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ISRAEL JOURNAL OF ZOOLOGY, Vol. 46, 2000, pp. 231–237

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MORPHOMETRIC ANALYSIS OF THE AFRICAN CHAMELEON *CHAMAELEO AFRICANUS* LAURENTI, 1768 FROM SOUTHWESTERN PELOPONNESE, GREECE

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The African chameleon *Chamaeleo africanus* Laurenti, 1768 is a new species for the Greek herpetofauna (Böhme et al., 1998; Kosuch, et al., 1999). In Greece, this species has been observed only at Divari lagoon, Gialova, near Pylos in the southwestern Peloponnese. It seems that this species was probably introduced into Greece because chameleons were used as pets by citizens and kings (Bodson, 1984).

Very few morphometric data on the African chameleon exist in the literature. The oldest reports for this species were made by Anderson (1898), who described it in detail and also took some body measurements. Hechenbleikner (1940) referred to earlier references for this species, including a few body measurements from the literature. The latest reference on the morphology of this species was given by Böhme et al. (1998), who measured only the total length of two very large individuals from Greece.

In the family Chamaeleonidae external characters are very important for distinguishing species and establishing their relationships (Klaver and Böhme, 1986). Taking into account the lack of a more complete contribution to the knowledge on this chameleon morphology, we studied a number of morphometric characters in a sample large enough to give reliable evidence.

The study area (20 ha) is a coastal area with sea inlets. The habitat in which the African chameleon has been observed consists of salt marshes and sand dunes, maquis vegetation, agricultural land, phrygana formations, and some reeds.

Field work was carried out in August 1997 and April, May, June, and August 1998. Body measurements were taken from a total of 47 adults and 22 juveniles. The animals were captured, measured, and released at the capturing place the next day. Most of the fieldwork was carried out between 18:30 and 03:00, although a few specimens were collected during the daytime. In the dark, the animals are found most effectively using

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Accepted April 2000.

flashlights (Cuadrado, 1997).

We considered the individuals with snout–vent length (SVL) equal to or more than 114 mm as adults because the African chameleon reaches this size about a year after birth, and many chameleon species, such as *C. jacksonii*, *C. hoehnelii*, and *C. chamaeleon*, reach sexual maturity at about one year of age (Fernández, 1988).

The animals were captured by hand. Some of them were found killed by cars, so a number of their measurements are missing. For each individual, the measurements of 15 morphometric variables and 18 ratios of the variables were taken according to those used for chameleons by Hillenius (1978), Blasco et al. (1985), Romero and Escudero (1985), and Wild (1993). These variables and ratios are the following:

1. BW (body weight)
2. SVL (length of head and trunk, from the tip of the snout to the vent)
3. TL (length of the tail, from the vent to the end of the tail)
4. HL1 (length of the head, from the tip of the snout to the corner of the neck)
5. CW (width of the casque, between the points directly above the center of the eye socket)
6. HH (height of the head, from the gular crest to the top of the casque)
7. CH (height of the casque, from the corner of the mouth to the top of the casque)
8. MW (width of the body, at the middle of the trunk)
9. FFL (length of the front foot, toe included)
10. HFL (length of the hind foot, toe included)
11. ML (length of the mouth, from the corner of the mouth to the tip of the snout)
12. TOL (length of the hind toe)
13. HL2 (length of the casque, from the tip of the snout to the top of the casque)
14. TLE (total body length)
15. EYE (eye diameter)

1. TL/SVL, 2. HL1/SVL, 3. ML/SVL, 4. CH/SVL, 5. CW/SVL, 6. MW/SVL, 7. HH/SVL, 8. HL2/SVL, 9. EYE/SVL, 10. HFL/SVL, 11. FFL/SVL, 12. TOL/SVL, 13. CH/ML, 14. CW/ML, 15. HL1/ML, 16. CW/HL1, 17. EYE/HL1, 18. FFL/HFL.

The measurements were taken with a vernier caliper (0–150 mm) to the nearest 0.1 mm. For SVL and TL, a steel ruler was used and the measurements were taken to the nearest mm. For body weight, two spring balances with capacities of 50 g (1/2 g) and 200 g (2 g) were used.

Sex identification of the specimens was made on the basis of the presence (male) or absence (female) of a swollen base of the tail (Hillenius, 1978) and the presence or absence of a spur at the hind foot (Anderson, 1898; Hechenbleikner, 1940).

Descriptive statistics were obtained for all variables. A regression analysis was used for studying the growth pattern. The *t*-test was used for the comparison among variables (males–females) and Mann–Whitney U-test for the comparison among the ratios of the measurements (males–females), as well as among our data and those from literature.

The results of the measurements of the variables are shown in Table 1.

We separately examined the data of the two size/age groups (adults and juveniles) for

Table 1
Descriptive statistics of the morphometric characters examined in male and female individuals of *Chamaelo africanus*

	Males			Females		
Variable	N	Mean ± SD	Range	N	Mean ± SD	Range
SVL	23	138.83 ± 12.52	114.00–163.00	21	136.29 ± 15.17	115.00–170.00
TL	23	159.83 ± 15.07	135.00–197.00	21	151.57 ± 19.44	120.00–195.00
TLE	23	298.65 ± 25.09	252.00–351.00	21	287.86 ± 32.10	236.00–365.00
HL1	21	33.80 ± 2.76	28.20 – 38.60	14	32.67 ± 3.08	27.30 – 38.10
ML	20	27.67 ± 3.78	16.40 – 32.30	15	27.48 ± 2.38	23.70 – 31.20
CH	20	29.20 ± 3.57	20.50 – 34.70	16	27.78 ± 3.32	20.70 – 34.10
CW	16	13.74 ± 1.51	9.80 – 16.60	16	12.93 ± 1.61	9.90 – 16.40
HFL	18	61.08 ± 9.76	50.00 – 78.30	16	61.41 ± 10.77	43.80 – 83.10
TOL	18	13.17 ± 2.40	9.60 – 19.40	16	13.84 ± 2.36	9.80 – 18.30
MW	17	35.26 ± 5.15	27.30 – 45.70	15	36.13 ± 9.03	21.80 – 56.90
HH	15	37.37 ± 3.99	31.60 – 45.20	12	35.97 ± 4.86	26.00 – 43.10
FFL	18	60.84 ± 6.63	52.20 – 72.40	15	58.03 ± 12.92	19.00 – 74.70
HL2	15	44.25 ± 3.79	38.30 – 51.40	12	42.26 ± 4.67	32.50 – 51.30
EYE	6	10.57 ± 0.35	10.30 – 11.10	6	9.93 ± 1.04	8.90 – 11.80
W	10	68.80 ± 14.66	41.00 – 88.00	9	76.78 ± 39.29	26.00–159.00

indications of sexual dimorphism. No sexual dimorphism was found for all the comparisons tested (t-tests and U-tests $p > 0.05$). According to Hillenius (1978), in the common chameleon *Chamaeleo chamaeleon*, males have a longer tail than females, as in many other lizards, and there is an eastward tendency both in males and females towards longer tails. Also, males have a larger casque than females. The length of the head (HL1) and width of the casque (CW) of the common chameleon are larger in males. However, females have greater body weight than males (Blasco et al., 1985). This is not the case in the African chameleon.

The regression between head length (HL2) and SVL is a straight line without an inflection point (HL2 = 2.72 + 0.29*SVL, $r = 0.97$) (Fig. 1). The head and body lengths grow in a simple linear fashion without a change with respect to tail length. The two sexes of the African chameleon have the same growth pattern. There are indications in the common chameleon that some parts of the body grow faster than SVL (Hillenius, 1978). According to Blasco et al. (1985), tail length increases with age in both sexes of the common chameleon, a tendency that is greater in females of this species. The length of the head (HL1), the width of the casque (CW), the width of the midbody (MW), the height of head (HH), and the height of the casque (CH) decrease in relation to the body and head length (SVL) as the animal grows (Blasco et al., 1985).

According to Anderson (1898), the African chameleon has a medium-sized casque, elevated posteriorly with a slight anterior convexity but nearly vertical posteriorly. There are no dermal occipital lobes and the supraorbital ridge is strong, prolonged onto the side of the casque but becoming indistinct as it ascends. The same author found that

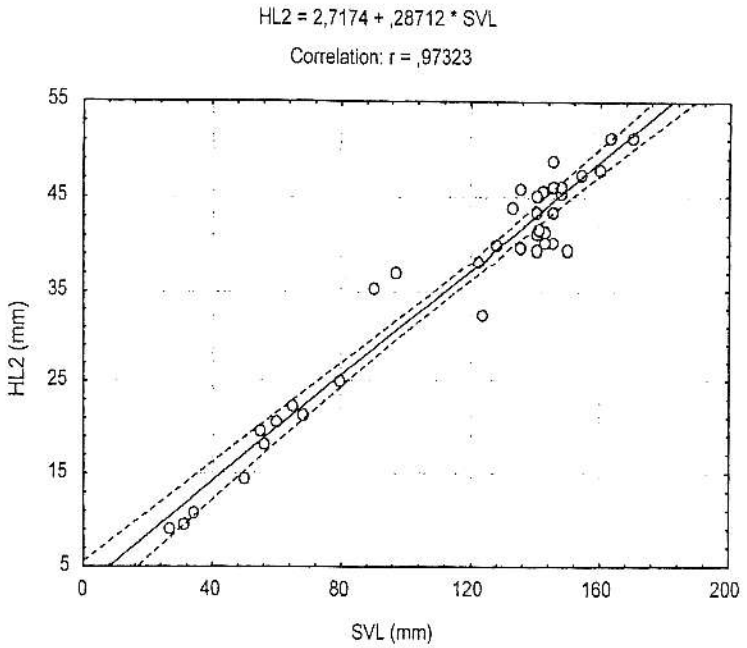

Fig. 1. Relationship between SVL and HL2 of *Chamaeleo africanus* in juveniles and adults of both sexes. Dotted lines represent 95% confidence limits.

the distance between the angle of the mouth to the apex of the casque (CH) equals or slightly exceeds the length of the labial border (ML). Our results agree with these observations (Table 1).

Furthermore, according to Anderson (1898) the tail length (TL) generally equals the head plus body length (SVL), while according to Hechenbleikner (1940) the tail is longer than the rest of the body. Our results agree with those of the latter author (Table 1). In the common chameleon, the tail is shorter than the rest of the body (Blasco et al., 1985).

The maximum total length that we have measured in the African chameleon was 365 mm (170 SVL + 195 TL), recorded in a female. However, this value is quite small compared to 430 mm and 460 mm recorded by Böhme et al. (1998) for two other Greek individuals.

Our measurements of SVL and TL, for males, are larger than those from Ramleh, near Alexandria, southern Egypt, and Sudan (Anderson, 1898; Hechenbleikner, 1940) (Table 2). Males from Pylos are generally larger than those from Egypt and Sudan. Our measurements of SVL and TL for females are similar to those of the female from Suakin, Sudan (Anderson, 1898) but are greater than south Egyptian and Sudanian specimens

Table 2
Morphometric data for *Chamaeleo africanus* and *Chamaeleo chamaeleon* mentioned in the literature

	Chamaeleo africanus					*Chamaeleo chamaeleon*			
	Anderson	Hechenbleikner[a]	Böhme[b]	Sauer	Böhme et al.	Anderson	Werner	Klaver and Böhme	Schleich et al.
SVL			150						
SVL male	115, 123	121				135		136	105.2
SVL female	132, 152	113				135		161	123.5
TL			143						
TL male	117, 138	136				125		122	83.5
TL female	123, 152	121				97		122	113.1
TLE		232–255	293	25–37	430, 460			250–300	
TLE							258		
TLE males average		257					280		
TLE females average		234							
HL			34						
HH			39						
W males average									29.3
W females average									48.5

[a]average values; [b]measurements of the sibling species *C. calcarinaceus*.

(Hechenbleikner, 1940) (Table 2). Statistically, we didn't find a significant difference in SVL among our measurements and those from Africa. However, we found a difference in TL and TLE (U-test, $p < 0.05$), but the data from literature are very few.

The range of total lengths reported by Sauer (1989) is similar to ours (Table 2).

The sibling species *C. calcarinaceus* (Böhme, 1985) is generally larger than *C. africanus*. However, these body measurements are closer to the respective measurements of *C. africanus* from Pylos. The height and length of the head are about the same (Table 2).

We also noted that although most of the examined animals had a curved parietal crest, a few had a straight one. The same observation has been recorded in the common chameleon, in which there are specimens with straight or curved parietal crest (Hillenius, 1978).

ACKNOWLEDGMENTS

We wish to thank the Hellenic Ornithological Society, which carries out the LIFE-Nature project B-3200/97/244 "Implementation of Management Plans for Pylos Lagoon and Evrotas Delta, Natura 2000 Sites, Greece" (funded by EU and the Greek Ministry of Environment, Physical Planning and Public Works) for accommodation during some of the field trips. Also, many thanks to Igor Schogolev and Yiannis Ioannidis for assistance in the field work and Jason Tylianakis for his comments on the manuscript.

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