Monitoring, threats and conservation of hibernating bats roosts in Lebanon

Mounir R. Abi-Said

Faculty of Sciences II, Lebanese University, Al Fanar, Lebanon and Animal Encounter, Ras-al Jabal, Aley-Lebanon,
E-mail: mabisaid9@gmail.com

ABSTRACT

In this study up to 41 sites known to contain hibernating bats were surveyed during the winter of 2012-2013. There was a noted increase in the Egyptian fruit bat, *Rousettus aegyptiacus*, population in Berqayel cave. This increase was probably due to the effectiveness of the awareness program that was conducted in Berqayel after the 2010 disturbance; where thousands of R. *aegyptiacus* were shot or suffocated by fire in the cave and the destruction of the cave entrance. New roosting sites were reported for different species. However, there was a decrease in *Rhinolophus blassii* and *Miniopterus schreibersii* populations, mainly due to human disturbance. Proposed conservation measures including follow-up monitoring of bats, and broader public awareness programs are highly recommended for more effective bat conservation.

Key words: Bats, Lebanon, Conservation, Monitoring

INTRODUCTION

Bats are the only true flying mammals and include around 20% of all described mammal species. Many species of bat are closely associated with cave where they can be considered keystone species for such habitats. Bats also play an important role in dispersing seeds, pollinating flowers and controlling insect agricultural and forest pests (Gnaspini & Trajano 2000).

Currently bats are one of the most threatened mammal groups and

are declining across the world. (Hutson et al. 2001; Fujita & Tuttle 1991; Schipper et al. 2008). Bats face acts of vandalism, especially when they are hibernating or roosting in large colonies.

In terms of biodiversity the fauna and flora of Lebanon is enhanced by its geographical location to the east of the Mediterranean, moderate climate and wide range of geology, landscapes and habitats. Two-thirds of Lebanon is covered by Karst limestone formations with over 1000 natural caves. These caves provide suitable sites as bat roost during summer and winter.

In addition, Karst formations, characterized by subterranean limestone caverns carved by groundwater, which provide an immense potential of bat roosts and feeding grounds. Old information and literary records on the Lebanese bats are surprisingly scarce except for some early records in the 1960s to 70s summarized by Tohme & Tohme (1985).

The situation has changed during recent years and an intensive bat monitoring and survey programme was initiated in 2006-2007. A yearly monitoring of hibernating roosts is being carried out. This paper is intended to provide data on the present state of bats in Lebanon, identify threats they face, and recommendations for their conservation.

MATERIALS AND METHODS

The bat survey was initiated late between December 2012 and February 2013. A total of 41 caves and roosting sites were visited (Table 1). Members from caving clubs assisted in visiting the caves. Hibernating bats were identified and their numbers were estimated by direct observation. When populations were too big, the number was estimated either by taking a photo of the colony and counting them later; or by taking a small quadrate and then multiplying it by the appropriate scale to get the approximate size. All data including the name of the cave, date, location, species and number of bats were recorded.

Table 1: Caves inspected for the presence of bats.

Location/ Governorate	Cave name	Date of visit
North*	Akroum Cave	26.12.2012
North*	Zebdeen Cave	16.1.2013
Mount Lebanon	AlDaba'a Cave- Maaser	9.1.2013
Mount Lebanon	Naba'a Niha Cave	9.1.2013
Mount Lebanon	Alwataweet Cave- Besri	29.12.2012
Mount Lebanon *	Howet Wadi Aldayr Baakleen	9.2.2013
Mount Lebanon	Naba'a AlMghara	30.12.2012
Mount Lebanon	Mgharet Fakherdeen	10.2.2013
Mount Lebanon	Mgharet Al-Wataweet- Debbayeh	10.2.2013
Mount Lebanon	Naba'a Niha	9.2.2013
Mount Lebanon *	Bsayr-Chehim	14.2.2013
Mount Lebanon	Saleh– Amcheet	24.12.2012
Mount Lebanon	22-April-Antelias	24.12.2012
Mount Lebanon	Kenaan-Antelias	24.12.2012
Beqa'a	Kfarzabad	23.2.2013
North	Gallery Msailha-Chekka	28.2.2013
Mount Lebanon	Hiba – Jbeil	24.12.2012
North	Deir Mahwet – Koura	28.2.2013
Mount Lebanon	AlTarrash - Hrajel	30.12.2012
Mount Lebanon	Ser`aya – Hrajel	30.12.2012
Mount Lebanon	Afqaa	8.2.2013
Mount Lebanon	AlRwaiss	8.2.2013
Mount Lebanon	Salem Cave – Lasa	8.2.2013
Mount Lebanon	Marjaba Mine	30.12.2012
Mount Lebanon	AlHeskan- Abadieh	22.1.2013
Mount Lebanon	Old House-Chweet	22.1.2013
Mount Lebanon	Zaytoun	26.1.2013
North	Berqayel Cave	3.12.2012

North	Ras Al Chequa Cave	3.12.2012
North	Yousef Karam – Qezhaya	19.2.2013
North	Qnat Cave	19.2.2013
North	Joulman-Bhairet Toula	19.2.2013
North	Qadeesha	22.2.2013
North	Church in Kfarsghab	22.2.2013
South	Em Bazzez Aadloun	5.2.2013
South	Al alalieh Aadloun	5.2.2013
South	AlReehan	21.12.2012
South	Wadi Jilo	21.12.2012
Mount Lebanon	Fowar Dara – Tarchich	4.2.2013
North	Tripoli-Mtal Azraq - Tripoli	3.12.2012
North	Alhab Cave – Tripoli	2.2.2013

RESULTS AND DISCUSSION

Bat Species Observed in Caves

A total of 10 bat species were recorded during this survey. Table (2) shows bat species incountered, their estimated numbers and cave location. The Egyptian Fruit Bat, *Rousettus aegyptiacus*, was recorded in nine sites ranging from the coastal areas to Mount Lebanon but not exceeding an altitude of 850m above sea level. Additional new location was recorded in the Al Shouf area of Mount Lebanon. The total population size was estimated to be about 9000 individuals. An increase in the number of the Egyptian Fruit Bat in Berqayel cave, North Lebanon, was observed (Figure 2). This cave was exposed to a significant disturbance in 2010: The number has risen from ca. 1500 bat in 2011 winter census to ca. 5000 in 2013 year.

Four species of horseshoe bats were observed during the present survey. The Greater Horseshoe Bat, *Rhinolophous ferrumequinum*, was

Table 2: Caves under study with estimated number of bat species observed.

	Species									
Cave name	Mca	Mmy	Msc	Pku	Ppi	Rea	Rhb	Rhe	Rhf	Rhh
Akroum Cave		2							1	5
Zebdeen Cave	10	3								1
ALDabe'a Cave- Maaser										
Nabe'a Niha Cave		3								
Alwataweet Cave- Besri						1000				3
Howet Wadi Aldayr-Baakleen									4	1
Nabe'a ALMghara									7	5
Mgharet Fakherdeen									5	1
Mgharet Awateet- Debbayeh						850				
Nabe Niha	13									
Bsayr- Chehim						1				
Saleh– Amcheet			1			150			1	
22-April-Antelias						500				2
Kenaan						150				
Kfarzabad							17			
Gallery Msailha									3	2
Hiba – Jbeil						150				
Deir Mahwet – Koura									2	1
AlTarrash - Hrajel									1	
Seraya – Hrajel			20						15	5
Afqaa									43	9
Al Rwaiss			~600						4	5
Salem Cave – Lasa									2	4
Marjaba Mine									650	
AlHeskan						100		15	20	
Old House-Chweet					1				200	
Zaytoun						150				
Berqayel Cave						5000			1	2

Qadeesha									5	15
Yousef Karam – Qezhaya								3	2	2
Cave Qnat									3	10
Joulman-Bhairet Toula									2	
Church in Kfarsghab										300
Cave Ras AlCheqa'a						100				
Em Bazzez Aadloun				4		50				
Al alalieh Aadloun					3	200				
AlReehan										1
Wadi Jilo						20				
Fowar Dara – Tarchich										
Tripoli-Mtal Azraq						250				
Alhab Cave – Tripoli	100							15	35	
Total	**123**	**8**	**622**	**4**	**4**	**8671**	**17**	**33**	**942**	**374**

Mca: *Myotis capacinii*, Mmy: *Myotis myotis*, Msc: *Miniopterus schreibersii*, Pku: *Pipistrellus kuhlii*, Ppi: *Pipistrellus pipiitrellus*, Rea: *Rousettus aegyptiacus*, Rhb: *Rhinolophus blassii*, Rhe: *Rhinolophus euryale*, Rhf; *Rhinolophous ferrumequinum*, Rhh: *Rhinolophous hipposideros*

Fig. 2: A colony of the Egyptian Fruit Bat, Rousettus aegyptiacus in Berqayel Cave.

recorded from 21 sites across Lebanon with a total population size of approximately 1000 individuals. The Lesser Horseshoe Bat, *Rhinolophous hipposideros*, was recorded from 19 sites from all over Lebanon. The total population size is estimated to be ca. 400 individuals. This bat was encountered individually except for one big colony of ca. 300 individuals located in a church in *Kfarsghab*, North Lebanon. The Mediterranean Horseshoe Bat, *Rhinolophus euryale*, was only recorded from three sites including one new site from the North of Lebanon. The Blasius' Horseshoe Bat, *Rhinolophus blassii*, was recorded for the first time in 2007 in Kfar Zabad cave on the western slope of the Anti-Lebanon (Horacek et al., 2008). In this survey it was recorded from the same site, however with a smaller colony size of 17 individuals compared to the 2012 census.

The Greater Mouse-eared Bat, *Myotis myotis*, has been recorded from seven different sites in Lebanon (Harrison & Lewis 1961, Lewis & Harrison 1992, Harrison 1964, Atallah 1970, Tohme & Tohme, 1985, Spitzenberger 1996, Horacek et al.2008). Two new records were added during this survey from Akkar in the North of Lebanon on the Lebanese Syrian border. Their total recorded population size was eight individuals.

The Long-fingered Bat, *Myotis capacinii*, has been documented as existing in different parts of Lebanon in the summer but only two findings were made here (Horacek et al. 2008). However, three new records were documented from the winter census—two in the North of Lebanon (Akkar and Tripoli) and one from Mount Lebanon (Niha Cave). Their total population size estimated was ca. 123 individuals (Table 2).

The Common *Pipistrelle* Bat, *Pipistrellus pipiitrellus*, is the most common bat in Lebanon (Horacek 2008). In this study, it was recorded from two sites with a total of 4 individuals. Four individuals of the Kuhl's Pipistrelle Bat, *Pipistrellus kuhlii*, were found at one site in the South of Lebanon (Table 2). The Schreibers' Bat, *Miniopterus schreibersii*, was recorded from three sites during this study. In Al Rwaiss cave, more than 600 individuals were observed.

A number of differences were found in both the distribution and abundance of many of those bat species recorded here, compared with previous records available. In some case these represented reestablishment of old sites, in others loss of species from known sites. Data recorded during this survey shows a noticeable positive difference from previous years (2011-2012) in species composition, proportion of particular species, and population re-establishment of some species.

The positive increase in the population size of *Rousettus aegyptiacus* in Berqayel cave and the reappearance of *Miniopterus schreibersii* in the Al Rwaiss Cave could be attributed to the awareness programs that were executed in both sites. The programs included meetings with locals, seminars, workshops and pamphlet distribution on bats and their positive role in the environment. Likewise, in Kathmandu-Nepal a radio program and lectures about bats were effective in bat conservation (Thapa et al. 2012). Moreover, environmental education programs on three critically endangered species of fruit bats in western Indian Ocean islands have led to increased awareness about bats and their conservation (Trewhella 2005).

On the contrary to what was found in Palestine (Qumsiyeh 1996), there was no evident effect of fruit bats on the insectivorous bat population in caves where both species coexist. This could be attributed to the size of the cave as most fruit bats inhabited the entrance of the caves while insectivores went deep in the caves. Besides, most insectivorous bats are found in roosts of higher elevation where fruit bats cannot survive due to the cold winter.

Horacek et al. (2009) reported a large number of hibernating bats in 2009 in Lebanon, probably due to the cold and early winter. On the contrary, during this survey a small number of bats were recorded compared to previous years. Apparently the winter of 2013 has been undoubtedly warmer than that of previous years and the temperature in low altitudes was higher. In the same way, in south-central Texas bats emerged earlier in years with extreme drought conditions than during moist years (Frick et al. 2012). The heavy rain that occurred this year flooded some caves which affected the roosting sites of some species. This was the case in Al-Tarrash cave

of Mount Lebanon where the water level reached above three meters inside the cave.

Threats on Bats in Lebanon

Threats to bats can be in different forms: ecotourism, entering caves during hibernating season, putting fire and fireworks in caves, as well as shooting bats. In quite a few caves, tracks of bats were found on the ceiling of the caves or guano was found on the ground without the existence of bats (Figure 4). These caves might have been used as summer roosts or bats were disturbed enough to leave the roost. In Al Rwaiss cave, the colony of Schreiber's bats was relocated into a new chamber within the cave (far from the entrance pathway). This is probably due to disturbance by visitors. Lately, this cave accepts a significant number of visitors; hence bats have to relocate their hibernating site away from the disturbance of visitors. In addition, the winter was exceptionally mild, the colony would be seeking thermal stability deeper inside the cave, as *Miniopterus schreibersii* can detect small temperature differences and use this ability to select cold areas of the cave in order to enter torpor.

Fig. 4: Tracks of bats on cave ceiling and guano encountered in some visited caves.

On the other hand, the population of R. *blassii* has decreased and this is mostly caused by human disturbance, since during the survey study, an electric generator, ropes and other man-made materials were found beside the cave. Similarly in China, caves that were exposed to human disturbance in the form of recreational activities had a negative pronounced effect on the number of bat

species present (Luo et al. 2013). Similarly, Barber et al. (2009) found urban noises to have a negative effect on terrestrial vertebrates. The relative abundance and distribution of fruit bats in Malaysia was affected severely by hunting (Mohd-Azlan et al. 2001).

In summary, whilst this study has highlighted the current status of bats across many areas of Lebanon there is an urgent need to extended surveys to check on other roosts, their status, as well as a follow up on the ones under study. This will lead to better conservation of species and their habitats, hence insuring their protection. It is strongly recommended to take measures to prevent any disturbance of bats hibernating roosts. These include: routine visits from concerned locals; preventing any activity in caves during the hibernating season; the establishment of an intensive awareness program directed towards conservation of bats, their role in the ecosystem, their benefits to humans, and the importance of their conservation. Awareness programmes have proved their efficiency in saving a number of different animal species by changing human attitudes and resolving human-wildlife conflict. Similar awareness programmes should be introduced across Lebanon for bats.

ACKNOWLEDGEMENTS

The author would like to thank EUROBATS for their financial support of this work and Mr. Richard KENT, Mrs. Lina JABER, Diana ABI-SAID, and Ashraf ABI-SAID for reviewing the text of this manuscript.

REFERENCES

Abi-Said MR 2006, Reviled as a grave robber: The ecology and conservation of striped hyaenas in *the human dominated landscapes of Lebanon*. Ph.D. thesis, Durrell Institute of Conservation and Ecology (DICE), University of Kent at Canterbury, Kent, UK.

Barataud, M 2002, *The World of Bats*. Sittelle Publishers. Mens, France.

Barber, JR, Crooks KR & Fristrup KM 2009, 'The costs of chronic noise exposure for terrestrial organisms', *Ecology and Evolution*, vol. 25, no. 3 pp 180-189.

Federico P, TG Hallam, TG, McCracken, GF, Purucker, ST, Grant,

W, Correa-Sandoval, AN, Westbrook, JK, Medelli, RA, Cleveland, CJ, Sansone, CG, Lo pez JR, JD, Betke, M, Moreno-Valdez, A & Kunz, T, 2008, 'Brazilian free-tailed bats (Tadarida brasiliensis) as insect predators in transgenic and conventional cotton crops', *Ecological Applications*, vol. 18, no. 4, pp. 826–837.

Fleming, TH, Geiselman, C & Kress, WJ 2009, 'The evolution of bat pollination: a phylogenetic perspective', *Annals of Botany*, vol. 104, pp. 1017-1043.

Frick, WF, Stepanian, PM, Kelly, JF, Howard, KW, Kuster, CM, Kunz, TH & Chilson, BP 2012, 'Climate and weather impact timing of emergence of bats', PLoS ONE 7(8): e42737. doi:10.1371/journal.pone.0042737

Fujita MS & Tuttle, MD 1991, 'Flying foxes (Chiroptera: Pteropodidae): threatened animals of key economic importance', *Conservation Biology*, vol. 5, pp. 455–463.

Gnaspini, P, Trajano, E 2000, 'Guano communities in tropical caves' *Ecosystems of the World. Subterranean Ecosystems*, Wilkens, H, Culver, DC & Humphreys, WF eds., vol. 30. Elsevier Science, Amsterdan. pp. 251-269

Hall, LS 1982, 'The effect of cave microclimate on winter roosting behaviour in the bat,*Miniopterus schreibersii blepotis*', Australian Journal of Ecology, vol. 7, pp. 129-136.

Horacek, I, Benda, P, Sadek, R, Karkabi, S, Abi-Said, M, Lucan, RK, Hulva, P & Karanouh, R 2008, 'Bats of Lebanon: state of knowledge and perspectives', *Al-Ouat' Ouate*, vol. 14 pp. 52-67.

Horacek, I, Benda, P, Sadek, R, Karkabi, S, Abi-Said, M, Lucan, RK, Uhrin, M, Bou Jaoude, I, Karanouh, R & Akil, S 2009, 'Bat census in Lebanese caves 2008 & 2009', *Al-Ouat' Ouate*, vol. 15, pp. 70-73.

Hutson, AM, Mickleburgh, SP & Racey, PA 2001, *Microchiropteran bats*: *global status survey and conservation action plan*, IUCN/ SSC Chiroptera Specialist Group. IUCN, Gland, Switzerland & Cambridge, UK, pp. 258.

Jepsen, GL 1966, 'Early Eocene Bat from Wyoming'. *Science vol.*154, no. 3754, pp. 1333-1339

Kalka, MB, Smith, AR & Kalko, EKV 2008, 'Bats limit arthropods and herbivory in a tropical forest', *Science*, vol. 320, no. 5872, 71. DOI: 10.1126/science.1153352.

Kunz, TH, Betke, M, Hristov, NI & Vonhof, MJ 2009, 'Methods for assessing colony size, population size, and relative abundance of bats', *Ecological and Behavioral Methods for the Study of Bats*, 2nd edn. Kunz, TH & Parsons, S eds. The John Hopkins University Press. USA. pp. 135-157

Kurta, A & Kunz, TH 1987, 'Size of bats at birth and maternal investment during pregnancy', *Symposia of the Zoological Society of London*, vol. 57 pp. 79 – 106.

Luo, J, Jiang, T, Lu, G, Wang, L & Feng, J 2013, 'Bat conservation in China: Should protection of subterranean habitats be a priority?', *Oryx*, CJO2013. doi:10.1017/S0030605311001505.

Mohd-Azlan, J, Zubaid, A & Kunz, TH 2001, 'Distribution, relative abundance, and conservation status of the large flying fox, Pteropus vampyrus, in peninsular Malaysia: a preliminary assessment', *Acta Chiropterologica*, vol. 3, no. 2, pp. 149-162.

Qumsiyeh, Mb 1996, 'Conservation', *Mammals of the Holy Land*. Texas Tech University Press. Texas, USA, pp. 51-58.

Racey PA, Speakman, JR & Swift SM 1987, 'Reproductive adaptations of heterothermic bats at the northern borders of their distribution', *South African Journal of Science*, vol. 83, pp. 635-638

Schipper, J, Chanson, JS, Chiozza, F, Cox, NA, Hoffmann, M, Katariya, V, Lamoreux, J, Rodrigues, AS, Stuart, SN, Temple, HJ, Baillie, J, Boitani, L, Lacher, TE, Mittermeier, RA, Smith, AT, Absolon, D, Aguiar, JM, Amori, G, Bakkour, N, Baldi, R, Berridge, RJ, Bielby, J, Black, PA, Blanc, JJ, Brooks, TM, Burton, JA, Butynski, TM, Catullo, G, Chapman, R, Cokeliss, Z, Collen, B, Conroy, J, Cooke, JG, da Fonseca, GA, Derocher, AE, Dublin, HT, Duckworth, JW, Emmons, L, Emslie, RH, Festa-Bianchet, M, Foster, M , Foster, S, Garshelis, DL, Gates, C, Gimenez-Dixon, M, Gonzalez, S, Gonzalez-Maya, JF, Good, TC, Hammerson, G, Hammond, PS, Happold, D, Happold, M, Hare, J, Harris, RB, Hawkins, CE, Haywood, M, Heaney, LR, Hedges, S, Helgen, KM, Hilton-Taylor, C, Hussain, SA, Ishii, N, Jefferson, TA, Jenkins, RK, Johnston, CH, Keith, M, Kingdon, J, Knox, DH, Kovacs, KM, Langhamer, P, Leus, K, Lewison, R, Lichtenstein, G, Lowry, LF, Macavoy, Z, Mace, GM, Mallon, DP, Masi, M, McKnight, MW, Medellín, RA, Medici, P, Mills, G, Moehlman, PD, Molur, S, Mora, A, Nowell, K, Oates, JF, Olech, W, Oliver, WR, Oprea, M, Patterson, BD, Perrin, WF, Polidoro, BA, Pollock, C, Powel, A, Protas, Y, Racey, P, Ragle, J, Ramani, P, Rathbun, G, Reeves, RR, Reilly, SB, Reyn-

olds, JE, Rondinini, C, Rosell-Ambal, RG, Rulli, M, Rylands, AB, Savini, S, Schank, CJ, Sechrest, W, Self-Sullivan, C, Shoemaker, A, Sillero-Zubiri, C, De Silva, N, Smith, DE, Srinivasulu, C, Stephenson, PJ, van Strien, N, Talukdar, BK, Taylor, BL, Timins, R, Tirira, DG, Tognelli, MF, Tsytsulina, K, Veiga, LM, Vié, JC, Williamson EA, Wyatt, SA, Xie, Y & Young, BE 2008, 'The sa tus of the world's land and marine mammals: diversity, threat and knowledge' *Science* vol. 322 pp. 225–230. (doi:10.1126/science.1165115)

Thapa, S, Shrestha, S, Dahal, S, Daniel, BA & Singh, NB 2012, 'Monitoring and conservation of bats in the Kathmandu valley, Nepal', *Asian Journal of Conservation Biology*, vol. 1, pp.1-4.

Tohme, G & Tohme, H 1985, Les *Mammiferes sauvages du Liban, Universite Libanaise*. Beirut – Lebanon.

Trewhella, WJ, Rodriguez-Clark, KM, Corp, N, Entwistle, A, Garrett, SRT, Granek, E, Lengel, KL, Raboude, MJ, Reason, PF & Sewall, BJ 2005, 'Environmental education as a component of multidisciplinary conservation programs: Lessons from conservation initiatives for critically endangered fruit bats in the Western Indain Ocean', Conservation Biology, 19, no. 1, pp. 78-85.

Tuttle, MD 2003, 'Texas Bats'. Austin, EUA. Bat Conservation International, pp. 5-13