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Sunbathing on the southern beach: evidence of Egyptian mastigurs (*Uromastyx aegyptia*) on the Island of Tunb-e Bozorg, Persian Gulf

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Abstract
The herpetofauna of numerous Iranian islands in the Persian Gulf is largely unknown, and baseline data are urgently needed to monitor future trends. This study provides for the first time evidence that *Uromastyx aegyptia leptieni* is present on Tunb-e Bozorg Island in the Persian Gulf, Iran. Mitochondrial 16S rRNA sequence data were used to infer the phylogenetic relationship of the two Egyptian mastigurs from Tunb-e Bozorg Island. The dorsal color pattern of the Iranian specimens perfectly matches with the original description of *Uromastyx aegyptia leptieni*. In addition, our phylogenetic analysis shows that the examined specimens are identical to a specimen of *Uromastyx aegyptia leptieni* from the United Arab Emirates. The special conditions on Tunb-e Bozorg Island have provided a suitable habitat for *Uromastyx aegyptia leptieni*, which has led to a relatively large and self-sustaining population.

Keywords: Iranian Islands, Persian Gulf, Uromastycinae, mtDNA, Haplotype, taxonomy

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The spiny-tailed lizards of the genus *Uromastyx* Merrem, 1820 are distributed in the arid regions of North Africa and extend across the Arabian Peninsula towards Iran (Sindaco and Jeremčenko, 2008; Uetz et al., 2023; Wilms, 2005; Wilms et al., 2009). The genus comprises a total of 15 species, of which *Uromastyx aegyptia* (Forskål, 1775) has been recorded in the coastal region of Iran (Uetz et al., 2023; Anderson 1999; Tamar et al., 2018). *Uromastyx aegyptia* (Forskål, 1775) is the largest species within the genus, with a potential body length of over 700 mm and a weight of up to 2,500 g (Wilms et al. 2009b). Three subspecies have been identified within this species: *Uromastyx aegyptia aegyptia* (Forskål, 1775), *Uromastyx aegyptia microlepis* Arnold 1980, and *Uromastyx aegyptia leptieni* Wilms & Böhme 2000 (Uetz et al., 2023). The species is currently classified as "Vulnerable" in the IUCN Red List of Threatened Species (IUCN, 2022) and has been listed in Appendix II of CITES (Safaei-Mahroo et al., 2015).

The *Uromastyx aegyptia* demonstrates remarkable adaptability to the extreme conditions of desert ecosystems, utilizing macro- and microhabitat shifting to facilitate effective thermoregulation (Wilms, 2005). It prefers to inhabit burrows with a length of up to 1025 cm and a depth of approximately 180 cm (Bouskila, 1983). Various environmental factors, such as climatic conditions, soil characteristics, vegetation density, and altitude, significantly influence the habitat preferences of *U. aegyptia* (Wilms et al., 2009b; Aghanajafizadeh and Mobaraki, 2018). It is noteworthy that *U. aegyptia* can adjust its dietary patterns, transitioning from a primarily herbivorous diet (based on a diverse array of native plant species) to a mainly carnivorous diet (consisting of insects and other arthropods) (e.g., Bouskila, 1987; Cunningham, 2000; Castilla et al., 2011a; Castilla et al., 2011b).

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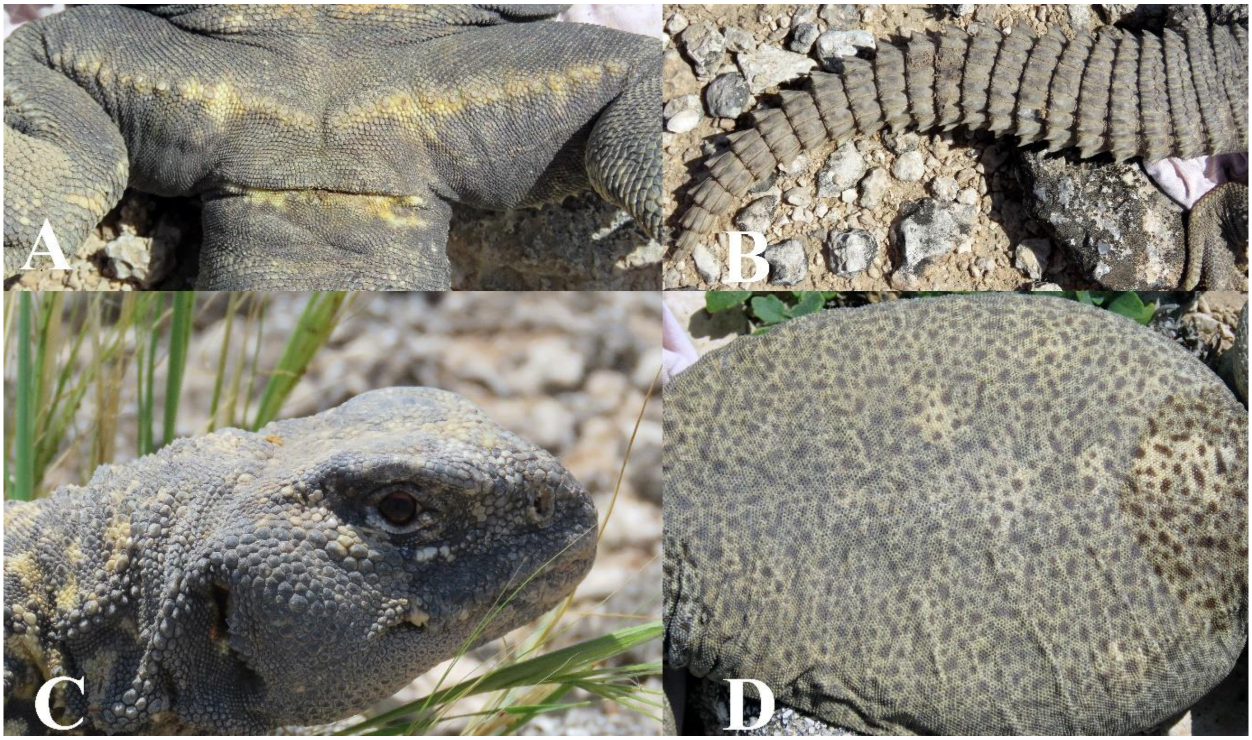

FIGURE 1. Photographs of *Uromastyx aegyptia leptieni*, caught on the island of Tunb-e Bozorg, Persian Gulf. Ventral view of the cloacal region, preanal and femoral pores present (A); whorls of spiny scales on the upper side of the tail (B); lateral view of the head (C); no enlarged scales on the upper side of the back (D).

Notwithstanding the absence of taxonomic studies, the Iranian populations are assigned to the subspecies *Uromastyx aegyptia microlepis* with a distribution range in the southern provinces of Hormozgan, Bushehr, and Fars (e.g., Anderson, 1999; Safaei-Mahroo et al., 2015). Herein, I present novel molecular data from two specimens collected from Tunb-e Bozorg Island, accompanied by natural history observations. It is noteworthy that Tunb-e Bozorg Island is one of the minor Iranian islands situated at the entrance of the Strait of Hormuz in the Persian Gulf, southern Iran.

During the field survey conducted on the Tunb-e Bozorg Island from May 6-9, 2024, aimed at examining the reptile's fauna, two juvenile specimens of *Uromastyx* were captured alive. The first step was to take high-resolution pictures of different body parts (Figure 1). Following standard protocols, blood samples were obtained from the caudal vein, and the animals were subsequently released back into their natural habitat (Figure 2B). The collected blood samples (HAC 1378, HAC 1379) were preserved at a temperature of −20 °C in a nucleic acid preservation buffer (NAP) in the Shahrekord University Herpetological Collection (HAC), Iran.

Total genomic DNA was extracted from the blood samples following standard extraction protocols (Green & Sambrook, 2012). Primers L16S, 5' - CGCCTGTTTATCAAAAACAT -3' and H16S, 5'- CCGGTCTGAACTCAGATCACG -3' were used to amplify a fragment of 16S rRNA gene (Kocher et al. 1989). The PCR protocol was as follows: Denaturation, 95 °C for 3 min; 36 cycles of 95 °C for 40 sec, primer annealing at 52 °C for 40 sec, and sequence elongation at 72 °C for 80 sec; 72 °C for 10 min; and subsequent storage at 4°C for 3 min. The amplification products were sequenced on an automated sequencer ABI 3730XL (GeneAzma Genetic Group, Isfahan, Iran) according to standard protocols.

A 494 base pair segment of the mitochondrial DNA sequences of the 16S rRNA gene was generated in this research and then deposited in the National Center for Biotechnology Information (NCBI) (PQ164784 (HAC 1378); PQ164783 (HAC 1379)). Sequences were edited in Bioedit version 7.0.0 (Hall 1999) and aligned with CLUSTAL W (Thompson et al. 1994). Additionally, available sequences of 16S rRNA for *Uromastyx aegyptia* were downloaded from GenBank (Table S1). The sequences that were acquired were trimmed, finally, a dataset with a final sequence length of 486 nucleotides was generated. An unrooted phylogenetic network between 16S haplotypes of *Uromastyx aegyptia* was constructed utilizing the TCS network algorithm (Clement et al. 2002) implemented in Hapsolutely 0.2.2 (Vences et al. 2021) with the use of default parameters.

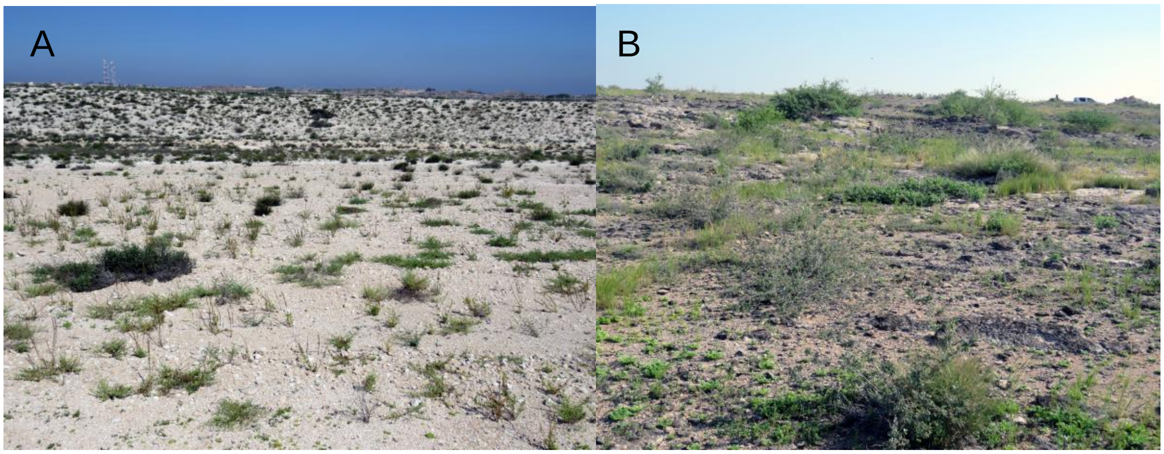

Figure 2. Different types of natural habitats of *Uromastyx aegyptia leptieni* on the island of Tunb-e Bozorg, Persian Gulf. () stony ground and gravelly plains with scattered bushes; (B) The flat silty gravel plains dominated by sparse vegetation.

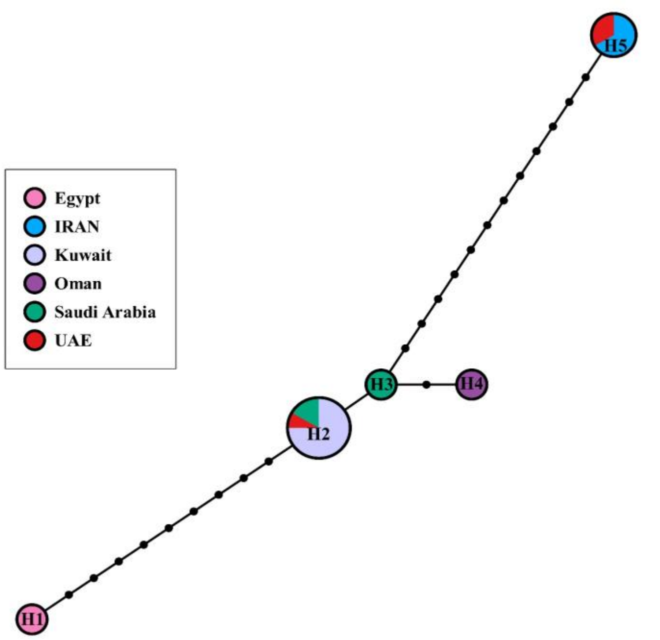

FIGURE 3. Phylogenetic network based on haplotypes for the *16S* rRNA fragment (486 bp) in *Uromastyx aegyptia*. Circles correspond to haplotypes, with size proportional to the number of individuals per haplotype. Vertical lines correspond to mutational steps. Colors represent the geographic origins of haplotypes according to Table S1.

The analysis of the 16S rRNA sequences provides convincing evidence that the samples collected on Tunb-e Bozorg Island belong to *Uromastyx aegyptia leptieni* (Figure 3). In addition, the fact that the dorsal coloration pattern observed in the Iranian specimens is in perfect agreement with the original description of *Uromastyx aegyptia leptieni* (Figure 1). Unfortunately, the lack of the necessary equipment prevents the verification of the ventral count in the field (see Wilms & Böhme 2000). This study provides the first confirmation of the existence of *Uromastyx aegyptia leptieni* in Iran. Moreover, since the type locality of *Uromastyx aegyptia microlepis* (near Basrah, Iraq) is geographically adjacent to Iran, it is plausible that this subspecies also occurs on Iranian territory. To confirm or refute this hypothesis, comprehensive environmental and genetic studies are required.

On the island of Tunb-e Bozorg, my observations have shown that *Uromastyx aegyptia leptieni* inhabits two different natural habitats (Figure 2). One habitat, characterized by flat, silty gravel plains and sparse vegetation, hosted a significant population of *Uromastyx aegyptia leptieni* with over 40 active nests (Figure 2A). These lizards-built burrows with a single entrance and quickly retreated into them as soon as they noticed a potential threat, making capture in this environment seemingly impossible. Due to the extreme depth of these burrows, an enormous amount of energy is required to dig down to the ground. Nevertheless, these holes were expertly dug in a zigzag and spiral pattern. The second habitat consisted of stony ground and gravelly plains dotted with scattered bushes (Figure 2B), where the lizards resided in crevices under rocks, with no signs of burrow construction. Some researchers have claimed that the spiny-tailed lizard shows a preference for basking just after sunrise (Cunningham, 2000). However, my personal observations did not agree with this claim, as the lizards were predominantly observed either basking or foraging in the grass near their burrow entrances at around 8am. According to my observations, its sympatric and/or syntopic lizard and snake species include *Echis carinatus*, *Hemidactylus sp.*, *Pristurus sp.* and *Mesalina brevirostris*.

Globally, the Egyptian spiny lizard's habitat is shrinking due to factors such as overgrazing by livestock, human settlement, large-scale agricultural expansion, land reclamation, waste disposal and off-road vehicle traffic (IUCN, 2022). The expansion of military infrastructure on Tunb-e Bozorg Island has likely resulted in the loss of a significant proportion of suitable habitat for *Uromastyx aegyptia leptieni*. Despite these challenges, the Egyptian spiny lizard still thrives in some areas of Tunb-e Bozorg Island. Human-induced habitat degradation has contributed significantly to the increase in species extinction rates and the decline of populations worldwide (Burriel-Carranza et al., 2024). In certain countries, *Uromastyx aegyptia* is captured and traded for its skin to make leather, while its meat is used as a source of protein (e.g. Monchot et al., 2014; Aloufi et al., 2019). So far, no damage to the spiny-tailed lizard has been reported by people living on Tunb-e Bozorg Island.

In summary, the unique circumstances on Tunb-e Bozorg Island have created a favorable environment for *Uromastyx aegyptia leptieni* in some regions, resulting in a relatively large and self-sustaining population. There is evidence that military training areas not only fulfill their primary purpose of defense and training, but can also play an important role in environmental conservation by providing refuges for wildlife and helping to maintain healthy ecosystems (e.g. Pascaline and Sébastien, 2024). It appears that *Uromastyx aegyptia leptieni* is thriving on Tunb-e Bozorg Island without the need for a specific conservation program and that there is no immediate threat. However, it is important to point out that the two mitochondrial sequences used in this study are not sufficient to accurately assess the genetic diversity of this population. Therefore, I look forward to the possibility of using additional genetic markers in future studies to investigate the genetic diversity of *Uromastyx aegyptia* in the southern regions of Iran.

Acknowledgments

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article at the publisher's web-site.

TABLE S1. Information of all sequences included in this study along with their localities and NCBI accession numbers.

DATA AVAILABILITY STATEMENT
The data for this study, including accession numbers for genetic sequences deposited on NCBI GenBank, are recorded in the Supporting Information, Table S1.

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