Sexual dimorphism and geographic variation in the morphology of a small southern African tortoise *Psammobates oculifer*

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Supplementary Material

Materials and methods

We collected data from 146 dead (dry shells and alcohol-preserved [wet] specimens of the Iziko Museum, Cape Town and the Ditsong National Museum of Natural History, Tshane) and 173 live *Psammobates oculifer* for this study. Data for live individuals were obtained while studying the species' ecology from March 2006 to April 2007 at Benfontein farm (28°53' S; 24°51' E), near Kimberley, South Africa. We counted the number of carapacial, plastral, axillary and inguinal scutes, noted the position of the latter two scutes relative to adjacent plastral and marginal scutes, and recorded the number and strength (none, weak, medium or strong) of serrated marginal scutes. We also recorded the presence or absence of a plastral concavity, rated the concavity as weak or strong, and noted its position relative to abdominal scutes. Furthermore, we noted the presence and intensity (weak, moderate or strong) of a marginal groove (indentation between pleural and marginal scutes) and bridge ridge (edge alongside of shell) and the associated marginal scute numbers. We could not collect a full set of data for each individual because some museum specimens were damaged whereas time constraints during peak activity periods did not allow detailed measurements of all live individuals. In order to evaluate shell colouration, we photographed the carapace and plastron of each tortoise with a Panasonic DMC-FZ30 digital camera. In this species, dark-brown to black pigmented rays overlay a yellow to brown shell base colour and we evaluated base colour gradations and estimated the amount of dark pigmentation in 10% increments for both the carapace and plastron.

When evaluating pigmentation data, we simplified data by using four categories and not 10% intervals. Category 1 (0%, 10%, and 20%; supplementary fig. S1a) included three

increments because only one animal had no dark pigment, whereas categories 2, 3 and 4, respectively, comprised of two increments each; 30% and 40%, 50% and 60%, and 70% and 80% (supplementary fig. S1b-d).

Supplementary Figure S1. Dark pigment categories for the shells of *Psammobates oculifer*. (A) Pigment category 1 (0%, 10%, and 20%), (B) category 2 (30% and 40%), (C) category 3 (50% and 60%) and (D) category 4 (70% and 80%).

Because there were individual variations in the number and symmetry of marginal scutes, we summarised the frequencies as number occurring per individual on each side. We divided marginal scute serration patterns into anterior (1-5) and posterior (6-12) and summarised frequencies for each side. To test for differences among cohorts in frequencies of marginal scute numbers, serration and percentages of carapacial colouration, we used χ^2 tests or Fisher's exact tests (2x2) where frequencies were low, with a Yates' correction if degrees of freedom equalled one and with mean expected frequencies always equalling six or more (Zar, 2001). Where contingency tables were 2x3, 2x4 or 3x3 and frequencies were low, we used the Freeman-Halton extension to the Fisher's exact test (Freeman and Halton, 1951). We used repeated measures ANOVA (RMA, F statistic) or Friedman's repeated measures ANOVA (FRMA, χ^2 tests) where data were non-parametric, followed by Student-Newman-Keuls post hoc tests to rank the plastral, pleural, and vertebral scutes formulae for males, females and juveniles. We used paired t tests or, when data were non-parametric, Wilcoxon Signed Rank tests (T statistic), to evaluate differences between carapacial and plastral pigmentation within each cohort and for all tortoises combined. All remaining morphological characteristics (axillary and inguinal scutes and adjoining scutes, plastral concavity

occurrences and bridge characteristics) were summarised as percentages among groups. VassarStats were used to calculate the Freeman-Halton (1951) extension to Fisher's exact test. We used SigmaStat 2.03 (SPSS Inc., Chicago, U.S.) and Microsoft Excel for all other statistical analyses.

Results

Scute dimorphism

Pleural, vertebral, and plastral scute lengths were compared using formulae based on proportional length (see below). Sexual dimorphism (SDI) for these scutes, however, ranged between 0.117 and 0.277 for the first five vertebral scutes, between 0.171 and 0.283 for the first four pleural scutes, and between 0.111 and 0.331 for plastral scutes, excluding the femoral scute (-0.001; table S1), for which ANOVA results showed no difference between females and males.

Scute counts and scute length formulae

All tortoises had a single nuchal and supracaudal scute with the exception of one female with no nuchal scute and one male with two nuchal scutes (table S2). Most individuals had five vertebral scutes and four pleural scutes on both sides (table S2). *Psammobates oculifer* usually had either 10 or 11 marginal scutes on a side (table S2), and the pattern was usually symmetrical (table S3). There was no difference among cohorts in the number of individuals with 10 or 11 marginal scutes on each side, or those with asymmetrical versus symmetrical marginals (χ^2 tests, $P \geq 0.61$; table S3).

All *P. oculifer* except one female had one axillary scute on each side of the plastron. The axillary scutes of all *P. oculifer* were in contact with the humeral and pectoral scutes, and were most often in contact with marginal scutes three and four (table S4). All tortoises had one inguinal scute on each side of the plastron, which was always in contact with the abdominal and femoral scutes. Contact of inguinal with marginal scutes was more variable, but was most often with marginal scutes seven and eight (table S4). Variation in the position of the inguinal scutes did not differ between males and females ($P = 0.95$), but inguinal position was more variable in adults than it was in juveniles (Fisher's exact tests, $P < 0.006$; table S4).

The length of individual vertebral scutes ($\chi^2_4 > 26.5$, $P < 0.0001$), pleural scutes ($\chi^2_3 > 30.9$, $P < 0.0001$), and plastral scutes ($\chi^2_5 > 160.2$, $P < 0.0001$) differed within each cohort.

Vertebral scute formulae differed among the three cohorts: it was $V5=V1=V4=V3>V2$ for females, $V5>V1>V4>V3>V2$ for males, and $V1>V5>V4=V3>V2$ for juveniles (see table S1 for actual scute measurements). The pleural scute formula for males ($P1>P3>P2>P4$) was different from those of females and juveniles ($P1>P3=P2>P4$). The plastral arrangement for females and juveniles was $AbL>HL>GL>AL>FL>PecL$, whereas it was $AbL>HL>GL>FL>AL>PecL$ for males. When considering these plastral formulae results, factors such as the occurrence of different plastral formulae among size classes should be noted (see Lovich and Ernst, 1989).

Other morphological characteristics

Most *P. oculifer* had three serrated marginal scutes on each anterior side (table S5) but in juveniles the number of anterior serrations exceeded three more often than in males and females ($\chi^2_1 \geq 5.68$, $P \leq 0.017$) with no difference between males and females ($P = 0.097$; table S5). Males and females usually had three posterior serrations on each side, whereas juveniles most often had four or more posterior serrations. The number of posterior serrations of juveniles exceeded those of males and females ($\chi^2_1 \geq 5.4$, $P \leq 0.02$) but serration in males and females did not differ ($P = 0.29$; table S5). Serrations in all *P. oculifer* were rated as strong except for four adults where the strength of serrations was rated as medium.

All *P. oculifer* had a weak bridge ridge, which most often incorporated marginal scutes three to seven or three to eight (table S6). The species lacked a marginal groove. Females did not have a plastral concavity whereas most males (85%) had. Male concavities occurred on the midline along the length of the abdominals up to the femoral scute (56%) or were limited to the midline at the junction of the abdominal and femoral scutes (44%).

The carapacial background colour of *P. oculifer* was most often orange-yellow or orange-brown (table S7). The frequency of occurrence of colour categories differed among cohorts ($\chi^2_3 \geq 11.1$, $P \leq 0.011$) with juveniles having the palest colour and males tending to have a paler background colour than females (table S7). All tortoises except one female had dark pigment on the carapace (table S8). Juveniles had more dark carapacial pigment than adults had, and male carapaces were darker than those of females were ($\chi^2_3 \geq 12.31$, $P \leq 0.0064$). The plastrons of all tortoises had dark pigment (table S8) but plastral pigmentation did not differ among cohorts ($P = 0.28$). Carapacial pigmentation was marginally greater than plastral pigmentation for females ($T_{117} = 1135$, $P = 0.04$) and substantially darker for males and juveniles ($T \geq 528$, $n \geq 32$, $P < 0.00001$).

Supplementary Table S1. Morphometric measurements (see table 1 for descriptions of abbreviations) of *Psammobates oculifer* cohorts presented as mean and standard deviation with sample size in brackets and minimum (Min) and maximum (Max) values underneath. Measurements were taken from live animals (Benfontein) and wet or dry museum specimens (Iziko and Ditsong museums). Measurements for SHM and SV are from museum specimens only. Mass is in g, shell volume in cm³, with all other measurements in mm. The asterisk indicates additional measurements in cases of abnormal scute numbers. We calculated sexual dimorphism indices (SDIs) as the mean of the larger sex (females) divided by the mean of the smaller sex (males) and subtracted one so that the result was positive when females were larger and negative when males were larger (Lovich and Gibbons 1992).

Measurement	Female		Male		SSD	Juvenile	
AbL	33.21 ± 3.55	(119)	24.96 ± 3.06	(137)	0.331	18.73 ± 3.29	(34)
Min-Max	20.94	39.88	17.75	33.18		11.95	25
AG	14.66 ± 2.86	(113)	14.46 ± 2.43	(133)	0.014	8.75 ± 2.06	(33)
Min-Max	8.91	21.54	9.2	21.86		5.01	13.38
AL	11 ± 1.83	(120)	8.85 ± 1.34	(137)	0.243	6.75 ± 1.72	(34)
Min-Max	6.13	15.29	5	12.79		3.78	10.6
AW	25.29 ± 2.81	(119)	26.17 ± 3.78	(136)	-0.034	14.99 ± 4.4	(32)
Min-Max	19.57	33.44	15.07	35.51		5.9	23.8
BL	52.26 ± 5.18	(49)	40.25 ± 3.83	(74)	0.298	28.72 ± 4.95	(17)
Min-Max	37.4	59.63	32.16	52		18.83	37.77
BM	318.83 ± 57.97	(84)	195.84 ± 35.49	(88)	0.628	105.68 ± 35.71	(17)
Min-Max	197.5	463.2	113	288		24.5	156
CS	20.47 ± 2.08	(49)	19.74 ± 2.11	(68)	0.037	13.87 ± 1.98	(14)
Min-Max	15.84	23.73	14.37	23.67		10.83	17.8
DCL	155.25 ± 12.95	(119)	134.15 ± 12.58	(137)	0.157	91.16 ± 19	(35)
Min-Max	114	189	101.5	163		47	121
DCW	140.5 ± 11.52	(120)	116.21 ± 9.15	(137)	0.209	87.53 ± 15.3	(35)
Min-Max	103	164	93	139.5		53	107
FARL	26.63 ± 2.79	(41)	24.4 ± 2.8	(63)	0.091	16.48 ± 2.61	(15)
Min-Max	19.54	33.42	17.31	31.02		12.59	20.85
FFRW	12.54 ± 1.49	(41)	11.09 ± 1.51	(60)	0.131	7.02 ± 0.84	(13)
Min-Max	8.44	14.74	8.28	14.19		5.36	8.07
FL	9.21 ± 1.94	(120)	9.22 ± 1.99	(136)	-0.001	5.62 ± 1.35	(34)
Min-Max	4.72	13.59	5.08	14.64		2.76	8.87
GL	13.16 ± 1.79	(120)	11.84 ± 1.72	(133)	0.111	8.32 ± 1.82	(34)
Min-Max	9.17	17.97	7.64	16.79		5.03	12.27
GW	20.7 ± 2.29	(48)	19.35 ± 2.12	(70)	0.070	14.55 ± 2.04	(17)
Min-Max	14.27	25.18	13.02	24.58		11.07	18.84
HFRW	10.9 ± 1.6	(40)	10.38 ± 1.35	(56)	0.050	6.35 ± 0.84	(12)
Min-Max	6.06	13.51	7.46	13.09		4.98	7.3
HL	23.33 ± 2.6	(121)	19.51 ± 2.7	(135)	0.196	14.35 ± 3.52	(34)
Min-Max	16.02	28.72	11.26	28.31		7.81	23

HLRL	29.89 ± 2.56	(40)	26.75 ± 3.21	(60)	0.117	15.94 ± 2.73	(12)
Min-Max	21.69 35.24		18.7 32.84			11.87 19.21	
HW	18.8 1.5	(39)	17.12 1.52	(59)	0.098	12.23 1.09	(10)
Min-Max	14.37 21.71		14.08 19.92			10.6 13.61	
MR6L	15.76 ± 1.92	(48)	12.6 ± 1.2	(75)	0.251	8.88 ± 1.59	(17)
Min-Max	10.46 20		9.68 15.19			5.37 10.94	
MR6W	21.62 ± 2.2	(48)	17.92 ± 1.94	(75)	0.206	12.51 ± 2.46	(17)
Min-Max	15.58 25.48		14.12 22.07			7.44 15.85	
NL	9.81 ± 1.89	(50)	8.72 ± 1.39	(70)	0.125	5.45 ± 1.36	(17)
Min-Max	6.13 15.64		5.5 11.53			3.56 8.79	
NW	6.39 ± 1.43	(50)	5.61 ± 1.22	(76)	0.139	3.94 ± 1.02	(18)
Min-Max	3.27 10.23		2.46 8.63			2.42 6.23	
PecL	5.78 ± 1.69	(117)	4.61 ± 1.51	(127)	0.254	3.72 ± 1.31	(34)
Min-Max	2.1 9.53		1.04 8.19			1.19 6.63	
PlasL	94.95 ± 7.13	(125)	79.15 ± 6.22	(148)	0.200	57.8 ± 10.33	(34)
Min-Max	72.52 109.7		63.51 95.82			35.07 71.6	
PlasW	55.46 ± 5.07	(96)	45.04 ± 3.85	(135)	0.231	33.5 ± 5.95	(31)
Min-Max	38.47 65.92		35.59 53.95			21.79 41.49	
PR1L	35.59 ± 3.6	(51)	29.73 ± 2.89	(75)	0.197	20.51 ± 3.62	(17)
Min-Max	26.87 43.27		22.75 35.41			15.06 25.43	
PR2L	25.51 ± 2.63	(115)	19.89 ± 2.01	(136)	0.283	15.21 ± 2.93	(34)
Min-Max	18.57 32.35		15.42 24.8			8.81 18.6	
PR3L	25.75 ± 2.94	(46)	20.96 ± 2.32	(72)	0.229	13.38 ± 2.54	(16)
Min-Max	18.43 30.71		16.55 26.81			9.54 17.56	
PR3W	34.86 ± 3.36	(49)	29.27 ± 2.95	(75)	0.191	20.63 ± 3.83	(18)
Min-Max	26.11 40.29		23.39 36.02			14.12 26.08	
PR4L	22.42 ± 2.77	(48)	19.14 ± 2.61	(72)	0.171	12.62 ± 2.41	(15)
Min-Max	16.85 27.39		13.55 25.44			7.58 16.76	
PR5L*	21.19 ± 2.74	(2)	13.95 ± 0.82	(2)	0.519		(0)
Min-Max	19.25 23.13		13.37 14.53				
SD	30 ± 2.98	(89)	28.53 ± 3.19	(126)	0.052	18 ± 4.29	(31)
Min-Max	21.37 36.66		16.63 34.81			9 24.43	
SP	23.2 ± 2.78	(49)	19.53 ± 2.86	(74)	0.188	12.17 ± 2.67	(17)
Min-Max	17.79 30.33		13.47 26.03			9.14 17.36	
SCL	113.05 ± 8.89	(126)	99.16 ± 8.79	(156)	0.140	68.1 ± 13.13	(35)
Min-Max	85.36 132.8		74.58 119.07			38.86 83.25	
SHM	63.56 ± 6.05	(48)	51.49 ± 5.18	(74)	0.234	38.48 ± 7.92	(35)
Min-Max	45.48 73.7		41.1 61.5			18.39 50.4	
SV	330.96 ± 81.65	(47)	197.89 ± 53.72	(74)	0.672	84.79 ± 38.01	(35)
Min-Max	130.58 460.96		96.09 315.11			17.64 144.56	
SWA	69.53 ± 5.64	(50)	60.91 ± 5.62	(75)	0.142	44.2 ± 7.37	(17)
Min-Max	55.74 79.78		44.4 72.23			32.06 58.51	
SWM	85.85 ± 6.34	(126)	72.34 ± 4.9	(155)	0.187	56.92 ± 8.14	(35)
Min-Max	63.97 97.59		59.87 84.97			38.31 66	
SWP	79.67 ± 7.32	(49)	68.78 ± 6.21	(76)	0.158	48.95 ± 8.66	(17)
Min-Max	60.82 90.55		53.9 83.11			35.77 64.17	

V1L	24.43 ± 2.69	(50)	21.08 ± 2.1	(72)	0.159	14.27 ± 2.66	(18)
Min-Max	17.95 31.11		15.96 24.56			9.47 17.63	
V2L	22.43 ± 2.95	(50)	17.62 ± 2.2	(71)	0.273	11.96 ± 2.31	(18)
Min-Max	16.64 28.37		12.3 21.82			8.35 15.34	
V3L	24.55 ± 2.98	(50)	19.22 ± 2.37	(72)	0.277	12.61 ± 2.34	(18)
Min-Max	17.54 30.12		14.45 24.58			9.4 16.96	
V3W	39.68 ± 4.68	(50)	31.4 ± 3	(75)	0.264	21.89 ± 3.23	(18)
Min-Max	24.89 46.64		24.82 38.4			16.4 27.61	
V4L	24.33 ± 3.18	(49)	20.12 ± 2.61	(70)	0.209	12.91 ± 3.13	(17)
Min-Max	16.92 31.47		14.62 25.84			7.91 19.39	
V5L	24.81 ± 3.38	(49)	22.22 ± 3.73	(72)	0.117	13.64 ± 3.99	(16)
Min-Max	17.19 31.3		15.26 33.27			6.11 21.15	
V6L*	18.45 ± 8.42	(2)	17.18 ± 6.75	(3)	0.074	14.18 ±	(1)
Min-Max	12.49 24.4		9.44 21.84			14.18 14.18	
V7L*		(0)	24.65 ±	(1)			(0)
Min-Max							

Supplementary Table S2. Summary of the carapacial scute counts of *Psammobates oculifer* from live specimens (Benfontein) and wet or dry museum specimens (Iziko and Ditsong museums) showing the number of each scute type with its occurrence (counts and percentages) amongst males, females, juveniles, and all cohorts combined.

Scute type	Number	Females		Males		Juveniles		Total	
		Count	%	Count	%	Count	%	Count	%
Nuchal	0	1	0.8	0	0.0	0	0.0	1	0.3
	1	123	99.2	153	99.4	35	100.0	311	99.4
	2	0	0.0	1	0.6	0	0.0	1	0.3
Vertebrales	4	2	1.6	3	1.9	0	0.0	5	1.6
	5	119	96.7	144	93.5	34	97.1	297	95.2
	6	2	1.6	6	3.9	1	2.9	9	2.9
	7	0	0.0	1	0.6	0	0.0	1	0.3
Pleurals-left	3	0	0.0	1	0.6	1	2.9	2	0.6
	4	118	94.4	149	96.1	33	94.3	300	95.2
	5	7	5.6	5	3.2	1	2.9	13	4.1
	6	0	0.0	0	0.0	0	0.0	0	0.0
Pleurals-right	3	0	0.0	1	0.6	1	2.9	2	0.6
	4	120	96.0	149	96.1	34	97.1	303	96.2
	5	5	4.0	4	2.6	0	0.0	9	2.9
	6	0	0.0	1	0.6	0	0.0	1	0.3
Marginals-left	9	1	0.8	0	0.0	1	2.9	2	0.6
	10	40	32.0	56	36.1	10	28.6	106	33.7
	11	82	65.6	95	61.3	24	68.6	201	63.8
	12	2	1.6	4	2.6	0	0.0	6	1.9
Marginals-right	9	0	0.0	0	0.0	0	0.0	0	0.0
	10	44	35.2	63	40.6	13	37.1	120	38.1
	11	79	63.2	89	57.4	22	62.9	190	60.3
	12	2	1.6	3	1.9	0	0.0	5	1.6
Supracaudal	1	122	100.0	154	100.0	35	100	311	100.0

Supplementary Table S3. Percentages (frequencies) of left and right marginal scute counts of *Psammobates oculifer* from live specimens (Benfontein) and wet or dry specimens (Iziko and Ditsong museums).

	12:12	11:11	11:10	10:11	10:10	9:10	12:10
Males	1.9 (3)	53.5 (83)	7.7 (12)	3.9 (6)	32.3 (50)	0	0.6 (1)
Females	1.6 (2)	59.2 (74)	6.4 (8)	4.0 (5)	28.0 (35)	0.8 (1)	0
Juveniles	0	62.9 (22)	5.7 (2)	0	28.6 (10)	2.9 (1)	0
Totals	1.6 (5)	56.8 (179)	7.0 (22)	3.5 (11)	30.2 (95)	0.6 (2)	0.3 (1)

Supplementary Table S4. Contact zone of inguinal and axillary scutes with marginal scutes for female, male and juvenile *Psammobates oculifer*, of live (Benfontein) and wet or dry museum (Iziko and Ditsong museums) specimens.

Scute type	Marginals	Females		Males		Juveniles		Total	
		Count	%	Count	%	Count	%	Count	%
Axillary	3, 4	48	98.0	67	93.1	17	100.0	132	95.7
	2, 3	0	0.0	3	4.2	0	0.0	3	2.2
	3	0	0.0	0	0.0	0	0.0	0	0.0
	4	1	2.0	2	2.8	0	0.0	3	2.2
Inguinal	6, 7	13	26.5	22	29.7	0	0.0	35	25.0
	7, 8	32	65.3	50	67.6	17	100.0	99	70.7
	7	2	4.1	2	2.7	0	0.0	4	2.9
	8, 9	2	4.1	0	0.0	0	0.0	2	1.4

Supplementary Table S5. Frequencies and percentages of the number of anterior and posterior marginal scutes serrated per tortoise amongst males, females, juveniles and all *Psammobates oculifer* from live specimens (Benfontein) and wet or dry specimens (Iziko and Ditsong museums). Of the female ‘others’, five had two, five had three and one had five posterior marginal scutes serrated on both sides. Of the male ‘others’ two had three, two had four and one had five posterior marginal scutes serrated on both sides. One juvenile had three posterior marginal scutes serrated on both sides.

Serrated marginals	Males		Females		Juveniles		Total	
	Count	%	Count	%	Count	%	Count	%
1-2	0	0.0	4	3.4	0	0.0	4	1.3
1-3	135	90.6	108	92.3	25	75.8	268	89.6
1-4	2	1.3	1	0.9	3	9.1	6	2.0
1-5	10	6.7	2	1.7	5	15.2	17	5.7
2-3	0	0.0	1	0.9	0	0.0	1	0.3
None	2	1.3	1	0.9	0	0.0	3	1.0
Total	149		117		33		299	
6-11	3	2.0	0	0.0	5	15.2	8	2.6
7-10	2	1.3	4	3.3	1	3.0	7	2.3
7-11	7	4.6	3	2.5	6	18.2	16	5.2
8-10	44	29.1	27	22.3	7	21.2	78	25.6
8-11	27	17.9	18	14.9	5	15.2	50	16.4
9-11	53	35.1	51	42.1	6	18.2	110	36.1
8-10L, 9-11R	7	4.6	3	2.5	0	0.0	10	3.3
8-10R, 9-11L	3	2.0	4	3.3	2	6.1	9	3.0
None	0	0.0	0	0.0	0	0.0	0	0.0
Other	5	3.3	11	9.1	1	3.0	17	5.6
Total	151		121		33		305	

Supplementary Table S6. The frequencies and percentages of marginal scutes contributing to the bridge ridge in male (M), female (F) and juvenile (J) *Psammobates oculifer*. Counts are from live specimens (Benfontein), and wet or dry museum specimens (Iziko and Ditsong museums).

Marginals	Females		Males		Juveniles		Total	
	Count	%	Count	%	Count	%	Count	%
3-6	2	4.2	5	6.8	0	0.0	7	5.1
3-7	26	54.2	37	50.7	7	41.2	70	50.7
3-8	13	27.1	24	32.9	10	58.8	47	34.1
4-7	6	12.5	5	6.8	0	0.0	11	8.0
4-8	1	2.1	2	2.7	0	0.0	3	2.2
Totals	48		73		17		138	

Supplementary Table S7. The frequencies and percentages of carapace colouration in male (M), female (F) and juvenile (J) *Psammobates oculifer*. Data are from live specimens (Benfontein) and wet or dry museum specimens (Iziko and Ditsong museums). Colour is ordered from light to dark as yellow, orange-yellow, orange-brown and brown.

Carapace colour	F	%	M	%	J	%	Total	%
Yellow	6	5.1	9	6.8	6	18.8	21	7.4
Orange-yellow	27	22.9	53	39.9	21	65.6	101	35.7
Orange-brown	54	45.8	52	39.1	5	15.6	111	39.2
Brown	31	26.3	19	14.3	0	0.0	50	17.7
Total	118		133		32		283	

Supplementary Table S8. The frequencies and percentages of male, female and juvenile *Psammobates oculifer* in each dark pigment category for the carapace and plastron. Category (Cat.) 1 represents 0, 10, and 20% black pigment, whereas categories 2, 3 and 4 each represents two pigments increments, 30 and 40%, 50 and 60%, and 70 and 80%, respectively. Assessments were made from live specimens (Benfontein), and wet or dry museum specimens (Iziko and Ditsong museums).

	Cat. 1	%	Cat. 2	%	Cat. 3	%	Cat. 4	%	Totals
Male carapace	17	12.8	14	10.5	42	31.6	60	45.1	133
Female carapace	24	20.5	25	21.4	36	30.8	32	27.4	117
Juvenile carapace	0	0.0	0	0.0	2	6.3	30	93.8	32
Total carapace	41	14.5	39	13.8	80	28.4	122	43.3	282
Male plastron	7	5.2	76	56.7	46	34.3	5	3.7	134
Female plastron	11	9.4	59	50.4	37	31.6	10	8.5	117
Juvenile plastron	3	9.4	20	62.5	9	28.1	0	0.0	32
Total plastron	21	7.4	155	54.8	92	32.5	15	5.3	283

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