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Identification and Protection of Bat Caves in Fars province (Southern Iran)

K. Kaka Abdella[1] and F. Ghasemi[1,*]

[1]*Department of Biology, Jahrom Branch, Islamic Azad University, Jahrom, Iran*

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ABSTRACT

Due to the almost constant internal conditions of cave terminal region, it is considered as one of the most important habitat for bats. The main cause of bats population decline is habitat loss. So cave protection is necessary for bat conservation. In present study, 36 caves in 4 climates of Fars province (southern Iran) were selected, and examined in different seasons. The climate condition and cave properties were recorded at each visit.15 species belonged to 8 genus and 7 families of bats were identified in the examined caves, and their diversity and density were reported. The most caves were in temperate (44.4%) and warm regions (36%) respectively. %38 of total caves had a high variety and population of bats and there were large and deep caves which were out of access. The greatest density and diversity of bat, also were in the warm (100%) and temperate regions (93 %), and the least (13.3%) in very hot region. Drought in research region, water shortage, human interference in ecosystems and their harassment in caves have threatened bat population. According to the results, it can be argued that Fars Province is an appropriate habitat for bats. So, its caves must be principally protected.

Keywords: bat, biodiversity**,** conservation**,** habitat loss**,** population density

INTRODUCTION

Bats with 19 families and more than 1,300 species included a quarter of all mammals (Altringham, 2011). They are distributed entire world and very divers (Fenton and Simmons, 2014).

Bats play an important role in terms of ecological and economic issues (Kasso & Balakrishnan, 2013). Fruit bat has an important role in spreading seeds and pollinating plant via eating fruit and clinging pollen to their hair, respectively (Hodgkison *et al*., 2003; Zohoori 2007). Insectivorous bats are also effective in controlling populations of insect pests (Boyles *et al*., 2011; Kunz *et al*., 2011). They usually lodge in one place for many years, and presence of huge pile of their waste is a sign of their long-term living in that place (Kunz and Fenton, 2006, Boyles *et al*., 2013).

Due to the almost constant internal conditions of the cave, the presence of water, Stalagmite and Stalactite and its biodiversity, it is considered as one of the best habitat for bats, and one of the most important threats to bat population is habitat loss (Kunz *et al*., 2011), therefore, identifying places which introduced as a bat habitat and existing species identification in it is very important. These caves which including the results of scientific research and information provided by local people should be mapped and recorded, and if necessary, protective-security measures to be applied to them.

Fars province with an area of over 122600 sq. km, roughly % 1.8 percent of Iran, is located in the southern part of this country (Sedaghat Zadeh *et al*., 2012). Zagros Mountains elongated from northwest to the southeast, so that some part of it is located in the high Zagros (Fig. 1).

The geographical and climatic variation in this province with four distinct climatic regions (Sedaghat Zadeh *et al*., 2012), and vegetation, wetlands, rivers, high mountains, caves and karst formation caused to accumulate large variety of bats. Ponds, streams and gardens being close to the caves are suitable shelter for insectivorous bats living there, but unfortunately, in recent years, due to the changes created by humans in ecosystems, bats life are in danger and this is an important ecological issue.

Cave is the suitable site for bat hibernation in winter, in order to mate, give birth and raise their young in summer, and the resting site for emigrant bats (Kunz *et al*., 2011).

Sadly, many bat species around the world are endangered due to the some factors such as loss and fragmentation of habitat, diminished food supply, destruction of roosts (Kunz & Lumsden, 2003). However, despite the considerable evidence to suggest a decline in population and extinction of some bat species in the world (Huston, 2014), a significant population of bats is seen in our country, especially in the southern regions (Karami *et al*., 2008; Benda *et al*., 2012).

Given the ecological and economic value of this beneficial mammal to source good investment for agriculture, and since one of the most important factors threatening them is humans and their thriving technology, therefore, identifying them and their habitats can help to their conservation. Putting the results to the public, especially indigenous people and cavers can prevent the destruction of their habitats.

*Corresponding Author's E-mail: ghassemi.fr@gail.com

Figure 1. Map of Fars Province (Southern Iran)

MATERIALS AND METHODS

Fars province is located at 27˚ 20' to 31˚ 40' N and 50˚ 42' to 55˚ 36' E, 1350 m above sea level in the south of Iran with four distinct climatic regions as follows: The north and northwest area, mountainous, with cold winters, the central regions include 2 area, temperate region with rainy mild winters, and warm area with dry summer, and south and southeast area, has very hot summers (Sedaghat Zadeh *et al*., 2012).

Proportionate to the extent of each area and its topography, the number of large caves, in total 36 caves (Marefat, 2005), was selected and examined during a year. A minimum and maximum length of these caves is 12m and 736m respectively. All selected caves had been mapped using standard cartographic techniques by Shiraz (Iran) Mountaineering Committee. Temperature, humidity and cave properties as height, depth, the number, size (by measuring the widest and highest point) and shape (horizontal or vertical) of entrance, internal topography, internal fauna and flora and the penetration of light were recorded at each visit. The bat fauna was identified locally and in some cases, they were captured by mist net, transferred to lab and classified accordance to taxonomic key. The results were confirmed by the authorities. Diversity and density of bats were approximately reported in every area, and the relationships of those with the above futures of examined caves were determined. Obtained data were analyzed using descriptive statistics.

RESULTS

In this study, 15 species belonging to 8 genera of 7 families were reported in 36 habitats (34 caves and 2 wells) in Fars province. (Fig. 2) showed that Family Vespertilionidae had the most distribution in research region (37%). The most of caves meeting were in temperate (44.4%) and warm regions (36%) respectively (Fig. 3). The highest density (in groups with more than 700 individuals) and diversity of bat also were in the warm (100%) and temperate regions (93 %). The least diversity (13.3%) was in very hot region (Fig. 4). %38 of total caves had a high variety and population of bats, and the most population and diversity were placed in the large caves (Fig. 5-13) and well (Fig. 14) with mean temperature (28˚ c) and humidity (78%). The small percentage of caves with more than one entrance (such as Sangtrashan) was observed, and the small percentage of them was specific roost (with one species of bat).

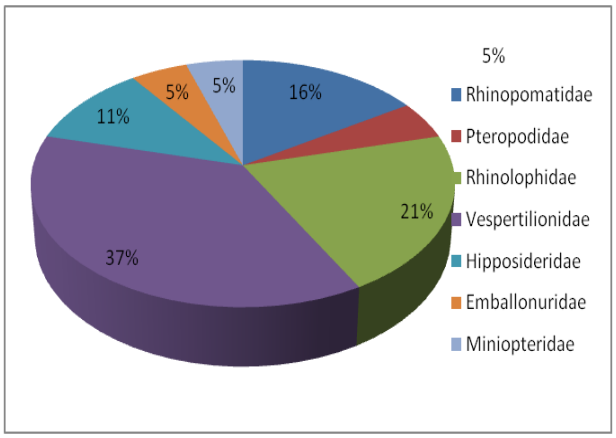

Figure 2. Distribution of bat's family in Fars province

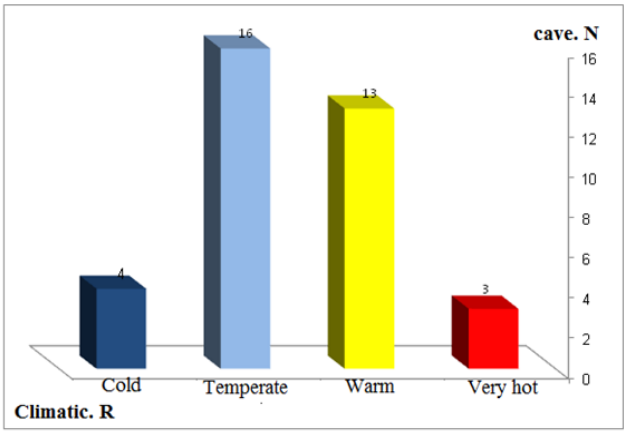

Figure 3. Distribution of caves in climatic regions of Fars province

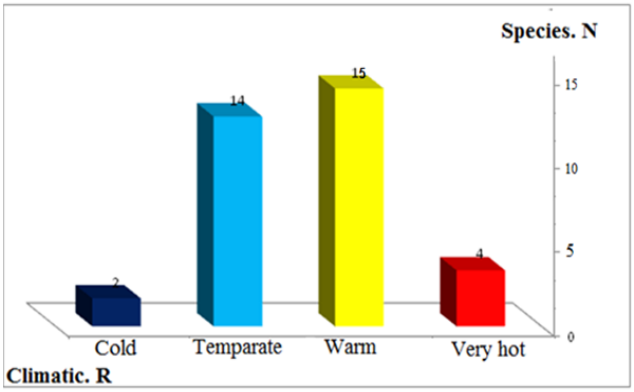

Figure 4. Diversity of bat in climatic regions of Fars province

The known species were as follows:

Pteropodidae [*Rousettus aegyptiacus* (Geoffroy, 1810)

Rhinopomatidae [*Rhinopoma hardwickei* (Gray, 1831); *Rhinopoma muscatellum*(Thomas, 1903) &*Rhinopoma microphyllum* (Brünnich, 1782)]

Rhinolophidae [*Rhinolophus hipposideros* (Borkhausen, 1797); *Rhinolophus ferrumequinum* (Schreber, 1774); *Rhinolophus Euryale* (Blasius, 1853; *Rhinolophus blasii* (Peters, 1866)]

Vespertilionidae [*Myotis blythii* (Tomes, 1857); *Myotis capaccinii* (Bonaparte, 1837); *Myotis*); *Pipistrellus kuhlii* (Kuhl, 1817)]

Miniopteridae [*Miniopterus schreibersii pallidus* (Thomas, 1907)]

Emballonuridae [*Taphozous perforates* (Geoffroy, 1818), *Taphozous nudiventris* Cretzschmar, 1830)]

Hipposideridae [*Asellia tridens* (Geoffroy, 1813)]

DISCUSSION

Bats like all animals need to food, water and shelter. They spend more than half of their lives in the roosts. Some species of bat use a variety of roosting in throughout of the year but some of them need to specific roost (Fenton and Bogdanowicz, 2002; Kunz & Fenton, 2006).

They are very sensitive during the maternity season and their young may die if their habitat conditions aren't suitable. Large cave (high and deep) with numerous tunnels, warm temperature, food resource richness (numerous insect), water and dim light sits like tunnel and hole spatially in the cave terminal often ideal for bat roosting (Lausen & Barclay, 2003), and protection of these roosts is very important for bat conservation (Presetnik, 2004).

Although the different types of habitat, bridges and large trees even houses, were in research region, but caves were the only studied site. The presence of bat guano in some sites indicating some degree of bat roosting activity. A large population of bats lives in this province, especially in warm and temperate climates. Except in the northern regions, we are facing much less cold in the province. So, warm weather is favorable for bats (Adams, 2010). Given the more extent of the warm and temperate climate in this province, it is logical that the greater number of caves is in these regions (Fig. 1).

It takes thousands of years that cave fauna adapt to life in the cave, so any change in natural conditions of cave can have irreversible effects, and the caves that include unique species are more vulnerable. In present study, the most of caves spatially large cave had a variety of bats. The temperature of a cave with some entrance is directly related to the outside temperature but the almost of the large caves that were bat roost have one entrance and their temperature change is very slow. The temperature of watering place or streamlet in the cave, also are approximately equal to the cave temperature.

It seems that positive correlation is between cave size (length, depth and height) and its topography (internal surface area) with bat population. Nui *et al.* (2007) showed that the larger caves support both greater numbers and greater diversity of bats. More height and area of these caves, habitat of bat, are desirable to their flight. Also Clawson (2002) concluded that the direct relationship is between the habitat features and morphology of bats that living in it. The most of observed bats in this study lived in the terminal of cave, deep and dark area, because there is constant temperature and abundant insects. The importance of temperature in the bat birth is more than the other factors (Mello *et al*., 2009; Voigt & Lewanzik, 2011). Although in some cases, bats (as *Rhinopoma hardwickii*) roosted close to entrance of caves.

Caves and karst contain dissolution features, sediments, and they are rich in resources as mineral (calcite, aragonite, gypsum, salt and phosphorus) and springs which provide a unique subsurface habitat for some animals such as bat. Heat enters the cave from the rock, sandstone and limestone overlying slowly. The phosphorus derived from bat droppings (guano).

Geological formations of examined caves are created from limestone, marl, chalk, salt, and thus creating pores, shallow and deep tunnels that are suitable roost for bat (Kunz *et al*., 2011), but the most of them are karst caves, and according to the fragility of this texture, it is important to protect them from destructive agents.

Water near or internal of the most examined caves due to high humidity which support vegetation within the cave even on its surrounding, and changes to airflow at the cave. Almost of meeting caves in this study, have high humidity, even 90%, that along with factors such as the presence of large piles of bat's guano is favorable for the growth of some pathogens especially fungal agents (McCallum, 2016). On the other hand the constant temperature of the cave causes the high humidity to be maintained.

Both the caves with small and horizontal entrances such as Tagi (Fig. 5), Shefagh (Fig. 6), Gharib Khane (Fig. 7), Chek (Fig. 8) and large or vertical entrances as Plangan (Fig. 9), Shopary (Fig. 10), Sangtashan with 12 large vertical entrances (Fig. 11), Shahpoor (Fig. 12), Tang Tikab (Fig. 13) and even the examined well (Fig. 14) included a large crowd of bat. As a result, the internal size of the cave is important to attract bats and not the entrance size or shape.

Numerous insects, Lepidoptera, Moths, Coleoptera and etc, spatially in large caves with high-altitude and depth, high humidity and dim light are food source for bats that most of them are insectivore and nocturnal (Paul *et al*., 2012). Since insectivorous bats feed the poikilotherm organism, arthropoda, are affected climate change (Talya *et al*., 2013). Food providing and its abundance are the important factors in growth population and diversity of bat (Wang *et al*., 2010). The caves with humidity are suitable sites for insect breeding. Also the effect of climate change on the vegetation as food resource of fruit bats isn't negligible. Of course these effects on different bat species in terms of habitat and habits are different (Kunz *et al*., 2011).

Some of the examined such as Sangtrashan (Fig. 11), Tang-Tikab caves (Fig. 13) are open to the public and a lot of visitors pass through each year. There are a number of these caves are easily available to

Figure 5. Tagi

Figure 6. Shefagh

Figure 7. Gharib Khane

Figure 8. Chek

Figure 9. Plangan

Figure 10. Shopary

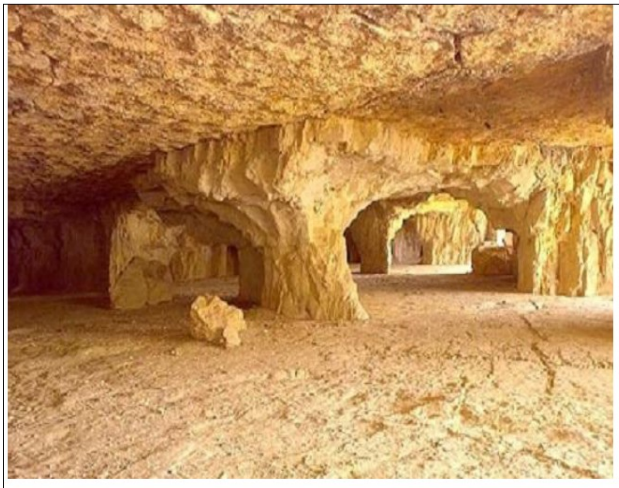

Figure 11. Sangtashan

Figure 12. Shahpoor

Figure 13. Tang tikab

Figure 14. Pardis well

the public which are more susceptible to degradation factors. The amount of CO2 of breathing or body heat of visitors and their flash light can have destructive impact in the texture of cave. The arrival of a group of 100 men to the cave can add 1 degree centigrade to cave heat for 7 minutes which has role in the evaporation of water (Cigna 1993). So interaction of tourism and environment authorities is very necessary to protection of this beneficial animal at sensitive times. Installation of signs, notifications and alerts in entrance of the caves which are exposed to visitors will reduce or prevent human disturbance of bats.

Bat conservation is important not only for biodiversity but also they provide ecological services for humans. The threat of cave is the most important factor in bat population decline, because cave is the site for their critical actions such as breeding and hibernation.

Risk factors for bat's vita

Some of known risk factors for bat's vita in examined caves in Fars province as followed:

1. Smoke from fire is fatal in the cave.
2. Excessive tourists and their noises in the cave, some trash left by tourists, changes in the ecosystems around the cave including the development of urban and rural areas as Gerdoo Eshkaft, Davan Eshkaft, Arsanjan Eshkaft) so that some caves are located within the village or even the city (Eshkoftaloo, Pardis, Sangtrashan).
3. Destruction (Degradation) of pastures and farms that are near the cave has led to reduce population of insects and food resources of bats.
4. Excessive groundwater withdrawal has caused to degrade the ground and destruct karst tissues of caves and gaps that are suitable refuges for bats, and habitat loss threatens their life.
5. It has been drawn road on the way of some caves, although it leads to attracts tourists, but non–systematic drainage causes to reduce the permeability of cave karst, and in addition, it damages formation of stalactites and stalactites in long term as well as damages biodiversity.

CONCLUSION

According to obtained results of this research, the caves of Fars province include high density and diversity of bats. So this study highlighted the importance of

the protection of these caves which leads to protect the bat population. Human interference in ecosystems, limited water resources, especially in recent drought years and visiting a cave frequently have played an important role in bat population decline. However assessment of not only large cave but also small caves must be done.

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REFERENCES

Adams, RA. 2010. Bat reproduction declines when conditions mimic climate change projections for western North America. Ecology 91: 2437–2445.

Altringham, J.D. 2011. Bats. From Evolution to Conservation. Second Edition. Oxford University Press, Oxford, 352.

Benda, P., Faizolâhi, K., Andreas, M., Obuch, J. and et al. 2012. Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 10. Bat fauna of Iran *Acta Soc. Zool. Bohem*. 76: 163–582.

Boyles, J.G, cryan, p.M, MccracKen, G.F. & KunZ, T.H. 2011. Economic importance of bats in agriculture. Science 332: 41–42.

Cigna, A.A. 1993. Environmental management of tourist caves. The examples of Grotta di Castellana and Grotta Grande del Vento, Italy. Environmental Geology .21(3): 173-180.

Clawson, R. 2002. Trends in population size and current status. In: Kurta, Allen; Kennedy, Jim, eds. The Indiana bat: biology and management of an endangered species. Austin, TX: Bat Conservation International: 2–8.

Fenton, M.B. & Bogdanowicz, W. 2002.: Relationships between external morphology and foraging behaviour: bats in the genus *Myotis*. Canadian Journal of Zoology 80: 1004–1013.

FenTon, M.B. & Simmons, N.B. 2014. Bats. A World of Science and Mystery. University of Chicago Press, Chicago, 240 pp.

Hodgkison, R, Balding, ST, Zubaid, A. & Kunz, TH. 2003. Fruit bat (*Chiroptera: Pteropodidae*) as seed dispersers and pollinators in a lowland malaysian rain forest. Biotropica 35(4): 491-502 .

Hutson, A.M., Aulagnier, S., Benda, P., Karataş, A., Palmeirim, J. & Paunović, M. 2008. *Miniopterus schreibersii*. The IUCN Red List of Threatened Species. Version 2014. at :www.iucnredlist.org.

Karami, M., Hutterer, R., Benda, P., Siahsarve, R. & Krystufek, B. 2008. Annotated check-list of the mammals of Iran. Lynx (Praha) 39(1): 63–102.

Kasso, M. & balaKrisHnan, M. 2013. Ecological and economic importance of bats (order Chiroptera). International Scholarly Research Notices Biodiversity 187415: 1–9.

Khanlari, F. 2000. Identifying the factors in the development of karstic carbonate rocks, Thesis University of Madares (Iran), 20 pp.

Kunz, T. & Fenton, M.B. 2006. Bat Ecology. University of Chicago Press, Chicago, Illinois, USA.

Kunz, T.H. & Lumsden, L.F. 2003. Ecology of Cavity and Foliage Roosting Bats, pp. 3–89, in *Bat Ecology* (T.H. Kunz and M.B. Fenton, eds.). University of Chicago Press, Chicago and London.

KunZ, T.H., Braun, D., Torrez, E., Bauer, D., lobova, T. and Fleming, T.H. 2011. Ecosystem services provided by bats. Annals of the New York Academy of Sciences 1223: 1–38.

Lausen, C.L. & Barclay, R.M.R. 2003. Thermoregulation and roost selection by reproductive female big brown bats (*Eptesicus fuscus*) roosting in rock crevices. Journal of Zoology (London) 260:235–244.

Marefat, A. 2005. The mountains and caves of Iran. Golli press. 484 pp.

Mello, MA., Kalko, EK. & Silva, WR. . .2009Ambient temperature is more important than food availability in explaining reproductive timing of the bat *Sturnira lilium* (Mammalia: Chiroptera) in amontane Atlantic Forest. *Canadian Journal of Zoology* 87: 239–245.

McCallum, E. 2016. Big trouble for little bats in humid caves, Journal of Experimental Biology 219: 1272-1273.

Nui, H, Wang, N, Zhao, L. & Lui, J. 2007. Distribution and underground habitats of cave-dwelling bats in China: Animal Conservation 10: 470–477.

Presetnik, P. 2004: Bat species and conservation issues in the castle Grad na Gorickem (NE Slovenia). Mammalia 68(4): 427-435.

Paul, R., Moosman, J.r., Howard, H., Thomas, J. and Pierre, V. 2012. Diet of the widespread insectivorous bats *Eptesicus fuscus* and *Myotis lucifugus* relative to climate and richness of bat communities. Journal of mammalogy 95(2): 491-496.

Talya, D., Hackett, C. and Marc, W.H. 2013. The Importance of *Acacia* Trees for Insectivorous Bats and Arthropods in the Arava Desert. PLoS One. 8(2): e52999.

Teeling, E.C. 2009. *Chiroptera*. Oxford University Press.

Voigt, C.C, Lewanzik, D. 2011. Trapped in the darkness of the night: thermal and energetic constraints of daylight flight in bats. *Proceedings of the Royal Society Series B, Biological Sciences* 278: 2311–2317.

Wang, J., Gao, W., Wang, L., Metzner, W., Ma, J. & Feng J. 2010: Seasonal variation in prey abundance influences habitat use by greater horseshoe bats (*Rhinolophus ferrumequinum*) in a temperate deciduous forest. *Canadian Journal of Zoology* 88: 315–323.

Zohoori, H. 2007. A Study of Population Status & Distribution of Fruit Bat (*Rousettus aegyptiacus*) in Iran. Ph.D dissertation, *Dept. of EnvironmentalScience& Energy,* Science and Research Branch of Islamic Azad University, Tehran, Iran.