DIVERSITY, ROLE AND THREATS TO THE SURVIVAL OF BATS IN PAKISTAN

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ABSTRACT

Bats are among the least studied group of mammals in Pakistan. We reviewed and compared the diversity of bat fauna of Pakistan with that of the world, the Palearctic region and the Indo-Malayan region and found that the bat diversity of the country is comparable to any other region of the world with similar climatic conditions. Eight families of order Chiroptera with 23 genera (11.5%) are represented within a short geographic area of Pakistan in comparison to the Palearctic (13%) and the Malayan regions (18.5%) where 26 and 37 bat genera are present, respectively. The country therefore deserves to be designated as a hotspot for conservation of bat biodiversity and measures should be taken to conserve it as public awareness about the significance of biodiversity is low.

Key words: Batso conservation, Indo-Malayan, Pakistan, Palearctic

INTRODUCTION

Pakistan is roughly rhomboidal in shape and lies between 24° and 36.7° north latitudes and 61.0° and 75.0° east longitudes. The total area of Pakistan is 807048 km^2 that can topographically be subdivided into two distinct regions - the mountain terrains and tableland in the north and the gradational flats in the south – the Indus Plains. The Indo-Gangetic plains were formed in the Tertiary period when great depressions in front of the newly up-heaved Himalayas appeared. The process of alluviation from the highlands and the subsequent severance of the river Indus from the river Ganges following the uplift of the Siwalik system resulted in the present form of the Indus and Gangetic Plains (Wadia, 1953). The plain is generally featureless sloping gently towards the sea - an important hydrographic feature in relation to flooding and irrigation. The Indus is the only south-flowing river in Pakistan and is fed by the glaciers in the Karakoram Range. The total length of the river in Pakistan is 2900 km and the total basin area is 259210 km^2 comprising nearly one third of the total area of the country (Roberts, 1997).

Geographically, Pakistan is uniquely located. It lies at the western end of the South Asian subcontinent, and its flora and fauna are comprised of a blend of Palearctic and Indo-Malayan elements, with some groups also containing forms from the Ethiopian region. Indo-Malayan forms are predominant in the east of the country, in the Indus basin, and the Palearctic forms in the mountains of the north and west. The Palearctic species contain a mixture of those common to a large part of Eurasia, along with affinities to the Middle East, West Asia (Afghanistan and Iran), Central Asia and Tibet. The rate of endemism is low but the blending of elements with different origins has ensured a diverse and unique mix of flora and fauna. The country can be subdivided into twelve vegetation zones and eighteen habitat types (Roberts, 1997), with a wealth of biodiversity that is comparable to any other unit of land with similar climatic conditions in the world.

Through this review we have made an attempt to highlight the need for conserving bat diversity of Pakistan. This paper provide a complete checklist of bats of Pakistan, their status according to 2002 Conservation Assessment and Management Plan of the International Union for Conservation of Nature (IUCN) report, and compares the Pakistan bat diversity with that of the Palearctic and Indo-Malayan regions.

Diversity in bat fauna: At present there are about 1,100 recognized species of bats (Chiroptera) worldwide, about a quarter of all known mammal species (Simmons, 2005). The Order Chiroptera is divided into two Suborders, the Megachiroptera (186 species) and the Microchiroptera (834 species). The former is represented by only one family (Pteropodidae) and is restricted to Old World tropics of Africa and Asia, while the latter includes 17 families viz. Rhinolophidae, Hipposideridae, Megadermatidae, Rhinopomatdae, Craseonycteridae, Emballonuridae, Nycteridae, Myzopodidae, Mystacinidae, Phyllostomidae, Mormoopidae, Noctilionidae, Furipteridae, Thyropteridae, Natilidae, Molossidae and Vespertilionidae, (Simmons, 2005). The Vespertilionidae (403 species) and the Phyllostomidae (160 species) are the largest families with a worldwide distribution found in the Nearctic and Neotropical regions (Hutson *et al*., 2001).

Uncertainty on the exact number of taxa of chiropterans occurring within the territorial limits of Pakistan has been a matter of debate (Roberts, 1997;

Bates and Harrison, 1997; Walker and Molur, 2003, Wilson and Reeder, 2005). Bats comprise 28% of known mammal species of the country. Roberts (1997) has listed 50 species of bats representing 23 genera and 8 families from Pakistan (Table 1) and expects the presence of some additional species (Table 2) as described by Walker and Molur (2003). India, that shares a long border with Pakistan on the eastern side, possesses 7 families of bats (Nameer, 2000). Table 3 documents the IUCN status and criteria for extension of some threatened bat species of Pakistan whereas Fig. 1 compare the richness in the bat fauna of Pakistan with the world (Wilson and Reeder, 2005), the Palearctic (Horáĉek *et al*., 2000) and the Indo-Malayan regions (Bates and Harrison, 1997). Just a cursory look on the figure shows richness of bat fauna of Pakistan. Bates and Harrison (1997) have made the most comprehensive and up-to-date revision of the Chiroptera of Indian subcontinent listing 119 species of bats belonging to 37 genera and eight families in India, Pakistan, Nepal, Sri Lanka, Maldives, Afghanistan, Tibet, and northern Mynamar.

The bat fauna of Pakistan is richer and more diverse than the whole Palearctic which is the largest biogeographic region of the world comprising 25 genera and 8 families (Horáĉek *et al*., 2000) Thirty-one of the 50 bat species of Pakistan representing 15 genera and 6 families belong to Palearctic region (Table 1) whereas the remaining belong to the Malayan fauna. There are four species that Roberts (1997) has not included in his list (Table 2) whereas the taxonomy of one species i.e. *Scotozous dormeri* Dobson, 1857 is not clear as Walker and Molur (2003) has assigned it to genus *Pipistrellus*.

Role of bats in agro-ecosystems: Bats may play a significant role in the agro-ecosystems of Pakistan, particularly those fruit bats which pollinate the flowers and serve as vectors for seed dispersal. About 75% of microchiropterans feed on insects, although food sources may include other invertebrates, fish, amphibians, small mammals (including other bats), fruit, and flowers. A review of the feeding ecology of insectivorous bats is given by Fenton (1982). Dobat and Peikert-Holle (1985) reviewed the foraging strategies of plant-visiting bats. Insects may be caught in flight, or taken from vegetation, the ground, or water surfaces in a foraging style referred to as gleaning. Echolocation is generally used to locate prey although some bats use 'passive listening', homing in on the sounds made by the prey themselves. Food may be consumed on the wing or taken to a perch to be eaten. Such feeding perches may be regularly used and rejected food remains discarded beneath the site may reveal the presence of bats in that area. Some insect species, such as some moths and lacewings, have developed means of avoiding capture by detecting the ultrasound of approaching bats and falling to the ground. No studies have been conducted to investigate the diet and foraging behaviour of the Pakistan bat fauna.

In South East Asia, the importance of the positive role of bats in the ecosystem was recognized in 1998 when the Malaysian Government passed a Wildlife Protection Ordinance which includes protection of all species of bat. In 1999 another Wildlife Protection Ordinance was approved according to which a license was required to sell and use mistnets in the country, with a penalty of both imprisonment and fine for the sale/and or use of mistnets (Gumal and Racey, 1999). In India, two species of bats viz., the Wroughtons free-tailed bat (*Otomops wroughtonii*) and Salim Ali's Fruit bat (*Latidens salimalii*) are highly protected and are on Schedule I of Wildlife (Protection) act 1972. The realization of the role of bats in agricultural economy of India can be documented from the fact that owing to its feeding habits in Bihar, the Indian false vampire is considered as a good friend of farmers who reward it by food in bad weather and call it goddess Laxmi (Sinha, 1986).

Threats: As far as the survival of bats in the region is concerned, the situation is very crucial. Of the 260 bat species recorded from the Indo-Malayan Region one is extinct and 43 are threatened – six Critically Endangered, nine Endangered and 28 Vulnerable. A total of 189 species are listed in the Lower Risk categories – 62 as Near Threatened and 128 as Least Concern. A further 27 species are listed as Data Deficient (Hutson *et al*., 2001). In Pakistan, one species of bat is Endangered, Four are Vulnerable, nine near Threatened, eighteen are Least Concern, seven are Data Deficient and one is Not Evaluated (Table 1) (Walker and Molur, 2003).

Loss of their natural habitat by increased human population and human activities such as deforestation, use of pesticides, industrial activities, loss of buildings or alteration in the design of their roofs and deliberate anthropogenic disturbance are the major causes of their population decline throughout the world. Even the minor alterations in the habitat such as the loss of key landscape elements for example tree lines, hedgerows, and canals that are used regularly by bats during flight result in the abandonment of their roosts and maternity colonies.

Our knowledge about distribution, nesting and roosting habits, and habitat requirements of bats is fragmentary both with respect to region and species. Although extensive studies about bats have been carried out in some parts of Southeast Asia (Francis *et al.* 1996, 1997a, b,; 1999, Francis and Vonghamheng 1998, Robinson 1997, Robinson and Webber 1998) but sufficient knowledge has not been gathered throughout the entire region. Similarly, sufficient is known about some species to indicate that they are not endangered (i.e., those that are abundant), but the status of those that are rarely found is hard to judge. This makes it very

difficult to assess which species are threatened or need of special conservation measures. Even in countries where bats are relatively well-studied, little is known about the species' requirements and their geographic distribution. In some countries, such as Myanmar, Laos, Cambodia, and Vietnam, information on bats is still limited. There have been recent surveys in Laos (Francis *et al.* 1996, 1997a, b, 1999, Francis and Vonghamheng 1998, Robinson 1997, Robinson and Webber 1998) and Vietnam that have found large numbers of bats of a variety of species, some of which are new records for the country (Bates *et al.* 1997). It is likely that further surveys in all these countries will uncover many new records and probably new species.

The biology and ecology of almost all species in Pakistan is poorly known and there is no specialized bat biologist in the country. There are only a few who are either interested or properly equipped to undertake such work. Similarly, bats are rarely considered in either environmental policies or educational projects. In many cases, the only information about a species is based on the original description since it has not been collected subsequently.

Novel techniques are already being used in systematics to separate taxa that are not separable by traditional methods. For example, mitochondrial DNA and analysis of echolocation calls have been used to establish that one of the most widespread species in Europe, *Pipistrellus pipistrellus*, actually comprises two species, the nominate species and *P. pygmaeus* (Barratt *et al.* 1997; Jones and Barrett 1999). These and other techniques may have far-reaching effects on species recognition and the clarification of higher classification in Pakistan.

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Table 1. A checklist of bat species of Pakistan and their status.

Family	Genus		Species (English name)	
Pteropidae	*Cynopterus*		*C. sphinx* (Vahl, 1797) Short-nosed Fruit Bat	*DD*
	Pteropus	*	*P. giganteus* (Brünnich, 1782) Indian flying fox €	*LC*
	Rousettus	*	***R**. aegyptiacus* E. Geoffroy, 1810) Egyptian Fruit Bat	*VU*
			R. leschenaulti (Desmarest, 1820) Fulvous Fruit Bat	*LC*
Rhinolophidae	*Rhinolophus*	*	*R. blasii* Peters, 1866 Blasius's Horseshoe Bat	*NT*
		*	***R**. ferrumequinum* (Schreber, 1774) Greater Horseshoe Bat	*NT*
		*	***R.** hipposideros* (Bechstein, 1800) Lesser Horseshoe Bat	*VU*
		*	*R. lepidus* Blyth, 1844 Blyth's Horseshoe Bat	*NT*
			R. macrotus Blyth, 1844 Big-eared Horseshoe Bat	*LC*
Hippsideridae	*Asellia*	*	*A. tridens* (E. Geoffroy, 1813) Trident Leaf-nosed Bat	*LC*
	Hipposideros		*H. diadema* (E. Geoffroy, 1813) Diadem Leaf-nosed Bat	*LC*
			H. fulvus Gray, 1838 Fulvus Leaf-nosed Bat	*LC*
	Triaenops	*	***T**. persicus* Dobson, 1871 Persian Trident Bat	*NE*
Megadermatidae	*Megaderma*		*M. lyra* Geoffroy, 1810 Indian False Vampire Bat	*LC*
Rhinopomatidae	*Rhinopoma*	*	*R. hardwickii* Gray, 1831 Lesser Mouse-talied Bat	*LC*
		*	*R. microphyllum* (Brünnich, 1782) Greater Mouse-tailed Bat	*LC*
		*	*R. muscatellum* Thomas, 1903 Small Mouse-Tailed Bat	*NT*
Emballonuridae	*Taphozous*	*	*T. nudiventrus* Cretzschmer,1830 Naked-rumped Tomb Bat	*LC*
		*	*T. perforatus* E. Geoffroy, 1818 Egyptian Tomb Bat	*LC*
Molossidae	*Tadarida*	*	*T. aegyptiaca* (E. Geoffroy, 1818) Egyptian Free-tailed Bat	*LC*
Vespertilionidae	*Eptesicus*	*	***E.** bottae* (Peters, 1869) Botta's Serotine	*DD*
		*	***E**. gobiensis* Bobsrinskii, 1926 Gobi Big Brown Bat	*DD*
		*	***E**. nasutus* (Dobson, 1877) Sindh Bat	*DD*
		*	*E. serotinus* (Schreber, 1774) Common Serotine Bat	*DD*
	Scotoecus		*S. pallidus* (Dobson, 1876) Desert Yellow Lesser House Bat	*NT*
	Scotophilus		*S. heathii* (Horsfield, 1831) Greater Asiatic Yellow House Bat	*LC*
			S. kuhlii (Leach, 1821) Asiatic Lesser Yellow Bat	*LC*
	Nyctalus	*	*N. leisleri* (Kuhl, 1819) Leisler's Noctule	*EN*
			N. montanus (Barrett-Hamilton, 1906) Mountain Noctule	
		*	*N. noctula* (Schreber, 1774) Noctule	*LC*
	Pipistrellus		*P. ceylonicus* (Kelaart, 1852) Kelaart's Pipistrelle	*LC*

Family	Genus		Species (English name)	
			P. cormandra (Gray, 1838) Indian Pipistrelle	
			P. javanicus (Gray, 1838) Javan Pipistrelle	*LC*
		*	*P. kuhlii* (Kuhl, 1817) Kuhl's Pipistrelle	*LC*
			P. paterculus Thomas, 1915 Mount Popa Pipistrelle	*NT*
			P. pipistrellus (Schreber, 1774) Common pipistelle	*LC*
			***P**. savii* (Bonaparte, 1873) Savi's Pipistrelle	*VU*
			P. tenuis (Temminck, 1840) Indian Pygmy Bat	*LC*
	Scotozous		*S. dormeri* Dobson, 1857 Dormer's Bat	
	Barbastella	*	*B. leucomeaals* (Cretzschmar, 1830-31) Eastern Barbatelle	*DD*
	Otonycteris	*	*O. hemprichii* Peters, 1859 Hemprich's Desert Bat	*NT*
	Plecotus	*	*P. auritus* (Linnaeus, 1758) Brown Long-eared Bat	*NT*
		*	*P. austriacus* (J. Fisher, 1829) Grey long-eared Bat	*NT*
	Myotis	*	*M. blythii* (Tomes, 1857) Lesser Mouse-eared Bat	*DD*
		*	*M. emarginatus* (E. Geoffroy, 1806) Notch-eared Bat	
		*	*M. longipes* (Dobson, 1873) Kashmir Cave Bat	
			M. muricola (Gray, 1846) Nepalese Whiskered Bat	*LC*
		*	*M. mystacinus* (Kuhl, 1819) Whiskered Bat	*VU*
	Miniopterus		*M. schreibersii* (Kuhl, 1918) Schreiber's Long-fingered Bat	
	Murina	*	*M. tubinaris* (Scully, 1881) Scully's Tube-nesed Bat	*NT*

(After Roberts, 1997; Bates and Harrision, 1997; Nameer, 2000; Horáček *et al.*, 2000; Walker and Molur, 2003; Wilson and Reeder. 2005). (Legends: EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concerned; DD = Data Deficient; NE = Not Evaluated; * = Palearctic bat species, € = CITES – Appendix II; the species with bold generic name possess a criteria for extension which is given in Table 3.)

Table 2. Bat species reported to be present in Pakistan (after Walker and Molur, 2003).

Hipposideridae	*Hipposideros*	*H. cineraceus* (Blyth, 1853) Least Leaf-nosed Bat
Vespertilionidae	*Kerivoula*	*K.hardwickii* (Horsfield, 1824) Hardwicke's Wooly Bat
	Murina	*M. huttonii* (Peters, 1872) Hutton's tube-nosed Bat
	Vespertilio	***V**. murinus* (Linnaeus, 1758) Partcoloured Bat

Table 3. Threatened bats of Pakistan (after Walker and Molur, 2003).

Species	Status	Criteria
R. aegyptiacus	VU	B1ab (iii) (Restricted extent and continuing decline in quality of habitat; D1 (Very small population)
R. ferrumequinum	VU	B2ab(iii) (Restricted area and continuous decline in quality of habitat)
R. hipposideros	VU	B1ab(iii)+ 2ab (iii) Restricted extent and area and continuing decline in quality of habitat.
H. diadema	VU	D2 (Very small population in restricted areas and locations.
M. mystacinus	VU	D1 (Very small population)
M. blythii	VU	D1 (Very small population)
N. leisleri	EN	D1 (Very small population)
P. Savii	VU	B1ab (iii) (Restricted extent and continuing decline in the quality of habitat)
T. persicus	VU	D2 (Very small population in restricted areas and locations.

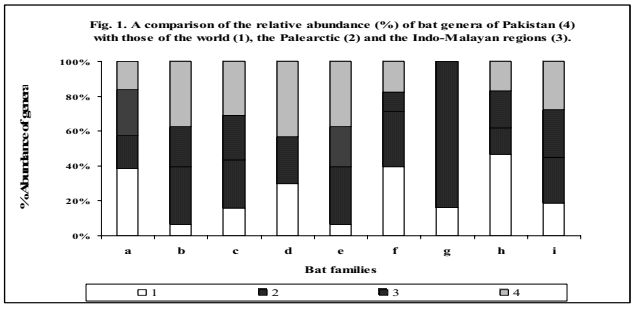

Fig. 1. A comparison of the relative abundance (%) of bat genera of Pakistan (4) with those of the world (1), the Palearctic (2) and the Indo-Malayan regions (3).

Symbols

a = Pteropodidae	**d** = Megadermatidae	**g** = Nyctridae
b = Rhinolophidae	**e** = Rhinopomatidae	**h** = Mollosidae
c = Hipposideridae	**f** =Emballonuridae	**i** = Vespertilionidae

REFERENCES

Barratt, E.M., Deaville, R., Burland, T.M., Bruford, M.W., Jones, G., Racey P.A., Wayne. R.K. (1997). DNA answers the call of pipistrelle bat species. Nature 387, 138–139.

Bates, P.J.J., Harrison, D.L. (1997). *Bats of the Indian Subcontinent.* Harrison Zoological Museum, Sevenoaks, UK.

Bates, P.J.J., Harrison, D.L., Jenkins, P.D., Walston, J.L. (1997). Three rare species of *Pipistrellus* (Chiroptera: Vespertilionidae) new to Vietnam. Acta Zoologica Academiae Scientiarum Hungaricae 43, 359–374.

Dobat, K., Peikert-Holle, T. (1985). *Blüten und Fledermäuse; Bestäubung durch Fledermäuse und Flughunde.* Waldemar Kramer, Frankfurt am Main.

Fenton, M.B. (1982). Echolocation, insect hearing, and feeding ecology of insectivorous bats. Pp. 261–285 *in: Ecology of bats* (ed. T.H. Kunz). Plenum, New York.

Francis, C.M., Guillen, A., Robinson. M.F. (1999). Order Chiroptera: Bats. Pp. 225–235 *in: Wildlife in Lao PDR. 1999 status report* (compilers Duckworth, J.W., Salter, R.E., and K. Khounboline). IUCN – The World Conservation Union, Wildlife Conservation Society and Centre for Protected Areas and Watershed Management, Lao PDR.

Francis, C.M., Guillen, A., Vonghamheng, C. (1997a). *Survey of bats and small mammals in Dong Amphan NBCA and nearby areas.* Unpublished report, Wildlife Conservation Society, New York.

Francis, C.M., Guillen, A., Vonghamheng, C. (1997b). *Preliminary survey of bats in Dong Hua Sao NBCA.* Unpublished report, Wildlife Conservation Society, New York.

Francis, C.M., Khounboline, K., Aspey, N. (1996). *Report on 1996 survey of bats and small mammals in the Nakai-Nam Theun NBCA and nearby areas.* Unpublished report, Wildlife Conservation Society, New York.

Francis, C.M., Vonghamheng, C. (1998). *Report on a survey of bats in Khammouane Limestone NBCA.* Unpublished report, Wildlife Conservation Society, New York.

Gumal, M.T., Racey, P.A. (1999). Legal protection of bats in Sarawak, Malaysia. Species 25, 31-32.

Horáček. I., Hanák V., Gaisler, J. (2000). Bats of The Palearctic Region: A Taxonomic and Biogeographic Review. Proceedings of theVIIIth EBRS 1, 11-157.

Hutson, A.M., Mickleburgh, S.P., Racey, P.A. (2001). *Microchiropteran bats: global status survey and conservation action plan*. IUCN/SSC Chiroptera Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. x + 258 pp.

Jones, G., Barrett, E. (1999). Case 3073. *Vespertilio pipistrellus* Schreber, 1774 and *V. pgymaeus* Leach, 1825 (Currently *Pipistrellus pipistrellus* and *P. pygmaeus*; Mammalia, Chiroptera): Proposed assignment of neotypes. Bulletin of Zoological Nomenclature 56, 182–186.

Nameer, P.O. (2000). *Checklist of Indian Mammals*, Kerala Forest Department (Wildlife Wing) and Kerala Agricutlure University. 90+xxv

Roberts, T.J. (1997). Mammals of Pakistan. Revised Ed. Oxford Univ. Press. Oxford.

Robinson, M.F. (1997). *Chiroptera survey. Rapid biologicalassessment Xe Paine Protected Area, Champassak Province, Lao P.D.R.* Unpublished final report, World Wide Fund for Nature, Thailand.

Robinson, M.F., Webber, M. (1998). *Small mammal survey. Khammouan Limestone National Biodiversity Conservation Area, Lao P.D.R.* Unpublished final report, World Wide Fund for Nature, Thailand. Lao PDR.

Simmons, N.B. (2005). Chiroptera. *In* Mammals Species of the World: A Taxonomic and Geographic Reference. (Eds.) Wilson, D. E. and Reeder, D. M. 3rd Edition. Volume I. John Hopkins University Press. USA.

Sinha, Y.P. (1986). The bats of Bihar: Taxonomy and Field Ecology. Records of the Zoological Survey of India. Occasional Papers 77, 1-60.

Wadia, D.N. (1953). Geology of India. 3rd Edition. McMillon Pub. Lonton, England.

Walker, S. and S. Molur. (2003). Summary of the status of the South Asian Chiroptera. Extracted from C. A.M. P. 2002 Report. Zoo Outreach Organization. CBSG South Asia and Wild, Coimbator, India.

Wilson, D.E. and D.A. M. Reeder. (2005). Mammal Species of the world-A Taxonomic and Geographic Reference. 3rd ed. Vol. The Jhon Hopkins University Press, Baltimore, U.S.A.