Phylogeny of African *Myotis* bats (Chiroptera, Vespertilionidae) inferred from cytochrome *b* sequences

BENOÎT STADELMANN¹, ², DAVID S. JACOBS³, CORRIE SCHOEMAN³, and MANUEL RUEDI¹, ⁴

¹Natural History Museum, P. O. Box 6434, 1211 Geneva 6, Switzerland
²Department of Zoology and Animal Biology, Molecular Systematics Group, University of Geneva, 30 quai Ernest-Ansermet, CH-1211 Geneva 4, Switzerland
³Department of Zoology, University of Cape Town, Private Bag, Rondebosch 7701, South Africa
⁴Corresponding author: manuel.ruedi@mhn.ville-ge.ch

The genus *Myotis* is comprised of about 100 species that are unequally distributed between the Northern (81% of the species) and the Southern hemisphere (19% of the species). Only eight species of *Myotis* occur in the Ethiopian region, but this is the only biogeographic region with representatives of all four classical subgenera, suggesting a diverse assemblage of morphotypes. We used sequences of a mitochondrial DNA gene (cyt *b*) to investigate the evolution and the phylogenetic position of seven of the eight Ethiopian species, and compared them to a broad sampling of *Myotis* from the World and of other vespertilionids. Phylogenetic reconstruction was based on 91 complete sequences representing 79 species of bats. The two endemic southern African species of the subgenus *Cistugo* were not placed within the genus *Myotis*, but were basal to the vespertilionid radiation, as suggested by earlier work based on karyology. The remaining Ethiopian species formed a strong monophyletic clade within *Myotis*, further stressing the importance of biogeography as a good predictor of phylogenetic relationships. This Ethiopian clade includes one Western Palaearctic and one Oriental species, both of which probably secondarily colonized these areas from the Ethiopian region. Molecular dating based on Bayesian inferences suggest that these faunal exchanges occurred at the end of the Miocene, while the split of the Ethiopian clade from the other Old World *Myotis* dates back to the middle Miocene, quite early in the *Myotis* radiation. Thus, the relative paucity of species in sub-Saharan Africa cannot be attributed to a late entry into this continent. Instead, these molecular results suggest that other evolutionary processes are responsible for the poor species diversity of *Myotis* found in Africa today.

Key words: *Cistugo*, African *Myotis*, Vespertilionidae, cytochrome *b*, molecular dating

INTRODUCTION

With about 100 currently recognized species (Koopman, 1994; Simmons, In press), bats of the genus *Myotis* represent one of the few mammalian groups with a natural distribution covering most of the world. The peak diversity of *Myotis* species is, however, reached in the northern continents. Eurasia supports the richest diversity (55 species), followed by the Nearctic region (24 species), while only 14 species are found in the Neotropics, eight in the Ethiopian, and three in the Australian region (Koopman, 1994; Horáček et al., 2000). This pattern is particularly surprising since *Myotis* bats have adapted to diverse habitats, from deserts to cloud forests, with a wide range of foraging habits (from insectivorous aerial hawkers to fish-eating). They
Systematic status of African populations of *Pipistrellus pipistrellus* complex (Chiroptera: Vespertilionidae), with a description of a new species from Cyrenaica, Libya

Petr Benda¹, Pavel Hulva², and Jiří Gaisler³

¹Department of Zoology, National Museum (Natural History), Václavské nám. 68, 115 79 Praha 1, Czech Republic; E-mail: petr.benda@nm.cz
²Department of Zoology, Charles University, Viničná 7, 128 44 Praha 2, Czech Republic
³Department of Zoology and Ecology, Masaryk University, Kotlářská 2, 611 37 Brno, Czech Republic

The distribution of pipistrelles of the *Pipistrellus pipistrellus* complex (= *P. pipistrellus* s.l.) reaches only marginally the African continent. These bats are known only from a narrow belt of the Mediterranean zone in Maghreb and from NE Libya. We analysed museum specimens of African populations of *P. pipistrellus* s.l. using both morphologic and genetic techniques and compared them with Eurasian specimens of the complex. The African representatives of *P. pipistrellus* complex include two morphologically, genetically and geographically distinct populations. One of them inhabits the Mediterranean part of Cyrenaica, Libya. Belonging to the *P. pygmaeus* genetic lineage, these bats are represented by larger and more rusty coloured individuals with large massive rostrum and canines. In morphologic traits, this population differs significantly from all Western Palaearctic populations of the *P. pipistrellus* complex. These bats differ by about 6–7% in genetic distance from *P. pygmaeus* s. str. Within the *P. pygmaeus* lineage Libyan bats seem to be unique in their echolocation calls: the maximum energy of terminal frequencies was recorded at about 45 kHz. We consider the Libyan pipistrelles to represent a separate species, *Pipistrellus hanaki* sp. nov. Another distinct African pipistrelle population inhabits the Mediterranean parts of NW African countries, Morocco, Algeria and Tunisia. Individuals from the latter population are small and somewhat darker members of the *P. pipistrellus* genetic lineage, with relatively short and narrow mesial part of rostrum. Although both morphological and genetic differences between this population and Eurasian *P. pipistrellus* s. str. were found (genetic distance about 3–5%), they are probably not sufficient for the separation of this form at the specific level. However, the differences from European samples show rather not a cline character and therefore potential subspecific level of NW African *P. pipistrellus* has to be taken into consideration.

Key words: *Pipistrellus pipistrellus*, *Pipistrellus pygmaeus*, Africa, morphology, morphometry, cytochrome *b*, mitochondrial DNA, taxonomy

INTRODUCTION

Pipistrelle bats of the *Pipistrellus pipistrellus* complex (or *P. pipistrellus* sensu lato) are widely distributed in the western part of Eurasia, from Iberia, British Islands and southern Scandinavia through the Middle East up to Central Asia (Corbet, 1978; Koopman, 1994; Taake and Vierhaus, 2004). Distribution range reaches only the northernmost margin of the African continent, where these bats are known solely from the narrow belt of the Mediterranean zone in Maghreb and from NE Libya (Fig. 1).
In November 1999, the Harrison Institute and the University of Yangon conducted the first international field survey for bats in Myanmar for fifty-five years. Four years later, following the award of a Darwin Initiative grant, an international bat workshop in the University of Yangon, numerous additional field surveys and 10 international expeditions to 12 of the 14 states and divisions of Myanmar, the programme of bat studies continues to develop. Results have been, and are being, published in a series of scientific papers and reports (Bates et al., 2000, 2001, 2004; Pearch et al., 2003).

In March 2003, a second team of UK scientists joined forces with students and staff of the University of Mandalay to conduct additional researches (M. J. Struebig, pers. comm.). This team, with its experience of working in forest habitats elsewhere in South-east Asia, had a particular interest in the forest bats of northern Myanmar. Results of their preliminary studies in southern Kachin showed a particularly rich bat fauna, with fourteen species collected from two survey sites. At least one of these represents a previously unknown species of Kerivoula, which is here described and compared to other taxa within the subfamily Kerivoulinae, Asiatic representatives of which were recently reviewed by Vanitharani et al. (2003).

**MATERIALS AND METHODS**

**Field Survey**

Namdee Forest was one of twenty-five localities in Kachin and Shan States and Mandalay and Sagaing...
A new species of *Chaerephon* (Molossidae) from Madagascar with notes on other members of the family

STEVEN M. GOODMAN\(^1\) and SCOTT G. CARDIFF\(^2\)

\(^1\)Field Museum of Natural History, 1400 South Lake Shore Drive, Chicago, Illinois 60605, USA, and WWF, BP 738, Antananarivo (101), Madagascar; E-mail: goodman@fieldmuseum.org

\(^2\)Columbia University, Department of Ecology, Evolution, and Environmental Biology, 1200 Amsterdam Avenue, New York, NY 10027, and Division of Vertebrate Zoology (Mammalogy), American Museum of Natural History, Central Park West at 79th Street, New York, NY 10024, USA

We describe a species of *Chaerephon* (Molossidae) new to science from western Madagascar. This bat differs from the other two *Chaerephon* occurring on the island and from comparably sized African and Asian *Chaerephon* based on measurements, pelage and wing coloration, and cranial and dental characters. *Chaerephon* sp. nov. occurs at three sites in the drier western portion of the island. We also provide some natural history and distributional information on other Malagasy members of this family.

**Key words:** *Chaerephon*, Molossidae, new species, distributional records, western Madagascar

INTRODUCTION

The bats of Madagascar are poorly known. As currently understood, seven taxa represent the Molossidae fauna of the island: *Mormopterus jugularis*, *Tadarida fulminans fulminans*, *Chaerephon leucogaster*, *C. pumilus*, *Mops leucostigma*, *M. midas miarensis*, and *Otomops madagascariensis* (Peterson *et al.*, 1995; taxonomy and spelling in accordance with Simmons, In press). Given the difficulty of capturing members of this family, few data are available about their distribution and natural history, even for the common commensal species.

On Madagascar two species of *Chaerephon* are currently recognized: *C. leucogaster* and *C. pumilus*. The former species often occurs as a commensal, living in man-made shelters, along the drier western coastal and inland areas and it is also reported from the eastern offshore island of Isle Sainte Marie (Peterson *et al.*, 1995). It can be found roosting in monospecific colonies or sharing sites with other molossid bats such as *M. jugularis* and *M. leucostigma*. *Chaerephon pumilus* occurs in areas of the humid east and central highlands and the vast majority of records are associated with human habitations (Peterson *et al.*, 1995). Its range at least partially overlaps with *M. jugularis* (see below).

During the course of biological inventories carried out over the past decade at different sites on the island (Fig. 1), particularly the western portion, we have captured a number of bats, including Molossidae. Amongst these collections is a species of *Chaerephon* that is unknown to science. The purpose of this paper is to describe the
Systematic notes on a collection of bats from Malawi. I. Megachiroptera: Epomophorinae and Rousettinae (Mammalia, Chiroptera)

WIM BERGMANS¹ and NICO J. VAN STRIEN²

¹Zoölogisch Museum, Universiteit van Amsterdam, P.O.Box 94766, Amsterdam, the Netherlands
E-mail: wim.bergmans@nciucn.nl
²Julianaweg 2, 3941 DM Doorn, the Netherlands

From July 1986 to August 1991 the junior author collected bats in various localities in Malawi. About 450 of these animals were preserved. In the present study the Megachiroptera are reported. Epomophorinae (Megachiroptera) collected in Malawi by H. Jachmann in 1982 are also reviewed. In addition, a number of specimens in collections in Malawi, Zambia and Zimbabwe have been examined by the junior author, while data on some other samples from Malawi in various other collections, examined earlier by the senior author, have been reconsidered as well. The combined collections contain eight species of Megachiroptera, including Epomophorus cf. labiatus, E. gambiaus crypturus, a new species of Epomophorus (described herein), E. wahlbergi, Epomops dobsonii, Rousettus aegyptiacus leachii, R. lanosus, and Eidolon helvum. For the new species, an IUCN Red List category is proposed.

Key words: Megachiroptera, Malawi, systematics, Epomophorinae, Rousettinae

INTRODUCTION

Since the 1980s, Dr. D. C. D. Happold and Mrs. M. Happold have published several reports on the bats of Malawi, the first co-authored by the late J. E. Hill (Happold et al., 1987, 1989, 1997). These studies are mainly faunistic, dealing with species inventories, distribution, ecology, status and conservation. Happold et al. (1997) listed the 59 bat species known to occur in Malawi, including seven species of Megachiroptera (they did not deal with subspecies): Epomophorus gambianus (Ogilby, 1835), E. labiatus (Temminck, 1837), E. wahlbergi (Sundevall, 1846), Epomops dobsonii (Bocage, 1889), Eidolon helvum (Kerr, 1792), Rousettus aegyptiacus (É. Geoffroy-St. Hilaire, 1810), and R. lanosus Thomas, 1906. Kock et al. (1998) recorded the eighth Megachiroptera, Plerotes anchietai (Seabra, 1900).

The objective of the present paper is to contribute to the knowledge of the taxonomy of Megachiroptera from Malawi. The taxonomic status of various forms of Epomophorus and Rousettus in Malawi is reviewed, and a new species of Epomophorus is described. The study builds on earlier ones dealing with or including the same subject (Bergmans et al., 1983; Bergmans, 1988, 1994). Bergmans (1988, 1994) gave
Changes in bat fauna during the Middle and Late Holocene as exemplified by thanatocoenoses dated with 14C AMS from Kraków-Częstochowa Upland caves, Poland

TOMASZ POSTAWA

Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, ul. Sławkowska 17, 31–016 Kraków, Poland; E-mail: postawa@isez.pan.krakow.pl

Fossil material from 12 caves situated in the Kraków-Częstochowa Upland (southern Poland) was studied. In 17 samples of osteological material, 8,275 individuals (Minimal Number of Individuals, MNI = 4,571) of 12 bat species were identified. Thirteen separate thanatocoenoses were found (R × C test) from which bone material was dated using the 14C AMS method; 13 dates from 6,725 to 820 14C yr BP (yr BP) were obtained. Correspondence analysis for thanatocoenoses from the Atlantic and Subboreal periods distinguished two bat species groups and two thanatocoenosis groups: 1) pontic-mediterranean species with a higher frequency during the Atlantic period, e.g., Rhinolophus hipposideros which reoccurs more abundantly at the end of the Subboreal period and Myotis emarginatus, which is absent in earlier sediments with the exception of one episode; 2) Myotis daubentonii, Plecotus auritus, and Myotis dasycneme which increase in frequency during humid and cool periods (5,500–4,200 and 3,000–2,700 yr BP); 3) thanatocoenoses from the Holocene climatic optimum (6,000–5,500 yr BP) characterized by a dominance of Myotis nattereri; a decrease in its frequency occurred during the cooler end of the Atlantic period; 4) thanatocoenoses from the Subboreal period (4,100–3,500 yr BP) characterized by a dominance of Myotis bechsteinii. The maximum frequency of M. bechsteinii correlates with an increasing share of Fagus and Carpinus in forest ecosystems, while its decrease was probably caused by disease and was independent of human activity. Myotis myotis was found in assemblages from the Atlantic period, while the remains of a nursery colony in Nietoperzowa Cave (820 ± 25 yr BP) indicate that reproduction of this species occurred to the north of the Carpathians before the appearance of houses with attics. The presence of mass concentrations of Pipistrellus pipistrellus (s.l.) in caves was confirmed for the Subatlantic period (2,325 ± 30 yr BP), which shows its independence from both thermal balance and human influence on contemporary ecosystems. The low frequency of Barbastella barbastellus in thanatocoenoses prevents reconstructions. Reconstructions for the Atlantic and Subboreal periods show that the composition of the bat fauna depends on changes in climate and vegetation, while human activity seems to have marginal impact. A comparison of paleozoological and radiocarbon datings revealed large differences in age estimation of the thanatocoenoses.

Key words: Kraków-Częstochowa Upland, Poland, Holocene, bat fauna, 14C AMS, cave, climate, vegetation change, human activity

INTRODUCTION

After the Pleistocene Vistulian glaciation, the contemporary warm period of the Quaternary, Holocene, had begun. Its beginning is dated from 10,250 14C yr BP in Poland and continues to this day (Starkel, 1999). As the climate warmed to the north of the Carpathian and Sudetes Mountains, the contemporary flora and fauna began to
Geographic distribution, ecology, and phylogenetic affinities of *Thyroptera lavali* Pine 1993

Sergio Solari¹, Ronald A. Van Den Busche², Steven R. Hooper¹, and Bruce D. Patterson³

¹Department of Biological Sciences, Texas Tech University, Lubbock, TX 79409, USA
E-mail: sergio.solari@ttu.edu
²Department of Zoology and Collection of Vertebrates, Oklahoma State University, Stillwater, OK 74078, USA
³Department of Zoology, Field Museum of Natural History, Chicago, IL 60605, USA

*Thyroptera lavali* (Chiroptera: Thyropteridae) is a rare Neotropical species that until now has been recorded from only five localities in the Amazonian rainforests of Peru, Ecuador, Venezuela, and Brazil. Fewer than 10 specimens of *T. lavali* exist and, accordingly, little is known about its distribution, natural history, and phylogenetic affinities. We report new records for the species from southeastern Peru. Together with other recently published records, these expand the known range of the species considerably, as well as increase our knowledge of its ecology. *Thyroptera lavali* seems to prefer primary forest near swamps, and probably roosts in palms; its reproductive pattern is similar to that of other Neotropical insectivorous bats, with parturition at the beginning of wet season. Finally, we used two different data matrices to assess its phylogenetic relationships: one of discrete morphological characters, the other of DNA sequences of mitochondrial genes. Both data sets support a sister relationship between *T. lavali* and *T. tricolor*, with *T. discifera* as the basal member of the genus *Thyroptera*.

Key words: disc-winged bats, distribution, ecology, Neotropics, systematics, *Thyroptera lavali*, Thyropteridae

INTRODUCTION

The family Thyropteridae (disc-winged bats) includes three species in the genus *Thyroptera* that are endemic to lowland Neotropical forests (mainly below 1,000 m; Koopman, 1978; Patterson et al., 1996). *Thyroptera discifera* and *T. tricolor* have extensive distributions throughout the Amazon basin and beyond (Wilson and Findley, 1977; Wilson, 1978). The third species, *T. lavali*, was described on the basis of four specimens from a single lowland locality in Loreto department, northeastern Peru (Pine, 1993). Previous reports of *T. lavali* include a fossil record in Colombia (as *T. robusta* from Magdalena Valley, Czaplewski, 1996, 1997), a northern record in Napo Province, Ecuador (Reid et al., 2000), the type locality (Quebrada Espe-ranza, Loreto; Pine, 1993), and the first extension southward (Bosque Von Humboldt, Ucayali; Solari et al., 1999). These records extended the latitudinal range more than 600 km north and 650 km south of the type locality, clearly indicating that the species has a more widespread distribution than previously known. Two recent records...
Habitat use of the Pacific sheath-tailed bat (*Emballonura semicaudata*) on Aguiguan, Mariana Islands

JACOB A. ESSELSTYN1, 2, GARY J. WILES3, and ARJUN AMAR1, 4

1Division of Fish and Wildlife, Rota, Northern Mariana Islands 96951, USA
2Present address: Natural History Museum and Biodiversity Research Center & Department of Ecology and Evolutionary Biology, University of Kansas, Lawrence, KS 66045, USA; E-mail: esselsty@ku.edu
3Washington Department of Fish & Wildlife, 600 Capitol Way North, Olympia, WA 98501, USA
4Present address: Centre for Ecology and Hydrology-Banchory, Hill of Bratherns, Banchory, Aberdeenshire, AB31 4BW, United Kingdom

We tested for differential habitat use by Pacific sheath-tailed bats (*Emballonura semicaudata*) in three major vegetation types on Aguiguan, Mariana Islands. Acoustic surveys of bat activity were conducted on a 370-m grid with 50 stations that covered the entire island. We controlled for a variety of extraneous factors through sampling design and use of a generalized linear model. Bat activity was significantly higher in native and non-native forests than in non-forest habitats. There was no significant difference between activity levels in the two forest types. However, our sample size in non-native forest was limited to seven stations, thus the conclusion that non-native forest is an important habitat for the species should be viewed with caution. Our finding that *E. semicaudata* may be reliant on forest is critical because forests on Aguiguan are threatened by feral goats.

*Key words: Emballonura semicaudata*, Pacific sheath-tailed bat, habitat use, Aguiguan, Mariana Islands, bat detector, conservation

INTRODUCTION

The Pacific sheath-tailed bat (*Emballonura semicaudata*) is broadly distributed across the tropical Pacific. The species is known from the Mariana and Caroline Islands, Fiji, Tonga, Samoa, and Vanuatu (Flannery, 1995; Koopman, 1997). It is the only microchiropteran in the Mariana Islands, where the endemic subspecies *E. s. rotensis* occurs (Yamashina, 1943; Lemke, 1986; Flannery, 1995; Koopman, 1997).

While some populations of *E. semicaudata* have remained stable (e.g., Carolines — Bruner and Pratt, 1979; Wiles et al., 1997), many others have suffered dramatic declines or extirpation (e.g., Marianas, Fiji, and the Samoas — Lemke, 1986; Grant et al., 1994; Flannery, 1995; Hutson et al., 2001; Tarburton, 2002). Possible causes of these declines have been proposed (e.g., effects of war and pesticides), but no hypotheses are supported by substantial evidence (e.g., Tarburton, 2002).

*Emballonura s. rotensis* once occurred on the five southernmost Mariana Islands of Saipan, Tinian, Aguiguan, Rota, and Guam (Oustalet, 1895; Yamashina, 1943; Lemke, 1986; Koopman, 1997; Steadman, 1999; P. Krutzsch, in litt.) and possibly on several islands in the northern portion of the archipelago (Lemke, 1986). Of these populations,
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Neotropical leaf-nosed bats (Chiroptera: Phyllostomidae) may be regarded as key-stone-species in forests (Marinho-Filho and Sazima, 1998), because of their roles as seed dispersers and pollinators of many plants (Kunz, 1982; Fleming, 1988; Charles-Dominique, 1991; Nowak, 1994). Consequently they are important to the processes of ecological succession and forest regeneration (Fenton et al., 1992; Whittaker and Jones, 1994; Estrada and Coates-Estrada, 2001).

Among the Phyllostomidae, bats of the subfamily Carolliinae (genera Carollia and Rhinophylla — Wetterer et al., 2000) interact with plants mainly by fruit consumption (Heithaus, 1982; Fleming, 1988). These bats forage mainly at ground level in the under-story (Bernard, 2001), focusing on shrubs and small trees, therefore being members of the guild ‘highly cluttered space gleaning frugivores’ (Kalko, 1998).
Bats of the Reserva Nacional Allpahuayo-Mishana, northeastern Peru, with notes on community structure

CHRISTINE L. HICE1, 2, PAUL M. VELAZCO3, 4, and MICHAEL R. WILLIG1

1Department of Biological Sciences and The Museum, Texas Tech University, Lubbock, TX 79409, USA
2Present address: Department of Biological Sciences, University of New Mexico, Albuquerque, NM 87131, USA; E-mail: clhice@unm.edu
3Division of Mammals, The Field Museum, Chicago, IL 60605, USA
4Department of Biological Sciences, University of Illinois at Chicago, Chicago, IL 60607, USA

An inventory of the bat fauna at the Reserva Nacional Allpahuayo-Mishana documented 63 species. Coupled with previous records, this becomes the second most species-rich site for bats in Peru, with 65 species. Reproductively, there was a peak in activity in the early rainy season (October–December) that steadily declined to a low in the late rainy or early dry season (May–June). The community was dominated by *Carollia perspicillata* in terms of relative abundance and biomass. Most species were frugivores (28) or insectivores (26), but frugivores were predominant in the community based on cumulative abundance and biomass. The bat fauna was sampled to 85–91% completion based on extrapolations of local species richness. Nonetheless, only 56% of the regional species pool was captured locally. The fauna was compositionally similar to that of other western Amazonian sites. Although the Reserva Nacional Allpahuayo-Mishana enjoys a relatively high protected status, this has yet to be translated into sustained conservation. As a hotspot of biodiversity in Peru, it deserves protection at the highest possible level.

Key words: Chiroptera, Peru, inventory, species richness, community structure, abundance, biomass, dominance, feeding guild, conservation, reproduction

INTRODUCTION

The Chiroptera is the second most species-rich order of mammals after Rodentia, comprising 17 families, 177 genera, and 925 species (Koopman, 1993). Like most mammal taxa, bat species richness peaks in tropical regions (Findley, 1993; Willig *et al.*, 2003) regardless of spatial scale (e.g., Willig and Selcer, 1989; Willig and Sandlin, 1991; Willig and Lyons, 1998; Lyons and Willig, 2002), with records of up to 175 species from a single country (Indonesia — Mickleburgh *et al.*, 2002). In the New World tropics, the richest bat fauna has been reported from Colombia, with 170 species (Rodriguez-Mahecha *et al.*, 1995). However, twelve of those species are not represented by voucher specimens and their occurrences are inferred from distributional records from bordering countries. As such, Peru ranks second in the Neotropics, with eight families, 61 genera, and 158 species (Pacheco *et al.*, 1995), of these, six species were documented recently, including *Centronycteris maximiliani* (Hice and Solari, 2002), *Micronycteris matses* (Simmons *et al.*, 2002), *Eumops maurus* (Montambault,
INTRODUCTION

Researchers often need to capture echolocating bats to study and survey them. Capture methods are reviewed by Kunz and Kurta (1988), and two of the most frequently employed capture methods are use of harp traps (Kunz and Kurta, 1988; Mills et al., 1996; Duffy et al., 2000) and mist nets (e.g., Sedlock, 2001). Tidemann and Woodside (1978) and Francis (1989) found harp traps much more effective than mist nets at catching small rhinolophids and vespertilionids, and the greater acoustic conspicuousness of mist nets may explain this disparity in capture rates. To date, the conspicuousness of bat traps as acoustic targets has not been studied, however.

Constantine (1958) developed the first harp trap, which was later modified to increase effectiveness and portability (Tuttle, 1974; Tidemann and Woodside, 1978; Francis, 1989). The design that is currently most popular for use in temperate regions makes use of two banks of vertically strung, 2.7–3.6 kg monofilament fishing lines with spacings of 2.5 cm (Kunz and Kurta, 1988). The trap is designed so that...
Recognizing species of echolocating bats by their calls has been valuable in assessing the distribution of, and habitat use by, bats not prone to capture (e.g., Kalko, 1997; Ochoa et al., 2000). Many authors (e.g., Fenton and Bell, 1981; Ahlén, 1990; O’Farrell and Miller, 1997, 1999; Russo and Jones, 2002; Rydell et al., 2002) have demonstrated that it is possible to distinguish among species of bats by their echolocation calls, reflecting diagnostic patterns of frequency change over time and species-specific frequencies in calls. The feasibility of detecting and identifying a bat by its echolocation calls is a direct function of call intensity. Species producing low intensity echolocation calls (the ‘whispering bats’ of Griffin, 1958) are more difficult to sample than bats using high intensity echolocation calls. Among species producing
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