart (TM).

Octopodidae

Octopus Lamarck, 1798

Type species. Octopus vulgaris Lamarck, 1798.

Diagnosis. Benthic octopodids. Mantle saccular, without fins. 8 arms lacking cirri, arms with biserial suckers, third right arm of males hectocotylised with end of arm modified into ligula and calamus. Web well developed. Ink sac present. Mantle aperture wide. Internal shell cartilaginous and vestigial.

Octopus australis Hoyle

Figures 1–5, 11

Octopus australis Hoyle, 1885a: 224. — 1885b: 98. — 1886: 88, pl. 3, figs 4, 5. — Brazier, 1892: 5. — Robson, 1929: 144, text fig. 51 (partim). — Tait, 1982: 15, text figs 1, 2, pl. 1 (partim).

Material examined. See Table 1.

Types. Lectotype (here designated): female, 23.3 mm ML; paralectotype: male, 12.0 mm ML; BMNH 1889.4.24.28-29; preserved in ethyl alcohol.

Type locality. Australia, New South Wales, Port Jackson [33°50'S, 151°17'E], 6–15 fathoms [11–28 m].

Description. Counts, measurements and indices listed in Tables 2–4. Medium sized animals with firm consistency (Fig. 1a). Mantle saccular, broadly ovoid (MWI 56.3–*80.7*–98.5); mantle wall moderately thin, muscular. Head narrow (HWI 41.0–*51.7*–64.6); demarked from mantle by moderate constriction. Eyes small, projecting above surface of head. Funnel large, slender, bluntly tapered (Fig. 1b; FuLI 40.4–*45.7*–54.6); free for about half its length (FFuI 18.0–*27.9*–36.4). Funnel organ consisting of 2 closely opposed V-shaped units; outer limbs approximately as long as median limbs (Fig. 1e). Mantle aperture wide (PAI 71.0–*97.7*–125.5).

Brachial crown strong, well developed. Arms long (MAI 23.4–*31.4*–44.3) (2.7–4.5 times mantle length in mature animals); slender (AWI 6.4–*9.6*–13.6); tapering to fine tips. Arm lengths subequal, arm order usually III,II,IV,I. Suckers biserial, without obvious radial grooves; moderately sized (ASI females 6.3–*9.7*–13.7, males 7.7–*11.2*–15.3); 16th to 20th suckers enlarged on arms II and III of mature males only.

Web formula variable, CDBAE to DCBEA; dorsal and ventral sectors always shallower. Web shallow (WDI 15.3–*22.7*–31.6); web remnants extend up ventral sides of arms for approximately three-quarters of their length.

Third right arm of males hectocotylised (Figs 1d–f); shorter than its opposite number (OAI 72.0–*78.3*–89.0; HcAI 170.5–*232.7*–258.8). Hectocotylised arm with 62–77 suckers; opposite arm with 124–217 suckers. Spermatophoral groove well developed, with conspicuous thickening of web membrane. Ligula 8–17% of hectocotylised arm length in mature animals (LLI 7.5–*12.7*–16.7). Ligula stout, bulbous, with well marked and deep groove, and 2 rows of minute papillae present along the groove. Calamus very short, acutely pointed (CaLI 15.0–*19.5*–29.4).

Gills with 7–9 lamellae on outer demibranch, plus the terminal lamella.

Digestive tract typically octopodan (Fig. 2a). Upper beak has short, blunt, curved rostrum; curved crest; large wings; large lateral walls, with posterior margin deeply indented (Fig. 2b). Lower beak has short, blunt rostrum; long, curved crest; large lateral walls; large wings (Fig. 2c). Rostrum, hood, crest and lateral walls of both upper and lower beaks, heavily pigmented dark brown to black in colour; margins of wings, hood, crest and lateral walls of both beaks transparent. Radula typically octopodan, with 7 transverse rows of teeth and marginal plates (Figs 3c, d). Rhachidian tooth has 1–2 lateral cusps on each side of large medial cusp. Lateral cusps in asymmetrical seriation, migrating from medial to lateral position over 6–7 rows (B_{6-7} type). First lateral teeth small and unicuspidate; second lateral teeth long with curved base; third lateral teeth long and curved; marginal plates rectangular and plain.

Anterior salivary glands small, bordering posterior buccal mass. Posterior salivary glands stout anteriorly, tapering posteriorly, with 1 duct from each gland running forward then uniting to form single duct running alongside oesophagus to buccal mass. Crop with anterior caecum of about 30% of its length. Posterior oesophagus short. Stomach typically bipartite. Caecum with a single loose coil. 2 separate ducts connect digestive gland with caecum. Intestine undifferentiated, although 1 coil occurs midway, but it is not enlarged to form pouch. Ink sac large, lying superficially in groove on ventral face of digestive gland. A short, stout duct connects ink sac with dorsal side of intestine near anus. Anus bears a pair of anal flaps.

Testis posterior in position. Vas deferens long, delicate, tightly coiled, entering spermatophoral gland at proximal end. Spermatophoral gland swollen proximally, with muscular walls, but becoming thin walled towards its junction with the long accessory gland. A short tube connects accessory gland and Needham's sac. Needham's

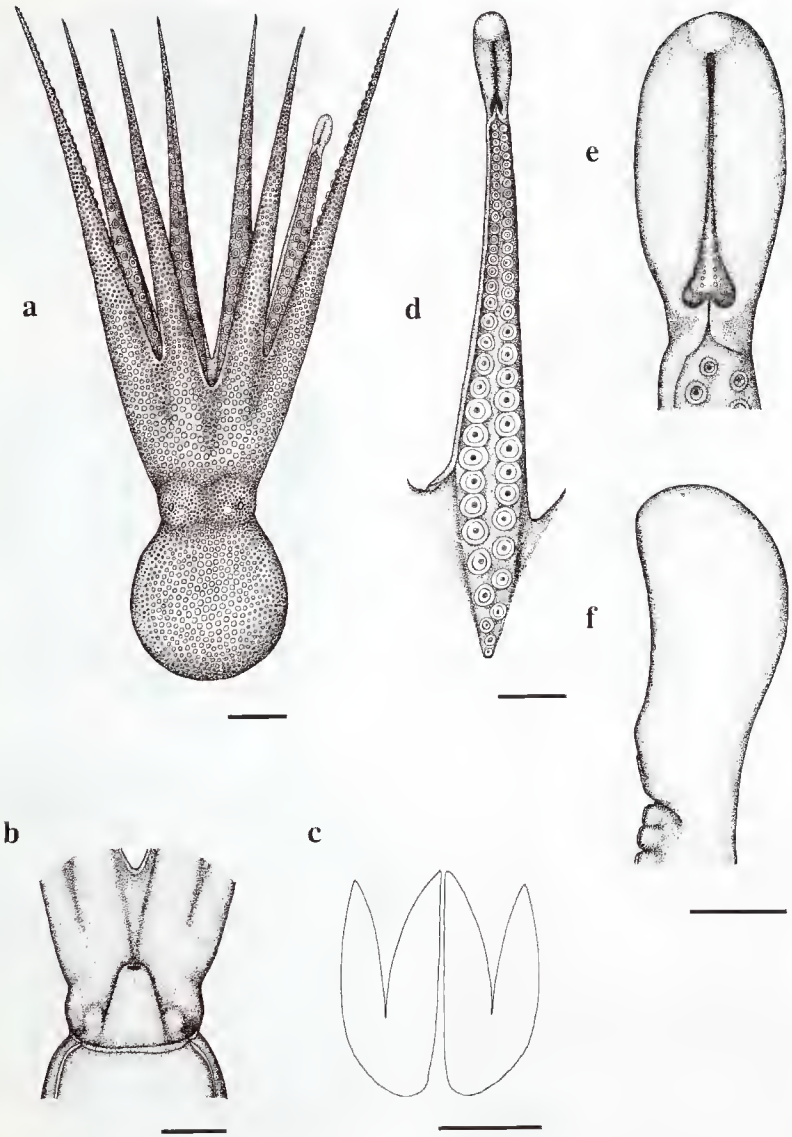

Figure 1. *Octopus australis* Hoyle: a, dorsal view of AM C156204, M, 67.1 mm ML (scale bar = 20 mm); b, ventral view of mantle opening and funnel of AM C156203, F, 50.7 mm ML (scale bar = 10 mm); c, funnel organ of NMV F65533, F, 45.4 mm ML (scale bar = 5 mm); d, hectocotylised arm of AM C166899, 40.5 mm ML (scale bar = 10 mm); e, dorsal, and f, lateral, detail of hectocotylus of NMV F65533, 68.7 mm ML (scale bar = 5 mm).

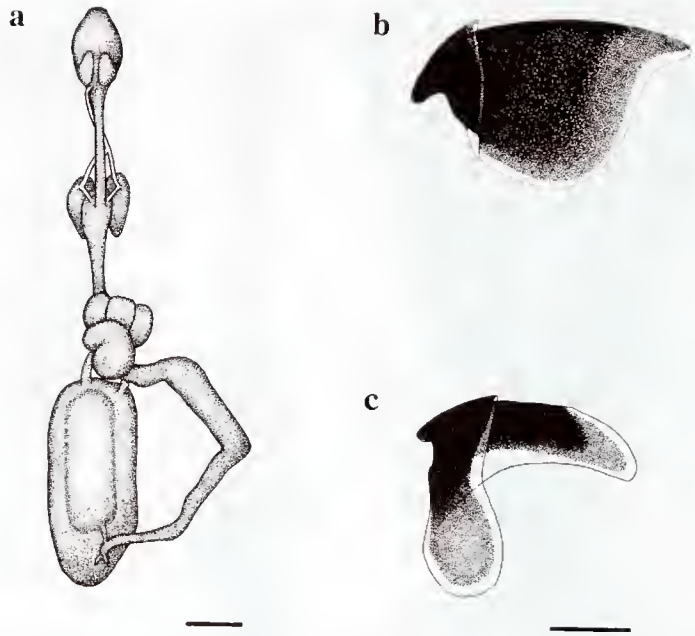

Figure 2. *Octopus australis* Hoyle: a, digestive tract of NMV F65533, M, 63.2 mm ML (scale bar = 10 mm); b, upper beak, and c, lower beak, of NMV F65533, M, 68.7 mm ML (scale bar = 5 mm).

sac long, conical, pointed at apex. Penis long (PLI 16.6–*18.8*–19.8), with a single coiled diverticulum. Genital aperture subterminal, on right side of penis (Figs 4a–c).

Spermatophores relatively long (SpLl 62.6–*73.7*–84.7), slender (SpWI 1.6–*2.5*–3.7) (Figs 4d–g). Oral cap simple, expanded, with a long cap thread. Ejaculatory apparatus is a tightly coiled tube, which narrows orally, with 2–3 coils close to the oral end. Small, bulbous cement body connects with both oral and aboral ends by narrow necks. Sperm reservoir spirally wound with a rounded aboral end; comprises approximately half of the spermatophore length (SpRI 34.7–*42.7*–55.6); forms widest region of spermatophore.

Ovary large, ovoid, displacing adjacent organs when mature (Fig. 5a). Proximal oviducts initially common, then dividing into 2 long, curved ducts. Oviducts attach to spherical oviductal glands, which are darker in colour. Distal oviducts straight, tapering gradually. No females were observing brooding eggs. Mature eggs from females with enlarged ovaries (NMV F65533: 54 mm, 62 mm, 65 mm ML) are large (8–12 mm long; 1.5–2.0 mm wide), yellow, translucent, with egg striation (EgLI 13.7–*17.0*–21.4; EgWI 2.6–*3.2*–4.4). Method of egg attachment unknown.

Integumental sculpture consists of a pattern of fine, rounded and closely set epidermal tubercles. The tubercles are largest and most dense on the dorsum; those on the ventral surface are similarly sized but more scattered. Unbranched papillae present in ocular region (Fig. 5b), with a row of 1 large and 3–4 small supraocular papillae. Ventrolateral integumentary ridge present on mantle; ridge obvious and continuous around entire mantle circumference, with the ridge forming an sharply angled peak on the posterior mantle (Figs 5c, d).

Colour of live animals unknown. Colour of specimens preserved in ethanol uniformly light brown to purple dorsally, cream to light brown ventrally. Ocelli absent.

Males mature at approximately 20–25 mm ML. Females attain ovarian maturity at about 50–60 mm ML. The largest specimen studied

Table 1. Material examined: *Octopus australis* Hoyle, 1885.

Status	Sex	ML (mm)	Reg. No.	Locality	Date	Depth (m)	Collector
Lectotype	1F	23.3	BMNH 1889.4.24.28-29	Port Jackson, NSW [33°50′S, 151°17′E]	Apr 1874	11–28	HMS "Challenger"
Paralectotype	1M	12.0	BMNH 1889.4.24.28-29	Port Jackson, NSW [33°50′S, 151°17′E]	Apr 1874	11–28	HMS "Challenger"
Other Material	1M	18.3	AM C166898	34°36′S, 151°03′E	5 Nov 1981	128–134	FRV "Kapala"
	1M	27.1	AM C170007	Port Jackson, NSW [33°50′S, 151°17′E]	—	—	—
	1F	30.4	AM C36592	Port Jackson, NSW [33°50′S, 151°17′E]	—	—	—
	1F	30.7	QM Mo36049	Moreton Bay, Qld [27°25′S, 153°20′E]	9 Dec 1921	—	K. Kandler
	1F	37.9	NMV F65532	27°42′S, 153°35′E	6 Nov 1981	57	FV "Iron Summer"
	1M	40.5	AM C166899	Sydney Harbour, NSW [33°50′S, 151°17′E]	—	—	Capt Comtesse
	1M	45.2	QM Mo4105	off Point Cartwright, Qld [26°41′S, 153°08′E]	7 Mar 1970	35–38	F. Wallace
	4M,5F	45.4–68.7	NMV F65533	27°45′S, 153°40′E	6 Nov 1981	83	FV "Iron Summer"
	1M	46.5	AM C71014	26°45′S, 153°21′E	27 Jul 1968	46–48	Qld Fish. Res. Inst.
	1F	50.7	AM C156203	Kurnell, Botany Bay, NSW [34°00′S, 151°50′E]	14 Oct 1974	5	CSIRO
	1M	60.4	AM C36580	Newcastle Bight, NSW [32°55′S, 151°50′E]	2 Mar 1898	29–35	HMCS "Thetis"
	1M	67.1	AM C156204	Kurnell, Botany Bay, NSW [34°00′S, 151°13′E]	18 Mar 1975	3	CSIRO
	1F	71.7	AM C36577	off Newcastle, NSW [32°55′S, 151°50′E]	4 Mar 1898	77–88	HMCS "Thetis"

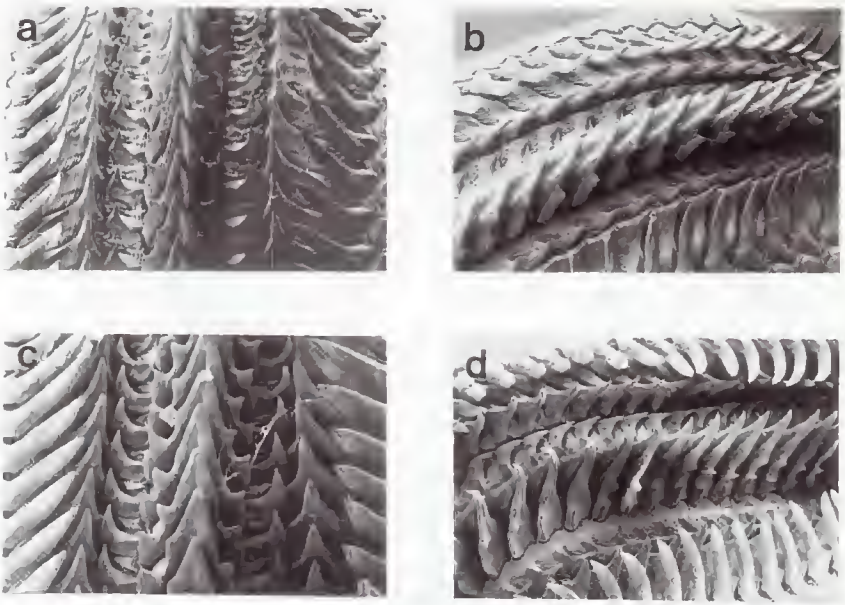

Figure 3. *Octopus berrima* sp. nov.: a and b, radula of NMV F31264, M, 71.4 mm ML. *Octopus australis* Hoyle: c and d, radula of NMV F65533, M, 68.7 mm ML.

was a female of 72 mm ML from off Newcastle, NSW (AM C36577).

Distribution. Eastern Australia, from Hervey Bay, Queensland (about 25°S) to Jervis Bay, New South Wales (about 35°S) (Fig. 11). Bathymetric records range from 3 to 134 m. The species is common in subtropical inshore waters, living on sand and mud bottom, and among sponges.

Remarks. Hoyle (1885a) described *O. australis* based on specimens collected in eastern Australia during the cruise of HMS "Challenger" (1873-1876). Additional details appeared in a following paper (Hoyle, 1885b), which was then again expanded with the inclusion of measurements and illustrations (Hoyle, 1886). Hoyle (1886) provided some details of what is now designated to be the submature female lectotype, but did not give any data on the immature male paralectotype.

Brazier (1892) later recorded *O. australis* from Georges Beach, NSW. To that date, *O. australis* had been recorded from two localities in NSW. Subsequently, the name *O. australis* was only employed for the morphologically similar, but distinct, species from south-eastern Australia, herein named *O. berrima* (see separate entry). From the 1890s to the present, the species now identified as occurring in NSW and Queensland waters was considered unnamed.

Robson (1929) and Tait (1982) had opportunities to examine in detail the type specimens of *O. australis*, and both authors continued usage of the name for the south-eastern Australian species. It was not until the present authors had begun a study of the eastern Australian octopodid fauna, and comparative work carried out between eastern and southern Australian octopuses, that the applicability of the name *O. australis* to the eastern and not the southern species was realised.

The present determination and redescription is based on examination of the two type specimens and 31 other specimen lots of *O. australis*, from the collections of the AM, BMNH, NMV and QM.

The morphology and measurements of the

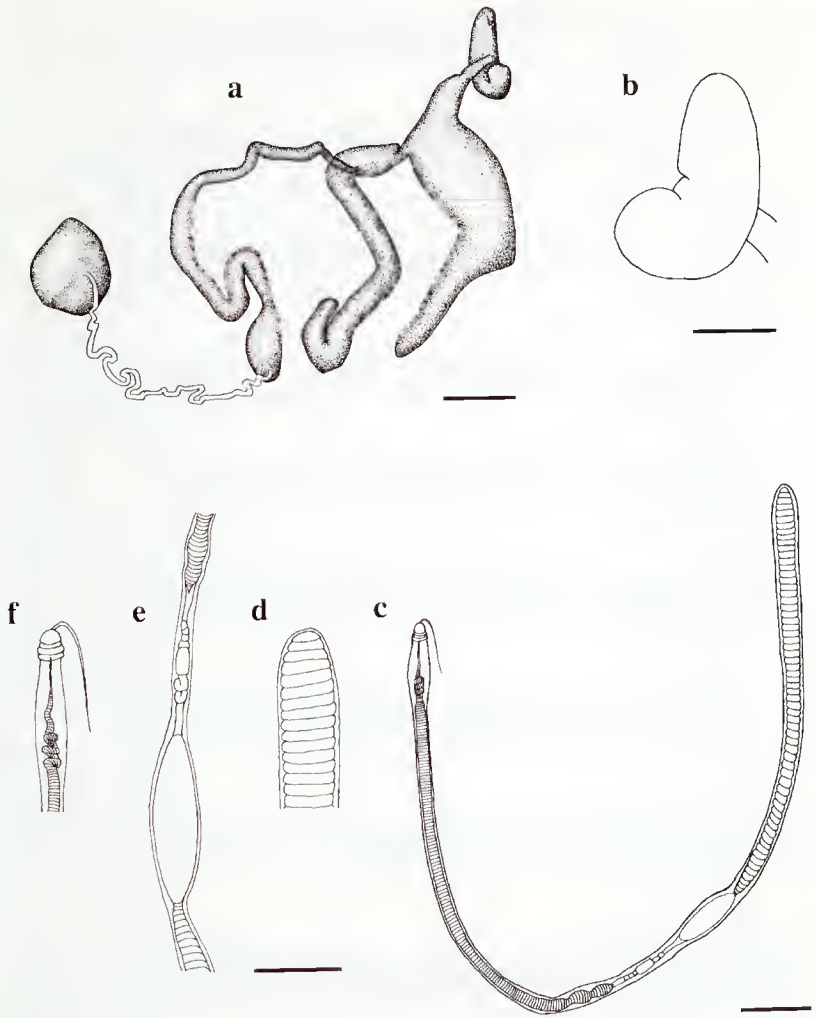

Figure 4. *Octopus australis* Hoyle: a, male reproductive organs (scale bar = 10 mm), b, penis (scale bar = 2 mm), and e–f, spermatophore, of NMV F65533, 57.6 mm ML; c, whole spermatophore (scale bar = 2 mm); d, aboral end of sperm reservoir; e, spermatophore midsection, cement body to sperm reservoir; f, oral cap and cap thread (scale bar = 1 mm).

Table 2. Measurements (mm) and indices of 10 female *Octopus australis* Hoyle, 1885. (S = submature; M = mature; * = arm severed or regenerated).

Museum Reg. No.	AM C36592	QM Mo36049	NMV F65532	NMV F65533	AM C156203	NMV F65533	NMV F65533	NMV F65533	NMV F65533	AM C36577
ML	30.4	30.7	37.9	45.4	50.7	53.0	54.3	62.1	64.9	71.7
StM	S	S	S	S	S	S	M	M	M	M
TL	125.3	139.5	207.5	229.5	197.2	264.5	237.5	237.5	282.3	282.0
MWI	92.1	69.4	96.3	90.1	75.5	94.3	85.3	75.4	83.8	80.5
HWI	63.5	52.1	63.1	53.1	51.7	51.9	49.9	41.9	45.9	44.9
MAI	33.3	29.7	23.4	24.9	33.9	25.7	31.1	31.7	29.8	33.2
ALI: 1	250.7	281.8	379.9	346.3	243.2	347.9	176.4*	276.2	284.7	263.6
2	299.3	312.7*	423.5	389.4	277.1	389.6	321.0	305.2	329.0	301.3
3	300.3	307.8	427.4	401.3	294.9	377.9	317.3	315.3	335.1	288.7
4	287.8	337.1	388.9	381.9	276.7	360.4	321.4	305.2	313.1	281.7
AWI	12.5	10.4	9.8	10.1	10.8	9.2	9.4	8.5	8.3	6.4
ASI	8.6–11.2	11.7–13.7	9.5–12.7	9.3–11.2	8.7–10.7	9.1–10.9	7.9–10.1	6.9–9.8	6.3–9.6	7.4–9.1
WDI	26.2	15.3	20.7	21.2	25.3	20.1	22.4	22.1	20.0	21.3
WF	DCBEA	CDBAE	CDBEA	CDBEA	CDBEA	DCBEA	DCBEA	CDBEA	CDBEA	DCBEA
GiLC	8	7	8	8	8	8	8	8	8	8
EgLI	6.3	5.2	6.3	7.7	10.1	7.9	21.4	15.3	17.7	9.5
EgWI	1.0	2.0	0.8	1.3	1.6	1.7	4.4	3.1	2.9	2.1
FuLI	54.6	41.7	54.6	45.8	46.7	43.4	45.7	42.2	45.1	43.2
FFuI	27.3	18.9	31.7	28.6	29.4	35.5	28.0	25.6	28.0	27.9
PAI	83.2	102.3	113.2	122.2	87.4	125.5	107.7	95.8	103.2	84.9

Table 3. Measurements (mm) and indices of 10 male *Octopus australis* Hoyle, 1885. (Imm = immature; M = mature; * = arm severed or regenerated).

Museum Reg. No.	AM C166898	AM C170007	AM C166899	QM Mo4105	AM C71014	NMV F65533	NMV F65533	AM C36580	AM C156204	NMV F65533
ML	18.3	27.1	40.5	45.2	46.5	57.6	58.2	60.4	67.1	68.7
StM	Imm	M	M	M	M	M	M	M	M	M
TL	61.0	111.5	148.2	202.0	195.0	263.5	258.8	254.0	249.5	298.5
MWI	56.3	88.9	81.7	81.6	69.9	82.8	77.3	98.5	68.1	65.9
HWI	52.5	64.6	51.1	51.1	51.2	49.8	54.5	54.0	46.6	41.0
MAI	44.3	32.6	37.1	29.2	31.0	28.6	29.7	30.5	36.9	31.1
ALI: 1	193.4	238.0	121.5*	298.7	289.2	294.8	278.0	293.0	243.7	290.4*
2	225.7	307.0	269.6	331.9	139.4*	335.9	336.4	317.9	270.8	305.7
3	216.4	281.2	221.0*	342.9	323.0	349.7	305.0	317.9	263.3	321.7*
4	188.5	280.4	263.0	329.6	320.4	338.5	280.9	327.8	263.0	296.2*
AWI	6.6	12.9	10.1	8.4	7.3	11.5	9.3	8.3	13.6	9.5
ASI	7.7–11.5	8.9–12.9	8.6–12.6	10.0–12.8	9.0–14.2	9.4–13.7	8.4–13.4	9.9–14.1	9.4–13.7	8.6–15.3
WDI	19.6	28.0	25.0	24.2	22.6	20.1	24.1	22.4	31.6	—
WF	CDBEA	DCBEA	B=C=DEA	DCBEA	DCBEA	CDBEA	DCBEA	DCB=EA	DCBEA	CDBEA
GiLC	8	8	8	8	9	8	8	8	8	8
HcAI	170.5	250.2	224.2	258.8	239.8	253.8	219.6	251.7	224.0	234.4
OAI	78.8	89.0	—	75.5	74.2	72.6	72.0	79.2	85.1	—
LLI	16.7	7.5	16.1	11.7	13.4	12.4	11.9	13.2	11.2	12.4
CaLI	25.0	29.4	15.8	20.4	15.4	17.1	20.4	15.0	18.5	18.1
HASC	35	70	62	74	77	73	66	70	68	67
PLI	18.6	16.6	16.8	19.7	19.6	19.6	19.8	19.5	19.8	17.6
SpLI	—	71.6	84.4	84.1	84.7	72.7	68.2	86.1	72.3	65.5
SpWI	—	3.1	3.7	2.8	2.7	1.7	2.5	2.8	2.5	2.1
SpRI	—	38.1	38.6	36.8	40.6	40.1	50.7	44.8	48.2	55.6
FuLI	50.3	48.7	48.4	46.9	41.3	45.5	40.4	50.3	40.5	39.6
FFuI	26.8	26.9	18.0	31.4	28.0	28.6	29.6	36.4	27.5	24.0
PAI	71.0	100.7	92.1	112.8	90.8	89.1	91.9	105.6	85.7	88.1

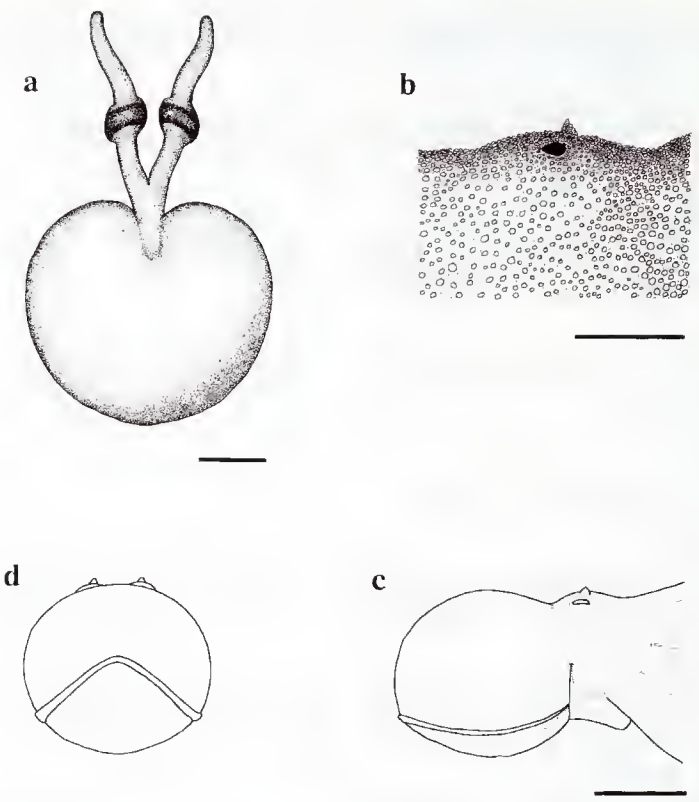

Figure 5. *Octopus australis* Hoyle: a, female reproductive organs of NMV F65533, 54.3 mm ML (scale bar = 10 mm), b, lateral view of unbranched ocular papillae (scale bar = 10 mm), c, lateral view, and d, posterior view, of mantle and ventrolateral integumentary ridge (scale bar = 20 mm), of NMV F65533, F, 45.4 mm ML.

immature male and submature female syntypes of *O. australis* fall largely within the ranges of variation from the sample of 10 females and 10 males from eastern Australia (see Table 4). Any significant discrepancies in morphometry between the type specimens and the larger sample (such as with the MAI, ALI, LLI, EgLI and EgWI indices) may be attributed to allometric variablity.

Octopus australis can be distinguished from other species of the genus on the basis of the following characters: a broadly ovoid mantle; skin with a pattern of fine, rounded and closely set tubercles on the dorsum, a continuous ventrolateral ridge around the mantle, and a large papilla over each eye; small but prominent eyes; long, subequal arms (2.7–4.5 times ML in mature animals); moderately large suckers, with 4–5 suckers slightly enlarged on the lateral arms of males only; a medium sized, stout, bulbous ligula (8–17% of third right arm length), and a very short calamus; large eggs (8–12 mm long), with unknown method of attachment to substrate; and 7–9 gill lamellae.

This species is common in inshore waters of eastern Australia, where it is frequently taken as a commercial by-catch by prawn trawlers operating in northern New South Wales and southern Queensland waters. Examination of catches by one of us (TNS) shows that the species

Table 4. Measurements (mm) and indices of types (BMNH 1889.4.24.28-29); and combined ranges, means and standard deviations of indices from another 10 males and females of *Octopus australis* Hoyle, 1885.
(Imm = immature; S = submature; * = arm severed or regenerated).

Museum Reg. No.	BMNH 1889.4.24.28-29 (Lectotype)	BMNH 1889.4.24.28-29 (Paralectotype)	Other material Range and mean	s.d.
ML	23.3	12.0		
StM	S	Imm		
TL	88.2	38.1		
MWI	84.5	80.8	56.3–*80.7*–98.5	(11.1)
HWI	56.2	63.3	41.0–*51.7*–64.6	(6.4)
MAI	36.1	45.5	23.4–*31.4*–44.3	(4.6)
ALI: 1	229.6	190.8	192.3–*277.9*–379.9	(43.9)
2	267.4	210.8	203.8–*312.1*–423.5	(48.2)
3	277.3	207.5	216.4–*318.0*–427.4	(49.2)
4	236.9	220.0	182.5–*303.2*–388.9	(48.8)
AWI	12.4	12.5	6.4–*9.6*–13.6	(2.0)
ASI: F	10.7		6.3–*9.7*–13.7	(1.9)
M		10.0	7.7–*11.2*–15.3	(2.4)
WDI	27.4	31.8	15.3–*22.7*–31.6	(3.6)
WF	CD=BEA	CBDEA		
GiLC	9	9		
EgLI	3.0		13.7–*17.0*–21.4	(2.7)
EgWI	1.3		2.6–*3.2*–4.4	(0.7)
HcAI		190.8	170.5–*232.7*–258.8	(25.9)
OAI		92.0	72.0–*78.3*–89.0	(6.1)
LLI		3.1	7.5–*12.7*–16.7	(2.6)
CaLI		14.3	15.0–*19.5*–29.4	(4.6)
HASC		60		
PLI		16.7	16.6–*18.8*–19.8	(1.3)
SpLI		—	62.6–*73.7*–84.7	(8.1)
SpWI		—	1.6–*2.5*–3.7	(0.6)
SpRI		—	34.7–*42.7*–55.6	(6.4)
FuLI		47.5	40.4–*45.7*–54.6	(4.4)
FFuI	40.2	49.1	18.0–*27.9*–36.4	(4.4)
PAI	86.3	111.7	71.0–*97.7*–125.5	(13.9)

constitutes a high percentage of the total octopus fisheries yield from the region, which has been estimated during recent years to be 150 000 kg (unpublished data, Bureau of Rural Resources, Canberra). Nothing is known of the general biology of the species.

Octopus berrima sp. nov.

Figures 3, 6–11

Octopus australis. — Pritchard and Gatliff, 1898: 241. — Robson, 1929: 144, text fig. 51 (partim). — Cotton, 1939: 165. — Cotton and Godfrey, 1940: 447, text figs 429–431 (partim). — Macpherson and Gabriel, 1962: 415 (partim). — Macpherson, 1966: 241. — Tait, 1982: 15, text figs 1, 2, pl. 1 (partim). — Stranks, 1988: 23, text figs 1–5.

Polypus cf. *australis*. — Berry, 1918: 276, text fig. 62, pl. 78, figs 1, 2, pl. 81, fig. 1 (partim).

Octopus superciliosus. — Macpherson, 1966: 244, pl. 3, figs 1, 2, pl. 4, figs 1–4, pl. 5, figs 1-4 (partim) (non *Octopus superciliosus* Quoy and Gaimard, 1832).

Material examined. See Table 5.

Holotype. Male, 58.9 mm ML, NMV F67132; preserved in ethyl alcohol.

Type locality. Australia, Victoria, Port Phillip Bay, off Mordialloc (38°02′S, 145°05′E), depth unknown.

Description. Counts, measurements and indices listed in Tables 6–8. Medium sized animals with

firm consistency (Fig. 6a). Mantle saccular, broadly ovoid (MWI 35.5–*73.8*–92.9); mantle wall moderately thin, muscular. Head narrow (HWI 26.8–*48.6*–68.3); demarked from mantle by moderate constriction. Eyes small, projecting above surface of head. Funnel large, slender, bluntly tapered (Fig. 6b: FuLI 31.2–*45.4*–52.4); free for about half its length (FFuI 17.8–*27.5*–37.7). Funnel organ consisting of 2 closely opposed V-shaped units which may be partially fused medially; outer limbs approximately three-quarters as long as median limbs (Fig. 6c). Mantle aperture wide (PAI 60.8–*99.1*–114.1).

Brachial crown strong, well developed. Arms long (MAI 25.1–*34.1*–50.3) (1.9–4.1 times ML in mature animals); slender (AWI 5.3–*8.9*–15.8); tapering to fine tips. Arm lengths subequal; arm order usually II.III.IV.I or III.II.IV.I. Suckers biserial, without obvious radial grooves; moderately sized (ASI 3.3–*7.3*–13.1); 12th to 20th suckers usually largest; without conspicuous sucker enlargement.

Web formula variable, CDBAE to DCBEA; dorsal and ventral sectors always shallower. Web shallow (WDI 19.8–*24.4*–32.2); web remnants extend up ventral sides of arms for approximately three-quarters of their length.

Third right arm of males hectocotylised (Figs 6d–f): shorter than its opposite number (OAI 63.0–*79.9*–97.0; HcAI 196.4–*246.6*–293.6). Hectocotylised arm with 66–78 suckers; opposite arm with 138–218 suckers. Spermatophoral groove well developed, with conspicuous thickening of web membrane. Ligula 11–16% of hectocotylised arm length in mature animals; usually recurved orally (LLI 10.9–*13.3*–15.5). Ligula conical, elongate, with well marked and deep groove, and 2 rows of minute papillae present along the groove. Calamus very short, acutely pointed (CaLI 15.3–*17.2*–20.2).

Gills with 7–8 lamellae on outer demibranch, plus the terminal lamella.

Digestive tract typically octopodan (Fig. 7a). Upper beak has short, blunt, curved rostrum; curved crest; large wings; large lateral walls, with posterior margin deeply indented (Fig. 7b). Lower beak has short, blunt rostrum; long, curved crest; large lateral walls; large wings (Fig. 7c). Rostrum, hood, crest and lateral walls of both upper and lower beaks, heavily pigmented dark brown to black in colour; margins of wings, hood, crest and lateral walls of both beaks transparent. Radula typically octopodan, with 7 transverse rows of teeth and marginal plates (Figs 3a, b). Rhachidian tooth has 1–2 lateral cusps on each side of large medial cusp. Lateral cusps in asymmetrical seriation, migrating from medial to lateral position over 3–4 rows (B_{3-4} type). First lateral teeth small and unicuspidate; second lateral teeth long with curved base; third lateral teeth long and curved; marginal plates rectangular and plain.

Anterior salivary glands small, bordering posterior buccal mass. Posterior salivary glands stout anteriorly, tapering posteriorly, with 1 duct from each gland running forward then uniting to form single duct running alongside oesophagus to buccal mass. Crop with anterior caecum of about 30% of its length. Posterior oesophagus short. Stomach typically bipartite. Caecum with a single loose coil. 2 separate ducts connect digestive gland with caecum. Intestine undifferentiated, although 1 coil occurs midway, but it is not enlarged to form pouch. Ink sac large, lying superficially in groove on ventral face of digestive gland. A short, stout duct connects ink sac with dorsal side of intestine near anus. Anus bears a pair of anal flaps.

Testis posterior in position. Vas deferens long, delicate, tightly coiled, entering spermatophoral gland at proximal end. Spermatophoral gland swollen proximally, with muscular walls, but becoming thin walled towards its junction with the long accessory gland. A short tube connects accessory gland and Needham's sac. Needham's sac long, conical, pointed at apex. Penis long (PLI 14.2–*25.2*–30.6), with a single coiled diverticulum. Genital aperture subterminal, on right side of penis (Figs 8a–c).

Spermatophores relatively long (SpLI 56.7–*87.3*–125.2), slender (SpWI 1.9–*2.6*–3.0) (Figs 8d–g). Oral cap simple, expanded, with a long cap thread. Ejaculatory apparatus is a tightly coiled tube, which narrows orally, without coils near the oral end. Small, bulbous cement body connects with both oral and aboral ends by narrow necks. Sperm reservoir spirally wound with a rounded aboral end; comprises approximately half of the spermatophore length (SpRI 37.5–*43.1*–50.2); forms widest region of spermatophore.

Ovary large, ovoid, displacing adjacent organs when mature (Fig. 9a). Proximal oviducts initially common, then dividing into 2 long, curved ducts. Oviducts attach to spherical oviducal glands, which are darker in colour. Distal oviducts tapering gradually. 1 female (NMV F52511) observed brooding eggs. Mature eggs large (10–14 mm long; 4–5 mm wide), white, translucent (Fig. 10e; EgLI 11.0–*17.3*–23.1;

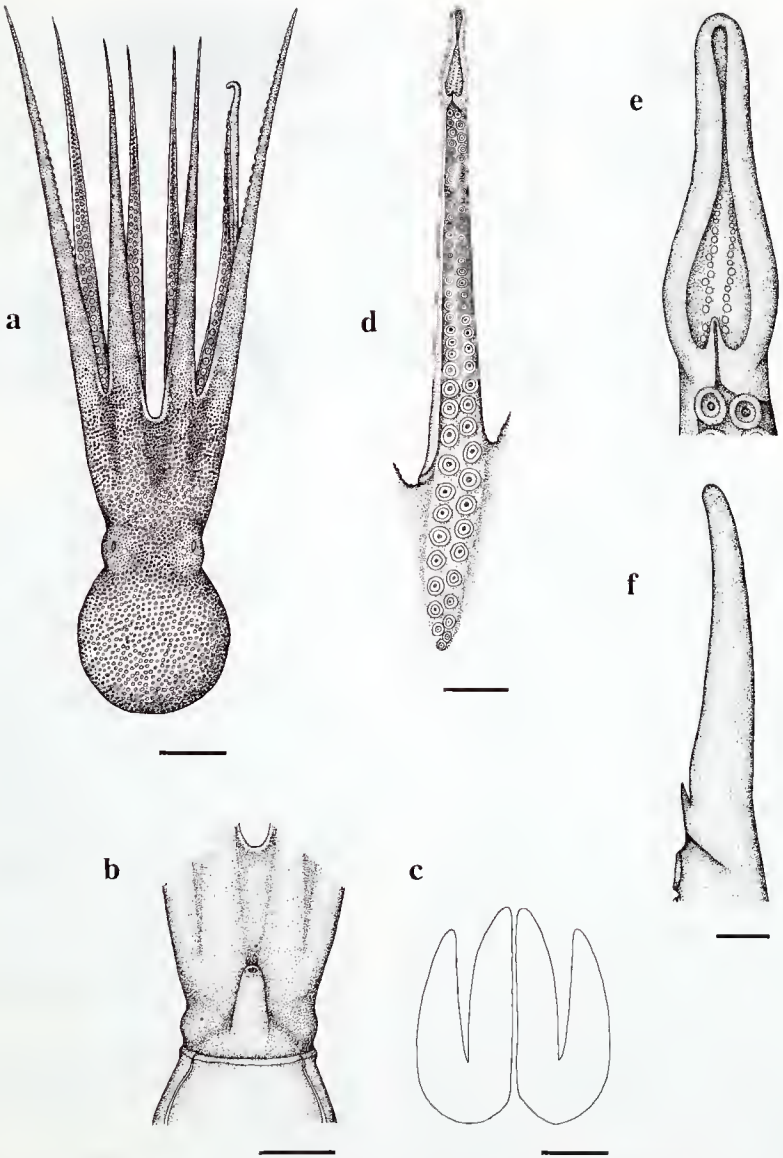

Figure 6. *Octopus berrima* sp. nov.: a, dorsal view of NMV F52509, M, 31.3 mm ML (scale bar = 10 mm); b, ventral view of mantle opening and funnel of SAM D18775, paratype, M, 36.3 mm ML (scale bar = 10 mm); c, funnel organ of NMV F67132, holotype, M, 58.9 mm ML (scale bar = 5 mm); d, hectocotylised arm (scale bar = 10 mm). e, dorsal, and f, lateral, detail of hectocotylus (scale bar = 2 mm), of SAM D18775, paratype, 36.3 mm ML.

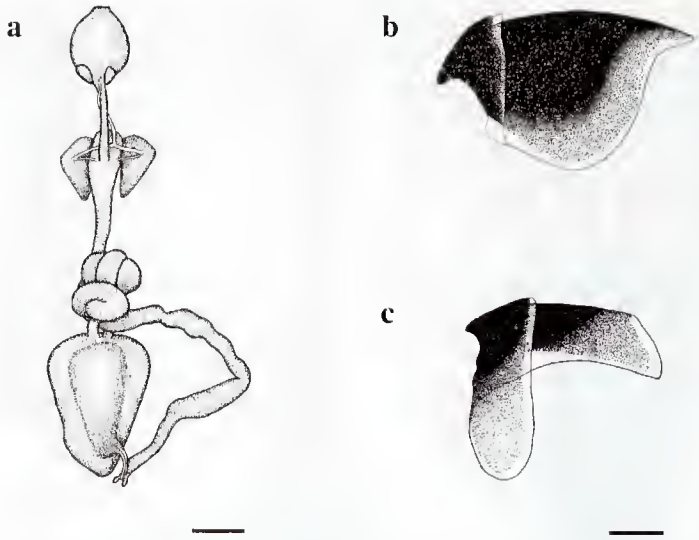

Figure 7. *Octopus berrima* sp. nov.: a, digestive tract of NMV F52509, M, 31.3 mm ML (scale bar = 5 mm); b, upper beak, and c, lower beak, of NMV F67132, holotype, M, 58.9 mm ML (scale bar = 2 mm).

EgWI 2.5–4.2–5.7). Eggs attached singly to substrate by long thin stalks (5–8 mm long). Egg striation absent.

Integumental sculpture consists of a pattern of fine, rounded and closely set epidermal tubercles. The tubercles are largest and most dense on the dorsum; those on the ventral surface are smaller and less prominent. Unbranched papillae present in ocular region with a row of 1 large and 3–4 small supraocular papillae (Fig. 9b), and on the mantle dorsum with 4 primary papillae in a diamond arrangement. Ventrolateral integumentary ridge present around mantle circumference; ridge obvious near pallial aperture, but less obvious posteriorly, where the ridge runs more or less straight around the posterior mantle (Figs 9c, d).

In life, colour of resting animals grey white with light brown mottling dorsally, white to pale cream ventrally. Lateral body bar of dark brown colour runs from posterior of each eye, passing through eye, to brachial crown. When stimulated, animals become darker in colour, uniformly dark brown to purple brown dorsally, cream to light brown ventrally. Posterior white spots consisting of 2 spots on dorsal mantle, posterior to eyes. White bar present between eyes. Frontal white spots consisting of 2 thin stripes along basal length of dorsal arms (Figs 10a–d). Ocelli absent.

Males mature at approximately 20–25 mm ML; females attain ovarian maturity at about 30–40 mm ML (Tait, 1982). The largest specimen studied was a male of 106 mm ML from off Stanley, Tasmania (NMV F52515).

Distribution. South-eastern Australia, from the central Great Australian Bight (about 132°E) to Twofold Bay, NSW (about 37°S), including Bass Strait and Tasmania (Fig. 11). Bathymetric records range from 5 to 267 m. The species is common in temperate inshore waters, living on sand and mud bottom, and among sponges and ascidians.

Etymology. The specific epithet *berrima* is derived from an Australian Aboriginal word meaning "to the south," and is to be treated as indeclinable.

Remarks. Octopus berrima has been previously incorrectly identified and described under the name *O. australis* Hoyle, 1885. The latter name was established for a species described from Port Jackson, NSW, but now known to occur in waters from central NSW to southern Queens-

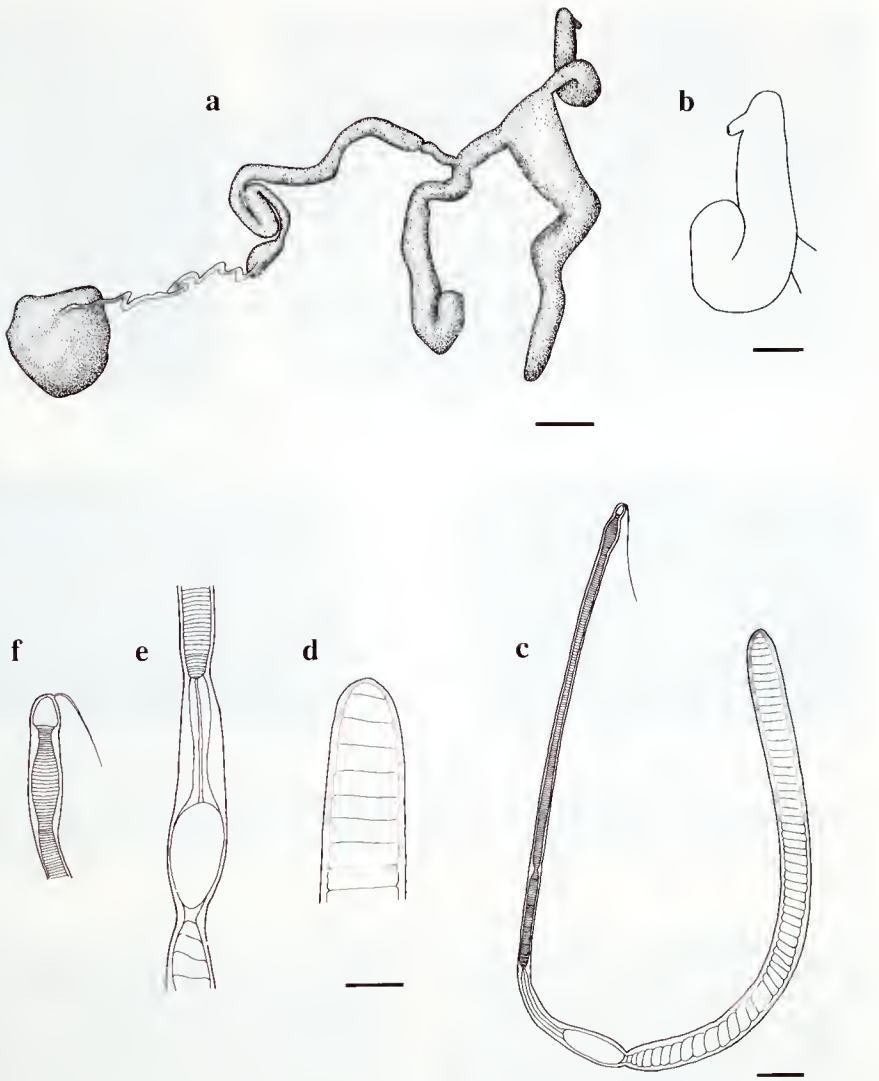

Figure 8. *Octopus berrima* sp. nov.: a, male reproductive organs (scale bar = 5 mm), and b, penis (scale bar = 2 mm), of SAM D18775, paratype, 36.3 mm ML; c–f, spermatophore from NMV F31002, 70.6 mm ML; c, whole spermatophore (scale bar = 2 mm); d, aboral end of sperm reservoir; e, spermatophore midsection, cement body to sperm reservoir; f, oral cap and cap thread (scale bar = 1 mm).

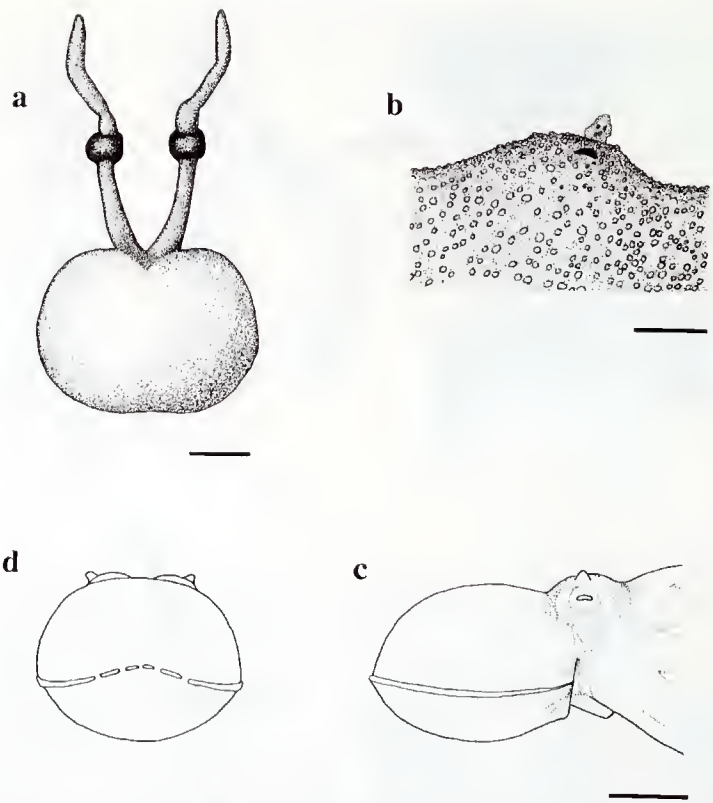

Figure 9. *Octopus berrima* sp. nov.: a, female reproductive organs of NMV F52514, paratype, 56.2 mm ML (scale bar = 10 mm); b, lateral view of unbranched ocular papilla of SAM D18775, paratype, M, 36.3 mm ML (scale bar = 5 mm); c, lateral view, and d, posterior view, of mantle and ventrolateral integumentary ridge of NMV F52509, M, 31.3 mm ML (scale bar = 31.3 mm ML).

land (see separate entry). Pritchard and Gatliff (1898) recorded *O. australis* in a faunal list from Port Phillip Heads, Victoria, but the material on which this identification was based is unknown. Since that date the name *O. australis* has been persistently and erroneously used for a separate and distinct south-eastern Australian species, instead of the eastern Australian taxon.

This description of *O. berrima* was based on examination of 176 specimen lots from collections of the AM, NMV, SAM, QVM and TM.

Octopus berrima can be distinguished from other species of the genus with a combination of characters: a broadly ovoid mantle; skin with a pattern of very fine, rounded and closely set tubercles on the dorsum, a ventrolateral ridge extending partway around the mantle, and a large papilla over each eye; small but prominent eyes; long, subequal arms (2–4 times ML in mature animals); moderately large suckers, without enlargement; a medium sized, elongated, conical ligula (11–16% of third right arm length), and a very short calamus; large eggs (10–14 mm long), attached singly to substrate; and 7–8 gill lamellae.

Growth, reproduction and diet of *O. berrima* (under the name *O. australis*) were studied by Tait (1980). Females brood 50–130 eggs for at

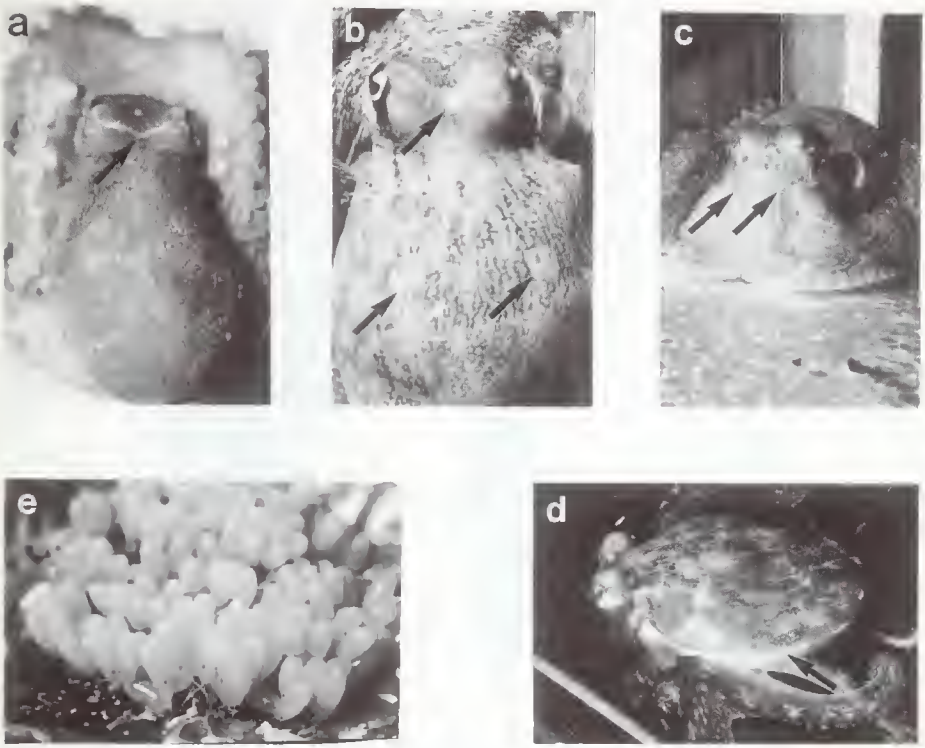

Figure 10. *Octopus berrima* sp. nov.: a, dorsal view of body showing white head bar (NMV F67133, 63.4 mm ML); b, dorsal view of body exhibiting white head bar and mantle white spots, c, anterior view of body and arms showing brachial crown white stripes, and d, view of body exhibiting ventrolateral integumentary ridge (NMV F67134, 61.8 mm ML); e, eggs (10–14 mm long) attached singly to valve of *Ostrea angasi* (photograph by R. Day) (Adelaide, South Australia).

least 100 days during summer. Hatchlings grow to a maximum size after 18–20 months. The species is an opportunistic predator, feeding mainly on isopod crustaceans, with other crustaceans, gastropods, bivalves, polychaetes and octopus forming a lesser component of the diet (Tait, 1980).

O. berrima is common in inshore waters of south-eastern Australia. The species is caught incidentally during scallop and mussel dredging, and seine netting; catches are mainly utilised as bait in the longline fishery for snapper, *Chrysophrys auratus* (Winstanley et al., 1983, as *O. australis*; personal observations).

Octopus campbelli (Smith)

Figures 12–14

Polypus campbelli Smith, 1902: 201, pl. 24, figs 7–11. — Suter, 1913: 1063, pl. 69, fig. 3.

Joubinia campbelli. — Robson, 1929: 190, text figs 73, 74.

Robsonella australis. — Benham, 1942: 227, text fig. 3, pls 18, 19 (partim). — Dell, 1952: 32, pl. 4, figs 2–6, pl. 5, figs 1, 3, 4, pls 7, 8 (partim) (non *Octopus australis* Hoyle, 1885).

Robsonella campbelli. — O'Shea, 1990: 65, text figs 6.1–6.8.

Material examined. Holotype: New Zealand, Camp-

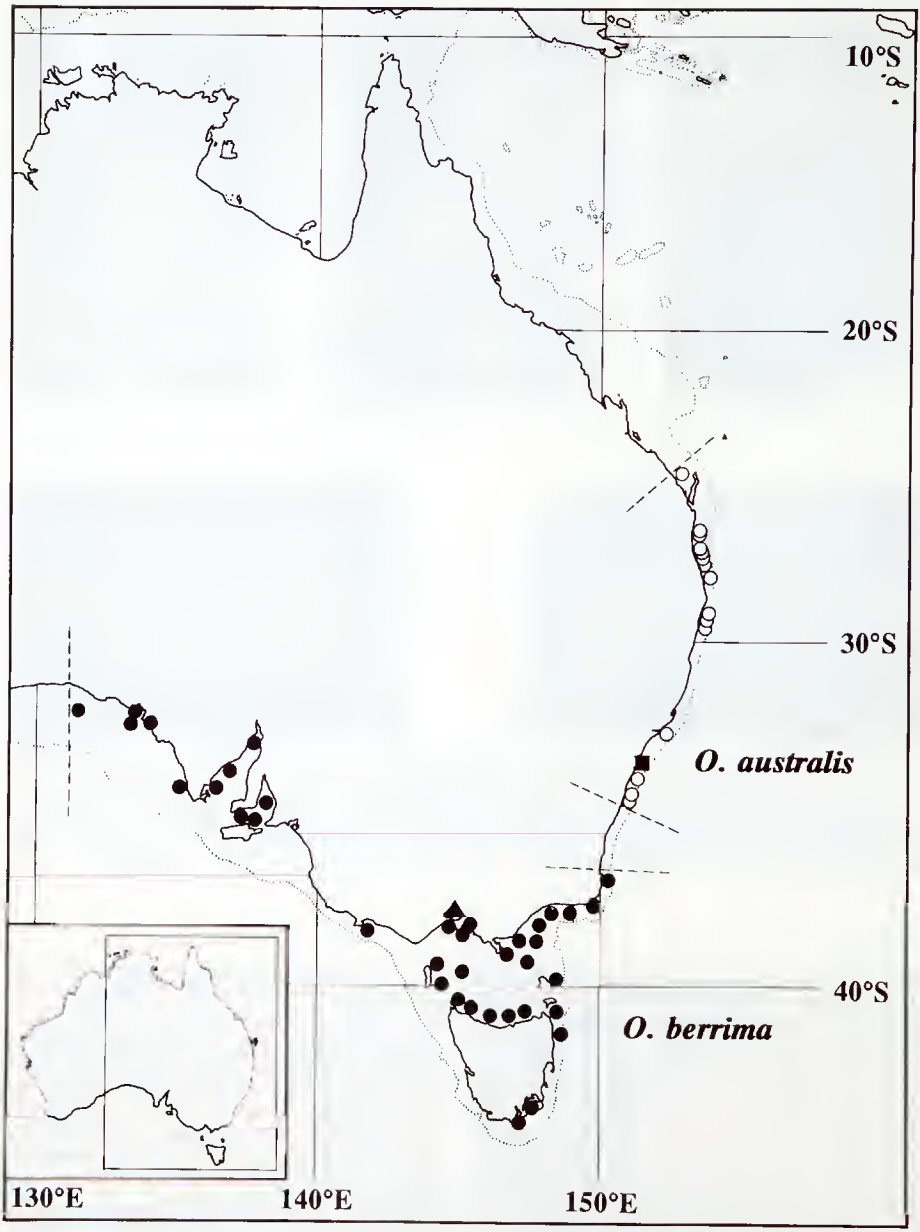

Figure 11. Geographical distribution of *Octopus australis* Hoyle in eastern Australia (■ = type locality; ○ = localities of other material), and *Octopus berrima* sp. nov. in south-eastern Australia (▲ = type locality; ● = localities of other material).

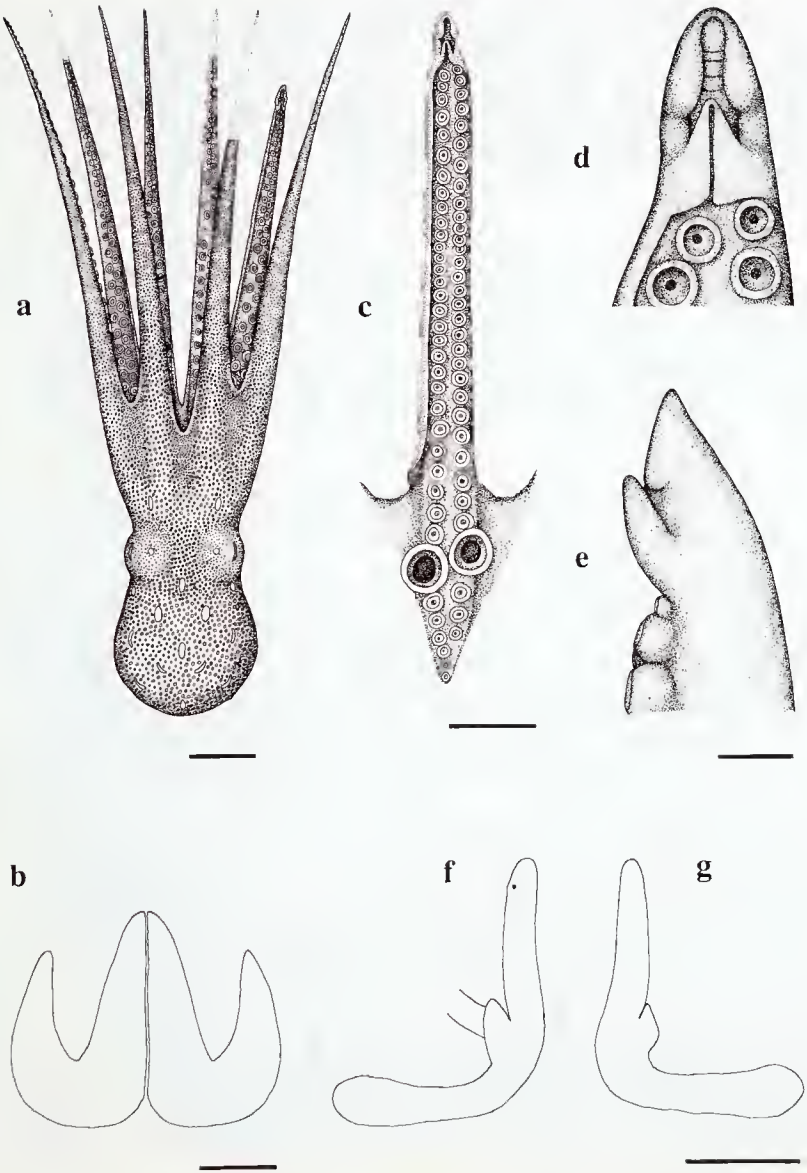

Figure 12. *Octopus campbelli* (Smith): a, dorsal view of BMNH 1902.5.16.2, holotype, M, 27.1 mm ML (scale bar = 10 mm); b, funnel organ (scale bar = 2 mm). c, hectocotylised arm (scale bar = 10 mm), d, dorsal, and e, lateral, detail of hectocotylus (scale bar = 2 mm), of BMNH 1902.5.16.2, holotype, 27.1 mm ML; f, ventral, and g, dorsal, view of penis of AIM AK75675, 34.1 mm ML (scale bar = 5 mm).

Table 5. Material examined: *Octopus berrima* n. sp.

Status	Sex	ML (mm)	Reg. No.	Locality	Date	Depth (m)	Collector
Holotype	1M	58.9	NMV F67132	38°02′S, 145°05′E	10 Oct 1984	—	FV "A.B. Hunter II"
Paratype	1M	36.3	SAM D18775	38°02′S, 145°05′E	25 Sep 1984	—	FV "A.B. Hunter II"
Paratype	1F	56.2	NMV F52514	38°02′S, 145°05′E	29 Jul 1985	—	FV "A.B. Hunter II"
Paratype	1M	63.5	NMV F52513	37°52′S, 148°10′E	5 Jun 1984	25	FV "Sarda"
Paratype	1M	79.6	AM C170006	Refuge Cove, Wilsons Promontory, Vic. [39°02′S, 146°29′E]	7 Feb 1982	—	FV "Sarda"
Other	1F	13.9	NMV F31262	35°23′S, 137°17′E	21 Jan 1971	54	J.E. Watson
Material	1M,1F	15.0-16.3	NMV F25247	Western Port, Vic. [38°22′S, 145°32′E]	6 Mar 1964	—	A. Gilmour
	1F	16.6	NMV F30927	40°56′S, 146°06′E	4 Feb 1981	64-68	FRV "Hai Kung"
	1F	17.8	NMV F52508	D'Entrecasteaux Channel, Tas. [43°15′S, 147°16′E]	2 Oct 1964	—	R.C. Robertson
	1M	21.9	NMV F30860	40°33′S, 144°45′E	4 Feb 1981	68	FRV "Hai Kung"
	1M	23.1	NMV F24450	Mentone, Port Phillip Bay, Vic. [38°00′S, 145°03′E]	26 May 1957	9	NMV
	1M	31.3	NMV F52509	38°11′S, 148°04′E	3 Oct 1983	56	FV "Silver Gull"
	1M	32.6	NMV F52510	38°02′S, 145°05′E	25 Sep 1984	—	FV "A.B. Hunter II"
	1F	43.6	NMV F25245	Western Port, Vic. [38°22′S, 145°32′E]	May 1964	—	A. Gilmour
	1F	45.0	NMV F24492	Black Rock, Port Phillip Bay, Vic. [37°59′S, 145°02′E]	10 Nov 1963	—	P. Egan
	1F	45.2	NMV F52511	38°02′S, 145°05′E	10 Oct 1984	—	FV "A.B. Hunter II"
	1M,2F	46.8-70.6	NMV F31002	39°38′S, 145°05′E	3 Feb 1981	66	FRV "Hai Kung"
	1F	61.8	NMV F67134	38°19′S, 144°43′E	Jun 1992	—	Uni. Melb. Dept. Zool.
	1M	63.4	NMV F67133	37°53′S, 144°57′E	29 Jul 1985	6	RV "Megalopa"
	1M	71.4	NMV F31264	38°03′S, 146°06′E	7 Jun 1978	—	G. Prince
	1F	87.4	NMV F24437	Mt Eliza, Port Phillip Bay, Vic. [38°11′S, 145°04′E]	13 Oct 1957	9	NMV
	1M	105.5	NMV F52515	Stanley, Tas. [40°46′S, 145°18′E]	May 1980	36	Tas. Fish. Dev. Auth.

Table 6. Measurements (mm) and indices of 10 female *Octopus berrima* n. sp. (Imm = immature; S = submature; M = mature; * = arm severed or regenerated).

Museum Reg. No.	NMV F31262	NMV F25247	NMV F30927	NMV F52508	NMV F25245	NMV F24492	NMV F31002	NMV F31002	NMV F52514 (Paratype)	NMV F24437
ML	13.9	16.3	16.6	17.8	43.6	45.0	46.8	50.5	56.2	87.4
StM	Imm	S	Imm	Imm	S	S	S	S	M	M
TL	52.8	52.6	75.8	53.4	177.1	172.4	218.0	261.9	215.4	250.3
MWI	85.6	79.8	84.3	55.1	67.7	60.0	79.5	89.9	88.6	35.5
HWI	68.3	63.8	62.7	51.1	46.3	40.7	42.7	48.3	43.6	26.8
MAI	32.7	39.8	28.3	50.3	33.9	37.1	28.7	25.1	36.6	50.1
ALI: 1	287.8	222.7	313.3	162.9	261.5	210.4	321.2	346.9	226.9	166.2
2	297.8	244.8	265.7*	191.0	289.0	268.4	341.5	377.6	273.0	190.0
3	305.8	251.5	353.0	194.4	295.2	266.7	347.9	397.8	260.1	199.4
4	300.0	235.6	315.1	198.9	278.2	269.8	335.7	378.2	222.6	190.8
AWI	10.8	10.4	7.2	7.3	9.1	7.8	7.5	8.9	7.3	5.3
ASI	7.2–7.9	7.4–9.2	6.0–7.8	3.3–3.9	6.2–7.3	5.6–6.4	6.4–7.3	7.5–8.5	5.7–7.7	4.5–5.4
WDI	25.2	28.0	25.1	32.2	22.2	23.9	22.1	21.0	24.5	25.4
WF	CBEAD	CDBEA	CDBEA	DECBA	DCBEA	DCBEA	DCBEA	DCBEA	CDBAE	CDEBA
GiLC	7	7	8	8	8	8	8	8	8	8
EgLI	—	9.2	—	—	14.0	7.1	4.5	7.1	23.1	12.5
EgWI	—	2.5	—	—	2.8	0.9	0.6	1.0	5.7	3.0
FuLI	50.4	43.6	52.4	39.9	47.7	50.7	49.6	52.1	40.2	31.2
FFuI	27.3	31.3	34.9	32.0	30.3	24.2	28.8	27.7	17.8	18.2
PAI	112.2	91.4	106.6	85.4	101.8	94.2	108.8	108.3	100.7	60.8

Table 7. Measurements (mm) and indices of 10 male *Octopus berrima* n. sp. (Imm = immature; M = mature).

Museum Reg. No.	NMV F25247	NMV F30860	NMV F24450	NMV F52509	NMV F52510	SAM D18775 (Paratype)	NMV F67132 (Holotype)	NMV F52513 (Paratype)	NMV F31264	AM C170006 (Paratype)
ML	15.0	21.9	23.1	31.3	32.6	36.3	58.9	63.5	71.4	79.6
StM	Imm	Imm	Imm	M	M	M	M	M	M	M
TL	48.2	90.7	106.8	124.8	151.8	149.8	273.3	310.7	294.9	361.2
MWI	76.0	78.1	81.0	82.7	92.9	80.4	74.2	68.5	47.8	67.8
HWI	60.0	55.3	52.8	50.8	56.1	47.1	47.0	40.0	32.8	36.1
MAI	43.1	32.5	31.0	34.4	29.2	31.5	28.4	28.0	30.4	30.6
ALI: 1	208.0	273.1	315.2	270.9	302.1	274.9	341.4	329.0	279.6	279.6
2	232.0	305.9	322.1	290.7	338.3	317.4	344.3	357.0	329.1	327.1
3	221.3	307.3	313.4	285.6	342.9	305.5	351.8	353.2	323.9	311.4
4	211.3	284.5	293.9	263.3	309.8	293.7	332.1	340.8	269.9	281.2
AWI	10.0	9.6	7.8	7.8	8.9	8.8	15.8	9.6	6.3	11.3
ASI	8.0–8.7	5.9–8.2	6.9–7.8	7.0–8.6	6.7–8.0	6.9–8.0	10.4–13.1	6.9–9.0	6.2–7.3	8.8–9.4
WDI	24.2	24.1	19.8	23.8	25.2	24.8	24.5	23.8	20.3	23.6
WF	CDBAE	CDBAE	CBDAE	CDBAE	CDBAE	CDBAE	CDBAE	DCB=EA	DCBEA	CDBEA
GiLC	8	7	7	7	8	8	8	8	8	8
HcAI	214.7	245.2	248.1	256.5	293.6	276.6	256.8	231.8	246.1	196.4
OAI	97.0	79.8	79.1	89.8	85.6	90.5	73.0	65.6	76.0	63.0
LLI	10.9	7.3	8.9	13.6	12.7	14.4	12.1	15.5	10.9	13.8
CaLI	20.0	20.5	15.7	20.2	16.4	18.6	15.3	16.2	17.2	16.3
HASC	62	76	79	70	66	74	76	74	78	76
PLI	20.7	14.2	20.3	30.0	27.3	30.3	26.3	30.6	27.0	25.1
SpLI	—	—	—	113.1	125.2	110.7	81.0	77.0	66.4	64.3
SpWI	—	—	—	2.9	2.9	2.6	3.0	2.4	2.5	2.9
SpRI	—	—	—	45.3	40.7	45.6	41.6	50.2	48.4	44.6
FuLI	43.3	50.7	49.4	40.6	43.6	44.4	46.5	43.8	45.7	41.5
FFuI	31.3	30.1	21.2	24.9	19.6	25.1	22.2	34.8	37.7	30.8
PAI	109.3	89.5	110.8	92.3	105.8	101.9	114.1	107.6	89.9	90.8

Table 8. Combined ranges, means and standard deviations of indices of 10 males and 10 females of *Octopus berrima* n. sp.

Index	Range and mean	s.d.(n–1)
MWI	35.5–*73.8*–92.9	14.8
HWI	26.8–*48.6*–68.3	10.7
MAI	25.1–*34.1*–50.3	7.0
ALI 1	135.2–*262.2*–346.9	54.5
2	183.1–*286.8*–377.6	51.3
3	174.2–*292.1*–397.8	58.5
4	177.5–*272.6*–378.2	52.4
AWI	5.3–*8.9*–15.8	2.2
ASI	3.3–*7.3*–13.1	1.7
WDI	19.8–*24.4*–32.2	2.8
HcAl	196.4–*246.6*–293.6	28.0
OAI	63.0–*79.9*–97.0	11.0
LLI	10.9–*13.3*–15.5	1.5
CaLI	15.3–*17.2*–20.2	1.7
PLI	14.2–*25.2*–30.6	5.3
SpLI	56.7–*87.3*–125.2	23.9
SpWI	1.9–*2.6*–3.0	0.3
SpRI	37.5–*43.1*–50.2	3.6
EgLI	11.0–*17.3*–23.1	6.4
EgWI	2.5–*4.2*–5.7	1.7
FuLI	31.2–*45.4*–52.4	5.3
FFuI	17.8–*27.5*–37.7	5.7
PAI	60.8–*99.1*–114.1	12.6

hell Island [52°30′S, 169°E], RV "Southern Cross." Sir G. Newnes, BMNH 1902.5.16.2 (mature male, 27.1 mm ML, preserved in ethyl alcohol).

Other material: New Zealand, Campbell Island, Perseverance Harbour (52°33′S, 169°09′E), 43 m, Galathea-Ekspeditionen, Station 595, 4 Jan 1952, AIM AK75675 (mature male, 34.1 mm ML).

Type locality. New Zealand, Campbell Island [52°30′S, 169°E].

Description. Counts, measurements and indices listed in Table 9. Medium sized animals with firm consistency (Fig. 12a). Mantle saccular, broadly ovoid (MWI 75.7–88.9); mantle wall moderately thin, muscular. Head wide, but narrower than mantle (HWI 56.0–75.3); demarked from mantle by moderate constriction. Eyes large, projecting above surface of head. Funnel large, slender, bluntly tapered (FuLI 38.7–46.5); free for about two-thirds of its length (FFuI 61.9–68.1). Funnel organ W-shaped, outer limbs three-quarters as long as median limbs (Fig. 12b). Mantle aperture moderately wide (PAI 75.1–94.1).

Brachial crown strong, well developed. Arms long (MAI 29.6–33.2) (2.7–3.4 times ML in mature animals); slender (AWI 9.7–11.4), tapering to fine tips. Arm lengths subequal; arm order I=II=III=IV. Suckers biserial, with obvious radial grooves; normal suckers small (ASIn 7.0–10.0), slightly raised from arm surface; 9th and 10th, or 10th and 11th suckers conspicuously enlarged on arms II and III of mature males, highly raised from arm surface (ASIe 13.5–21.4) (Fig. 13).

Web formula B=C=DAE or B=C=DEA; dorsal and ventral sectors shallower. Web shallow (WDI 20.4–22.9); web remnants extend up ventral sides of arms for approximately two-thirds of their length.

Third right arm of males hectocotylised (Figs 12c–e); shorter than its opposite number (OAI 78.8; HcAl 225.2–279.7). Hectocotylised arm with 69–70 suckers; opposite arm with about 150 suckers. Spermatophoral groove well developed, with conspicuous thickening of web membrane. Ligula approximately 6–7% of hectocotylised arm length in mature animals (LLI 6.7–6.8). Ligula conical, with indistinctly marked and shallow groove, and approximately 2–4 poorly defined transverse ridges. Calamus well formed, very long, acutely pointed (CaLI 50.0–51.0).

Gills with 9–10 lamellae on outer demibranch, plus the terminal lamella.

Digestive tract not dissected. Ink sac large, lying embedded on ventral face of digestive gland.

Male reproductive tract not dissected. Penis very long (PLI 47.2–56.3), with 1 very long, curved diverticulum and a second small appendicular diverticulum. Genital aperture subterminal, on right side of penis (Figs 12f, g). Spermatophores relatively long (SpLI 108.5–117.6), slender (SpWI 1.9–2.0), with large, coiled sperm reservoir (SpRI 37.9–39.3).

Female reproductive tract not known.

Integumental sculpture consists of a pattern of fine, rounded and closely set epidermal tubercles; tubercles evenly cover both dorsal and ventral surfaces. Unbranched papillae present in ocular region with 1 large supraocular papilla, and on the dorsal mantle with 4 primary papillae forming diamond arrangement. Ventrolateral integumentary ridge or fold around mantle circumference absent.

No information available on colouring of live animals. Preserved specimens in ethanol uniformly light brown to red brown dorsally, cream to light brown ventrally. Ocelli absent.

Figure 13. *Octopus campbelli* (Smith): oral view of enlarged suckers on lateral arms of AIM AK75675, M, 34.1 mm ML (1 = dorsal arm; 2 = dorsolateral arm; 3 = ventrolateral arm; 4 = ventral arm) (scale bar = 10 mm).

Distribution. New Zealand, Campbell Island (Fig. 13). The species appears to be uncommon, living in subantarctic inshore waters on mud and sand bottom. One depth record exists of 43 m.

O'Shea (1990) also recorded the species from off Timaru, South Island, New Zealand (44°38′S, 172°38′S), in 365 m depth.

Remarks. Smith (1902) originally described *Polypus campbelli* from a specimen collected at Campbell Island during the cruise of RV "Southern Cross" (1898–1900). The description was repeated by Suter (1913), without additional information.

There has since been considerable discussion concerning the taxonomic placement of this species. Robson (1929) provided additional details and illustrations of the type specimen, and placed the species in the genus *Joubinia*. Adam (1938), however, noted that the name *Joubinia* was preoccupied, and proposed the new name, *Robsonella*. An additional complicating factor was Robson's (1929: 145) footnote added in proof, considering this species to be identical to *O. australis*.

The specific name *campbelli* was thus submerged in synonymy with *Robsonella australis* by Benham (1942) and Dell (1952). Subsequently, the systematic characters distinguishing *Robsonella* were reviewed by Pickford (1955), and it was concluded that species previously assigned to the genus *Robsonella* should be reassigned to *Octopus*.

Tait (1982) later recognised *O. campbelli* as a separate and distinct species from *O. australis*.

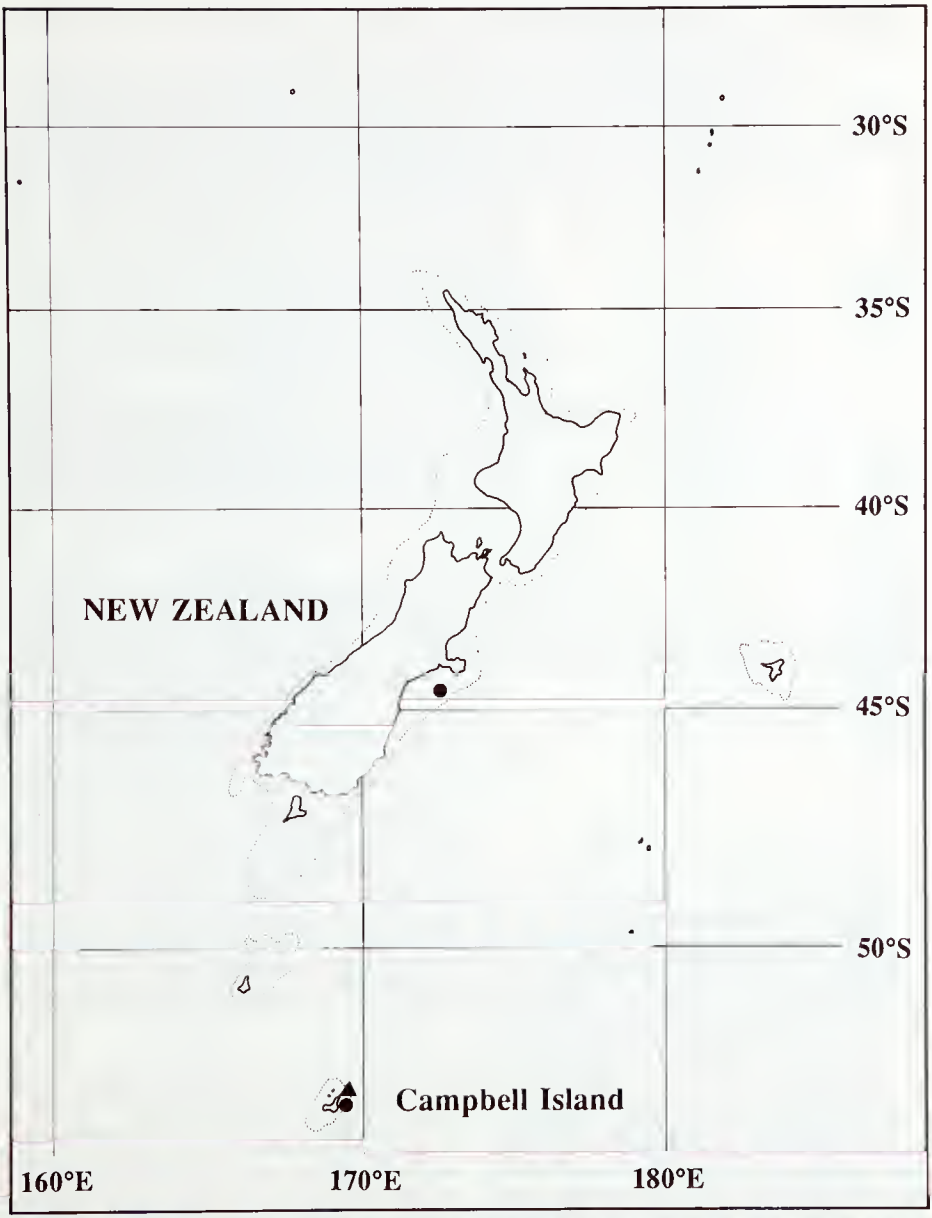

Figure 14. *Octopus campbelli* (Smith): geographical distribution at Campbell Island, New Zealand (▲ = type locality; ● = localities of other material).

Table 9. Measurements (mm) and indices of two male *Octopus campbelli* (Smith, 1902). (M = mature; N.R. = not recorded; * = arm severed or regenerated).

Museum Reg. No.	BMNH 1902.5.16.2	AIM AK75675
ML	27.1	34.1
StM	M	M
TL	122.2	137.2
MWI	88.9	75.7
HWI	75.3	56.0
MAI	29.6	33.2
ALI: 1	325.1	287.4
2	338.0	300.9
3	301.8*	285.9
4	324.0	296.8
AWI	11.4	9.7
ASIn	10.0	7.3
ASIe	21.4	15.8
WDI	22.9	20.4
WF	B=C=DEA	B=C=DAE
GiLC	10	9
HcAI	279.7	225.2
OAI	—	78.8
LLI	6.7	6.8
CaLI	51.0	50.0
HASC	69	70
PLI	47.2	56.3
SpLI	N.R.	117.6
SpWI	N.R.	2.0
SpRI	N.R.	39.3
FuLI	46.5	38.7
FFuI	61.9	68.1
PAI	94.1	75.1

In light of the previous confusion, Tait (1982) and Stranks (1988) recommended a revision of the taxon to determine its systematic status.

O'Shea (1990) described two specimens of *Robsonella campbelli* collected off Timaru, New Zealand, and gave detailed measurements and figures. O'Shea (1990), however, gives little discussion to the taxonomy of the species, and no mention of the systematic decisions of Robson (1929), Pickford (1955) or Tait (1982).

The present redescription is based on examination of the holotype from the BMNH collection, and another specimen of *O. campbelli* from the AIM collection. The few available specimens, and the poor likelihood of a significant number of specimens being collected in the near future, have necessitated the brief form of this redescription. A comprehensive description, particularly of female morphology, must await further material.

O. campbelli can be distinguished from other species of the genus on the basis of a combination of characters: a broadly ovoid mantle; skin with a pattern of fine, rounded and sparsely set tubercles on the dorsum, a large papilla over each eye, but no ventrolateral ridge on the mantle; small but prominent eyes; long, subequal arms (2.7–3.4 times ML in mature animals); large suckers, with two suckers distinctly enlarged on lateral arms of males; a medium sized, stout, conical ligula (6–7% of third right arm length), and a very long calamus; unknown egg size or method of attachment; and 9–10 gill lamellae.

Nothing is known of the biology of the species. The unusual distribution pattern of *O. campbelli* in the shallow waters of subantarctic Campbell Island, as well as in much deeper waters off temperate South Island, New Zealand, may be an example of temperate water submergence.

Discussion

In a recent note, Toll (1991) attempted a revision of *O. australis* and *O. campbelli*, based on one specimen lot from the collection of the Rosenstiel School of Marine and Atmospheric Sciences, University of Miami, and on literature accounts. Toll's material comprised four males and two females from Portobello, New Zealand, identified as *O. campbelli*. Unfortunately, very few counts or measurements and no figures were included in the account to enable confirmation of that identification. Working with inadequate material, confusing literature, and without examining relevant types, Toll (1991) concluded that specimens previously identified as *O. australis* could be attributed to either *O. australis* (in the case of Australian specimens) or *O. campbelli* (for New Zealand specimens). Considering results from the present study, Toll's (1991) conclusions are obviously an oversimplification.

Much of the uncertainty about *O. australis* arose from the brief original description, and lack of a mature type specimen of *O. australis*. Many subsequent workers have relied on inadequate published data on the two syntypes of *O. australis* to make taxonomic decisions. Above all, the present study should warn systematists against working purely from published accounts, but instead to rely as far as possible on information gained first hand (especially from

Table 10. Comparison of species in the *Octopus australis* complex.

Species	*O. australis*	*O. berrima*	*O. campbelli*	*O. warringa**
Distribution	Subtropical waters of eastern Australia	Temperate waters of southeastern Australia	Subantarctic waters of New Zealand	Temperate waters of southeastern Australia and New Zealand
Size at Maturity: F M	50–60 mm ML 20–25 mm ML	30–40 mm ML 20–25 mm ML	Unknown ~25 mm ML	>20 mm ML >15 mm ML
Hectocotylus Size and Shape	LLI: 7.5–*12.7*–16.7 CaLI: 15.0–*19.5*–29.4 (medium sized, very robust, bulbous ligula with deep groove and very short calamus)	LLI: 10.9–*13.3*–15.5 CaLI: 15.3–*17.2*–20.2 (medium sized, elongate, conical ligula with deep groove and very short calamus)	LLI: 6.7–6.8 CaLI: 50.0–51.0 (medium sized, robust, conical ligula with shallow groove and very long calamus)	LLI: 6.3–*7.9*–10.2 CaLI: 24.0–*35.7*–50.0 (medium sized, very robust, bulbous ligula with deep groove and short calamus)
Sucker Enlargement	~4–5 suckers enlarged on arms 2 and 3 of males only	No suckers enlarged	2 suckers enlarged on arms 2 and 3 of males	~4–5 suckers enlarged on all arms of males and females
Penis Size and Shape	PLI: 16.6–*18.8*–19.8 (long, simple penis with single coiled diverticulum)	PLI: 14.2–*25.2*–30.6 (long, simple penis with single coiled diverticulum)	PLI: 47.2–56.3 (very long, complex penis, with one long, curved diverticulum and a second smaller diverticulum)	PLI: 15.2–*29.3*–51.9 (very long, simple penis, with a single coiled diverticulum marked with 3 lobes)
Egg Size and Attachment	Large eggs (8–12 mm long) with unknown method of attachment	Large eggs (10–14 mm long) attached singly to substrate	Unknown	Small eggs (2–3 mm long) attached in festoons to substrate
Tubercle Sculpture	Rounded, coarse, closely set tubercles on dorsum. Tubercles on ventral mantle similarly sized, just as prominent, but more scattered	Rounded, very fine, closely set tubercles on dorsum. Tubercles on ventral mantle smaller, less prominent, and more scattered	Rounded, fine, sparsely set tubercles on dorsum. Tubercles on ventral mantle similarly sized, just as prominent, and just as scattered	Rounded, very fine, closely set tubercles on dorsum. Tubercles on ventral mantle smaller, less prominent, and more scattered
Integumentary Ridge on Ventrolateral Mantle	Obvious and continuous ridge around mantle, angled sharply on posterior mantle	Obvious but discontinuous ridge around mantle, roughly straight around mantle posterior	Ridge absent	Ridge absent
Gill Count	7–9	7–8	9–10	6–8

*from Stranks, 1988; 1990

examination of type material as well as an extensive series of comparative specimens).

The complex of previously confused species comprises: *O. australis*, *O. berrima*, *O. campbelli* and *O. warringa*. The species are similar in gross morphology, with broadly ovoid mantles, long and subequal arms, and fine and rounded tubercles on the skin. The four species are otherwise separable on the basis of absolute size, dermal sculpture (particularly the presence or absence of a ventrolateral skin ridge), shape of the hectocotylus and penis, presence or absence of enlarged suckers, and size of eggs (see Table 10). Unfortunately, several of the primary distinguishing characters are sexual, and mature males are easier to identify than females or juveniles.

The four taxa listed are presently considered to belong to the genus *Octopus*. Bearing in mind the relatively fluid state of octopod higher systematics currently, the authors acknowledge that generic re-assignment may be recommended in the future. The current priority has been to rectify species-level taxonomy. *O. australis* and *O. berrima* appear to be species very closely related in terms of morphology, and it is not surprising that they were previously confused. On the other hand, *O. campbelli* and *O. warringa* are very distinctive and would not appear to be as closely related to the former two species.

Each species may be categorised by its reproductive behaviour and associated distribution pattern.

O. australis and *O. berrima* possess relatively large eggs, and in the case of *O. berrima* (and probably also *O. australis*), relatively large juveniles. Therefore juveniles of both species may be assumed to adopt a benthic rather than planktonic existence after hatching (see the classification scheme of Boletzky, 1974; 1977). The geographical distributions of each allopatric species are accordingly limited. *O. australis* is endemic to subtropical waters of southern Queensland and central New South Wales; and, *O. berrima* is endemic to more temperate seas off southern New South Wales and southern Australia.

O. warringa broods relatively small eggs, which hatch out as small juveniles (Stranks, 1988, 1990). Hatchlings of this species probably exist for a period in the plankton before settling out to a benthic habitat. The geographic range for this species may be presumed to be more widespread. Indeed, *O. warringa* is found in temperate waters of both south-eastern Australia and New Zealand (Stranks, 1988, 1990).

Information on size of eggs and juveniles of *O. campbelli* is not available. The species is apparently endemic to subantarctic waters of New Zealand.

Live animal observations, particularly regarding reproductive behaviour or resource partitioning, should reveal other differences between each species.

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