

Present distribution and taxonomic status
of the Spotted Toad-headed Agama
Phrynocephalus guttatus (GMELIN, 1789)
in the Volga region, Russia
(Squamata: Sauria: Agamidae)

Gegenwärtige Verbreitung und taxonomischer Status der Gefleckten Krötenkopf-Agama
Phrynocephalus guttatus (GMELIN, 1789) in der Wolga-Region, Rußland
(Squamata: Sauria: Agamidae)

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KURZFASSUNG

Nach Feldbeobachtungen in den Jahren 1996 bis 2003 bevorzugen die Populationen der Gefleckten Krötenkopf-Agama *Phrynocephalus guttatus* (GMELIN, 1789) aus der Wolga-Region als Lebensraum verfestigte und mäßig verfestigte Sande mit spärlicher Busch- und Grasvegetation. Untersuchungen von russischem und ukrainischem Museumsmaterial ergaben, daß die Populationen auf den Don-Sanden im Volgograd-Gebiet zu *Ph. g. guttatus* zu stellen sind. Sie zeigen jedoch aufgrund ihrer Randlage hinsichtlich des Gesamtverbreitungsgebietes der Art gewisse Eigentümlichkeiten in bezug auf die Ausprägung einiger meristischer Merkmale.

ABSTRACT

According to field observations made in 1996-2003, the Volga region populations of the Spotted Toad-headed Agama *Phrynocephalus guttatus* (GMELIN, 1789) prefer fixed and weakly fixed sands with sparse bush and grass vegetation. Analysis of Russian and Ukrainian museum specimens revealed that the populations on the Don sands in the Volgograd region belong to *Ph. g. guttatus*. However, they are specific by some metric characteristics due to their outlying position in the north of the species' range area.

KEY WORDS

Reptilia: Squamata: Sauria: Agamidae: *Phrynocephalus guttatus guttatus*, Spotted Toad-headed Agama, distribution, taxonomy, Volga region, Russia

INTRODUCTION

According to modern data, what was called Spotted Toad-headed Agama is a group of taxa. The supraspecies and species taxonomy of the genus *Phrynocephalus* KAUP, 1825 is complex and often contradictory, and subspecific classification is still under debate (SHENBROT & SEMENOV 1987; GOLUBEV 1989; MANILO & GOLUBEV 1993; GOLUBEV et al. 1995). A significant number of synonyms to describe geographical forms of these lizards by different authors confirm this statement.

Until the 1980s, *Ph. guttatus guttatus* (GMELIN, 1789) [Terra typica: "in deserto Uralensi" steppes along the lower Ural River, Kazakhstan] was regarded to represent the species in the Volga region (BANNI-

KOV et al. 1977). Later the populations of the European part of the habitat (from the right Volga bank of the Volgograd region to the northern Caucasus) were proposed for consideration as an independent subspecies *Ph. g. kalmykus* (BADMAEVA & ŠČERBAK 1983) [Terra typica: Kalmykia, Yashkol district, near the town Khulkhuta]. This supposition was based on some morphological peculiarities of the Kalmykian Spotted Toad-headed Agama but was not accepted by the majority of researchers without reserve. Based on additional materials from the northern part of the Lower Volga region the authors analyzed the morphological differences between *Ph. guttatus* populations from different parts of the habitat in detail.

MATERIALS AND METHODS

This study is based on fieldwork carried out in the Astrakhan and Volgograd regions and Kalmykia in 1996-2003. In addition, collection materials were analyzed from the Zoological Museums of Moscow (ZM MSU) and Saratov State Universities (ZM SSU), Institute of Zoology of RAS (ZIN, St.-Petersburg) and National Museum of Natural History of NAS, Ukraine (NMNH, Kiev) (fig. 1). Standard metric and meristic indices suitable for comparison purposes were used, namely: snout-vent-length ($L.$), length of intact tail ($L. cd.$), thigh ($L. f.$), and shank ($L. t.$); ratios of body length to length of the tail ($L. / L. cd.$), thigh ($L. / L. f.$), and shank ($L. / L. t.$); number of interorbital scales (supraoculars not counted) ($I. o.$), number of subdigital lamellae underneath 1st toe of the hind leg (*Lam. Subdig.*), number of scales between parietal and rostral shields (*Fr.*), number of ciliary scales on the lower eyelid (*Pl. i.*), and number of black bands on the

ventral side of the tail (*BBN*) (BADMAEVA & ŠČERBAK 1983; SHENBROT & SEMENOV 1987). There is a clear spatial isolation of the populations from the Volgograd region (vicinity of v. Peskovatka, Gorodiščeno district, $n = 31$), Astrakhan region (vicinity of the towns Molodyozhnyi, $n = 14$, Dosang, $n = 21$, and Stepnoy, $n = 20$; Krasnyi Yar district) and Kalmykia (vicinity of the towns Lagan, $n = 20$, and Kovylnyi, $n = 28$; Chernye Zemli district). This made it worthwhile to analyze the material as three combined samples "Volgograd region", "Astrakhan region" and "Kalmykia". In total, 134 individuals of the species were examined. Statistical data processing was carried out by means of statistical software (TYURIN & MAKAROV 1995) and included the calculation of arithmetic mean values for each character and sample (M) and their standard errors (m); Student's T (T_{st}) was used to compare groups.

RESULTS AND DISCUSSION

Analysis of the literature and field observations from this study show that the Spotted Toad-headed Agama settles in fixed and feebly fixed hilly sands and sandy walls, on railway embankment slopes with sparse bush and grass vegetation within the steppe and semidesert zones in the Astrakhan and Volgograd regions and Kalmykia (ANANJEVA 1981; BADMAEVA & ŠČERBAK 1983; KIREEV 1983; ANANJEVA 1997; ZAVIALOV & TABACHISHIN 1997; ANANJEVA et al. 1998; ZHDOKOVA et al. 2002). Until recently, the northern boundary of the lizard's habitat in European Russia was associated with the Don river sands in the vicinity of v. Golubinskaya (Kalachev district, Volgograd region) (STARKOV 1996). In the 1999 field survey, Spotted Toad-headed Agamas were found somewhat north of this boundary, on the left bank of the Don river, near v. Peskovatka, Gorodiščeno district (fig. 1).

The outlying position of the Don populations is linked with a relatively low number of agamas in their habitats. For example, the population density of Spotted Toad-

headed Agamas in an isolated sand massif near v. Golubinskaya and near v. Peskovatka is as low as 3.0 and 4.1 individuals/ha, respectively (STARKOV 1996). In the periods of spring-summer 1991 and summer-autumn 1994, similar results were obtained for the fixed and hilly sands immediately adjoining the Volga-Akhtuba flood lands, where the abundance of agamas was 0.75 individuals/ha while that of the isolated sand massif Berly (near the town Kharabali, Astrakhan region) was 3.75 (BOZHANSKI & POLYNOVA 1995). Higher population densities were registered for the sand massifs of the zone between the Volga and Ural rivers (Krasnyi Yar district, Astrakhan region) in May, 1998: the population density of agamas ranged from 13.6 individuals/ha on even parts of the steppe in depressions between hills, and 24.6 on hilly Barkhan-like sands to 38.5 on fixed hilly sands.

The population density of the Spotted Toad-headed Agama in Kalmykia was 15-25 individuals/ha (KIREEV 1982) and 5.9 - 99.1 individuals/ha (BADMAEVA 1983). At pres-

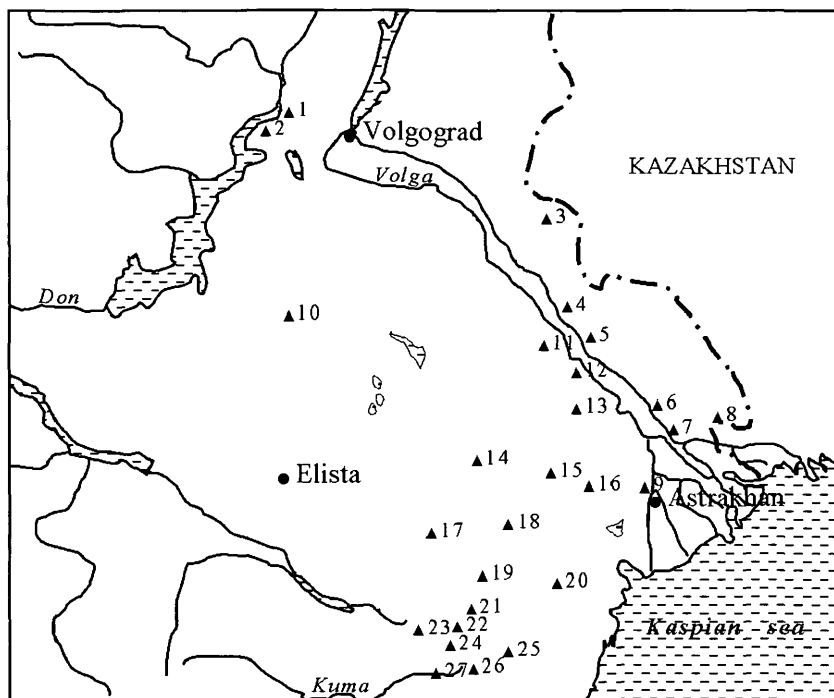


Fig. 1. Records of *Phrynocephalus guttatus* (GMELIN, 1789) in the South-East of European Russia. 1-2 – Volgograd region; 3-9 – Astrakhan region; 10-27 – Kalmykia.

Abb. 1: Nachweise von *Phrynocephalus guttatus* (GMELIN, 1789) vom Südosten des Europäischen Rußlands. 1-2 – Region Volgograd; 3-9 – Region Astrachan; 10-27 – Kalmükien.

- 1 – Gorodiščeno district, near v. Peskovatka (ZM SSU); 2 – Kalachev district, near st. Golubinskaya (STARKOV 1996); 3 – Akhtubinsk district, near town New Baskunchak (ZM SSU); 4 – Kharabalinsk district, ur. Chapchachi (ZIN); 5 – near town Kharabali (BOZHANSKI & POLYNOVA 1995); 6 – Krasnyi Yar district, near st. Dosang (ZM SSU); 7 – Krasnyi Yar district, near town Stepnoy (ZM SSU); 8 – Krasnyi Yar district, near town Priozornui (ZM SSU); 9 – near Astrakhan (ZM MSU); 10 – Sarpino district, near town Godzhur (ZM SSU); 11 – Yustin district, near town Kharba (KIREEV 1982); 12 – Yustin district, near town Bergin (Polynnoe) (NMNH); 13 – Yustin district, near town Smushkovoe (ZM MSU); 14 – Yashkul district, near town Utta (KIREEV 1982); 15 – Yashkul district, near town Khulkhuta (NMNH); 16 – Chernye Zemli district, near town Kovyl'ny (ZM SSU); 17 – Yashkul district, near town Tavan-Gashun (ZHDOKOVA et al. 2002); 18 – Chernye Zemli district, near town Aadyk (BADMAEVA 1983); 19 – Chernye Zemli district, near town Naryn-Khuduk (KIREEV 1982); 20 – Kaspiyskiy district, near town Ulan-Khol (KIREEV 1982); 21 – Chernye Zemli district, near town Lagan (ZM SSU); 22 – Chernye Zemli district, near town Komsomol'ski (KIREEV 1982); 23 – Chernye Zemli district, near town Achinery (ZHDOKOVA et al. 2002); 24 – Chernye Zemli district, near town Prikumski (BADMAEVA 1983); 25 – Chernye Zemli district, near st. Artezian (KIREEV 1982); 26 – Chernye Zemli district, town Andra-Atinski (ZHDOKOVA et al. 2002); 27 – Chernye Zemli district, near town Kumskoj (NMNH).

ent, the maximum abundance there does not exceed 20-25 individuals/ha (ZHDOKOVA et al. 2002). Similar results were obtained in the spring of 2000: the species abundance on the outlying parts of semifixed hilly sands and on the sand massif near the town Lagan (Chernye Zemli district) was 18.1 and 9.9 individuals/ha, respectively.

The color pattern of the Lower Volga populations of Toad-headed Agamas was analyzed in detail. On the whole, it is similar to that of the animals from other parts of the habitat (fig. 2). However, a number of peculiarities were revealed. In particular, the color of the dorsal side of head, body, extremities, and tail except its end is sandy

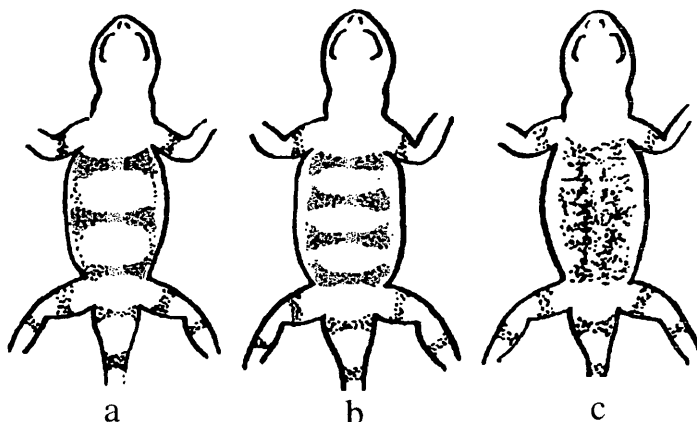


Fig. 2. Main types of color pattern of *Phrynocephalus guttatus* (GMELIN, 1789) from the Volga region.
a – three-banded, b – cross-striped, c – spotted.

Abb. 2: Haupttypen von Zeichnungsmustern bei *Phrynocephalus guttatus* (GMELIN, 1789) des Wolgagebietes.
a – dreibändig, b – quergestreift, c – gefleckt.

or sandy-brownish of variable intensity. Such a background is formed by tiny spots and points of grey and sandy colors. There are contrasting or barely visible light-grey ocelli with an intense grey or brown mount as well. On this background, three to four medially interrupted or continuous bands across the body (19.9% of the population) or pairs of dark-brown, black-brown, or, rarely, light-brown or dark-sandy spots located symmetrically on the sides of the spine (80.1%) stand out against the background or are barely visible. Similar interrupted bands or spots are on the dorsal portion of the tail and extremities, two longitudinal short dark bands are well visible on the neck. A longitudinal row of brownish spots contrasts with the background on the body sides; below there is a row of small inconspicuous light-grey or whitish spots merged together to an uneven band and separated from the belly by a grey band. On the extremities there are cross-bands as on the dorsum.

The dorsal side of the head is studded with dots and spots of brown-grey and sandy color of various tints and intensities. The eyelash-like scales of the eyelids are whitish. The throat is white with a weak cream tint; the labials and underside of the fingers are of a rich yellow. The venter is white while the tail end is black with a blue metallic tint.

Near the body the black tail gets pale, and its bottom white with three to six bright grey-blackish or light-grey vague bands aslant the tail. Young individuals exhibit more bright and contrasted dark cross-bands on the bottom of the tail, its background being pale-yellow. Our comparative analysis of morphometric indices of males and females from the population of both the northern and southern parts of the Volga region and Kalmykia (table 1) shows no sexual dimorphism in the majority of indicators. However, males differed constantly from females in their body proportions (short body in relation to the long extremities and tail; $p < 0.01$).

Concerning basic morphometric indices, some variance is revealed by comparison of the series under study (Stavropol region, which is part of the habitat of *Ph. g. kalmykus*) with samples of the species from south-eastern parts of European Russia and western Kazakhstan (Ural – Volga and Ural – Emba countries) (table 2).

The maximum differences between the populations of the left Astrakhan bank of the Volga river and that of Kalmykia were found in the pholidosis counts, and one can speak of a specific Volgograd population in comparison with the agamas from Kalmykia with high certainty. These differences are significant for the number of scales between the eyes (supraoculars not counted) (*I. o.*),

Table 1. Morphometric characteristics of *Phrynocephalus guttatus* (GMELIN, 1789) of the Volga region and Kalmykia. $M \pm m$ – arithmetic mean \pm standard error of the mean; min – minimum; max – maximum; $L. / L. cd.$ – ratio of snout-vent-length to length of intact tail; $L. / L. f.$ – ratio of snout-vent-length to length of thigh; $L. / L. t.$ – ratio of snout-vent-length to length of shank; $I. o.$ – number of interorbital scales (supraoculars not counted); *Lam. Subdig.* – number of subdigital lamellae underneath 1st toe of hind leg; *Fr.* – number of scales between parietal and rostral shields; $Pl. j.$ – number of ciliary scales on the lower eyelid; *BBN* – number of black bands on the ventral side of the tail; δ – males; ♀ – females; T_{st} – Student's T; * – $p < 0.05$; ** – $p < 0.01$

Tab 1. Morphometrische Merkmale von *Phrynocephalus guttatus* (GMELIN, 1789) des Wolgagebietes und Kalmükiens. $M \pm m$ – arithmetisches Mittel \pm Standardfehler des Mittels; min – Minimum; max – Maximum; $L. / L. cd.$ – Verhältnis von Kopf-Rumpflänge zur Länge des unversehrten Schwanzes; $L. / L. f.$ – Verhältnis von Kopf-Rumpflänge zur Oberschenkelänge; $L. / L. t.$ – Verhältnis von Kopf-Rumpflänge zur Unterschenkelänge; $I. o.$ – Anzahl Schilde zwischen den Augen (Supraocularia nicht mitgezählt); *Lam. Subdig.* – Anzahl Subdigital-lamellen unter der ersten Hinterbeinzehe; *Fr.* – Anzahl Schilde zwischen Parietale und Rostrale; $Pl. j.$ – Anzahl Ciliarschuppen auf dem Unterlid; *BBN* – Anzahl dunkler Streifen auf der Schwanzunterseite; δ – Männchen; ♀ – Weibchen; T_{st} – Student T; * – $p < 0.05$; ** – $p < 0.01$.

Sex n (d. f.)	Character / Merkmal								
	<i>I. o.</i> M \pm m min-max	<i>Fr.</i> M \pm m min-max	<i>Lam. Subdig.</i> M \pm m min-max	$Pl. j.$ M \pm m min-max	<i>BBN</i> M \pm m min-max	$L. / L. cd.$ M \pm m min-max	$L. / L. t.$ M \pm m min-max	$L. / L. f.$ M \pm m min-max	
Volgograd Region									
δ 15	24.0 \pm 0.47 21-27	16.9 \pm 0.32 15-19	16.0 \pm 0.22 14-18	10.7 \pm 0.19 9-12	5.3 \pm 0.16 4-6	0.72 \pm 0.01 0.67-0.88	3.43 \pm 0.03 3.06-3.54	4.09 \pm 0.02 3.90-4.27	
♀ 16	23.8 \pm 0.32 21-26	17.5 \pm 0.16 16-19	16.8 \pm 0.17 15-18	10.8 \pm 0.18 10-12	4.9 \pm 0.16 4-6	0.79 \pm 0.01 0.70-0.87	3.52 \pm 0.02 3.36-3.90	4.28 \pm 0.05 3.88-4.55	
T_{st}	0.352	1.681	2.877**	0.383	1.769	4.949**	2.496*	3.528**	
Astrakhan Region									
δ 20	23.8 \pm 0.42 20-27	16.9 \pm 0.28 14-19	15.6 \pm 0.24 14-19	9.4 \pm 0.25 8-12	5.0 \pm 0.12 4-6	0.72 \pm 0.005 0.68-0.77	3.36 \pm 0.02 3.12-3.63	4.38 \pm 0.04 3.89-4.83	
♀ 25	22.8 \pm 0.31 20-26	16.3 \pm 0.38 14-21	15.1 \pm 0.19 13-17	10.4 \pm 0.24 8-12	5.4 \pm 0.14 4-7	0.80 \pm 0.01 0.72-0.89	3.53 \pm 0.02 3.24-3.76	4.61 \pm 0.05 4.02-5.15	
T_{st}	1.923	1.277	1.613	2.857**	2.222*	7.272**	6.071**	3.833**	
Kalmykia									
δ 24	25.0 \pm 0.22 22-27	17.3 \pm 0.19 15-19	18.1 \pm 0.11 15-19	11.2 \pm 0.11 10-13	5.3 \pm 0.12 4-7	0.68 \pm 0.003 0.66-0.74	3.52 \pm 0.01 3.25-3.89	4.27 \pm 0.03 3.93-4.59	
♀ 25	24.3 \pm 0.17 21-26	18.4 \pm 0.19 15-21	17.1 \pm 0.19 14-19	10.4 \pm 0.14 9-12	5.5 \pm 0.15 3-7	0.77 \pm 0.008 0.66-0.87	3.85 \pm 0.02 3.67-4.14	4.62 \pm 0.03 4.26-5.10	
T_{st}	2.517*	0.377	4.566**	4.494**	1.042	10.538**	15.000**	8.333**	

and between the parietal and rostral shields (*Fr.*), the number of subdigital lamellae (*Lam. Subdig.*) and black bands on the ventral side of the tail (*BBN*) ($p < 0.01$). The agamas from the Volgograd region differ significantly from the typical ones only in the number of scales between the parietal and rostral shields (*Fr.*) ($p < 0.05$). On the whole, the pholidosis indices of the Spotted Toad-headed Agama of the Volgograd region are within the variability limits characteristic of the nominate subspecies (SHENBROT & SEMENOV 1987; GOLUBEV 1989). Thus, the individual subspecies *Ph. g. kalmykus* should not be maintained, and all local *Phryno-*

cephalus populations in the Lower Volga region should be considered as *Ph. g. guttatus*. In conclusion, the Don river sands of the Volgograd region are inhabited by *Ph. g. guttatus*. However, this population differs from the neighboring populations by some of their pholidosis values, probably due to its northern outlying position within the European Russian distribution area of the species. It seems no longer justified to adhere to the form *kalmykus* because the metric and meristic features analyzed largely overlap in all the examined populations and are within the variability range characteristic of *Ph. g. guttatus*.

Table 2: Comparative characterisation (T_{st} – Student's T) of the Volga populations of *Phrynocephalus guttatus* (GMELIN, 1789) with populations from adjoining territories. For abbreviations of characters analyzed see table 1. Source of data in parentheses. t. p. – this paper. * – $p < 0.05$, ** – $p < 0.01$.

Tab 2: Vergleichende Charakterisierung (T_{st} – Student T) der Wolgapopulationen von *Phrynocephalus guttatus* (GMELIN, 1789) mit Populationen benachbarter Gebiete. Abkürzungen der untersuchten Merkmale siehe Tabelle 1. Datenquelle in Klammern; t. p. – diese Arbeit; * – $p < 0.05$, ** – $p < 0.01$.

Population	d. f.	I. o	Fr.	Lam. Subdig.	Pl. ₁	BBN	L./L.cd
Volgograd Region – Astrakhan Region (t. p.)	41	2.247*	2.910**	6.667**	1.333	2.347*	0.714
Volgograd Region – Kalmykia (t. p.)	41	1.381	3.629**	1.176	1.754	2.739**	1.563
Astrakhan region - Kalmykia (t. p.)	50	4.242**	4.943**	7.443**	0	0.487	2.342*
Volgograd Region – Stavropol Region (BADMAEVA & ŠČERBAK 1983)	29	1.196	0.858	6.431**	1.000	1.209	–
Volgograd Region – Ural- Emba country (BADMAEVA & ŠČERBAK 1983)	29	2.539*	3.816**	0.283	1.178	0.429	–
Volgograd Region – Ural - Volga country (BADMAEVA & ŠČERBAK 1983)	25	1.603	2.506*	2.255*	0.381	1.412	–
Volgograd Region – Terra typica of <i>Ph. g. kalmykus</i> (BADMAEVA & ŠČERBAK 1983)	36	8.009**	4.160**	12.062**	2.136*	3.569**	–

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