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An assessment of the current and historical records of the Schreibers' Bent-Winged Bat *Miniopterus schreibersii* (Kuhl, 1817) in Piedmont (Northwestern Italy)

Roberto Toffoli

CHIROSPHERA, Associazione per lo Studio e la Tutela dei Chirotteri e l'Ambiente, Via Tetti Barbiere 11, 10026 Santena (TO), Italy; e-mail: rtoffoli@iol.it.

ABSTRACT The presence of *Miniopterus schreibersii* in Piedmont (Italy) is being updated. The species was first reported in the Region in 1973, and until 2000 only five records were known. Subsequently, the number of presence data increased due to improved acoustic identification capabilities. From 1973 to 2025, thirty records of the species were collected concerning specimens foraging or in transit, and two hibernation roosts were frequented by single specimens. One of the two roosts is the Rio Martino Cave where the species has been regularly present in winter since 2018 with up to a maximum of four single specimens in 2025. In the last decade, the presence of the species in Piedmont has become more regular compared to previous years, suggesting a regular presence of the species in the Region.

KEY WORDS Mammalia; Chiroptera; *Miniopterus schreibersii*; distribution.

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INTRODUCTION

Miniopterus schreibersii (Kuhl, 1817), a cave-dwelling bat associated with warm limestone areas, is found in southern Europe, including several large islands, in western North Africa, and in some areas of western Asia bordering the Mediterranean Sea (Wilson & Mittermeier, 2019). The northern boundary of the range encompasses central France, the French and Swiss Jura, northern Italy, southeastern Austria, Slovakia, and Romania (Aulgnier & Presetnik, 2023). Scattered specimens have been reported north of this range (Bartonička & Jedlička, 2011) or in some Mediterranean islands such as Malta (Borg et al., 1997). The species is classified as vulnerable on the IUCN Red List (Cistrone et al., 2023) and is considered a long-distance migrant throughout its European range (Wright et al., 2020), making seasonal movements between nursery roosts and hibernacula (Palmerin & Rodrigues, 1995).

In Italy, it has been reported in all regions (Lanza 2012, Loy et al. 2019), except for the Aosta Valley (Patriarca and Debernardi, 2021) and Trentino-Alto Adige (Niederfriniger, 2001; Deflorian et al.). The species is more prevalent in central and southern Italy, as well as the islands, while it is less common in the north (Ercole et al., 2021). It is more regularly and widely found in the eastern regions of Veneto and Friuli Venezia Giulia (Bon, 2017; Lapini et al., 2019).

In Piedmont, the species was first reported on December 26, 1973, when a male was found in an abandoned mine in Santa Vittoria d'Alba, Cuneo province. This was confirmed the following year with the discovery of a pregnant female in the same location on April 25, 1974 (Boano & Curletti, 1974). A subsequent review of the species' records

in Piedmont highlighted its rarity in the region, adding only two presence data. These were related to a specimen found dead on July 24, 1984, in Stazzano (province of Alessandria), and the discovery of a sub-fossil skull in the Grotta dei Partigiani in Artesina, province of Cuneo in June 1986 (Sindaco et al., 1992). After this date, no further reports of the species were provided, except for the observation of specimens in hibernation in an abandoned mine in Santa Vittoria d'Alba during the winters of 2007/2008 and 2016/2017, and in the Rio Martino Cave during the winters of 2017/2018 and 2018/2019 (Toffoli, 2019; Toffoli & Calvini, 2021). This article provides an update on the presence of *M. schreibersii* in Piedmont, examining new records of the species to determine its status, phenology, and distribution in the region.

MATERIAL AND METHODS

To determine the distribution of *M. schreibersii* in Piedmont, we analyzed data from various sources, including bibliography and direct observations made by the author, from the first reported sighting in 1973 to 2025. The acquired records were mapped with the highest level of precision. Each record was accompanied by a specific data type, such as observation of specimens during daytime rest or hibernation, acoustic recordings, or captures. The observations were accompanied by the number of specimens detected, while the acoustic recordings were solely marked with the presence data.

In the analysis of acoustic sequences, we only considered those that could be confidently attributed to the species with characteristic social calls (Fig. 2), consisting of a long buzz (Russo & Papadatou, 2014), or with echolocation signals (Fig. 3), consisting of a modulated frequency (FM) section followed by a quasi-constant frequency (QFC) section, with a final maximum energy frequency greater than 50 kHz and a total signal duration greater than 10 ms (Barataud, 2015).

RESULTS

Between 1973 and 2025, a total of 30 records were collected (Table 1) from 12 locations, spanning an altitude range of 69 to 1760 meters.

All records are situated in the southern sector of the Region, in the provinces of Cuneo and Alessandria (Fig. 3). Four records date back to before 1990, one from the 1990s, and the rest from after 2000. Post-2000 observations involve direct

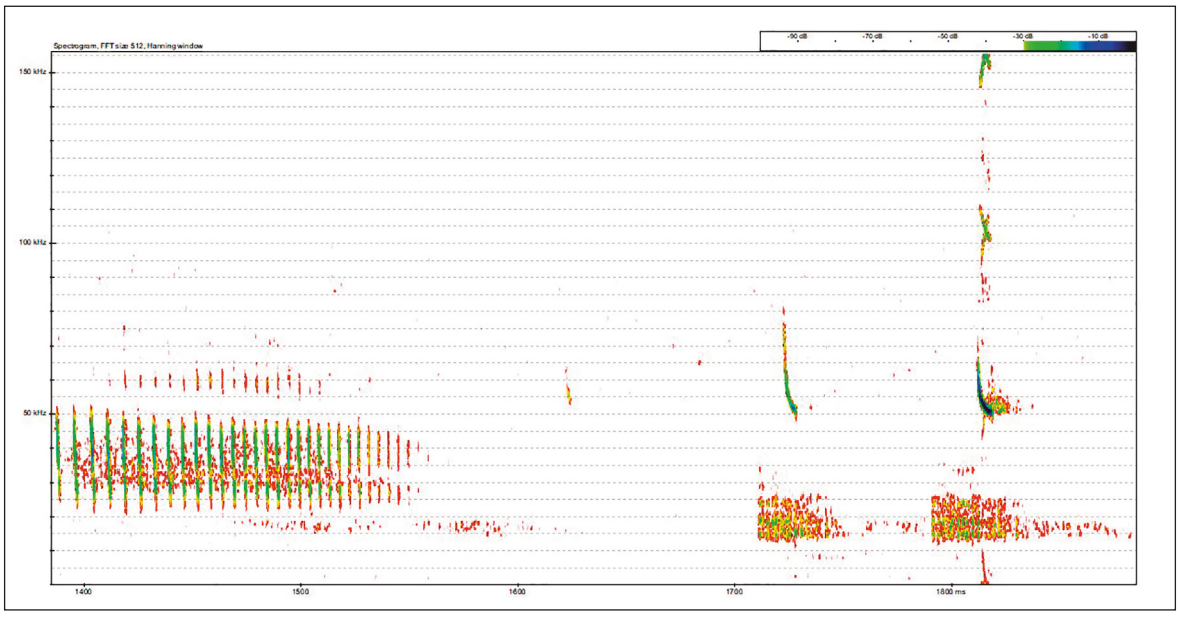

Figure 1. Social buzz associated with echolocation calls (Castelnuovo Scrivia, 7/08/2023).

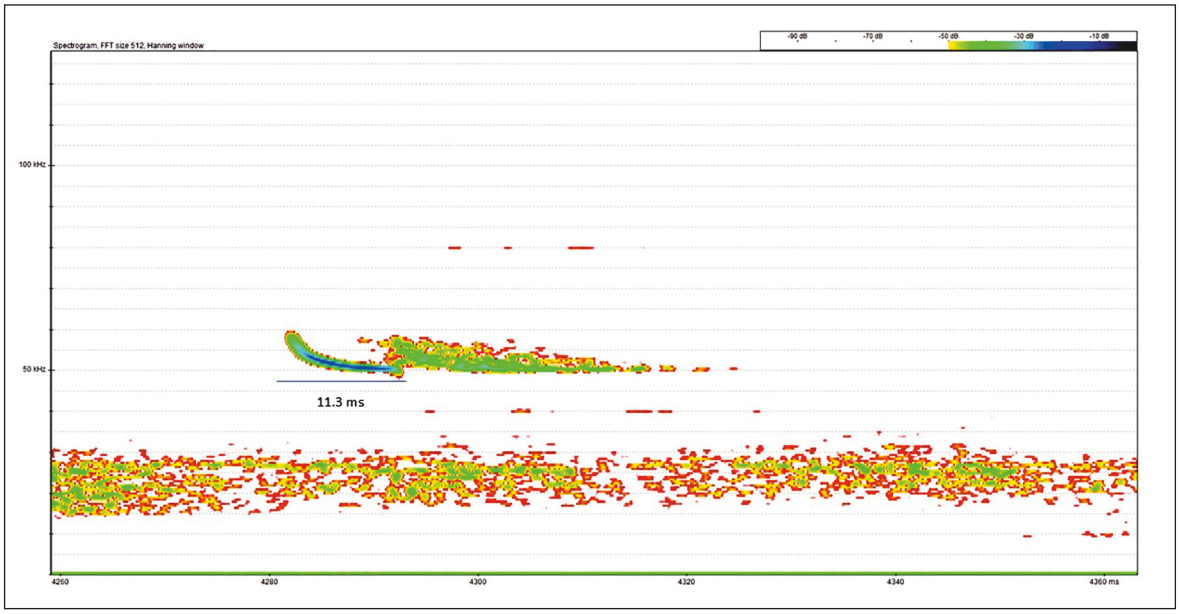

Figure 2. Echolocation call with maximum energy frequency greater than 50 kHz and duration of 11.3 ms (Fabbrica Curone, 3/09/2022).

observations of specimens in diurnal rest or hibernation at two sites (13 records) or detected through acoustic methods during foraging or transit (11 records). From a phenological perspective, all reports are concentrated between July and April, with a lack of data in May and June (Fig. 4). Beginning in the mid-2000s, reports of the species have become more frequent, particularly in the last decade (Fig. 5).

DISCUSSION

The data presented here update the presence of *M. schreibersii* in Piedmont, confirming its rarity in the region. However, the species is regularly present at least during migration or dispersive phases (March-April and August-October) and more limitedly in the winter months (December-February). This further supports the findings of regular monitoring of bats in Piedmont during summer (Debernardi et al., 2010) and winter (Toffoli & Calvini, 2021). These studies did not identify reproductive roosts for the species, but only two hibernation sites used by specimens, one of which has been used with some regularity in recent years, the Rio Martino cave (Toffoli, 2019). The

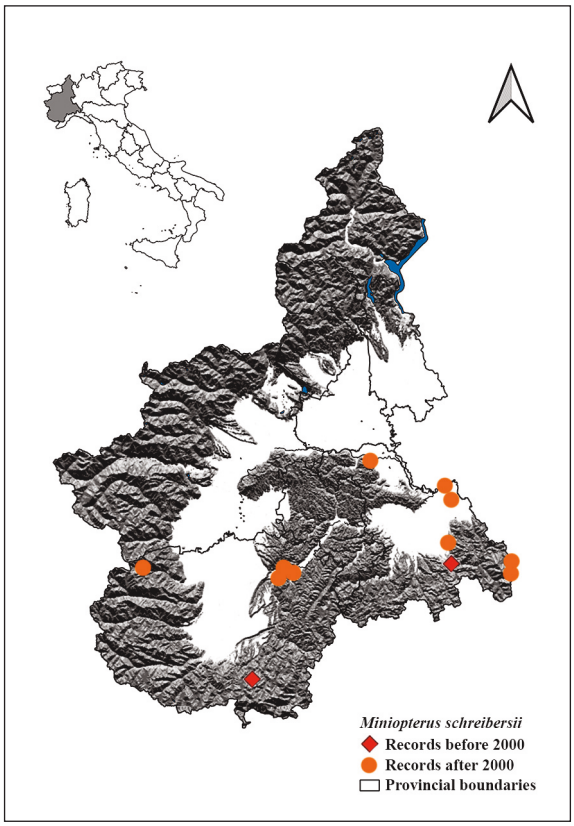

Figure 3. Occurrences of *M. schreibersii* in Piedmont (Italy): red diamond records before 2000, orange circles record after 2000.

Date	Location	Altitude	Specimens	Detail	References
26/12/1973	Santa Vittoria d'Alba (CN)	201	1	B	Boano & Curletti, 1974
25/04/1974	Santa Vittoria d'Alba (CN)	201	1	B	Boano & Curletti, 1974
24/07/1984	Stazzano (AL)	228	1 dead	B	Sindaco et al., 1992
28/06/1986	Grotta dei Partigiani Artesina (CN)	1760	1 skull	B	Sindaco et al., 1992
14/03/1995	Santa Vittoria d'Alba (CN)	201	1	O	Toffoli personal data
25/01/2008	Santa Vittoria d'Alba (CN)	201	1	O	Toffoli personal data
18/10/2009	Santa Vittoria d'Alba (CN)	201	1	O	Toffoli personal data
10/10/2012	Fiume Tanaro Roddi (CN)	176		A	Toffoli personal data
26/10/2012	Santa Vittoria d'Alba (CN)	201	1	O	Toffoli personal data
29/12/2016	Santa Vittoria d'Alba (CN)	201	1	O	Toffoli personal data
26/09/2017	Fiume Po Isola Sant'Antonio (AL)	69		A	Toffoli personal data
02/02/2018	Rio Martino cave Crissolo (CN)	1530	1	O	Toffoli, 2019
20/04/2018	Fiume Po Isola Sant'Antonio (AL)	69		A	Toffoli personal data
12/01/2019	Rio Martino cave Crissolo (CN)	1530	1	O	Toffoli, 2019
08/02/2019	Rio Martino cave Crissolo (CN)	1530	1	O	Toffoli, 2019
26/08/2019	Fiume Po Casale Monferrato (AL)	115		A	Toffoli personal data
11/01/2020	Rio Martino cave Crissolo (CN)	1530	1	O	Toffoli personal data
08/02/2020	Rio Martino cave Crissolo (CN)	1530	1	O	Toffoli personal data
March-20	Rio Martino cave Crissolo (CN)	1530	1	B	Garzoli et al., 2021
05/11/2021	Fiume Tanaro Verduno (CN)	202		A	Toffoli personal data
12/04/2022	Rio Martino cave Crissolo (CN)	1530	1	O	Toffoli personal data
26/04/2022	Alta Val Curone Fabbrica Curone (CN)	1555		A	Toffoli personal data
03/09/2022	Alta Val Curone Fabbrica Curone (CN)	1555		A	Toffoli personal data
03/09/2022	Alta Val Curone Fabbrica Curone (CN)	1465		A	Toffoli personal data
12/09/2022	Torrente Scrivia Villarvernia (AL)	149		A	Toffoli personal data
24/12/2022	Santa Vittoria d'Alba (CN)	201	1	O	Toffoli personal data
04/02/2023	Rio Martino cave Crissolo (CN)	1530	2	O	Toffoli personal data
07/08/2023	Torrente Scrivia Castelnuovo Scrivia (AL)	83		A	Toffoli personal data
07/08/2023	Fiume Po Isola Sant'Antonio (AL)	69		A	Toffoli personal data
01/02/2025	Rio Martino cave Crissolo (CN)	1530	4	O	Toffoli personal data

Table 1. Occurrences (N = 30) of *M. schreibersii* in Piedmont (Italy) with details on the date, location, altitude, number of observed specimens with detail (A = acoustic data, B= bibliographic records, C= capture, O=observation specimens in roost) and references.

rise in frequency and regularity of records over the past decade can be attributed to the growing number of chiroptera surveys in Piedmont, as well as the ongoing efforts to improve acoustic identification of species through bioacoustic methods (Russo & Papadatou, 2014; Barataud, 2015; Russ, 2021). The echolocation calls of *M. schreibersii* are strikingly similar in structure and frequency to those of *Pipistrellus pygmaeus* (Barataud, 2015; Russ, 2021), often making it challenging to distinguish between the two species acoustically, which frequent similar habitats (Wilson & Mittermeier, 2019). However, acoustic sequences with echolocation signals lasting over 10 ms, with a maximum energy frequency of the final signal part greater than 50 kHz, and a curvature shape between the modulated (FM) and quasi-constant (QFC) parts of the signal, enable the reliable discrimination of *M.*

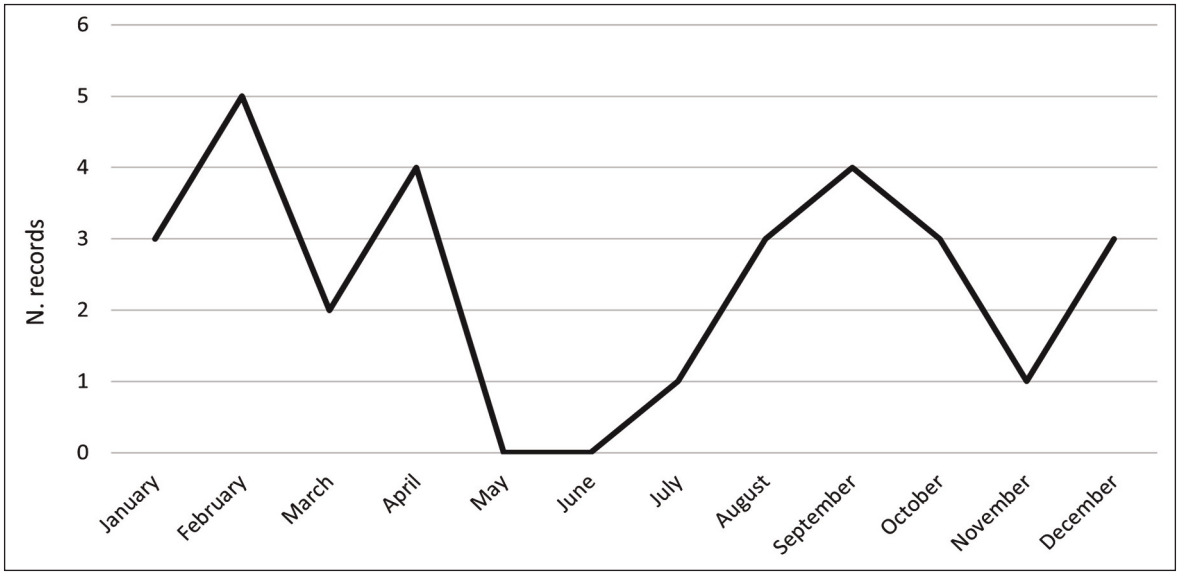

Figure 4. Monthly trend of *M. schreibersii* records in Piedmont (N = 30).

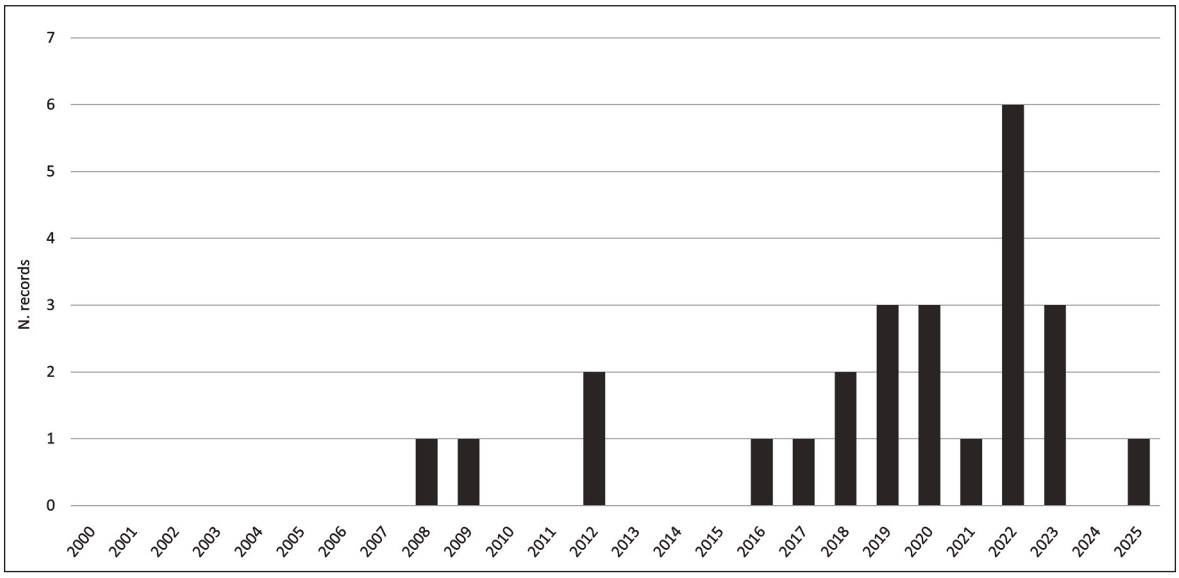

Figure 5. Occurrences of *M. schreibersii* in Piedmont during the period 2000-2025 (N = 25).

schreibersii (Barataud, 2015), as well as sequences with the characteristic social calls of the species (Russo & Papadatou, 2014).

The acoustic signals concern specimens in foraging or transit activity. These occurred mainly along some of the main rivers of central-southern Piedmont (Po, Tanaro, and Scrivia rivers), confirming that ripisylve and rivers constitute flight corridors of the species during migratory and dispersive movements and possible landmarks during orientation flight (Serra-Cobo et al., 2000). The remaining data were recorded in ecotonal mountain grassland, located in the Apennine sector of the region, at altitudes ranging from 1450 to 1550 meters above sea level. In other European mountain areas, specimens in transit or foraging have been observed at similar or higher altitudes: 1500 m in the Austrian Alps (Spitzenberger, 1981), 1630 m in the French Alps (Drousie & Cosson, 2016), and 2260 m in the French Pyrenees (Bertrand, 1992). This highlights the species' ability to inhabit a wide range of environments, including mountainous areas, for foraging or transit purposes (Wilson & Mittermeier, 2019; Aulgnier & Presetnik, 2023).

The abandoned mine of Santa Vittoria d'Alba is the only known historical refuge site, discovered in the early 1970s (Boano & Curletti, 1974). It is currently used by specimens as a stopover site during migration, and occasionally for hibernation. The discovery of a pregnant female in April 1974 has led to speculation about historical reproduction at the site. However, given that the species typically gives birth between the first half of June and mid-July (Aulgnier & Presetnik, 2023), it is believed that this specimen was resting during migratory or dispersal movements. The current lack of records in the region between May and early July, particularly regarding specimens foraging, as detected by acoustic techniques, suggests the absence of potential reproductive roosts.

Figure 6. Two *M. schreibersii* in a cluster of *Barbastella barbastellus* in Rio Martino Cave on 01/02/2025.

Hibernation has been detected in two sites: the abandoned mine of Santa Vittoria d'Alba and the cave of Rio Martino. In the first site, single specimens in hibernation have been observed irregularly over the years, while in the Rio Martino cave, regularly monitored since 1991, the species was observed for the first time in the winter of 2017/2018 (Toffoli, 2019). Subsequently, singles were observed every winter except 2023/2024 up to a maximum of 4 on February 1, 2025. Observations often refer to specimens of the species associated with clusters of *Barbastella barbastellus* (Fig. 6). The hibernation roost of the Rio Martino Cave is situated at a relatively high altitude for the hibernation of *M. schreibersii*, as reported in the literature. The species' hibernation roosts, situated at higher altitudes than their breeding roosts, are found below 1400 m (Wilson & Mittermeier, 2019), with a maximum altitude of 1325 m in Bulgaria (Toshkova et al., 2025).

This report aims to shed light on the presence of *M. schreibersii* in Piedmont. The advancement of bioacoustic survey methods and acoustic identification capabilities will enable a more precise understanding of the species' phenology in the region. This will facilitate the assessment of potential migration corridors and foraging habitats, as well as the identification of additional roosting sites.

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