Reproductive biology of the golden cuttlefish *Sepia esculenta* (Cephalopoda, Sepiida)

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Table S1 Studied specimens of *Sepia esculenta.* ML – mantle length.

Specimen code	Sex	Location	Data	Maturity stage	ML (mm)
1-1	Males	Ushimado	15.03.2012	V_2	141
2-1			15.03.2012	V_2	147
3-1			15.03.2012	V_2	139
7-2		Mukaishima	09.03.2007	V_2	154
3-2			09.03.2007	V_2	154
6-2			09.03.2007	V_2	153
4-2			09.03.2007	V_2	158
3-3		Iriomote	05.05.2005	V_2	-
1-3			30.04.2005	V_2	-
22-3			May-June	V_2	-
33-3			May-June	V_2	-
28-3			May-June	V_2	-
31-3			May-June	V_2	-
25-3			May-June	V_2	-
23-3			May-June	V_2	-
27-3			May-June	V_2	-
6-3			17.05.2005	V_2	-
16-3			17.05.2005	V_2	-
11-3			17.05.2005	V_2	-
13-3			17.05.2005	V_2	-
7-3			17.05.2005	V_2	-
8-3			17.05.2005	V_2	-
1-1	Females	Ushimado	15.03.2012	V_2	140
3-1			15.03.2012	V_2	139
5-1			15.03.2012	V_2	137
6-1			15.03.2012	V_2	140
7-1			15.03.2012	V_2	142
8-2		Mukaishima	09.03.2007	V_2	-

Table S2 Measurements of the female and male reproductive system parts in *Sepia esculenta*. ML – mantle length; SG – spermatophoric gland. The values are min–max (mean ± SE).

Measurements of the female reproductive system parts			**Measurements of the male reproductive system parts**		
Character	Absolute length (in mm)	Relative length (in % of ML)	Character	Absolute length (in mm)	Relative length (in % of ML)
Oviduct length	23.0–44.0 (32.2 ± 3.43)	16.8–31.0 (23.02 ± 2.33)	Testis length	19.0–48.5 (31.2 ± 2.05)	13.3–20.9 (17.5 ± 1.20)
Oviducal gland length	15.0–21.00 (18.0 ± 1.10)	10.7–14.8 (12.9 ± 0.78)	Testis width	19.0–37.0 (27.8 ± 1.67)	18.0–18.4 (18.3 ± 0.14)
Right nidamental gland length	35.0–48.0 (39.6 ± 2.34)	25.2–34.3 (28.4 ± 1.60)	Sperm duct length	17.0–35.0 (24.5 ± 1.57)	14.4–22.70 (18.9 ± 2.43)
Right nidamental gland width	20.0–22.0 (21.2 ± 0.49)	14.3–16.06 15.2 ± 0.36	Part I of SG length	7.0–19.0 (10.2 ± 0.50)	5.7–13.5 (8.34 ± 1.18)
Left nidamental gland length	35.0–45.0 (37.8 ± 1.83)	25.2–32.14 (27.1 ± 1.29)	Part II of SG length	8.0–19.0 (10.4 ± 0.53)	5.2–13.5 (7.8 ± 1.15)
Left nidamental gland width	20.0–28.0 (22.4 ± 1.47)	14.3–20.14 (16.1 ± 1.06)	Part III of SG length	8.0–16.0 (10.7 ± 0.38)	5.1–11.4 (7.2 ± 0.84)
Right accessory nidamental gland length	20.0–33.0 (28.0 ± 2.49)	14.4–23.6 (20.1 ± 1.79)	Part IV of SG length	12.0–29.0 (19.1 ± 0.77)	10.1–19.9 (13.4 ± 1.18)
Right accessory nidamental gland width	15.0–19.0 (17.6 ± 0.87)	10.8–13.87 (12.6 ± 0.62)	Part V of SG length	13.0–21.0 (16.5 ± 0.39)	8.4–14.2 (10.6 ± 0.77)
Left accessory nidamental gland length	22.0–30.0 (27.8 ± 1.50)	15.8–21.4 (19.9 ± 1.04)	Part VI of SG length	7.0–16.0 (12.2 ± 0.40)	7.1–9.5 (8.6 ± 0.35)
Left accessory nidamental gland width	14.0–18.0 (16.8 ± 0.80)	10.1–13.1 (12.03 ± 0.57)	Spermatophoric sac length	39.0–75.0 (56.02 ± 2.08)	29.8–42.48 (39.80 ± 1.73)
			Penis length	7.0–25.0 (14.3 ± 1.10)	5.04–13.6 (7.2 ± 1.12)

Figure S1 Correlations between mantle length and different parts of male reproductive system in *Sepia esculenta*. ML – mantle length; SG – spermatophoric gland.

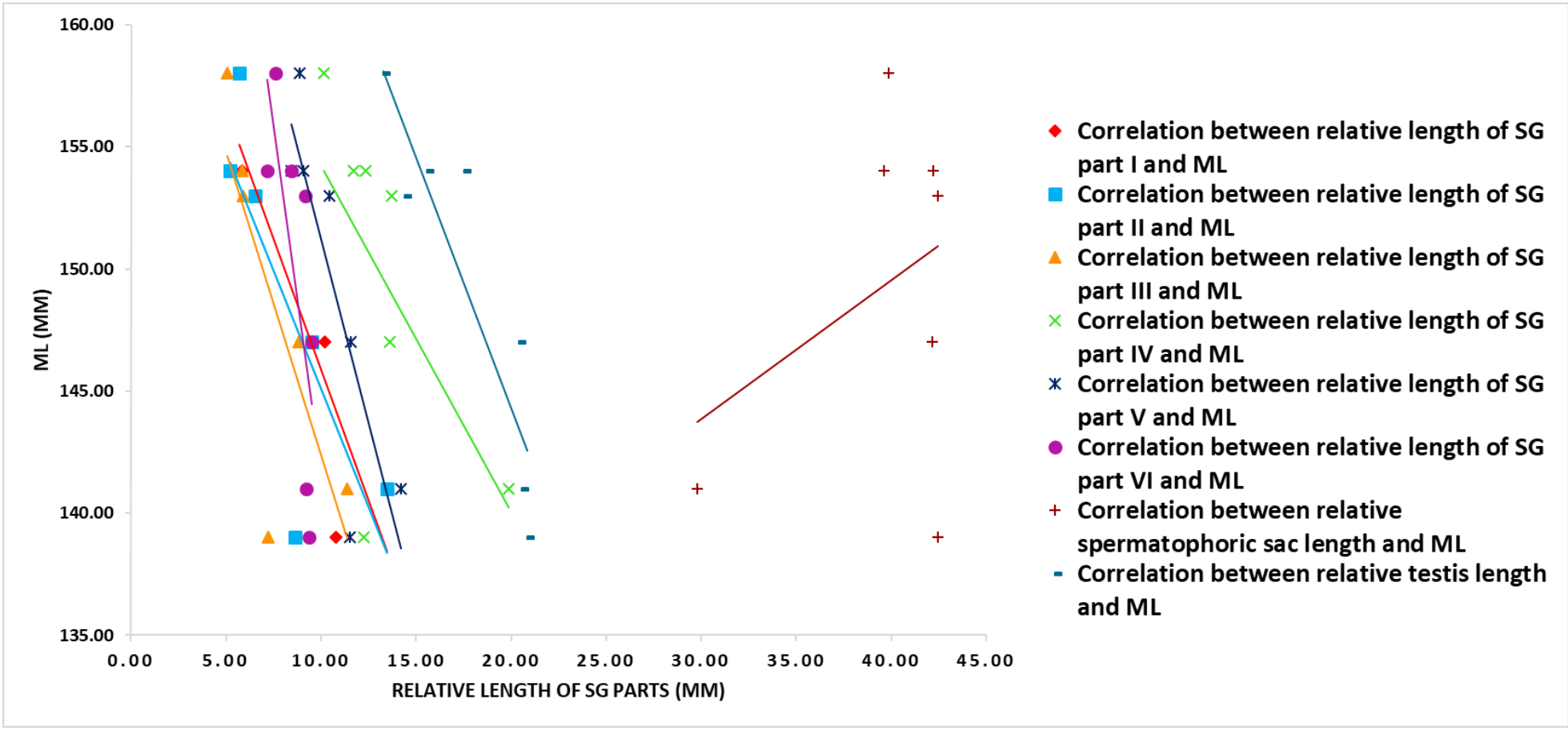


Table S3 Equations of correlations between mantle length and different parts of male reproductive system in *Sepia esculenta*. ML – mantle length; SG – spermatophoric gland. Significant p-values are in **bold.**

Correlations	Equation
Correlation between relative testis length and ML	Relative testis length = -0.40*ML + 76.50; r^2 = 0.811; $\boldsymbol{p}$ = **0.0058**; n = 7
Correlation between relative length of SG part I and ML	Relative length of SG part I = -0.40*ML + 68.02; r^2 = 0.85; $\boldsymbol{p}$ = **0.0033**; n = 7
Correlation between relative length of SG part II and ML	Relative length of SG part II = -0.34*ML + 58.75; r^2 = 0.659; p = **0.0272**; n = 7
Correlation between relative length of SG part III and ML	Relative length of SG part III = -0.28*ML + 52.35; r^2 = 0.493; p = 0.8; n = 7
Correlation between relative length of SG part IV and ML	Relative length of SG part IV = -0.26*ML + 52.57; r^2 = 0.372; p = 0.15; n = 7
Correlation between relative length of SG part V and ML	Relative length of SG part V = -0.24*ML + 45.95; r^2 = 0.714; $\boldsymbol{p}$ = **0.0180**; n = 7
Correlation between relative length of SG part VI and ML	Relative length of SG part VI = -0.09*ML + 22.61; r^2 = 0.522; p = 0.07; n = 7
Correlation between relative spermatophoric sac length and ML	Relative spermatophoric sac length = 0.23*ML + 5.80; r^2 = 0.129; p = 0.43; n = 7

Figure S2 Correlation between number of spermatophores and ML. ML – mantle length.

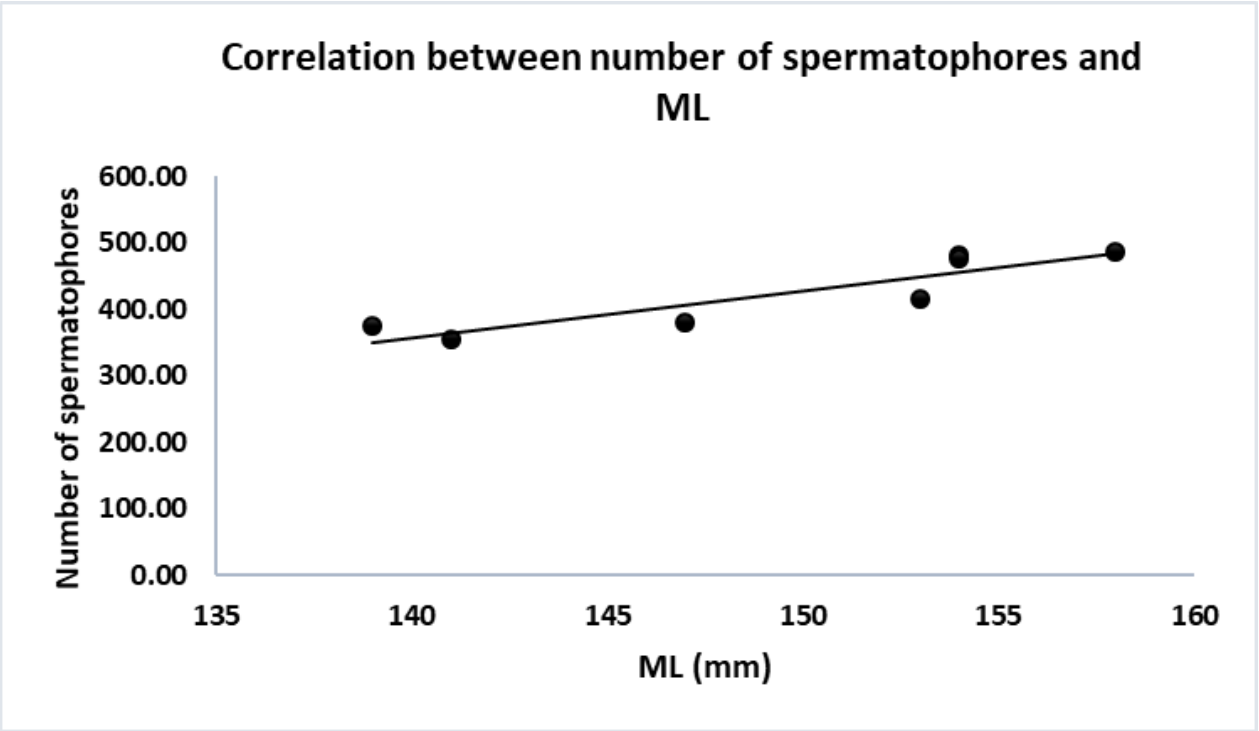


Figure S3 Correlation between number of spermatophores and weight of reproductive system.

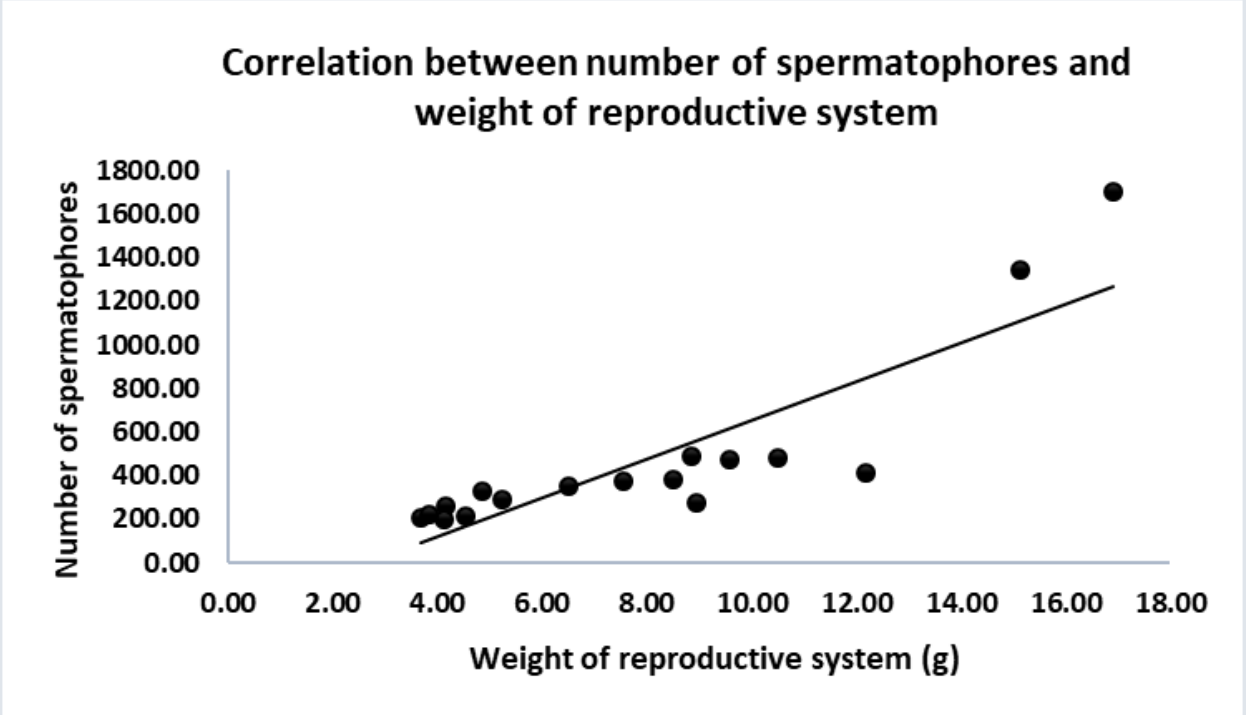


Figure S4 Correlation between number of spermatophores and total volume of sperm.

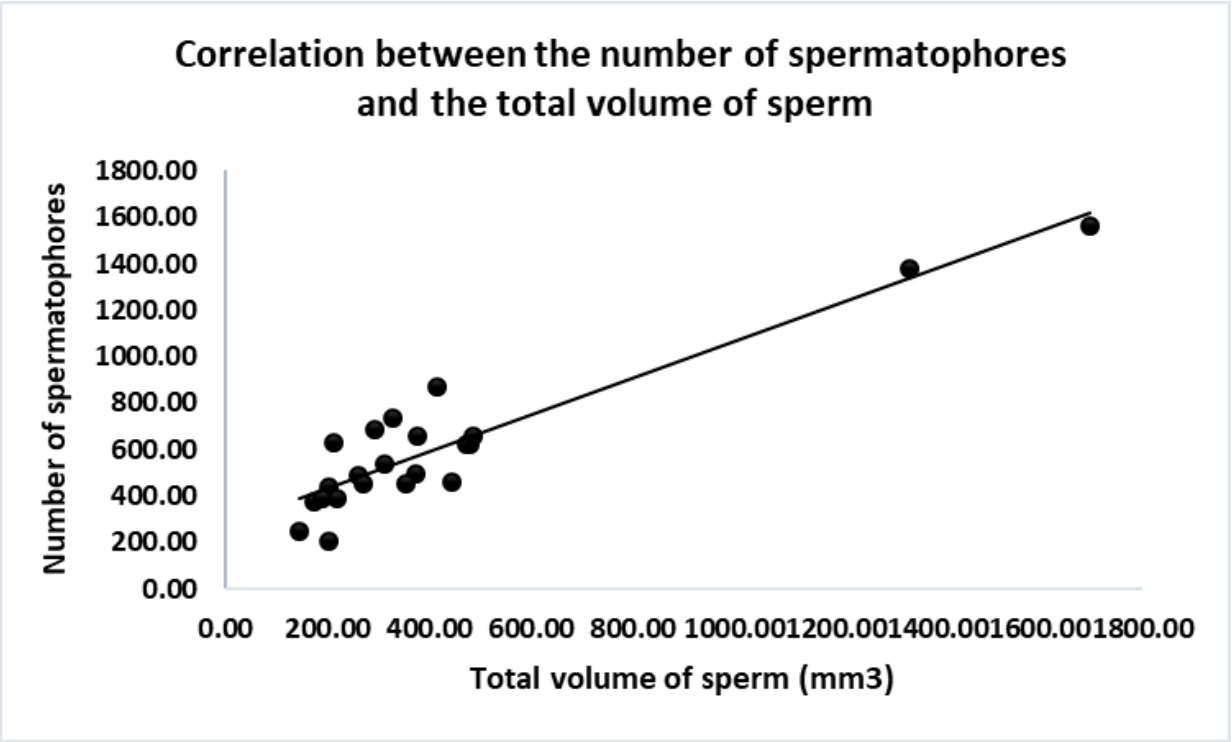


Figure S5 Correlations between absolute/relative spermatophore length and ML. ML – mantle length, SL – spermatophore length.

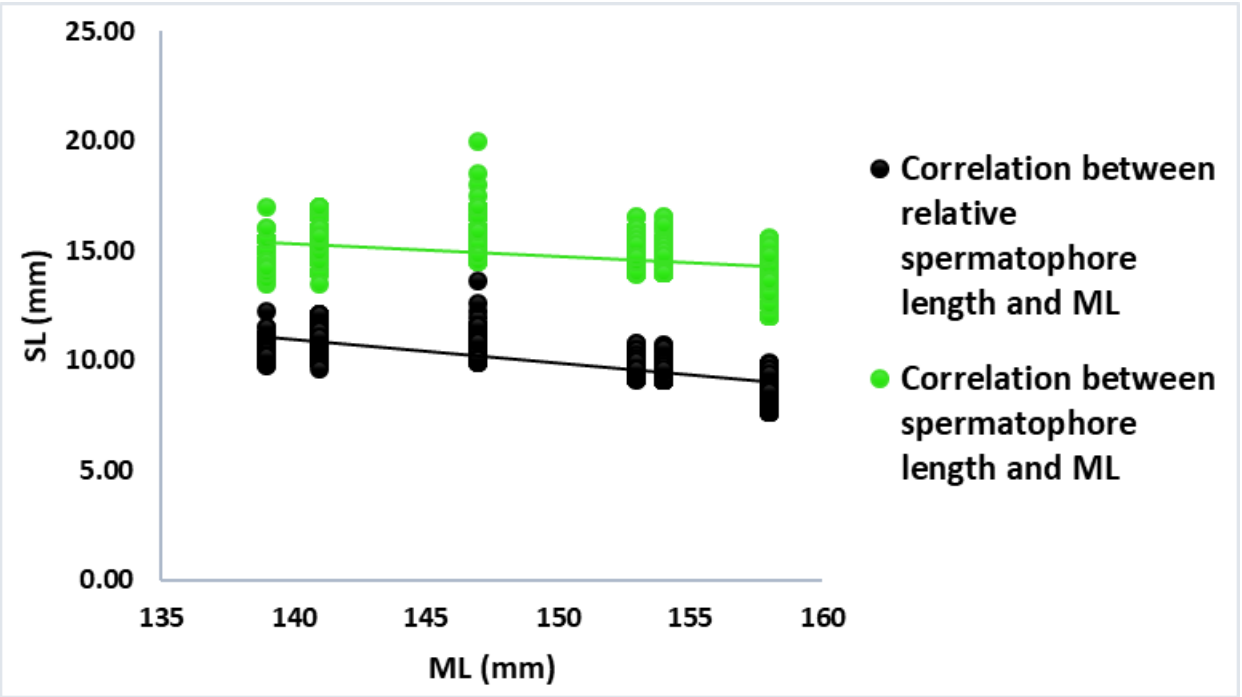
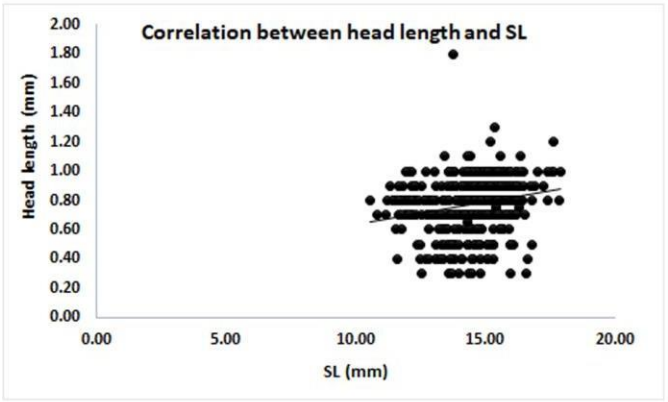
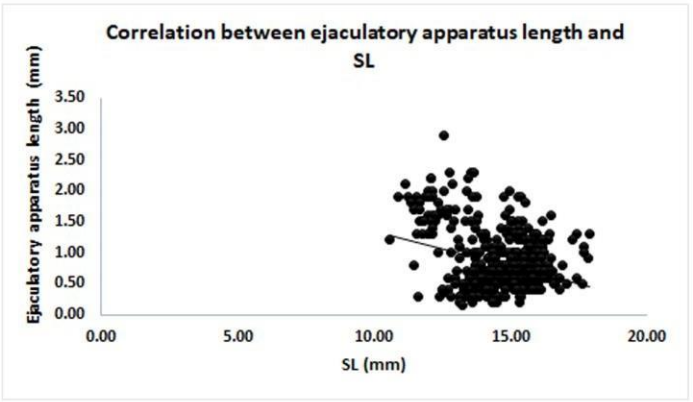
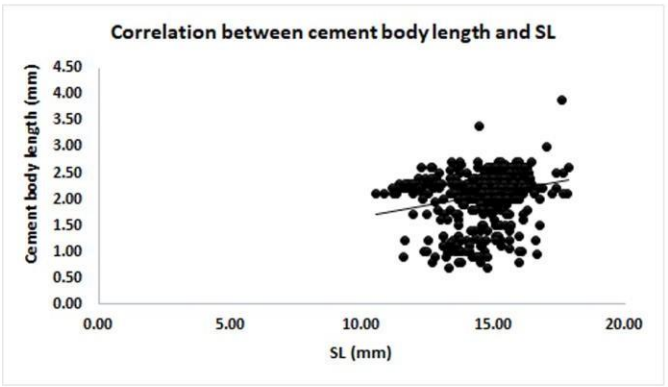
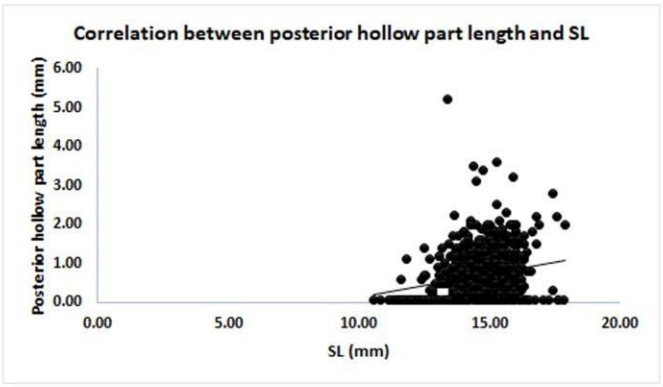


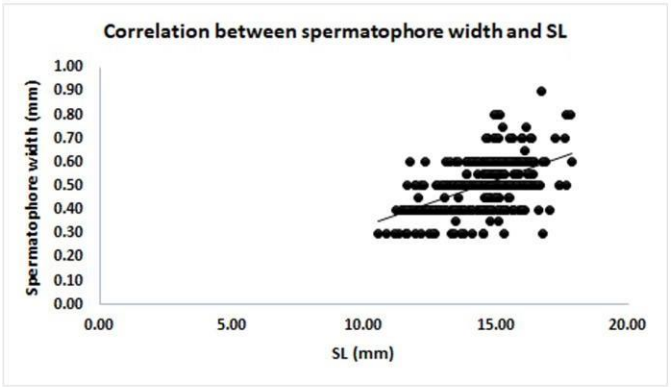
Figure S6 Correlations between spermatophore length and different parts of spermatophore. ML – mantle length, SL – spermatophore length.

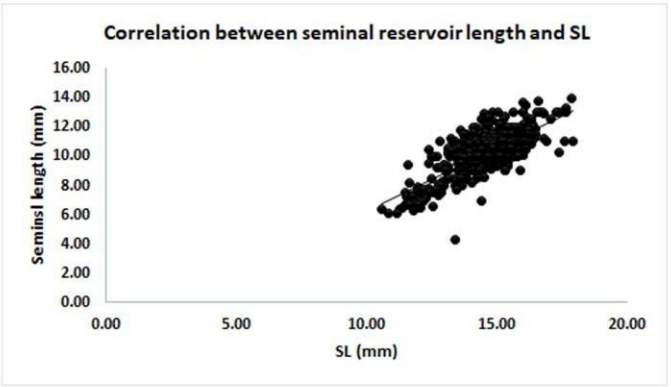


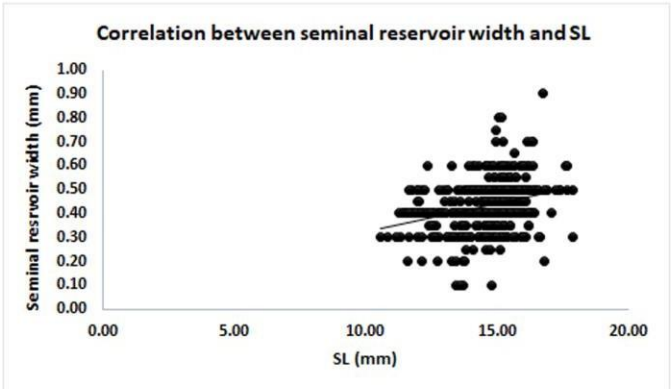












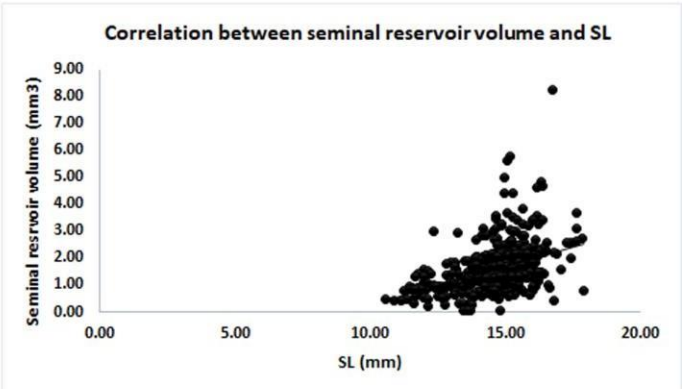


Table S4 Equations of correlations between mantle length and spermatophore length, and correlations between spermatophore length and different parts of spermatophore. ML – mantle length, SL – spermatophore length. Significant *p*-values are in **bold**

Correlations	Equation
Correlation between spermatophore length and ML	Spermatophore length = -0.06*ML + 23.45; r^2 = 0.233; ***p*<0.00001**; *n* = 2570
Correlation between relative spermatophore length and ML	Relative spermatophore length = -0.11*ML + 25.78; r^2 = 0.705; ***p*<0.00001**; *n* = 2570
Correlation between head length and SL	Head length = 0.03*SL + 0.32; r^2 = 0.050; ***p*<0.00001**; *n* = 752
Correlation between ejaculatory apparatus length and SL	Ejaculatory apparatus length = -0.11*SL + 2.47; r^2 = 0.108; ***p*<0.00001**; *n* = 752
Correlation between cement body length and SL	Cement body length = 0.09*SL + 0.78; r^2 = 0.057; ***p*<0.00001**; *n* = 752
Correlation between seminal reservoir length and SL	Spermatophore reservoir length = 0.86*SL - 2.31; r^2 = 0.576; ***p*<0.00001**; *n* = 752
Correlation between posterior hollow part length and SL	Posterior hollow part length = 0.12*SL - 1.04; r^2 = 0.042; ***p*<0.00001**; *n* = 752
Correlation between Spermatophore width and SL	Spermatophore width = 0.04*SL - 0.05; r^2 = 0.242; ***p*<0.00001**; *n* = 752
Correlation between seminal reservoir width and SL	Seminal reservoir width = 0.0234*SL + 0.0882; r^2 = 0.082; ***p*<0.00001**; *n* = 752

Table S5 Spermatophore length and number of spermatophores of the different *Sepia* spp. and *Sepiella* spp.

Species	Spermatophore length (in mm)	Number of spermatophores
Sepia esculenta	9.0–20.0 (15.0 ±0.02) (This study)	146–1698 (422.7 ± 79.92) (This study)
Metasepia tullbergi	4.7–5.9 [92]	-
Sepia bidhaia	2.9–3.2 (3.1 ± 0.1) [53]	-
Sepia braggi	2.4–4.4 (3.4 ± 0.6)[53]	-
Sepia brevimana	6–8 [93]	200–300 [93]
Sepia dollfusi	5.3–11.5 (8.0 ±1.27) [7]	34–460 (224 ± 99) [7]
Sepia elegans	3.9–5.5 (mean 4,7) [16]	167–486 (mean 370) [16]
Sepia filibrachia	3.4–5.2 (4.5 ± 0.7) [57]	-
Sepia grahami	3.4–6.2 (4.5 ± l. l) [54]	-
Sepia hedleyi	5.8–7.9 [55]	-
Sepia koilados	6.3 [53]	-
Sepia limata	2.1–3.2 (2.7. ± 0.5) [53]	-
Sepia mestus	2.7–4.0 (3.3 ± 0.6) [57]	-
Sepia mira	2.8–3.0 [52]	-
Sepia officinalis	5–14 [8]	-
Sepia opipara	6.6–17.1 [27]	-
Sepia orbignyana	3.32–11.81 (7.95 ± 1.49) [18]	68-1055 (mean 485) [15] 32-597 (178 ± 123) [18]
Sepia pharaonis	5.3–11.5 (8.0 ± 1.27) [7]	38-530 (188 ± 104) [7] 400-500 [93]
Sepia plangon	4.9–9.7 [27]	
Sepia prashadi	7–8 [93]	600-800 [93]
Sepia rhoda	3.2–6.1 (4.8 ± 0.9) [53]	-
Sepia rozella	8.1–14.0 [53]	-
Sepia senta	4.8–6.5 (5.6 ± 0.5) [51]	-
Sepia sulcata	4.8–8.5 (6.0 ± 1.5) [51]	-
Sepia tanybracheia	4.2–4.9 (4.6 ± 0.5) [53]	-
Sepia vercoi	2.1–3.7 (3.2 ± 0.6) [53]	-
Sepiella mangkangunga	3.3–5.0 [56]	-
Sepiella weberi	4.5–6.0 (SD 0.7) [56]	-

Table S6 Some features of cuttlefish females reproductive biology.

Species	Fecundity	Ripe oocyte diameter (in mm)	Ovulation pattern
Sepia esculenta	1701–3719 (2945.1 ± 317.30) (this study)	3.6–5.8 (5.3 ± 0.08) (this study)	group synchronous (this study)
Sepia aculeata	206–1568 (mean 587) [6]	1-5 (mean 3.4) [6]	-
Sepiella inermis	216–354 [12]	3.6 [12]	-
Sepia pharaonis	75–1525 [7] 102–616 [15]	-	-
Sepia dollfusi	30–273 [7]	-	-
Sepia orbignyana	201–1532 [13] 77–806 (365 ± 179) [18]	6.7–8.3 (mean 7.9) [13] 4.9–9.3 [18]	group synchronous [13]
Sepia elegans	513–1190 (mean 985) [16]	2.0–25.0 (mean 5.0) [16]	group synchronous [16]
Sepia opipara	4473–22333 [27]	-	group synchronous [27]
Sepia plangon	988–2781 [27]	-	group synchronous [27]
Sepia rozella	1198–4819 [27]	-	group synchronous [27]
Sepia mestus	-	8.1–10.5 [57]	-
Sepia filibrachia	-	2.7–5.2 [57]	-
Sepia officinalis	3700–8000 (mean 5871) (in maturing and pre-spawning females) 1380-6200 (mean 3265) (in mature spawning females) [26]	3.5–8.5 (mean 5.5 ± 1.29) [28] 6.45–7.53 [26]	group synchronous [28]