

## NEW DATA ON ABUNDANCE AND DISTRIBUTION OF THE PERSIAN TOAD-HEADED LIZARD IN THE GORAVAN SANDS SANCTUARY, ARMENIA

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### ABSTRACT

The Goravan Sands Sanctuary is the only “especially protected area” supporting the endangered Persian toad headed lizard. The objectives of the study were 1) to determine mean abundance of *P. persicus* in order to compare it with earlier published data and to develop grounds for further monitoring and 2) to delineate the spatial distribution of *P. persicus* within the Goravan Sands Sanctuary for conservation management planning. Visual encounter survey of 35 random quadrats (20x20 m) and on the way to the quadrats was implemented to determine the lizard’s abundance and distribution. The locations of specimens were registered with a GPS unit and mapped using Arc View GIS. Mean abundance of *P. persicus* in April-May, 2005 was  $Mean \pm SE = 0.457 \pm 0.14$ ;  $R = 0-4$ ,  $n = 35$ , or nearly 11 specimens per hectare. It is nearly 4 times higher than in 1980s. However, no population increase is stated. 5 isolated population fragments were detected for *P. persicus* within 4 of 10 plots of sandy habitats. Sizes of population fragments (numbers of specimens) directly correlate with area ( $R_{sp} = 0.96$ ;  $p < 0.0001$ ) and perimeter ( $R_{sp} = 0.91$ ;  $p < 0.0001$ ) of sandy plots, and with edge effect values ( $R_{sp} = -0.65$ ;  $p < 0.05$ ). Plots of sands with area of about 2 ha do not support *P. persicus*. As conservation actions for larger habitat plots supporting all population fragments it is proposed to increase control and develop a public awareness system, to limit overgrazing, collection of lizards and sand mining. For poorest population fragments it is suggested also to perform translocations and support the populations using bordering within natural vivaria.

**Key words:** *Phrynocephalus persicus*, mean abundance, spatial distribution, edge effect, habitat management plan, Goravan Sands Sanctuary, Armenia

### INTRODUCTION

The Persian toad-headed lizard (*Phrynocephalus persicus* De Filippi, 1863, Fig. 1) was included in the Red data books of the USSR (1984), Armenian SSR (1987) and Azerbaijan as an endangered taxon [6, 13, 15].



Fig. 1. Adult male of *P. persicus* in Goravan Sands.  
Photo by Tigran Tadevosyan, May, 2005.

The commonly used synonym of this taxon is Transcaucasian sun-watcher lizard (*Phrynocephalus helioscopus persicus* De Filippi, 1863) [1, 3, 7, 13, 15]. Although *P. persicus* was not included in the list of priority groups developed at the workshop “Development and Harmonization of International Transboundary Cooperation in The Field of Conservation of Herpetocomplexes and Ecosystems of Caucasian Ecoregion” held in Saint-Petersburg (2005), this taxon remains conservation priority at national and regional level.

Nearly 20 isolated localities of *P. persicus* were known in Armenia, all within the most populated and extensively transformed region of the Ararat valley (within Armavir, Yerevan and Ararat districts) [1, 2, 7, 10, 12-14]. The Goravan Sands Sanctuary is one of the largest complexes of patches of sandy semi-desert habitats and the only “especially protected area” supporting *P. persicus* in our country [1, 13, 15, 26].

All earlier published data, including maps, only reflect large-scale distribution of *P. persicus* in Armenia [2, 7, 13]. However, a local scale distribution map is necessary for conservation management planning [21, 24] for the Goravan Sands. On the other hand, past assessments of population density of *P. persicus* were performed in 1984 [15]. Thus, there are no new exact data on the lizard's conservation status. Besides, earlier published materials include only assessment results [1, 13, 15]. Absence of details on sampling techniques, numbers of used samples and statistical treatment make these data low applicable to replication and further monitoring of population density.

Based on noted points, I solved the following 2 objectives:

1. I measured abundance and calculated the mean abundance of *P. persicus* to compare it with earlier published data and to develop grounds for further monitoring.
2. I collected data on the locations of *P. persicus* within the Goravan Sands to create a corresponding map and to analyze the spatial distribution of the lizard.

## MATERIALS AND METHODS

### *Study area*

The Goravan Sands Sanctuary is situated in arid zone of Ararat region of Armenia, in the basin of the Vedi River, on the NW piedmont of the Urtz mountain ridge [26]. 200 ha of sandy semi-desert habitats were assigned for the sanctuary in 1958, according to the governmental decision [22]. However, since the year of its establishment, the sanctuary, with no exact formal boundaries, has been actually neglected. Decoding of satellite image Landsat 7. ca, 2000 (NASA ES Ent., USA) and analysis of digital elevation model, performed in the framework of this project, show that sandy habitats are presented by 10 plots with total area of nearly 175 ha, situated in elevation range of 894-1060 m a.s.l. (Fig. 2). The dominant plants of sandy semi-desert are semi shrubs of *Noaea mucronata*, *Kochia prostrata* and *Achillea tenuifolia* (My observations). From the north, the sands are limited by reclaimed land of the Goravan village community, and from the other sides with dry limestone rocks covered with sparse shrubby vegetation called phryganoids [27, 28].

I have conducted my study on abundance within two largest plots of sands: the main and eastern massifs (~136 ha, 894-965 m a.s.l.), considered as a sanctuary by most of scientists having worked here earlier [A.V. Aslanyan's personal comment, 22, 27]. However, to determine spatial distribution of population of *P. persicus* all 10 sandy plots were surveyed.

The Atlas of Reptiles of Northern Eurasia [4] was used to standardize taxonomic nomenclature.

### *Sampling*

We registered lizards in 35 randomly selected 20x20m quadrats, as well as during the movements between them, using visual encounter surveys [11, 17, 26].

Quadrat positions were determined using a digital map of the Goravan Sands Sanctuary using Arc View GIS v. 3.2.a (ESRI Inc., USA). The digital map was geo-referenced in WGS-84, UTM (zone 38 N) coordinate system. I used Random Point Generator software [20] to randomly generate 35 sampling plots. Point coordinates were uploaded into an Etrex GPS unit with accuracy averaging 5 m (Garmin Intern. Inc., Kansas, USA), with DNR Garmin software (Minnesota Department of Natural Resources, Minnesota, USA).

We searched quadrats with GPS unit and surveyed in randomized order, once each, between 10:00-18:00 hrs in March-June, 2005. Lizards were captured and individually marked on the venter with a felt tip marker pen and then released at the capture site. Location coordinates, time of capturing, sex and age (adult, sub adult, juvenile) were registered for each captured lizard.

### *Mapping and GIS-based measurements*

Basic GIS was developed using a 1: 25000 topographic map [5] and 30m satellite image Land sat 7 ca, 2001, and classified in 16 classes using Arc View Image analysis 1.0. to determine boundaries of sandy habitats. I also determined areas, perimeters and proportion perimeter/area as the measure of edge effect [23, 29] for each of 10 sandy plots, using Patch Analyst extension (Northwest Science & Technology, Ontario, Canada). To delineate spatial distribution of *P. persicus* I created a vector point map using the data of lizard localities registered with GPS unit. To determine the possibility of contact between specimens I also created buffers, which show probable individual ranges of lizards, using the data on individual movements of *P. persicus* obtained by I.S. Darevsky [14].

Numbers of specimens per population fragment were manually calculated as a measure of population survival.

### Statistical treatment

I calculated mean abundance ( $M$ ), standard error ( $SE$ ) and variation range ( $R$ ) of abundance of *P. persicus* per quadrat, and determined mean abundance per ha as  $(M) \times 25$  (number of 20x20 m sampling plots per ha). I used Spearman rank correlation coefficient ( $R_{sp}$ ) to testify hypothesis that the number of specimens per population fragment is related to the area of habitat plot and edge effect value. Significance level is accepted as  $p < 0.05$ . The calculations were performed using Statistica 6.0. software (StatSoft Inc. Tulsa, OK., USA).

## RESULTS

Totally 104 individuals of *P. persicus* were registered during the survey. Only 16 (15%) of them were registered within sampling quadrats (Tab. 1). 45 (43 %) of lizards were males, 56 (54%) females, while the sex of 3 specimens (<3%) remains undetermined. 72 (69%) of the registered lizards were adults, 32 (31%) sub adults and juveniles. The data on the abundance of *P. persicus* in sampling quadrats with their coordinates in decimal degrees, as well as mean abundance per sample quadrat and per ha are presented in Tab. 1.

**Table 1.** Data on locations of surveyed sample quadrats and abundance of *P. persicus*.

Sampling quadrats			Abundance of <i>P. persicus</i>
N/N	E (d.ddddd)	N (d.ddddd)	
1	44.73482	39.88888	0
2	44.72092	39.89254	0
3	44.73539	39.89287	0
4	44.71978	39.89458	1
5	44.71834	39.89322	0
6	44.71819	39.89076	0
7	44.71972	39.89736	0
8	44.71692	39.89290	0
9	44.73691	39.89411	0
10	44.72696	39.89258	0
11	44.71582	39.89253	1
12	44.71691	39.89289	0
13	44.72065	39.89838	0
14	44.72462	39.89553	0
15	44.72854	39.89257	0
16	44.72553	39.89489	0
17	44.73206	39.89496	2
18	44.71295	39.89197	1
19	44.70940	39.89175	0
20	44.71901	39.89486	1
21	44.71109	39.89511	2
22	44.71631	39.89463	1
23	44.72166	39.89635	0
24	44.71280	39.89325	0
25	44.73710	39.88860	1
26	44.71752	39.89199	0
27	44.73018	39.89245	4
28	44.71760	39.89720	0
29	44.72830	39.89317	1
30	44.73278	39.89307	0
31	44.73538	39.88933	0
32	44.73179	39.89441	0
33	44.71880	39.89740	0
34	44.73139	39.89584	1
35	44.71090	39.89180	0
Mean			$M \pm SE = 0.457 \pm 0.14$ ; $R = 0-4$ , $n = 35$ Or nearly 11.4 specimens/ha

According to the data collected during the survey, the population of *P. persicus* in the Goravan Sand is divided into 5 main isolated fragments (Fig. 2). The data on fragment sizes, areas, perimeters and edge effect, as well as significant Spearman rank correlation coefficients between fragment sizes and noted plot variables are presented in Tab. 2.

## DISCUSSION

During the soviet period density per ha was recognized as the main index of conservation status of reptiles [1, 12, 14, 24]. However, for this purpose, it is preferable to measure mean abundance because this process is almost twice cheaper and does not require recaptures and reiterative visits to sampling quadrats [19]. On the other hand, measuring abundance per time period [11] can be rather less expensive and testing and comparison of these methods can become a subject of further research.

While planning the present study I assumed that mean abundance of *P. persicus* would have decreased as compared with its density of 1980s [1, 15]. This assumption was *a priori* based on the following arguments:

1. Tendency towards density decrease [1, 13, 15].
2. Absence of any measures against earlier defined negative factors [1, 13, 15], such as overgrazing, mining and illegal collection of lizards.
3. Mean abundance value may be lower, but not higher than the respective density value, because density measurements need more detailed surveys and recaptures [11].

However, if we compare the present data on mean abundance of *P. persicus* with those of 1980s [1, 15], we will see that since then the population has increased almost 4 times in comparison with the result published in [1], or remain relatively stable as compared with the data available in [15]. This non-agreement with the initial assumption may be connected either with real fluctuations of population or with the subjectiveness of the previously used methods of density assessment. Unfortunately, it is actually impossible to evaluate the quality of the assessments performed earlier [1, 13, 15], because of the absence of basic data sheet, details on sampling technique and statistical treatment in the publications. Thus it would be very subjective to state population increase. The same situation is actual for other micro-populations in other parts of the geographical range of *P. persicus*. In this regard there is a reason to perform new assessments to develop a ground for further monitoring and to determine an actual conservation status of this lizard.

The 5 population fragments are isolated from each other differently (Fig. 2). The isolation of fragments 1 and 2 can be connected with unsuitable soil quality. Whereas, isolation of fragment 3 can be connected with both sand mining and overgrazing, which were earlier determined as negative factors for reptiles [8, 9]. All noted assumptions need a further research. Finally fragments 4 and 5 are isolated by rocky habitats, which were also determined as unsuitable for *P. persicus* in this area [14].

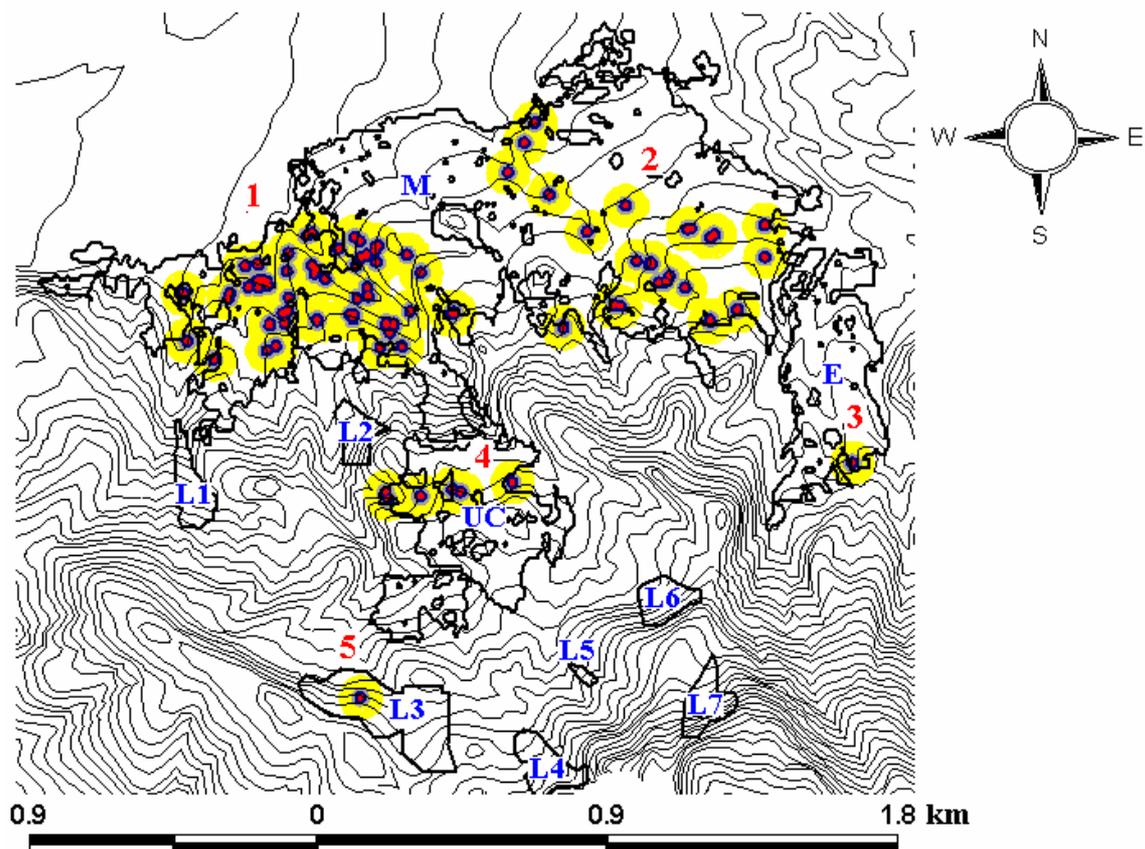
The comparatively richer population fragments (1, 2 and 4) (Tab. 2) need a strict protection by limiting such negative factors as overgrazing, collection of lizards and sand mining, developing a control body, and setting up a public awareness system for local community. At the same time, the poor fragments 3 and 5 are in need of limitation of the same factors in complex with recovery actions, including relocations and protection of growing generations with bordering in natural vivaria [16, 24]. Lesser sandy plots (L1, L2, L4-L7) with an area of nearly 2 ha each are probably not suitable for long term survival of *P. persicus*, because of strong impact of the edge effect [23, 29], the details of which should be researched.

**Table 2.** Data on dependence of population fragment sizes on sizes and edge effect within sandy plots near Goravan.

Population fragments			Variables of Sandy Plots			
№	Specimens		Plot names	Area (km <sup>2</sup> )	Perimeter (km)	Edge effect (km)
	Numbers	%				
1	65	62	M	1.18	27.87	23.6
2	28	26.2	M	1.18	27.87	23.1
3	1	0.96	E	0.17	5.8	34.1
4	9	8.65	UC	0.2	6.56	32.8
-	0	0	L1	0.02	0.83	41.5
-	0	0	L2	0.02	0.62	31
5	1	0.96	L3	0.08	1.47	18.4
-	0	0	L4	0.02	0.78	39
-	0	0	L5	0.003	0.24	80
-	0	0	L6	0.02	0.56	28
-	0	0	L7	0.02	0.72	36
Rank correlations				$R_{Sp}=0.96; p<0.0001$	$R_{Sp}=0.91; p<0.0001$	$R_{Sp}=-0.65; p<0.05$

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### Legend

 Sands	<b>Point locations</b>	<b>Sandy massifs</b>
 Elevations	<b>with presumed individual ranges</b>	<b>M</b> Main
	<b>of <i>P. persicus</i>:</b>	<b>E</b> Eastern
	 0 - 10	<b>UC</b> Upper central
	 10 - 20	<b>L1</b> 1
	 20 - 30	<b>L2</b> 2
	 30 - 75	<b>L3</b> 3
	<b>Population fragments</b>	<b>L4</b> 4
	<b>1, 2, 3, 4, 5</b>	<b>L5</b> 5
		<b>L6</b> 6
		<b>L7</b> 7
		<b>Lessers</b>

Fig. 2. Distribution of *P. persicus* in the Goravan Sands.

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