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Contribution to the knowledge of the gecko *Tenuidactylus longipes* (Nikolsky, 1896) in northeastern Iran

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Thin-toed geckos of the genus *Tenuidactylus* are among the more complicated Palearctic lizard genera, and many taxonomic revisions have been done on this genus and its subgenera (*Cyrtopodion*, *Mediodactylus*, *Tenuidactylus*). In the latest revision by Bauer et al. (2013), molecular markers were used to uncover the phylogenetic relationships among all Palearctic thin-toad geckos, resulting in the synonymy of the subgenus names used by Szczerbak and Golubev (1996) with *Tenuidactylus*. The genus *Tenuidactylus* now comprises seven species, *T. caspius* (Eichwald, 1831), *T. dadunensis* (Shi & Zhao, 2011), *T. elongatus* (Blanford, 1875), *T. fedtschenkoi* (Strauch, 1887), *T. longipes* (Nikolsky, 1896) and the subspecies *T. l. microlepis* (Lantz, 1918), *T. turcmenicus* (Szczerbak, 1978), and *T. voraginosus* (Leviton & Anderson, 1984).

Tenuidactylus longipes (Fig. 1) was first described from Nehbandan, Iran, and in 1918 the subspecies *T. l. microlepis* was described from the Tajan River in the Afghanistan-Iran-Turkmenistan border region (Lantz, 1918). According to Smid et al. (2014), *T. longipes* is found in various parts of eastern Iran, specifically along the borders of Afghanistan and Turkmenistan. This includes areas such as Khorasan Razavi and South Khorasan Provinces. The populations in Iran are classified as *T. l. longipes*, perhaps to indicate a specific adaptation to local environments within the broader distribution of *T. longipes* across Central Asia (Bauer et al., 2013). These studies collectively highlight the significance of northeastern Iran as a critical area for the conservation and study of the species, providing a foundation for further research on its ecological requirements and potential threats due to habitat changes. *Tenuidactylus longipes* inhabits arid and semi-arid environments in northeastern Iran, including mud-brick buildings, rocky hills, dry open country, and central desert areas. These habitats provide essential microhabitats for thermoregulation and access to food sources (Khan, 2008). In the present study, we evaluate whether sexual dimorphism is present in northeastern Iranian populations of *T. longipes*, and we provide additional information about a new locality.

A total of 45 adult *T. longipes* (29 males, 16 females) was collected at two localities in Khorasan Razavi Province, northeastern Iran: (1) Derakht Bid Village, Mashhad (35.8053°N, 60.3517°E) and (2) Shorije Sofla Village, Sarakhs (35.9976°N, 60.9691°E). Specimens have been deposited in the herpetological collection of Damghan University as IRHC 186–230. Sex was determined in the field by gently pressing on the base of the tail. Fieldwork was conducted during the summers of 2013 and 2014 from 18:00–23:00 h on 15 days in the months of July-September of each year). The habitat is composed of semi-desert, riverine areas, and valleys with sandstone, which in this region is a periodic rock of red sandstone and micrite limestone. The area is covered with weak to medium vegetation, including trees – wild pistachio (*Pistacia vera*), fig (*Ficus carica*); shrubs and bushes – Russian sage (*Salvia abrotanoides*), buckthorn (*Rhamnus lycioides*), almond (*Prunus eburnea*), tamarisk (*Tamarix leptopetala*, *T. ramosissima*), raspberry (*Rubus idaeus*), camelthorn (*Alhagi maurorum*), mullein (*Verbascum thapsus*), Kopet Dag wormwood (*Artemisia kopetdaghensis*), Syrian rue (*Peganum harmala*); grasses – wall barley (*Hordeum murinum*); and herbaceous perennials – knapweed (*Onopordum heteracanthum*). The species is nocturnal and spends most of the time near cracks and holes, into which it retreats in the presence of a threat. It is often seen on the vertical surfaces of rocks and rarely on the flat ground.

We obtained 16 morphometric and 14 meristic characteristics. Morphometric characters were obtained to the nearest 0.01 mm using digital calipers, while

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Figure 1. Photo of *Tenuidactylus longipes* in northeastern Iran. Photo by Reza Babaei Savasari.

meristic characters were counted using a dissecting microscope. The characters include snout–vent length (SVL), tail length (TL), head length (HL), head width (HW), head height (HH), snout length (Sn Eye), eye diameter (Oeb D), ear length (Ear L), eye–ear distance (Eye Ear), trunk length (TrunkL), upper arm length (LS), humerus length (ForeaL), femur length (FemurL), tibia length (CrusL), length of 4th finger (LD4A), and length of 4th toe (LD4P). Meristic characters include the numbers of longitudinal abdominal scales (SAB), horizontal abdominal scales (SLB), subdigital lamellae on the 4th finger (LF4), subdigital lamellae on the 4th toe (LT4), precloacal pores (PP), supralabials (SL), infralabials (IL), longitudinal head scales (SLH), head scales in width (SAH), scales around the dorsal tubercles (SDT), scales separating the nasals (SSFNSH), pairs of postmentals (PMS), mid-dorsal longitudinal tubercles (Tub L), and mid-dorsal width tubercles (Tub W).

Statistical analyses were carried out with SPSS v27.0 software, and the significant threshold for all tests was $p \leq 0.05$. All measured characters were checked for normality using Kolmogorov-Smirnov and Shapiro-Wilks tests. Parametric statistics were performed for the normally distributed metric characters (*t*-test) and non-normal meristic characters were analyzed using non-parametric tests (Mann-Whitney *U*-test). Principal Component Analyses (PCA) and Discriminant Function Analyses (DFA) were done using the characters showing significant differences between sexes.

Results and Discussion

Two characters differed significantly between sexes, SAH and PP (Table 1). PP is absent in females and cannot be used for statistical analyses. Thus, we could only consider SAH as a significant character difference between male and female *T. longipes* in northeastern Iran.

The near-absence of sexual dimorphism in *Tenuidactylus longipes* may be attributed to several evolutionary factors that influence lizard and gecko morphology. Understanding these factors provides insight into the ecological and behavioral adaptations of these reptiles. It can be assumed that evolutionary reasons may underlie the lack of sexual dimorphism.

Geckos and other lizards adapt morphologically to their environments. In cases where both sexes share similar habitats and ecological roles, there may be less evolutionary pressure for sexual dimorphism. For example, if both males and females forage and avoid predators in the same way, sharing a similar body size and shape can enhance their survival and reproductive success. This is particularly relevant in environments where resources are limited or competition is high, leading to a convergence in morphology (Kratochvíl and Frynta, 2002; Heydari et al., 2011).

The mating strategies employed by a species can significantly influence the development of sexual dimorphism. In the species where females are choosy and males compete for their access, traits such as larger

Table 1. Descriptive statistics of morphometric characters for *Tenuidactylus longipes microlepis* from northeastern Iran. Measurements are in mm.

Character	Sex	Mean ± SD	Range	*p*-value
SVL	♂	53.26 ± 5.58	39.76 – 61.42	0.98
	♀	53.30 ± 6.02	40.99 – 59.92	
TL	♂	72.18 ± 8.25	55.44 – 85.00	0.56
	♀	70.40 ± 9.01	49.91 – 81.84	
HL	♂	13.99 ± 1.29	11.06 – 16.08	0.59
	♀	13.78 ± 1.18	11.57 – 15.31	
HW	♂	10.69 ± 1.23	8.25 – 13.19	0.45
	♀	10.43 ± 0.93	8.74 – 11.85	
HH	♂	6.04 ± 0.88	4.34 – 7.53	0.42
	♀	8.84 ± 0.64	4.64 – 6.81	
Sn Eye	♂	6.73 ± 0.81	4.95 – 8.35	0.61
	♀	6.61 ± 0.70	5.22 – 8.14	
TrunkL	♂	22.54 ± 3.14	16.79 – 29.96	0.81
	♀	22.31 ± 3.11	15.47 – 29.96	
LS	♂	10.77 ± 1.20	7.51 – 13.18	0.24
	♀	10.35 ± 1.00	8.60 – 11.55	
ForeaL	♂	9.71 ± 1.09	6.81 – 11.68	0.75
	♀	9.61 ± 1.06	7.64 – 11.11	
FemurL	♂	13.64 ± 1.60	10.26 – 17.66	0.86
	♀	13.72 ± 1.32	11.44 – 15.70	
CrusL	♂	13.01 ± 1.36	9.73 – 15.80	0.86
	♀	12.94 ± 1.26	10.19 – 14.29	
LD4A	♂	6.44 ± 0.64	4.33 – 7.31	0.22
	♀	6.19 ± 0.62	4.72 – 7.10	
LD4P	♂	8.17 ± 0.74	6.73 – 9.27	0.18
	♀	8.48 ± 0.72	6.98 – 9.83	

Character	Sex	Mean ± SD	Range	*p*-value
SAB	♂	42.31 ± 6.37	32 – 57	0.76
	♀	42.88 ± 5.09	30 – 49	
SLB	♂	147.93 ± 5.83	137 – 160	0.20
	♀	150.50 ± 7.23	139 – 165	
LF4	♂	21.00 ± 1.58	16 – 24	0.12
	♀	21.75 ± 1.48	20 – 24	
LT4	♂	24.76 ± 1.40	22 – 28	0.34
	♀	25.19 ± 1.47	22 – 27	
SL	♂	13.07 ± 0.75	12 – 15	0.11
	♀	13.44 ± 0.72	12 – 15	
IL	♂	9.55 ± 0.78	8 – 11	0.13
	♀	9.19 ± 0.75	8 – 10	
SLH	♂	49.41 ± 5.67	37 – 60	0.63
	♀	48.50 ± 6.89	36 – 60	
SAH	♂	54.93 ± 4.59	46 – 63	**0.02**
	♀	51.19 ± 6.00	41 – 60	
SDT	♂	11.07 ± 0.92	10 – 14	0.78
	♀	11.00 ± 0.51	10 – 12	
SSFNSH	♂	1.07 ± 0.25	1 – 2	0.53
	♀	1.13 ± 0.34	1 – 2	
PMS	♂	2.69 ± 0.47	2 – 3	0.67
	♀	2.75 ± 0.44	2 – 3	
TubL	♂	25.45 ± 1.57	23 – 29	0.17
	♀	24.81 ± 1.27	23 – 28	
Tub W	♂	12.00 ± 0.92	10 – 13	0.80
	♀	11.94 ± 0.57	11 – 13	

size or specific morphological features may evolve in males. Conversely, if *T. longipes* exhibits a mating system characterized by low competition among males or a lack of female choice, there would be no selective pressure for males to evolve traits that differentiate them from females (Kelly, 2015; Glynne and Adams, 2024).

The lack of sexual dimorphism in *T. longipes* likely results from a combination of the effects ecological adaptations and mating systems. These elements interact to shape the evolutionary trajectory of species, influencing their morphology and behavior in ways that either promote or inhibit the development of distinct male and female characteristics. Understanding these dynamics is crucial for comprehending the evolutionary biology of lizards in diverse environments. Working with this species in its natural habitat and understanding its reproductive behavior and that of syntopic species will help to inform the reason for the lack of sexual dimorphism in this species.

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