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AMPHIBIANS AND REPTILES IN THE SUBTERRANEAN CAVITIES OF THE CRIMEAN MOUNTAINS

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The current paper summarizes old and recent herptiles records in the karst cavities of the Crimean Mountains, highlighting also the means of entry of poikilothermic vertebrates into the karst. It was found that the underground habitats are on purpose utilized by some amphibians and reptiles, characterized by mostly crepuscular and/or night activity as well as by the pronounced ability to move on the vertical surfaces and, in many cases, by the synanthropization tendency. One of the prerequisites for the animals' entry to the karst might be their habitat's conditions such as arid climate, absence of the forest, harsh winters at the upper distribution limit.

Keywords: Amphibia; Reptilia; karst; subterranean habitats; Crimean Peninsula.

INTRODUCTION

The Crimean Mountains embrace the area of circa 7000 km^2 organized in three more or less parallel ridges of different origin and age (Yena et al., 2004). The most outstanding part of these mountains is the Main (Mountain) Ridge consisting of Upper Jurassic limestone displayed aboveground as block low mountains and giant massifs with plateau-like summits (latter called yailas). The cuesta ridges of the Premountaun (Piedmont, or Foothills) are composed from the younger limestones of Upper Cretaceous, Paleocene and Eocene (Inner Ridge), or Neogene limestones (Exterior Ridge). Current landscapes of the Crimean Mountains are supposed to be formed in Late Pliocene as well as in Quaternary periods (Muratov and Nikolaev, 1940; Muratov, 1954), what defines mainly the Pleistocene age of the Crimean karst (Dublyansky, 1966, 1977). The high intensity of karst processes in the Crimean Mountains takes place mostly due to the abundancy and remarkable thickness of the water-soluble rock deposits (limestones), which are completely denuded by water-wind erosion at far distances as well as by the specific climate characterized by heavy rains in summer period.

The Crimean karst is usually related to the Mediterranean (open) type and is called holokarst, or bare karst (Maksimovich, 1963). However, it has to be noticed that in many upland parts and in the mountain hollows a sodded or covered (underground) karst prevails (Amelichev and Matyushkin, 2011). Today in karst landscapes of the Crimean Mountains the combination of all surface and underground karst types including ponors, pits, caves, grottos, etc. can be observed. Recent Cadaster of karst caverns of the Crimea has catalogued over 1500 caves with a total length of about 120 km: 590 caves on the Ai-Petri Yaila, 422 on the Karabi Yaila, 155 on the Chatyrdag Yaila massifs, and 101 in the Piedmont area (Amelichev et al., 2014). Therefore, the Mountain Crimea is a significant karst area, even in the scale of Alpine Mediterranean folded belt. Currently, karstologists include the Crimean Mountains into the Crimean-Caucasian karst country as a special province (Vakhrushev, 2009).

Relatively old age (mostly Middle or Late Pleistocene), the presence of multiple underground cavities and a high diversity of the conditions determine altogether

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the uniqueness of the Crimean cave fauna characterized by a high level of endemism primarily among the crustaceans (Isopoda), false scorpions (Pseudoscorpiones), myriapods (Diplopoda), springtails (Collembola), insects (Coleoptera) and other groups of animals. The Crimean Peninsula, according to the latest underground fauna survey of the former USSR (Turbanov et al., 2016a, 2016b, 2016c), is a karst-enriched glacial refugium of the nemoral biota with 44 troglo-stigobiont invertebrate species. At the same time, true troglobionts among poikilothermic vertebrates are not registered in the Crimean cave fauna, while their several species are known from the caves of Western Eurasia mountain group (Parin, 1983; Sket, 2017). Such deficiency can be explained by many reasons, for instance, the long-term insularity of the Crimea, the flooding of the Crimean karst during marine transgressions, and the immersion under the sea level of a significant part of the mountain "core" (Muratov, 1960). Moreover, an unfavorable conditions for the cave fauna development and survival within the cold and dry Pleistocene periods, and also, probably, in the modern epoch — primarily due to the drastic seasonal fluctuations of water level in caves and scarce trophic resources insufficient to the existence of vertebtates' populations might input to this deficiency as well (Dublyansky, 1977; Vakhrushev and Amelichev, 2001).

Nevertheless, the Crimean Peninsula has not been fully explored yet in faunistic relation. As for the subterranean cavities, their systemic zoological studies have been started only since the last decade. The majority of the known cave systems have been poorly investigated, and many karst cavities, undoubtedly, remain undiscovered. For instance, Mamut-Chokrak Cave in Bayidarskaya valley (territory of Sevastopol City), the second largest cave on the Peninsula, was found by the first author of this paper in 2010. At the moment, the total length of the traversed passes of this cave comprises more than 5450 m. Another example illustrating that the Crimean Karst is still *terra incognita* is the discovery of a very large (with a length over 1 km) Tavrida Cave in the Eocene Nummulite limestones of the Inner Ridge in 2018.

Until recently, the Crimean caves have been known mainly as a shelter for some troglophilous bat species (Chiroptera). Meanwhile, not only mammals, but also other vertebrates, including amphibians and reptiles, have been regularly registered in the Crimean karst, but, unfortunately, without the relevant description in the scientific literature.

Surprisingly, the first record of the amphibians in the Crimean Karst refers to an European olm (or "human fish"), *Proteus anguinus* Laurenti, 1768 — a member of tailed amphibians, which, in fact, has not been found in the Crimea yet. For example, V. Kondaraki reported that the olm ("*Proteus anquineus* [sic!]") dwells "...in the underground basins and generally near by the sources of rivers, where there are gloomy grottos filled with water" (Kondaraki, 1875, p. 37). Furthermore, A. Brauner (1904) did not exclude the presence of the European olm in the Crimea, since in his field guide to reptiles and amphibians of the Crimea even the morphological description of this amphibian can be found. At the same work A. Brauner discusses the members of herpetofauna absent at the Crimean Peninsula, though occuring in the adjascent areas: "Finally, probably in caves with large reservoirs, the olm (*Proteus anguinus*), which is still not found in the Crimea, dwells" (Brauner, 1904, p. 57). Later many researchers emphasized on the question of olm's presence in the Crimea (Birstein, 1963; Sharygin, 1998; Kotenko, 2010; Pysanets and Kukushkin, 2016). However, the most detailed survey of this problem is given in monograph "Herpetologica Taurica" (Szczerbak, 1966) with the references to two findings of olm-like animals residing in the Crimean caves in the first half of the 20th century. It has to be mentioned that M. M. Szczerbak has been also searching the olm personally in cavities of Chatyrdag (Suuk-Koba, Bin-Bash-Koba, and Dlinnaya) and Kizil-Koba caves at the Dolgorukovskaya Yaila on June 1 – 2, 1958, which were discovered only recently and, therefore, not visited by tourists (see Voinstvensky, 2006).

Unfortunately, it has to be admitted that there is no any reason for hope to find troglobiont amphibians like the *Proteus* in the Crimean karst, since the representatives of the extinct genus *Mioproteus* Estes et Darevsky, 1977, known from Early Pleistocene of the Eastern Europe including the territories adjacent to the Crimea were reophilic forms, not associated with the underground and generally mountain habitats (Averinov, 2001; Ratnikov, 2010).

Whereas the first mention about the record of amphibians in the Crimean caves belonged to the legendary "olm," the second concerned a species that was considered as extinct in the Crimea at that times. Only weakly calcinated subfossil remnants of a common spade-footed toad, *Pelobates fuscus* (Laurenti, 1768) (currently referred to as a Pallas' spadefoot, *Pelobates vespertinus* (Pallas, 1771)) was found in a remote hall of one of the caves on large upland called Karabi Yaila (Burchak-Abramovich, 1936). It is reported that "... in October 1929 I found in one of the karst caves at Karabi Yaila (1 km the north from the foot of the Kara-Tau Mt.), along the other osteological material, three sacral bones of *Pelobates fuscus* (Laur.)" and also "... it is more correct to attribute them to the subfossils category, very close to our time. It is very likely that spadefoot toad is still living near this cave, in limestone crevices of the yaila" (Burchak-Abramovich, 1936, p. 131). According to this author, amphibians might entered the caves hiding from the daylight, or be brought there by owls as a prey (most likely — little owl, *Athene noctua* (Scopoli, 1769), which is known for its preference of amphibians and reptiles in a diet).

In addition, the records of rare findings even of an ordinary members of the Crimean batrachofauna refer mainly to the second half of the 20th – the beginning of the 21st centuries. Thus, V. Taraschuk in his monograph mentioned the record of a marsh frog *Pelophylax ridibundus* (Pallas, 1771) in the subterranean habitats: "Marsh frogs have been occasionally registered in the underground water reservoirs — in the caves of the Crimea" (Taraschuk, 1959, p. 93). The same information was given by M. Szczerbak (1966) without the description of the specific localites. Only few records of an Eastern tree frog *Hyla orientalis* (Bedriaga, 1890) in the Karabi Yaila underground cavities were published recently (Pysanets and Kukushkin, 2016). It is noteworthy that an adult specimen of this frog was found in "Myshinaya Schel'" grotto ("Bat's Fissure") at the Coastal Crest of the Karadag mountain group on June 25, 1980 (Szczerbak, 1984). It has to be emphasized that the amphibian travelled to the distance of 20 m from the entrance to the cave. Therefore, the question, how has the frog got so deep into an abrasion grotto on a bare cliff at the sea level remains open.

Moreover, a green toad, *Bufotes viridis* (Laurenti, 1768), was discovered near one of the entrances to the Kizil-Koba Cave on February 26, 2001 (Zagorodniuk, 2004). The author suggested that the amphibian felt into the trap in search of a suitable place for wintering. Finally, an amateur, though valuable paper dedicated to the Karelin's newt, *Triturus karelinii* (Strauch, 1870) findings in caves of the south-western Crimea (Matyushkin, 2010) has to be mentioned here.

The information about the reptiles records in the Crimean caves is scarce as well. In observations in summertime 1939 some lizards were reported as a blood sourse for the sandflies *Phlebotomus sequens* (= *Sergentomyia minuta* Rondani, 1843), which reside in caves near Sevastopol and at the Southern Coast of the Crimea, however, without their exact locations: "... specific habitats of these sandflies are caves... Females of this species in the Crimea apparently feed mainly on the blood of reptiles — lizards, which are many in those caves, where sandflies live," and "... sandflies were caught mainly in shallow caves, mostly close to the entrance, staying in numerous cracks and clefts, where lizards usually hide" (Perfiliev, 1941, p. 275). It is known that the sandflies usually attack reptiles with a twilight-night rhythm of activity, and geckos in particular (Alekseev, 2008). *S. minuta*, along with *S. dentata* (Sinton, 1933) feed on Kotschy's gecko, *Mediodactylus kotschyi* (Steindachner, 1870) in the Eastern Mediterranean region (Naucke, 2002). Therefore, it was suggested that, regarding the work of Perfiliev, we can refer only to the Crimean (Danilewski's) gecko, *M. danilewskii* (Strauch, 1887), but not to any other lizard species (Turbanov et al., 2015). It can be anticipated that the geckos in the southern Crimea caves might be found before the Second World War, however, this fact was not adequately highlighted in the scientific literature and/or analyzed by herpetologists.

And, finally, in the publication on the biogeographical status of the Crimean populations of *M. danilewskii* and the leopard snake, *Zamenis situla* (Linnaeus, 1758), some data about the use of relic karst cavities by both of these species in Balaklava and Aya Cape surroundings were presented (Kukushkin et al., 2017).

Therefore, the current review is the first attempt to summarize all data regarding the findings of poikilothermic vertebrates in underground cavities of the Crimean Mountains. The main objectives of our study were to analyse the data on the amphibians and reptiles records in this area, to evaluate the possibility and scale of animal entry into the caves, as well as to identify the regularities of underground habitats use by various representatives of the Crimean herpetofauna.

MATERIAL AND METHODS

All materials were collected at the territory of the Crimean Peninsula within 2003 – 2018. Hardly accessible caves and mountain trials on the Baydarskaya and Ai-Petrinskaya Yailas were explored mainly by the first author using special speleological and climbing equipment. The caves near the top of the Aya Cape (Balaklava District, Sevastopol) were repeatedly monitored by the second author in 2015 – 2018, technically supported by P. Oksinenko (Simferopol). The Karadag grottos were also surveyed during the whole period of observations by the second author as well.

Laser distometer, an inclinometer and a mountain compass were used for the topographical studies in caves. The geographical coordinates and the altitudes of the terrain above the sea level were determined using the GPS navigator Garmin 64st. The air temperature in the cavities was measured by the Exo-Terra digital thermometer with the accuracy of 0.1°C.

The zonation of the Crimean karst is given according to the B. Vakhrushev's scheme (Vakhrushev, 2009).

A significant and exclusively important part of our data on reliable amphibians and reptiles findings in the

TABLE 1. Records of Amphibians in Caves of Mountainous Crimea

Species	Karst area, administrative affiliation of the point of record	Mountain massif, element of relief	The name of the cavity (its cadastral number)	Altitude, m a.s.l.	Date of observation	Depth of the record from the surface, m	Distance from entrance, m (for the caves with horizontal stretch)	Number of individuals	Source of information
T. karelinii	AY, Yalta	btw. Mt. Byuzyuka and Mt. Balchik-Kaya	Razocharovanie (= Uparennaya) (4425/3353 – 3)	940	2nd half of May 1999	5	—	2	A. Yushko, O. Peretyatko (personal communication)
	BB, Sevastopol	Canyon of Chernaya River, Mt. Khlama	Grot Anny Cave (4431/3345-1)	354	31.05.2003	—	At entrance	ca. 10 (ad., juv.)	Matyushkin (2010)
	AY, Sevastopol	locality Karadagsky Les	Kristalnaya (= Maksimovich) (4426/3354-2)	834	2003 – 2004	Up to 64	—	Several adults and larvas	Kotenko, Kukushkin (2010)
	AY, Sevastopol	Ai-Petrinskaya Yaila	Gibel' Yaponii (4427/3355-24)	1051	15.12.1990	20	—	5	Matyushkin (2010)
					05.07.2004			1	
	AY, Sevastopol	Ai-Petrinskaya Yaila	Aie-Kale (4428/3356-10)	1096	11.08.2004	10	—	1	Matyushkin (2010)
	AY, Sevastopol	Talakanskaya Hollow	Unnamed karst ponor	810	13.10.2007	under stone at the bottom of a karstic funnel	—	2 juv.	Matyushkin (2010)
	AY, Sevastopol	Ai-Petrinskaya Yaila	Raskop Medvezhyi (4428/3354-6)	871	18.01.2008	8	—	1	Matyushkin (2010)
	BB, Sevastopol	Bayidarskaya Hollow	Mamut-Chokrak (4425/3345-2)	280	08.10.2016	3 – 4	—	1	S. Kebets, A. Akimov (personal communication)
	AY, Sevastopol	Mt. Kurt-Kaya	Entuziastov (4427/3351-1)	296	20.11.2016	27	—	3	Ye. Yanovskyi (personal communication)
	AY, Sevastopol	Ai-Petrinskaya Yaila	Gelektitovaya-Vesennyaya (4428/3356-6)	1075	02.04.2017	40	—	2	A. Akimov, S. Kebets (personal communication)
	BB, Sevastopol	Canyon of Chernaya River	Chernorechenskaya (4431/3342-2)	77	05.05.2017	—	30 – 40	1	I. Turbanov
	AY, Sevastopol	Bolshoyi Babulgan Hollow	Kuban' (4428/3356-4)	956	15.07.2017	26	—	1	I. Turbanov, S. Arefiev, O. Kukushkin
H. orientalis	KY, Belogorsk	Karabi Yaila	Gvozdetsky (4452/3433-23)	985	Late October 1990	180	—	1	A. Papyi (personal communication)
					December 2011			1	Pysanets, Kukushkin (2016)
	KY, Belogorsk	Karabi Yaila	Monastyr-Chokrak (= Su-Teshigy) (4452/3432-2)	998	10.08.1993, 06.08.2003	90	—	Several specimens	R. Vargovitsh
					Early July 2007	110		adult and several lumps of eggs in the pool of condensate	M. Grishkov (personal communication)
	BB, Sevastopol	Bayidarskaya Hollow	Mamut-Chokrak (4425/3345-2)	280	19.08.2010	—	30	1	I. Turbanov

Species	Karst area, administrative affiliation of the point of record	Mountain massif, element of relief	The name of the cavity (its cadastral number)	Altitude, m a.s.l.	Date of observation	Depth of the record from the surface, m	Distance from entrance, m (for the caves with horizontal stretch)	Number of individuals	Source of information
	AY, Yalta	Ai-Petrinskaya Yaila	Oreshek (4427/3359-3)	1070	23.10.2010	24	—	1	A. Papyi (personal communication)
	BB, Sevastopol	Bayidarskaya Hollow, Mt. Biyuk-Sinor	Sakhtykh (4425/3348-1)	639	11.08.2012	7	—	1	S. Bogdanenko (personal communication)
B. viridis	SY, Simferopol	Dolgorukovskaya Yaila	Kizil-Koba (= Krasnaya) (4452/3420-7)	585	26.02.2001	—	4 – 6	1	Zagorodniuk (2004)
	AH, Sudak	Mt. Shpil', Agarmysh massif	Pogreb (4500/3500-1)	420	27.11.2005	—	7 – 8	1	V. Nuzhdenko (personal communication)
	BB, Sevastopol	Ravine Kobalar-Dere	Karan'-Koba (= Temnaya) (4430/3348-1)	339	18.11.2006	—	16	1	Matyushkin (2010)
	KY, Belogorsk	Karabi Yaila, Ridge Bagalma	Kara-Murza (4454/3433-5)	625	22.08.2009	130	—	1	P. Oksinenko (personal communication)
	BB, Sevastopol	Ridge Spilia, Mt. Asketi	Asketi-2 (not included in the Cadastre)	ca. 320	Mid-Aug. 2014	—	5 – 7	1	P. Oksinenko (personal communication)
					26.09.2015		5 – 7	1	O. Kukushkin, P. Oksinenko
	BY, Alushta	Babugan Yaila, area of the Mt. Zeytin-Kosh	Unnamed cave (not included in the Cadastre)	1460	Nov. 2014	—	3 – 4	1	Yu. Balakhtinova, S. Klushin (personal communication)
	AY, Sevastopol	locality Karadagsky Les	Bizyukskaya (not included in the Cadastre)	756	01.04.2017	106	—	1	R. Potapov (personal communication)
	KY, Belogorsk	Karabi Yaila, Egiz-Tinakh Valley	Yabushkan-Koba (4452/3434-1)	967	11.08.2017	—	10	1	O. Kukushkin, I. Turbanov
	KD, Theodosia	Ridge Khoba-Tepe	Grotto under the Rock Mayak (not included in the Cadastre)	ca. 200	19.08.2017	—	6 – 7	1	O. Kukushkin, P. Oksinenko
	KY, Alushta	Karabi Yaila	Tserkov' (4451/3436-1)	ca. 985	02.12.2017	—	10	1	Yu. Balakhtinova, S. Klushin
P. (*ridi-bun-dus*) complex	AY, Yalta	Ai-Petrinskaya Yaila, Mt. Morcheka	Druzhba (4425/3354-10)	969	01.01.2007	45	—	1 juv.	A. Shendrik (personal communication)
	AY, Sevastopol	Mt. Karadag	Skelskaya (4427/3352 – 3)	304	09.04.2009	—	20	1	I. Turbanov
					11.04.2010	—	2 – 3	1	
					06.03.2015	—	2 – 3	1	
					Sept. 2017	15	50	up to 10 juv.	K. Moskvina (personal communication)
					04.03.2018	15	50	3 juv.	I. Turbanov. A. Aschepkova
	AY, Sevastopol	Mt. Villya-Burun	Lyagushach'ya 4428/3356-3)	905	23.02.2010	23	—	1	S. Kebets (personal communication)
	KY, Belogorsk	NE spures of Karabi Yaila, area of the Mt. Gol'-Kaya	Karasu-Bashy (4458/3434-1)	390	30.08.2015	8	—	1	A. Akimov, Yu. Balakhtinova (personal communication)

TABLE 2. Records of Reptiles in Caves of Mountainous Crimea

Species	Karst area, administrative affiliation of the point of record	Mountain massif, element of relief	The name of the cavity (its cadastral number)	Altitude, m a.s.l.	Date of observation	Depth of the record from the surface, m	Distance from entrance, m (for the caves with horizontal stretch)	Number of individuals	Source of information
M. danilewskii	KD, Theodosia	maritime slope of the Ridge Karagach	Unnamed grotto (not included in the Cadastre)	ca. 20	July 2001	—	2	1	M. Afanasiev (personal communication)
	BB, Sevastopol	Cape Aiya, Mt. Kalafatlar	Gekkonovaya (4427/3338-2)	496	08.09.2012	—	5 – 12	3	Yu. Balakhtinova (personal communication)
					28.12.2012		3 – 20	ca. 18	I. Turbanov, Yu. Balakhtinova
					20.03.2016		3 – 5	1	O. Kukushkin, P. Oksinenko
					09.10.2016		2 – 3	1	O. Kukushkin, A. Nadolny
	BB, Yalta	Bayidarskaya Yaila, Mt. Chelebi	Gravitational peel break on the climbing route “Kamin v kamine”	610	16.09.2012	—	1	1	I. Turbanov
	BB, Sevastopol	Cape Aiya, Mt. Gurush	Arochnaya (4428/3338-2) and Dvukhkupolnaya (4428/3338-1)	403	05.12 and 15.12.2012	—	from 7 – 10 to 15 – 25	ca. 10 and up to 20	I. Turbanov, Yu. Balakhtinova
				385	26.09.2015		3	1	O. Kukushkin, P. Oksinenko
	BB, Sevastopol	Ridge Spilia, Mt. Asketi	Asketi-1 and Asketi-2 (not included in the Cadastre)	ca. 320	Mid-August 2014	—	5 – 12	ca. 16	P. Oksinenko, Ye. Oksinenko (personal communication)
			Asketi-1		26.09.2015		5 – 7	1	O. Kukushkin, P. Oksinenko
	BB, Sevastopol	Karanskie Rocks, Kaya-Bash Heights	Unnamed cave (not included in the Cadastre)	ca. 270	10.06.2016	—	At entrance	1	I. Turbanov
L. agilis	AY, Sevastopol	Ai-Petrinskaya Yaila	Tri Slepykh (4428/3354-2)	860	14.05.1994	10	10	1 female and its egg	Matyushkin (2010)
C. austriaca	AY, Yalta	maritime cliff of the Mt. Morcheka	Medovaya (4425/3354-9)	910	19.06.2006	—	30	1 juv.	A. Shendrik (personal communication)
	CY, Simferopol	Chatyrdag, Lower plateau	Vyalov-Azimutnaya (= Togerik-Alan-Khosar) (4445/3417 – 6)	1020	07.08.2006	30	—	1 (dead specimen)	E. Bednarskaya (personal communication)
	KY, Belogorsk	Karabi Yaila	Skazka (4452/3433-7)	1002	Early July 2009	45	—	1	I. Turbanov
	KY, Belogorsk	Karabi Yaila	Monastyr-Chokrak (= Su-Teshigy) (4452/3432-2)	998	18.07.2010	95	—	1	À. Akimov (personal communication)
	KY, Belogorsk	Karabi Yaila	Kastere (4452/3432-7)	1011	24 – 27.07.2010	70	—	1	I. Turbanov

Species	Karst area, administrative affiliation of the point of record	Mountain massif, element of relief	The name of the cavity (its cadastral number)	Altitude, m a.s.l.	Date of observation	Depth of the record from the surface, m	Distance from entrance, m (for the caves with horizontal stretch)	Number of individuals	Source of information
D. caspius	KY, Belogorsk	KarabiYaila	Kruber (4451/3430 – 8)	998	24 – 27.07.2010	12	—	1	I. Turbanov
	KD, Theodosia	Ridge Khoba-Tepe	Kostrovy Grotto (not included in the Cadastre)	ca. 230	30.05.2008	—	4 – 5	1	O. Kukushkin, E. Gladilina, A. Nadolny
	DY, Simferopol	Demerdzhi Yaila	Maloy Akademii Nauk (= MAN) (4446/3422-2)	1170	Summer 2008	—	1 – 2	1	E. Bednarskaya (personal communication)
	BB, Sevastopol	Cape Aiya, Mt. Kalafatlar	Gekkonovaya	496	20.03.2016	—	10	1	O. Kukushkin, P. Oksinenko
	BB, Sevastopol	Bayidarskaya Hollow	Urkusta-Chokrak-Koba (4431/3349-2)	385	06.08.2017	—	30	1 (dead specimen)	I. Turbanov, S. Arefjev
Z. situla	BB, Sevastopol	Bayidarskaya Hollow, Mt. Biyuk-Sinor	Sakhtykh (4425/3348-1)	639	11.08.2012	7	—	1	S. Bogdanenko (personal communication)
	BB, Sevastopol	Cape Aiya, Mt. Gurush	Unnamed grotto (not included in the Cadastre)	ca. 400	02.12.2012	—	2	1	Yu. Balakhtinova (personal communication)
	BB, Sevastopol	Cape Aiya, Mt. Kalafatlar	Gekkonovaya	496	05.12.2012	—	10	1 juv.	I. Turbanov
	BB, Sevastopol	Ridge Spilia, Mt. Asketi	Asketi-2	300 – 330	26.09.2015	—	At entrance	1 (moulted skin)	O. Kukushkin, P. Oksinenko
	BB, Sevastopol	Cape Aiya, Mt. Gurush	Dvukhkupolnaya	385	26.09.2015		At entrance	1 (moulted skin)	O. Kukushkin, P. Oksinenko
	BB, Sevastopol	Cape Aiya, Mt. Kalafatlar	Gnomov (not included in the Cadastre)	ca. 490	31.03.2016	—	3	1	O. Kukushkin, E. Gladilina
	BS, Bakhchisarayi	Mt. Baba-Dag	Mangup-Kale-14 Cave (4435/3348-2)	ca. 550	03.05.2018	10	14	1	I. Turbanov
E. sauromates	BB, Sevastopol	Bayidarskaya Hollow	Mamut-Chokrak (4425/3345-2)	280	13.05.2013	—	At entrance	1	L. Bogdanenko (personal communication)
V. renardi	CY, Simferopol	the head of Orlinoe gorge	Monashjya (not included in the Cadastre)	1025	17.05.2009	—	At entrance	1	E. Bednarskaya (personal communication)
Ophidia indet.	CY, Simferopol	Chatyrdag, Lower plateau	Viking (not included in the Cadastre)	ca. 950	05.04.2006	ca. 50	—	1	E. Bednarskaya (personal communication)
	CY, Simferopol	Chatyrdag, Lower plateau	Golubinaya-2 (4447/3417-3)	ca. 990	28.07.2007	15	—	1	E. Bednarskaya (personal communication)
	CY, Simferopol	Chatyrdag, Lower plateau	Tryokhetazhnaya (4447/3417-7)	1009	12.11.2007	10	—	1	E. Bednarskaya (personal communication)

underground cavities confirmed with the photos was given by our correspondents: speleologists, mountaineers, biologists, and local historians. Findings of 1990s – 2010s were organized in chronological order (Tables 1 and 2).

The free accessible "Caves. Information retrieval system" Internet resource (https://speleoatlas.ru) was used for the specification of the cavities cadastral number (for each cavity — at the first mention in the tables). The current taxonomy of the amphibians and reptiles has to be reffered according to D. Frost and P. Uetz et al. databases (both were accessed on August 17, 2018).

In the tables the following abbreviations were used for the Crimean Mountains karst areas: BB — Bayidarsko-Balaklavsky; AY — Ai-Petrinsky; BY — Babugansky; CY — Chatyrdagsky; SY — Dolgorukovsky; DY — Demerdzhinsky; KY — Karabyisky; AH — Agarmyshsky; KD — Sudaksky (karst areas of the Mountainous Crimea); BS — Bakhchisaraysky (karst area of the Crimean Piedmont).

In our paper, a four category cave animals ecological classification proposed by B. Sket was used: (i) troglobionts species strictly associated with hypogean habitats; (ii) eutroglophilic, originally epigean species able to exist permanently in subterranean habitats; (iii) subtroglophilic species able to live in subterranean habitats temporarily or permanently, though occasionally going out to the surface to support their biological functions such as feeding or reproduction; (iv) trogloxenic species occasionally got into the caves (Sket, 2008). However, the differences between subtroglophiles and trogloxenes seem to be quite vague at the moment (Trajano and de Carvalho, 2017), and the representatives of the same species under the diverse circumstances can be classified into the third or the fourth category. Moreover, the periodicity of visiting underground cavities and the reason for their usage by the Crimean amphibians and reptiles should be studied more carefully. Obviously, in such a cases, the simple categorization of animals found in caves can be challenging. Therefore, for the characterisation of the amphibians and reptiles, which get into the underground cavities purposefully in some phases of their life cycle and then able to travel back to their typical habitats, the definition of a facultative cavernicole is used. In turn, an accidental trogloxenes get into the caves unintentionally and after a while, without the opportunity to go out to the surface, die there.

RESULTS

The data on the amphibians and reptiles found at the Crimean underground cavities within the 1980s – 2010s are summarized, respectively, in Tables 1 and 2.

Amphibia

Four amphibian species from four families were recorded in the cave habitats (Fig. 1A).

Order Caudata
Salamandridae
Karelin's newt — *Triturus karelinii* (Strauch, 1870)

This Caudata species has the maximum number of individuals (more than 30 in total) as well as localities (12 in total) found. Most of the records belong to Ai-Petrinsky karst area (the western part of the Ai-Petrinskaya Yaila and its spurs). Single individuals or groups, sometimes including up to 10 newts, were also seen in the Bayidarsko-Balaklavsky karst area within the known range of the species (more often in the Chernaya River basin). The altitudes range of the findings varies between 250 and 1100 m a.s.l., which is only slightly lower as compared to the limiting altitude of the species records in the Crimea (1200 m a.s.l.) (Szczerbak, 1966). The newts were registered at depths up to 64 m with the maximum distance from the horizontal caves entrance of 30 – 40 m. Amphibians occured both in comparatively dry cave sections (Fig. 2*a*) and puddles of the condensed water (Fig. 2*b*). It is well-known fact that the newts are able to climb on vertical surfaces, and they were often found on the rock ledges of several meters in hight from the cavity floor. According to the seasonal distribution of records, newts visit caves all the year round. Individuals observed in winter were quite active and were in a good fit (Matyushkin, 2010). Besides the newts, in the same caves the numerous invertebrates such as troglophilic spiders, centipedes, and insects (Trichoptera, Lepidoptera, Diptera) as well as vertebrates — horseshoe bats (*Rhinolophus* sp.) were observed. The adult male of *T. karelinii* found in July 2017 at the bottom of the Kuban' Cave in the Bolshoy Babulgan hollow (26 m in depth, air temperature at midday 8.2°C) was inert and almost irresponsive to various stimuli. However, after being transfered aboveground, it became active within the several minutes and took an indicative alert position typical for the newts from *T. karelinii* group, exhibited in the display of ventral aposematic coloration. Moreover, *T. karelinii* large larvae were recorded in the Skelskaya Cave (Table 1), though this information needs to be verified.

Order Anura
Family Bufonidae
Green toad — *Bufotes viridis* (Laurenti, 1768)

Toads in the underground habitats occurs in the Crimean Mountain from Balaklava in the west to Karadag and Agarmysh massives in the east (Table 1). Generally, more than 10 individuals were recorded in 10 localities in total. The altitude range of the findings is much higher

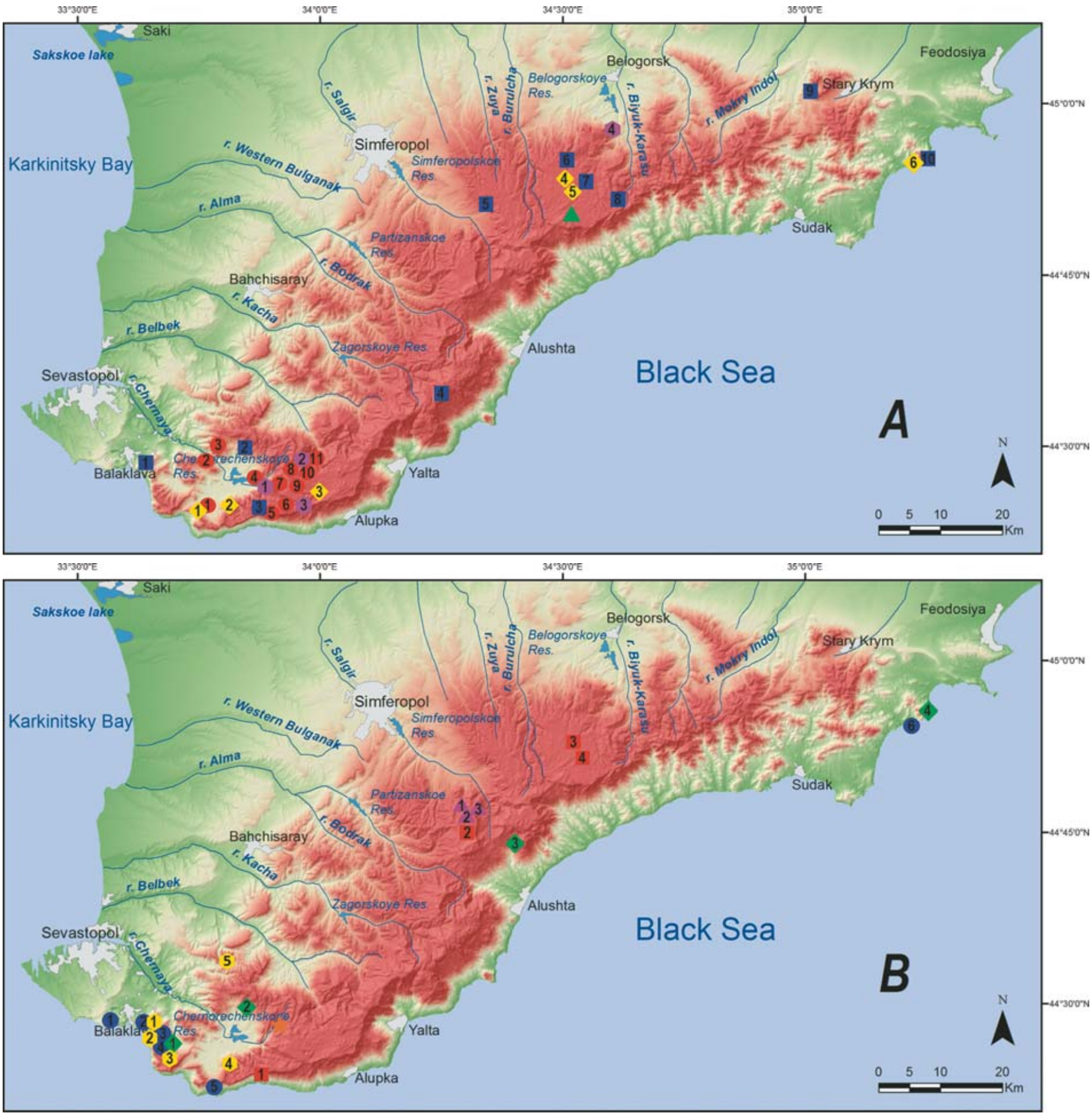

Fig. 1. Records of poikilothermic vertebrates in the karst cavities of the Mountainous Crimea: *A*, records of amphibians: **red circle**, *Triturus karelinii*: 1, Mamut-Chokrak Cave; 2, Chernorechenskaya Cave; 3, Grot Anny Cave; 4, Razocharovanie Cave; 5, Entuziastov Cave; 6, Kristalnaya Cave; 7, unnamed karst ponor in Talakanskaya Hollow; 8, Aie-Kale and Raskop Medvezhyi caves; 9, Gibel' Yaponii Cave; 10, Gelektitovaya-Vesennyaya Cave; 11, Kuban' Cave; **green triangle**, *Pelobates vespertinus*: unknown cave, 1 km to the north from the Kara-Tau Mt., Karabi Yaila; **blue square**, *Bufotes viridis*: 1, Asketi-2 Cave; 2, Karan'-Koba Cave; 3, Bizyukskaya Cave; 4, unnamed cave on the Babugan Yaila; 5, Kizil-Koba Cave; 6, Yabushkan-Koba Cave; 7, Tserkov' Cave; 8, Pogreb Cave; 9, grotto under the Rock Mayak, Khoba-Tepe Ridge; **yellow rhombus**, *Hyla orientalis*: 1, Mamut-Chokrak Cave; 2, Sakhtykh Cave; 3, Oreshek Cave; 4, Monastyr-Chokrak Cave; 5, Gvozdetsky Cave; 6, seaside grotto on the Khoba-Tepe Ridge; **violet hexahedron**, *Pelophylax* (*ridibundus*) complex: 1, Skelskaya Cave; 2, Lyagushach'ya Cave; 3, Druzhba Cave; 4, Kara-su-Bashy Cave; *B*, records of reptiles: **blue circle**, *Mediodactylus danilewskii*: 1, unnamed cave on the Karanskie Rocks; 2, Asketi-1 and Asketi-2 caves; 3, Arochnaya and Dvukhkupolnaya caves; 4, Gekkonovaya Cave; 5, gravitational peel break on the climbing route "Kamin v kamine"; 6, unnamed grotto on the Ridge Karagach; **orange star**, *Lacerta agilis*: Tri Slepykh Cave; **red square**, *Coronella austriaca*: 1, Medovaya Cave; 2, Druzhba Cave; 3, Vyalov-Azimutnaya Cave; 4, Tryokhetazhnaya Cave; 5, Monastyr-Chokrak, Kastere and Skazka caves; 6, Kruber Cave; **green rhombus**, *Dolichophis caspius*: 1, Gekkonovaya Cave; 2, Urkusta-Chokrak-Koba Cave; 3, Maloyi Akademii Nauk Cave; 4, Kostrovyi Grotto on the Khoba-Tepe Ridge; **yellow hexahedron**, *Zamenis situla*: 1, Asketi-2 Cave; 2, Dvukhkupolnaya Cave and unnamed grotto on the Gurush Mt.; 3, Gekkonovaya and Gnomov caves; 4, Sakhtykh Cave; 5, Mangup-Kale-14 Cave; **violete triangle**, Ophidia indet. (unidentified snakes): 1, Golubinaya-2 Cave; 2, Tryokhetazhnaya Cave; 3, Viking Cave.

Fig. 2. Amphibians in the Crimean caves: *a*, *Triturus karelinii* in Entuziastov Cave, 20 November 2016, photo by Ye. Yanovsky; *b*, *Triturus karelinii* in Gelektitovaya-Vesennyaya Cave, April 2, 2017, photo by A. Akimov; *c*, *Bufotes viridis* in Asketi-2 Cave, Mid-August 2014, photo by P. Oksinenko; *d*, *Hyla orientalis* in Mamut-Chokrak Cave, 19 August 2010, photo by I. Turbanov.

than those of other amphibian species, varying from 200 to circa 1500 m a.s.l., while the maximum depth comprises up to 130 m, and the distance from the entrance in the horizontal caves exceeds 16 m. The entrances to the caves, where the toads were observed, were sometimes located on hardly accessible cliffs (for example, as the Asketi Cave near Balaklava) (Pysanets and Kukushkin, 2016). An adult toad was caught on a narrow rock cornice at 560 m a.s.l. during the climbing of "Ukho" ("The Ear") alpinistic trail on the Mshatka-Kayasy Mountain (the western part of the Ai-Petrinskaya Yaila) on August 24, 2012. The rock wall height below the cornice was almost 250 m. Toads are recorded in caves all the year round. In the hot season (July – September), their findings in the cavities are usually confined to the humid soil areas in moisture infiltration zone after an abundant precipitation or to the sources of the condensed water (Fig. 2*c*). Numerous records of *B. viridis* in the same cavities within the long time intervals indicate that toads systematically use the caves as summer shelters (Table 1).

It has to be also noticed that the air temperature in a site of a large *B. viridis* female finding in the Asketi-2 Cave was 17.8°C, while at the entrance –26.5°C on 10:43 a.m. at the end of September 2015.

The altitude of *B. viridis* records at the Crimean upland is of a great interest. Thus, a toad has been observed in nameless cave at an altitude of 1460 m. a.s.l. (44.620917° N 34.291278° E) near the Babugan Yaila southeastern spur, what is supposed to be the highest finding of *B. viridis* in the Crimea. Moreover, this is the first record of a green toad at Babugan Yaila in general, despite it was reported before that this toad may dwell on its northwestern spur in the cordon Alabach area of the Crimean Nature Reserve at 1200 m. a.s.l. (S. Kostin, personal communication). In 2000s the targeted expeditions were undertaken by T. Kotenko aimed to reveal toads, since it was anticipated that a common toad, *Bufo bufo* (Linnaeus, 1758) could be found in the cool and humid wooded areas adjacent to Yaila. According to some sources, this species resided the Crimea in the 19th century (Kotenko, 2010). However, these attempts were predictably unsuccessful. At the same time, at Chatyrdag massif *B. viridis* was found up to 1030 m a.s.l. (its spawning ocurrs in the deep gorges below 700 m), at Karabi Yaila — up to 990 m (toad reproduction was observed on the northern side of the plateau at 680 – 830 m a.s.l.), and at Ai-Petrinskaya Yaila — up to 1160 m a.s.l. A large number of larvae close to the final stage of metamorphosis were found at this elevation in the mountain meadow steppe to the west from Mt. Bedene-Kyr in the muddy road puddles on July 15th, 2017. Approximately at the same altitudes (1100 – 1150 m a.s.l.) the spawning reservoirs of *B. viridis* on the Chuchel' Pass in the Crimean Nature Reserve were recorded (Szczerbak, 1966).

Family Hylidae
Eastern tree frog —
***Hyla orientalis* Bedriaga, 1890**

Circa 10 individuals (mostly adults, less often juvenils) were observed in 5 caves, 3 of which are located in the southwestern Crimea, including the Ai-Petrinskaya Yaila, and 2 — in the central part of the Karabi Yaila plateaus. The majority of the tree frogs were observed in the Karabi Yaila caves. The maximum depth of findings in karst is up to 180 m, while the horizontal distance from the cave entrance is about 30 m. The altitude range of the findings varies from 250 to 1100 m a.s.l. The maximum altitudes of amphibians records outside cavities are 1000 m a.s.l. at Dolgorukovskaya and Karabi Yailas, up to 1150 m at the Chuchelsky Pass, up to 1200 m at Ai-Petrinskaya Yaila, and 1230 m a.s.l. at Demerdzhi Yaila (Pysanets and Kukushkin, 2016). All *H. orientalis* findings in caves occurred in the second half of the year — from July to December. Only once the tree frog spawning was observed in mid-summer (July 2007) in a complete darkness in the bottom of one of the Karabi Yaila caves (Table 1). The pattern (presence and/or absence of the spots) and coloration of the amphibians found in the caves varied in many shades of green from salad-light to olive-green (Fig. 2*d*). Several clutches of whitish eggs were on the wet rock surface in condensate streams and in small puddles on the cavity bottom.

Family Ranidae
Marsh frog – *Pelophylax* (*ridibundus*) complex

In 4 localities about 10 individuals in total were recorded. A marsh frog is more closely related to the aquatic habitats as compared to other amphibian species of the Crimean Peninsula, what might explain its attraction to the cave springs. Only one large adult was found on the northern part of the Karabi upland, while most of the findings are confined to the western part of the Ai-Petri karst area — primarily to the Skelskaya Cave (Table 1). The maximum depth of the findings is up to 45 m, while the horizontal distance from the cave entrance is up to 50 m. In the Skelskaya Cave, groups of 5 – 10 juveniles were observed in the puddles of circa 0.25 m in depth (for example, in September 2017). However, *P. ridibundus* has not been observed in the cave lakes of the Crimea, although in other karst areas (for instance, in the Balkans) the large clusters of the Ranidae family members in the underground reservoirs were observed (Koller, 2017). The altitude range of *P. ridibundus* records in the Crimean caves comprised 300 – 1000 m a.s.l., with the maximum elevation of the species in the Crimea of 1150 – 1200 m a.s.l. on the Mt. Chuchel' and Ai-Petrinskaya Yaila (Pysanets and Kukushkin, 2016).

REPTILIA

At least 8 species of reptiles from 4 families (3 species of lizards and not less than 5 species of snakes) have been discovered inside or at a high proximity to the entrance of underground cavities (Fig. 1*b*).

Order Sauria
Family Gekkonidae
Crimean (Danilewski's) gecko —
***Mediodactylus danilewskii* (Strauch, 1887)**

During the daytime in July 2001, a student M. Afanasyev observed an adult gecko moving in the shade on the shallow grotto vault located on a very steep talus of the Karagach ridge in the Karadag Nature Reserve (Fig. 3*a*). A few years later, in 2005 – 2006, a large *M. danilewskii* population was found at the western part of the coastal Karadag ridge (Kukushkin, 2009). It has to be emphasized that it is the northernmost Danilewski's gecko population in the world living in natural landscapes, which was revealed for the first time by the second author of this paper.

In the evening twilight on September 16, 2012, an adult gecko was photographed on the southern cliff of Mt. Chelebi (657 m a.s.l.) on "Kamin v kamine" ("Fireplace inside the fireplace") alpinistic trail above the Foros settlement (Fig. 3*b*). Since the lizard was found at 610 m a.s.l., it is now recognized as one of the highest locations of Danilewski's gecko at the Crimea. Moreover, the highest point of *M. danilewskii* habitat in the Crimea is Mt. Ilyas-Kaya (above the Sarych Cape), which peak rises 682 m a.s.l., where the gecko was tracked in deep cracks along the brink of a great southern cliffs (Kukushkin, 2004, 2009). It is anticipated that the Crimean gecko can be found in other gravigenic cracks on the Bayidarskaya Yaila southern cliffs and the Bayidaro-Kastropol Wall of Ai-Petrinskaya Yaila as well, though unlikely — on the yiala cliffs to the east from the Shaytan-Merdven Pass.

Fig. 3. Landscapes where *Mediodactylus danilewskii* was observed in the cavities: *a*, grotto at the foot of the Ridge Karagach in Karadag paleovolcanic group, photo by O. Kukushkin; *b*, southern cliffs of the Upland Bayidarskaya Yaila, Mt. Chelebi, photo by O. Kukushkin; *c*, maritime cliffs of the Cape Aiya, view from the sea, photo by O. Kukushkin; *d*, upper edge of western cliffs of the Mt. Kalafatlar, photo by O. Kukushkin.

During 2012 – 2017 geckos have been repeatedly observed in caves of Baidarsko-Balaklavsky karst area: near the northern border of the "Cape Aya" State Landscape Reserve, and both to the west and east from Balaklava Bay (Table 2). This species was recorded in 6 relic erosion-karst systems in the cracks of Upper Jurassic conglomerates and limestones. The cavities are opened by narrow entrances (in some cases circa 0.5 – 1 m in diameter) on the gigantic cliffs of southern and western slope exposures (Fig. 3*c*, *d*). The total length of these almost horizontal systems exceeds 58 – 64 m (e.g., Gekkonovaya (Gecko's) and Arochnaya (Arch) Caves), while the thickness of the cave's vault varies from 0.5 – 2 m on Mt. Kalafatlar to up to 80 m on Mt. Gurush (Fig. 4*a*). The total length of the Mt. Asketi cave system is about 50 m; the height of the entrances to the caves approximates 7 – 15 m, whereas the total height of the cliffs reaches in some cases 35 – 40 m (Fig. 4*b*).

Geckos were concentrated mostly at depths of 3 – 25 m from the entrance in the dim light of meanders and halls as well as in the dark distant passages. The width of cavities in the sites of lizards records varied from 0.3 – 0.5 to 3 m, while the height was 0.6 – 2 m. In total, about 70 *M. danilewskii* individuals were observed in caves — close to the Cape Aya summit (2012) and in Balaklava town vicinity (2014) (Table 2). Groups of the lizards comprising up to 15 – 20 individuals were found both in winter (Aya Cape caves, December 2012) and in summer (Mt. Asketi, mid-August 2014). It is remarkable that within one cavity the lizards were distributed more or less evenly, but sometimes 2 – 3 individuals were found close to each other. In winter time geckos remained quite active and moved along the cave walls, vaults and clay

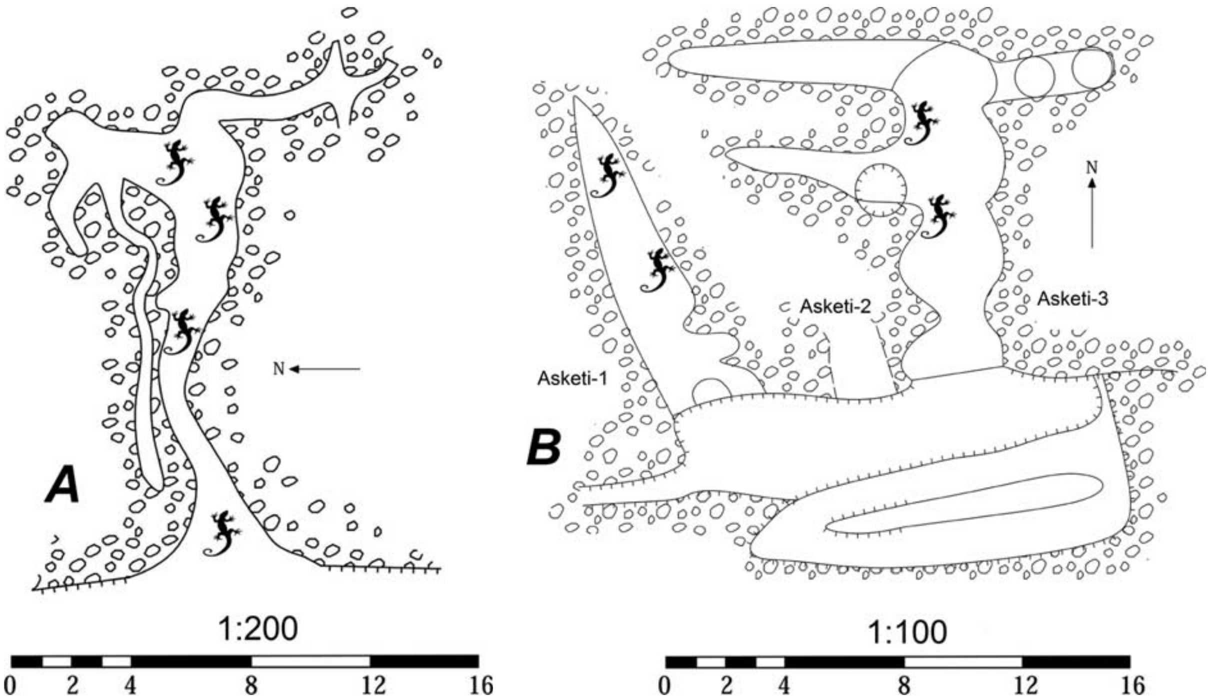

Fig. 4. Sketchs of some underground systems where large aggregations of *Mediodactylus danilewskii* were observed: *a*, Gekkonovaya Cave, Mt. Kalafatlar, Cape Aiya, made by I. Turbanov and A. Kurichenko; *b*, Asketi cave system, Ridge Spilia, environs of Balaklava, made by P. Oksinenko and A. Kurichenko.

bottoms (Fig. 5*a* – *c*). During the monitoring of the same caves in 2015 – 2018 no large groups of geckos were recorded, only single individuals.

As for the caves microclimate, it can be generally characterized as ventillated by a warm scheme with the heat accumulation in cavities during the cold season. The temperature varies in these cavities, since in the second half of December 2012 the temperature outside was –2 to –4°C, while inside the caves it was 10 – 14°C at a distance of 10 – 20 m from the entrance, where most of the lizards were concentrated). In turn, on September 26th, 2015 at 11.00 a.m. the temperature outside was 27°C, though at the entrance hall of the Asketi-1 Cave it was only 18°C. Furthermore, the same day at 3.00 p.m., at the entrance of the Arch Cave it was 25.8°C, but at the site of gecko tracking at the beginning of the narrow hollow upright path starting immediately after the entrance to the hall it comprised 23.6°C. At the same time, in March 31st, 2016 at 1.00 p.m. at the entrance to the Gekkonovaya Cave the temperature was 13.5°C, while at 10 – 12 m from the entrance –7.6°C.

Geckos were not the only inhabitants of these caves, since they were accompanied by the numerous invertebrates such as spiders (*Meta* sp.), centipedes (*Pachyiulus varius*, *Scutigera coleoptrata*; Lithobiidae), Coleoptera (Tenebrionidae), Lepidoptera (Noctuidae), and Diptera. Besides that, under the cave vaults small groups or sole horseshoe bats [*Rhinolophus hipposideros* (Borkhausen, 1797) and *Rh. ferrumequinum* (Schreber, 1774)] were repeatedly observed.

Therefore, the height range of gecko's findings in karst cavities varied from almost 300 to 500 m a.s.l. Within the last two decades the predominant point of view that the Crimean gecko is an exclusively synanthropic species confined to the lower sea-side zone (Szczerbak, 1966) has been subjected to critical correction. Throughout the coast of the Crimean Mountains from Mt. Kaya-Bash and the southern border of the Balaklava Valley in the west to the Karadag mountain group in the east, numerous natural *M. danilewskii* populations were revealed. The upper limit of this species distribution in the Crimea "shifted" from previously established 150 – 200 m to 600 – 700 m a.s.l. depending on the orographic and climatic characteristics of the region (Kukushkin, 2004, 2009; author's unpublished data).

Family Lacertidae
Lindholm's rock lizard — *Darevskia lindholmi* (Szczerbak, 1962)

There were a plethora of findings of this species at the illuminated parts of karst caves and grottos uniformly throughout the territory of the Crimean Mountains and

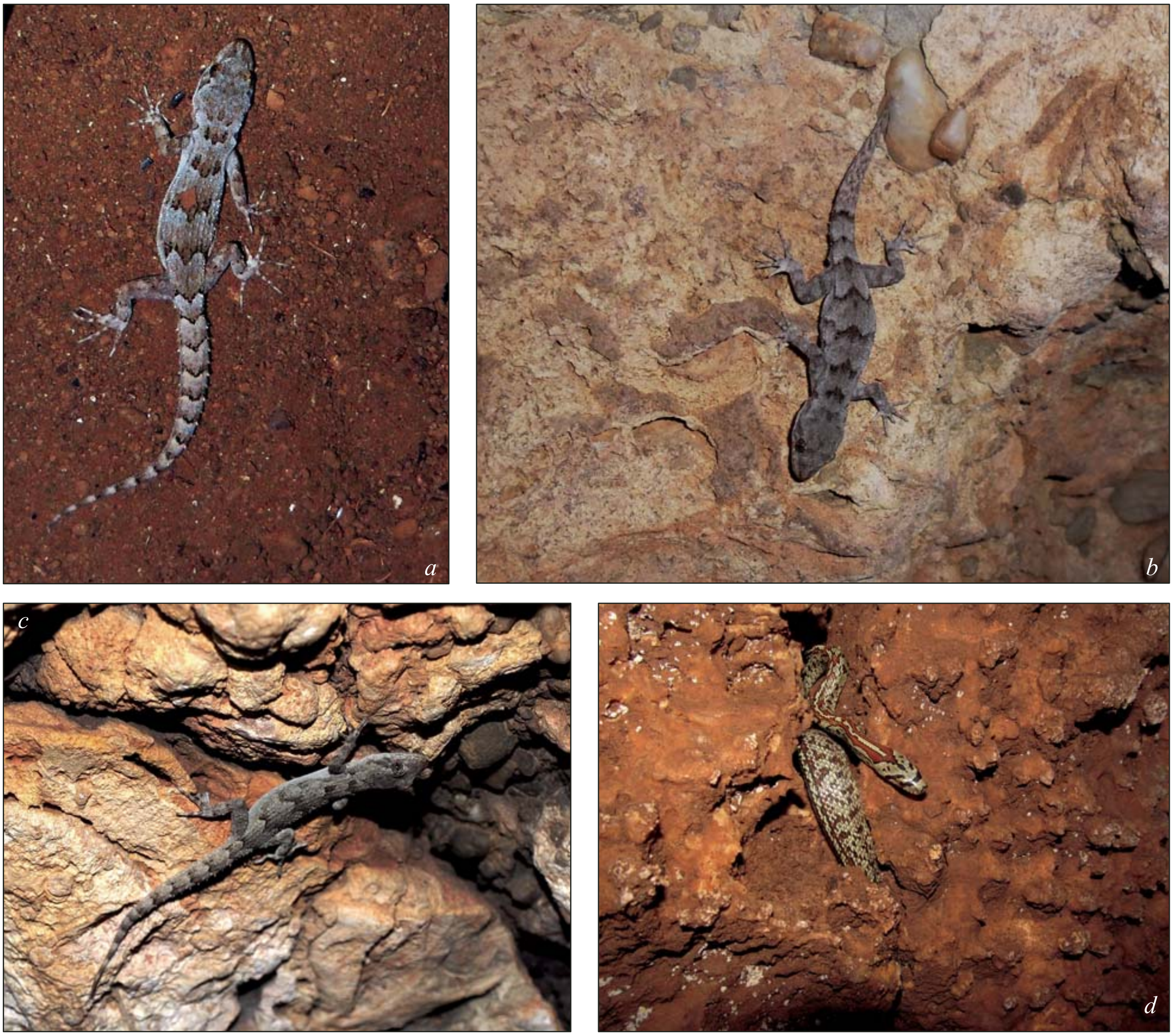

Fig. 5. Reptiles in the Crimean caves: *a*, *b*, *Mediodactylus danilewskii* in the relic karst caves of Cape Aiya environs, December 2012, photos by Yu. Balakhtinova; *c*, *Mediodactylus danilewskii* in Asketi cave system, Balaklava surroundings, Mid-August 2014, photo by P. Oksinenko; *d*, *Zamenis situla*, Sakhtykh Cave, Mt. Biyuk-Sinor, 11 August 2012, photo by S. Bogdanenko.

Piedmont at a small distance (up to 2 m) from the entrance, but in rare cases — up to 7 – 10 m (for example, in artificial cavities of Mangup-Kale "cave town"). Generally, single individuals getting into the grotto were recorded during the daytime with high temperatures. Occasionally, small groups of Lindholm's rock lizards were observed at the entrance to shallow, but fairly wide (0.5 – 1 m) vertical crevices in the stony mountain-meadow steppe (for instance, at the top of Mt. Takja-Tepe on the Karabi Yaila, 1250 m a.s.l., or in the limestone pavement landscapes of the western part of Ai-Petrinskaya Yaila). Unlike the crepuscular geckos, petrophilic lacertids are active during the day hours, use the cavity entrances only as a temporary shelter and for the thermoregulation during the warm time of the day. Therefore, they were not registered in caves during the wintering. The data on this lizard species is not included in Table 2.

Taurida's sand lizard —
***Lacerta agilis tauridica* Suchow, 1926**

On some stony plots of yaila characterized by poor vegetation, sand lizards live in karst funnels with the abundant grasses. Large olive-green specimen (apparently female) was observed on May 14, 1994 in one of the caves on Ai-Petrinskaya Yaila (Table 2). It seems to

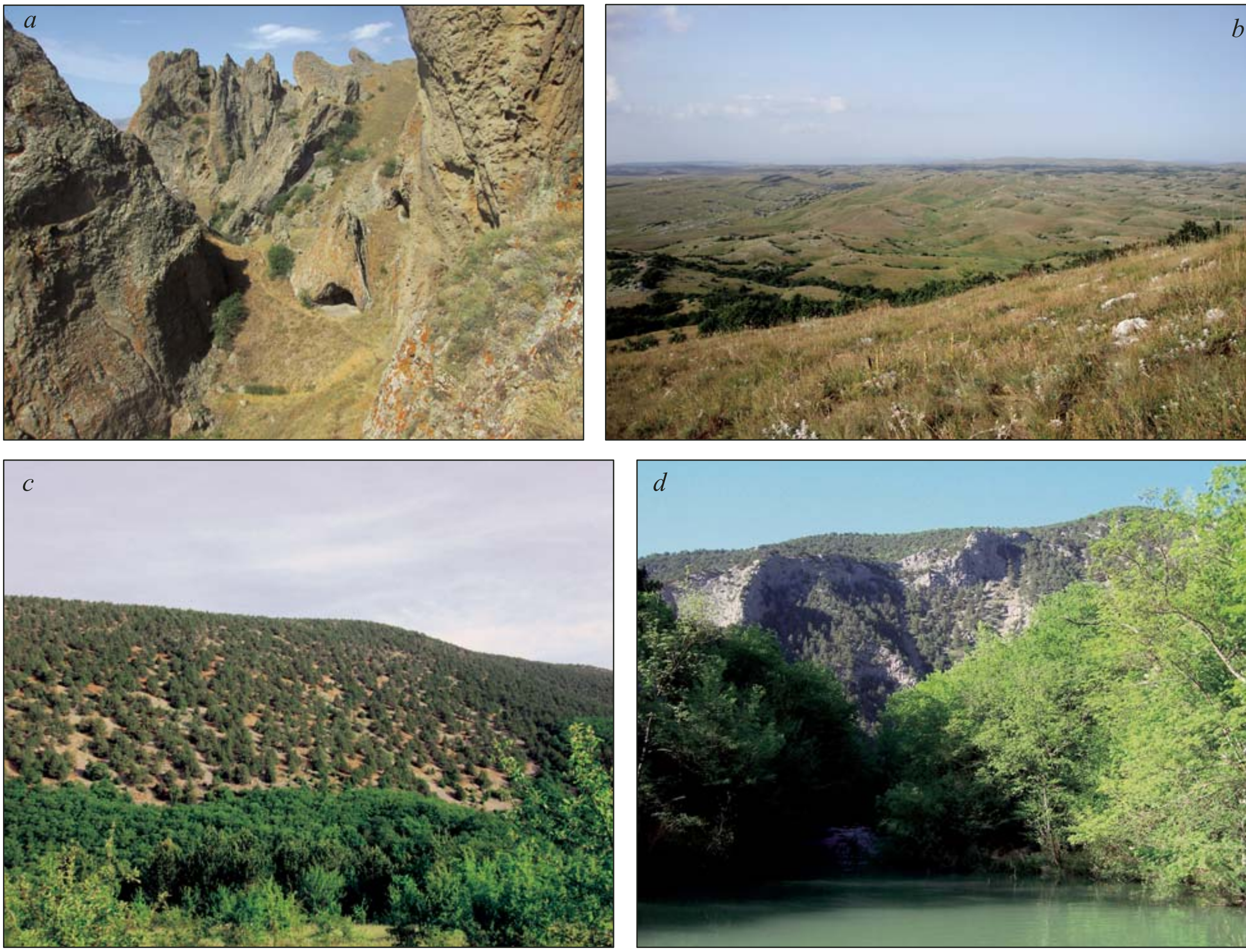

Fig. 6. Habitats of the Crimean anurans in terrains where they penetrate into the caves: *a*, *Bufotes viridis* habitats on the Coastal Crest of Karadag mountain group, Ridge Khoba-Tepe, photo by O. Kukushkin; *b*, *Hyla orientalis* and *B. viridis* habitats on the Karabi Yaila Plateau, photo by A. Nadolny; *c*, *Triturus karelinii* habitats in *Juniperus* sparse forest at NW spures of Ai-Petrinskaya Yaila, photo by O. Kukushkin; *d*, in canyon of the River Chernaya, photo by I. Turbanov.

be interesting that a laid egg close to the lizard was found (Matyushkin, 2010).

Order Serpentes
Family Colubridae
Smooth snake —
***Coronella austriaca* Laurenti, 1768**

To our knowledge, at least 8 findings of the smooth snake were registered in karst fitting the known range of this species at the Crimea, while one half of our records attributed to the central part of Karabi Yaila. Majority of specimens were recorded in summer, what indicates the occasional entry of snakes into the cavities within the peak of the seasonal activity. The maximum depth of the findings is up to 95 m, while the horizontal distance from the entrance into the caves is circa 30 m. It is noteworthy that *C. austriaca* is the most common snake species on the Crimean yailas up to the Shaitan-Merdven Pass in the west and can be seen not only near the plateau edge, but also in its central parts. On Karabi plateau this snake is quite ordinary: up to 3 records during the day in June 2011 at the altitude range between 900 – 1050 m a.s.l. On Ai-Petrinskaya Yaila and the Karatau Upland (Karabi Yaila) the smooth snake is observed up to 1200 m a.s.l., while at Chatyrdag and Dolgorukovskaya Yaila — up to 1000 m (Szczerbak, 1966; own observations).

Caspian whipe snake —
***Dolichophis caspius* (Gmelin, 1789)**

There are data on 4 findings of this species in cavities throughout the Crimean Mountains with the altitude range from about 200 m to almost 1200 m a.s.l. The highest locality on the western slope of Demerdzhi Yaila is of unique importancy, since usually *D. caspius* in the Cri-

Fig. 7. Remains of snakes in the Crimean caves: *a*, decomposed corpse of *Dolichophis caspius* in Urkusta-Chokrak-Koba Cave (*Diptera puparia* are clearly visible on the right side of the photo), photo by I. Turbanov; *b*, skeleton of a colubrid snake (most likely *D. caspius*) in recently discovered Tavrida Cave (border of Simferopol and Belogorsk District, surroundings of the settlement Zuya), photo by D. Tikhomirov.

mea does not occur in the mountains higher than 1000 m a.s.l. However, due to the climatic characteristics of this area, extraordinary high findings of thermophilic reptiles are described from here: for example, the Balkan wall lizard, *Podarcis tauricus* (Pallas, 1814) was registered on Mt. South Demerdzhi at up to 1200 m a.s.l.

Caspian whipe snake uses caves for wintering (one case) and visits them while hunting for food (2 cases). A small adult snake was found on hibernation in a rock crack in the Gekkonovaya Cave at the end of March 2016 (Table 2). At midday of May 30, 2008 the snake of about 1 m long was observed on a narrow ledge under one of the Karadag's grotto vaults at the altitudes of more than 5 m. The snake has been hunting for two *Rh. hipposideros* individuals under the wedge-shaped cave arch. The disturbed snake disappeared in a deep crack on the surface with a negative inclination angle. Next time, a large whipe snake has been wading through the bush branches to the swift (*Apus* sp.) nest on the rock at the cave entrance. In the eastern part of the Inner Ridge of the Sabah-Kogey Valley an active whipe snake was recorded inside a deep (over 1.5 m) niche under the rock canopy at a wall foot hunting for lacertids on October 7, 2017 (data not shown). Recently, the decayed adult snake, most likely to be the prey of a fox (*Vulpes vulpes krymea-montana* Brauner, 1914) was found in one of the caves on the northern side of the Bayidarskaya Valley (Table 2; Fig. 7*a*).

Blotched rat snake — *Elaphe sauromates* (Pallas, 1814)

The only record of this species is known from the entrance to the Mamut-Chokrak Cave in the Bayidarskaya Valley in mid-May 2013.

Leopard snake — *Zamenis situla* (Linnaeus, 1758)

Fresh moulted skin found in underground cavities as well as findings of snakes themselves allowed to register 7 records within the known range of the species at the Crimea. The distance from the entrance to the cave was up to 14 m, the altitudes varied from 300 m to almost 650 m a.s.l., and the highest finding of *Z. situla* in the subterranean cavities was detected in the northern macroslope inside the ponor of the Sakhtyh Cave on the northern flank of Mt. Biyuk-Sinor on August 2012 (Fig. 5*d*). The fact of *Z. situla* occurence at relatively high altitudes under the harsh mountain climate is worth of the special attention. For example, in summertime of 1998 and 1999 the leopard snakes were found on Ai-Petrinskaya Yaila in the retaining wall of the old road near the Bayidarsky Pass and in the deep cracks on the top of Mt. Ilyas-Kaya at circa 630 m a.s.l. In the mid-June 2011 *Z. situla* was observed on the north-western slope of Mt. Kilse-Burun at about 700 m a.s.l. Moreover, a young *Z. situla* female was found on Ai-Petrinskaya Yaila in a stony steppe near the top of Mt. Merdven-Kaya (688 m a.s.l.) on May 23, 2012.

Leopard snakes have been often recorded in the karst area close to the top of Cape Aya (Table 2), what is consistent with the previously published data on the abundancy of *Z. situla* in this region (Kukushkin and Tsvelykh, 2004). In one case, a hibernating young snake was found in a shallow rock crack at a distance of 10 m from the entrance, while in other two cases (in early December 2012 and at the end of March 2016), active snakes were observed close to the entrance to the cave. On September 26, 2015, quite fresh and still wet moulted skins of *Z. situla* were found on the vertical rock surfaces at a height of 1.2 – 1.5 m from the ground at the entrance of 2 of 4 caves explored at a site between Mt. Asketi to Mt. Gurush.

The data of locals from the mid-1990s on aggregations of the hibernating leopard snakes in artificial cavities of the "cave towns" Eski-Kermen and Mangup in the western part of the Inner Ridge still has to be checked and verified. It is noteworthy, however, that these localities in the South-Western Piedmont are included into the species range. A young snake was caught on May 3, 2018 in the Mangup-Kale-14 Cave with the entrance turned to south-east, what favors the sufficient warming in the morning hours. The air temperature at the location of the snake's finding on the far wall of the cavity was 28.8°C at 11.30 a.m.

Leopard snake found in the Sakhtyh Cave was full, with a clearly visible thickening on its belly. Probably, the snake might hunt small bats in the same manner as *D. caspius* (see above), since this cave is a shelter for a small *Rh. hipposideros* colony and these bats are in the diet of European colubrids belonging to several genera: *Zamenis longissimus* (Laurenti, 1768), *Hemorrhois hippocrepis* (Linnaeus, 1758), and *E. sauromates* (Kauch and Balaž, 2005; Garrido-García et al., 2013; Ostrovskikh et al., 2015).

Family Viperidae
Puzanov's (Crimean) steppe viper —
***Vipera* (*Pelias*) *renardi puzanovi* Kukushkin, 2009**

The steppe viper was observed only once in stones near the Monashya (Monk) Cave entrance on the Lower Chatyrdag plateau at 1025 m a.s.l. in mid-May 2009. This location almost reaches the upper limit of this species range in the Crimea.

Ophidia indet.

All three unknown snake records (due to the limited observation time and lack of photo proofs) were from the Lower Chatyrdag plateau at 950 – 1000 m a.s.l. (E. Bednarskaya, personal communication). With high probability it might be the most common Chatyrdag's snake species, namely *C. austriaca* and/or *V. renardi*. However, according to the responsdent's descriptions, it can be assumed that at least in one case the snake belonged to the genus *Natrix* Laurenti, 1768 and might be identified as a common grass snake, *N. natrix* (Linnaeus, 1758), or the dice snake, *N. tessellata* (Laurenti, 1768). It has to be noticed in this regard that *N. tessellata* occuring in a very small number in the pre-yaila forest-steppe of the northern slope of Chatyrdag massif, has been registered at altitudes not higher than 750 m a.s.l. This mainly ichthyophagous snake climbs Chatyrdag slopes from the Ayan water reservoir, but keeps the distance from it not more that 2 km. On other Crimean uplands *N. tessellata* has not been recorded yet. Unlike *N. tessellata*, *N. natrix* was observed on Yaila on October 6, 2003 in one of the streams of Besh-Tekne Hollow in western part of Ai-Petrinskaya Yaila at about 1000 m a.s.l.[6] At the beginning of the 20th century, the grass snake was also registered on the Lower Plateau of Chatyrdag (Puzanov, 1931).

DISCUSSION

From five known Crimean amphibian species only *P. vespertinus* was not detected in the subterranean cavities, since till the end of the 20th century this species has been considered to be extremely rare or even extinct at the Crimean Peninsula. According to the numerous findings of this very hidden burrowing species at the eastern part of the Crimean Mountains in 2003 – 2016, the chances to record it at Karabi Plateau are relatively high (Pysanets and Kukushkin, 2016). In karst areas characterized with drought climatic conditions and heavy or stony soils this anurans find a shelter in caves and can reach up to 100 m from the entrance to the subterranean cavities (Ostrovskikh, 2012). Almost complete absense of water reservoirs at Karabi Yaila is not necessarily a limiting factor for *P. vespertinus*, because our long-time observations in the arid zones of the South-Eastern Crimea suggest that the reproduction of this amphibian can occur in small stagnant reservoirs (in fact, puddles) with muddy water, which do not exist annually. However, *P. vespertinus* in the Crimea has not been found at altitudes above 250 m a.s.l. yet, and the question of its occurence on the upland remains open.

The analysis and the detailed study of the amphibian records in the Crimean caves revealed that they are not accidental trogloxenes, but cave visitors or facultative cavernicoles. Undoubtedly, amphibians in some cases might enter the underground cavities accidentally, first of all, just fall down into the vertical shafts during their surface activity. Such tunnels and holes in karst caves are often ending up in a dense grassy or shrubby vegetation and trap the terrestrial animals, which have only two ways — to die or to escape. Another way of amphibians' entry into the underground cavities is through the systems of caverns and cracks in the epikarst zone.

Some amphibians due to their ecological preferences are pre-adapted to the life in the karst cavities or at least their limited use. A green toad such as a very eurytopic

[6] In the annotated list of amphibians and reptiles of the Crimean reserves (Kotenko and Kukushkin, 2010), the maximum elevation of *N. natrix* finding at 850 m a.s.l. in Yalta Mountain Forest Reserve is incorrect, since, in fact, it is much higher — circa 1030 m a.s.l.

species expresses itself as a typical petrophil at the Crimean Mountains and during the out-of-breeding season prefers rock clumps, grottos, or ruins as a safe shelter with favorable microclimate (Fig. 6*a*). Moreover, toads are excellent climbers and have been recorded even on rock ledges while passing the climbing trails. According to our observations, *B. viridis* purposefully uses caves and grottos both during the summer drought and hibernation (Table 1). Throughout the Crimean Mountains, wintering toads have been repeatedly observed in the cavities of walls and in cracks of rocky cliffs opened on vertical surfaces at a height of 1.5 – 2 m from the ground, sometimes sharing their shelters with lizards — *M. danilewskii* and *D. lindholmi*.

Probably, it is not accidental to find single individuals or small groups of *H. orientalis* in arid karst areas in the caves primarily on Karabi Yaila plateau (Fig. 6*b*). Basing on the frequency of occurrence in some caves, the frogs can use underground habitats for wintering and/or the prolongation of their active period intentionally, especially on the upland with severe climate. It was established that a growling grass frog, *Litoria raniformis* Keferstein, 1867 (Hylidae) demonstrates trogloxenic behavior differentially: it appears in the caves in one area in some cases, though is totally absent in others (Fordham, 1985), what can take place in the Crimea as well in a similar way. Inspite of the finding of *H. orientalis* eggs in completely dark cave, its successful reproduction even in small cavities is still doubtful; however, it can not be completely excluded, since the reproductive biology of this species is very flexible. Thus, in areas with a hot arid climate (such as Karadag in the South-Eastern Crimea) during an extremely hot summers, when all natural reservoirs dry up for a long time, the spawning and development of the Eastern tree frog larvae still occurs in small artificial reservoirs such as darkened concrete cisterns and shallow muddy wells. Nevertheless the success of the reproduction in such cases is extremely low, a limited number of juveniles successfully finish metamorphosis (Pysanets and Kukushkin, 2016). The use of the reservoirs of this type for the reproduction can be understood as a step towards the underground reproduction, for example, in the entrance part of the caves.

One more amphibian, *T. karelinii*, also visits various artificial reservoirs with vertical walls (wells, collectors, etc.) periodically. Definitely, in karst areas with the lack of surface waters a stable caves microclimate attracts amphibians not only for the time of the breeding season. For instance, newts in karst were mostly found on dry south-western slopes of the western part of Ai-Petrinskaya Yaila covered with sparce juniper forests (Fig. 6*c*) (Matyushkin, 2010). However, this tendency is not so strict, and the newts during the hot season can live in suitable biotopes in thick leaf litter of hornbeam or beech forests near the entrance to the caves on the Yaila plateau.

Today the biology of *T. karelinii* in the Crimea remains poorly studied. It is known that this amphibian is adapted to quite an arid conditions, characterized by a comparatively short water phase of life cycle (sometimes less than 2 months) with a reproduction period extended from late-February to late-August (Pysanets and Kukushkin, 2016). The existence of spawning reservoirs of *T. karelinii* in the Crimea is unstable: from time to time they dry up and remains critically shallow or empty for a long time, sometimes for several years (Kukushkin and Kuschan, 2015). In especially arid and hot areas of the southern macroslope within the territory of Sevastopol (Laspi amphitheatre), the aggregations of adult newts were observed near small (several meters in diameter) shallow puddles covered with branch and leaf litter on the bottom under the forest canopy near the springs (May 7, 2018). Such situation is supposed to be typical for newts, because the fish in these reservoirs is completely absent or does not have opportunity to form large populations. Some of the newts might migrate to the shallow karst to survive the dry seasons.

There are some prerequisites for the reproduction of *T. karelinii* in underground habitats. For example, in 1999 – 2004 in the Ulu-Uzen River Valley near Alushta a small "ruinous" newts population has been reproducing in darkness of the flooded basement of the abandoned bulding, where females attached eggs to the floating debris and even to the concrete bottom of the reservoir (Pysanets and Kukushkin, 2016). Of course, this case of newt's reproduction in the flooded ruins does not confirm the possibility of its reproduction in the underground cavities, though the specifics of the conditions in the caves (primarily, the temperature) is not an insurmountable limitation for it, especially since the conditions in the Crimean karst are quite variable. For example, it became evident recently that a fire salamander, *Salamandra salamandra* (Linnaeus, 1758) uses the caves systematically not only for wintering, but also for the reproduction[7] (Manenti et al., 2009, 2011; Ianc et al., 2012). *S. salamandra* life cycle is toughly connected with the caves in

[7] Within the territory of the former USSR *S. salamandra* has been frequently observed in underground cavities (caves, grottos, wells, tunnels, etc.) of the Ukrainian Carpathians (Pokynchereda, 1989; R. Vargovitsh, unpublished data). These amphibians form the winter aggregations of up to 20 – 35 individuals (for example, in a semi-watered 20-m long abandonen adit with a narrow entrance near Mukachevo Town) retaining only basic activity. Probably, they can also feed on invertebrates, hibernating in caves. In a number of localities (for instance, near Hlyboke Village, Uzhgorod district) in the adits with the permanent water flow salamanders larvae at different developmental stages have been regularly observed, what migh indirectly prove the reproduction of salamanders in a complete darkness.

karst-enriched areas, which allows to categorize this species as a subtroglophile or facultative troglophile (Balogová et al., 2015, 2017).

The reports about the findings of the mysterious "white newts" in the underground waters of the southwestern Crimea (Sharygin, 1998) is undoubtedly related to *T. karelinii* larvae with light coloration of integuments even under normal insolation, which are able to bleach (lose the pigmentation quickly) under light-deficiency conditions. However, the means of their entry into the karst are still unclear. The larvae might enter the underground habitats by water streams during floods or through the system of cracks in the epikarst zone, which may, apparently, become easier by the regular use of the karst wells by newts for the reproduction (Kotenko and Kukushkin, 2010; Matyshkin, 2010). It has to be noticed that the development of larvae is delayed in cold-water oligotrophic reservoirs. *T. karelinii* hibernated larvae have been repeatedly found in wells, spring reservoirs, and drinking water collectors (Pysanets and Kukushkin, 2016) with the majority of findings at the western spurs of Ai-Petrinskaya Yaila and the Bayidarskaya Hollow.

At the same time, the reproduction of single newts in shallow karst in case of drying up of water reservoirs suitable for spawning remains possible. The small size of cave reservoirs seems not to be an insurmountable obstacle. For instance, in underground habitats an onset of fire salamander larvae in small puddles at a distance of more than 20 m from the entrance to the cave was observed, what can be considered anomalous, as far as the animals living on the surface spawn in brooks (Balogová et al., 2017).

The eggs (portions of 2 – 10 eggs in a clutch) were laid in wet moss in the terrarium by the Karelin's newt females within 1 – 15 days after being captured. One group of females was obtained under a beech forest canopy at a distance of 10 – 50 m from the shallowed lake in the area of the Angarsky Pass in the second half of April 2016. In turn, the second group was collected at the bottom of the dried lake with the poor vegetation in the forest-steppe near the Mt. Mangup. Some of the eggs developed normally in the water film on the moss. At 16 – 20°C the embryonic development before the appearance of larvae comprised two weeks.

Assuming that *T. karelinii* lay fertilized eggs outside the water reservoirs may also occur in nature, the embryonic development takes place in wet litter near the water sources, under the stones deeply anchored in the ground or in cavities of the epikarst zone. In case of the abundant precipitation, the water level in reservoirs suitable for spawning rises rapidly, flooding their banks, the hatching of larvae and further development continue under normal conditions — in the water.

In Mediterranean some cases of atypical localization of salamandrid species clutches were described. For instance, females of Sardinian brook salamander, *Euproctus platycephalus* (Gravenhorst, 1829) sometimes lay eggs near or above the water level under the moist conditions, although normally eggs of this species are laid into the streams (Sotgiu et al., 2017).

It is necessary to distinguish several records of *T. karelinii* in the peak of breeding season in caves at a small distance from the affluent Chernaya River which is unavaliable for the newts' life because of the strong current and predatory fishes abundance (Fig. 6d). Presumably, *T. karelinii* might use the karst cavities (or, in any case, karst and erosional relief forms) for their reproduction. Breeding of newts might occur as well in whirlpool depressions (eversion hollows) in ephemeral stream beds or at the entrance to the caves with the underground streams, what has to be studied in details.

It can be generally concluded that *T. karelinii* has closer ecological bonds with the underground habitats than other amphibians living in the Crimea, and that during different phases of its life cycle it uses underground cavities in karst landscapes systematically. At the same time, in spite of a certain similarity of manifestations, this bond is undoubtedly much less close than that of the eutroglophilic European lungless cave salamanders (Plethodontidae). These salamanders reveal well-developed troglophily, despite being found in both cavities and surface habitats, such as rock outcrops, dry-stone walls, etc. (Vignoli et al., 2008; Lunghi et al., 2015).

Almost in all cavities, where amphibians were found, numerous invertebrates were registered as well. Observations of *T. karelinii* in the terrestrial phase of its life cycle characterize it as a nimble and voracious predator with a broad feeding spectrum, which actively searches for a prey just like lizards. However, the direct observations of the amphibian's diet in caves are lacking, hence, it is doubtful, whether it continues to feed at low temperatures deep in underground. At the same time, tailless amphibians (e.g., marsh frogs and green toads) hunt near the entrances to caves and grottos. Thus, in stomachs of three *P. ridibundus* juveniles collected in Skelskaya Cave in early spring 2018 (Table 1) no food remnants were revealed.

In turn, three Crimean reptile species have never been recorded in karst. One of them is the European pond turtle, *Emys orbicularis* (Linnaeus, 1758) toughly connected to water reservoirs (usually lower than 500 m a.s.l.) and absent in the open Yaila karst zone — a possible explanation, why the probability of its entry into the underground cavities is not so high. Nevertheless, there is an evidence for the presence of *E. orbicularis* in an underground lake in Croatia, where it could have entered through an underground tunnel about a hundred meter long (Koller, 2017).

Two thermophilic species of lizards common in the Crimea, both in the plain area and in the mountains — the Balkan wall lizard and the glass-lizard, or zheltopuzik, *Pseudopus apodus* (Pallas, 1775) have not been found in the caves as well. Both species in the Crimea prefer gentle slopes with weakly developed karst, usually at altitudes lower than 700 m a.s.l. Despite that fact, some steppe populations of *P. tauricus* are distinguished by their preference of bare rock cliffs and low precipices, what is always supposed to be the lizards' specific traits, since in danger they seek shelter on the rocks and navigate vertically almost as nimbly as *D. lindholmi*. *P. tauricus*'s entries were noted in shallow karst grottos with wide entry holes, but usually not further than one meter from the entrance. As for *P. apodus*, this large anguid lizard was observed only in artificial analogs of caves (road collectors, various tanks with low overboard, etc.), where they fall into accidentally. We also observed *P. apodus* in rock shelters and at the entrance to the shallow grottos on the slopes of the gulches and valleys at the Western Foothills. However, such findings are of no interest for the key issue of the present article.

There is also a lack of reliable evidence for the snakes from the genus *Natrix* as well as *E. sauromates* and *V. renardi* entering caves, although some of the species mentioned above were registered near the entrances into the underground cavities (Table 2). Only a few representatives of *Natrix* genus, as it was noticed before, were recorded on the plateau and on the Crimean Upland's slopes.

In future the dice snakes are likely to be found in caves along the sides of the river valleys. However, the vast Crimean foothills are still very poorly studied regarding the use of the caves by reptiles, and evidences for it have to be accumulated. As for the steppe viper, it is a quite common, though not numerous snake species of the forest-steppe pre-Yaila slopes at altitudes of about 850 – 900 m a.s.l. Within the last decade the data on its habitats on the steppe plateaus of the central and eastern uplands was obtained. In particular, this snake was found at Mt. Chatyrdag not far from the Suuk-Koba Cave (found by I. Turbanov, April 13, 2009, 1070 m a.s.l.) and in the Egiz-Tinakh Hollow in the southeastern part of Karabi plateau (found by E. Bednarskaya, May 23th, 2009, 1000 m a.s.l.). However, *V. renardi* abundance on the mountain plateaus is quite low.

A blotched rat snake is the only species of the Crimean ophidiofauna that never appears in the middle mountain belt. It has not been registered higher than 600 m a.s.l. both on the northern and southern macroslopes. In this regard, it is noteworthy that in the Middle Valday deposits of the Emine-Bair-Khosar Cave at Chatyrdag massif (the entrance to the cave is located at 980 m a.s.l.), not only the remains of the representatives of the regional contemporary ophidiofauna were recorded (e.g., *C. austriaca* and *V.* cf. *renardi*), but also those of the species, which currently do not inhabit the uplands — *Z. situla* (Vremir and Ridush, 2005) and *E.* cf. *sauromates* (Ratnikov, 2015).

At the same time, several species of reptiles have been repeatedly registered in the karst cavities of the Crimea. Among them there are two most thermophilic and brightly petrophilic species characterized by the predominantly crepuscular and night activities (Crimean gecko and Leopard snake), which are apparently more related to cave habitats than others.

The numerous facts of the use of underground shelters by gekkotans (it refers to the infraorder Gekkota) have to be mentioned here as well. A large number of cave-dwelling species of a bent-toed geckos of the genus *Cyrtodactylus* Gray, 1827 related to the karst regions of Southeast Asia has been described. Usually, these geckos are found in dry cave areas and should be described as a facultative cavernicoles (Bauer et al., 2002) or trogloxenes using the caves as a shelter and for the breeding, but feeding aboveground (Ellis and Pauwels, 2012). Moreover, various representatives of Phyllodactylidae and Gekkonidae (including species of the genus *Mediodactylus* Szczerbak et Golubev, 1977) are not rare in caves of Near East (Iraq Kurdistan, Zagros in Iran) (Afrasiab and Mohamad, 2009; Esmaeili-Rineh et al., 2016). Mediterranen house gecko, *Hemidactylus turcicus* (Linnaeus, 1758) has been recorded in caves of Sardinia Island forming colonies of more than 20 individuals in the moist cave passages in early spring (Rivera et al., 2011). In the same cavities, a European leaf-toed gecko, *Euleptes europaea* (Gené, 1838) (Sphaerodactylidae), and plethodontid salamanders are occurred. Geckos were found no deeper than 15 m from the entrance — in the place coinsiding with the concentration of invertebrates.

In turn, an information about the common *M. kotschyi* findings in the caves of southern Europe and the Near East is practically absent today. The only record of *M. danilewskii* is known from the 1960s at the entrance of the Orlova Chuka Cave in the Cherny Lom River valley in northern Bulgaria (Koynova et al., 2017). Later there were no novel findings in this area, and, most likely, it was a single case of delivery from the Black Sea coast or from the nearby Danube harbor of Ruse (B. Petrov, personal communication). Thus, the observation of *M. danilewskii* aggregations in the Crimean caves at a quite high altitudes above the sea level enriches the knowledge on its biology.

In the Crimea, geckos' habitats reach their maximum heights on particularly steep and narrow parts of the coast, which at the same time are good-insulated (Kukushkin, 2004). The hibernation of this species usually takes place in rock cracks and wall crevices in close proximity to the surface, where geckos form aggregations of several individuals (up to 12) in one place. Shallow wintering shelters sometimes are freezed for short periods, which usually does not lead to the death of lizards (Kukushkin, 2005). Moreover, some populations of *M. danilewskii* retain the basic level of activity even during the wintering period. Geckos, leaving their shelters with the beginning of darkness at an air and substrate temperatures of 7.2 – 9.8°C or lower have been regularly observed on the surface of walls or rocks throughout the cold season. Nevertheless, despite some resistance to low temperatures, according to the biotope nature and habitat type, *M. danilewskii* is the most thermophilic species of the Crimean herpetofauna. Although during the extremely cold winters with the prolonged frosty periods geckos die on hibernation. Sometimes the overall frost devastation of local populations in the northernmost areas of the range has been observed (Kukushkin, 2007). Therefore, the usage of the karst cavities with the inert microclimate for wintering should definitely increase the probability of geckos survival during the cold season — especially near the upper limit of species distribution. The deep gravigenic separation cracks also contribute to geckos upward movement on the Yaila cliffs and isolated rocks. Lizards find favorable conditions for wintering in caves and deep crevices with a stable positive temperatures and the abundance of invertebrates for the occasional feeding. Under the experimental conditions, the hunting of the Crimean geckos for the spiders has been observed even in January in the dark at temperatures above 10.5°C (Kukushkin, 2005). This temperature threshold level corresponds to the winter microclimate of the caves, where geckos aggregations were found. However, their aggregations in karst cavities with the sources of condensate have been also observed during the hottest period of the year, while in winter they were not found here (Table 2). Altogether, it can be concluded that the part of the lizard's population uses underground shelters on purpose to optimize their living conditions not only during the cold season, but also in periods of extreme drought.

Among the Eurasian ophidiofauna representatives, troglophily is a quite rare phenomenon. In relation to the cave habitats, few Colubridae species have been mentioned, and the most frequently a striped racer, or a cave-dwelling ratsnake, *Orthriophis taeniurus* (Cope, 1861), and a Moellendorff's trinket snake, *O. moellendorfi* (Boettger, 1886) (McClur et al., 1967; Zhou et al., 2012). Comparatively regular *Z. situla* findings in the Crimean karst suggest that in some localities it is both a cave visitor and facultative cavernicole, which systematically uses karst cavities for wintering, molting, and probably feeding. This snake, characterized mainly by the twilight-night activity during the hot season with the preferance of the rocky habitats (Kukushkin and Tsvelykh, 2004) is pre-adapted for living in caves to some extent as the Crimean gecko.

A Caspian whipe snake as the diurnal species with a well-developed climbing ability, supllements well the list of the potentially nocturnal species of reptiles mentioned above. It has been established that *D. caspius* visits caves in search of prey or can use them for wintering. In shallow caves these snakes are able to feed by bats and rodents, whose burrows can be often met in cave alluvium, and also, probably, geckos (hunting *D. caspius* on *M. danilewskii* has been observed repeatedly — on walls, rocks, trunks of fallen trees, etc.).

Other snakes species of the Crimean fauna in most cases find themselves in the underground cavities accidentally and, if they do not escape, die there. First of all, this is true for *C. austriaca*, the most common mainly saurofag species in the open Yaila karst areas, which may fall into the cracks and karst holes while hunting lizards.

Another conclusion concerns the origin of fossil remains of herpetofauna in the underground cavities of the Crimea. Usually the findings of the reptile fossils of late Pleistocene and Holocene age in caves and grottos are associated with the activity of predators — diurnal birds of prey or owls (Burchak-Abramovich, 1936; Gromov, 1961; Vremir and Ridush, 2005). Based on our data, the possibility of this is not excluded, however, the extent of reptile's entry to the caves during their active phase of life cycle should not be underestimated and it can be quite significant. The aditional evidence for this is the brand new record of the full skeleton of colubrid snake found near the entrance to the newly discovered Tavrida Cave in July 2018 (Fig. 7*b*).

Therefore, these ecological characteristics may be the background for the systemic use of cave habitats by amphibians or reptiles: petrophylity or, at least, a well-developed climbing skills; mainly twilight-night type of activity related to the ability to remain active at a relatively low temperatures; a sort of time budget, when the animal spends most of the time in shelters with a relatively low amplitude of diurnal fluctuations of temperature and humidity.

CONCLUSIONS

It is evident that the current data on the usage of underground habitats in the Crimean Mountains by amphibians and reptiles is still insufficient and mostly fragmented in many respects. However, even at this stage it seems possible to draw several conclusions.

The majority of the Crimean herpetofauna representatives are trapped in underground cavities occasionally and can be categorized as accidental trogloxenes. Moreover, several amphibian and reptile species of the Crimean Peninsula enter the karst cavities on purpose and systematically use them, what allows to categorize them as facultative cavernicoles. Among the amphibians, the closest ecological relation to the karst is revealed by the *T. karelinii*, though its nature remains unclear, as well as of *B. viridis*. Apparently, amphibians enter underground habitats for the survival during the dry period, recovery of water balance within the hot season, wintering and feeding in the entrance parts of the caves.

Among the reptiles, *M. danilewskii* and *Z. situla* are considered to be the species, associated with the underground habitats to high extent. The use of cavities by reptiles (mainly relic caves of karst origin with the warm-type ventilation) might be related with the optimization of living conditions in winter and summer as well as with molting and feeding.

The intensity of underground cavities usage might be determined by the conditions of the specific locality. Thus, the mesophilous amphibian species enter karst more actively in arid zones with a harsh climate and poor vegetation (*T. karelinii* and *H. orientalis*), while the most thermophilic reptile species (*M. danilewskii* and *Z. situla*) — near the upper limit of their range.

Some parallels between the synatropization degree of the species and the preference of the natural underground cavities should be also noticed. Among the amphibians this relation is clearly visible on *B. viridis*, while on reptiles — on *M. danilewskii* and *Z. situla*.

For accidental trogloxenes, there is a relationship between the species entry into the underground cavities and its presence and population density in open karst zone. For instance, the most frequently recorded snake species in the Crimean Yaila cavities is *C. austriaca*, which is, at the same time, the most abundant species there.

In mountainous areas, speleoresearch plays an important role for the establishment of the upper limit of distribution and detalization of batracho- and herpetofauna species range. In this regards, the cases of *B. viridis* and *M. danilewskii* are quite illustrative, since the highest finding of a green toad in the Crimea was made in a karst cave at Babugan Yaila, while a single finding of Danilewski's gecko in a grotto on the Karadag coast triggered more thorough study of this area resulted in the identification of large population of this lizard of exclusive scientific importance.

At the moment, the hottest issue of the Crimean speleozoology is the study of the amphibians' (mainly newts) episodic reproduction in the underground habitats and trophic bonds of both amphibians and reptiles visiting caves regularly. In this regards, the snakes feeding on bats is the issue of a particular interest.

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