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THE ITALIAN BAT ROOST PROJECT: A PRELIMINARY INVENTORY OF SITES AND CONSERVATION PERSPECTIVES

GRUPPO ITALIANO RICERCA CHIROTTERI (GIRC)

c/o Dipartimento Ambiente-Salute-Sicurezza, Università degli Studi dell'Insubria, Via J. H. Dunant 3 I-21100 Varese Italy
Corresponding author: Adriano Martinoli, Dipartimento Ambiente-Salute-Sicurezza, Università degli Studi dell'Insubria Via J. H. Dunant 3 I-21100 Varese Italy
E-mail: adriano.martinoli@uninsubria.it

ABSTRACT - The Italian bat roost project, launched by the Italian Chiroptera Research Group (GIRC), aims to develop a constantly updated national database of bat roosts. Short-term objectives are to inventory roosts and identify the most important ones from a conservation perspective, in order to set priorities for management actions. Published records and field data from 1990 onwards are filed.

To date, the database contains 1243 records from 750 roosts, covering 352 10x10 km UTM grid-cells. Among roosts, 167 were used for hibernation (S roosts), 244 for breeding (R roosts) and 431 as either temporary roosts or for unknown needs, not verified or not considered in the survey (X roosts).

Roosting sites occurred in buildings (45.1%), caves (35.3%), artificial underground sites (10.3%), trees (5.5%), bridges (2.1%), bat boxes (1.3%) and rocky cliffs (0.4%).

At least 29 species were found, and the number of roosts per species ranged between 1 and 261.

S and/or R roosts fulfilling certain combinations of number of species and individuals or having at least 50 individuals of species cited in Annex II of the 92/43/EEC Directive (excluding *Miniopterus schreibersii*, adding *Myotis punicus*) were classified as sites of special conservation interest. When meeting at least one such conditions, type X roosts that were not classified as either S or R, were considered potential sites of special conservation interest, for which further data collection is recommended.

In all, 97 roosts of special conservation interest were identified: 30 S roosts, 60 R roosts and 7 roosts selected for both hibernation and breeding. 20 X roosts were identified as potential sites of special conservation interest.

For at least 93.7% of roosts, factors potentially harming the bats were documented, particularly people access to the roost, and renovation of buildings used as a roost. In almost two thirds of such cases it was judged that conservation was not ensured.

Only 52.6% of roosts selected for their special conservation interest were located within protected areas, including areas proposed as Sites of Community Importance (92/43/EEC Directive). The situation is particularly remarkable in Sardinia, which hosts 24.7% of the selected sites of national importance, and only 29.2% of these are within protected areas.

The results highlight major knowledge gaps, from both the geographical and species perspectives. There is an urgent need to encourage roost surveying, activate roost protection mea

surements and initiate demographic monitoring, giving priority to the roosts identified as sites of special conservation interest.

Key words: Chiroptera, roost, bat conservation, Italy

RIASSUNTO - ***Progetto* Roost *Chirotteri Italia: inventario preliminare dei siti e indicazioni sulle strategie di conservazione.*** Il Progetto *Roost* Chirotteri Italia, avviato dal Gruppo Italiano Ricerca Chirotteri nel 1999, si propone la realizzazione di una banca dati nazionale dei siti di rifugio utilizzati dai chirotteri. Obiettivo a breve termine è stilare un inventario dei *roost* e individuare quelli di maggiore importanza conservazionistica, ai fini di un'attivazione prioritaria di interventi concreti di tutela.
L'archivio considera i dati rilevati a partire dal 1990, comprendendo tutte le informazioni ricavabili dalla letteratura e dati inediti. Sono state finora archiviate 1243 segnalazioni, relative a 352 particelle UTM 10 x 10 km e 750 *roost*, dei quali 167 utilizzati per lo svernamento (*roost* S), 244 per il parto e l'allevamento della prole (*roost* R) e 431 per il riposo diurno ed eventualmente altre funzioni biologiche non accertate o non considerate nell'ambito dell'indagine (*roost* X).
I siti sono rappresentati da: edifici (45,1%), grotte (35,3%), ambienti ipogei artificiali (10,3%), alberi (5,5%), ponti (2,1%), *bat box* (1,3%) e pareti rocciose esterne (0,4%).
La frequentazione è complessivamente riferibile ad almeno 29 specie. Il numero di *roost* noti per specie varia da 1 a 261.
Vengono proposti criteri di selezione per la valutazione dell'importanza, a livello nazionale, dei diversi siti: i *roost* S e/o R che presentano determinate combinazioni di numero di specie e numero di esemplari presenti o che ospitano almeno 50 esemplari di specie in allegato II Direttiva 92/43/CEE (con l'esclusione di *Miniopterus schreibersii* e l'aggiunta di *Myotis punicus*) sono considerati siti di speciale interesse conservazionistico. I *roost* X per i quali non è stata accertata la funzione R e/o S e che soddisfano gli stessi criteri, vengono considerati potenziali siti di speciale interesse conservazionistico, da sottoporre prioritariamente a ulteriori accertamenti chirotterologici.
Complessivamente risultano individuati come siti di speciale interesse conservazionistico 30 *roost* S, 60 *roost* R e 7 *roost* selezionati per entrambi i ruoli S ed R. Sono inoltre individuati come potenziali siti di speciale interesse conservazionistico 20 *roost* X.
Per il 93,7% dei *roost* complessivamente inventariati risultano segnalati fattori d'interferenza con la chirotterofauna (in particolare: afflusso antropico e, nel caso dei *roost* in edifici, lavori sugli immobili). Le garanzie di conservazione di tali siti e della chirotterofauna associata sono giudicate insoddisfacenti in quasi due terzi dei casi.
Solo il 52,6% dei *roost* selezionati come siti di speciale interesse conservazionistico risulta inserito in aree protette (pSIC compresi). Particolarmente degna di nota la situazione della Sardegna: tale regione ospita il 24,7% dei siti di speciale interesse conservazionistico complessivamente rilevati, ma solo il 29,2% di essi è inserito in aree protette.
Il quadro conoscitivo delineato appare lacunoso. E' necessario approfondire l'indagine, nonché attivare interventi urgenti di tutela e protocolli di monitoraggio demografico, con priorità nei confronti dei siti di speciale interesse conservazionistico.

Parole chiave: Chiroptera, *roost*, conservazione, Italia

INTRODUCTION

The first data on bat distribution in Italy were provided by Gulino and Dal Piaz (1939), followed by the detailed monograph of Lanza (1959).
Recently, a database featuring records of 10,000 species among terrestrial invertebrates and vertebrates (including bats), based on the existing literature as well as museum collections, was developed by the Ministero dell'Ambiente, Museo Civico di Storia Naturale di Verona and Università della Calabria (http://www.faunaitalia.it/ckmap/).
The study covers data up to 2002 but overlooks the information concerning current bat roosts. Some data refer to past situations, while most of the recent ones concern the species presence, with no details on the roosts occupied, roosting period and colony size.
Although some data on roosts are available in local publications, a nation-wide perspective is needed to evaluate the ecological significance of roosts and their conservation function. The need for a nation-wide survey is also highlighted by the fact that for most Italian bat species, locating and monitoring the major breeding and hibernation colonies constitutes the most effective way to assess trends in their conservation status, an objective explicitly addressed by recent law (92/43/EEC Directive; D.P.R. 357/1997 and subsequent modifications and riders, art. 7).
In 1998 many bat specialists founded the Italian Chiroptera Research Group (GIRC), as part of the Associazione Teriologica Italiana (A.T.It.) to encourage and coordinate studies and conservation actions of Italian bats. The first major project launched by the GIRC was the so-called Italian bat roost project (P.Ro.Ch.I.) aiming to develop a constantly updated national database of bat roosts. On the short-term it aims to list roosts and identify the most important ones from a conservation perspective, in order to set priorities for management actions. On the longer-term it aims to develop standardised monitor of bats in a sample of representative roosts to investigate the species demography and optimise conservation strategies.
The project has been started thanks to the voluntary collaboration of bat researchers and enthusiasts (Appendix).
This paper presents an analysis of the data obtained so far.

METHODS

1. Data collection

Apart from a few published records, most data were recorded in the field by the project collaborators. Data were collected in the period 1990-2003. Only direct observations of bats were considered.
In the database, each roost was identified by unique name and geographic data: council, province, UTM-grid (Military Grid Reference System, DMA, 1990) 10x10 and 50x50 km, elevation (m a.s.l.) and type (e.g. cave, mine, tree cavity). Each roost was also assigned from one to three 'biological roles': hibernation (S, used in the middle of the hibernation period, i. e. in December-January), breeding (R, used for parturition and/or young rearing, as verified by direct observation of lactating females with their young), other (X, including resting and mating sites, plus sites used for unknown reasons or those for which classification as S or R was uncertain). For each

roost, the maximum number of individuals per 'taxon' recorded for each biological role of the roosting site was noted; hence, for a given bat species in a roost the collected data were maximum three.
When possible, bats found in a roost were identified at the species level, otherwise they were attributed to a species group (e.g. *Pipistrellus pipistrellus vel pygmaeus*). Colony size was assessed by either counts or estimates, specifying the census technique used (visual inside the roost site, visual at dusk emergence, by photographs taken inside the roost, by video recording or via electronic counting devices at dusk emergence, and by capture).
Potential disturbing factors (e.g. people entering the roost, works affecting the site, forestry practices) were recorded, and roost conservation status was evaluated (answering questions such as: Is the conservation of the site guaranteed? Are management actions to be taken?).

2. Criteria to determine the importance of roosts

The criteria used to determine the importance of a roost (Tab. 1) were based on the analysis of the data recorded in the country so far and on the experience acquired in other countries (Moretti *et al.*, 2003; Nature Conservancy Council, 1989; Palmeirim and Rodrigues, 1993). Such criteria will have to be validated and improved when more information becomes available.
When meeting at least one of the criteria in Table 1, S and/or R roost types were classified as sites of special conservation interest, while type X roosts (those which not classified as either S or R), were considered potential sites of special conservation interest, for which further data collection is recommended.
The exceptions made for *Pipistrellus kuhlii*, *Hypsugo savii*, *P. pipistrellus* and *P. pygmaeus* (Tab. 1) were decided because of their abundance and wide distribution in Italy and/or their good adaptation to human-altered habitats; nevertheless, the scarcity of data so far included in the database (especially for *P. pipistrellus* and *P. pygmaeus,* generally referred to as a single taxon) and the lack of information on the role of the Italian populations for conservation at the global-scale, highlight that in the future the appropriateness of such exceptions will have to be verified.
A lower selection threshold (50 individuals, Tab. 1) was used for particular species, considered of major conservation concern. Because of the lack of adequate knowledge about the status of bat species in Italy as well as of the role of Italian populations for global conservation, this criterion was applied to the species cited in Annex II of the 92/43/EEC Directive, adding *Myotis punicus* (previously confounded with sibling species featuring in the annex; Ruedi and Arlettaz, in press) and excluding *Miniopterus schreibersii*. Although included in Annex II, the selection threshold adopted for the latter species relied upon a higher number of animals (according to the general criteria, 200 individuals in cases of monospecific colonies) as this species often congregates in large colonies.

RESULTS AND DISCUSSION

In all, 1243 records were collected from 750 roosts, covering 352 10x10 km UTM grid-cells. The area where most data were recorded is the north-west of Italy, whilst data are particularly scarce for Friuli-Venezia Giulia, Marche, Calabria and Sicilia (Fig. 1; Tab. 2).
Most roosts were recorded at underground sites (45.6%) and buildings (45.1%). The former were mainly used for hibernation, the latter for breeding (Fig. 2).
At least 29 species were found in roosts

Table 1 - Preliminary criteria used to select sites of special conservation interest (R and S roost types) and potential sites of special conservation interest (X roost types not classified as either S or R) .

No. species	Species	No. individuals	
≥ 4	All	≥ 50	GENERAL CRITERIA
3	All	≥ 100	
2	All except if both belong to: *P. kuhlii*, *H. savii*, *P. pipistrellus* and *P. pygmaeus*	≥ 150	
1	All except: *P. kuhlii*, *H. savii*, *P. pipistrellus* and *P. pygmaeus*	≥ 200	
≥ 1	*R. blasii, R. euryale, R. ferrumequinum, R. hipposideros, R. mehelyi, M. bechsteinii, M. blythii, M. capaccini, M. dasycneme, M. emarginatus M. myotis, M. punicus, B. barbastellus*	≥ 50	SPECIES OF MAJOR CONCERN

Figure 1. Distribution of roosts on 10x10 km UTM grid-cells.

(Tab. 3), representing all species recently recorded for Italy except some either rare or found only in some areas of the country (*Myotis brandtii*, *Vespertilio murinus*, *Plecotus sardus*) (Agnelli *et al.*, 2004).

The number of roosts per taxon ranged between 1 and 261. The species most frequently recorded were cave-dwellers (*R. ferrumequinum*, *R. hipposideros*), easy to spot thanks to their conspicuous roosting behaviour and carefully recorded by observers due to the often high conservation value (unlike house-dwelling species, e.g.: *P. kuhlii*, often overlooked in spite of their abundance). The species most rarely recorded were those difficult to survey since their roosts are easily overlooked, such as those roosting in tree holes (*M. bechsteinii*, *Nyctalus* spp., *P. nathusii*) and rock crevices (*T. teniotis*), species possibly rare in Italy for their biogeographic (*E. nilssonii*) or phenological characteristics

Table 2 - Number of roosts recorded in each region of Italy, classified according to their biological role. Note that S+R+X can be higher than the total number of roosts in a given region, because some roosts can show more than one biological role.

Region	Total	S	R	X
Abruzzo	44	1	36	9
Basilicata	5			5
Calabria	6	1	1	5
Campania	58	19	13	36
Emilia Romagna	61	30	18	26
Friuli-Venezia Giulia	5	1	3	1
Lazio	19	2	4	17
Liguria	17	3	4	10
Lombardia	66	2	20	47
Marche	3	3		2
Molise	18	17	1	2
Piemonte	179	55	60	78
Puglia	14	1	7	11
Repubblica S. Marino	2	2		2
Sardegna	80	18	18	57
Sicilia	3		1	2
Toscana	107	8	31	78
Trentino-Alto Adige	34		13	25
Umbria	7		4	5
Valle d'Aosta	14	2	4	10
Veneto	8	2	6	3
Total Italy	750	167	244	431

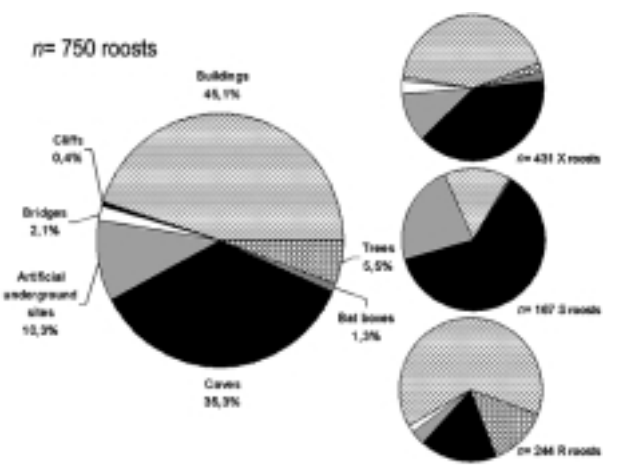

Figure 2 - Type of all roosts and according to their biological role.

Table 3 - Number of X, R and S roosts and abundance of individuals recorded for each species.

n = total number of roosts recorded.
(*) Colonies constituted by more than one species for which only the total number of bats was available were not considered.

Species		No. unknown	1-3	4-9	10-19	20-29	30-39	40-49	50-99	100-199	200-499	500-999	1000-1999	2000-2999	3000-3999	≥ 4000	Total	Maximum no. of individuals recorded at a single site (*)
Barbastella barbastellus n=42	X	2	2														4	2
	R	23	2		5	2											32	23
	S		4		1				1								6	76
Eptesicus nilssonii n=1	X																	
	R				1												1	16
	S																	
Eptesicus serotinus n=15	X	3	8	1													12	9
	R																	
	S		4														4	3
Hypsugo savii n=18	X	5	4		1												10	10
	R	4			2	1											7	20
	S		1														1	1
Miniopterus schreibersii n=74	X	4	5	4	5	1	3		4	2	5		3				36	1500
	R	8							1	2	4	4	4	3	2		28	3250
	S	3	2	2				1			3	3		2	1	1	18	10000
Myotis bechsteinii n=12	X		11														11	3
	R																	
	S		1														1	1
Myotis blythii + M. myotis n=78	X	2	23	6	4		2	1	1	1							40	100
	R	6			1		1	1	2	4	4	5	1	1			26	2000
	S	1	6	7	1	1			1								17	60
Myotis punicus n=26	X		5		1							1					7	700
	R										1	6	6	1			14	2000
	S		2			1								1			4	2000
Myotis capaccinii n=45	X	3	11	2	2	2			1	3	2						26	300
	R	8				1	1		1	5	1	1					18	720
	S	1	3		1												5	16
Myotis daubentonii n=45	X	2	21	3	5	1	2		2								36	51
	R	2				2		1	2	1							8	100
	S	1	2														3	2
Myotis emarginatus n=62	X	1	24	7	3	3											38	20
	R	2		2	2	3	1		4	5							19	189
	S		5	2		1											8	23

Myotis mystacinus n=5	X		3	1													4	4
	R				1												1	17
	S																	
Myotis nattereri n=31	X	1	24	2													27	4
	R		1														1	3
	S		3														3	1
Nyctalus lasiopterus n=1	X		1														1	2
	R																	
	S																	
Nyctalus leisleri n=9	X		4		3				1								8	70
	R																	
	S			1													1	7
Nyctalus noctula n=3	X			2													2	4
	R									1							1	120
	S																	
Pipistrellus kuhlii n=66	X	4	3	3	2		1			2							15	150
	R	13	1	1	4	11	7	1	5	3							46	127
	S		2		1	1											4	20
Pipistrellus nathusii n=2	X		1				1										2	30
	R																	
	S																	
Pipistrellus pipistrellus + *P. pygmaeus* n=27	X	1	5	2	1				1								10	78
	R				6	2	3	1		3							15	129
	S			1													1	6
Plecotus auritus + *P. austriacus* + *P. macrobullaris* n = 98	X	2	48	5	3												58	15
	R	5		2	14	1	3	1	1		1						28	200
	S		14														14	2
Rhinolophus euryale n=32	X	4	2	2			2	1	1		1						13	350
	R	2			1		1		1		1	2					8	600
	S	1	4	3	1					1	2		1				13	1274
Rhinolophus ferrumequinum n=261	X	4	98	28	17	2	1		5	2							157	140
	R	4		1	2	3		2	7	2							21	127
	S	3	52	10	6	1	4	2	11	5	7						100	400
Rhinolophus hipposideros n=210	X	1	79	10	8	1											99	20
	R	2	2	7	6	5	3	1	3	1							30	150
	S	4	60	12	6	3	2				1						88	388
Rhinolophus mehelyi n=24	X		7	3			1				1						12	200
	R						1		1	2	3	1	1				9	1000
	S										2		1				3	1500
Tadarida teniotis n=9	X	3		3	2			1									9	40
	R																	
	S		1														1	2

(*P. nathusii*, *Nyctalus* spp.) and species whose apparent rarity cannot be evaluated due to insufficient taxonomic and biogeographical knowledge (the "*Myotis mystacinus"* group) (Tab. 3). For some species, neither hibernation nor breeding roosts were documented (*N. lasiopterus*, *P. nathusii*), while for others hibernation (*M. mystacinus*, *N. noctula*, *E. nilssonii*), or breeding (*M. bechsteinii*, *N. leisleri*, *E. serotinus*, *T. teniotis*) roosts were unknown; for all

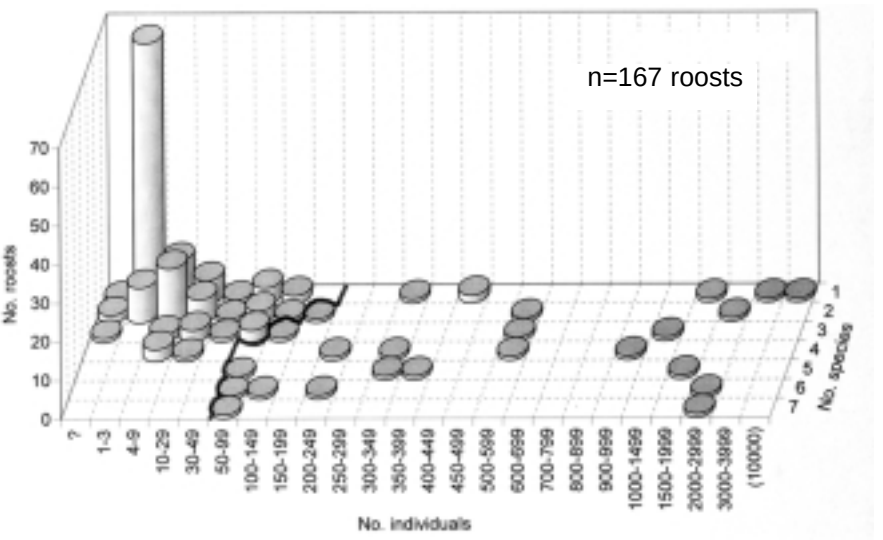

Figure 3 - Classification of hibernation roosts (S) by number of species and colony size. Roosts to the right of the bold line meet the general selection criteria adopted to recognise sites of special conservation interest.

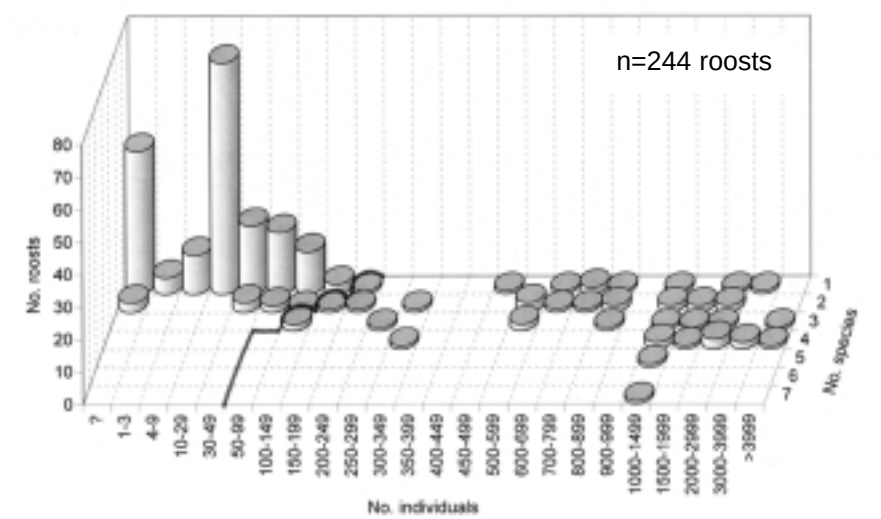

Figure 4 - Classification of breeding roosts (R) by number of species and colony size. Roosts to the right of the bold line meet the general selection criteria adopted to recognise sites of special conservation interest.

other species, data were available for all three biological roles considered (Tab. 3).

In 50.5% of cases, a roost was used by only 1-3 bats. However, some very large colonies were found (largest colonies recorded belong to *M. schreibersii* and large-sized *Myotis* (Tab. 3).

Figure 5 - Regional distribution of roosts of special conservation interest. Bold lines divide northern, central and southern Italy.

Roost classification based on species richness and numerical abundance, according to general criteria shown in Table 1 led to the identification of 25 hibernation roosts and 47 breeding roosts of special conservation interest (Figs. 3, 4). Regarding the species of major concern, the threshold for selecting sites of special conservation interest was overcome, partly at sites already selected according to the general criteria, partly at other sites, increasing the number of hibernation and breeding roosts of special interest at, respectively 37 and 67. Seven of them were selected both as hibernation and breeding sites so that in all, 97 sites of special conservation interest were recorded.

Data show the high conservation inte-

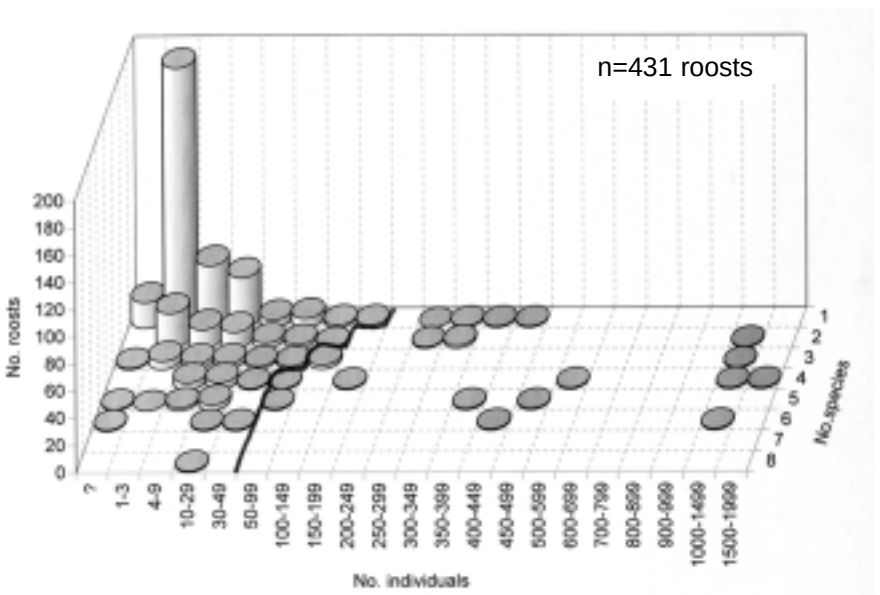

Figure 6 - Classification of 'X-roosts' (see methods) by number of species and colony size. Roosts to the right of the bold line meet the general selection criteria adopted to recognise potential sites of special conservation interest.

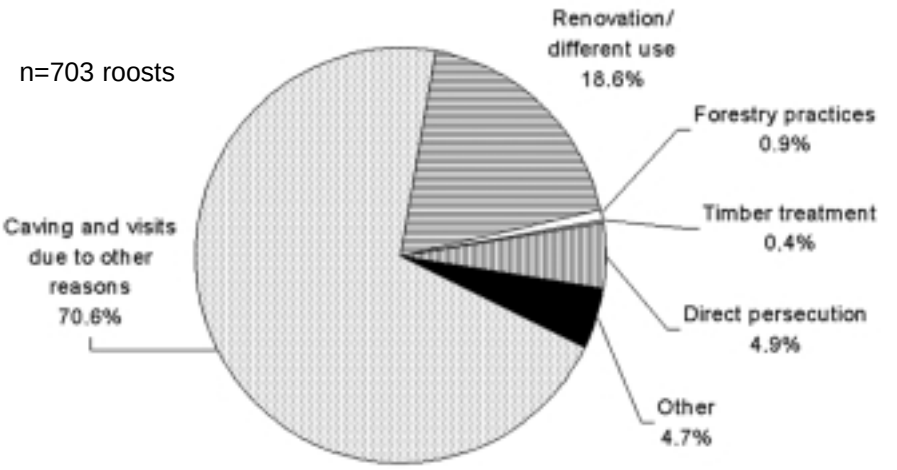

Figure 7 - Factors potentially harming bats at 703 roost sites.

rest of Sardegna, where in spite of the limited surveying effort, a high proportion of sites of special conservation interest was recorded (Fig. 5).

A total of 27 roosts, classified as 'X roosts', were selected, 19 of which met the general criteria (Tab. 1; Fig. 6) and 8 met the criteria for species of major interest. Among them only 7 were also used for breeding or hibernation (five

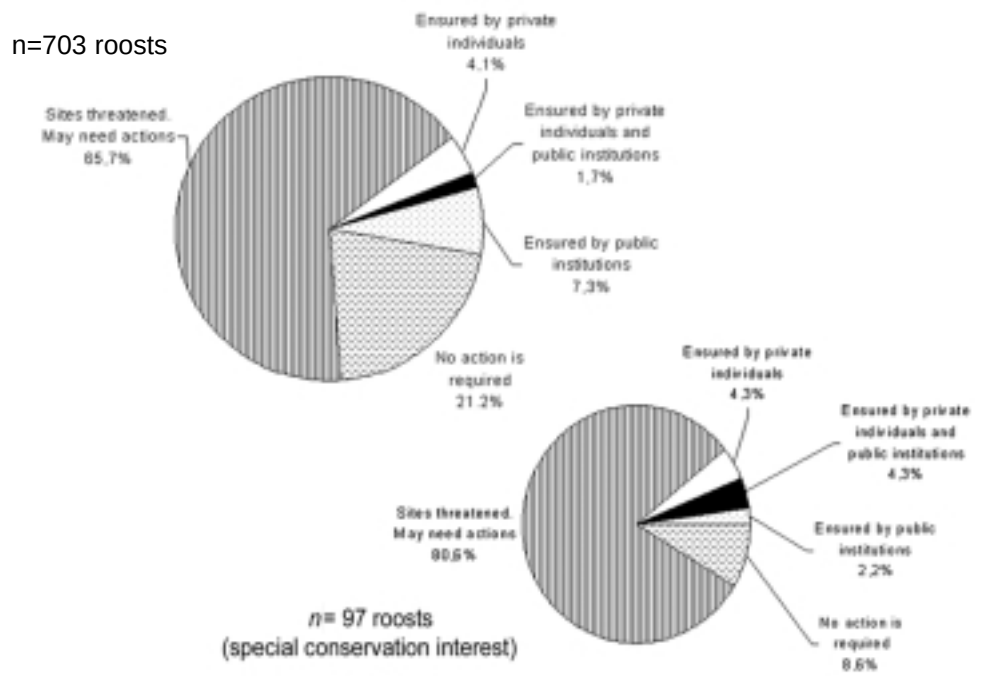

Figure 8 - Conservation probability for 703 roosts as assessed by surveyors.

were classified as sites of special conservation interest); for the other 20 monitoring will have to be carried out to verify their biological role.
For at least 93.7% of roosts, factors potentially disturbing the bats were documented, particularly people access to the roost, and renovation of buildings used as roost (Fig. 7). Surveyors judged

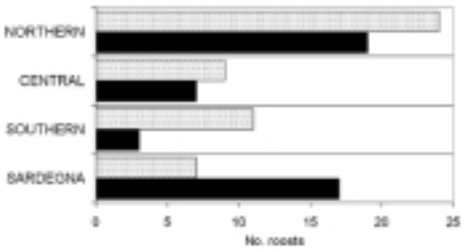

Figure 9 - Number of roost sites of special conservation interest within (grey) or outside (black) protected areas (national, regional and provincial parks and reserves, SCIs and proposed SCIs) in northern, central, southern Italy and in Sardegna (see also fig. 5).

that in almost two thirds of such cases conservation was not ensured. These problems proved even more pronounced when the 97 sites of special conservation interest were considered (Fig. 8). Only about half of them (52.6%) are located within protected areas, including areas proposed as Sites of Community Importance (92/43/EEC Directive) (Fig. 9). The situation is particularly worrying in Sardegna, where only 29.2% of sites of special conservation interest are within protected areas. Moreover, for north-west Italy, it has been underlined that even roosts occurring within protected areas, do not receive the necessary conservation attentions (Debernardi *et al.*, 2003). The results presented (Fig. 8) suggest that this is probably true for many other roosts included in protected areas around the country.

CONCLUSIONS

Results show knowledge gaps, both from the geographical and species perspectives. Even the data collected for the regions most extensively surveyed are very scarse when compared to information available in other European countries (e.g.: The Bat Conservation Trust - DEFRA, 2001).
There is an urgent need to encourage roost surveying, to acquire more complete data on bat distribution and population size, and because many of the identified roosts are subject to disturbance and their conservation is not guaranteed: consequently, there is a high risk that important roosting sites still will be destroyed before being discovered.
Priority should be given to urgent protection of roosts selected as sites of special conservation interest. Of course, threatened sites of local (regional) importance may also need immediate conservation actions.
Bats and their roosts are protected by law: it is forbidden to kill, capture and keep in captivity bats (L. 157/1992, art. 21), as well as to disturb them and either destroy or alter roost conditions (Bern Convention, chapter III, art. 6; D.P.R. 357/1997, art. 8). Thus, in most cases effective conservation would simply require to enact the existing law, too often ignored and violated.
The list of roosts selected as sites of special conservation interest identifies

a first group of sites where monitoring programmes should be started to monitor demographic trends. The same list should be implemented to include a representative sample of sites for species and areas.

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APPENDIX

Project's collaborators listed according to the amount of their contributions (number of recorded roosts in decreasing order). Between slashes those who contributed the same number of records. A few data were obtained from literature and the Authors considered as recorders.

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