SEPIA HEDLEYI BERRY, 1918 (CEPHALOPODA: SEPIIDAE): A COMPLETE DESCRIPTION AND CLARIFICATION OF THE STATUS OF *S. DANNEVIGI* BERRY, 1918 AND *S. REX* (IREDALE, 1926)

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REID, A. L. 2001. *Sepia hedleyi* Berry, 1918 (Cephalopoda: Sepiidae): a complete description and clarification of the status of *S. dannevigi* Berry, 1918 and *S. rex* (Iredale, 1926). *Records of the South Australian Museum* **34**(2): 79–97.

Following the examination of both qualitative and quantitative morphological characters, *Sepia dannevigi* Berry, 1918 from off Kangaroo Island, South Australia and *Sepia rex* (Iredale, 1926) from eastern Australia (Manly Beach, NSW) are synonomised with *Sepia hedleyi* Berry, 1918, also from off Kangaroo Island. These three species have never been satisfactorily delimited in the literature, so this synonomy is long overdue. A full redescription of *Sepia hedleyi* is provided.

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The cuttlefish *Sepia hedleyi* was described by Berry (1918) on the basis of a number of specimens collected from the Great Australian Bight, off the coast of South Australia. While the original description is detailed and relatively well illustrated, the cuttlebones of all the specimens were missing or damaged, and its structure was estimated in a reconstruction of the ventral side of the bone from fragments obtained from a single female specimen. In the same publication, another species from the same collection locality, *S. dannevigi*, was described on the basis of three female specimens, again with damaged cuttlebones.

Perhaps (in part) because the cuttlebones of these species were so incompletely known, another species, *S. rex*, was described by Iredale in 1926 on the basis of a cuttlebone collected on Manly Beach, Sydney (33°48'S 151°17'E). Iredale (1926) provided no justification for the erection of this new species: no comparison was made with other cuttlefish species. In addition, he placed *S. rex* in a new genus, *Decorisepia*, on the basis of its 'remarkable' rounded spine and the absence of an inner cone and ventral sulcus. Strangely, the two latter traits are clearly visible in his illustration accompanying the description (Iredale 1926: pl. xxii, figs 9–10) and are obvious on the type specimen. Following the comprehensive revision of the Sepiidae by Adam and Rees (1966), the validity of *Decorisepia* (and many other sepiid genera) has been questioned, and few workers follow this scheme, preferring to retain most sepiids within a single genus *Sepia* until more is known about the phylogenetic relationships among species. The generic classification of Adam and Rees (1966) is the one followed in this paper.

In a later work, Adam (1979) placed two other species, *Decorisepia cottesloensis* Cotton, 1929 and *D. jaenschi* Cotton, 1931, both known only from cuttlebones, in synonomy with *S. rex*. However, the description of *S. rex* in Adam (1979) is clearly that of yet another species, *S. opipara* (Iredale, 1926), so Adam's synonomy is not valid. After examining the type cuttlebones of all these species, Lu (1998) confirmed that *D. cottesloensis* and *D. jaenschi* are indeed synonyms of *S. rex*, so that part of the story, at least, has been resolved.

The three names, *S. dannevigi, S. hedleyi* and *S. rex*, have persisted in the literature until now, though they have never been satisfactorily differentiated from each other. Lu (1998) gave a diagnosis for each species based on his examination of the type specimens and comparison with other material housed in the Museum Victoria collections. The only difference he noted between *S. hedleyi* and *S. rex* is that the cuttlebone striae are nearly straight in *S. hedleyi* (based on Berry's figure of the reconstructed cuttlebone), but rounded in *S. rex.* He also noted the similarity between *S. dannevigi* and *S. hedleyi* and suggested they may be conspecific.

The aim of the present study is to clarify the status and identity of the three putative species, *S. dannevigi, S. hedleyi* and *S. rex.*

Materials And Methods

This work was based on museum material. The non-type material examined is listed in Appendix 1. Material examined in detail for both qualitative and quantitative characters is listed in the *Material examined* section of the species description below. Australian institutional abbreviations used are: AM, Australian Museum, Sydney; MV, Museum Victoria, Melbourne; SAM, South Australian Museum, Adelaide.

To determine whether *S. dannevigi, S. hedleyi* and *S. rex* are conspecific, the type specimens and their original descriptions were compared. In addition, specimens from close to the type locality of *S. rex* (Manly Beach, NSW, 33°48'S 151°17'E) were compared with specimens from southern Australia. Because the *S. rex* type specimen is a beachwashed cuttlebone, it may have drifted from any distance before reaching Manly Beach, so the selection of specimens for comparison is not entirely satisfactory, but unavoidable. Identification of these specimens could only be based on the appearance of the cuttlebones and their comparison with the type specimen.

Unfortunately, apart from the type specimens, no other material was available for study from the type locality of *S. dannevigi* and *S. hedleyi*, both from the 'Investigator St. Area, south of Kangaroo Island, South Australia' (Berry 1918: 263, 266). (Herein lies another difficulty: the Investigator Strait is actually north of Kangaroo Island, and no latitudes and longitudes are given in Berry's paper, so the exact type locality is unknown.) Some additional specimens were examined from sites that were as close as possible to Kangaroo Island, though some distance away (see Fig. 1). Apart from the appearance of the cuttlebone (see *Results* to follow), these specimens conformed in all other respects to Berry's (1918) descriptions and type specimens of both *S. hedleyi* and *S. dannevigi* (the two of which appear to be indistinguishable).

In addition to comparing qualitative characters, the statistics package 'Systat' (Systat Incorporated) was used to compare differences in morphometric characters between the populations from eastern Australia (ten males and ten females) and those from southern Australia (seven males and nine females). Sexes were treated separately.

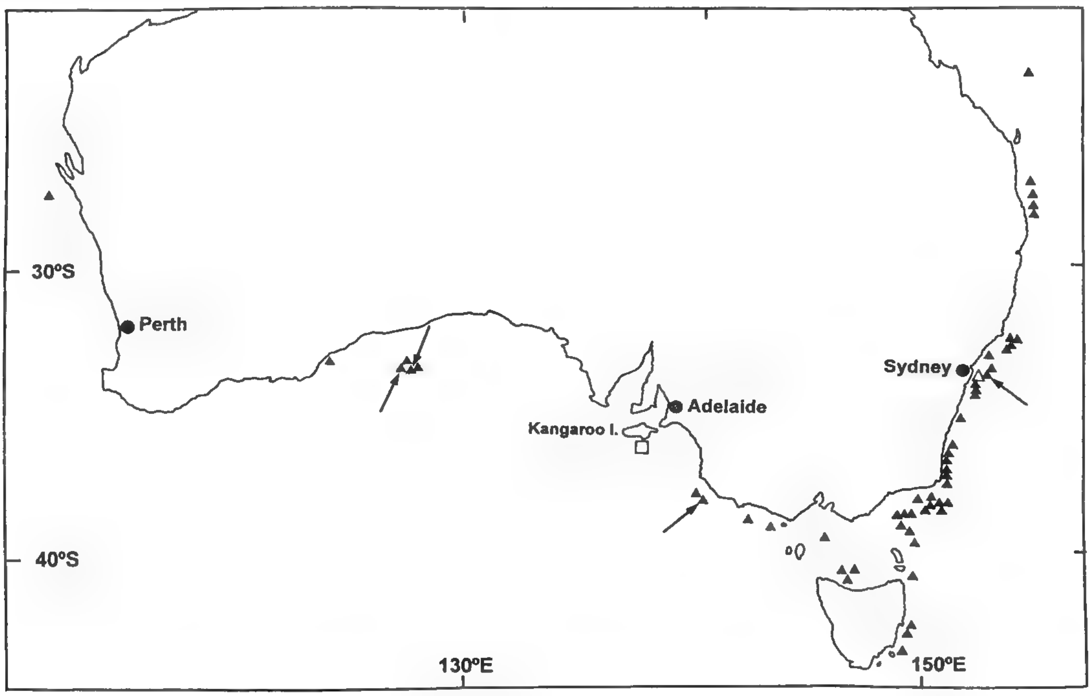

FIGURE 1. Distribution of *Sepia hedleyi* Berry, 1918 based on specimens examined in this study (solid triangles). The open square indicates the approximate type locality of *S. dannevigi* and *S. hedleyi* (see Materials and Methods), and the open triangle the type locality of *S. rex*. Arrows indicate the collection sites for specimens that were examined in detail for both morphological and morphometric characters.

In addition to preserved specimens, the measurements given in Berry's (1918) paper for *S. hedleyi* were included in the analyses. The measurements of one female specimen (E4377) were excluded for reasons given in the *Results* section below. Slopes and intercepts of regression equations were compared statistically between the eastern and southern Australian specimens for those characters showing a significant correlation with body size. For soft parts, mantle length was used as a size indicator. For cuttlebone measurements, cuttlebone length was used.

Measurements and indices used throughout this paper are primarily those given in Roper and Voss (1983), using dorsal mantle length (ML) as a size standard. Some additional measurements are used, and these with the definitions listed by Roper and Voss (1983) are given in Appendix 2. In the species description to follow, parts of the club and arm sucker rims are described using the terminology of Nixon and Dilly (1977) while nomenclature for the radula follows Nixon (1995). The beak was described following Clarke (1986). Diagrammatic illustrations of measurements and terminology used for key structures are shown in Reid (2000).

Measurements were made either using dial callipers, or an eyepiece micrometer inserted in a stereo microscope. All measurements are expressed in millimetres (mm). Measurements and counts for individual specimens and ranges of arm length indices, arm sucker diameter indices and arm sucker counts are presented in tables; ranges for all other characters appear in the text. In the species description and tables, the range of values for each character is expressed as: minimum–mean–maximum (standard deviation, SD). Values for each sex are given separately. Measurements were not taken from the *Sepia dannevigi* (AM C148249) or *Sepia hedleyi* (AM C148252) holotype specimens because of the poor state of preservation of these animals.

Measurements for structures that were clearly distorted or broken were not attempted; these, in addition to missing and unknown values, appear as a dash (–) in the appendices. Ranges for specific character traits given with the species description do not, therefore, always refer to the total number of specimens examined.

For examination of arm and club sucker rims, suckers were removed from the middle of designated arms and the tentacular club, mounted in glycerine jelly and viewed using a compound microscope. Radulae and beaks were dissected from the buccal mass and soaked for approximately 30 minutes in a warm, saturated potassium hydroxide solution; then radulae were cleaned using forceps and a fine brush. Radulae were mounted in glycerol and the new, unused portion was examined. All characters refer to both sexes unless stated otherwise.

The species description was generated using DELTA (DEscription Language for TAxonomy) software (Dallwitz, 1980; Dallwitz et al., 1993; Partridge et al., 1993).

Results

With a single exception, only minor differences were found between the type specimens and descriptions of *S. dannevigi* Berry, 1918, *S. hedleyi* Berry, 1918 and *S. rex* (Iredale, 1926). The exception is in the shape of the cuttlebone striae of *S. hedleyi* (Berry's figure pl. lxii, fig. 2, reproduced here as Fig. 2A), which are nearly straight compared with those of *S. rex* (Fig. 2C, D) which are an inverted U-shape (Fig. 2D). Unfortunately, the cuttlebone upon which Berry's illustration is based could not be found in the Australian Museum collection (Ian Loch, personal communication), so the accuracy of the reconstruction of the cuttlebone could not be checked. Assuming the shape of the striae as illustrated is true to the original specimen (a possibility that seems likely given that this section of the cuttlebone fragment is largely intact), a striking resemblance between this cuttlebone and that of another southern Australian species, *S. cultrata* Hoyle, 1885, is apparent (compare Fig. 2A and 2B). Females of *S. hedleyi* and *S. cultrata* are not easy to distinguish in most respects, however, the club suckers of *S. cultrata* are in 5–6 transverse rows and larger than those of *S. hedleyi*, which are in 9–12 rows. The tentacles were missing from the specimen Berry (1918) used for the illustration of the cuttlebone, so it is possible that this specimen may have been misidentified, and is actually *S. cultrata*. Both species inhabit similar depths and are often trawled together, so I believe this possibility is a real one. Given the doubt about the identity of the specimen (E4377, Berry's register [507]), its measurements were excluded from consideration in this study.

Morphometrics

Nine characters for males (MW, VML, FuL, HW, AS3, ASl4, ClL, ClSv and CbL) and 19 characters for females (MW, AMH, VML, HW,

TABLE 1. Morphological parameters showing differences in eastern and southern populations for females. Regression data $Y = a + bX$, where Y = dependent variable, a = intercept, b = slope, X = ML, Sig. = significant difference between the regression lines of eastern (E) and southern (S) Australian populations (Pop.) with respect to intercept, N = number of specimens, r^2 = proportion of total variation accounted for by regression.

Y	Pop.	N	r^2	a	b	Sig.
VML	E	10	0.922	0.46	0.88	$P < 0.001$
	S	8	0.882	18.65	0.61	
AS3	E	10	0.508	–0.23	0.02	$P < 0.05$
	S	5	0.833	–0.41	0.02	
ClL	E	10	0.748	–9.83	0.27	$P < 0.001$
	S	4	0.980	–11.91	0.35	

ED, AL1, AL2, AL3, AL4, AS2, AS3, AS4, ClL, ClSd, GiL, CbL, CbW, CbB and LoL) were significantly correlated with mantle length in both populations. Therefore, the slopes and intercepts of the regression equations could be compared statistically between the eastern and southern populations to determine whether there are any differences in these quantitative characters.

For males, no significant differences in either the slopes or the intercepts of the regression equations were found, suggesting that (for the characters that could be compared) the southern and eastern populations do not differ. Three characters differed between the eastern and southern populations in females: VML, AS3 and ClL (Table 1). To determine whether these differences are significant, or perhaps the result of geographic variation across the range of a single species, residual variables calculated for each of these characters were regressed against latitude and longitude of each specimen collection site following the methods detailed in Reid (1991). Residual values for VML and ClL were correlated with both latitude and longitude, indicating a strong geographic component in the difference between the eastern and southern populations (Table 2). The character AS3 was not correlated with either latitude or longitude and represents the only significant difference between the two populations in quantitative characters. A difference in this trait alone, the diameter of the suckers on the third arm of females, does not warrant further detailed investigation and is of not sufficient magnitude to warrant distinct species recognition.

One further difference was noted in the number of club suckers, with ClRC for the southern Australian population 9–10 (Appendix 3) and 11–12 for the eastern Australian population (Appendices 4 and 5), though the *S. hedleyi* holotype clearly has 12 suckers in transverse rows as noted by Berry (1918). While this does not appear to be a significant difference between the two populations, and given the difficulty in determining the exact number of club suckers, particularly in species where the suckers are small, it may still be worth investigating this character when more material from southern Australia becomes available.

From all available evidence, I conclude from the examination of both qualitative and quantitative characters that all specimens currently referred to as *S. dannevigi*, *S. hedleyi* and *S. rex* belong to a single species. Unless specimens are found that match all parts of Berry's (1918) description of *S. hedleyi*, including the shape of

TABLE 2. Latitudinal and longitudinal regression of residual variables pooled from female specimens from eastern and southern Australia tested by $Y = a + bX$ where Y = the predicted dependent variable, a = y intercept, b = slope, X is either latitude or longitude, N = number of specimens, r^2 = proportion of total variation accounted for by regression, N/S = not significant.

		X = Latitude				X = Longitude			
Variable	N	r^2	a	b	Sig.	r^2	a	b	Sig.
VML	28	0.511	54.40	–1.59	$P < 0.05$	0.360	–42.09	0.29	$P < 0.05$
AS3	25	0.217	–1.84	0.06	N/S	0.032	0.75	–0.01	N/S
ClL	28	0.670	–39.79	1.71	$P < 0.01$	0.354	23.61	–0.16	$P < 0.05$

the cuttlebone striae, I believe his illustration of the cuttlebone of *S. hedleyi* is in fact the cuttlebone of a specimen of a different species, probably *S. cultrata*. *Sepia hedleyi* has date precedence (ICZN, 1999: Art. 23.1) with respect to *S. rex*, and page precedence (ICZN, 1999: Art. 69A.10) with respect to *S. dannevigi*, so the latter two species are placed in synonomy with *S. hedleyi* in the description to follow.

Counts and indices for individual specimens from southern Australia are given in Appendix 3, and from eastern Australia in Appendices 4 and 5. Ranges for arm length indices, arm sucker diameter indices and arm sucker counts for southern Australian specimens are shown in Appendix 6. Measurements included in the description refer only to southern Australian specimens.

Taxonomy

Sepia hedleyi Berry
(Figs 1(in part)–7, Appendices 3, 6)

Sepia hedleyi Berry, 1918: 258–264, pls 71–72. – Lu, 1998: 169, fig. 10.

Sepia dannevigi Berry, 1918: 264–268, pls 73–74, figs 1–2. – Lu, 1998: 168, fig. 8.

Decorisepia rex Iredale, 1926: 193. – Lu, 1998: 180–181, fig. 22.

Material examined

Holotype. Sepia dannevigi, 1F (61.0 mm ML), Investigator St. Area, south of Kangaroo Is, South Australia, Jan–Feb 1912, FIS 'Endeavour' E2466 (AM C148249).

Holotype. Sepia hedleyi, 1M (56.9 mm ML), Investigator St. Area, south of Kangaroo Island, South Australia Jan–Feb, 1912, FIS 'Endeavour' E2464 (AM C148252).

Holotype. Sepia rex, 1 cuttlebone (107.0 mm CbL), Manly Beach, NSW [33°48'S 151°17'E] (AM C127593).

Other material examined. **Australia: New South Wales:** 1M (84.3 mm ML), 2F (83.1, 103.8 mm ML), 32°27'S 152°54'E, 244–242 m, 30 Jan 1982, coll. C. C. Lu & R. Tait (MV F77179); 1F (108.8 mm ML), 33°40'S 151°50'E, 210–204 m, 25 Jan 1982, coll. C. C. Lu & R. Tait (MV F77138); 5M (75.9–100.5 mm ML), 9F (72.6–107.7 mm ML), 33°42'S 151°51'E, 300–293 m, 25 Jan 1982, coll. C. C. Lu & R. Tait (MV F77136). **South Australia:** 3F (93.1–107.6 mm ML), 25.5

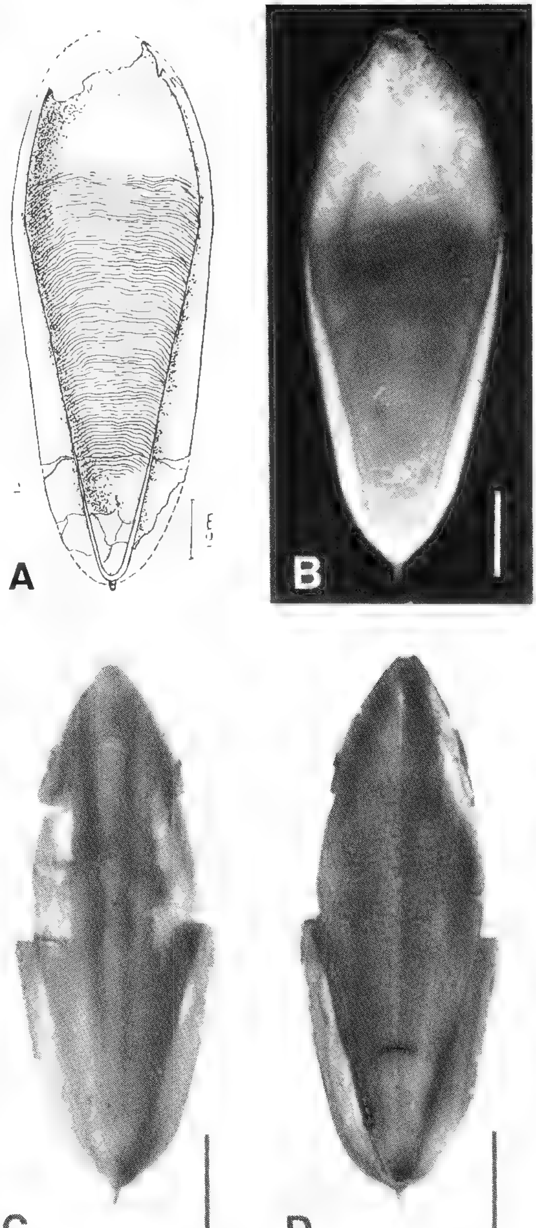

FIGURE 2. *A*, *Sepia hedleyi* Berry, 1918, reconstructed cuttlebone, pl. lxxii, fig. 2 Berry, 1918, female [507], 91.0 mm ML (E4377) (specimen possibly *S. cultrata* Hoyle, 1885); *B*, *Sepia cultrata* Hoyle, 1885, cuttlebone, ventral view, female, 67 mm ML (MV F66203); *C*, *Sepia rex*, cuttlebone, dorsal view, holotype, 107.0 mm CbL (AM C127593); *D*, *Sepia rex*, cuttlebone, ventral view, specimen as in *C*. Scale bars; A, B = 10 mm; C, D = 20 mm.

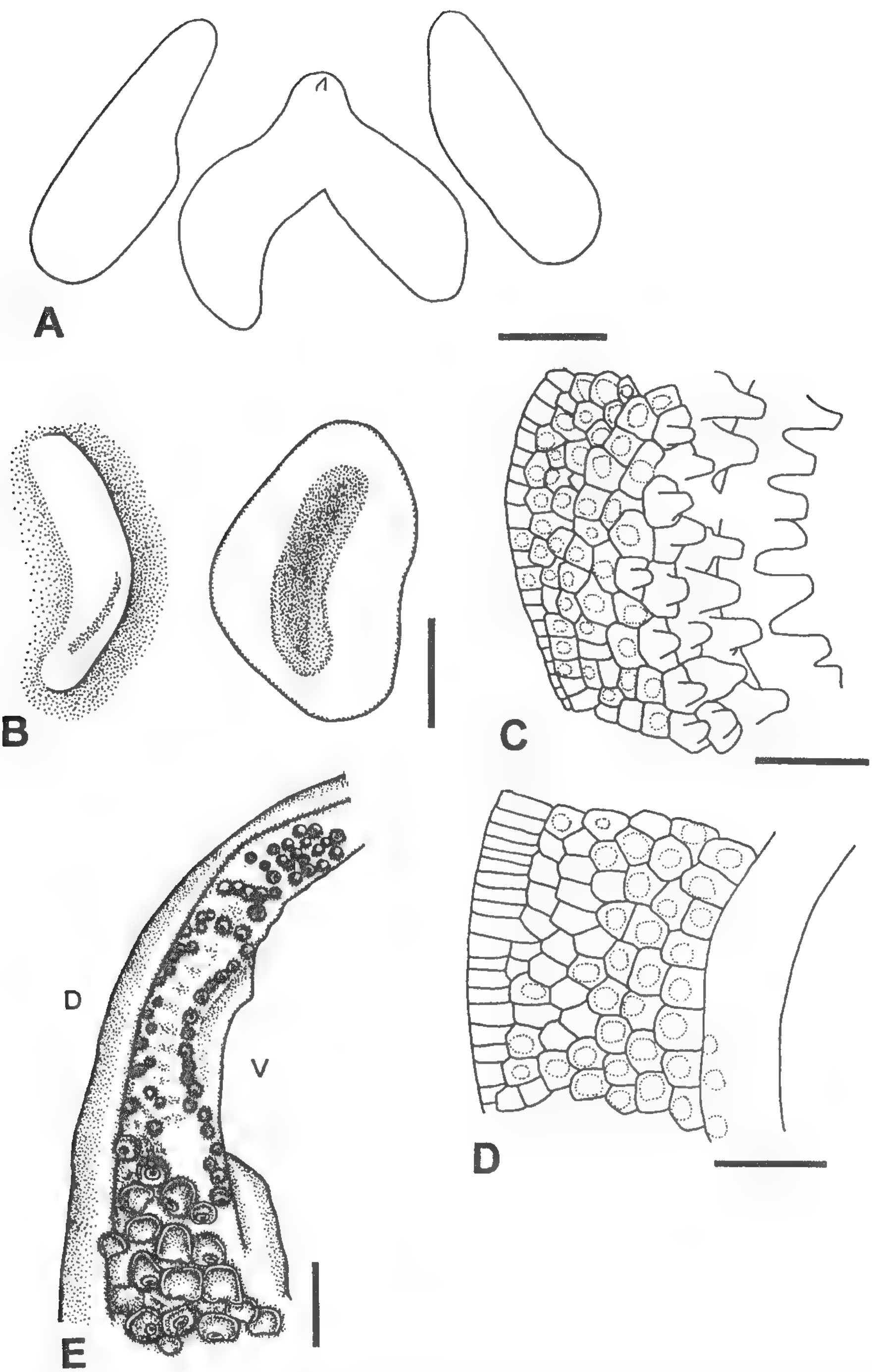

FIGURE 3. *Sepia hedleyi* Berry, 1918. ***A***, funnel organ, male, 47.2 mm ML (SAM D19241); ***B***, funnel-locking (right) and mantle-locking (left) cartilage, male, 47.2 mm ML (SAM D19241); ***C***, sucker rim arm 1, portion of toothed half, male, 55.0 mm ML (SAM D19243); ***D***, sucker rim, portion of non-toothed half, specimen as in *C*; ***E***, portion of hectocotylised arm, male, 75.7 mm ML (SAM D19241) (D, dorsal; V, ventral). Scale bars; A = 5 mm; B = 2 mm; C, D = 0.05 mm; E = 2.0 mm.

miles [41 km] SW of Cape Buffon, 37°58'S 139°45'E, 300 fm [549 m], May 1981, coll. J. Sealey (SAM D19240). **Western Australia:** 2M (47.2, 75.7 mm ML), Great Australian Bight, 115 nm SW Eucla, 33°18'S 127°40'E, 180 m, 16 Jan 1989, coll. W. Zeidler & K. Gowlett-Holmes (SAM D19241); 2F (67.9, 68.6 mm ML), Great Australian Bight, 110 nm SW of Eucla, 33°19'S 127°50'E, 250 m, 16 Jan 1989, coll. W. Zeidler & K. Gowlett-Holmes (SAM D19242); 1M (55.0 mm ML), Great Australian Bight, 115 nm SW of Eucla, 33°19'S 127°50'E, 180 m, 16 Jan 1989, coll. W. Zeidler & K. Gowlett-Holmes (SAM D19243).

Diagnosis

Male and female arms subequal in length; arm suckers tetraserial throughout. Hectocotylus present, left ventral arm of males modified: 6–8 rows of normal suckers proximally, 9–10 rows of reduced suckers, remaining suckers normal to arm tip; suckers in two dorsal series smaller than those in two ventral series, dorsal and ventral series widely spaced, those in ventral two series aligned in a single row. Club with 9–12 suckers in transverse rows, all similar sized, small; dorsal and ventral protective membranes not fused at base of club; swimming keel extends well beyond carpus along stalk. Cuttlebone acute anteriorly and posteriorly, with median rib dorsally; spine without keels; anterior striae inverted U-shape; inner cone limbs uniform width, narrow, V-shaped posteriorly.

Description

Counts and indices for individual specimens are given in Appendix 3; ranges for arm length indices, arm sucker diameter indices and arm sucker counts are shown in Appendix 6.

Small to moderate-sized species; ML males 47.2–70.7–83.0 (SD, 13.9); females 67.9–87.8–107.6 (SD, 13.9). Mantle broad, oval; MWI males 41.9–49.8–55.6 (SD, 5.4); females 44.2–51.6–59.8 (SD, 5.9); dorsal anterior margin triangular, acute; extending anteriorly beyond eyes; AMHI males 11.9–14.2–15.5 (SD, 2.0); females 12.8–14.6–17.8 (SD, 2.0). Ventral mantle margin emarginate, without distinct lateral angles; VMLI males 80.7–86.0–93.7 (SD, 4.4); females 75.3–83.1–88.4 (SD, 4.5); posterior gland and gland pore absent. Fins widest in posterior third; FWI males 7.2–9.7–11.7 (SD, 1.3); females 4.4–8.6–11.6 (SD, 2.4); anterior origin posterior to mantle margin; FIIa males 4.5–5.0–5.3 (SD, 0.4); females 2.0–3.7–5.7 (SD, 1.5); rounded posteriorly; with narrow gap between; FIIp males 6.4–7.3–8.0 (SD, 0.8); females 4.7–7.9–12.4 (SD, 3.3). Funnel short, robust, broad; extends to level of anterior rim of eye; FuLI males 27.7–33.2–40.5 (SD, 5.5); females 25.6–30.0–34.6 (SD, 3.3). Funnel free portion approximately half funnel length; FFuI males 14.5–17.3–20.1 (SD, 2.8); females 12.6–15.3–19.3 (SD, 2.8). Funnel organ dorsal elements inverted V-shape with small anterior papilla; ventral elements oval with acute anterior tips (Fig. 3A). Mantle-locking cartilage curved, with semicircular ridge; funnel-locking cartilage with depression that corresponds to ridge (Fig. 3B). Head short; HLI males 17.6–23.2–29.7 (SD, 4.8); females 13.4–25.8–40.8 (SD, 9.4); broad, narrower than mantle; HWI males 33.8–37.8–44.4 (SD, 3.7); females 31.6–41.3–46.6 (SD, 5.1). Eyes moderate size; EDI males 12.7–14.2–16.5 (SD, 2.1); females 8.9–10.8–12.7 (SD, 1.6); ventral eyelids present.

Male and female arms subequal in length (Appendix 6). Arm length index (ALI) of longest arms in males (ALI4) 33.8–40.2–54.4 (SD, 7.2); ALI of longest arms in females (ALI4) 34.7–42.0–51.3 (SD, 4.8). Protective membranes in both sexes narrow. Non-hectocotylised arms normal, not thickened. Distal arm tips in both sexes not markedly attenuate. Arm sucker arrangement same in both sexes: arm suckers tetraserial. Male non-hectocotylised arm suckers normal in size (not greatly enlarged); smaller than female arm suckers in size (Appendix 6). Chitinous rims of arm suckers with elongate rectangular teeth on distal half of inner ring (Fig. 3C), teeth absent on proximal half of ring (Fig. 3D); infundibulum with 7–8 rows of hexagonal processes, inner 4–5 (variable) rows with elongate rounded pegs, pegs becoming smaller towards periphery of sucker; peripheral sucker rim processes radially arranged, elongate, without pegs.

Arm sucker counts range from 106 to 248; females with higher average counts than males (Appendix 6).

Hectocotylus present, left ventral arm modified; sucker size normal proximally, reduced medially, then normal to arm tip; from proximal to distal end of arm, 6–8 rows of normal suckers; 9–10 rows of reduced suckers (Fig. 3E). Suckers in two dorsal series smaller than those in two ventral series; reduced suckers much smaller than normal arm suckers: ASIn4 1.32–1.46–1.69 (SD, 0.20) *v.* ASInl4m 0.26–0.36–0.42 (SD, 0.09). Oral surface of modified region wide, swollen, fleshy, with transversely grooved ridges. Suckers in two dorsal and two ventral series displaced laterally, suckers

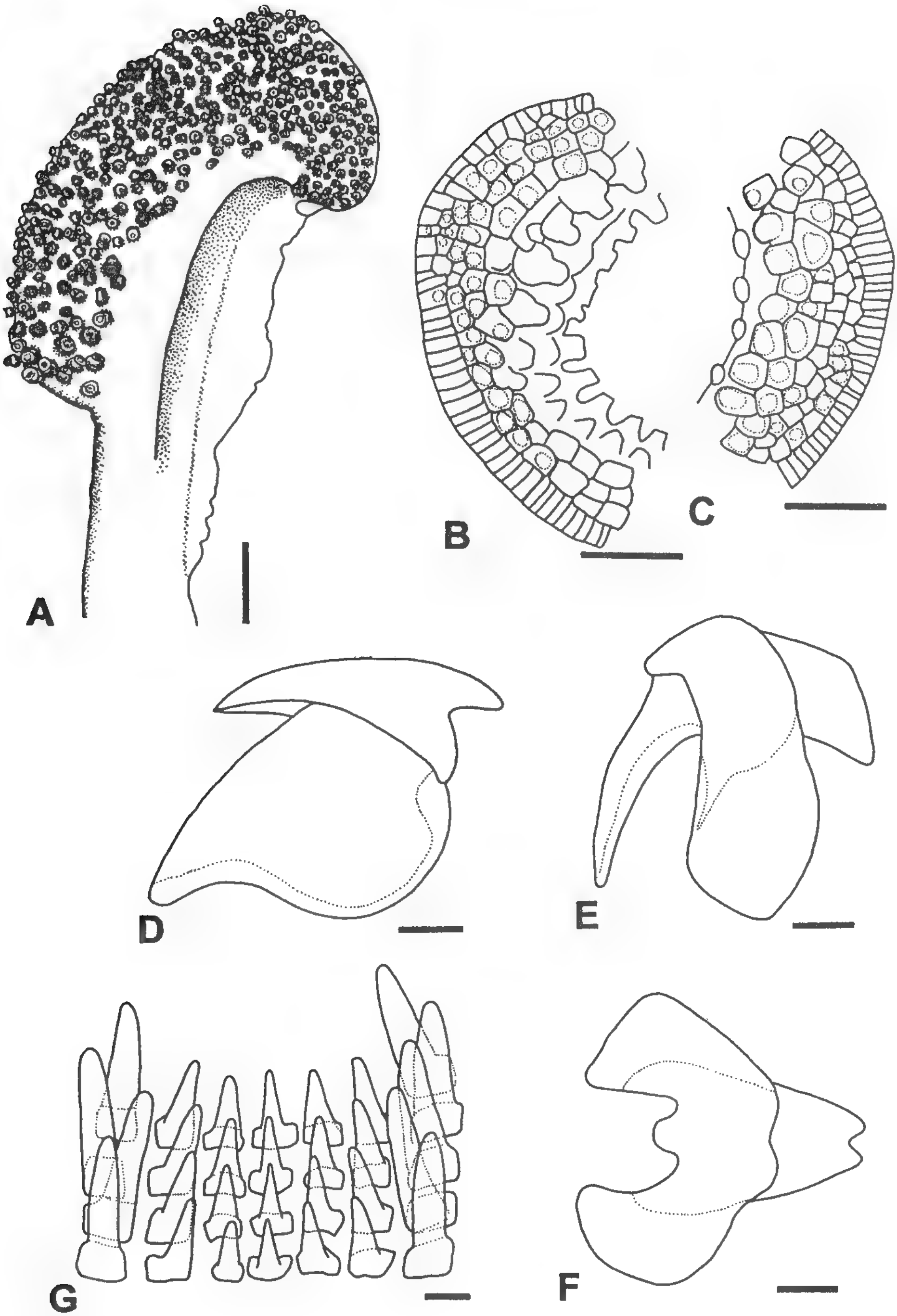

FIGURE 4. *Sepia hedleyi* Berry, 1918. ***A***, club, male, 75.7 mm ML (SAM D19241); ***B***, club sucker rim, portion of toothed half, male, 75.7 mm ML (SAM D19241); ***C***, club sucker rim portion of non-toothed half, specimen as in *B;* ***D***, upper beak, lateral view, female, 68.6 mm ML (SAM D19242) (stippling indicates extent of dark brown highly sclerotised portion of beak); ***E***, lower beak anteriolateral view, specimen as in *D*; ***F***, lower beak, ventral view, specimen as in *D*; ***G***, radula, male, 75.7 mm ML (SAM D19241). Scale bars; A = 1.0 mm; B, C = 0.05 mm; D–F = 2.0 mm; G = 0.2 mm.

in two ventral series aligned in a single row (Fig. 3E). Hectocotylised arm not markedly attenuate distally.

Tentacular club longer in females than males; ClLI males 9.9–13.9–17.2 (SD, 2.8); females 16.2–20.0–24.2 (SD, 3.4). Club crescent-shaped; moderate length; sucker-bearing face flattened. Club with 9–12 suckers in transverse rows; 32–42 suckers in longitudinal series. Suckers all similar size; small (Fig. 4A). Distal tip of club with pair of slightly larger suckers partially covered by a thick, fleshy flap. ClSI males 0.40–0.45–0.53 (SD, 0.07); females 0.40–0.46–0.52 (SD, 0.05); dorsal and ventral marginal longitudinal series of suckers similar in size; ClSId males 0.40–0.42–0.42 (SD, 0.01); females 0.40–0.46–0.52 (SD, 0.05); ClSIv males 0.29–0.37–0.42 (SD, 0.07); females 0.32–0.41–0.52 (SD, 0.10). Sucker dentition: half inner ring circumference in both sexes with elongate-rectangular teeth (Fig. 4B), remaining half with blunt projections (Fig. 4C); infundibulum with 5–7 rows of hexagonal processes, innermost with elongate rounded pegs, pegs smaller towards periphery of sucker; at periphery, processes smaller, elongate-rectangular, without pegs (similar to arm suckers). Swimming keel of club extends well beyond carpus (Fig. 4A). Dorsal and ventral protective membranes not fused at base of club; joined to stalk; dorsal and ventral membranes same length; extend beyond carpus along stalk; approximately equal width; dorsal membrane forms shallow cleft at junction with stalk.

Gills with 29–30 lamellae per demibranch; GiLC males 29–29–29 (SD, 0); females 29–29–30 (SD, 0.7). Gill length: GiLI males 24.9–30.0–35.0 (SD, 5.0); females 29.5–33.9–38.2 (SD, 3.6).

Buccal membrane without suckers. Upper beak (Fig. 4D) rostrum pointed, short, length approximately equal to width, cutting edge

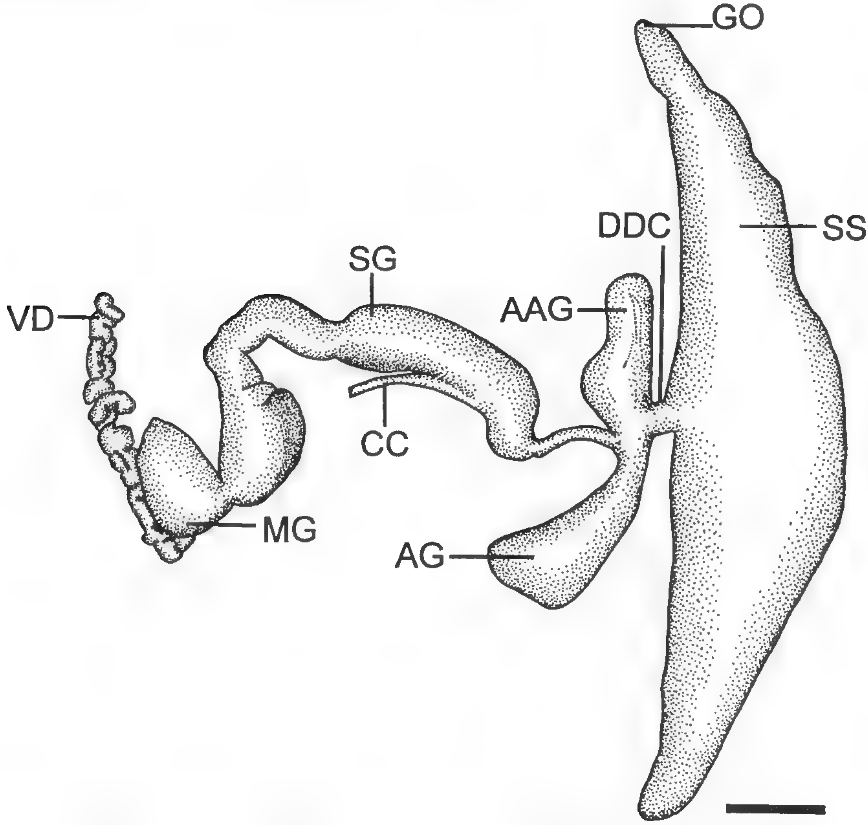

FIGURE 5. *Sepia hedleyi* Berry, 1918. Male reproductive tract (testis not shown), 55.0 mm ML (SAM D19243) (AAG, appendix of accessory gland; AG, accessory gland; CC, ciliated canal; DDC, distal deferent canal; GO, genital orifice; MG, mucilaginous gland; SG, spermatophoric gland; SS, spermatophoric sac (containing spermatophores); VD, vas deferens). Scale bar = 3 mm.

slightly curved; hood high above crest posteriorly; crest curved, lateral wall shallowly indented posteriorly; wings and hood narrow and short; jaw angle approximately 90 degrees; hood and crest dark brown. Lower beak (Fig. 4E, F) rostrum protrudes only slightly, cutting edge straight; hood low on crest; crest straight, no indentation on lateral wall edge; lateral wall edge angled posteriorly, not perpendicular to crest; hood and wings, width broad; hood notch shallow, broad; wings widely spaced; crest narrow; rostrum pigmented dark brown, wings dark brown on inner margin only, rest of wing light brown, crest dark brown. Radula (Fig. 4G) homodont; rhachidian teeth with truncate bases, slender, triangular, sides straight; first lateral teeth similar length and width to rhachidian teeth, asymmetrical with mesocone slightly displaced toward centre of radula; second laterals slightly longer than first, not distinctly curved on lateral margin, with broad heels; marginal teeth much longer than second lateral teeth, elongate with long tapered and curved mesocone. Digestive tract: (not illustrated) paired salivary glands approximately one-third length of buccal mass; paired digestive glands large, located close together, with narrow, elongate triangular lobes posteriorly, ducts connect digestive glands near midline with caecum, ducts with branched attached pancreatic tissue; oesophagus runs dorsally along median junction of digestive glands, joins sac-like stomach immediately posterior to digestive glands; caecum disc-like, grooved in a blunt V-shape anteriorly, surface lining finely pleated; intestine undifferentiated; ink sac very large, elongate; anal flaps well developed.

Male reproductive tract (Fig. 5): testis on left posterior side of viscero-pericardial coelom; at distal end, convoluted vas deferens opens into broad, cone-shaped mucilaginous gland, then narrower, curved, spermatophoric gland. Close to junction with lobe-shaped accessory gland and gland appendix, delicate ciliated canal joins spermatophoric gland; distal deferent canal connects appendix of accessory gland to spermatophore storage sac; genital orifice opens dorsal to left gill in anterior end of mantle cavity. Spermatophores (Fig. 6): cement body unipartite (not divided into distinct regions); flask-shaped, rounded posteriorly, connects to sperm reservoir via narrow duct; tapers abruptly following junction with middle tunic, which commences towards basal half of cement body; ejaculatory apparatus coiled, extends into oral dilation of spermatophore. Spermatophores 5.8–7.9 mm long; 0.2–0.4 mm wide; SpLI 10.4–11.5–12.3 (SD, 0.9); SpWI 3.4–4.4–5.1 (SD, 0.8). Buccal membrane in females extends ventrally with spermatheca.

Female reproductive tract: (not illustrated) ovary hangs from dorsal wall of posterior viscero-pericardial coelom. Oviduct thin-walled, continuous with body cavity; distally with thickened, glandular walls (oviducal glands). Nidamental glands in mature animals occupy large portion of ventral side of mantle cavity. Accessory nidamental glands anterior to nidamental glands. Eggs spherical; 2.5–3.1 mm diameter; EgDI 2.5–2.8–3.2 (SD, 0.4).

Cuttlebone length approximately equal to mantle length. Subdermal cartilaginous layer

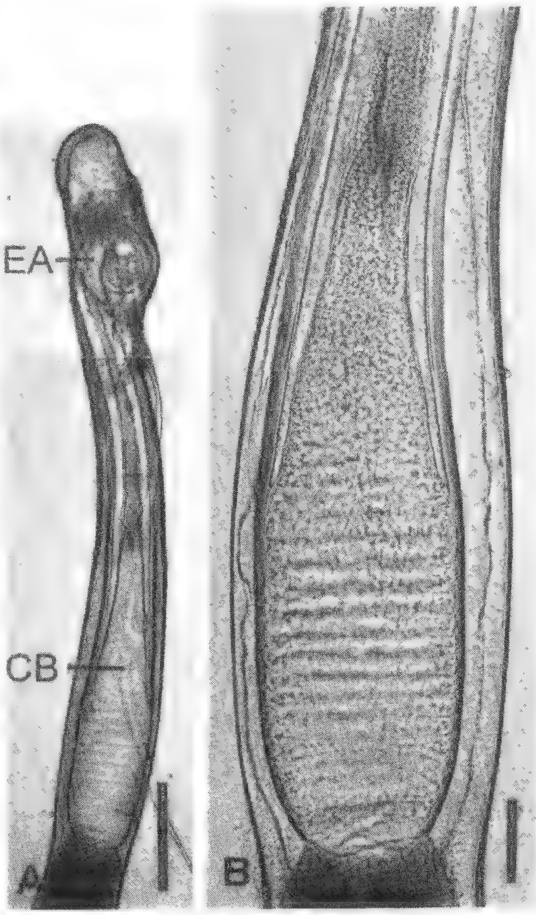

FIGURE 6. *Sepia hedleyi* Berry, 1918. ***A***, spermatophore, oral end, male, 85.6 mm (MV F56762) (CB, cement body; EA, ejaculatory apparatus); ***B***, enlargement of cement body, male, 90.0 mm ML (MV F57291). Scale bars; A = 0.15 mm; B = 0.10 mm.

between cuttlebone and skin absent. Cuttlebone outline oblong (Fig. 7); CbL males 46.2–50.6–55.0 (SD, 6.2); females 69.3–94.2–107 (SD, 16.9); CbWI males 34.7–36.4–38.1 (SD, 2.4); females 33.4–35.2–37.8 (SD, 2.0); not strongly convex in lateral view; CbBI males 9.6–10.0–10.4 (SD, 0.5); females 9.9–10.9–11.9 (SD, 1.1). Bone acuminate, acute anteriorly (Fig. 2C, D); acuminate, acute posteriorly (Fig. 2C, D and Fig. 7A, B); not strongly recurved ventrally. Dorsal surface creamy white; evenly convex; entire surface calcified with very fine granulose sculpture; spine and extreme posterior tip of bone covered with smooth glaze-like substance. Dorsal median rib present (Fig. 2C and Fig. 7A); distinct; sides approximately parallel, broaden slightly anteriorly; bordered laterally by distinct grooves; lateral ribs present, indistinct. Chitin surrounds entire margin of cuttlebone. Spine present; short, pointed; SLI females 4.7–4.9–5.1 (SD, 0.3); straight, parallel to bone; keel(s) absent; cuttlebone smooth between spine and outer cone; ventral notch at base of spine absent. Dorso-posterior end of cuttlebone without median longitudinal ridge anterior to spine. Striated zone flat; extends laterally to inner cone; not separated from outer cone by smooth marginal zones; StZI males 61.3–63.2–65.1 (SD, 2.7); females 64.1–65.5–66.8 (SD, 1.3). Last loculus convex; LoLI males 32.2–34.1–35.9 (SD, 2.7); females 28.7–30.8–33.6 (SD, 2.6); at midline half length of striated zone. LoL/StZ(%) males 49.4–54.0–58.7 (SD, 6.5); females 43.7–45.3–46.9 (SD, 2.2). Loculus ends at striated zone, does not extend posteriorly on each side of striated zone. Sulcus extends entire length of cuttlebone; shallow, narrow; not flanked by rounded ribs. Last loculus with shallow median indentation, not very pronounced. Anterior striae inverted U-shaped. Limbs of inner cone extend anteriorly to end of striated zone; inner cone lateral limbs not separated from outer cone by two distinct smooth zones. Inner cone limbs uniform width, narrow, V-shaped posteriorly; not raised to form ledge

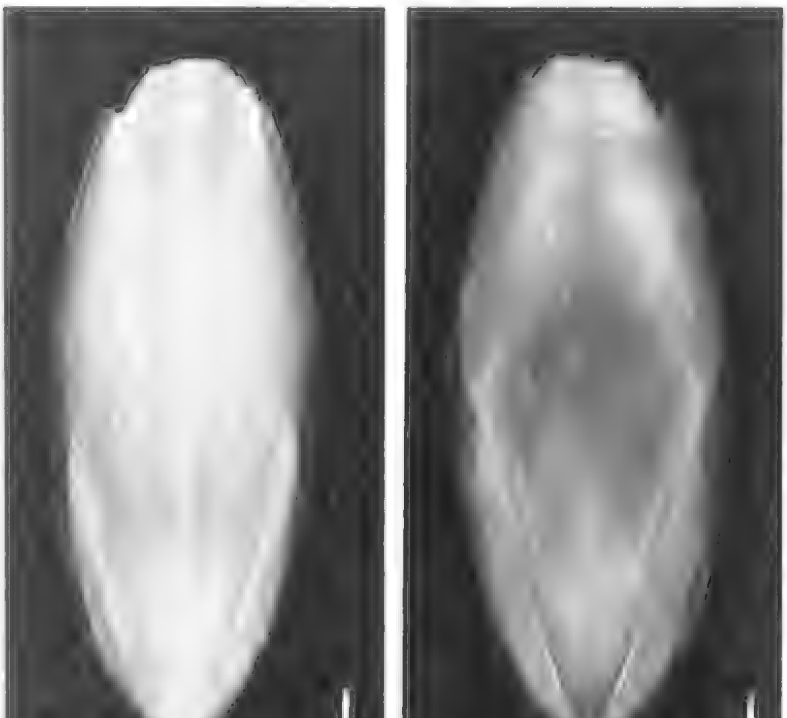

FIGURE 7. *Sepia hedleyi* Berry, 1918. *A*, cuttlebone, dorsal view, female, 93.1 mm ML (MV F57307); *B*, cuttlebone, ventral view, specimen as in *A*. Scale bars = 10 mm.

posteriorly; thickened; shiny; without calcareous ribs radiating into outer cone. Outer cone present; calcified; moderate width; narrow anteriorly, broadens posteriorly; posteriolateral wall without, or with weak, indentation in both sexes; lateral limbs not flared ventro-laterally; limbs forming thin rim ventral to spine.

Body papillae present; dorsal mantle with longitudinal row of ridge-like papillae along each side, close to base of each fin; up to six fin papillae (approximately) in each row. Ventral mantle without ridges; head and arm papillae absent.

Ground colour (alcohol preserved specimens) pale buff pinkish-brown; arms without markings. Paired dorsal eye spots absent; fins pale. Fins without markings at base. Ventral pigment present, pale. Ridges orange-pink in colour.

Distribution

Australia: Queensland, from off the southern Great Barrier Reef, 22°35.3'S 153°46.7'E around southern Australia to Western Australia, SW of Shark Bay, 27°07'S 112°49'E. Depth range 47–1092 m (average collection depth 218 m).

Acknowledgments

Thanks to Wolfgang Zeidler from the South Australian Museum, Adelaide and Ian Loch from the Australian Museum, Sydney for the loan of specimens. I would also like to acknowledge C. C. Lu for initiating this study of the Australian sepiids and for providing helpful advice. I also thank Dermot Henry from the Museum Victoria for providing facilities at the Museum Victoria, Melbourne; and the referees for their helpful comments.

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APPENDIX 1. Complete list of non-type material examined (not all specimens were sexed and are cited only as number in each specimen lot).

Australia: Queensland: 1, off GBR, 22°35.3'S 153°46.7'E, 350–345 m, 4 Nov 1985, coll. FV 'Soela' (MV F57306); 1F, off Brisbane, 26°40'S 153°41.9'E, 380 m, 2 Aug 1982, coll. M. Potter on 'Iron Summer' (MV F57294); 2, 27°11.48'S 153°43.9'E, 230–210 m, 14 Dec 1982, coll. G. Smith on 'Iron Summer' (MV F57299); 1, W Moreton I., 27°35'S 153°50'E, 210 m, 15 Dec 1982, coll. G. Smith on 'Iron Summer' (MV F57309); many 27°46'S 153°51'E, 205 m, 23 Mar 1983, coll. C. C. Lu on 'Iron Summer' (MV F57308); 1M, 1F, 27°58'S 153°49'E, 220 m, 23 Mar 1983, coll. 'Iron Summer' (MV F57300); many, off N Stradbroke I., 27°58'S 153°51.5'E, 183 m, 28 Jul 1982, coll. 'Iron Summer' (MV F89852); 1M, 9F, 32°23'S 152°49'E, 278 m, 30 Jan 1982, coll. C. C. Lu & R. Tait on FV 'Soela' (MV F77180); 10M, 6F, off NSW, 32°23'S 152°59'E, 278 m, 30 Jan 1982, coll. C. C. Lu & R. Tait on FV 'Soela' (MV F77191); 3M, 6F, 32°23'S 152°59'E, 278 m, 30 Jan 1982, C. C. Lu & R. Tait on FV 'Soela' (MV F77182); 7M, 5F, 32°24'S 152°56'E, 246–244 m, 30 Jan 82, coll. C. C. Lu & R. Tait on FV 'Soela' (MV F77084). **New South Wales:** 4, off Port Stephens, 32°24'S 152°56'E, 240 m, 30 Jan 1982, coll. FV 'Soela' (AM C152609); 2M, 10F, 32°27'S 152°54'E, 244–242 m, 30 Jan 1982, coll. FV 'Soela' (MV F77178); 1M, 2F, 32°27'S 152°54'E, 244–242 m, 30 Jan 1982, coll. C. C. Lu & R. Tait (MV F77179); 14, off Port Stephens, 32°50–52'S 152°42–41'E, 550 m, 6 Dec 1978, coll. K. J. Graham, W. B. Rudman & P. H. Colman on FRV 'Kapala' (AM C152641); 2, 8 mls E of Port Stephens, 101 m, 18 Aug 1975, coll. K. J. Graham & C. Short on FRV 'Kapala' (AM C100805); many, off Newcastle, 33°01'S 152°01'E–33°03'S 151°58'E, 121 m, 28 Oct 1993, coll. FRV 'Kapala' (MV F89853); 17, 33° 06'S 124°33'E, 28 Nov 1981, coll. FV 'Soela' (MV F89854); 4, off Sydney 33°33–36'S 151°59–57'E, 373–366 m, 21 Dec 1976, coll. K. J. Graham & P. H. Colman on FRV 'Kapala' (AM C105862); 1F, 33°40'S 151°50'E, 210–204 m, 25 Jan 1982, coll. C. C. Lu & R. Tait (MV F77138); many, 33°42'S 151°51'E, 300–293 m, 25 Jan 1982, C. C. Lu & R. Tait (MV F77136); many, off Sydney, 33°45–34'S 151°39–40'E, 143 m, 5 Dec 1978, coll. FRV 'Kapala' (AM C152596); many, E of Cronulla, 34°05–11'S 151°19–14'E, 132 m, 22 Apr 1975, coll. FRV 'Kapala' (AM C152594); many, E of Wollongong, 34°19–20'S 151°19–18'E, 161 m, 12 Dec 1978, coll. K. J. Graham, W. B. Rudman & P. H. Colman on FRV 'Kapala' (AM C152646); many, Wreck Bay, 35°13'S 150°41'E–35°12'S 150°44'E, 60–47 m, 20 Oct 1993, coll. FRV 'Kapala' (MV F89855); many, off NSW, 36°20'S 150°20'E, 130 m, coll. FV 'Soela' (MV F77164); 1, 34°22'S 151°23'E, 26 Mar 1981, coll. FV 'Soela' (MV F89856); 1F, 36°26'S 150°12'E, 104 m, 21 Apr 1981, coll. FV 'Soela' (MV F77207); 2, off Tathra 36°35'S 150°11'E–36°39'S 150°10'E, 117–115 m, 8 Dec 1993, coll. K. Graham on FRV 'Kapala' (MV F89857); 2M, 1F, 25 km SSE Merimbula, 36°56.5'S 150°11.8'E–36°54.1'S 150°11.9'E, 115 m, 5 Aug 1993, coll. RV 'Southern Surveyor' (MV F89858); 1F, NE Twofold Bay, 37°05'S 149°54'E, 29 Dec 1960, coll. R. Slack-Smith (MV F89859); several, off Eden, 131.7 m, FRV 'Kapala' (AM C174072); 5M, 8F, E of Disaster Bay, 37°24'S 150°17.5'E, 172–162 m, 2 Aug 1993, coll. FRV 'Southern Surveyor' (MV F89860). **Victoria:** 4, 38°01.7'S 150°04.9'E, 3 Feb 1985, coll. FV 'Soela' (MV F89861); 5, 38°02'S 150°05'E, 4 May 1984, coll. FV 'Soela' (MV F51887); 1M, 3F, 38°06'S 149°55'E, 270–267 m, 18 Jan 1982, coll. C. C. Lu & R. Tait (MV F77112); 4, 38°09.1'S 149°54.0'E, 3 Feb 1985, coll. FV 'Soela' (MV F89862); 4, 38°13'S 149°43'E, 4 May 1984, coll. FV 'Soela' (MV F51888); 3, 38°15.4'S 149°19.5'E, coll. FV 'Soela' (MV F89863); 2, 38°34.25'S 148°32.25'E, 24 Aug 1982, coll. MSL (MV F89864); 1F, E Bass Strait 38°34.3'S 148°16.1'E, 86 m, 6 Jun 1984, coll. P. Moulton, MSL (MV F89865); 1F, 18 mls S of Cape Nelson, 38°44'S 143°33'E, 152.9 m, 26 Aug 1975, coll. FV 'Sarda' (MV F56764); 1F, off Portland, 38°50'–51'S 141°46'–55'E, 54.8 m, 5 Mar 1980, coll. M. Gomon on 'Halcyon' (MV F30332); 3, 38°50'S 141°46'E, 6 Mar 1980, coll. 'Halcyon' (MV F30843); 1M, 1F, eastern Bass Strait, 38°53.05'S 148°24.2'E, 126–101 m, 8 Feb 1981, coll. RV 'Hai Kung' (MV F57310); 1F, 38°55.6'S 148°27.7'E, 210–150 m, 27 Aug 1994, coll. FRV 'Southern Surveyor' (MV F89866); many, 39°16'S 145°05.08'E–38°77'S 145°07.64'E, 65.9 m, 3 Feb 1981, coll. M. F. Gomon et al. on RV 'Hai Kung' (MV F89867); 1 juv., E Bass Strait, 39°28.4'S 148°41.8'E, 110 m, 28 Mar 1979, coll. HMAS 'Kimbla' (MV F57292); many, central Bass Strait, 39°44.55'S 143°33.82', 78.7 m, coll. C. C. Lu on 'Hai Kung' (MV F57296). **Tasmania:** 1M, S of Flinders I., 40°43.79'S 148°32.7'E, 58.6–54.9 m, 7 Feb 1981, coll. FV 'Hai Kung' (MV F57311); 1F, SE Tasmania, 42°42.8'S 148°24.4'E, 446 m, 26 Jun 1984, coll. FV 'Soela' (MV F52265); 4, 42°38'S 148°24'E, 23 Jun 1984, coll. FV 'Soela' (MV F52100); 3, 42°42.8'S 148°24'E, 26 Jun 1984, FV 'Soela' (MV F51908); 6, 42°43.7'S 148°22.3'E, 15 Jun 1984, coll. FV 'Soela' (MV F52099); 1F, off Tasmania, 43°38.9'S 147°49.4'E, 160 m, 16 Feb 1976, coll. K. Nesis on RV 'Dmitry Mendeleev' (MV F57307). **South Australia:** 4F, 27 nm SW of Beachport, 37°50'S 139°46'E, 1092 m, 24 Oct 1981, coll. M. F. Gomon & R. Wilson on 'Halcyon' (MV F52793); 1F, off Beachport, 37°51'S 139°48'E, 437–400 m, 24 Oct 1981, coll. M. F. Gomon & R. Wilson on 'Halcyon' (MV F51369); 2F, off Beachport, 180 fm [329 m], Apr 1981 (SAM D19239). **Western**

Australia: 1M, 1F, SW of Shark Bay, 27°07'S 112°49'E, 248–238 m, 3 Mar 1981, coll. M. F. Gomon on 'Hai-Kung' (MV F56762); 1F, Great Australian Bight, 12.0 km S of Middini Beach, 33°17.4'S 127°44.5'E–33°17.1'S 127°31.25'E, 180–167 m, 14 Feb 1990, coll. R. Poole on FV 'Comet' (MV F89868); 1F, Great Australian Bight, 33°20'S 128°10'E–33°22'S 128°08'E, 200 m, 29 Sep 1980 (MV F56763).

APPENDIX 2. Description of measurements and counts. Definitions largely follow Roper and Voss (1983). New or modified definitions are indicated by an asterisk (*). Indices (shown in square brackets) are calculated by expressing each measure as a percentage of mantle length or, for cuttlebone characters, cuttlebone length (unless otherwise specified).

Arm Length - **AL**: length of each designated (ie 1,2 etc) arm measured from first basal (proximal-most) sucker to distal tip of arm (Arm 1, dorsal; 2, dorso-lateral; 3, ventro-lateral; 4, ventral) [**ALI**].

Anterior Mantle to Head length *: **AMH**: dorsal length of mantle measured from anterior-most point of mantle to intersection of transverse line joining dorso-lateral mantle margin [**AMHI**].

Arm Sucker Count *: **ASC**: total number of suckers on each designated arm (eg.ASC2).

Arm Sucker diameter: **AS**: diameter of largest normal sucker on each designated (ie 1,2 etc) arm [**ASIn**]; **ASI4m*** diameter of smallest sucker on modified portion of left ventral arm of males [**ASInl4m**].

Cuttlebone Breadth*: **CbB**: greatest dorso-ventral width of cuttlebone.

Cuttlebone Length: **CbL**: dorsal length of cuttlebone along midline, including spine.

Cuttlebone Width: **CbW**: greatest lateral width of cuttlebone [**CbWI**].

Club Length: **ClL**: length of tentacular club measured from proximal-most basal suckers (carpus) to distal tip of club [**ClLI**].

Club Row Count: **ClRC**: number of suckers in transverse rows on tentacular club.

Club Sucker diameter: **ClS**: diameter of largest sucker on tentacular club [**ClSI**].

Club Sucker dorsal *: **ClSd**: diameter of largest tentacular club sucker in dorsal-most (closest to swimming keel) longitudinal row [**ClSId**].

Club Sucker ventral *: **ClSv**: diameter of largest tentacular club sucker in ventral-most (opposite swimming keel) longitudinal row [**ClSIv**].

Eye Diameter: **ED**: diameter of eye [**EDI**].

Egg Length *: **EgL**: length of egg [**EgLI**].

Egg Width *: **EgW**: width of egg [**EgWI**].

Free Funnel length: **FFu**: the length of the funnel from the anterior funnel opening to the point of its dorsal attachment to the head [**FFuI**].

Fin Insertion anterior *: **FIa**: anterior origin of fin measured from mantle margin to anterior-most junction of fin and mantle [**FIIa**].

Fin Insertion posterior*: **FIp**: measured between posterior junctions of fins with mantle [**FIIp**].

Funnel Length: **FuL**: the length of the funnel from the anterior funnel opening to the posterior margin measured along the ventral midline [**FuLI**].

Fin Width: **FW**: greatest width of single fin [**FWI**].

Gill Lamellae Count: **GiLC**: number of lamellae on outer demibranch including the terminal lamella.

Gill Length *: **GiL**: length of gill [**GiLI**].

Head Length: **HL**: dorsal length of head measured from point of fusion of dorsal arms to anterior tip of nuchal cartilage [**HLI**].

Head Width: **HW**: greatest width of head at level of eyes [**HWI**].

Loculus Length *: **LoL**: length of the last loculus (ventral anterior smooth zone of the cuttlebone) [**LoLI**].

Mantle Length: **ML**: dorsal mantle length. Measured from anterior-most point of mantle to posterior apex of mantle.

Mantle Width: **MW**: greatest straight-line ventral width of mantle [**MWI**].

Spine Length *: **SL**: length of spine [**SLI**].

Spermatophore Length: **SpL**: length of spermatophore [**SpLI**].

Spermatophore Width: **SpW**: greatest width of spermatophore. Spermatophore width index is expressed as a percentage of spermatophore length [**SpWI**].

Striated Zone length: **StZ**: length of striated zone of cuttlebone [**StZI**].

Transverse Row Count: **TrRC**: number of suckers in longitudinal series on tentacular club (counted from proximal-most basal suckers (carpus) to distal tip of club).

Ventral Mantle Length: **VML**: length of ventral mantle measured from anterior mantle margin at ventral midline, to posterior apex of mantle [**VMLI**].

APPENDIX 3. Measurements (mm), counts and indices of *Sepia hedleyi* Berry, 1918 from southern Australia.

Museum Reg. no.	SAM D19241	SAM D19243	SAM D19241	SAM D19242	SAM D19242	SAM D19240	SAM D19240	SAM D19240
SEX	M	M	M	F	F	F	F	F
ML	47.2	55.0	75.7	67.9	68.6	93.1	95.5	107.6
MWI	55.1	55.6	51.8	55.5	45.5	54.7	59.8	55.0
AMHI	11.9	15.5	15.3	14.7	13.0	12.8	14.8	17.8
VMLI	85.0	80.7	82.8	85.6	84.8	81.2	81.8	75.3
FWI	11.7	10.2	9.4	7.2	8.2	7.8	9.1	4.4
FIIa	5.1	4.5	5.3	2.8	3.2	4.9	5.7	2.0
FIIp	6.4	8.0	7.4	5.6	12.4	10.3	4.7	6.7
FuLI	40.3	34.5	27.7	34.6	34.3	25.6	30.4	28.8
FFuI	20.1	14.5	17.2	14.7	16.8	19.3	12.6	13.0
HLI	25.6	27.5	29.7	23.9	13.4	40.8	30.3	35.8
HWI	38.1	44.4	35.7	44.0	45.0	40.5	46.6	43.5
EDI	13.3	16.5	12.7	10.0	12.1	12.7	8.9	10.2
ALI1	33.9	34.5	35.7	33.1	34.3	37.6	49.2	42.3
ALI2	33.9	30.9	29.1	31.7	35.7	39.2	42.4	42.8
ALI3	38.1	33.6	29.1	37.6	34.3	41.4	44.0	43.7
ALI4	43.4	40.9	34.3	39.0	42.3	41.9	51.3	44.6
ASIn1	1.69	1.36	1.32	1.47	1.53	1.72	1.68	1.77
ASIn2	1.48	1.36	1.59	1.47	1.53	2.15	1.68	1.77
ASIn3	1.48	1.36	1.59	1.47	1.75	2.15	1.78	1.77
ASIn4	1.69	1.36	1.32	1.33	1.56	2.15	1.78	1.77
ASC1	118	112	116	148	144	106	106	144
ASC2	140	152	148	148	156	130	175	176
ASC3	148	132	144	200	172	157	164	172
ASC4	180	208	164	240	248	193	212	224
ASIn14m	0.42	0.40	0.26	–	–	–	–	–
ClLI	17.2	–	13.2	18.6	16.2	–	21.2	24.2
ClRC	10	10	10	10	10	–	9	10
TrRC	42	–	32	36	32	–	40	34
ClSI	0.42	0.40	0.53	0.40	0.47	–	0.52	0.46
ClSId	0.42	0.40	0.42	0.40	0.47	–	0.52	0.46
ClSIv	0.42	0.40	0.29	0.32	0.32	–	0.52	0.46
GiLC	29	29	29	29	30	–	–	–
GiLI	35.0	24.9	30.1	29.5	38.2	–	33.6	34.5
SpLI	12.3	11.6	10.4	–	–	–	–	–
SpWI	3.45	4.69	5.06	–	–	–	–	–
EgDI	–	–	–	–	–	2.7	3.2	2.5
CbL	46.2	55.0	–	–	69.3	100.5	99.8	107.0
CbWI	38.1	34.7	–	–	37.8	35.5	33.4	33.9
CbBI	10.4	9.6	–	–	11.8	9.9	10.2	11.9
SLI	–	–	–	–	–	4.7	5.1	–
StZI	61.3	65.1	–	–	66.8	65.6	64.1	–
LoLI	35.9	32.2	–	–	–	28.7	30.1	33.6
LoL/StZ (%)	58.7	49.4	–	–	–	43.7	46.9	–

APPENDIX 4. Measurements (mm), counts and indices of 10 male *Sepia hedleyi* Berry, 1918 from eastern Australia.

Museum Reg. no.	MV F77136	MV F77179	AM C152623	AM C152623	AM C152623	MV F77136	MV F77136	MV F77136	MV F77136	AM C152623
ML	75.9	84.3	84.8	85.7	86.1	87.0	90.9	91.7	100.5	103.5
MWI	53.0	49.2	50.7	48.4	49.2	54.6	51.7	54.1	48.1	46.6
AMHI	16.2	15.1	12.5	13.0	15.0	14.4	13.3	12.5	11.9	14.9
VMLI	88.8	88.3	89.2	91.4	87.8	90.9	90.4	88.3	81.9	88.3
FWI	9.6	11.4	9.4	10.5	8.2	10.5	12.7	9.8	5.6	10.9
FIIa	4.2	3.3	3.8	4.8	4.8	6.6	3.7	3.8	7.0	4.4
FIIp	5.8	3.0	5.8	5.6	7.7	7.5	5.5	8.2	4.5	8.6
FuLI	32.9	31.2	30.4	31.0	31.1	36.6	30.3	31.7	32.7	30.7
FFuI	14.5	15.4	15.2	17.7	15.2	18.4	15.4	20.7	16.8	13.0
HLI	30.4	23.3	31.7	27.3	31.6	30.9	23.7	30.9	30.3	26.5
HWI	38.3	38.7	35.1	36.6	36.5	40.9	40.9	38.8	–	34.3
EDI	15.5	11.0	13.2	14.0	11.0	12.0	13.1	15.7	12.5	12.3
ALI1	38.2	33.2	33.6	32.8	26.7	37.4	33.0	33.8	27.9	26.1
ALI2	34.3	32.0	30.7	31.5	25.6	37.4	34.1	31.6	27.9	32.9
ALI3	36.9	32.0	34.2	32.7	29.0	36.8	31.9	28.4	31.4	33.3
ALI4	40.8	37.4	36.6	30.2	30.8	40.2	34.1	37.6	40.6	32.8
ASIn1	1.54	1.59	1.42	1.27	1.21	1.64	1.43	1.42	1.42	1.22
ASIn2	1.45	1.48	1.13	1.33	1.02	1.49	1.43	1.56	1.42	1.28
ASIn3	1.37	1.48	1.49	1.46	1.30	1.64	1.43	1.56	1.42	1.39
ASIn4	1.45	1.48	1.27	1.25	1.11	1.64	1.43	1.42	1.42	1.16
ASC1	96	93	72	89	76	93	89	86	92	119
ASC2	136	128	105	106	93	126	124	120	135	121
ASC3	139	142	121	112	101	124	124	142	144	123
ASC4	204	202	171	151	102	185	178	196	–	140
ASInl4m	0.47	0.37	0.25	0.28	0.29	0.36	0.40	0.36	0.39	0.20
ClLI	13.7	15.5	15.3	17.4	14.2	16.1	15.8	15.5	15.8	19.8
ClRC	12	11	11	12	11	12	12	12	12	12
TrRC	36	32	31	31	36	34	35	33	35	39
ClSI	0.51	0.52	0.65	0.53	0.64	0.60	0.43	0.43	0.52	0.68
ClSId	0.51	0.66	0.65	0.46	0.64	0.45	0.35	0.35	0.52	0.53
ClSIv	0.38	0.52	0.35	0.42	0.35	0.45	0.43	0.39	0.39	0.48
GiLC	30	31	34	32	27	33	32	32	32	32
GiLI	30.3	26.0	27.9	30.9	33.7	33.6	26.7	29.8	–	22.2
SpLI	10.9	8.7	–	–	–	9.7	9.1	9.2	8.5	–
SpWI	3.15	3.01	–	–	–	4.62	3.15	4.62	4.55	–
CbL	75.8	85.1	84.8	–	–	86.5	92.7	90.0	100.2	101.6
CbWI	36.1	35.6	32.0	–	–	34.9	32.9	34.7	31.2	31.3
CbBI	10.0	10.5	10.0	–	–	9.5	9.2	9.9	10.0	9.0
SLI	–	4.3	4.1	–	–	–	2.8	3.0	3.9	2.6
StZI	63.6	60.2	59.0	–	–	46.6	66.1	61.7	65.0	64.5
LoLI	37.6	33.0	32.5	–	–	34.0	28.5	31.1	31.8	29.4
LoL/StZ (%)	59.1	54.9	55.2	–	–	73.0	43.1	50.5	49.0	45.6

APPENDIX 5. Measurements (mm), counts and indices of 10 female *Sepia hedleyi* Berry, 1918 from eastern Australia.

Museum Reg. no.	MV F77179	MV F77136	MV F77136	MV F77136	MV F77136	MV F77136	MV F77136	MV F77136	MV F77179	MV F77138
ML	83.1	89.0	91.7	94.7	99.1	99.4	99.8	102.1	103.8	108.8
MWI	51.9	52.2	52.1	51.3	53.7	46.7	51.9	58.1	47.1	51.5
AMHI	16.1	12.9	12.3	14.8	15.9	13.6	13.9	14.8	13.2	14.8
VMLI	85.0	91.0	91.1	89.2	86.0	90.0	89.7	87.9	86.6	88.8
FWI	12.0	10.1	11.7	11.9	11.6	12.4	10.5	11.0	9.6	7.4
FIIa	4.5	7.0	4.1	4.9	3.6	4.0	4.2	3.1	4.6	6.3
FIIp	13.7	8.4	4.3	6.7	6.6	7.1	5.1	2.8	4.5	7.2
FuLI	30.7	38.3	34.4	32.5	32.2	33.7	33.6	32.6	27.3	35.2
FFuI	16.8	15.7	17.4	18.5	18.2	18.1	16.5	16.7	15.4	13.3
HLI	27.0	21.3	37.1	26.1	27.7	36.2	39.1	27.5	26.8	26.4
HWI	39.4	36.4	39.8	38.5	39.9	41.6	40.7	39.5	38.8	36.5
EDI	12.4	12.4	14.1	11.7	14.3	13.6	12.4	16.4	13.0	12.8
ALI1	33.7	32.6	38.2	35.9	41.4	37.2	36.1	41.1	34.3	31.3
ALI2	34.9	30.3	34.9	32.7	40.4	34.2	36.1	38.2	32.8	35.8
ALI3	36.1	34.8	39.3	34.3	40.4	41.2	41.1	42.6	36.6	32.2
ALI4	39.7	42.7	37.1	39.6	46.4	46.3	38.1	44.1	40.5	41.4
ASIn1	1.56	1.46	1.34	1.58	1.84	1.70	1.56	1.40	1.42	1.43
ASIn2	1.56	1.61	1.48	1.52	1.84	1.70	1.56	1.66	1.45	1.49
ASIn3	1.56	1.46	1.48	1.48	1.84	1.63	1.69	1.66	1.36	1.55
ASIn4	1.72	1.53	1.48	1.52	1.71	1.70	1.69	1.66	1.45	1.55
ASC1	106	112	94	110	120	96	106	102	98	92
ASC2	138	133	158	166	156	156	162	170	142	138
ASC3	150	142	148	192	168	162	154	168	162	138
ASC4	178	162	192	227	204	206	214	110	214	171
ClLI	15.4	15.7	15.0	15.2	18.3	16.3	18.5	16.7	15.2	18.4
ClRC	12	12	12	11	12	12	12	12	12	12
TrRC	27	35	47	29	38	30	32	36	30	38
ClSI	0.67	0.51	0.43	0.57	0.32	0.71	0.45	0.64	0.72	0.53
ClSId	0.49	0.44	0.43	0.57	0.32	0.58	0.39	0.64	0.75	0.53
ClSIv	0.42	0.40	0.43	0.57	0.32	0.52	0.42	0.44	0.54	0.41
GiLC	28	33	32	30	35	28	31	28	33	30
GiLI	24.5	23.0	25.8	25.3	32.0	30.5	27.5	30.7	27.2	31.6
EgDI	3.9	4.1	5.0	5.3	4.4	4.8	3.4	3.9	4.8	3.3
CbL	82.1	87.0	89.0	99.7	98.0	99.2	96.6	105.2	104.9	108.0
CbWI	34.0	35.3	34.2	32.1	36.8	34.6	37.9	37.0	35.3	34.3
CbBI	10.0	–	10.1	11.2	9.4	10.9	10.1	9.5	10.0	9.6
SLI	3.3	–	–	3.3	3.2	–	3.0	4.6	4.9	–
StZI	65.0	–	79.4	79.4	67.3	65.4	67.7	63.1	63.5	64.6
LoLI	22.4	–	20.6	20.6	21.1	20.3	27.3	30.6	30.9	35.4
LoL/StZ (%)	34.5	–	25.9	25.9	31.4	31.0	40.4	48.5	48.6	54.7

APPENDIX 6. *Sepia hedleyi* Berry, 1918; ranges of arm length indices (ALI), arm sucker diameter indices (ASIn) and arm sucker counts (ASC) of mature males and females from southern Australia; N = number of specimens, min. = minimum, max. = maximum, SD = standard deviation.

	Males					Females				
	N	min.	mean	max.	SD	N	min.	mean	max.	SD
ALI1	7	25.3	34.9	55.7	9.8	8	30.6	37.4	49.2	6.2
ALI2	7	25.9	31.5	45.6	6.8	8	27.6	35.8	42.8	5.6
ALI3	7	29.1	33.5	44.3	5.8	8	30.6	33.7	44.0	5.2
ALI4	7	33.8	40.2	54.4	7.2	8	34.7	42.0	51.3	4.8
ASIn1	3	1.32	1.46	1.69	0.20	5	1.47	1.63	1.77	0.13
ASIn2	3	1.36	1.48	1.59	0.11	5	1.47	1.72	2.15	0.27
ASIn3	3	1.36	1.48	1.59	0.11	5	1.47	1.78	2.15	0.24
ASIn4	3	1.32	1.46	1.69	0.20	5	1.33	1.72	2.15	0.30
ASC1	3	112	115	118	3	5	106	130	148	22
ASC2	3	140	147	152	6	5	130	157	176	19
ASC3	3	132	141	148	8	5	157	173	200	16
ASC4	3	164	184	208	22	5	193	223	248	22