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SEXUAL DIMORPHISM IN HEAD SIZE OF THE MEDITERRANEAN GECKO *HEMIDACTYLUS TURCICUS* (SAURIA: GEKKONIDAE)

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Abstract.-Comparisons were made between 53 female and 67 male Mediterranean geckos (*Hemidactylus turcicus)* collected from the campus of Stephen F. Austin State University in Nacogdoches, Texas. Head dimensions (length, depth and width) and weight of adult males and females were compared with analysis of covariance using snout-vent-length as a covariate. Males were significantly larger in head size and weight at a given snout-vent-length. Males and females did not differ significantly in snout-vent-length. Larger heads in males may be the result of sexual selection, as males with larger heads may exhibit greater success in intrasexual encounters. There may also be an ecological advantage for larger body size in females resulting in parallel increases in body size in both sexes. Larger females may produce better quality eggs which may enhance survival rates in offspring.

The Mediterranean gecko *Hemidactylus turcicus* is an introduced lizard native to the Old World that has recently colonized (since the 1920s) the gulf coastal states of the U. S. (Stejneger 1922; Conant & Collins 1991). Some previously identified sexual differences in the gecko include enlarged preanal pores and post-cloacal bones in mature males that are not obvious in immature males and females (Selcer 1986). This study was undertaken to examine body-size dimorphism between adult male and female *H. turcicus* and possible factors related to its origins.

The Mediterranean gecko is known to use its tail in behavioral displays. Klawinski (1991) observed a male gecko tail-waving while engaged in an aggressive intrasexual encounter, while Marcellini (1977) observed a male gecko tail-waving at a female apparently in a courtship display. Although tail-waving has been observed, it is not well studied in this species. There are no investigations into tail-length differences between the sexes.

Head-size dimorphism, which is common in squamates, 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 adaptations for prey-size specialization. Head-size dimorphism in lizards is usually

Table 1. Morphological measurements of adult Mediterranean geckos.

	N	Mean ± SD	Adjusted Mean	Range
SVL (mm)				
male	67	50.9 ± 3.77	—	44.0 - 58.0
female	53	51.5 ± 4.45	—	44.0 - 60.0
Head length (mm)				
male	67	12.4 ± 1.13	12.5	10.0 - 15.0
female	53	12.2 ± 1.20	12.2	8.0 - 14.0
Head width (mm)				
male	67	10.1 ± 0.90	10.1	8.0 - 12.0
female	53	9.7 ± 0.99	9.7	7.0 - 12.0
Head depth (mm)				
male	67	6.5 ± 0.84	6.5	4.0 - 8.0
female	53	6.1 ± 0.86	6.1	4.0 - 8.0
Tail length (mm)				
male	52	52.4 ± 6.31	52.4	31.0 - 64.0
female	42	51.0 ± 8.47	50.9	28.0 - 66.0
Weight (g)				
male	67	3.5 ± 0.94	3.6	1.9 - 5.8
female	53	3.4 ± 1.02	3.4	1.4 - 5.6

attributed to sexual selection or resource defense where males with larger heads are more successful in intrasexual confrontations (Carothers 1984; Vitt & Cooper 1985; Hews 1988; Smith 1992; Mouton & Wyk 1993).

METHODS AND MATERIALS

Geckos were collected on the campus of Stephen F. Austin State University in Nacogdoches, Nacogdoches County, Texas (94°W longitude and 31°N latitude). All geckos (N = 200) were taken after sunset between 1844 and 0045 hrs from 19 April to 15 October 1990. The first 15 geckos encountered during a sampling session were collected.

Specimens were returned to the lab where snout-vent-length (SVL), head length (measured from the base of the skull to the tip of the snout), head depth (measured from the deepest part of the head), head width (measured from the widest part of the head), and tail length (measured from the vent to the tip of the tail) were measured to the nearest 1.0 mm with dial calipers, and they were also weighed to the nearest 0.1 g. All geckos were measured (and weighed) before they were preserved. Individuals ≥ 44 mm SVL were considered adults (Selcer 1986). All lizards with broken or regenerated tails were excluded from testing for

Table 2. Analysis of covariance comparing morphological characters of adult male and female Mediterranean geckos using SVL as a covariate.

Morphological character	*F*	*df*	
Head length	3.96	117	0.0491
Head depth	12.35	117	0.0006
Head width	15.18	117	0.0002
Tail length	1.17	91	0.2829
Weight	5.82	117	0.0174

tail length differences. Sex was determined using the presence of preanal pores to identify males. Only adult males and females were used for statistical comparisons. A two-tailed t-test was used to evaluate differences in SVL between adult males and females. Analysis of covariance was used to compare differences in body size (head width, head length, head depth, tail length and weight), using SVL as a covariate, between adult male and female geckos ($P < 0.05$ was considered significant).

RESULTS

One hundred and twenty of the 200 geckos collected were identified as adults, using 44 mm SVL as a minimum size (Selcer 1986). Adult female geckos (N = 53) on average had a slightly longer SVL than males (N = 67) (Table 1), but the difference was not significant (t = 0.7927, P = 0.2148). Twenty-two percent of all adult males had broken or regenerated tails compared to 20.8% for all adult females. Relative tail length of males was slightly longer than females, but not significantly larger (t = 1.2336, P = 0.1103). Head dimensions (length, depth and width) and weight of adult males and females were significantly different, with males being larger at a given SVL (Table 2).

DISCUSSION

Male specimens examined during this study were significantly heavier than females at a given SVL (Table 2). This difference may be caused by weight loss of females following oviposition, therefore no conclusions are proposed relative to sexual selection of body mass.

Klawinski (1991) suggested that Mediterranean geckos may be territorial, demonstrated by low home range overlap and observations of intrasexual aggression in males. He also found that the males of this species emerge from winter retreats earlier than females, possibly to establish territories prior to the breeding season. Although there have been no studies conducted on this species concerning mate acquisition, it is possible that sexual dimorphism in head size in *H. turcicus* (males having the significantly larger heads) may be the result of sexual selection. This is based on studies of other species of lizards that exhibit sexual dimorphism in head size. Hews (1988) found that most female *Uta palmeri* mated with the owner of a territory and found that territorial males had larger heads than non-territorial males. Carothers (1984) studied 11 species of herbivorous lizards and found that low male aggression species have little or no head-size sexual dimorphism, while the aggressive male species showed significant differences in head and body size between males and females.

Another possible influence on head-size dimorphism may be ecological segregation. Saenz (1992) suggests that, while there is some evidence indicating differences in the diets of male and female Mediterranean geckos, the differences are probably due to differences in microhabitat selection because female geckos consumed the same size prey items as males.

If sexual selection has lead to the evolution of head-size dimorphism between the sexes of *H. turcicus,* the similarity of SVL between sexes remains unexplained. If there is competition among males for mating opportunities, selection for larger males might be expected. Why then, are females not smaller than males? A possible answer is that there is also an ecological advantage to larger body size in females resulting in parallel increases in body size in both sexes, where both sexes have reached their maximum size due to niche and habitat constraints but from different selective pressures. Increased body size in some lizards and snakes has been shown to be positively correlated with increased fecundity (Cuellar 1984; Shine 1986; Ford & Seigel 1989; Vial & Stewart 1989; Taylor et al. 1992). In temperate climates *H. turcicus* has a fixed reproductive output of two clutches per year (possibly more in tropical climates) and a fixed clutch size of two eggs (Selcer 1982), therefore, body size can not influence fecundity. Although fecundity is not related to female body size, there still may be some advantages. Selcer (1990) stated that larger Mediterranean geckos produce more lipid in their eggs, thus, larger females may produce better quality eggs, which may transfer a higher survival rate to offspring.

There may be converging selective pressures for larger body size in male and female Mediterranean geckos based on available behavioral studies and morphology. Because the morphometric differences between sexes were small (Table 1), conclusions resulting from statistically significant differences must be tempered with biological meaningfulness. Hence, there may be some uncertainty of the biological significance of the morphometric differences detected in this study. In order to better understand the origins of sexual dimorphism in this species, selective pressures should be examined more closely for both sexes, specifically head size in males as it relates to mate acquisition and lipid mass in eggs as it relates to survivorship of young.

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LITERATURE CITED

Camilleri, C. & R. Shine. 1990. Sexual dimorphism and dietary divergence: differences in trophic morphology between male and female snakes. Copeia, 1990(3):649-658.

Carothers, J. H. 1984. Sexual selection and sexual dimorphism in some herbivorous lizards. Am. Nat., 124(2):244-254.

Conant R. & J. T. Collins. 1991. A field guide to the reptiles and amphibians of eastern and central North America. Third Edition. Boston: Houghton Mifflin Company. 450 pp.

Cuellar, 0. 1984. Reproduction in a parthenogenic lizard: with discussion of optimal clutch size and a critique of the clutch weight/body weight ratio. Am. Midl. Nat., 111(2):242-258.

Ford, N. B. & R. A. Seigel. 1989. Relationships among body size, clutch size, and egg size in three species of oviparous snakes. Herpetologica, 45(1):75-83.

Hews, D. K. 1988. Resource defense and sexual selection on male head size in the lizard *Uta palmeri*. Am. Zool., 28(4):52A.

Klawinski, P. D. 1991. Home range, activity and spatial distribution of the Mediterranean gecko, *Hemidactylus turcicus*. Unpubl. M. S. Thesis, Stephen F. Austin State University, Nacogdoches, Texas. 51pp.

Marcellini, D. L. 1977. Acoustic and visual display behavior of gekkonid lizards. Amer. Zool., 17:251-260.

Mouton, P. le F. N. & J. H. Van Wyk. 1993. Sexual dimorphism in Cordlid lizards: a case study of the Drakensburg crag lizard, *Psuedocordlylus melanotus*. Can. J. Zool., 71(9):1715-1723.

Saenz, D. 1992. Dietary analysis of ***Hemidactylus turcicus***, the Mediterranean gecko, a population in Nacogdoches, Texas. Unpubl. M. S. Thesis, Stephen F. Austin State University, Nacogdoches, Texas. 45pp.

Selcer, K. W. 1982. Demography of the introduced gecko, ***Hemidactylus turcicus***, in southern Texas. Unpubl. M. S. Thesis, Pan American University, Edinburg, Texas.

81pp.
Selcer, K. W. 1986. Life history of a successful colonizer: the Mediterranean gecko, *Hemidactylus turcicus,* in southern Texas. Copeia, 1986(4):956-962.
Selcer, K. W. 1990. Egg-size relationships in a lizard with fixed clutch size: variation in a population of the Mediterranean gecko. Herpetologica, 46(1): 15-21.
Shine, R. 1986. Sexual differences in morphology and niche utilization in an aquatic snake, *Acrochordus arafurae.* Oecologia, 69:260-267.
Shine, R. 1991. Intersexual dietary divergence and the evolution of sexual dimorphism in snakes. Am. Nat., 138(1):103-122.
Smith, G. R. 1992. Sexual dimorphism in the curly-tailed lizard, *Leiocephalus psammodromus.* Caribb. J. Sci., 28(1-2):99-101.
Stejneger, L. 1922. Two geckos new to the fauna of the United States. Copeia, 192256.
Taylor, H. L., C. R. Cooley, R. A. Aguilar, & C. J. Obana. 1992. Factors affecting clutch size in the Teiid lizards *Cnemidophorus tigris gracilis* and *C. t. septentrionalis.* J. Herpetol., 26(4):443-447.
Vial, J. L. & J. R. Stewart. 1989. The manifestation and significance of sexual dimorphism in anguid lizards: a *case* study of *Barisia monticola.* Can. J. Zool., 67:68-72.
Vitt, L. J. & W. E. Cooper, Jr. 1985. The evolution of sexual dimorphism in the skink *Eumeces laticeps:* an example of sexual selection. Can. J. Zool., 63:995-1002.

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