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ORIGINAL ARTICLE

Burrow Characteristics and Microhabitat Use of the Turpan Wonder Gecko *Teratoscincus roborowskii* (Squamata, Gekkonidae)

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Abstract Burrow structural charactersitcs and microhabitat use of the Turpan wonder gecko *Teratoscincus roborowskii* (Gekkonidae) were studied between April and September of 2013 in the Turpan Eremophytes Botanic Garden, in the Turpan Depression of Western China. Burrow depth, entrance orientation, entrance height and width were observed. We assessed microhabitat selection and noted differences in microhabitat use among males, females, and juveniles. The magnitude of selection was measured using Jacobs' index of selectivity. Entrance height and width of the burrows of adults were significantly larger than those of juveniles, but the difference in burrow depth was not significant. The directional orientation of the burrow entrance showed a preference for the north-northeast and south-southeast, which were likely influenced by local prevailing winds and sunlight. Both the adult and juvenile geckos prefer to construct their burrows in sandy soil within a layer of loose soil whose thickness is greater than 30 cm. A majority of the burrows were located within 20 m of the nearest plant. Nearly half (48%) of the entrances of juveniles were located within 5 m of the nearest vegetation, significantly different from those of the adults. Results showed that the Turpan wonder gecko did not utilize microhabitats according to their availability, but rather that it preferred microhabitats which contained dead wood or the caper bush. Our results suggested that burrow characteristics and microhabitat selection were important factors in *T. roborowskii* adaptation to harsh and arid desert habitats.

Keywords arid desert habitat, burrow depth, entrance height, entrance orientation, entrance width, microhabitat selection, retreat site

1. Introduction

The habitat use of animals is influenced by several factors that can have a dramatic influence on an individual animal's health (Lovich and Daniels, 2000). The selection of certain habitats can facilitate access to important resources such as food, water, mates, and nesting sites (Perry and Garland, 2002), as well as providing protection from predators (Irschick *et al.*, 2005) and harsh environmental conditions (Qi *et al.*, 2012). When specific habitats are selected (preferred) by animals, they are used to a degree which is disproportionate to their availability (Manly *et al.*, 1993). Major assumptions that researchers make regarding habitat selection are that animals select habitats which maximize their health and the meeting of their ecological needs, and that high quality habitats are chosen more often than low quality habitats (Manly *et al.*, 1993). In comparison with habitats which are only occupied transiently, the location of nests, burrows, and other structures used by animals for longer periods of time represents a relatively long-term, and potentially costly, commitment to a particular microhabitat (Hansell, 1993). Consequently, the location of these structures has significant physiological and life history consequences (Huey, 1991; Lovich and Daniels, 2000). One of the main factors determining the microhabitat use of lizards is the

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vegetation structure (Attum and Eason, 2006; Dias and Rocha, 2004; Huey *et al.*, 1983), which is usually thought to be closely linked with microclimatic conditions, burrow location, and the availability of mates and food (Attum and Eason, 2006; Converse and Savidge, 2003; Huey, 1991). Microhabitat use is also related to the age and sex of individuals (Butler *et al.*, 2007).

The Turpan wonder gecko (*Teratoscincus roborowskii*) is a species endemic only to the Turpan Depression of the Xinjiang Uyghur Autonomous Region, China (Shi *et al.*, 2002). Most research on the Turpan wonder gecko has focused on mimicry (Kellar and Batur, 1989), foraging mode (Werner and Okada, 1997), activity rhythm (Song *et al.*, 2009), sexual dimorphism and diet (Liu *et al.*, 2010), skeletochronology (Li *et al.*, 2010), and home range (Li *et al.*, 2013). Sparse data is available on the structural characteristics of their burrows and their selection of microhabitat. The purpose of this study was to examine and codify the environmental characteristics of Turpan wonder gecko burrows and microhabitat selection in the desert landscape of the Turpan Depression in Western China. Two questions were posed at the beginning of the study: 1) Does the Turpan wonder gecko randomly locate its burrows? If not, then which environmental factors determine burrow site selection? 2) Were there differences in microhabitat use between males, females, and juveniles?

2. Materials and Methods

2.1 Site description The study site was the Chinese Academy of Sciences' Turpan Eremophytes Botanic Garden (TEBG, E89°11′, N42°54′), which is located in the Turpan Basin of China's Xinjiang Uyghur Autonomous Region. TEBG lies at an altitude of -80.97 m. It contained many dry dunes covered with small patches of desert vegetation, which rarely exceeding a height of more than 5 m above the surrounding ground. These dunes were covered by moderately dense patches or stands of *Tamarix* spp. (tamarisk or saltcedar), *Calligonum* spp., *Ammopiptanthus* spp., *Nitraria* spp., or *Haloxylon* spp. (saxaul). There were also many other reptiles present such as the rapid racerunner (*Eremias velox*), the Yarkand toad-headed agama (*Phrynocephalus axillaris*) and the Tartar sand boa (*Eryx tataricus*). The climate of the study area was classified as temperate with a mean annual temperature of 14°C. This area has an annual average precipitation of 16.4 mm, with a maximum temperature of 49.7°C in summer and a minimum temperature of –28.7°C in winter (Yin, 2004).

2.2 Data collection

2.2.1 Gecko sampling We collected data from April to September of 2013. Individual specimens of the Turpan wonder gecko were caught using a net and marked by toe-clipping and a number which was painted on its back with white paint (Semenov and Borkin, 1992). Snout-vent length (SVL, from the tip of snout to vent, to the nearest 0.02 mm) was measured with dial calipers. Age was estimated based on SVL (Song *et al.*, 2009). Field records indicated that the minimum SVL of a pregnant individual is 75.52 mm, therefore, we assumed that a SVL ≥ 75.52 mm was an adult and a SVL < 75.52 mm was a juvenile (Li *et al.*, 2010; Liu *et al.*, 2010). Sex was determined by an examination of the base of the tail, where males had two prominent protuberances. Sex was not determined for juveniles since the small size of the individuals made it difficult. After marking and collecting data, the individuals were released in the exact location where they were caught.

2.2.2 Burrow confirmation The burrow of the Turpan wonder gecko was identified using the plugging and digging method (Herbst and Bennett, 2006). First, all holes were plugged with sand and then a layer of fine sand (about 1 cm thick) was spread in front of the hole at dusk before the Turpan wonder gecko had gone out of its burrow and after other types of lizards had returned to their own places of refuge. The following morning, the active burrows of the Turpan wonder geckos were identified by the opened hole and the footprints left in the fine sand immediately in front of the hole. Using the spotlighting technique, the Turpan wonder gecko can be spotted through its eyeshine when it comes out of its burrow during the night (Semenov and Borkin, 1992). We identified the individual and its burrow using the number painted on its back just as it came out of its burrow each day.

2.2.3 Burrow characteristics Data on 131 burrow structures were recorded. Thirty-two burrows were excavated during our research. To prevent losing the direction of the burrow as we dug, we first inserted a thin, soft, flexible branchlet from a shrub into the hole and into its various branches, which we were able to follow while digging (Wu *et al.*, 2004). The width and height of the entrance and the maximum depth of the burrow underground were measured. We also measured the distance of each burrow opening to the nearest plant, which was a shrub in most cases. Grass was rare and there were no trees in our area of study.

The possible directions which each entrance faced were divided into the following eight sections with north being 0° and were given names corresponding to the names of the eight half-winds of the compass rose on which they are centered: north-northeast (0°–44°), east-northeast (45°–89°), east-southeast (90°–134°), south-southeast (135°–179°), south-southwest (180°–224°), west-southwest (225°–269°), west-northwest (270°–314°), and north-northwest (315°–359°).

2.2.4 Burrowing site selection Data regarding microhabitat selection on 56 burrows was collected. The soil within a 5 m × 5 m square centered on the burrow entrance was classified as either sandy or semi-sandy (Huang, 2000). We also measured the distance from the ground surface to the top of the compact loam layer.

2.2.5 Microhabitat use. Field work to observe Turpan wonder gecko microhabitat use was conducted during August of 2013 at night from 22:00 to 2:00 o'clock (peak activity for the species, Song *et al*., 2009). In order to delineate the different types of microhabitat that were available to the wonder gecko, line transects (n = 28; 100 m length) were sampled and 11 microhabitat categories present in the environment were identified and labeled as follows: (1) *sand*, (2) *Calligonum* spp, (3) *Zygophyllum fabago*, (4) *Alhagi sparsifolia*, (5) *Phragmites australis*, (6) *Karelinia caspia*, (7) *Hexinia polydichotona*, (8) *Capparis spinosa*, (9) *Tamarix* spp, (10) *Haloxylon* spp, and (11) *dead wood*. Transect lines were arranged systematically in the study area. Parallel transect lines were 100 m apart. We used a 100-meter measuring rope randomly placed in the field and recorded the horizontal projection length of each microhabitat category on the rope. We choose the line transect method because plants in our area of study were sparsely distributed, and quadrat sampling can be fairly imprecise in this environment (Buckland *et al*., 2007).

The line cover percentage (%) was equal to (=) the length of the horizontal projection of each category divided by (/) total length times (×) 100%

All surveys were performed under similar weather conditions: average temperature ± SD of 30 ± 3ºC; a cloudless sky, and a moderate wind. Total survey effort was 80 person-nights. For each lizard detected through its eyeshine and caught by hand (Semenov and Borkin, 1992), the microhabitat type of the location where it was first detected was recorded using the method above to describe that microhabitat. Microhabitats, both those used and preferred, were characterized using these microhabitat categories. Three ways to categorize individual specimens were also utilized: adult males, adult females, and juveniles (Kacoliris *et al*., 2009).

2.3 Data analysis The difference in burrow dimensions between juveniles and adults was compared using Independent-Samples *t* Test and the chi-squared test. Manly's alpha α_r value for nr microhabitats was estimated (Kacoliris *et al*., 2009; Manly *et al*., 1993). This index represents the preference of the taxon of interest for resource r, defined as:

$$\alpha_r = \frac{\frac{f_r}{g_r}}{\sum_{j=1}^{n_r} \frac{f_j}{g_j}}$$

Usage (f_r) was measured as the number of individuals found in each type of microhabitat, and availability (g_r) was measured as the line cover of each microhabitat category.

The deviation of the α_r estimate from $1/n_R$, $D_r = \alpha_r - 1/n_R$ was utilized as a two-sided test for selection or avoidance of a particular microhabitat. The direction of preference was data $D_r > 0$ indicating preference, and data $D_r < 0$ indicating avoidance (Kacoliris *et al*., 2009).

In order to evaluate the magnitude of selection of each lizard category, Jacobs' index (JI) was calculated:

$$JI = \frac{p_r - g_r}{p_r + g_r - (2p_r g_r)}$$

This index took into account the proportion of use (p_r) and the proportion of availability (g_r) (Manly *et al*., 1993); an index value of –1 indicates that a particular microhabitat was completely avoided, whereas +1 indicates maximum preference.

Statistical procedures were performed using SPSS 19.0. Levels of statistical significance were set at α = 0.05. The chart was generated using Microsoft Excel 2003. Average in the text was Mean ± SD.

2.4 Animal care Specimens were collected and toe-clipped following the guidelines of the American Society of Ichthyologists and Herpetologists (ASIH, 2004). This work was performed in compliance with the current laws on animal welfare and research in China.

3. Results

3.1 Burrow characteristics From April to September of 2013, a total of 131 burrows were investigated and 32 were excavated to determine the burrow structure of the Turpan wonder gecko. The field investigation revealed that Turpan wonder gecko usually lived singly. Occasionally, a male and female adult emerged from the same burrow in the early evening. This meant that they may have cohabited for a short time. The width and height of the entrance of the burrow of an adult was significantly greater than that of the juvenile (Table 1).

There were between 1 and 4 branches in a single burrow, which generally had only one open entrance with any others buried by sand. The burrows of adults were deeper than those of juveniles, but the difference was not significant (Table 1). The maximum depth of most burrows (71.88 %) exceeded 20 cm.

Figure 1 shows the directions which the entrances faced of the 132 burrows surveyed. There were significant differences in the tendencies of the entrances to face in the various directions (X^2 = 21.46, df = 8, P = 0.003). As can be seen from Figure 1, the Turpan wonder gecko tended to orient its burrow's entrance facing north-northeast (0°–44°), south-southeast (135°–179°), and north-northwest (315°–359°), while avoiding east-northeast (45°–89°), west-southwest (225°–269°), and west-northwest (270°–314°) orientations. There were no significant patterns of selectivity for the remaining two directions. Overall, the Turpan wonder gecko had a tendency to build north or south facing entrances, and most notably avoided building ones which faced either east or west.

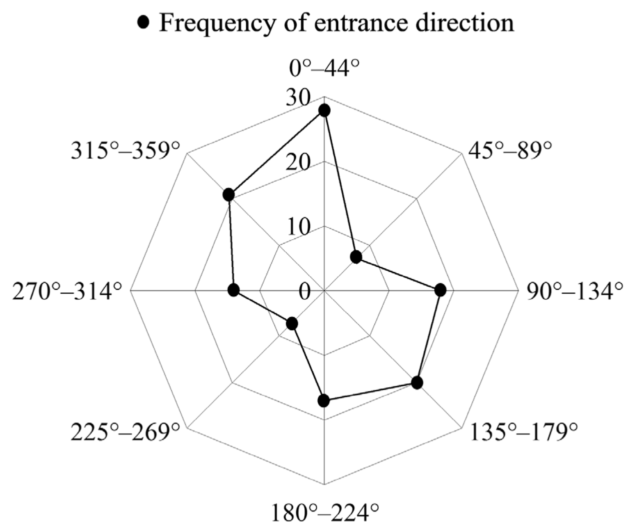

Figure 1 The burrow entrance selection of *Teratoscincus roborowskii* in 8 directions.

3.2 Burrow site selection In September of 2013, 56 burrows were surveyed to assess the burrow site selection of the gecko. The Turpan wonder gecko selected sandy and semi-sandy zones in which to excavate its place of refuge (Table 2). There were significantly more burrows located in sandy ground compared to the number located in semi-sandy ground (X^2 = 16.690, df = 2, P = 0.001). Both adults and juveniles showed significant preference for sandy habitat (adult: X^2 = 21.631, df = 2, P = 0.001; juvenile: X^2 = 10.452, df = 2, P = 0.001), and in this regard, there was no significant difference between them (X^2 = 2.253, df = 2, P = 0.133).

The distance from the entrance to the nearest plant ranged between 0.80 and 25 (6.79 ± 3.65) m for adults and between 0.25 and 18 (6.28 ± 5.71) m for juveniles. There was no significant differences (t = 0.117, df = 2, P = 0.103).

Nearly half (48%) of the burrow entrances of the juveniles were located less than 5 m from the nearest vegetation. This proportion was significantly larger than adults (X^2 = 4.7, df = 2, P = 0.03).

The Turpan wonder gecko showed significant preference for burrowing in a layer of loose earth whose thickness was greater than 30 cm (X^2 = 30.868, df = 2, P = 0.001). Both adults and juveniles preferred this loose layer to be more than 30 cm thick (Table 2), with no significant difference between the two (X^2 = 0.000, df = 2, P = 1.000).

3.3 Microhabitat selection We recorded data on 215 individual specimens, of 93 were males, 55 were females, and 67 were juveniles (More details concerning measurements are provided in Appendix Table 1). Jacobs' selectivity index showed that our *dead wood* microhabitat (JI = 0.93–0.94) was the most highly preferred by males, females, and juveniles alike. The most avoided microhabitats in all cases were those we labeled as *Zygophyllum fabago*, *Alhagi sparsifolia*, *Phragmites australis*, *Karelinia caspia*, *Hexinia polydichotona*, *Tamarix* spp, and *Haloxylon* spp (JI = –1). Juveniles avoided *Haloxylon* spp and *sand*, which adult males and females preferred. However, the general patterns of preference were similar among males, females, and juveniles (Table 3).

4. Discussion

4.1 Burrow characteristics Many animals choose to live in burrows for a variety of reasons. Burrows provide them with protection from surface high temperatures (Keswick and Hofmeyr, 2014) and from predators (Rand and Dugan, 1983). However, the activity of burrowing itself requires high energy consumption in a dark environment (at night) and inside the burrow, the animal must face many other disadvantages such as a low air exchange rate and restricted activity (Wu *et al.*, 2015). The ratio of the differing habitats which are available in the environment

Table 1 Measurements of burrow entrance and depth.

Index	Average (cm)		Range (cm)		Significance
	Adult (n = 19)	Juvenile (n = 13)	Adult (n = 19)	Juvenile (n = 13)	
Width of entrance	3.58 ± 1.13	2.42 ± 0.10	2.5–8.0	1.5–5.6	t = 5.403, df = 2, P = 0.001
Height of entrance	2.75 ± 0.83	1.65 ± 0.76	1.2–5.5	1–5.5	t = 6.042, df = 2, P = 0.001
Depth of burrow	32.50 ± 9.37	27.86 ± 12.08	11–62	13–42	t = 0.838, df = 2, P = 0.417

Table 2 Burrow distributing frequency of *Teratoscincus roborowskii* in different arrangements of habitat factors.

Ecological factor	Grade	Frequency (%)			Ratio of Availability (%)
		Adult	Juvenile	Total	
Soil	sand	68.7	56	63.8	20
	semi-sand	31.1	44	36.2	80
Distance to nearest individual plant	≤ 5 m	29.03	48	37.5	
	> 5 m, ≤ 10 m	29.03	24	26.79	
	> 10 m, ≤ 15 m	29.03	16	23.21	
	> 15 m	12.90	12	12.5	
Depth of loose soil	≤ 30 cm	18.75	19.23	18.97	72
	> 30 cm	81.25	80.77	81.03	28

is disproportionate, which makes it obvious that many animals intentionally select their microhabitats (Chesson, 1978). According to meteorological data (gathered in the field and provided by Dr. Kang Xiaoshan), a north-west wind is prevalent in our study area. As mentioned above, the Turpan wonder gecko tends to choose an entrance which faces either north-northeast (0°–44°), south-southeast (135°–179°) or north-northwest (315°–359°), while avoiding those which face east-northeast (45°–89°), west-southwest (225°–269°) and west-northwest (270°–314°). This behavior probably seeks to avoid the entrance being buried or destroyed by sand (Peter and Cunning, 2001). The reason that no significant selectivity was demonstrated for the other two orientations may be related to sunlight intensity or daytime temperature changes, but further study would be needed to determine that.

One important function of a burrow is to provide a place of shelter against unfavorable external environmental conditions (Roper *et al.*, 2001). Hot desert environments can produce periods of high ambient air temperatures (sometimes in excess here of 50°C) intense solar radiation, desiccating winds, a lack of surface water for hydration, and low primary production, conditions which in combination may pose a serious challenge to the survival and reproduction of any inhabitants (Shenbrot, 2004). High summer temperatures of the desert region are hazardous for animal life. Animals must therefore regulate their body temperature to endure this extreme condition.

The Turpan wonder gecko is nocturnal and retreats to its burrow during the day to escape the sun and high temperatures outside. Temperature data according to the Turpan Desert Botanical Garden Station show that in the hot summer months, the temperature of the earth 20 to 50 cm below the ground surface is relatively constant (Figure 2).

According to Song *et al.* (2009), the minimum external ambient air temperature at which the Turpan wonder gecko will be active is 17°C and the maximum temperature is about 41°C. So 17 to 41°C is the gecko's approximate active temperature range. Meteorological data from April to September show that the temperature ranges from 16.1 to 41°C 20 to 50 cm below the ground surface (Figure 3). The Turpan wonder gecko hibernates in its burrow through the cold winter. The minimum temperature inside the burrow during hibernation needs to be above 0°C to prevent its body from freezing. According to meteorological data, the lowest temperature

Table 3 Microhabitat use availability analysis for the Turpan wonder gecko *Teratoscincus roborowskii*.

Categories	Av	All individuals			Male		Female		Juvenile	
		n	αr	Dr	*n*	JI	*n*	JI	*n*	JI
Calligonum spp.	0.17	48	0.030	–0.061	7	–0.43	4	–0.45	4	–0.53
Zygophyllum fabago	0.06	2	0.003	–0.087	0	–1.00	0	–1.00	0	–1.00
Alhagi sparsifolia	0.11	1	0.001	–0.09	0	–1.00	0	–1.00	0	–1.00
Phragmites australis	0.07	0	0	–0.091	0	–1.00	0	–1.00	0	–1.00
Karelinia caspia	0.06	0	0	–0.091	0	–1.00	0	–1.00	0	–1.00
Hexinia polydichotona	0.06	1	0.002	–0.089	0	–1.00	0	–1.00	0	–1.00
Capparis spinosa	0.16	187	0.125	0.034	36	0.54	20	0.50	34	0.69
Tamarix spp.	0.07	12	0.017	–0.074	0	–1.00	0	–1.00	0	–1.00
Haloxylon spp.	0.01	17	0.148	0.057	3	0.46	3	0.65	0	–1.00
Dead wood	0.01	71	0.618	0.527	25	0.94	15	0.94	17	0.93
Sand	0.20	109	0.056	–0.035	22	0.08	13	0.08	12	–0.09

Av = proportion of microhabitat availability; *n* = number of detected lizards; αr = Manly's alpha index; Dr = deviation between αr and 1/nR ; JI = Jacobs index.

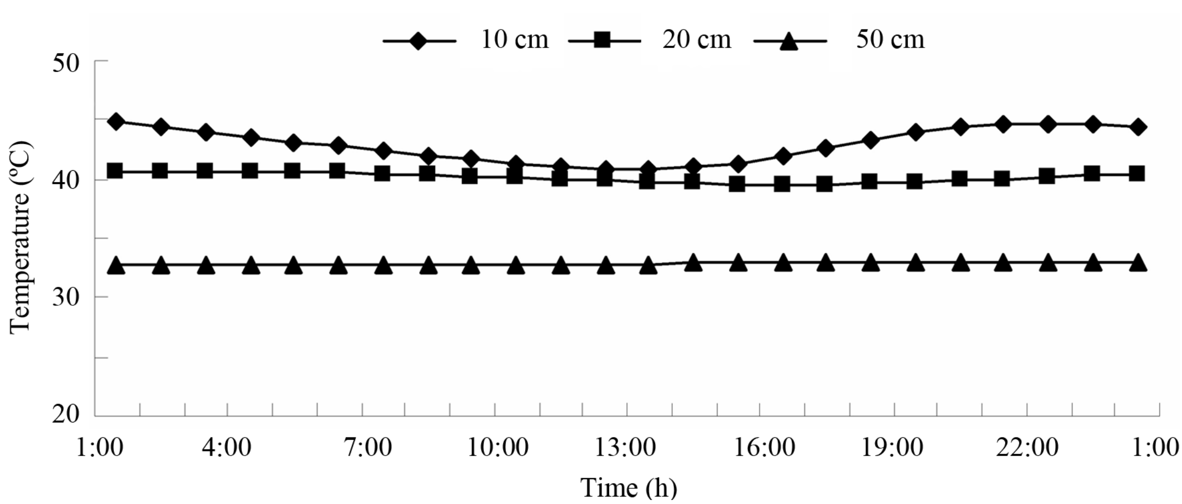

Figure 2 Diel temperature variations in different depths of soil in summer.

20 cm below the ground surface is –3.3°C in winter; Obviously, at a depth of more than 20 cm, the lowest temperature will be higher than –3.3°C, and temperature fluctuation will be minimal (Figure 3). Therefore, a burrow at a depth of more than 20 cm provides a suitable place for the Turpan wonder gecko. This is certainly the reason the majority of the burrows are deeper than 20 cm. We also found that most burrows with a depth of less than 20 cm were simple in their structure having only one entrance and a short and straight tunnel. These may have been temporary burrows, or ones that were in the process of being dug.

4.2 Burrowing site selection The choice of habitat has been one of the core subjects of animal behavior and evolutionary ecology. Habitat selection can have a direct impact on the health of individual animals and on a populations' evolutionary mechanisms (Morris, 2003). For example, habitat selection has an important impact on foraging, predator avoidance, and reproductive success. It also has an important role on ecological diversity of the structure and evolution of the population (Steele, 1993). Among the various factors that affect habitat selection,

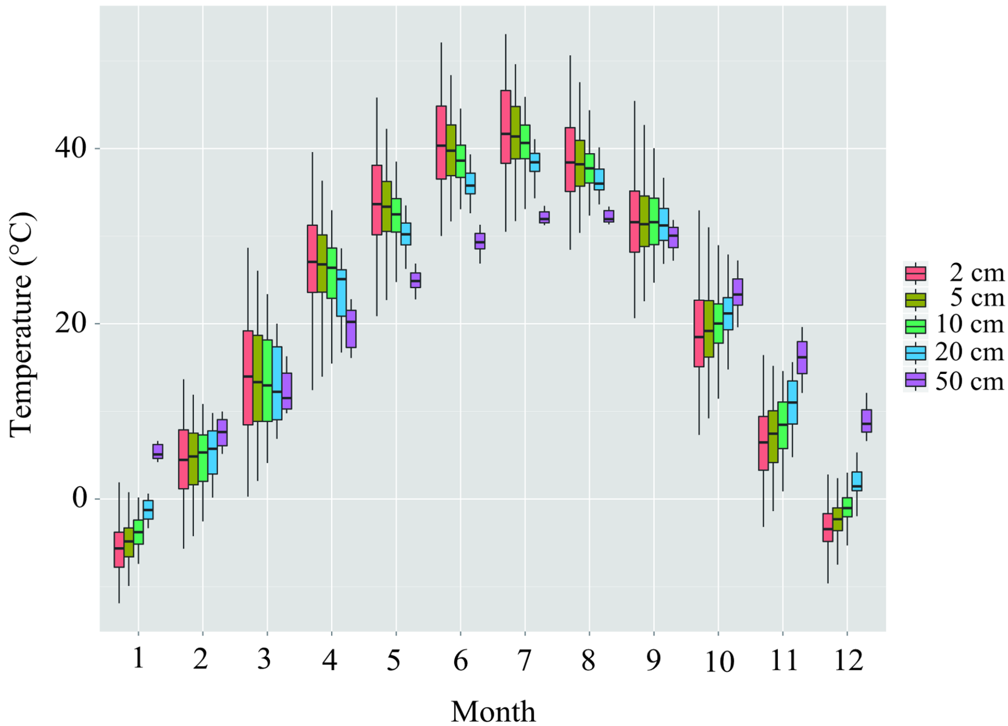

Figure 3 Range of temperature variation in different depths of soil in a year.

habitat quality is the most important (Huey, 1991). Proper selection of microhabitat allows reptiles to keep their body temperature within a reasonable range, which is important in order for them to maintaining their normal physiology and behavior (Huey, 1991). Individual animals ideally should choose microhabitats which increase their fitness and maximize their ecological performance (Orians and Wittenberger, 1991).

The Turpan wonder gecko is a typical sandy-soil-dwelling lizard species, readily identified by its soft skin and comb edge on both sides of their toes. Loose sandy-soil may reduce burrowing energy consumption (Šumbera *et al.*, 2004). The vertical depth or thickness of sandy or loose soil also has influences the location at which the Turpan wonder gecko chooses to dig its burrow. In addition to the factors mentioned above, the selection by the Turpan wonder gecko of sandy or loose soil may also be related to its relatively good air permeability and perhaps other characteristics as well. A classical study has shown that O_2 content in animal burrows was significantly lower than that of the external environment and the CO_2 content is higher than that of the external environment (Roper *et al.*, 2001). The effective air permeability of loose soil is beneficial for gas exchange between the inside of the burrow and the outside world.

Field observations have found that the Turpan wonder gecko often forages under or near plants and quickly flees into a nearby shrub when frightened on bare ground. It seems that plants in the environment provide feeding areas and shelters for Turpan wonder geckos. The potential for maximum energy input may be the principle driving force behind habitat selection and food choices (Downes, 2001). The juvenile wonder geckos prefer to burrow 5 m or less from the nearest vegetation, which may be a strategy to minimize energy consumption.

4.3 Microhabitat selection Seasonal climate change, vegetation type, and body size influences refuge selection. Selecting an appropriate microhabitat has profound implications for the ecology of reptiles. Reptiles must ‘trade off’ or balance the costs and benefits related to avoiding predators and competitors, and obtaining food, mates, and shelter (Howard *et al.*, 2003; Penado *et al.*, 2015). For example, the sand dune lizard (*Liolaemus multimaculatus*) prefers microhabitats with low to medium vegetation to provide shade and open sites to allow efficient thermoregulation (Kacoliris *et al.*, 2009). The availability of suitable refuges to buffer temperature extremes may be a critical determinant in the distribution of arid-zone ectotherms (Keswick and Hofmeyr, 2014). Kalahari tent tortoises (*Psammobates oculifer*) prefer tall grass in summer because it provides better protection against heat and predators (Keswick and Hofmeyr, 2014).

Other studies have shown that reptiles tend to select habitats based on other factors, such as foraging requirements (Compton *et al.*, 2002) and thermoregulation (Goller *et al.*, 2014). The Turpan wonder gecko has been described as a sit-and-wait predator, catching small invertebrates and feeding mostly on caper berries (of *Capparis spinosa*) in summer (Liu *et al.*, 2010). As for predator avoidance, Turpan wonder geckos are highly cryptic and are rarely observed out in the open (personal observation). The Turpan wonder gecko prefers the caper bush, which not only provides safe refuge (as it is dense and spiny) but also is a food source (fresh fruit).

Dead vegetation serves as key microhabitat for many species, which use it for shelter (Mushinsky, 1992), foraging, and perch sites (James and M'Closkey, 2003; M'Closkey, 1997). Due to their dependence on environmental temperature, the selection of a suitable site of refuge is of particular importance to ectotherm lizards such as geckos, particularly in temperate zones (Penado *et al.*, 2015). The Turpan wonder gecko has been described as a thermoconformer, where the mean body temperature and the substrate temperature are closely related (Song *et al.*, 2009). As for thermoregulation, the Turpan wonder gecko prefers *dead wood* for regulating its body temperature (personal observation).

Conclusions

The purpose of this study was to analyze the factors which affect the burrow characteristics and microhabitat selection of the Turpan wonder gecko. Through our analysis, we found that in our study area the preferred direction of orientation of the burrow entrance was north-northeast and south-southeast, which are likely related to the local prevailing winds and illumination. Results regarding microhabitat selection indicated that the Turpan wonder gecko, both adults and juveniles, prefers to construct its burrows in sandy soil which contained a layer of loose soil more than 30 cm thick. Our research indicated that burrow characteristics and microhabitat selection were beneficial factors in the adaptation of the Turpan wonder gecko to its harsh and arid desert habitat. In summary, our results support the hypothesis that the thermal, food-availability, and plant-cover characteristics of the environment are strong determinants of habitat selection by reptiles living in austere environments.

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Appendix Table 1 Measurements (mm) of *Teratoscincus roborowskii.*

Sex	Mean ± SD (Range)			
	Snout-vent length	Tail length	Head length	Head width
Female	79.58 ± 0.57 (75.52–93.62)	49.99 ± 0.48 (44.42–59.16)	21.26 ± 0.24 (17.54–24.74)	19.34 ± 0.18 (15.88–21.86)
Male	81.01 ± 0.56 (75.62–90.64)	52.48 ± 0.37 (44.34–57.16)	21.62 ± 0.12 (18.92–24.22)	20.33 ± 0.12 (18.12–24.22)
Juvenile	50.35 ± 1.12 (35.22–69.06)	35.08 ± 0.70 (23.88–52.42)	14.43 ± 0.27 (10.7–20.32)	12.89 ± 0.25 (8.96–17.94)