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THE BATS OF THE LAKE MAGGIORE PIEDMONT SHORE (NW ITALY)

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ABSTRACT - In the period 1999-2005 we carried out a bat survey along the Piedmont shore of Lake Maggiore (provinces of Verbania and Novara, NW Italy), in order to collect data on species distribution, with special reference to wetlands.
A total of 155 potential roost sites were checked: natural or artificial underground sites (11%), bridges and boat basins (25%), churches (36%), cemeteries (12%) and other buildings (16%). Underground sites were visited both in summer and winter, the other sites only in summer. Mist-netting was performed in wetlands at sites located in the southern, central and northern parts of the lake area. Additional data were obtained by acoustic surveys and from the finding of dead or injured bats.
We recorded at least 18 species and 79 roosts. *Pipistrellus kuhlii* and *P. pipistrellus* were the species most frequently observed roosting in buildings; *Myotis daubentonii* was the commonest species in bridges and boat basins. Such species were also the most frequently caught in mist-netting sessions.
Three winter roosts (each used by 1-10 bats) and a nursery site used by species of major conservation concern (Habitats Directive, Annex II) were found. Annual counts of the maternity colony varied from 694 to 919 bats aged $\geq$ 1 year, mainly *M. capaccinii*, marginally (about 50) *M. blythii* and *M. myotis*. At present, this is the only known site of occurrence for *M. capaccinii* in Piedmont.
Rhinolophus ferrumequinum was recorded only once (a single hibernating individual). Old guano dumps referable to the species were discovered in five buildings, now abandoned, suggesting it was formerly more common. *R. hipposideros* is probably locally extinct, or very close to extinction. The species, never recorded in the survey, was deemed very common and widespread in Piedmont in the first half of last century.

Key words: Bats, Chiroptera, roost, conservation, Lake Maggiore, Italy

RIASSUNTO - Fra il 1999 e il 2005 è stata effettuata un'indagine chirotterologica lungo la sponda piemontese del Lago Maggiore (province di Verbania e Novara, Italia nord occidentale), al fine di raccogliere dati sulla distribuzione delle specie, con particolare riferimento a quelle presenti nelle zone umide.
Sono stati ispezionati 155 potenziali siti di rifugio: cavità ipogee naturali e artificiali (11%), ponti e darsene (25%), edifici ecclesiastici (36%), cimiteri (12%) e altri edifici (16%). Le cavità ipogee sono state ispezionate sia in inverno sia in estate, gli altri siti solo in estate. Catture notturne con *mist-net* sono state effettuate presso zone umide localizzate nelle parti meridionale, centrale e settentrionale del lago. Ulteriori dati sono stati ricavati da rilievi

bioacustici e dal ritrovamento di esemplari morti o in difficoltà.
È stata rilevata la presenza di almeno 18 specie e 79 siti di rifugio. *Pipistrellus kuhlii* e *P. pipistrellus* sono risultate le specie più frequentemente osservate in *roost* all'interno di edifici; *Myotis daubentonii* quella rinvenuta più comunemente in ponti e darsene. Le tre specie citate sono risultate quelle più frequentemente catturate nelle zone umide.
Relativamente alle specie di particolare interesse conservazionistico (Allegato II Direttiva Habitat) sono stati rilevati 3 siti frequentati in inverno da 1-10 esemplari ciascuno e una *nursery*. Censimenti annuali della colonia riproduttiva hanno portato a rilevare da 694 a 919 individui di età $\geq$ 1 anno, prevalentemente riferibili a *M. capaccinii*, marginalmente (circa 50 individui) a *M. myotis* e *M. blythii*. Attualmente questo è l'unico sito di presenza noto per *M. capaccinii* in Piemonte.
La presenza di *Rhinolophus ferrumequinum* è stata rilevata una sola volta (un singolo esemplare ibernante), ma accumuli di vecchio guano riferibili alla specie sono stati rinvenuti in 5 edifici, attualmente abbandonati, a testimonianza di come la specie fosse in passato più comune nell'area. Per *R. hipposideros* si sospetta l'estinzione locale o una rarefazione prossima all'estinzione: la specie, non rilevata nel corso dell'indagine, era segnalata come molto comune e ampiamente distribuita in Piemonte nella prima metà del secolo scorso.

Parole chiave: Chirotteri, *roost*, conservazione, Lago Maggiore, Italia

INTRODUCTION

Information on the bat fauna of Lake Maggiore Piedmont shore (NW Italy) relied on research papers and museum specimens dating back to the end of the 19th and the first half of the 20th century. It was based on just a few specimens of *Myotis capaccinii*, *M. blythii* and *M. blythii vel myotis* (Gulino, 1938; Lanza, 1959; Sindaco *et al*., 1992*)* and the record of a roost of *M. blythii vel myotis* (Fatio, 1869).
To achieve up-to-date information, mandatory to develop effective conservation strategies, during 1999-2005 a survey was carried out, in the context of Interreg II and III Italy-Switzerland Projects, by the Lake Maggiore Park and Natural Reserve Management Institution. For the first time the presence in Piedmont of *Plecotus macrobullaris* was determined, reported by Trizio *et al*. (2003). The present paper reports other results of the survey.

STUDY AREA

The survey was carried out in Novara and Verbania provinces (Piedmont, NW Italy, Fig. 1) and covered an area averaging 2.5 km in width from the western shore of Lake Maggiore (one of the three major prealpine lakes of Northern Italy), also enclosing the small islands in the Italian part of the lake (Borromee Islands, Cannero Castles).
The area is located in the Insubric ecogeographical region (De Biaggi *et al*., 1990), characterised by a high precipitation rate (mean annual values from 1400 to 2000 mm, moving northwards along the lake shore towards the Swiss border, Biancotti *et al*., 1998), high atmospheric humidity and mild winter temperatures, thanks to the presence of the water body.

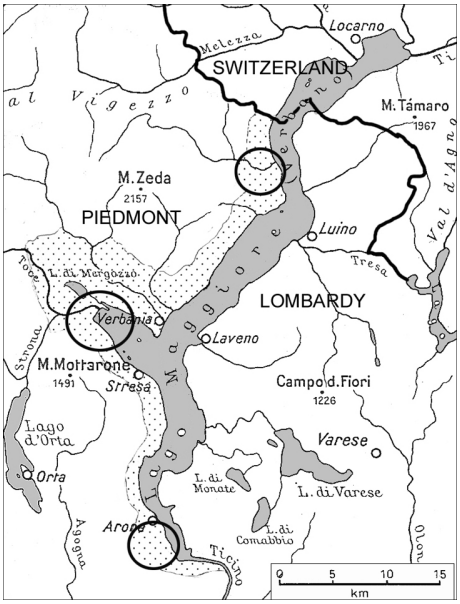


Figure 1 - Study area (dotted). Circles identify mist-netting wetland areas.

An almost uninterrupted series of inhabited areas is present along the lake shore (of these Verbania and Arona are the major towns, with approximately 30000 and 15000 inhabitants respectively), interspersed with monumental villas and wide gardens. Several species typical of the Mediterranean flora have spread from the gardens to the spontaneous vegetation of the slopes, dominated by chestnut (*Castanea sativa*) coppices and mixed broadleaf woods, where the beech (*Fagus sylvatica*) is the prevalent species in wet and cold zones.

Lake Maggiore is fed by several mountain streams with pebble riverbeds and by the River Toce, that near the lake has a slow and meandering course with a muddy riverbed. At its confluence, approximately at the middle of the lake shore, the IT1140001 SCI "Fondotoce" includes an important stand of *Phragmites australis* together with relict patches of a hygrophilous forest dominated by *Salix alba* and *Populus alba*.

Other SCIs are present in the southern part of the area, namely the reed stands near the town of Dormelletto (SCI IT1150004 "Canneti di Dormelletto") and the ponds and bogs with *Querco-carpinetum* patches near Mercurago di Arona (SCI IT1150002 "Lagoni di Mercurago").

There are few cave habitats in the area. Mount Massone (Ornavasso, Verbania) is the wider karstic massif, caves totalling 2150 m in length, a third of which has been artificially created by marble extraction. The only other cave extending for more than 500 m (Cà d'la Cusc, S. Bernardino Verbano, Verbania) is in the Val Grande National Park; other minor caves are located near Arona, Mergozzo and Ornavasso (Cella and Ricci, 2004). Several artificial underground sites are present, mainly World War I artifacts connected to the Cadorna Line fortifications (Viviani and Corbella, 2000).

Mist-netting sessions in wetland (the lake shore itself, ponds, streams and reed stands) were carried out in three different areas, in the northern, central and southern part of the lake area, at elevations ranging from the lake shore (195-200 m a.s.l.) up to 300 m. In these three areas the three SCIs mentioned above are located.

Other survey techniques were applied in the whole study area, from 200 to 500 m a.s.l. and, marginally, at higher elevations up to 1300 m, to take into account all the known significant caves present to 7.8 km from the lake.

METHODS

1. Survey techniques

Mist-netting: bats in flight over water bodies were mist-netted in three areas (southern, central and northern part of the lake, Fig. 1). Three to four mist-netting sites were utilized in each area. In each site, nets for an average length of 60 m were placed, continuously monitored by trained

personnel and operated for an entire night or in some cases until midnight. Since during several nights, catching success was negatively influenced by weather. In order to achieve a constant surveying effort, sessions were repeated to obtain at least 10-11 successful surveys for each area (approximately 7 all-night and 3 to 4 dusk-to-midnight sessions), equally distributed during the summer months.
All bats caught were measured and other relevant observations useful for determination were recorded, then they were released at mist-netting sites. All surveys were carried out according to the good practice and survey methods outlined by Agnelli *et al*. (2004).

Roost inspection: 155 sites were identified as potential roosting sites and inspected: caves and main artificial underground sites (11%), bridges and boat basins accessible for inspection (25%), most of the churches (36%) and cemeteries (12%), and other buildings (16%). Caves were inspected both in summer and in winter, the other sites were surveyed in summer only.
For each site, all inner spaces (rooms, garrets, cellars, etc.) and accessible cavities were inspected. Bat occurrence, present or recent, was ascertained by the finding of fresh droppings or direct observation of bats. When necessary for a precise identification of the roosting species, mist-netting and ultrasound recordings were performed during bat emergence at dusk. Since captures were limited to a low number of individuals, it was not always possible to exclude the occurrence of other bat species, particularly for larger colonies. Moreover, during mist-netting sessions carried out in the vicinity of some roosts, but not directly at their entrances, species different to those recorded in the roosts were caught. Lacking a sure association with the roosts, such species were only considered for the general species inventory and not for roost characterisation. Hibernating bats were observed from afar, avoiding any manipulation. For this reason their identification to species level was not always possible.
Counts were performed inside roosts or during bat emergence at dusk. Species emerging when light was still sufficient were visually counted (*Pipistrellus* spp., *Eptesicus serotinus*), whereas other species were counted from videotapes recorded using a thermal camera (FLIR Systems PM 545 PAL) or highly sensitive video cameras (Sony CCD TRV410, Sony DCR PC9E) in conjunction with an infra-red light source. Bat counts lasted until emergence end or when the number of bats re-entering the roost was significantly greater than that of bats leaving. If the roost was accessible, a visual or photographic count of bats remaining inside was made, and the result added to the number of bats that had left. Maternity colonies were censused during the perinatal period, before newborn bats were able to leave the roost, in order to distinguish and count only individuals $\geq$ 1 year, hereinafter designed as "adults". For the same reason counts inside the roost were performed without considering newborn bats.
Old droppings and other signs of bat occurrence, not indicating recent presence, were recorded as evidence of former roost occupancy.

Other methods: preliminary bioacoustic surveys were carried out at mist-netting sites and near some roosts. Ultrasounds were recorded with a Pettersson Elektronik D240X ultrasound detector and stored in digital format (44100 Hz sampling frequency, 16 bit resolution) on a laptop computer. Calls were then analysed with BatSound 1.3.1 (Pettersson, 1999) and SonoBat 2.5 (DNDesign, 2004) softwares. Ultrasound recording and analysis, as well as species determination criteria were those suggested by Russo and Jones (1999, 2000, 2002) and by Waters *et al*. (1999).

Reference recordings, previously made from hand-released bats from Piedmont, were also used for species identification.
Due to the lack of standardisation of bioacoustic surveys and also to the low sampling effort, we preferred to derive only qualitative information about easily detectable species from bioacoustics, always excluding dubious or unclear cases. All *Eptesicus serotinus* recordings were always coupled with direct visual observation of animals in flight, in sufficient light conditions.
In Fondotoce Natural Reserve 13 woodcrete and 14 wooden bat boxes were placed in June 1999, and subsequently monitored twice a year, in late June and early September.
Random findings of dead or injured bats provided other useful data.

2. Species identification

Bats were identified according to Arlettaz *et al*. (1991), Schober and Grimmberger (1997) and Dietz and Von Helversen (2004). *Plecotus* species were genetically identified using wing membrane biopsies (Trizio *et al*., 2003). The cryptic species *Pipistrellus pipistrellus*/*P. pygmaeus* were discriminated by bioacoustic analysis as suggested by Russo and Jones (1999, 2000, 2002).
Hair found in old guano deposits inside the roosts were observed under an optical microscope and determined according to the keys by Pierallini *et al*. (2004) and through comparison with personal hair collections.
Roosts where no bats were found resting during the day, but showing presence of moth wings and fresh droppings identifiable as belonging to genus *Plecotus*, were classified as feeding roosts used by *Plecotus*.

RESULTS AND DISCUSSION

1. Species inventory and distribution

Surveys confirmed the presence of at least 18 bat species, two of them (*Nyctalus noctula* and *Tadarida teniotis*) exclusively recorded using bioacoustics (Tab. 1). Bat boxes proved useless, since only one record of bat occurrence was obtained, represented by a few droppings probably of *Pipistrellus* sp.
The inventory comprises all of the historically known species, among which is worth mentioning *Myotis capaccinii*, which has not been recorded in Piedmont since 1945 (Sindaco *et al*., 1992) and is considered extinct in Switzerland (Moretti *et al*., 2003).
On the basis of external characteristics (biometry, teeth morphology) a female bat was identified as *Myotis mystacinus,* whereas another female was determined as *Myotis mystacinus vel brandtii*: body size excluded *M. alcathoe* in both cases. Tissue samples were taken from both individuals for future genetic analysis.
Myotis daubentonii, *Pipistrellus kuhlii*, *P. pipistrellus*, *Hypsugo savii*, *Eptesicus serotinus, Tadarida teniotis* and genus *Plecotus* can be assumed to occur in the whole study area, since they were recorded frequently and/or for uniformly distributed localities of the entire area. Recorded localities of rare or otherwise difficult-to-record species are listed in Table 2.
The species inventory comprises all species which are known to occur in the Swiss part of Lake Maggiore, with the exception of *Myotis bechsteinii* and

Table 1 - *Taxa* recorded in the study area. Numbers refer to captured or found dead bats. B = bioacoustics; G = genetically identified; I = found injured; S = skeleton; T = food remains, guano and/or other tracks; W = complete specimen.

Taxa	Sighted/caught at roost sites (N=72)	Mist-netted in wetland (N=104)	Found dead (N=32)	Otherwise recorded
Rhinolophus ferrumequinum	√		S	T
Myotis blythii	√		S	
Myotis capaccinii	√		S	
Myotis daubentonii	√	√		
Myotis emarginatus	√			
Myotis myotis	√		S	
Myotis mystacinus		√		
Myotis mystacinus vel brandtii	√			
Myotis nattereri		√	W	
Pipistrellus kuhlii	√	√	W	
Pipistrellus nathusii		√		
Pipistrellus pipistrellus	√ (plus B)	√ (plus B)		B
Nyctalus leisleri		√	W	B
Nyctalus noctula				B
Hypsugo savii				I, B
Eptesicus serotinus	√	√	W	B
Plecotus auritus		√ (plus G)		
Plecotus macrobullaris		√ (plus G)		
Plecotus spp.	√	√	W	T
Tadarida teniotis				B

Eptesicus nilssonii, recorded sporadically and judged as very rare in the same area, and of *Pipistrellus pygmaeus*, whose distribution and demography are still poorly known, although preliminary observations would suggest it not to be rare (Moretti *et al*., 2003). A similar comparison with neighbouring Swiss areas is not possible for *Plecotus* species, since data from Canton Ticino were collected before the description of *P. macrobullaris*.

In Campo dei Fiori Regional Park (Varese province, Lombardy), the only other neighbouring area (about 10 km away) for which recent chiropterological data are available, the presence of the same *Plecotus* species recorded in our study area is reported (Martinoli, 2005). The other species recorded in the Park (Fornasari *et al*., 1999; A. Martinoli, pers. comm.) were all observed also in our study area, except

Table 2 - Sampling locations of species less frequently recorded. * Recorded by acoustic surveys only. ***Plecotus* occurrence was recorded frequently, but only a few individuals were genetically identified, so data referred to each species are scarce.

Species	Site	Location (East, North; meters; UTM zone 32N CRS)
Rhinolophus ferrumequinum	Ornavasso	453613, 5091088
Myotis blythii	Stresa	463481, 5082624
Myotis myotis	Stresa	463481, 5082624
Myotis blythi vel myotis	Cannero riviera	472701, 5096676
Myotis capaccinii	Stresa	463481, 5082624
Myotis emarginatus	Cannero riviera	472701, 5096676
Myotis mystacinus	Cannobio	474451, 5101085
Myotis mystacinus vel brandtii	Cambiasca	465008, 5089764
Myotis nattereri	Cannobio	476489, 5101853
Pipistrellus nathusii	Dormelletto	467210, 5065397
Nyctalus leisleri	Verbania Cannobio	461447, 5087603*; 458405, 5087038* 474451, 5101085*
Nyctalus noctula	Cannobio Mergozzo	476489, 5101853*; 474451, 5101085* 458688, 5088232*
*Plecotus auritus***	Arona Verbania	465328, 5064664 465221, 5085917
*Plecotus macrobullaris***	Arona Premeno	465328, 5064664 468684, 5091913

for *Myotis bechsteinii*, recorded several times in Campo dei Fiori (probably due to the high number of caves) and *Rhinolophus hipposideros*, recorded only once by ultrasound detector. The presence of *Miniopterus schreibersii*, reported for Campo dei Fiori on the basis of ultrasound detection and the finding of a skull inside a cave (Fornasari *et al*., 1999), has not been confirmed by further investigations (A. Martinoli, pers. comm.).

Both *M. bechsteinii* and *P. pygmaeus* could have been missed by our surveys. The same hypothesis can be made for *Barbastella barbastellus*, a rare species which is known to occur in uniformly distributed localities of Piedmont and Aosta Valley regions (Sindaco *et al*., 1992; Baratti *et al*., 1994).

The presence of *Eptesicus nilssonii* is possible but only occasional, the study area being at the limit of the species range; the same consideration could be made for *Vespertilio murinus* and *Miniopterus schreibersii* (Mitchell-Jones *et al*., 1999).

The absence of records for *Rhinolophus hipposideros* must be related to this species decline, particularly in central

Europe (Ohlendorf, 1997), Switzerland (Bontadina *et al*., 2000) and Northern Italy (Sindaco *et al*., 1992; Bon *et al*., 1995; Prigioni *et al*., 2001). In Canton Ticino *R. hipposideros* is considered extinct (Moretti *et al*., 2003) and in Piedmont, where the species was reported as common and widespread in the first half of the last century (Gulino, 1938) recent records are almost exclusively related to the southern part of the region (Debernardi *et al*., 2003). Considering that the species is sedentary (Rodrigues *et al*., 2002) and that the nearest known viable populations occur in central Switzerland (Bontadina *et al*., 2000) and in southern Piedmont (Toffoli, 2002; Debernardi *et al*., 2003), if the species still occurs in our study area, it is facing a very high risk of local extinction.

2. Preliminary characterisation of the wetland bat fauna

In the three mist-netting areas 97 individuals have been caught, belonging to 10 species: *P. kuhlii* (37%), *P. pipistrellus* (26%), *M. daubentonii* (18%), *Plecotus* spp. (*P. auritus*, *P. macrobullaris* and some individuals not determined at species level: 14%) and, accounting for 1% each, *Myotis mystacinus, M. nattereri*, *P. nathusii*, *N. leisleri* and *E. serotinus*. Due to the scarcity of information on its ecology, it is worth reporting that *P. macrobullaris* has been caught while foraging in sintopy with *P. auritus*, in the southern part of the lake.

The low number of captured animals (possibly related to the local abundance of water bodies and consequent dispersion of bats foraging over them) allows us to make only qualitative assumptions about the most frequent species (Fig. 2), also considering that acoustic recording revealed the presence in the same areas of other species (*H. savii* and *T. teniotis* in the southern area; *H. savii*, *E. serotinus* and *T. teniotis* in the central area; *H. savii*, *N. leisleri*, *N. noctula* and *T. teniotis* in the northern area).

Synanthropic species predominated, *P. kuhlii* and *P. pipistrellus* accounting for 59-68% of the total catches in each area. At a preliminary level, similarity in species composition seems to be higher between southern and central sites, where *P. kuhlii*, *Plecotus* spp., *P. pipistrellus* and *M. daubentonii* were caught in decreasing order of abundance.

In the northern mist-netting area *M. daubentonii* and *P. pipistrellus* were the most frequently caught species, as recorded in the nearby wetland of Bolle di Magadino, near the Swiss shore of Lake Maggiore (Moretti and Maddalena, 2001).

3. Roosts

Recent occupation by bats has been verified for 68 sites (44% of total inspected). For all sites except caves (also visited in winter), the biological role recorded was constrained by the period (summer) when surveys were carried out. Two sites were positively identified as hibernacula, one site was used both in winter and summer, while for 65 sites summer use was determined. In some cases, all relating to roosts in buildings, a single site hosted more than one roost. In total, 79

roosts were identified (Tab. 3).
For 36 summer roosts, bat occurrence was recorded only from droppings, mostly referable to a single or a few animals. For the others the most frequently observed species were *Pipistrellus kuhlii* and *P. pipistrellus* inside buildings and *Myotis daubentonii* in bridges and boat basins (Fig. 3).

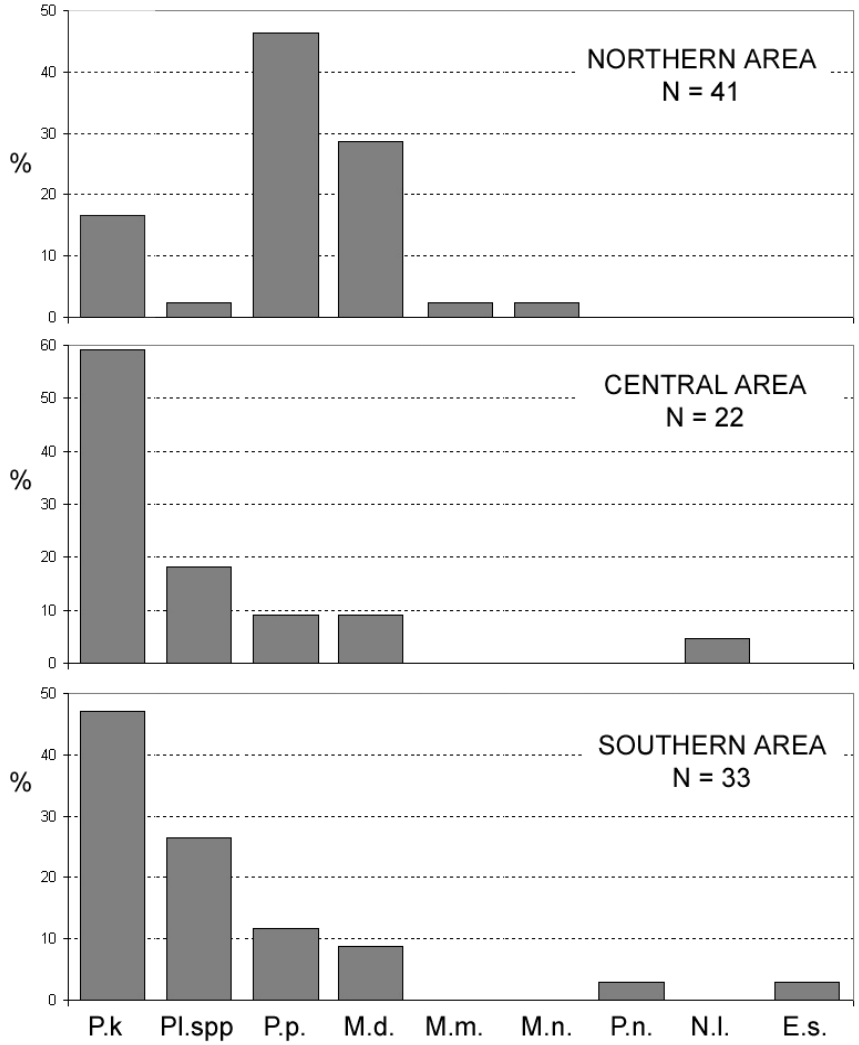


Figure 2 - Percentage composition of captures for each mist-netting wetland area. P.k. = *Pipistrellus kuhlii*; Pl.spp. = *Plecotus* spp.; P.p. = *Pipistrellus pipistrellus*; M.d. = *Myotis daubentonii*; M.m. = *Myotis mystacinus*; M.n. = *Myotis nattereri*; P.n. = *Pipistrellus nathusii*; N.l. = *Nyctalus leisleri*; E.s. = *Eptesicus serotinus*.

Table 3 - Results of inspection of potential roost sites, with respect to current or recent use by bats ("positive").

Site type	No. of visited sites	No. of positive sites	No. of roosts
Churches (and bell towers)	56	30	35
Other buildings	25	18	22
Bridges	21	5	5
Boat basins	18	4	4
Cemeteries	18	6	8
Underground sites	17	5	5
Total	155	68	79

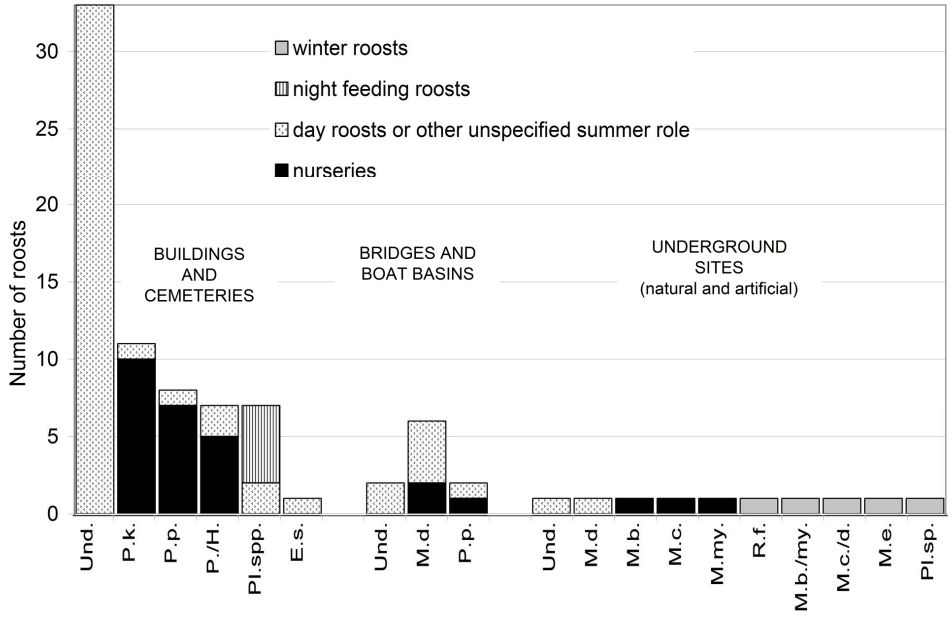


Figure 3 - Number and type of the roosts in use or recently used by bats. Und.= undetermined bats; P.k. = *Pipistrellus kuhlii*; P.p. = *Pipistrellus pipistrellus*; P./H. = *Pipistrellus vel Hypsugo*; Pl.spp. = *Plecotus* spp.; E.s. = *Eptesicus serotinus*; M.d. = *Myotis daubentonii*; M.b. = *Myotis blythii*; M.c. = *Myotis capaccinii*; M.my. = *Myotis myotis*; R.f. = *Rhinolophus ferrumequinum*; M.b./my. = *Myotis blythii vel myotis*; M.c./d. = *Myotis capaccinii vel daubentonii*; M.e. = *Myotis emarginatus*.

Among these species the largest maternity colonies were recorded for *P. pipistrellus* (Fig. 4), but their monitoring was complicated by roost switching behaviour, which caused the sudden "disappearance" of some colonies, even in perinatal periods. Maximum colony size (251 adult individuals) is slightly higher than that reported for Canton Ticino (225 individuals, Pierallini and Moretti, 2002) and higher than any previously recorded value for Italy (129 individuals), even though it is worth pointing out that data for Italy are still scarce and fragmented (GIRC, 2004).

P. kuhlii breeding colonies contained fewer individuals than the former species, as reported also by Pierallini and Moretti (2002). The maximum number of adults counted was 81, less than those already reported for Canton Ticino (100 individuals, Pierallini and Moretti, 2002) and Italy (127 individuals, GIRC, 2004). Also in this case it is worth noting that data for Italy are still scarce: being located in a more central position than Switzerland in the *P. kuhlii* range (Mitchell-Jones *et al.*, 1999), Italy should host larger colonies.

It must be noted that, for some colonies attributed to a single *Pipistrellus* species it was not possible to exclude the occurrence of other bat species (see Methods). Nevertheless, this would be in contrast with results for Canton Ticino where, after thorough investigations, roosts with more than one species of *Pipistrellus* or *Hypsugo* were never recorded (Pierallini and Moretti, 2002).

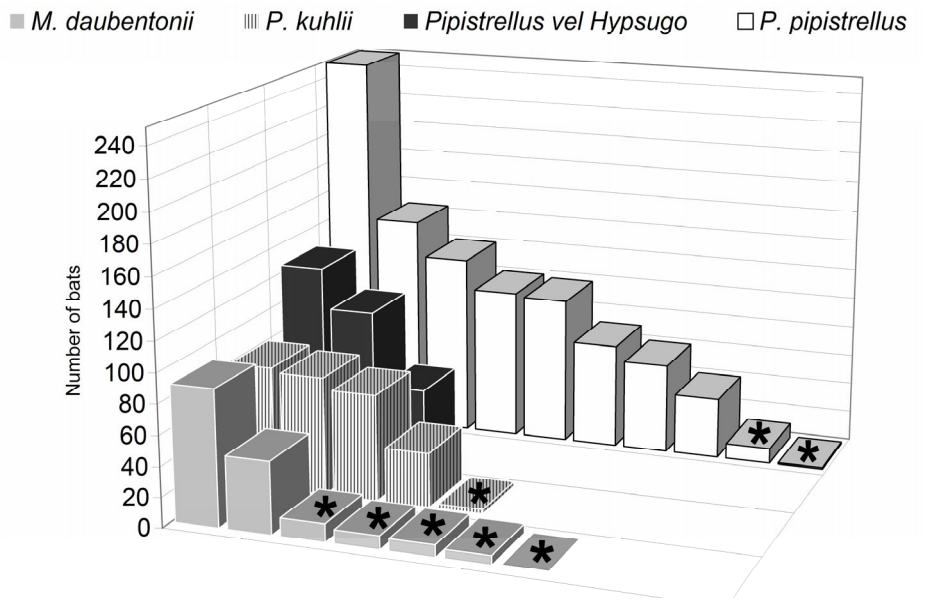


Figure 4 - Results of censuses carried out at roosts, for most frequently encountered species. Each bar represents a nursery or (*) a summer roost used for day-resting and, possibly, other unknown reasons. All the values refer to ≥1 year old bats.

Some colonies of small synanthropic bat species for which a clear species identification has not been possible were cautiously attributed to the *Pipistrellus vel Hypsugo* (Fig. 4), although their belonging to *Pipistrellus* genus is more probable since our general results suggest a lower abundance of *H. savii*, recorded in the area only by ultrasound surveys and by the rescue of an injured individual (Tab. 1). Moreover, in Canton Ticino *H. savii* has been reported as scarcely using buildings as summer roosting sites (Pierallini and Moretti, 2002).

Only 2 *M. daubentonii* roosts, both in bridges, could be identified as nurseries. Recorded numbers of adult bats, 48 and 90, probably under-estimated real colony sizes. Roost switching behaviour and the subdivision of colonies into small clusters using several different cavities inside bridges made counts particularly difficult.

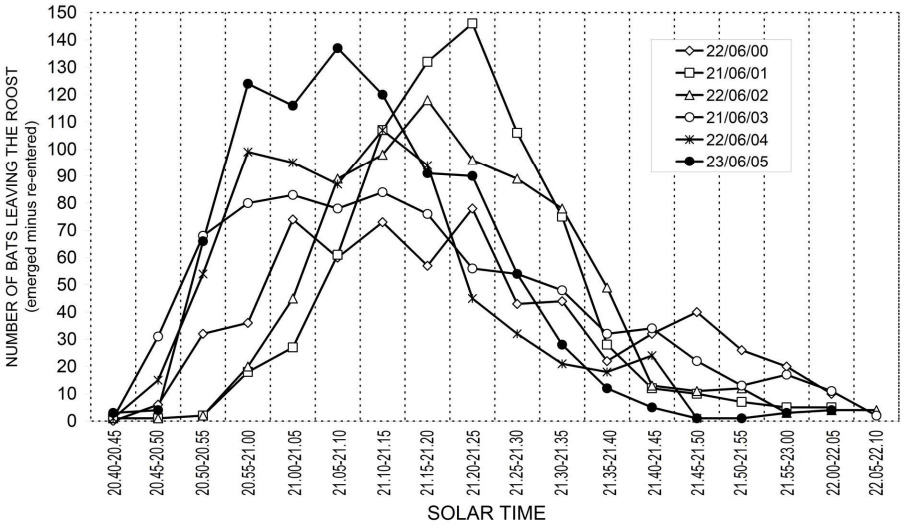
A single maternity colony belonging to species listed in Annex II of the Habitats Directive was found, roosting in a cave-like artificial underground site, beneath Isola Bella gardens. The roost was that cited by Fatio, who visited it in 1865, stating (from the amount of guano) that the colony must have occurred there for many years (Fatio, 1869). Due to the fact that the site was never used by man, it is highly probable it has been used by bats for at least 150 years.

Annual censuses recorded from 694 to 919 adults (Fig. 5), attributed to *M. capaccinii* and, marginally (about 50 individuals), to *M. blythii and M. myotis*. Identification of the three species was based on captured individuals (1 *M. blythii* and 36 *M. capaccinii*) and skulls found in the roost (3 *M. blythii*, 5 *M. myotis* and 2 *M. capaccinii*). All the visual observations and photographs of the colony were consistent with the same species, nevertheless, due to the large number of bats present, it is not possible to exclude occurrences of other species.

During counts a conspicuous number of bats moved in and out the roost repeatedly (for light sampling and re-entering after short foraging periods) but this did not impede counts from videotapes. If any bias is present in census results this is minor and related to difficulties in estimating the number of bats remaining in the roost, that in some cases was rather high (Fig. 5).

The colony seemed to increase in number during the survey period, but a longer run of data is needed to establish whether an upward trend is sustained. Performing more counts per year would be useful too, but logistical problems (reaching the island during the night; obtaining permission from the owners of the site) render it problematic.

The conservation value of the colony is noteworthy: it represents one of the biggest known maternity colonies of *M. capaccinii* in Italy (GIRC, 2004) although located at the extreme of the known range (Mitchell-Jones *et al.*, 1999) for this endangered species (Hutson *et al.*, 2001). For these reasons, the Isola Bella roosting site has been highlighted for inclusion in the nearby SCI IT1140001 “Fondo-toce”. Occasionally, the Isola Bella roost is used also in winter: 10 *M. capaccinii vel daubentonii* were found during a visit in January 2005, while



Census date	Bats exited	Bats inside roost	Colony size
22 June 2000	653	41	694
21 June 2001	743	7	750
22 June 2002	733	25	758
21 June 2003	790	37	827
22 June 2004	692	84	776
23 June 2005	859	60	919

Figure 5. Counts at Isola Bella roost. Colony size is determined adding counts of bats emerged at dusk (in the chart the number of bats which left the roost every 5 minutes), performed using a thermal camera, to the number of bats remaining inside the roost, counted by sight or from photographs. All the values refer to ≥1 year old bats.

in other inspections in January, carried out in different years, no bat was recorded.

Two sites were found to be regularly used as hibernacula: a mine, where a single *R. ferrumequinum* was found, and an artificial underground site belonging to Cadorna Line fortifications, where a *M. blythii vel myotis*, 2 *M. emarginatus* and a *Plecotus* sp. were observed. The latter site recently underwent work aimed at facilitating the visits, including consolidation of the vaults and installation of automatic lighting equipment. Since surveys were made only after such activities, it is not known whether in the past the site hosted more bats than now, and if the work had any impact on them. Probably in autumn some of the bats frequenting the study area move towards the nearby karstic area of Campo dei Fiori, where more than 130 known caves, for a total length of 25 km, supply plenty of winter roosting sites (Fornasari *et al.*, 1999).

Sometimes, surveys in deserted buildings

Table 4 - Sites occupied in the past by bat species in Annex II of Habitats Directive and now deserted.

Site	Record type	Factors potentially impacting on colonies
Prepositural Church of Baveno (VB)	Verbal report of a large colony hanging from the bell-tower ceiling until restoration works. Signs still present on the ceiling; floor has been cleaned.	Restoration works in the middle of the 90s. External lighting of the building.
Mount Orfano Church, Mergozzo (VB)	Verbal report of bats hanging from the bell-tower ceiling until restoration works. At present no signs, but the site has been cleaned.	Restoration works in the middle of the 80s. External lighting of the building.
Dal Pozzo Castle, Oleggio Castello (NO)	Verbal report of many bats hanging from the garret ceiling. At present no signs, but the site has been cleaned.	Potential entrances closed in the 90s.
S. Maria della Guardia Church, Ornavasso (VB)	Verbal report of a conspicuous colony in the garret. Guano dumps still present, referable to a large *R. ferrumequinum* maternity colony.	Restoration works during all the 80s.
S. Carlo Church, Arona (NO)	Medium quantities of old guano and skeletal remains of *R. ferrumequinum* in the garret, notwithstanding the site has been cleaned.	Restoration works and entrance occlusion in 1990. External lighting of the building.
Parochial Church, Oggebbio (VB)	Medium quantities of old guano of *R. ferrumequinum*.	Unknown.
Parochial Church, Cannero (VB)	Large quantities of old guano of *R. ferrumequinum*, probably referable to a maternity colony.	Restoration works and entrance occlusion. External lighting of the building.
Parochial Church of Traffiume, Cannobio (VB)	Small quantities of old guano of *R. ferrumequinum* and medium quantities of guano referable to unidentified species.	Restoration works in 80s and 90s.

provided evidence of formerly extant colonies. By interviews, it was possible to assume three monumental buildings had hosted in the past colonies of Annex II bat species. Skeletal remains and droppings referable to *R. ferrumequinum* were found inside five churches, for two of which the amount of guano still present suggested their former use as maternity colonies (Tab. 4). Restoration works, carried out without considering bat presence, could have contributed to the disappearence of such colonies. These records, together with the single recording of *R. ferrumequinum* mentioned above, suggest the species underwent a severe decrease in the area, as reported for Canton Ticino (Moretti *et al*., 2003), for other areas of Piedmont and Aosta Valley (Sindaco *et al*., 1992; Debernardi *et al*., 2003) and, more generally, for several European countries (Ransome and Hutson, 2000). Results confirm the need for further investigations, aimed in particular at the identification and protection of still unknown colonies which could play a relevant role in bat conservation.

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