

First records of the European free-tailed bat *Tadarida teniotis* (Rafinesque, 1814) in Slovenia

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Abstract. An acoustic survey of bats was conducted throughout 2016 on the slopes of the hill Črna griža near Kozina, and from the end of August 2016 to the end of October 2017 on a small Griško polje plateau close to the village of Dolenja vas near Senožeče — both sites are located in the south-west of Slovenia. Echolocation calls of *Tadarida teniotis* were recorded at both sites. *T. teniotis* was recorded near Kozina during 11 nights from April to October 2016, but it was rare, with its 38 passes constituting just 0.53% of all bat passes. It was even rarer near Dolenja vas where it was recorded twice only on the hill Veliki Ognjivec — in April and October 2017 — where constituting only 0.0001% of all bat passes. Both sites are located on the northern border of *T. teniotis* Submediterranean range. *T. teniotis* is the 31st bat species recorded in Slovenia and the 30th bat species currently living in the country.

Key words: *Tadarida teniotis*, distribution, echolocation, acoustic survey, Slovenia

Izvleček. Prve najdbe dolgorepega netopirja *Tadarida teniotis* (Rafinesque, 1814) v Sloveniji – Leta 2016 smo napravili celoletni zvočni popis netopirjev na območju hriba Črna griža pri Kozini, podobno študijo pa tudi med avgustom 2016 in oktobrom 2017 na Griškem polju pri Dolenji vasi pri Senožečah (oboje v jugozahodni Sloveniji). Na obeh mestih smo posneli tudi ehokacijske klice dolgorepega netopirja *Tadarida teniotis*. Pri Kozini smo dolgorepega netopirja zabeležili v 11 nočeh od aprila do oktobra 2016, vendar je bil redek in njegovih 38 posnetih mimoletov je sestavljalo le 0,53 % vseh mimoletov netopirjev. Pri Dolenji vasi je bil še redkejši, saj smo ga na hribu Veliki Ognjivec zaznali le enkrat v aprilu in enkrat v oktobru 2017, kar je bilo le 0,0001 % vseh mimoletov netopirjev. Obe mesti najdb ležita na severnem robu submediteranske razširjenosti te vrste. Dolgorepi netopir je 31. vrsta netopirjev, najdena v Sloveniji, in 30. vrsta netopirjev, trenutno živeča pri nas.

Ključne besede: *Tadarida teniotis*, razširjenost, ehokacija, zvočni popis, Slovenija

Introduction

In Europe, the European free-tailed bat *Tadarida teniotis* (Rafinesque, 1814) has a predominantly circum-Mediterranean distributional range, although it reaches as far as southern Switzerland, and has even been recorded further north (Dietz & Kiefer 2014). It is common along the Adriatic shores in Italy and Croatia (Lanza 2012, Tvrtković 2017) and was

recently found in Italy, very close to the Slovenian border (Lapini et al. 2014, Zagmajster et al. 2015). Considering its known distribution, the species was long presumed to be present in Slovenia as well (Kryštufek 1991, Presetnik et al. 2009). Researchers have tried to confirm the presence of *T. teniotis* in southeast Slovenia (e.g. Kryštufek 1991, Presetnik 2005) a number of times by conducting surveys near rocky cliffs with fissures, which are generally its typical roosts (Dietz & Kiefer 2014), but all their attempts were unsuccessful. Although Lanza (2012) reported the species' existence near the village of Osp in Slovenia citing Kryštufek (1991), this is erroneous, as Kryštufek (1991) merely reported on an unsuccessful survey for *T. teniotis*. However, the results of our present studies finally confirm the presence of *T. teniotis* in Slovenia.

Materials and methods

During 2016, we carried out an acoustic inventory of bats on the hill Črna griža and its vicinity (lat. 45.6064°N, long. 13.9238°E, approximately 520 m a.s.l.), close to the town of Kozina in the south west of Slovenia. The hill is partly covered by forest stands of *Pinus nigra* of medium age, partly by overgrown meadows and partly by regularly mown meadows separated by lines of trees. The valley of the Glinščica River begins on the southwestern side of the hill, and approximately 9 km to the west the river flows into the Adriatic Sea, near the city of Trieste. On the Črna griža hill we recorded, on 17 evenings from 12 May 2016 to 13 November 2016, bat calls in 10× time-expansion mode with manually operated ultrasound detectors (Pettersson D240x, Pettersson Elektronik, Sweden) and a digital recorder (Marantz PMD 670, Marantz Professional, USA). The audio settings were: a) detector: maximum storage time – 1.5 s, b) recorder: 16 bit rate, 48 kHz sampling frequency. We also carried out 51 all-night surveys (March: 6, April: 6, May: 3, June: 3, July: 6, August: 7, September: 9, October: 8, November: 3) with three automatic acoustic recorders, Song Meter SM4BAT FS with SMM-U1 ultrasonic microphones protected by windscreens (Wildlife Acoustics Inc., Maynard, USA) placed at ground level. The audio settings used were: gain – 12 dB, 16k High Filter – off, sample rate – 256 kHz, minimum duration of signal for scrubber – 1.5 ms, maximum duration of signal for scrubber – none, minimum trigger frequency – 11 kHz, trigger level – 12 dB, trigger window – 3 s, maximum length of recording – 15 s, compression – none. The automatic acoustic recorders also recorded the ambient temperature with a precision of 0.25°C for each minute.

A similar study was conducted on a small plateau – commonly known as Griško polje, located approximately 2 km west of the village of Dolenja vas near Senožeče. On the plateau, there are pastures for cattle, horses, donkeys and sheep, meadows, as well as small forest islands. Most of the continuous forest is concentrated on the slopes descending to the west of the plateau towards the valley of the small river Raša. The area is situated approximately 20 km NE of the Adriatic Sea. There we also carried out an inventory using manually operated detectors (26 evenings), and 80 all-night surveys with three automatic recorders (2016: August: 4, September: 13, October: 8, November: 3; 2017: March: 9, April: 4, May: 7, June: 4, July: 4, August: 7, September: 7, October: 10).

In this paper, each separate recording made by automatic recorders is referred to as a »bat pass«, and we define a »bat visit« as a group of bat passes made sequentially with pauses of less than 3 minutes. We regard such bat visits as an indication of the number of separate visits *T. teniotis* made to the area. All recordings were later analysed with the program BatSound 4.0 (Pettersson Elektronik, Sweden). On the spectrogram we manually measured the duration of bat calls, the frequency of maximum energy, the start and end frequencies, as well as intercall intervals. The program settings for the analysis of *T. teniotis* calls were: FFT size – 1024 samples, threshold – 15, window type – Hanning, segment duration – 250-2000 ms per plot. We used echolocation call characteristics described by Haquart & Disca (2007) and Barataud (2015) to discriminate *T. teniotis* calls from the calls of other bat species. Specifically, short call duration (e.g. < 20 ms) in combination with low end frequency (e.g. < 14 kHz) are, according to the above mentioned authors, characteristic enough to separate *T. teniotis* from observations of *Nyctalus lasiopterus* which also uses low echolocation calls. Characteristically, the echolocation calls of the latter species are usually of much longer duration (>20 ms) at the frequencies of maximum energy and end frequencies below 14 kHz.

To investigate whether *T. teniotis* had been more active at certain times of the night, we divided each night into ten equal time periods (deciles) and made a visual comparison of the number of passes in each particular time period. Our interest was only in the deciles where *T. teniotis* was present, regardless of the fact that the deciles differentiated in absolute time length (from 49 minutes to 1 hour and 27 minutes) as the nights differed in length throughout the season.

Results and discussion

Surveys with manually operated detectors on the hill, Črna griža, and at the plateau, Griško polje, failed to reveal the presence of *T. teniotis*. Nevertheless, we identified its calls on the recordings made with the automatic acoustic recorders. We counted 38 bat passes of the species (grouped in 17 bat visits) on 11 nights (Tab. 1) at Črna griža, and 2 bat passes (2 visits) on separate nights close to the hill, Veliki Ognjivec, which is above the Raša valley at Griško polje. The terminal buzzes of the species were also present on some of the recordings at Črna griža. The measured parameters of selected echolocation calls, excluding terminal buzzes, were: frequency of maximum energy ranged from 10.6–12.7 kHz, start frequency from 11.0–15.0 kHz, end frequency from 10.0–11.6 kHz, call duration from 13–24 ms and the intercall interval ranged from 361–1240 ms (N = 14). The combination of the low frequency of maximum energy and the low end frequency of the echolocation calls, with the relatively short call duration clearly discriminated *T. teniotis* echolocation calls (Fig. 1) from observations of *N. lasiopterus*, which was also recorded at both areas investigated. We recorded the latter species more frequently than *T. teniotis*, but still very sporadically, on 27 nights (129 passes) at Črna griža, and on 32 nights (88 passes) at Griško polje. These sites are the second and third locations of recent sighting of *N. lasiopterus* in Slovenia (Presetnik & Knapič 2015).

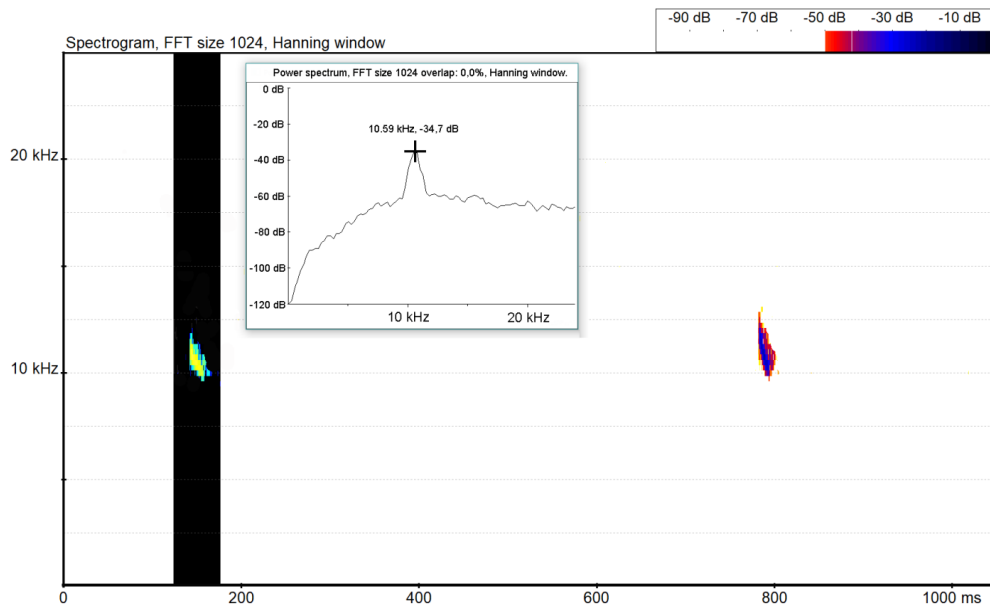


Figure 1. Spectrogram of an exemplary echolocation call sequence and power spectrum of the marked *Tadarida teniotis* call recorded on the hill Črna griža near Kozina in Slovenia.

Slika 1. Spektrogram primera zaporedja eholokacijskih klicev in jakostni spekter označenega eholokacijskega klica dolgorepega netopirja, posnetega na hribu Črna griža pri Kozini v Sloveniji.

Table 1. Dates and number of European free-tailed bat *Tadarida teniotis* passes on the Črna griža hill in 2016.

Tabela 1. Datumi in število mimoletov dolgorepega netopirja na hribu Črna griža v letu 2016.

Night / Noč	Duration of one decile / Trajanje ene desetine noči [h:min]	Sum of bat visits (no. of bat passes) / Število netopirskih obiskov (št. mimoletov)	Decile of the night (no. of bat passes) / Desetina noči (št. mimoletov)
5.4./6.4.2016	1:05	1 (3)	9 (3)
15.4./16.4.2016	1:02	1 (1)	6 (1)
16.4./17.4.2016	1:02	4 (5)	1 (1), 4 (2), 7 (2)
3.5./4.5.2016	0:57	1 (1)	1 (1)
13.8./14.8.2016	0:59	1 (1)	5 (1)
14.8./15.8.2016	0:59	1 (3)	8 (3)
25.8./26.8.2016	1:02	1 (5)	7 (5)
10.9./11.9.2016	1:07	3 (13)	3 (6), 4 (2), 5 (5)
11.9./12.9.2016	1:07	1 (2)	8 (2)
30.9./1.10.2016	1:13	1 (2)	3 (1), 5 (1)
1.10./2.10.2016	1:14	1 (2)	2 (2)
Median / Mediana	-	1 (2)	5

The presence of *T. teniotis* on the hill, Črna griža, was not a surprise as this site (in UTM square VL 15) is a mere 9 km ENE from the recent observations recorded by Zagmajster et al. (2015) just across the border in Italy (UTM square VL 04). The hill, Veliki Ognjivec at Griško Polje (in UTM square VL 26) is approximately 20 km NE from the site in Italy, but still in the expected distribution range of the species.

T. teniotis very rarely made an appearance on the hill, Črna griža, because we could attribute only 0.53 % of all bat passes (out of 7231) to this species. We recorded 17 separate bat visits of the species on 11 nights or 21% out of 51 possible nights. However, it was recorded from early April until early October 2016 (Tab. 1) at air temperatures ranging from 10 to 23 °C. On each recording, the echolocation calls of only one *T. teniotis* were observed. In most cases, *T. teniotis* visited the area under investigation only once per night, with two exceptions. On the nights of 16 April and 10 September 2016, *T. teniotis* visited the area 4 and 3 times respectively (Tab. 1). The median number of bat passes per bat visit was 1 (maximum 6) and the bat visits lasted 4 minutes at most, with the median being 1 minute. In general, the median was 2 bat passes by *T. teniotis* per night, and usually no more than 5 passes were recorded each night, the exception being the night of 10 September 2016 (13 passes). At Veliki Ognjivec (Griško polje), one bat pass by *T. teniotis* was recorded on 8 April 2017, and one on 7 October 2017, amounting to just 0.0001 % of all the bat passes (out of 16759), or on only two nights (i.e. 0.025 %) out of 80 possible nights.

We attribute the lack of *T. teniotis* records for the months of June and July (Tab. 1) at Črna griža, and from May to September at Griško polje, more to its rarity in the areas than to less intensive summer samplings. Zagmajster et al. (2015) also reported on the rarity of the species in the neighbouring Italian region of Friuli Venezia Giulia (4 out of 820 ultrasound detector sites or 0.49%), though they reported the presence of *T. teniotis* in the vicinity of the Slovenian border also from mid-July. Therefore, a possible seasonal variation of the presence of *T. teniotis* in Slovenia and adjacent areas requires further investigation.

Why had this species not been recorded in Slovenia earlier, despite a number of focused surveys carried out to ascertain its presence? One explanation may be its rarity, and/or the time of night when *T. teniotis* is active in the area. In the case of Črna griža, most of the *T. teniotis* passes occurred after the first fifth of the night, and over 60% of passes were recorded after the second fifth of the night (Fig. 2). Similarly, at Veliki Ognjivec (Griško polje) one bat pass was recorded in third and one in fourth fifth of the night. Therefore, *T. teniotis* occurred at the times of night when surveys with manually operated detectors had been less intensive or not conducted in the past.

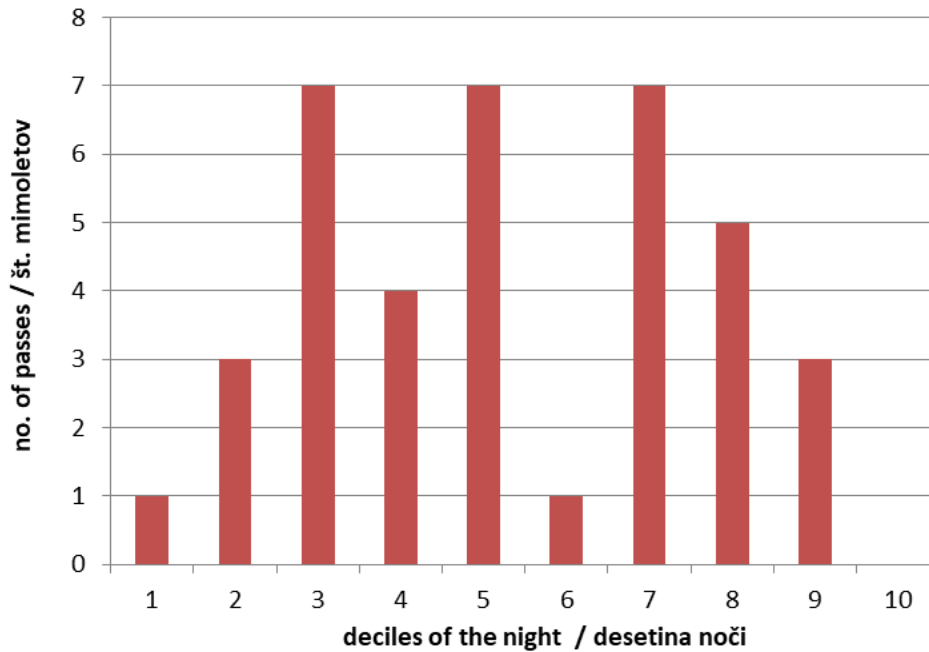


Figure 2. Number of *Tadarida teniotis* passes in each of the ten time periods (deciles) of the night in the year 2016 on the hill Črna griža (for the duration of each decile of the night see Tab. 1).

Slika 2. Število mimoletov dolgorepega netopirja v desetinah noči v letu 2016 na hribu Črna griža (za dolžino trajanja desetine noči glej Tab. 1).

Conclusions

Tadarida teniotis was recorded in areas close to the seashore in the western part of Slovenia. The species seems to occur there throughout the year, and therefore should be considered a permanent part of Slovenian bat fauna. It is the 31st bat species recorded for our country, and is considered the 30th bat species currently living in Slovenia (Presetnik et al. 2009, Presetnik 2012, Presetnik & Knapič 2015). However, because Slovenia is at the edge of its current areal, it is only to be expected that observations of it would be rare, which might explain the late confirmation of its presence in the country. We are confident that further acoustic surveys, especially using automatic recorders, will shortly reveal more sites containing this species in Slovenia.

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