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Horseshoe Bats (Chiroptera, Rhinolophidae) in the south-western Crimea and problems of their protection

Ilya S. Turbanov* & Alexander N. Ivanitsky

ABSTRACT. Largely based on original data, the distribution and abundance of Rhinolophidae in south-western Crimea are updated and summarized, with only two species involved — *Rhinolophus hipposideros* and *R. ferrumequinum*. Their colonies, both wintering and maternity, have been found. Several breeding colonies of *R. ferrumequinum* have been recorded for the first time at and near Sevastopol. A total of 24 and 32 shelters and roosts of *R. hipposideros* and *R. ferrumequinum* have been registered in the study region, respectively. The main factors affecting Horseshoe bat occurrences and conservation in south-western Crimea are outlined as well.
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KEY WORDS. *Rhinolophus hipposideros*, *Rhinolophus ferrumequinum*, south-western Crimea, caves, distribution, abundance, species protection.

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Подковоносы (Chiroptera, Rhinolophidae) Юго-Западного Крыма и проблемы их охраны

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РЕЗЮМЕ. В статье приводятся оригинальные данные, а также обобщаются все известные сведения о распространении и численности подковоносов (Rhinolophidae) в Юго-Западном Крыму, которые представлены двумя видами — *Rhinolophus hipposideros* и *R. ferrumequinum*. В описываемом регионе найдены как зимовочные, так и выводковые колонии обоих, обитающих здесь видов. Выводковая колония *R. ferrumequinum* в Севастополе и на сопредельных территориях впервые отмечена нами. Всего в исследуемом регионе зарегистрировано 24 убежища *R. hipposideros* и 32 — *R. ferrumequinum*. В работе рассматриваются также лимитирующие факторы для подковоносов Юго-Западного Крыма, а также вопросы охраны этих животных.

КЛЮЧЕВЫЕ СЛОВА. *Rhinolophus hipposideros*, *Rhinolophus ferrumequinum*, Юго-Западный Крым, пещеры, распространение, численность, охрана видов.

Introduction

The study of Horseshoe bats in south-western Crimea enjoys a history of more than a century (Brauner, 1911; Lebedev, 1912, 1914; Konstantinov *et al*., 1976; Dulitsky & Kovalenko, 2003; Denisova & Amelichev, 2005; Amelichev, 2008; Godlevskaya *et al.,* 2009; Amelichev & Klimchuk, 2010; Matyushkin, 2010a,b; Turbanov *et al.*, 2015). At the same time, the available published information still remains highly fragmented and incomplete, and offers limited information concerning the present distribution, abundance and ecology of Horseshoe bats in the region.

The Horseshoe bat family Rhinolophidae Gray, 1825 (Mammalia: Chiroptera) is globally represented by at least 70–80 species (Csorba *et al*., 2003; Simmons, 2005) predominantly inhabiting the tropical and subtropical parts of the Old World, with only a few extending into temperate areas and mainly occurring there in regions with a relatively mild winter. The northern range limit of Horseshoe bats in the Black Sea region lies in Crimea, approximately at a latitude of 45°30' N.

For the Crimean Peninsula generally and its south-western part in particular the occurrence of only two species of this family have been confirmed: *Rhinolophus hipposideros* (Bechstein, 1800) and *R. ferrumequinum* (Schreber, 1774). The former species has been reported from south-western Crimea since the early 20th

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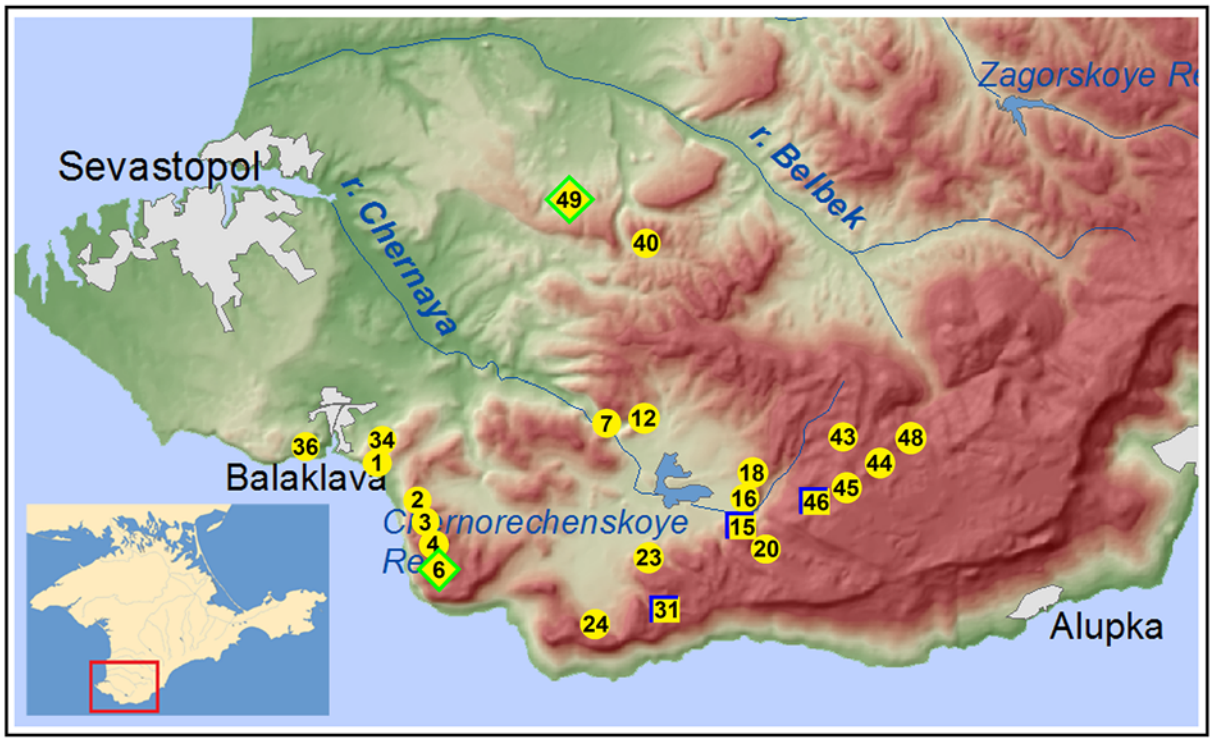

Fig. 1. Distribution of the Lesser Horseshoe bat (*R. hipposideros*) in south-western Crimea. The number inside the marks (circle — the site of the finds; square — maternity colony, rhombus — wintering record) corresponds to that of the *R. hipposideros* shelter in Tabs 1–3.

century (Brauner, 1911); the latter one was first recently observed in October 1999 (Denisova & Amelichev, 2005). However, both these species are known to have occurred in the Crimean Peninsula much earlier, at least since the second half of the 19th century. *R. ferrumequinum* has been documented there in 1856, based on the collection of Christian von Steven kept in the Zoological Institute of the Russian Academy of Sciences in St. Petersburg (ZIN) (Dulitsky & Kovalenko, 2003). This corresponds well to the time of the first catches of other bat species in Crimea and suggests the historic presence of these species in the region, rather than their recent introductions due to range expansion.

Two other species of Horseshoe bats, *R. euryale* Blasius, 1853 and *R. mehelyi* Matschie, 1901, have erroneously been recorded from Crimea (Zagorodniuk, 1999; Dulitsky *et al.,* 2001), but both of these records are likely a result of misidentifications. Finding these two latter species in Crimea is quite doubtful, as their nearest reliable records come from very distant areas: *R. euryale* is known from as far as the south of the Krasnodar Territory, Russian Federation, i.e. over 220 km direct flight distance across the Black Sea (Gazaryan & Ivanitsky, 2005; Gazaryan, 2007), while the most proximate records of *R. mehelyi* are from the Black Sea regions of Romania, also several hundred km away (Nagy & Postawa, 2010). These species are non-migratory, the maximum distance records they are known to seasonally travel being some 134 km in the eastern Pyrenees for *R. euryale* (see Heymer, 1964) and 94 km in Bulgaria for *R. mehelyi* (Dietz *et al.*, 2009).

Material and methods

Material for the present paper was obtained in the course of original annual studies conducted from 2009 to 2017 in caves and artificial underground structures located within the Sevastopol City and the neighbouring Bakhchisaray District of the Republic of Crimea. In addition, all known literature data concerning the bats of the above territories were reviewed, and information obtained from speleologists and spelestologists was surveyed to identify new, previously unknown shelters or roosts of Horseshoe bats.

Bats were studied without catching them through their daytime visual records and counts in caves and various artificial underground structures. Our earlier surveys were carried out almost throughout the year, including winter. The last, almost continuous inspection was undertaken during the summer of 2017 as part of a more general project aimed at monitoring the wildlife objects listed in the Red Data Book of the city of Sevastopol. As that most recent survey covered nearly all previously identified shelters and roosts of Horseshoe bats in south-western Crimea, it has allowed us not only to obtain new data, but also to refine and update all available information on their distribution, numbers and locations in the region concerned.

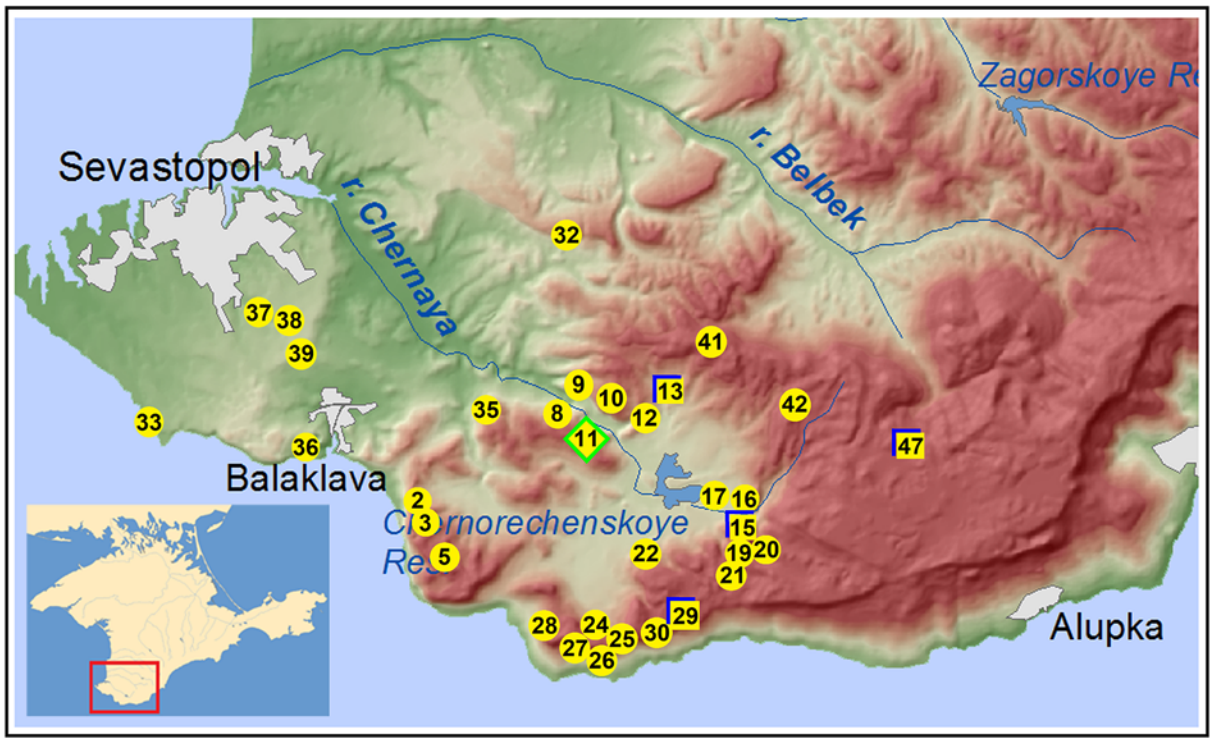

Fig. 2. Distribution of the Great Horseshoe bat (*R. ferrumequinum*) in south-western Crimea. The number inside the marks (circle — the site of the finds; square — maternity colony; rhombus — wintering record) corresponds to that of the *R. ferrumequinum* shelter in Tabs 1–3.

Results and Discussion

The original research 2009–2017 and an analysis of the literature make it possible to get a relevant picture of the current distribution and abundance of *R. hipposideros* and *R. ferrumequinum* in entire south-western Crimea. Unfortunately, some literature data are deficient in species determination, e.g. the report on the Horseshoe bats of the Karan-Koba Cave near the Village of Peredovoye (see Matyushkin, 2010a).

Shelters and roosts. According to the "Caves" information retrieval system which represents a survey of the caves of Russia and neighbouring countries (see Appendix 1), the Sevastopol region supports 125 caves, while about another 150 caves are located in the adjacent territories. However, this survey is still in an early stage of development, as the number of caves is actually much higher.

To date, Horseshoe bats have been registered in 39 shelters (32 natural caves and 7 artificial structures) in the study area. The known shelters and roosts of Horseshoe bats in south-western Crimea are listed in tables 1–3 and also shown on schematic maps (Figs 1, 2).

***Rhinolophus hipposideros*.** To date, *R. hipposideros* has been identified in 24 shelters in south-western Crimea, including 15 caves and 2 artificial dungeons of Sevastopol, as well as 7 shelters in the adjacent territories in the Republic of Crimea (Tabs 1–3, Figs 1, 3A).

Hibernating colonies were found within the two caves — Raskop Medvezhiy (Matyushkin, 2010b, 2012) and Egerskaya II (original unpublished data). Maternity colonies of *R. hipposideros* were recorded in niches of the ancient settlement of Eski-Kermen (Konstantinov *et al*., 1976), as well as in the Gekkonovaya Cave (original unpublished data). Unfortunately, some of the literature information concerning the study region was accompanied by neither an exact date and nor a reproductive status of the animals. Perhaps some of these data also apply to wintering or nursery colonies. Thus, for example, a cluster of 10 individuals of *R. hipposideros* found on May 2nd of 2006 in the Raskop Medvezhiy Cave (Matyushkin, 2010b, 2012) was probably a maternity colony. The number of hibernating animals per shelter varied from 1 to 8 individuals, maternity colonies formed in both cases contained 9 females, in one case two females were already with newborns. A similar number of hibernating bats per shelter was observed in other Black Sea regions — in Abkhazia (Ivanitsky & Smirnov, 2016), Romania (Nagy & Postawa, 2010), Bulgaria (Benda *et al*., 2003), where winter shelters accumulated up to a dozen or ever a little more individuals. Maternity colonies of *R. hipposideros* in other regions were located in buildings, as a rule: basements, attics, etc. (Rakhmatulina, 2005; Ivanitsky & Smirnov, 2016). Natural caves are not a typical place for the breeding colonies of this species, although there are known records of such colonies from caves and from other regions, particularly Transcaucasia (Rakhmatulina, 2005; Ivanitsky, 2017). Several larger colonies can be formed in artificial structures, usually 20–

Table 1. List of shelters of Horseshoe bats in caves of the Sevastopol City with original data.

No*	Shelter	*R. hipposideros*	*R. ferrumequinum*
1.	Asketi	31.07.2017 — 2 ind. [1]**	–
2.	Dvukhkupolnaya	27.06.2017 — 2 ind., 30.07.2017 — 3 ind. [1]	27.06.2017 — 2 ind., 30.07.2017 — 2 ind. [1]
3	Arochnaya	27.06.2017 — 3 ind., 30.07.2017 — 3 ind. [1]	27.06.2017– 1 ind., 30.07.2017 — 2 ind. [1]
4.	Bely Brat	27.06.2017 — 1 ind. [1]	–
5.	Kalafatlar-Kobasy	–	27.06.2017 — 4 ind. [1]
6.	Gekkonovaya	27.06.2017 — 11 ind. (n.c. — 9♀♀, 2 juv.) + [1]	–
7.	Kara-Koba	5.07.2017 — 3 ind. [1]	–
8.	Tshernorechenskaya	–	5.07.2017 — 5 ind. [1]
9.	Tomenko	–	5.07.2017 — 2 ind. [1]
10.	Karshi-Kaya-Koba	–	5.07.2017 — 1 ind. [1]
11.	Langa-Kaya-Koba	–	5.07.2017 — 25-30 ind. (n.c.)+[1]
12.	Anny	21.10.1999 — 2 ind. [5]	21.10.1999 — 4 ind. [5]
13.	Eldorado	–	Dec 2003 — 7 ind.^ [5]
14.	Karan-Koba	Several [10]	Several [10]
15.	Skelskaya	Several [4,9]	–
		Solitary ♂♂ [7]	–
		4.09.2004 — 1 ind. [5]	4.09.2004 — >10 ind. [5]
		5–7 ind. (summer) [2]	20–30 ind. (summer) [2]
		16.06.2006 — 2 ind. [6]	16.06.2006 — 2 ind. [6]
		5.05.2017 — No, fresh guano [1]	
		10.07.2017 — 1 ind. [1]	10.07.2017 — 2 ind. [1]
16.	Entuziastov	5.05.2017 — 1 ind. [1]	5.05.2017 — 1 ind. [1]
17.	Tshernaya	–	5.05.2017 — 2 ind. [1]
18.	Myshinaya	Many [8,9]	–
		19.07.2017 — 3 ind. [1]	–
19.	40 Let Sevastopolskoy Speleologii	–	5.07.2017 — 2 ind. [1]
20.	Tainstvennaya	5.07.2017 — 2 ind. [1]	5.07.2017 — 2 ind. [1]
21.	Nassonova	–	5.05.2017 — 1 ind. [1]
22.	Baydar-Tshokrak	–	2.07.2017 — 2 ind. [1]
23.	Sakhtykh	11.08.2012 — small colony [13]	–
24.	Mamut-Tshokrak	6.05.2012 — 4 ind. (dead) [1]	2.07.2017 — 2 ind. [1]
25.	Biyuk-Tekne-Bel	–	26.04.2011 — 1 ind. [1]
		–	2.07.2017– No [1]
26.	Forosskaya	–	25.06.2017 — 5 ind. [1]
27.	Baydarskaya	–	25.06.2017 — 1 ind. [1]
28.	Machuk	–	25.06.2017 — 2 ind. [1]
29.	Zhemchuzhnaya	–	2011-14 — 1–5 ind.^ [1]
30.	Gravitsapa	–	March–Apr 2012 — 3–5 ind. [1]
31.	Egerskaya II	4.02.2011 — 3 ind.^ [1]	–

Notes: ind. — individuals; ♂♂ — males; ♀♀ — females; juv. — juvenile; n.c. — maternity colony; ^ — wintering record; + — breeding record; * — number of the locality (see Figs 1–2). **Source: 1 — Personal data; 2 — Amelichev, 2008; 3 — Amelichev & Klimchuk, 2010; 4 — Brauner, 1911; 5 — Denisova & Amelichev, 2005; 6 — Godlevskaya *et al*., 2009; 7 — Konstantinov *et al*., 1976; 8 — Lebedev, 1912; 9 — Lebedev, 1914; 10 — Matyushkin, 2010a; 11 — Matyushkin, 2010b; 12 — Matyushkin, 2012; 13 — Turbanov *et al*., 2015.

Table 2. List of shelters of Horseshoe bats in artificial underground structures of the Sevastopol City with original data.

No	Shelter	*R. hipposideros*	*R. ferrumequinum*
33.	The abandoned tunnel and lift shaft of the "Caravella"	–	20.07.2017 — 4 ind. [1]
34.	Fort "South Balaklava"	31.07.2017 — 1 ind. [1]	–
35.	Reserve object of the Russian Black Sea Fleet ("Object 221")	–	5.07.2017 — 6 ind. [1]
36.	19th coastal battery (Battery "Drapushko")	31.07.2017 — 1 ind. [1]	31.07.2017 — 1 ind. [1]
37.	The unfinished atomic bomb shelter of the Russian Black Sea Fleet (Object Kvadraty)	–	10.07.2017 — 2 ind. [1]
38.	Abandoned excavations in Chomutovaya gully	–	10.07.2017 — 1 ind. [1]
39.	Watershed galleries in the park "Maksimova Dacha"	–	10.07.2017 — 1 ind. [1]

Notes and source corresponds to that in Table 1.

40 individuals per site, although such clusters can contain up to 50–200 individuals (Ivanitsky & Smirnov, 2016). Mating in *R. hipposideros* in south-western Crimea occurs in autumn (Matyushkin, 2010b, 2012), possibly also throughout winter (original unpublished data). Newborns appear mainly in the first ten days of July (Konstantinov *et al.*, 1976; original unpublished data). These phenological observations agree with those, for example, known from western Transcaucasia (Ivanitsky, 2015).

Wintering *R. hipposideros* in the study region are only known from caves and at least some maternity colonies are also located in dungeons. This allows us to attribute this species to troglophiles closely associated with caves.

***Rhinolophus ferrumequinum*.** At present, 34 shelters of *R. ferrumequinum* have been found in south-western Crimea, including 25 natural and 6 artificial dungeons of Sevastopol, as well as 3 caves in the adjacent territories of the Bakhchisaray District (Tabs 1–3, Figs 2, 3B).

Hibernation of this species has been documented within the three caves — Eldorado (Denisova & Amelichev, 2005), Zhemchuzhnaya and Villyaburunskaya (original unpublished data). We have been the first to record a breeding colony *R. ferrumequinum* in south-western Crimea. It was a cluster of 25–30 pregnant females located in the Langa-Kaya-Koba Cave, some of them were already with newborns. Possibly the summer report by Amelichev (2008) of 20–30 individuals in the Skelskaya Cave is to be referred to a nursery colony as well, but this remains uncertain, since it was accompanied by data on neither the sex and age composition of this colony nor on their reproductive status of adults. Winter shelters of *R. ferrumequinum* in south-western Crimea contained 2–7 individuals per site.

As part of our regular monitoring, from April 29th to July 30th of 2017, in 30 natural and artificial dungeons of Sevastopol and the Bakhchisaray District of the Republic of Crimea, 42 individuals of *R. hipposideros* and 82 *R. ferrumequinum* specimens were counted. In addition, during the same observation period representatives of the bat family Vespertilionidae were also found in the same shelters: *Plecotus auritus* (Linnaeus, 1758), *Barbastella barbastellus* (Schreber, 1774), as well as small mouse-eared bats, *Myotis* gr. *mystacinus*.

Problems of the conservation of Horseshoe bats in south-western Crimea. Declining numbers of bats in the caves of Sevastopol and adjacent territories is increasingly evident. At present, no large colonies of bats numbering 100 or more individuals have been traced in south-western Crimea. However, based on huge deposits of guano in some dungeons, for example, such as we noted in the Kara-Koba Cave in the Tshernaya River canyon, and considering some literature reports, in particular one on a large bat colony that existed for many years in the Partizanskaya Cave, Murkum-Ulle Mountain Ridge, Sukhaya Rechka River valley (Dushevsky & Stenko, 1986), we can assume that large clusters of bats did live in the study region in the past.

Given the weak reproductive potential and special sensitivity of Horseshoe bats to negative impacts at the northern periphery of the range, including south-western Crimea, the limiting natural and anthropogenic factors are critical to the distribution and abundance of these animals.

There are not many natural enemies to Crimean horseshoes; these include the Eagle Owl (*Bubo bubo*), the Grey Owl (*Strix aluco*) and the Leopard Coluber (*Zamenis situla*) (Abelentsev *et al.*, 1956; Bednarskaya

Table 3. List of shelters of Horseshoe bats in caves of the Republic of Crimea, along the borders with Sevastopol City with original data.

No	Shelter	*R. hipposideros*	*R. ferrumequinum*
40.	Mangupskaya I	29.04.2017 — 5 ind. [1]	–
41.	Lopata-Koba	–	1.04.2013 — 2 ind. [1]
42.	Syundyurlyu	–	23.10.2009 — 1 ind. [3]
43.	Mal-Koba	Several [9]	–
44.	Gelektitovaya-Vesennyaya	Apr 1994 — 1 ind. [11]	–
45.	Priyut Barsuka	Apr 2008 — Several [11]	–
46.	Raskop Medvezhiy	8.11.1997 — 1 ind., 16.10.2004 — 6 ind., mating, 23.04.2005 — 4 ind., 2.05.2006 — 10 ind., 11.08.2006 — 2 ind., 24.09.2006 — 12 ind., 2.05.2007 — 4 ind., 18.01.2008 — 1 ind.^, 13.02.2008 — 1 ind.^, 8.05.2009 — 2 ind., 15.12.2011 — 8 ind.^, 4.11.2011 — 16 ind., 15.12.2011 — 8 ind.^, 24.08.2012 — 4 ind. [11,12]	–
47.	Villyaburunskaya	–	2.05.2015 — 2 ind., 11.02.2015 — 3 ind.^, 16.07.2017 — No, fresh guano[1]
48	Ayu-Teshik	18.04.1903 — ?, 2 ind. in coll. ZISP [9] 2.05.2015 [1], 16.07.2017 — No, fresh guano[1]	–
49.	The niches of the cave settlement Eski-Kermen	29.06.1960 — 9 ind.	–

Notes and source corresponds to that in Table 1.

& Dulitsky, 2015; Turbanov *et al*., 2015). In the course of our research, a specialized ixodid tick, *Ixodes* (*Eschatocephalus*) *vespertilionis*, was found on Horseshoe bats in the Kara-Koba, Tshernorechenskaya, Skelskaya, Gekkonovaya, Forosskaya, Mangupskaya I, Ayu-Teshik and Villyaburunskaya caves. Some more ectoparasites of Horseshoe bats in Crimea have also been described in a number of special papers (Abelentsev *et al*., 1956; Vshivkov, 1963; Bobkova, 2003; Ševèík *et al*., 2011; Orlova & Orlov, 2018; etc.).

Natural limiting factors also include floods in caves during hibernation. Such situations are described for the caves Kizil-Koba and Yeni-Sala III (Denisova & Amelichev, 2005). During our research in the Mamut-Tshokrak Cave, four specimens of *R. hipposideros* were found drowned in the winter of 2011–2012, when the water level in the cave changed repeatedly (Fig. 3A).

At the same time, it is obvious that there are anthropogenic factors that render the strongest impact on the troglophilic bats of south-western Crimea, including horseshoe bats. The main is the loss of habitats (1. Habitat Loss) because of shelter troubling due to man's activities (1.3.3. Tourism). We use the IUCN Red List of Threatened Species (Version 2014.3) criteria to characterize the types of anthropogenic factors (see Appendix 2). Especially tragic consequences of troubling the Horseshoe bat shelters are during hibernation, when the animals are forced to spend precious energy for awakening. In additional, a significant negative impact on the condition of a population disturbed during the birth and feeding of offspring is caused through the death of flightless juvenile bats falling down during the inevitable turmoil. Ironically, childbirth occurs in the summer months, when visits to caves increase several times. Eventually, the disturbance factor leads to the loss of the cave as a refuge suitable for the life of bats and, as a consequence, the loss of the entire chain of organisms associated with bats and products of their vital activity.

Fig. 3. Common views of the bats: A — Lesser Horseshoe bats (*R. hipposideros*) drowned in the Mamut-Tshokrak Cave; B — Great Horseshoe bat (*R. ferrumequinum*) live in the Skelskaya Cave. Photographed by Ilya S. Turbanov.

It is very difficult to completely exclude the factor of disturbance. In order to implement some activities to neutralize this threat, a whole set of measures is required. It is necessary to conduct explanatory work among speleologists and diggers about the rules of behaviour in caves where horseshoe and other species of bats live. It is important to normalize visiting excursion caves, while in individual caves, which are the most important for horseshoe bats, we recommend to limit the penetration of visitors by installing an iron antivandal grille at the entrance. In addition, it is necessary to limit the dissemination of information on the exact location of the entrance to caves inhabited by Horseshoe bat colonies.

In addition to the protection of Horseshoe bat shelters, measures are also necessary to conserve the animals themselves, primarily eco-education and legislative nature. *Rhinolophus hipposideros* and *R. ferrumequinum* are rare and vulnerable species of bats, both included into the Federal (Panyutin & Borissenko, 2001; Panyutin & Kruskop, 2001) and regional Red Data Books, the Republic of Crimea (Bednarskaya & Dulitsky, 2015; Beskaravayny, 2015) and Sevastopol (Order No. 66 dated May 11, 2016 "On the approval of lists of objects of flora and fauna, fungi included in the Red Data Book of the Sevastopol City").

Protected nature reserve areas (PAs) in the region could also play their roles in the conservation of Horseshoe bats. Within Sevastopol, Horseshoe bats have been identified in the following PAs: the landscape reserves of national importance "Baydarskiy" and "Cape Aya", the hydrological nature monument of regional significance "Coastal aquatic complex at Cape Fiolent", and the nature park of regional importance "Maksimova Dacha".

Conclusion

At present, 24 and 34 shelters and roosts of *R. hipposideros* and *R. ferrumequinum*, respectively, have been recorded in south-western Crimea, respectively. In the study region, both species occur throughout the year, being represented there both by wintering and maternity colonies. We have confirmed the reproduction of *R. ferrumequinum* at Sevastopol for the first time. Information on the condition of the populations of Horseshoe bats, as well as an analysis of anthropogenic and natural threats, reaffirms to the need for active measures to be taken in order conserve these animals in the region.

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Appendix 1. Internet-source is used for searching of caves and grottoes within territory of the Sevastopol City and the neighbouring Bakhchisaray District of the Republic of Crimea.

Web-resource "The information retrieval system "Caves", https://speleoatlas.ru

Appendix 2. Internet-source is used for assessment of criteria and characteristics of types of anthropogenic impact on the Horseshoe bats.

Web-resource "The IUCN Red List of Threatened Species", http://www.iucnredlist.org