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PRELIMINARY CHOROLOGIC ATLAS OF THE BATS FROM FRIULI VENEZIA GIULIA REGION (MAMMALIA, CHIROPTERA: NORTH-EASTERN ITALY)

ATLANTE COROLOGICO PRELIMINARE DEI PIPISTRELLI DELLA REGIONE FRIULI VENEZIA GIULIA (MAMMALIA, CHIROPTERA: ITALIA NORD-ORIENTALE)

Abstract - The Authors present a provisional chorologic Atlas of the bats of North East Italy (Friuli Venezia Giulia Region). It has been realized following the UTM 10x10 km grid cartographic system, verifying all the available records, both bibliographic and original. Field recent data have been collected particularly since 2013, in the frame of specific cooperation projects and agreements between Friulian Natural History Museum, Italian Ministry of the Environment and Biodiversity Services of the Autonomous Friuli Venezia Giulia Region, all attempting to the sessennial report of the conservation status of various species protected by the EEC 92/43 Habitats Directive. The Atlas summarizes both bio-acoustic data collected in specific bio-acoustic surveys and mistnetting campaigns, and information derived from the recovery of injured bats, thank to various coworkers (Regional Forestry Agents from CFR-Corpo Forestale della Regione Autonoma Friuli Venezia Giulia; Agents from the previous Italian State Forestry Corps - now named Comando unità per la tutela forestale, ambientale ed agroalimentare dei Carabinieri-; various Ngo of nature lovers; private citizens), with the constant cooperation of the Regional Centres for the Recovery of Wild Fauna (CRAS) funded by the Autonomous Friuli Venezia Giulia Region.
Key words: Bats, Distribution, North-eastern Italy, Friuli Venezia Giulia Autonomous Region.

Riassunto breve - *Gli Autori presentano un Atlante corologico preliminare dei pipistrelli diffusi nel Nord-Est italiano (Regione Friuli Venezia Giulia). Esso è stato realizzato utilizzando il sistema cartografico UTM 10x10 km, verificando tutte le informazioni disponibili, sia bibliografiche, sia originali. Dati recenti di campagna sono stati raccolti sul campo soprattutto a partire dal 2013 nel quadro di specifici accordi di collaborazione tra Museo Friulano di Storia Naturale, Ministero dell'Ambiente Italiano e Servizio Biodiversità della Regione Autonoma Friuli Venezia Giulia, che si occupano delle rendicontazioni sessennali all'UE relative allo stato di conservazione di varie specie di interesse unionale protette dalla Direttiva Habitat 92/43 CEE. Sono quindi stati utilizzati sia dati derivanti da specifiche survey bio-acustiche, sia dati derivanti da campagne di cattura con mist nets, dalla occasionale raccolta di animali in difficoltà, effettuata da numerosi collaboratori, da Agenti del Corpo Forestale della Regione Friuli Venezia Giulia (CFR), da Carabinieri Forestali (ex CFS) e dal pubblico generico, con la costante collaborazione dei Centri di Recupero della Fauna Selvatica finanziati dall'Amministrazione della Regione Autonoma Friuli Venezia Giulia.*
Parole chiave: *Pipistrelli, Distribuzione, Italia nord-orientale, Regione Autonoma Friuli Venezia Giulia.*

Introduction

Even tough recent data indicate long-terms recovery of the Bats in various European countries (EEA 2013) these flying mammals are still endangered in large parts of the world. For these reasons they are protected by local (Regional Law 9/2007 by Friuli Venezia Giulia), national (Italian Law 157/1992 and DPR 357/1997) and international Laws (they have been listed in the II and IV App. of the 92/43 EU "Habitat" Directive).

Bats are also protected by other international conventions and agreements (Bern Convention, App. II; Bonn Convention, App. II with Eurobats Agreements). These last has limited local cogency, while the protection of the European bats imposed by the 92/43 EU "Habitat" Directive requires regular six-years checks and monitoring in the whole EU Countries, in Italy conducted both on regional (Lapini & Dorigo 2011, 2015a; Lapini et al. 2014) and national scale (Ruffo & Stoch 2005; Agnelli et al. 2004), locally aimed to reduct the biological impact of various activity of habitat management (Lapini 2013).

The sessennial report of the conservation status of all the species of Unional Interest, indeed, is imposed to all EU countries. Heavy communitary fines to defaulted countries obliged to ensure the conservation of these species in all the Natura 2000 protected EU System. In Italy the sessennial checking of the conservation status

of protected species and habitats is entrusted to the Ministries of Environment of each European countries, in Italy trough each single Regional Administration. The Friulian Museum of Natural History followed all the sessennial reports for as concerns terrestrial and flying vertebrates, performed by Friuli Venezia Giulia Regional Administration from late 90's of the XX century (Lapini et al. 1996, 1999). In 2013-2014 the Friulian Natural History Museum and the Public Administration of the Autonomus Region Friuli Venezia Giulia (Italy) started a first large-scale Regional bat monitoring programme, which include the use of mist-netting, harp-trapping and bat-detector studies.

Bat-detector field surveys had been initially conducted in cooperation with the Department of Biology of Biotechnical Faculty of the University of Ljubljana (Slovenia), in the frame of the project targeted to determine the regional distribution of *Pipistrellus pipistrellus* and *Pipistrellus pygmaeus*. This monitoring gathered important data (Zagmajster 2014a, 2014b; Zagmajster et al. 2015), and for this reason had been continued in the following years.

In the frame of this wide Regional 2013-2014 bat monitoring program, after extended to 2020, it was possible to collect and critically re-examine all chorologic records of recorded species, whose distributions are critically presented in this paper.

The bat community of Friuli Venezia Giulia Region is among the richest in Italy, with 31 species signaled so far. Nevertheless, the overall knowledge about the validity of some signalations and on the distribution of many species is still very poor (Dall'Asta 1995-1996; Lapini et al. 1996; Lapini & Dorigo 2011; Lapini, 2012; Lapini et al. 2014; Lapini & Dorigo 2015a, 2015b) with new species only recently recorded (Zagmajster et al. 2015b).

In this paper we critically summarize all the available verified data, waiting for further extended synthesis of the overall Regional knowledge.

Methods

Our long-term bat studies had been realized following the National and International methodological Indications (Agnelli et al. 2004), with the verification of all available records, due both to occasional sampling and Museum collection checking.

Dead or alive specimens were identified mostly following Lanza (2012) and Dietz et al. (2009), measured, sexed, if necessary fed, rehydrated and released in the wild as soon as possible. In some cases they were determined only on the basis of good photographs, but this was generally possible only with species with unmistakable diagnostic characters (Lapini et al. 2017a, 2017b, 2019a).

The study of injuried bats recovered in some Wild Animal Recovery Centres (CRAS-Centri di Recupero Animali Selvatici) of the Friuli Venezia Giulia Region was a very important source of original data (e. g. Lapini et al. 2019b). Some European bat species and genera are difficult to distinguish by using bat detector surveys (e. g. genera *Myotis* and *Nyctalus*), and they are only rarely found dead or injuried because of peculiar semiaquatic behaviour (e.g. *Myotis daubentonii* and *Myotis capaccinii*).

Opportunistic inspections in buildings requested by both private citizen and public entities gathered other important data. They are sometimes necessary to define the selection of maternal roosts operated by various rare elusive bats (Lapini et al. 2019b).

Bio-acoustic surveys constituted another integrative source of data. They were mostly used to verify the presence of some rare species recovered in the Wild Animal Recovery Centres, searching for them in and around the collecting sites of the recovered bats. In north-eastern Italy these data have been already utilised for various studies on *Vespertilio murinus*, *Eptesicus nilssonii* and other rare or poorly known species Lapini et al. (2014, 2017a, 2017b, 2019a, 2019b).

Bat detector surveys, anyway, were performed in various environment to direct some field sampling, always by using a D1000x Pettersson Bat Detector set in Time-expansion 10x mode. All the recorded sounds have been then studied by using the software Batsound-4 (Pettersson), mostly following Russo & Jones (2002).

Harp trapping and mist-netting were also used, but these invasive methods had been performed only if strictly necessary, to verify or confirm uncertain bio-acoustic or visual data (Lapini et al. 2019b).

In the present paper Chorologic data had been again represented following the UTM 10x10 km Cartographic System, to gather comparison with previous partial synthesis of the same data (Lapini & Dorigo 2011, 2015a; Lapini et al. 2014), even tough in some cases they have been better geo-referenciated.

The systematic and nomenclatural assessment adopted in this paper refers to Loy et al. (2019) and Ruedi et al. (2019).

Results

CHIROPTERA Blumenbach, 1779
MINIOPTERIDAE Dobson, 1875

Common bent-wing bat
Miniopterus schreibersii (Kuhl, 1817)

Distributed from Southern Europe to India, China and Japan, is also present in Africa. Widespread in Continental Italy, Sicily, Sardinia, and other small islands (Lanza 2012; Loy et al. 2019), in north-eastern

Italy is quite common on Carnic and Julian Pre Alps and on the Karst (Lapini et al. 1996, 2014). In Friuli Venezia Giulia this species forms very big nurseries, in late summer sometimes constituted by 5000-7000 specimens, together with various species of the genus *Myotis*. The echolocation ultrasonic emissions of the species are quite similar to the higher ultrasonic calls of *Pipistrellus pipistrellus*, but its social calls are very different (Russo & Papadatou 2014).

MOLOSSIDAE Gervais, 1856

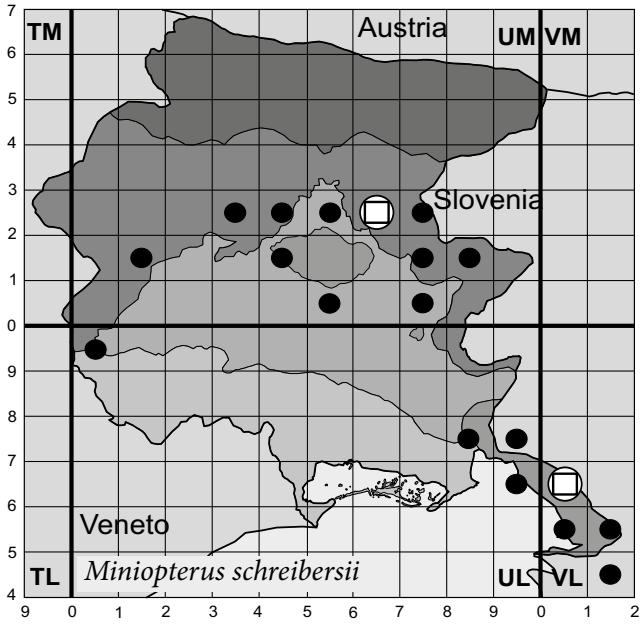
European free-tailed bat
Tadarida teniotis (Rafinesque, 1814)

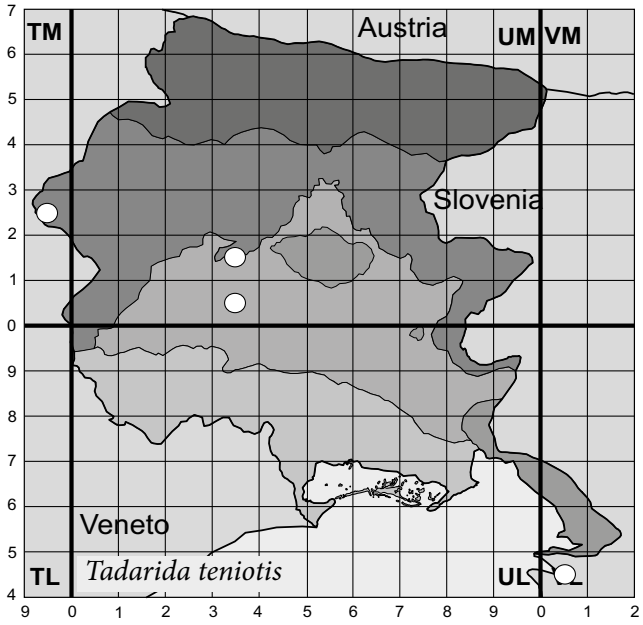
Palaearctic taxon, with the South-Eastern portion of the range extending into the Indomalayan region. Widely distributed throughout the Mediterranean basin, including the Mediterranean islands and archipelagos. Present in Continental Italy, Sicily, Sardinia, and other small islands (Lanza 2012; Loy et al. 2019). Its distribution in Friuli Venezia Giulia Region is still poorly known (Carnic Pre-Alps and High Plain of Pordenone Province; Karst of Trieste), at present only due to recent bio-acoustic records in part published by Zagmajster et al. (2015).

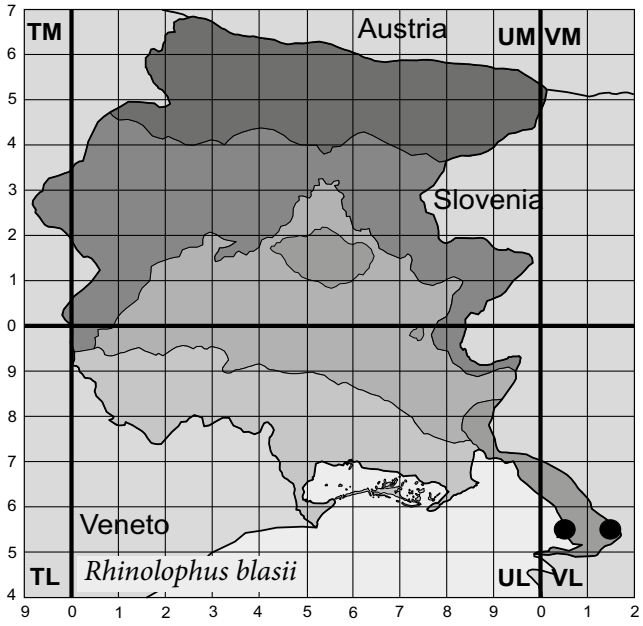
RHINOLOPHIDAE Gray, 1825

Blasius horseshoe bat
Rhinolophus blasii Peters, 1867

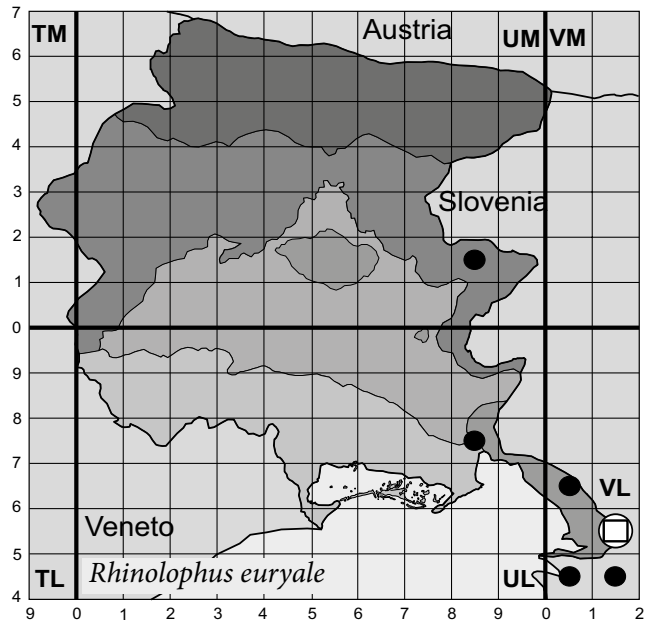
The species has a wide Palaearctic and Afrotropical distribution, but its geographic range shows large disjunctions, often patchily distributed. In south-eastern Europe at present it is considered almost or totally extinct (Slovenia and Italy) (Lanza 2012; Loy et al. 2019). The last data about the presence of this species on the Karst near Trieste dated back to the beginning of







Chorologic UTM (10x10 km grid) maps of the distribution of 30 bats in north-eastern Italy (Friuli Venezia Giulia Region) / *Mappe UTM (10x10 km) della distribuzione di 30 specie di pipistrelli nell'Italia nord-orientale (Regione Friuli Venezia Giulia).*
Legend / *legenda:*
● Hard records due to mistnetting, occasional findings or recovery of injuried bats / *Dati relativi a catture*
○ Records due to bio-acoustic surveys / *Dati relativi a survey bio-acustiche*
◎ Records due to bio-acoustic surveys confirmed by hard data / *Dati relativi a dati bio-acustici catture confermati da catture*
+ Data referred to specimens not surely attributed to the species / *Dati relativi a soggetti non certamente attribuiti alla specie in parola*
? Data referred to specimens attributed only to a single genus / *Informazioni incerte, riferite al genere*
⊙ Data referred to a couple of similar species (symbol used to represent historical data of *Myotis daubentonii/capaccinii* and *Myotis myotis/blythii*) / *Dati relativi a due specie simili (simbolo utilizzato per indicare dati storici relativi a* Myotis daubentonii/capaccinii *e* Myotis myotis/blythii).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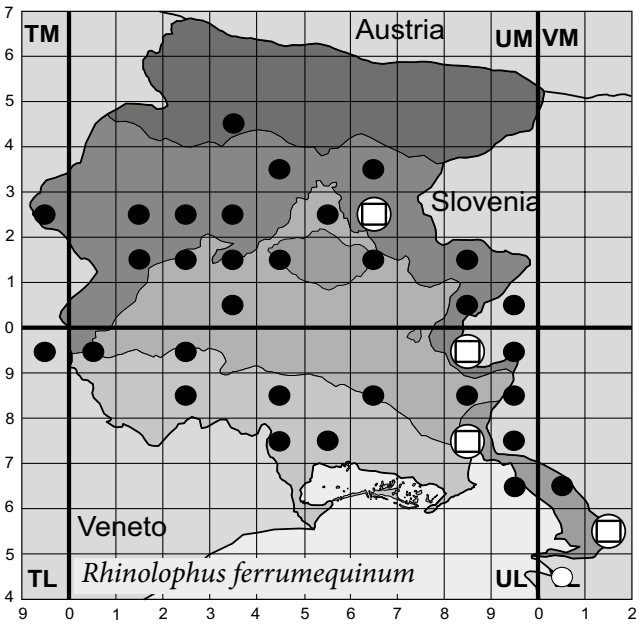
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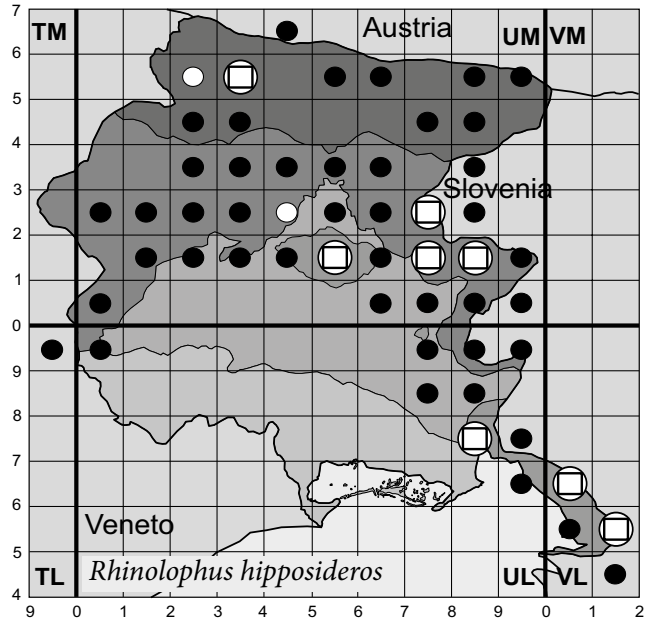
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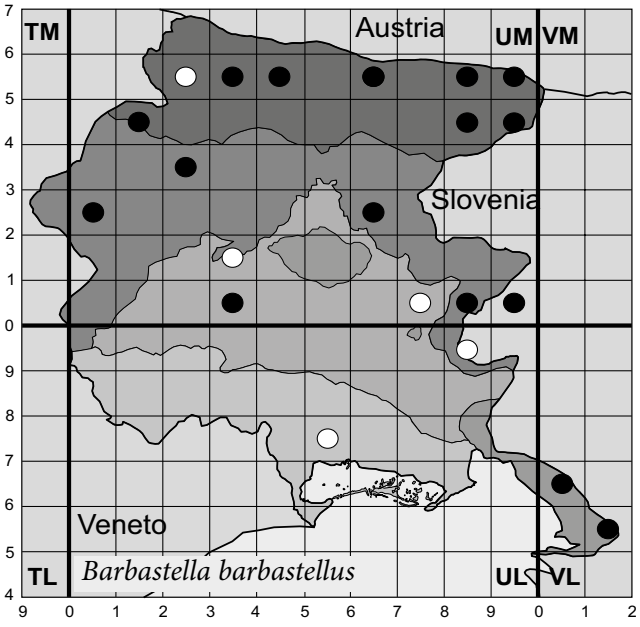
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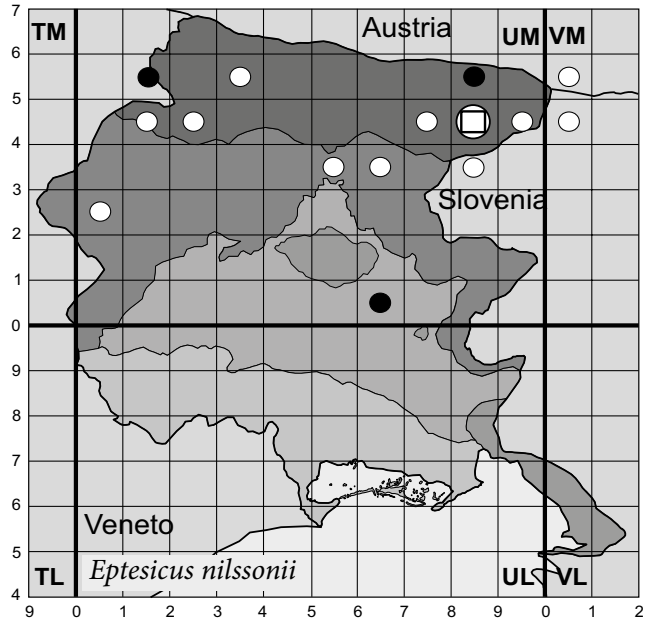
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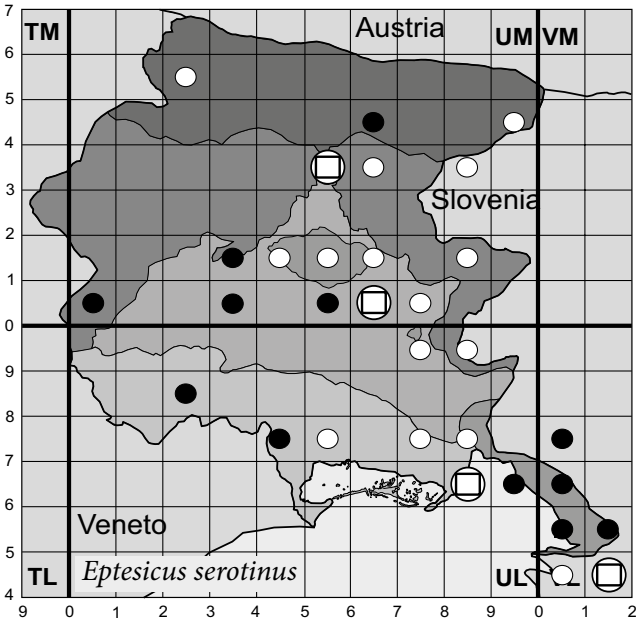
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60's (last record: 3 males, October, 20th, 1964, Grotta del Guano, 527Reg./2686 VG, S. Dorligo della Valle, Trieste, G. B. Benasso leg.). In this locality the species shared its roosts with *Rhinolophus euryale*. During our recent surveys we were not able to confirm the presence of the species for the Friuli Venezia Giulia Region.

Mediterranean horseshoe bat
Rhinolophus euryale Blasius, 1853

Widespread in northern Africa, Southern Europe, South-Western Asia, Iraq, including Continental Italy, Sicily, Sardinia, and Montecristo island (Lanza 2012; Loy et al. 2019). Quite rare and localized in all Friuli Venezia Giulia Region, in Julian Pre-Alps it reaches the northernmost distributive Italian limit, but it is present also on the Karst of the province of Gorizia and Trieste. The rare nurseries known so far in northeastern Italy are often shared with *Miniopterus*, *Myotis*, *Pipistrellus* and other species of the genus *Rhinolophus*.

Greater horseshoe bat
Rhinolophus ferrumequinum (Schreber, 1774)

Palaearctic species widely distributed in all Continental Italy, Sicily, Sardinia, and other small islands (Lanza 2012; Loy et al. 2019). Well distributed on the lowlands, on the Karst and on the Pre-Alps of the whole Friuli Venezia Giulia Region, it becomes very rare or sporadic on the mountains, where it is often vicariated by *R. hipposideros*. In Julian Pre-Alps the species forms very big maternal roosts of more than 322 specimens (probably 350 specimens: Lapini & Dorigo 2015a: 22), together with a large nursery of *Myotis emarginatus*. This is probably one of the biggest Italian nursery of *Rhinolophus ferrumequinum*.

Lesser horseshoe bat
Rhinolophus hipposideros (Bechstein, 1799)

Widely distributed in large parts of Europe, in large parts of Mediterranean basin (all Continental Italy, Sicily, Sardinia and some small islands), Central Asia (Kashmir) (Lanza 2012; Loy et al. 2019). In Friuli Venezia Giulia it seems almost completely excluded from the lowlands, but is common and widespread on mountains and hills (Karst of Gorizia and Trieste provinces, Morainic Hills, Carnic and Julian Alps and Pre-Alps). Its nurseries are mostly located in rural or military abandoned buildings, rarely in caves or hypogean military shelters (Karst of Gorizia Province).

VESPERTILIONIDAE Gray, 1821

Western barbastelle bat
Barbastella barbastellus (Schreber, 1774)

Distributed in Central and Southern Europe, Caucasus, Anatolia, Morocco, and Canary Islands, it is present in whole Continental Italy, Sicily, Sardinia, and Capri island (Lanza 2012; Loy et al. 2019). In Friuli Venezia Giulia Region it is widespread on the mountains, dwelling in various forest habitats (summer), but also in caves (winter; Fig. 1). It is present both on the Karst of Trieste Province (Zagmajster et al. 2012), along River Canyons (River Natisone Canyon, Premariacco, Udine: Lapini & Dorigo 2015a, 2015b), and in lowland woods, sometimes located near the sea (Bosco Coda Manin, Muzzana del Turgnano, Udine) (Zagmajster 2014a, 2014b; Lapini & Dorigo 2015a).

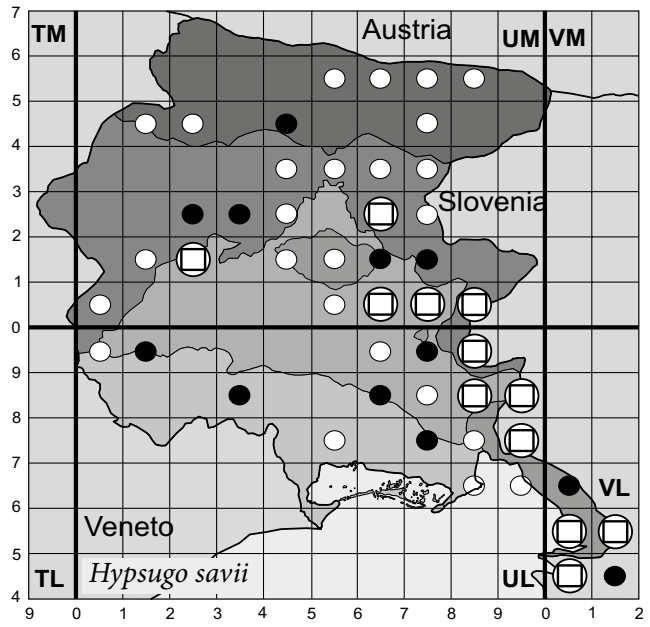
Fig. 1 - Hybernating Western barbastelle portrait (*Barbastella barbastellus*), rare flagship species indicator of old forests (Bunker del Cristo di Raibl, Rio del Lago di Raibl Valley, Tarvisio, Udine, January 12th, 2015; photo L. Lapini-R. Pontarini).
- *Ritratto di barbastello ibernante (*Barbastella barbastellus*), rara specie bandiera indicatrice di foreste vetuste (Bunker del Cristo di Raibl, Valle del Rio del Lago di Raibl, Tarvisio, Udine, 12 gennaio 2015; foto L. Lapini-R. Pontarini).*

Northern bat
Eptesicus nilssonii (Keyserling & Blasius, 1839)

Palaearctic, it is widely distributed from Central-Eastern Europe to China and Eastern Russia; Northwards it reaches Norway (Lanza 2012; Loy et al. 2019). In northern Italy it is present only in some regions (Trentino Alto Adige, Veneto and Friuli Venezia Giulia). The species turned out to be quite frequent in Friuli Venezia Giulia (Lapini et al. 2015), both in the summer and in the winter, sometimes also as hibernating bat (Tarvisio, Udine). Up to now the reproduction of the species in Italy had been ascertained only in Trentino Alto Adige.

Serotine bat
Eptesicus serotinus (Schreber, 1774)

Widely distributed from whole Europe to South-Western Asia and China, widespread in Continental Italy, Sicily, Sardinia, and various small Mediterranean islands (Lanza 2012; Loy et al. 2019). The species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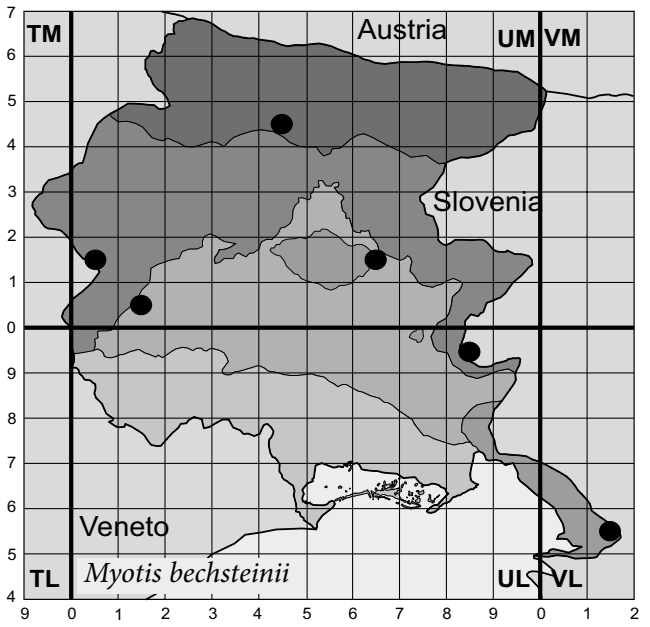
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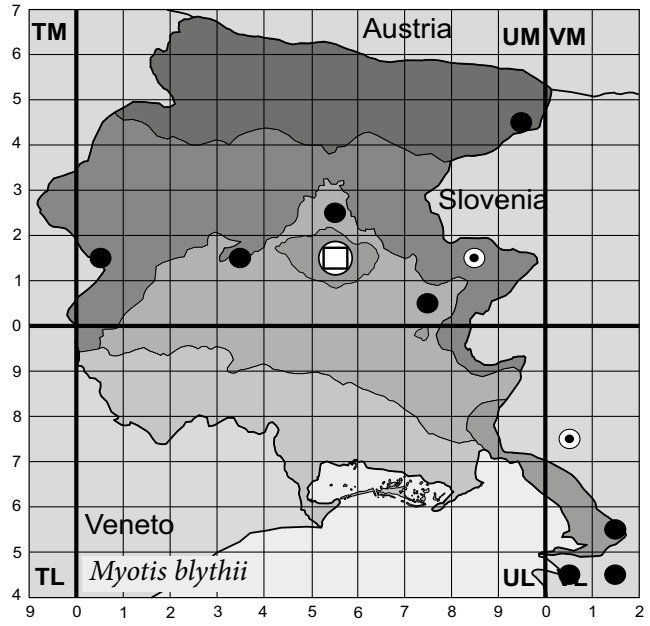
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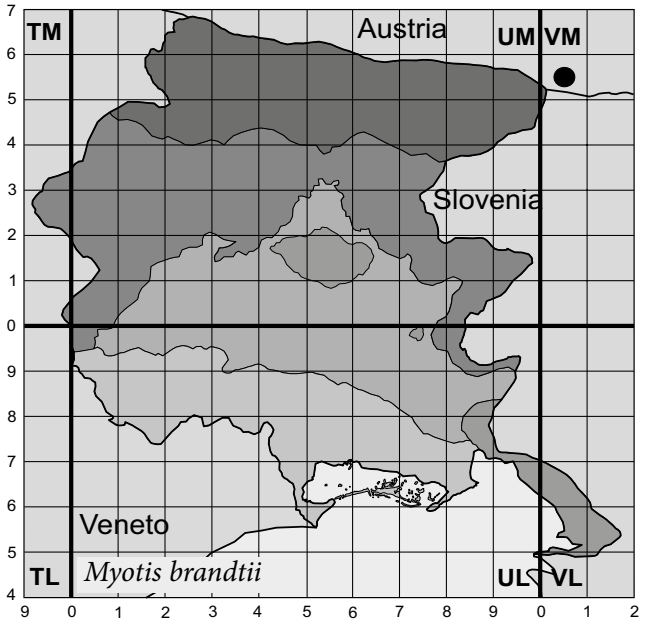
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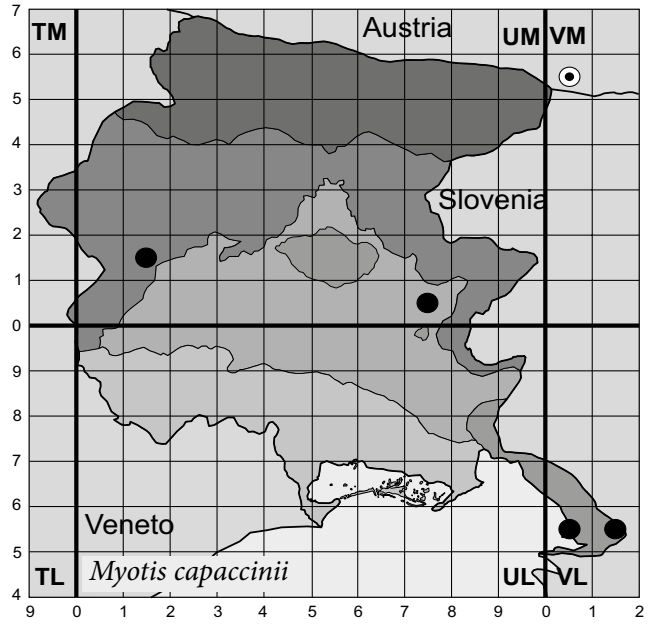
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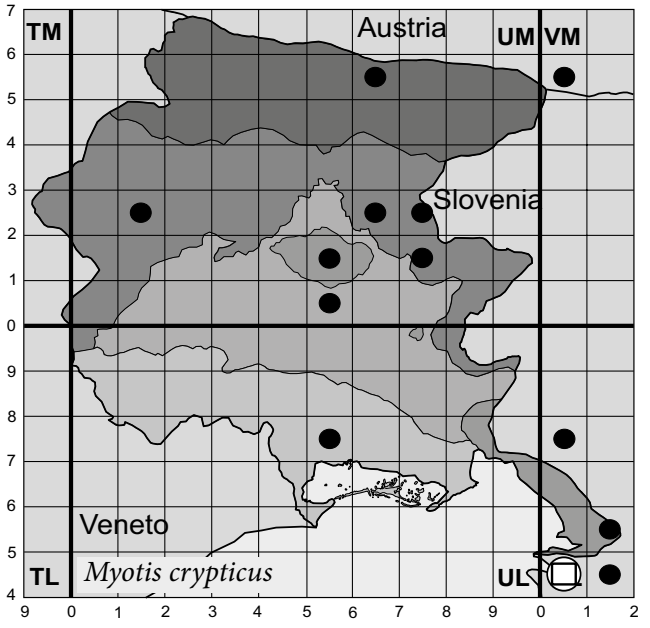
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seems to be quite common and widespread in large part of Friuli Venezia Giulia, perhaps more frequent than previously supposed. In this Region the species rarely roosts also in some town an rural buildings, sometimes together with various species of the genera *Myotis* and *Pipistrellus*.

Savi's pipistrelle
Hypsugo savii (Bonaparte, 1837)

Species with a wide world distribution, from Southern Europe to Northern Africa and South-Western Asia (Lanza 2012; Loy et al., 2019). Common and widespread in whole Continental Italy, Sicily, Sardinia, and other small islands. Very common species in all Friuli Venezia Giulia Region, both in the lowlands, on the hills and on the mountains (Karst, Julian and Carnic Alps and Pre-Alps, etc.), at least up to 1500 m a.s.l. Very common also in towns and villages of the whole Region, often roosts together with other anthropophilous bats of the genus *Pipistrellus*.

Alcathoe whiskered bat
Myotis alcathoe von Helversen & Heller, 2001

Endemic to Central and Southern Europe (Lanza 2012; Loy et al. 2019), present both in Italy, Austria and other European countries. Up to now this taxon had been only erroneously quoted from Friuli Venezia Giulia on the base of newspaper rumors (Anonymous, 2019. In *Sopra e sotto il Carso*. Gorizia, VIII (2): 53-57) referred to a very small male of *Myotis mystacinus* collected on Dec, 6th, 2017 in Val Saisera, Tarvisio, Udine (forearm: 32,5). The specimen was later correctly determined with bio-molecular methods by Biolab. FEM2 Ambiente (University of Milano Bicocca, head V. Mezzasalma).

Bechstein's bat
Myotis bechsteinii (Kuhl, 1817)

Widely distributed in Europe with the exception of the Scandinavian Peninsula (Lanza 2012; Loy et al. 2019). Rare but widespread in Continental Italy and Sicily, seems to be quite rare also in Friuli Venezia Giulia. Recent data, anyway, suggest that its local rarity could be overestimated, due to its elusive arboreal-dwelling behavior (Lapini et al. 2014, 2019b). On Carnic Pre-Alps, indeed, a nursery of about 450 specimens has been recently discovered in the attic of an industrial building under construction (Lapini et al. 2019b). This is probably the biggest nursery known for *Myotis bechsteinii*.

Lesser mouse-eared bat
Myotis blythii (Tomes, 1857)

Widely distributed in Southern Europe, Caucasus, South-Western Asia, India, and China (Lanza 2012; Loy et al. 2019). Widespread in Continental Italy, in Friuli Venezia Giulia is not particularly common, but present both on Morainic Hills, Julian Pre-Alps, and Karst of Gorizia and Trieste. A single hybernating *Myotis blythii* has been recently found on Julian Alps too. In some localities it forms monospecific nurseries (Morainic Hills), but usually shares its maternal roosts with other big *Myotis*, often together with *Miniopterus schreibersii* and various species of the genus *Rhinolophus*.

Brandt's bat
Myotis brandtii (Eversmann, 1845)

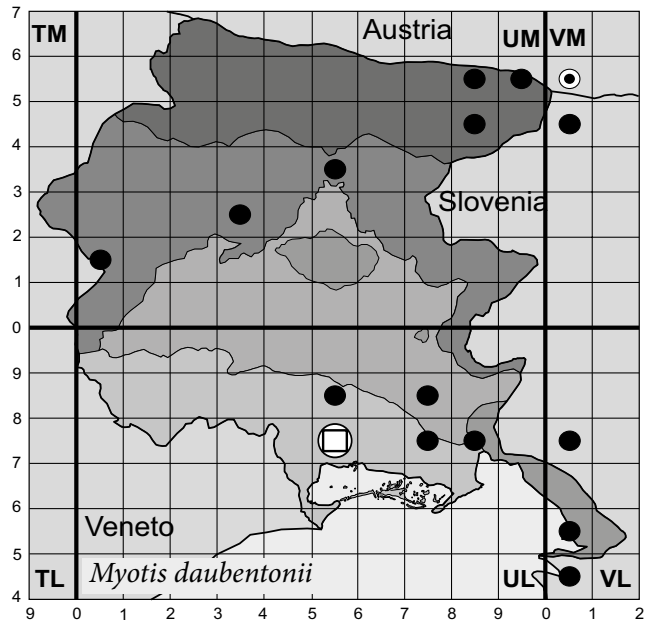
Distributed in Central and Eastern Europe, East to China and Japan. Difficult to distinguish from other small *Myotis*, it seems to be quite rare in Peninsular Italy, but its true diffusion could be underestimated (Lanza 2012; Loy et al. 2019). In Friuli Venezia Giulia this taxon had be only erroneously signaled (see the atypic dental characters showed by some specimens of *M. mystacinus* collected on Carnic Alps: Lapini et al. 1996: 170, in the past attributed to *M. brandtii* by Vernier 1994), but there are some Slovenian data on the Italian-Slovenian borders (Kryštufek & Rešek Donev 2005). Its presence in north-eastern Italy seems to be quite probable but not verified yet (Lapini et al. 2014).

Long-fingered bat
Myotis capaccinii (Bonaparte, 1827)

Widely distributed in Mediterranean basin, Southern Europe and South-Western Asia, it is present in Continental Italy, Sicily, and Sardinia (Lanza 2012; Loy et al. 2019). Not common in large parts of Italy, in Friuli Venezia Giulia seems to be very rare (Lapini et al. 2019b). Anyway, various records indicate its presence on the Karst of Trieste, on Julian and Carnic Pre-Alps, where it naturally selects very humid caves.

Cryptic bat
Myotis crypticus (Juste, Ruedi, Puechmaille, Salicini & Ibáñez, 2018)

Çoraman et al. (2018) treat the Italian bats of the *M. nattereri* complex as *M. nattereri helverseni*, while Ruedi et al. (2019) clearly indicate that this name must be considered a nomen nudum. On the base of these last considerations the only name available for thise bat seems to be *Myotis crypticus*, proposed by Juste et al. (2019) to indicate a new full species. This taxon seems to be widespread in Spain, France, and Continental Italy (Loy et al. 2019), but in north-western Slovenia it could be sympatric with *Myotis nattereri*. The true limits of their mutual distribution in this area are not well defined yet. Anyway, the species is quite common in all Friuli Venezia Giulia region, dwelling both under bridges (lowlands, Karst of Trieste), natural caves (Julian and Carnic Pre-Alps), and anthropic hypogean structures (Morainic Hills). In the winter is particularly easy to find this bat in caves.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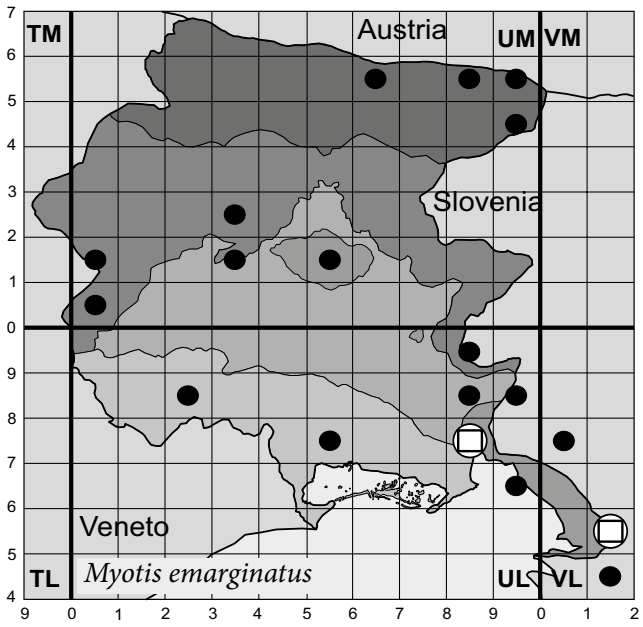
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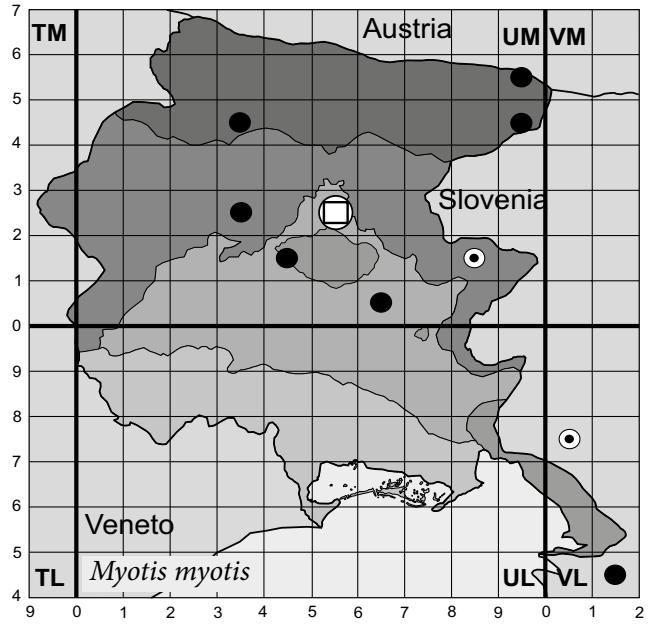
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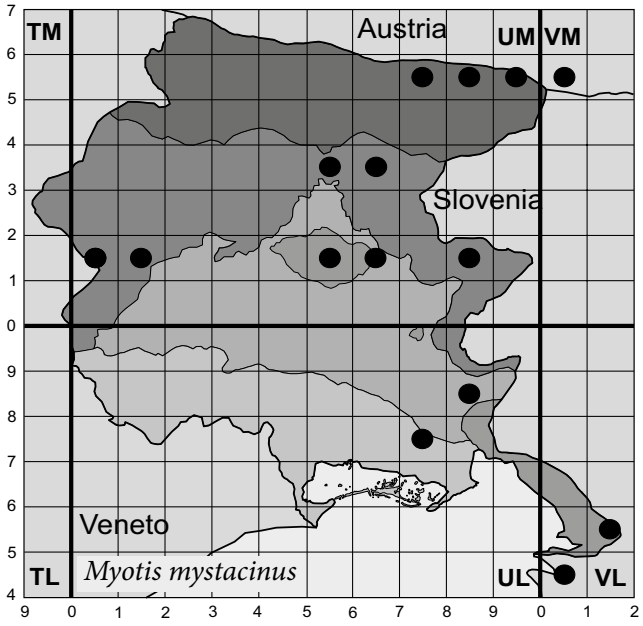
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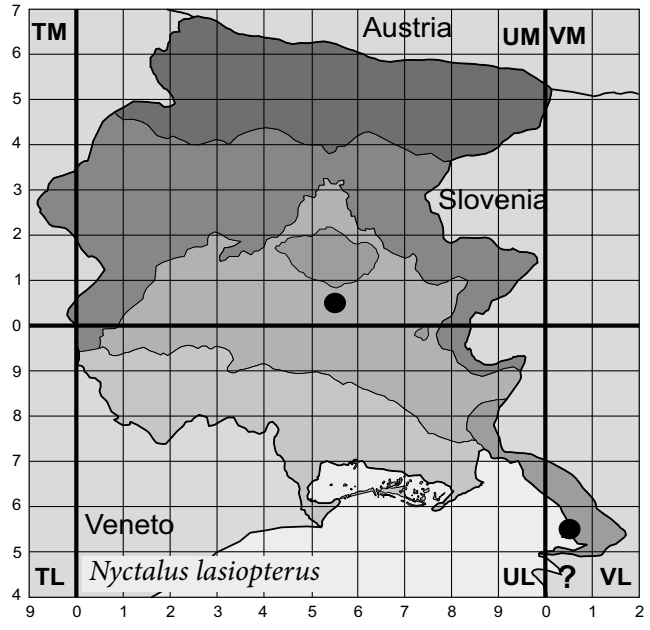
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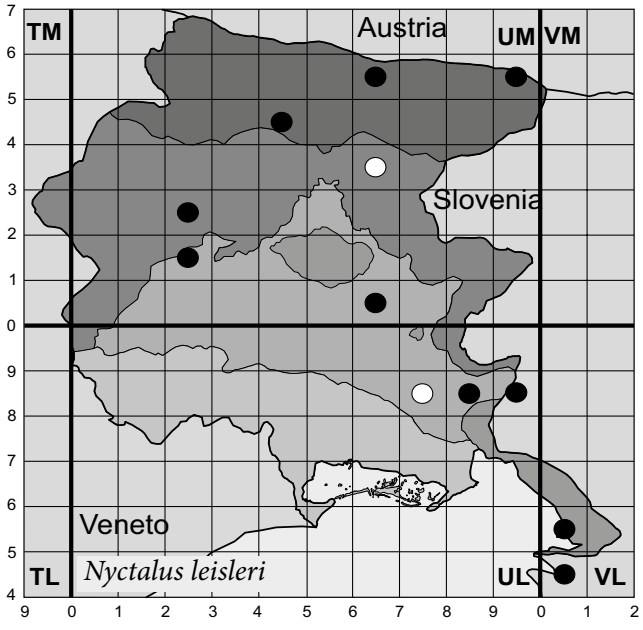
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Daubenton's bat
Myotis daubentonii (Kuhl, 1817)

Distributed in large parts of Europe and Central Asia, East to China and Japan, it is widespread in Continental Italy, Sicily, and Sardinia (Lanza 2012; Loy et al. 2019). Semi-acquatic trawling species, in Friuli Venezia Giulia it selects nursery roosts located under river bridges, but also in buildings, sometimes together with other species of the genera *Nyctalus*, *Pipistrellus*, *Plecotus*, *Rhinolophus* and *Myotis* (Lapini et al. 2019b).

Geoffroy's bat
Myotis emarginatus (E. Geoffroy, 1806)

Distributed in Europe, North-Western Africa, East to South-Western Asia (Lanza 2012; Loy et al. 2019). Widespread in Continental Italy, Sicily, Sardinia, and Elba Island, in the Friuli Venezia Giulia Region is not so common, with at least five maternal roosts located under bridges, old buildings, rarely in caves, often together with various species of the genera *Rhinolophus* and *Myotis*. In Friuli Venezia Giulia Region, anyway, the species has been recorded both on Julian and Carnic Alps and Pre-Alps, in the lowlands, on the Morainic Hills and on the Karst.

Greater mouse-eared bat
Myotis myotis (Borkhausen, 1797)

Widely distributed in Europe, with the exception of the Scandinavian Peninsula, Eastwards to Anatolia and South-Western Asia (Lanza 2012; Loy et al. 2019). Quite common in whole Continental Italy, is present also in Sicily, Sardinia, Lampedusa, Capri, and on Elba islands. In Friuli Venezia Giulia it seems to be quite common on Alps and Pre-Alps, often sympatric with *M. blythii*, *Miniopterus* and other species of the genus *Rhinolophus*.

Whiskered bat
Myotis mystacinus (Kuhl, 1817)

Small wood bat widely distributed in Europe, Eastwards to Central Asia and China (Lanza 2012; Loy et al. 2019). Widespread in Continental Italy, Sicily and Sardinia, is often dominant in forest environments. In Friuli Venezia Giulia Region it seems to be very common on the mountains, but it is widespread also in the lowlands and in karstic environments. Its morphologic determination could be very difficult, due to the possible presence of similar sibling species (see the crytical notes concerning *Myotis alcathoe* and *Myotis brandtii*). On the mountain the species often shows antropophilic behaviour, nursing in rural buildings, also in towns and villages of Julian and Carnic Alps.

Giant noctule
Nyctalus lasiopterus (Schreber, 1774)

Widely distributed from Western Europe to Kazakhstan, Cyprus, Malta, and Balearic Islands (Lanza 2012; Loy et al. 2019). Widespread in Continental Italy, usually only with rare and scattered records (Agnelli et al. 2019). In Friuli Venezia Giulia the giant noctule seems to be very rare too, probably only because it is very difficult to find (Lapini et al. 2014, 2019; Presetnik & Knapič 2015). This fact could be due both to its elusive arboreal-dwelling behaviour, and to its highly specialized hunting strategy, with very wide foraging home ranges (up to 430 Km^2) , very long foraging transits (up to 130 km) at high altitude (124-1659 m a.s.l.) (Nad'o et al. 2019).

Leisler's bat
Nyctalus leisleri (Kuhl, 1817)

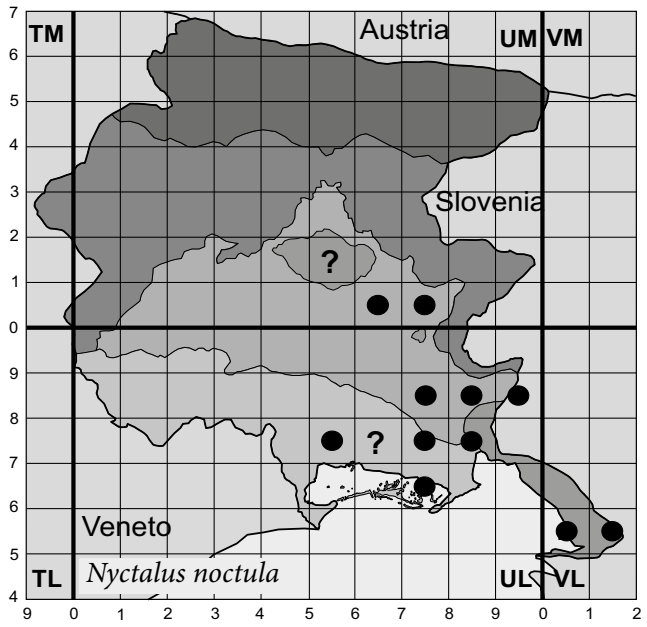
Widely distributed in Europe, Northern Africa, East to the Urals and Iran (Lanza 2012; Loy et al. 2019). Present also in Continental Italy, Sardinia, Elba and Capri islands with an expanding reproductive range that encompassed large parts of Central Italy (Ancillotto & Russo 2015). In Friuli Venezia Giulia it seems to be not common, but widespread (Alps, Pre-Alps, Karst, Lowlands), for the moment without reproductive evidences.

Common noctule
Nyctalus noctula (Schreber, 1774)

Arboreal bat distributed all over Europe, East to South-Eastern Asia and China (Lanza 2012; Loy et al. 2019). Present in whole Continental Italy, in Friuli Venezia Giulia seems to be quite common too, but its distribution is not particularly known yet, probably due to its elusive arboreal behavior (Lapini et al. 2014). Recent data, however, indicate that in this Region the Common noctule often uses antropophilic roosts located in buildings, in the chimneys of various villages or under river bridges. In these roosts the overall numbers of breeding noctules could be very high, reaching more than 200 specimens at the end of the summer (chimneys of lowlands villages), exeptionally exceeding 300 individuals in a nursery located under a lowland bridge (Lapini et al. 2019b). These are probably the biggest nurseries known for the Italian Common noctule.

Kuhl's pipistrelle
Pipistrellus kuhlii (Kuhl, 1817)

Distributed in large parts of Europe, Eastwards to the Southern Carpathians and Western Russia (Lanza 2012; Loy et al. 2019), where it shows a clear range expansion probably due to the climate warming (Ancillotto et al. 2016). Very common in Continental Italy, Sicily, Sardinia, and other small islands, usually shows strict synanthropic behaviour. In Friuli Venezia Giulia Region it is surely the most common and widespread bat, both in the lowlands and on the mountains, during the summer at least up to 1550 m a.s.l. (Nassfeldpass/Passo Pramollo, Carnic Alps). Its nurseries are usually located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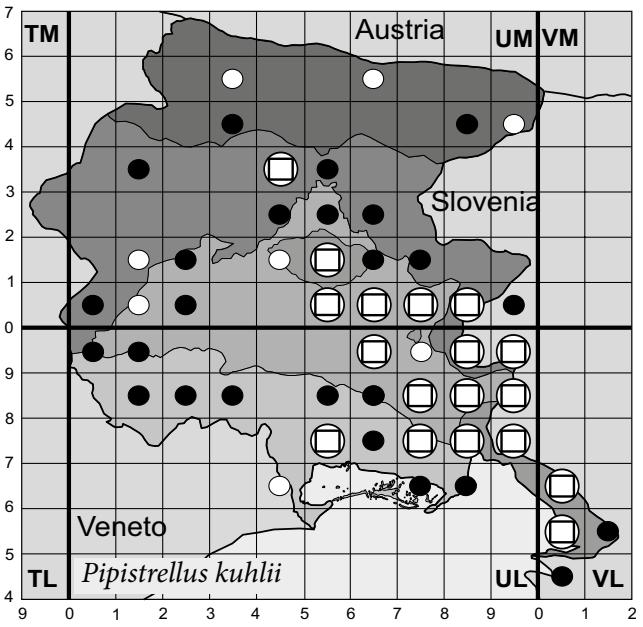
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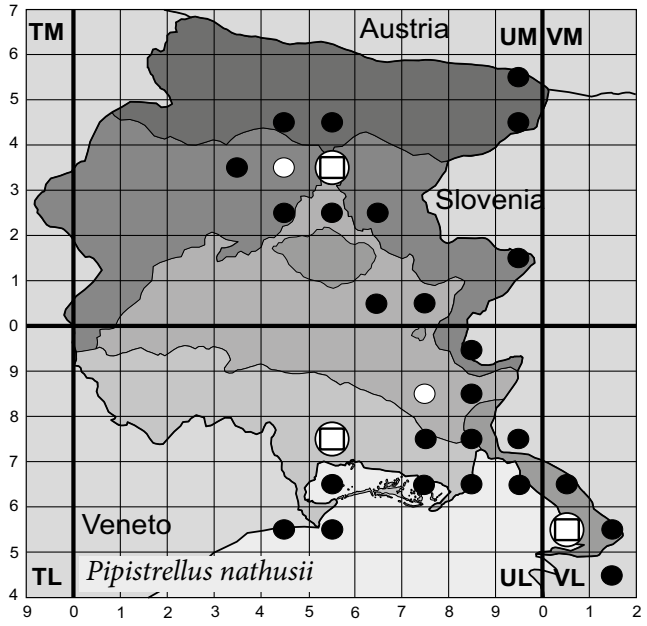
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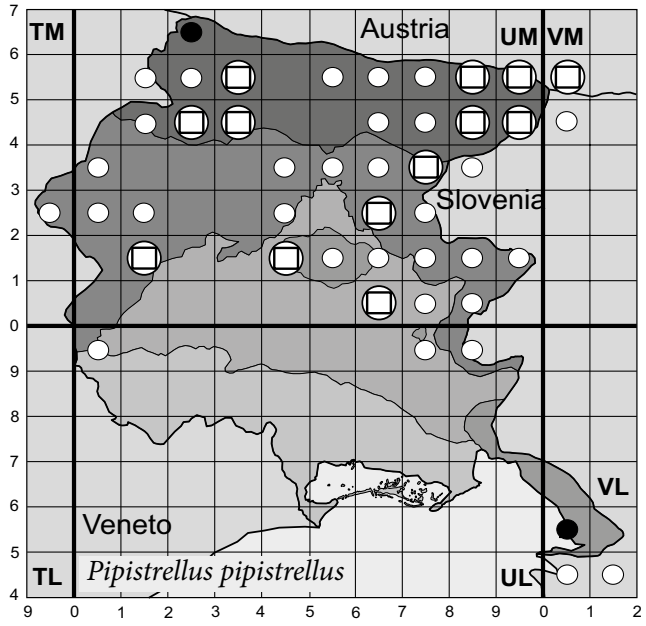
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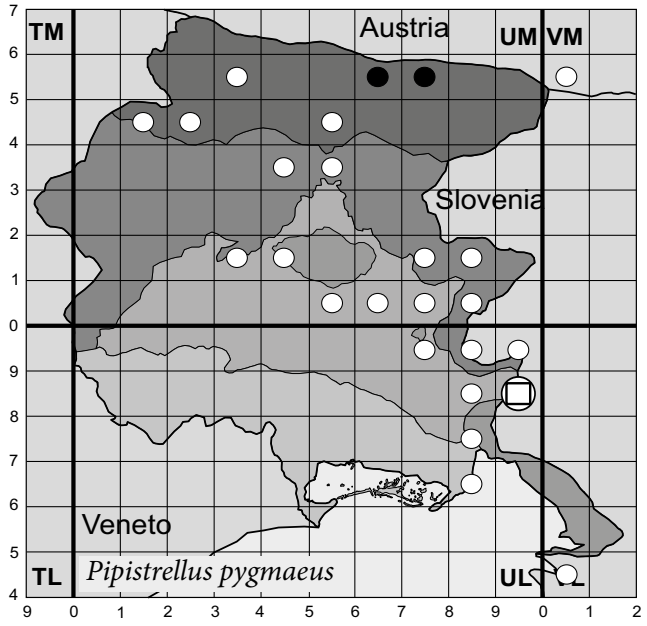
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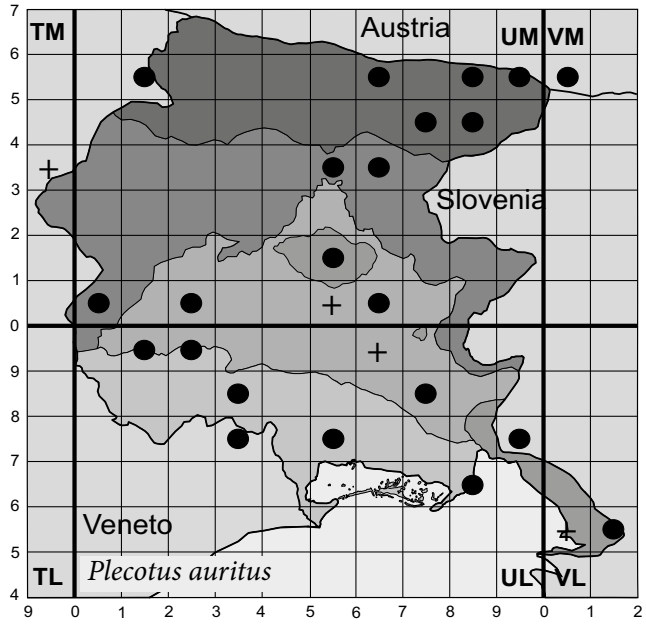
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in buildings, mostly under gutters and shingles, often shared with *Hypsugo savii* and other *Pipistrellus*. In various mountain villages the cohabitation with *Pipistrellus pipistrellus* could be quite common. The bio-acoustic identification of *Pipistrellus kuhlii* was possible only if the recorded vocalizations were complete of the very low social calls typical of the species (Russo & Jones 1999), distinctive from those of the similar *P. nathusii*.

Nathusius' pipistrelle
Pipistrellus nathusii (Keyserling & Blasius, 1839)

Widespread in Europe, Transcaucasia, and South-Western Asia (Lanza 2012; Loy et al. 2019). Present also in Northern and Central Italy, where it breeds in various localities (Ancillotto & Russo 2015). In Friuli Venezia Giulia the species seems to arrive at the end of the summer, to hybernate on the North Adriatic coasts. Fall and winter presences of the species are very common all over the Region, but in some lowland woods it has been observed also during the summer (Muzzana del T., Udine, 4-5 August 2014: Zagmajster 2014a, 2014b). Up to now no nursery roosts were found in north-eastern Italy, but the expansion to the South of its breeding range is so evident that it seems quite probable that it breeds also in these zones of Adriatic hinterland (Ancillotto & Russo 2015).

Common pipistrelle
Pipistrellus pipistrellus (Schreber, 1774)

Widely distributed all over in Europe, Mediterranean basin included, East to the Caucasus and Volga river (Lanza 2012; Loy et al. 2019). Nevertheless, in Central and Eastern Asia it seems to be only patchily distributed. In Friuli Venezia Giulia it usually shows a strict antropophily, nursing in buildings of towns and villages, often sharing its maternal roosts with *Pipistrellus kuhlii* and *Hypsugo savii*. During the present distributive mapping we have verified all information to avoid misidentification with the very similar sympatric sibling species *Pipistrellus pygmaeus*. For these reasons each available museum voucher has been re-determined by using various dental and mandibular characters indicated by Jenrich et al. (2012) (Lapini & Dorigo 2015a), while bio-acoustic records were used only if they were complete of the social calls considered diagnostic for these sibling bats (Zagmajster 2014a, 2014b).

Soprano pipistrelle
Pipistrellus pygmaeus (Leach, 1825)

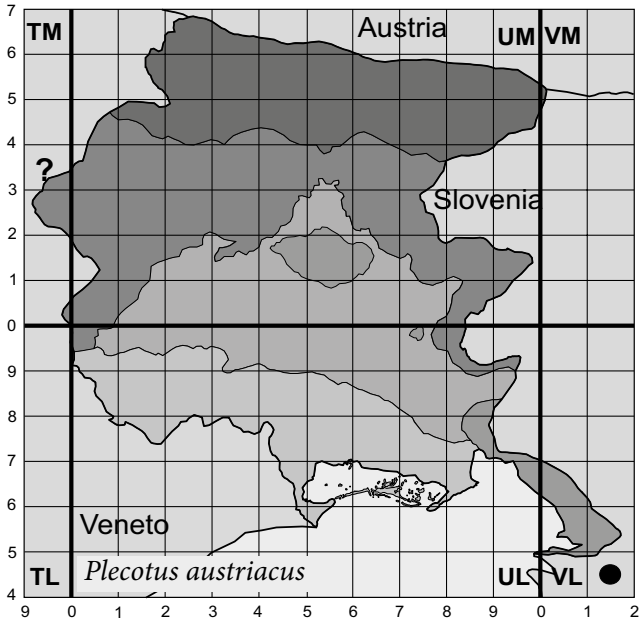
Widely distributed in the whole Europe to Western Russia (Lanza 2012; Loy et al. 2019). Surely present also in Continental Italy, Sicily, and Sardinia, but available records are still scattered. In Friuli Venezia Giulia it usually selects river valleys and riverine habitats, if possible showing high antropophily sometimes sharing its maternal roosts with other *Pipistrellus*. During the present mapping activities we have verified all available information, to avoid misidentification with the very similar sibling species *Pipistrellus pipistrellus*. For this Atlas, indeed, each available museum voucher has been re-determined mostly on the base of clear dental and mandibular characters indicated by Jenrich et al. (2012) (Lapini & Dorigo 2015a). Bio-acoustic records were used only if they were complete of the social calls considered diagnostic for this species (Zagmajster 2014a, 2014b).

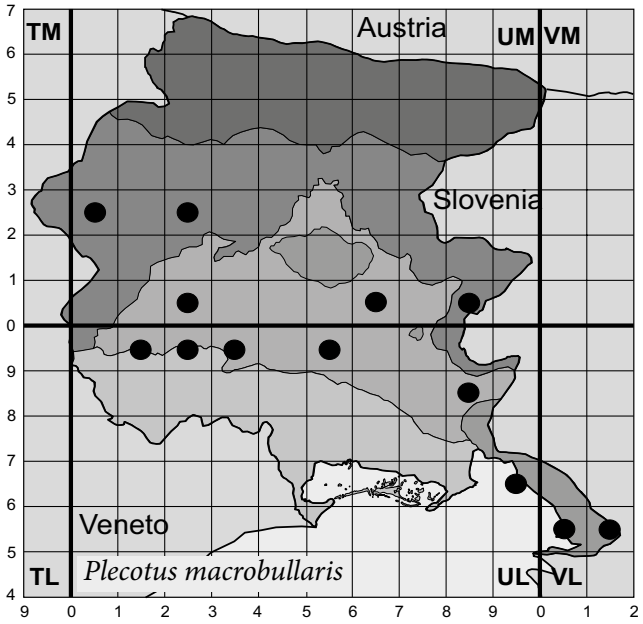
Brown long-eared bat
Plecotus auritus (Linnaeus, 1758)

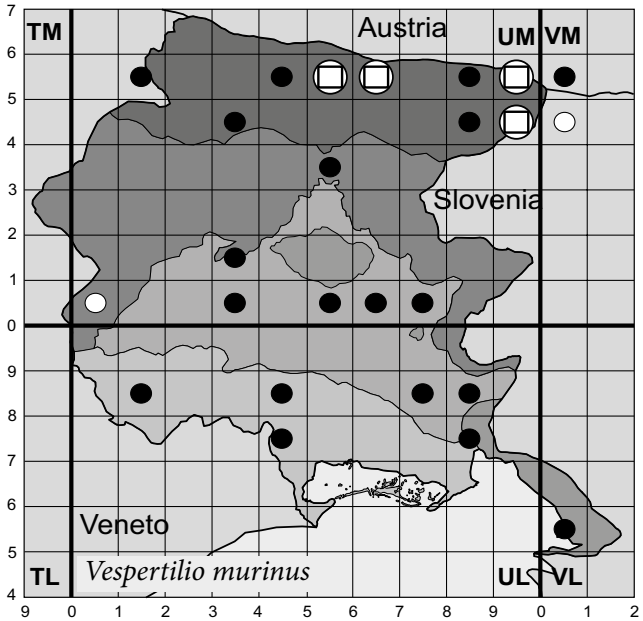
Widely distributed in Europe, it is widespread also in northern and Central Italy, Sardinia and Sicily (Lanza 2012; Loy et al. 2019). In Friuli Venezia Giulia this taxon is widepread both on the mountains and on the lowlands. Difficult to distinguish from other sympatric *Plecotus* both from bio-acoustic data (Russo & Jones 2002; Zagmajster 2014a, 2014b) and from hard samples, intially was studied by bio-molecular methods to obtain certainty (Spitzenberger et al. 2003, 2006), later by using the phenetic criteria by Tvrtković et al. (2005). With this methodology our synthesis (Lapini & Dorigo 2015a; present paper) could be considered mostly correct. In Friuli Venezia Giulia Region the species is very common on the mountains, where it reachs 1900 m a.s.l., while on the lowlands it selects fresh habitats. It mostly roosts under bridges, in various attics, rural buildings, military hypogean shelters, sometimes also in towns and villages, often together with various *Myotis*, *Eptesicus* and *Pipistrellus*.

Gray long-eared bat
Plecotus austriacus (J. B. Fischer, 1829)

Widely distributed in Europe, including Continental Italy, Sicily, Sardinia, and Elba Island (Lanza 2012; Loy et al. 2019). After the recent description of *Plecotus alpinus* and *P. microdontus*, both junior synonyms of *P. macrobullaris*, we have revised all the Regional available samples in the past attributed to *P. austriacus*, because its large cranial measurements are quite similar to those of *P. macrobullaris*. From this revision, later completed with biomolecular methods (Spitzenberger et al. 2003, 2006; Lapini & Dorigo 2015a), it seemed to be clear that the only record of the species could be a specimen collected in the village of Pontebba (Carnic Alps, Udine Province) preserved in the Mammal Collection of the Zool. Museum of the University of Florence (a female, collected on April, 28th, 1883: Inv. Number 4848). The specimen was later determined by P. Agnelli as *Plecotus auritus* by using the methodology of Tvrtković et al. (2005). These consideration lead us to radiate *P. austriacus* from the bat faunal assemblage of Friuli Venezia Giulia Region (Lapini & Dorigo 2015a). Nevertheless, the species has been quoted in the neighboring north-







western Slovenia (on the border of Karst of Trieste: Kryštufek & Rešek Donev 2005) and it could be easily present also in neighboring northeastern Italy.

Mountain long-eared bat
Plecotus macrobullaris Kuzyakin, 1965

Distributed in large parts of Europe, in Central and Eastern Caucasus and in South-Western Asia, in Italy is widespread on the Alps and surroundings (Lanza 2012; Loy et al, 2019). In Friuli Venezia Giulia it is relatively common (Lapini & Dorigo 2015a), and it is distributed in the lowlands and Pre-Alps with two genotypes (Spitzenberger et al. 2003). The western group -*P. m. alpinus*, distributed in Italy, France, Austria, etc.- is surely dominant in the whole studied Region (various samples collected on the lowlands, on the Karst of Gorizia and Trieste, on Carnic Pre-Alps), while the eastern one seems to be rare. Up to now the only sample of the eastern group, belonging to *P. m. macrobullaris* - distributed in Turkey, Greece, Russian Federation, Caucasus -, had been collected on Julian Pre-Alps (a road kill specimen found by A. dall'Asta at Scrutto, S. Leonardo, Udine, later indicated with the acronym Plesp18 by Spitzenberger et al. 2003: 41). The species roosts in buildings, attics, military hypogean shelters, clearly showing a typical antropophilic behaviour, often roosting together near other bats of the genera *Plecotus* and *Pipistrellus*. It seems to be necessary to increase the genetic knowledge of the eastern long eared bats from Julian Pre-Alps with particularly focused sampling.

Particoloured bat
Vespertilio murinus Linnaeus, 1758

Northern long-distance migratory bat widely distributed in Central-Northern Europe East to China, including Central Asia North to Himalaya (Lanza 2012; Loy et al. 2019). Present in Northern and Central Italy, at least to Tuscany. Its reproduction had been only recently ascertained in Italy (Verona province, Veneto: Lapini et al. 2017). Scattered records from various Italian Regions, including Liguria, Lombardy, Piedmont, Trentino-Alto Adige, Valle d'Aosta, Emilia Romagna, Tuscany, could be often due to vagrants (Dondini & Vergari 2015; Lapini et al. 2015, 2017a, 2017b, 2019a). Nevertheless, the recent increase of the Italian findings of this migratory bat is impressive, particularly considering the specimens recovered in various Regional Wild Fauna Recovery Centre (CRAS) in the last 25 years. The adults of this species, indeed, are unmistakable for their silvery-grizzled dorsal fur and in the last years they became very common in the majority of northern Italian CRAS (Lapini et al. 2017a, 2017b, 2019a). In these years, furthermore, occasional findings of adult females in the reproductive period have became quite common, like as those of yearlings both in Friuli Venezia

Giulia and in Veneto Regions (Lapini et al. 2015, 2017a, 2017b). The increase of findings of spring adult females in north-eastern Italy dates back to 2007 (Lanza 2012). The reasons of this breeding expansion are not clear yet, but it is possible to note some parallelisms with the expansion of *Pipistrellus nathusii* and *Nyctalus leisleri* (Ancillotto & Russo 2015). The majority of the data on this species are due to occasional findings (Lapini et al. 2015, 2017a, 2017b).

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Additional cautionary note (April 16th, 2020)

After the acceptation of this paper for the publication on Gortania Botanica-Zoologia, a dangerous world-wide pandemic exploded, due to a group of viruses widely spread in bats.

The responsible of this pandemic outbreak is a new betacoronavirus named covid19 (more properly named SARS-CoV-2)[1, 3], similar to a virus found in *Rhinolophus affinis*, a Rhinolophid bat from Yunnan (South-Western China). This bat surely hosts betacoronaviruses with high genetic affinity with SARS-CoV-2, but they cannot infect human cells, lacking special ACE2 receptors on the tips of their peplomers[1, 3].

A virus more similar in this aspects to SARS-CoV-2 had been found on *Manis javanica*, a pangolin on sale as food in South China wet-market stalls[2, 3]. It is possible that the spillover of covid19 from animal to humans has occurred in the particular situation of biological-promiscuity of wet China-markets, with pangolins as intermediate guests.

Even though the knowledge are still provisional, even with contradictory hypotheses on covid19 origins[3], in Europe it had never been detected in wildlife, nor in wild-living bats, neither in other wild species[4].

Recent German experiments, anyway, indicate that laboratory infections of captive fruit bats and ferrets are possible[5]. This suggests to adopt special cautions in manipulation of wild living bats both for scientific and recovery purposes[6], reducing these practices to a minimal indispensable extent[6].

Acknowledgements

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1) https://www.nature.com/articles/s41586-020-2012-7.pdf
2) https://www.scientificamerican.com/article/how-chinas-bat-woman-hunted-down-viruses-from-sars-to-the-new-coronavirus1/
3) https://www.nature.com/articles/s41591-020-0820-9.pdf
4) http://www.isprambiente.gov.it/it/evidenza/coronavirus/covid-19-e-pipistrelli-chiarimenti-circa-le-relazioni-tra-la-presenza-di-chirotteri-e-il-rischio-di-trasmissione-covid-19
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