Notes on sexual size dimorphism in the Iranian Short-fingered Gecko *Stenodactylus affinis* (Reptilia, Gekkonidae)

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ABSTRACT - Using univariate and multivariate techniques, I evaluated sexual dimorphism in 12 external characteristics from 36 specimens of the gecko lizard *Stenodactylus affinis*. For this study, I chose *Stenodactylus affinis* sampled from northern Persian Gulf littorals. Results obtained from this study are based on 36 specimens (19 females and 17 males) and revealed that female specimens had significantly larger body features than male specimens (P <0.05). Larger body size in female *S. affinis* is likely a reproductive advantage as females develop two large eggs in the abdomen.

SEXUAL dimorphism in size and shape is a common feature of many organisms and has been reported for many species of vertebrates. Several theories have been developed to explain ecological and evolutionary significance for sexual size dimorphism (SSD). Darwinian sexual selection is likely the most important single cause that generates dimorphism, but other factors such as mate choice or mating system, selection on reproductive life history traits, and intersexual ecological divergence have been considered to be significant. For instance, Selander (1966) presented a case for a relationship between sexual dimorphism and differential niche utilization and suggested reasons why such dimorphism would develop. Alternative hypotheses such as bio-energetic pressures, predation pressures, non-monogamous mating systems, or various combinations of these factors have been suggested. By any mechanism large females are presumably able to support more offspring than small females and males increase their reproductive success by mating with large, more fecund females.

Stenodactylus affinis (Murray, 1884) is a medium sized gecko that is distributed in southwestern and southeastern Iran (Afrasiab, 1987; Anderson, 1999). There is no available information on sexual dimorphism for this species. In this short paper, I report on sexual dimorphism in *S. affinis*.

METHODS AND MATERIALS

I collected 36 specimens (19 females; 17 males) of *Stenodactylus affinis* from Bandare-Genave, western Bushehr province, coastal Persian Gulf, southern Iran (50º 20´ E; 29º 44´ N) at an elevation is 40 m, in late spring and early summer 2008. A total of 12 characters were taken: SVL: snout-vent length; TL: tail length; IL: inter-limbs distance; RF: rostral to forelimbs; HW: head width; HD: head depth; HL: head length (snout to posterior border of the ear opening); YD: eye diameter (horizontal); RD: diameter of ear opening (vertical); F: forelimb length (including fingers); H: hind-limb length (including toes) AW: annual width. Measurements were taken in mm with a digital caliber. Statistical procedures used to test for differences included t-tests (at 95% confidence level [0.05]) and Principle Component Analysis (PCA).

RESULTS

Descriptive statistics of 12 characters are shown in Table 1. Based on these results seven characters are significantly different between male and female. Body size (t = 19.12, P >0.01), tail length (t = 8.67, P >0.01), inter-limbs (t = 2.89, P >0.01), head size including head length (t = 5.11, P >0.01), head width (t = 7.52, P >0.01) and head depth (t = 0.01, P >0.01) were significantly greater in females than males. Nevertheless, differences in other characters were not statistically significant. These included lengths of forelimbs (t = 1.43, P = 0.16) and hind-limbs (t = 1.51, P = 0.14) which was greater in females (P <0.05). In general all characters except ear diameter in females were greater than males (Table 1). With regard to the PCA, male results

	SVL	IL	TL	RF	HW	HL	HD	YD	RD	F	H	AW
Female (N=19)												
Mean	59.04	28.64	32.73	21.10	12.09	16.94	8.55	3.18	1.20	21.71	24.53	4.68
SEM	0.35	0.38	0.3	0.49	0.21	0.15	0.11	0.04	0.03	0.47	0.45	0.1
Min	55.89	26.2	30.81	18.51	10.89	15.45	7.41	2.95	1.03	19.1	22.01	3.45
Max	61.52	31.79	36.53	24.82	13.99	17.95	9.8	3.73	1.45	27.74	27.46	5.39
Male (N=17)												
Mean	50.53	27.36	29.54	20.09	9.96	15.38	6.68	2.99	1.22	20.80	23.79	4.48
SEM	0.25	0.18	0.19	0.54	0.18	0.27	0.13	0.09	0.02	0.41	0.13	0.13
Min	48.74	25.98	28.36	17.06	9.05	13.9	5.8	2.02	1.05	17.21	22.76	3.42
Max	52.67	28.56	31.12	23.65	11.44	17.95	7.25	3.56	1.37	23.22	24.52	5.39
t-test												
t	19.12	2.89	8.67	1.37	7.52	5.11	10.45	1.88	0.66	1.43	1.51	1.23
P	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.06	0.51	0.16	0.14	0.22
DD	F>M	F>M	F>M	F>M	F>M	F>M	F>M	F>M	M>F	F>M	F>M	F>M

Table 1. Descriptive analysis and results of t-test (at the 0.05 level) in 12 characters of *Stenodactylus affinis*. SEM: standard error of mean; Min: minimum; Max: maximum; DD: direction of difference (for character abbreviations see Methods and Materials).

were distant from females indicating distinct size differences (Fig. 1).

DISCUSSION

Sexual size dimorphism is exhibited from the measurements herein. There are also other qualitative differences between the sexes. Body colour in females is generally lighter than males and limb radius in males was smaller than in females. Similarly, scales on the dorsum (granules) in females were relatively larger than in males. While the tail in both sexes is slender, it is more robust in females. Dark spots on the female body were more abundant than on male bodies. Similarly, granules in females were larger than in males.

Arnold (1980) suggested that female *Stenodactylus affinis* to have a larger body size than male specimens. This study reports quantitatively that females of *S. affinis* generally have larger dimensions than males (Fig. 2). Arnold (1980) reported the largest body size from a female to be 60 mm and for a male to be 45 mm. In this study I found a slightly larger diameter in a female (61.52 mm) and a male (52.67 mm) *S. affinis*. Arnold's study is based on only five specimens of *S. affinis,* but I report this larger body size from a sample of 36 specimens from southern Iran.

Based on Arnold's (1980) study, female specimens in all species of *Stenodactylus* have larger body sizes than males. All females of

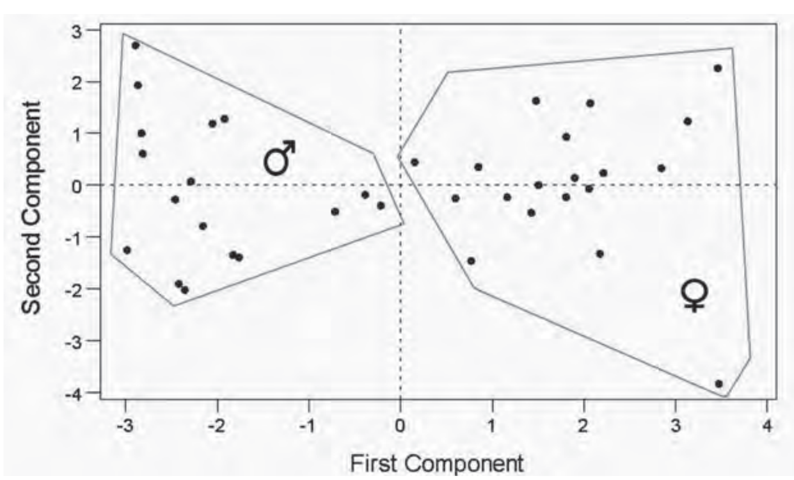

Figure 1. The results of PCA among 12 characters in *Stenodactylus affinis.*

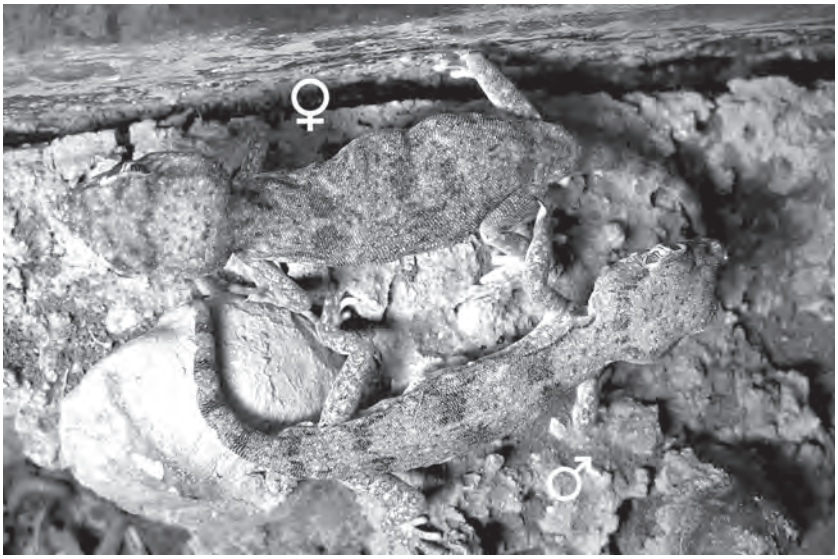

Figure 2. Male and female specimens of *Stenodactylus affinis*. © Farhang Torki.

S. doriae from all sample areas are larger than males, except in one locality, Oman, where males have a larger body size. It could be possible that the male specimens in the *S. doriae* samples were not adults but were subadults. The size of the sample group was also only based on five specimens from Oman. It is possible that, considering my study herein, and the above low sample size, that an altered morphology and maximum size for *S. doriae* may exist in wild populations. Further collection of wild specimens would be needed to prove this.

Arnold's (1980) study also reported maximum body size differences between the sex of *S. doriae* (24 mm) and *S. leptocosymbotes* (20 mm), and these are currently the largest known specimens of each species (Arnold, 1980). Differences of similar size contrast can be found in other species. In *S. grandiceps* the females differ from males by 2.5 mm and by 3.0 mm in *S. khobarensis*. Other *Stenodactylus* spp. also have maximum sizes between these ranges. Differences between the largest male and female of *S. affinis* in Arnold (1980) was 15 mm. Herein I report a a maximum difference to be 8.8 mm for *S. affinis*. This reduced difference could be because of an increased, and perhaps more accurate, sample size. It is possible that the number of specimens sampled may influence the relationships between body size divergence in Arnold (1980). He measured 182 specimens of *S. doriae* and 120 *S. leptocosymbotes* but only a few specimens of *S. grandiceps* (11), *S. affinis* (5) and *S. yemenensis* (9).

Although female specimens in all *Stenodactylus* have a larger body size, sexual divergence occurs in only two species (*S. doriae* and *S. leptocosymbotes*). To compare my study with Arnold (1980), body size divergence in *S. affinis* (8.8 mm) is similar to *S. pulcher* (8.5 mm), *S. petrii* (9.0 mm), and *S. slevini* (9.0 mm). Head size of females in these species is bigger than males. This is similar to some other geckos, for example, *Tropiocolotes helenae fasciatus* (Torki, 2007).

Head-size dimorphism, which is common in squamate reptiles is a trait that may be influenced by both ecological segregation as well as by sexual selection (Shine, 1991). Camilleri & Shine (1990) suggest that head-size dimorphism in some snakes is the result of morphological adaptation for prey-size specialization. Head-size dimorphism in lizards is usually attributed to sexual selection or resource defense where males with larger heads are more successful in intra-sexual confrontations (Carothers, 1984; Hews, 1988).

Body size, as expressed by inter-limb distance, is one factor that shows fecundity selection. Interlimbs in females of some geckos such as *T. h. fasciatus* are significantly larger than males. This aspect is similar for *S. affinis*. Larger inter-limbs in females may also affect reproductive success because larger females can support larger clutches more effectively (by holding two large eggs as opposed to just a single egg). There may also be a similar contribution to the reproductive success for the role of body width as this character is also larger in females (Torki, 2007). This is in contrast with available information for some non-geckos such as *Liolaemus occipitalis* (Verrastro, 2004) in which annual width in males is greater than females. However, this difference in annual diameter in gecko and non-geckonid lizards may well be the result of large, developing eggs. Female specimens in *Stenodactylus affinis* are possibly larger because they are more reproductively successful than small females. Phylogenetic relationships between *Stenodactylus* spp. are understudied and further studies are recommended to unravel relationships between sexual divergence and evolution in the genus.

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