Artificial Bat Roosts of Lesser Asiatic Yellow Bat, *Scotophilus kuhlii* (Leach, 1821) in Zalun Township

Aye Mon Sann[1], Khaing Wai Oo[2], Lai Lai Tun[3],
Min Zaw Latt[4], Moe Moe Khine[5]

Abstract

The present study focused on artificial bat roosts of *Scotophilus kuhlii* with the association of bat population and guano production. The chosen study sites were recorded by choosing three bat roosts in Ye Le Lay village in Zalun Township. The study was conducted from July, 2018 to June, 2019. In the study area, the artificial bat roosts were made of bamboo with dry palm leaves. In Ye Le Lay village, bat population number increased in the rainy season while reduced in cold and hot seasons. The artificial bat roosts of Site I and II were rebuilt in May, 2019. So, the higher bat population (Site I - 4882; Site II - 3279) and guano production (Site I - 10.56 kg; Site II - 7.26 kg) were recorded in June, 2019. The artificial bat roost of Site III was rebuilt in May, 2018. So, the higher bat population (Site III - 4495) and guano production (Site III - 10.56 kg) were recorded in July 2018. It was found that *S. kuhlii* roosted at the artificial roost with high population during the rainy season. The incomplete cover could not provide as a good quality shelter for roosting bats during the rainy season. The bat population and guano production were related in all study sites.

Keywords: Artificial bat roosts, bat population, guano production

Introduction

Bats are mammals of the order Chiroptera, derived from the Greek-cheir (hand) and pteron (wing) whose forelimbs form webbed wings, making them the only mammals naturally capable of true and sustained flight. Bats represent about 20% of all classified mammal species worldwide, with about 1,240 bat species divided into two suborders: the less specialized and largely fruit-eating megabats, or flying foxes, and the highly specialized and echolocating microbats. About 70% of bat species are insectivores (Brooks and Bickham, 2014). Microchiroptera is found in tropical regions with the richness of species decreasing with increasing latitude (Findley and Wilson, 1982). Roosting habits of bats are influenced by the diversity and abundance of roosts, risks of predation, the distribution and abundance of food resources, social organization and an energy economy influenced by body size and the physical environment (Kunz, 1982).

In natural habitat, the yellow house bat roosts communally in hollow trees, but the species has adapted well to urban areas and frequently roosts in large numbers in attics or abandoned buildings. They also commonly roost in buildings and in "tents" formed from modified palm fronds (Mackay, 2008). Artificial roosts are very large bat houses. Many people put up bat houses to attract bats just as some put up birdhouses to attract birds. Bat houses can be made from scratch or from kits, or bought readymade. The odor and the guano from this newly arrived colony did not please spectators, thus furthering the movement for a new bat-ordained structure (Brooks and Bickham, 2014).

Most of the *S. kuhlii* live in toddy palm trees in Myanmar. Toddy palms are mainly found in the middle and upper part of Myanmar where the climate is dry and hot. Toddy palm

[1]Lecturer, Dr, Department of Zoology, Hinthada University
[2]Associate Professor, Dr, Department of Zoology, Hinthada University
[3]Lecturer, Dr, Department of Zoology, Hinthada University
[4]Assistant Lecturer, Department of Zoology, Hinthada University
[5]Professor and Head, Dr, Department of Zoology, Sagaing University

trees stand as one of the major economies in the dry zone areas. A toddy palm trees could be continuously used for production for more than 60 years (Kyi *et al*. 2005).

In recent years, the increased use of artificial fertilizers had led to a decline in the use of bat guano in developed countries. Bat guano is an organic fertilizer, obtained naturally from the excrement and physical remains of bats living in caves. These products are rich in nutrients out classing all other existing organic fertilizers with a better balance of essential nutrient of (N.P.K), a wealth of micro-organisms and much higher levels of organic matter. Its chemical and biological composition varies according to the bat's feeding habits, type of cave, age of guano, etc. It is still however, an important source of revenue for communities in the developing world (Hutson e*t al*. 2001).

In addition, the guano can be used in any state of freshness, semi-fossilized or fossilized. Guano is provided in the ready-to-use condition. Guano can be used inside or outdoors for all living plants. Guano supplies fast and slow release nutrients to the biological system. The guano is much cheaper to use than regular manure if it is harvested naturally. Also, a smaller amount is needed to cultivate plants than ordinary barnyard or poultry manure. Using this cheap fertilizer could boost the income of farmers, and other food growers, by reducing the cost of fertilizer and the amount needed. This would result in a better crop output, and higher income. The gathering of this bat guano could be a source of income for those who do not grow food. They could sell the guano as fertilizer to those who don't have a way of getting any of this useful bat waste (Mackey, 2008).

Local people reported that the system of artificial bat roosts has been practised in Zalun environs since early 1900. Guano collection has still been undertaken in a few areas while others ended up without success. The collected guano was used by local people and sold extra guano, and got 5000 kyats per tin. To apply guano in cultivation, economically important plants such as betel plants, flowering plants, and egg plants were grown in this study area.

One of the tropical bats, *S. kuhlii* is known to be distributed throughout Myanmar. And then guano is being used as a source of fertilizer in some parts of Myanmar. So, the present work was aimed with the following objectives:

- to investigate the artificial bat roosts in Zalun Township
- to estimate the population size related with guano production in artificial bat roosts

Materials and Methods

Study site

Field work was carried out in three bat roosts in Ye Le Lay Village, (17° 43.53′N and 95° 60.273′E) in Zalun Township (Fig. 1).

Study period

The study period lasted from July 2018 to June 2019.

Artificial bat roosts

The artificial bat roosts were made of bamboo with dry palm leaves.

Collection of data

Monthly observation and collection of bats and guano was conducted at Ye Le Lay village, Zalun Township. Bats were caught by using hand net and hand collected from each

visit to the study sites. Captured individuals were kept in the bat bags and weighed using a pesola spring balance. External morphometric characters were noted down and length of the forearm were measured by calipers. The specimens were then released back after the measurement was taken. Accidentally dead bats were preserved in 70% alcohol for other examination.

Identification of the bat specimens

The collected bat species were identified according to Corbet and Hill (1992), Bates and Harrison (1997), and Borrisenko and Kruskop (2003).

Estimation of bat population

Population status of bats colony was estimated in the study sites by using tally counter during their emergence time, started with the 1th bat flew out from the roost at dusk and ended after the last bat had emerged according to Speakman *et al*., (1992) and Kunz *et al.*, (1996) (Plate 1).

Collection of guano

Guano produced from each roost site was collected and volume monthly was weighed by using Spring Dial Scale Balance (Plate 2).

Fig. (1) Map of specimen collection in the study site

Plate (1) Bats roosted in palm fronds

Plate (2) Fresh guano

Source: Geography Department, Hinthada University

Results

Systematic position of *Scotophilus kuhlii*

Phylum	-	Chordata
Class	-	Mammalia
Order	-	Chiroptera
Family	-	Vespertilionidae
Genus	-	*Scotophilus*
Species	-	*S. kuhlii* (Leach, 1821)
Common name	-	Lesser Asiatic Yellow Bat (Bates and Harrison, 1997)

Diagnostic features

The average forearm length of this species was (46.02±6.16) mm. A unique physical characteristic of the lesser yellow house bat was the tail, which is long and covered with the interfemoral membrane between the hind legs. This species has pointy ears and a dog-like face with a dull muzzle. The muzzle is broad, blunt and dull muzzle. The tragus is about half the size of the ear and is crescent shaped and separated from the pinna by a distinct notch. Dorsally, the pelage is soft and olive brown in colour and ventrally pale brown (Plate 3).

(A) Front view

(B) Head

Plate (3) *Scotophilus kuhlii* Leach, 1821

Construction of artificial bat roost

New artificial bat roosts at study site I and II of Ye Le Lay village were built during May 2019. The construction was made by using four giant bamboo poles, small bamboo poles and hundred dried palm fronds. The giant bamboos were used as main poles while small poles were used as frames of the roost. Palm fronds were used as side cover while about 60 da-ne sheets were applied for roof of the house. The height of artificial bat roost was (4.85 m) and the basal width was (2.28 x 2.28 m) and the upper roost width was (1.64 x 1.64 m). Changing and washing dirty or dry leaves were also conducted to reject bugs and attract bats for staying in roots in long period (Plate 4).

(A) Typing of palm fronds

(B) Frame bamboos

(C) Construction of roof

(D) Complete bat roost

Plate (4) Construction of artificial bat roost in Ye Le Lay Village

Association of bat population and guano production at artificial bat roosts

Three artificial bat roost sites in Ye Le Lay village, Zalun Township, Hinthada District were recorded (Plate 5).

The highest bat population in Ye Le Lay village site I was 4882 individuals in June 2019 and the highest guano production was 10.56 kg in June 2019. The lowest bat population

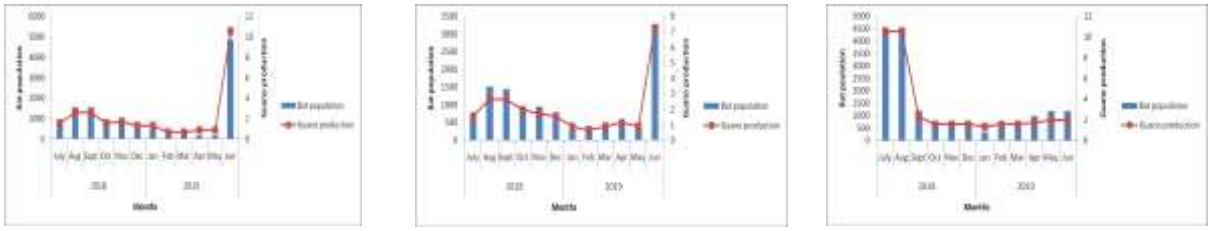
was 148 individuals in February 2019 and the lowest guano production was 0.66 kg in February and March 2019 (Fig. 2.A).

The highest bat population in Ye Le Lay village site II was 3279 individuals in June 2019 and the highest guano production was 7.26 kg in June 2019. The lowest bat population was 242 individuals in February 2019 and the lowest guano production was 0.66 kg in February 2019 (Fig. 2.B).

The highest bat population in Ye Le Lay village site III was 4495 individuals in August 2018 and the highest guano production was 10.56 kg in the July and August 2018. The lowest bat population was 328 individuals in January 2019 and the lowest guano production was 1.32 kg in January 2019 (Fig. 2.C).

(A) Site I (B) Site II (C) Site III

Plate (5) Artificial bat roost in Ye Le Lay Village



(A) Site I (B) Site II (C) Site III

Figure (2) Association of bat population and guano production in Ye Le Lay Village

Discussion

The artificial bat roosts of *Scotophilus kuhlii*, Lesser Asiatic Yellow bat was studied in Zalun Township. Three study sites were chosen in Ye Le Lay village and bat roosts were made by using palm fronds with bamboo poles. The guano production was also recorded during the period of study.

Sinha (1986) stated that *S. kuhlii* frequents both the rural and urban landscapes and is known to roost in crevices and holes in walls of huts and old buildings, caves, old temples, palm fronds, hollows in palm trees and dried leaves on trees. In Brooks and Bickham (2014), the yellow house bat can co-exist with humans in rural and urban areas. In the natural environments, they roost in dark caves, the dried leaves of palm trees, hollow tree trunks and so forth. They reside in natural surrounding or man-made constructions or they truck themselves into narrow dark clefts.

In Ye Le Lay village, the changes of roosting bat population were found depending on different sites in study area. The artificial bat roosts of Site I and II were rebuilt in May, 2019. So, the higher bat population (Site I - 4882; Site II - 3279) and guano production (Site I

- 10.56 kg; Site II - 7.26 kg) were recorded in June, 2019. The artificial bat roost of Site III was rebuilt in May, 2018. So, the higher bat population (Site III - 4495) and guano production (Site III - 10.56 kg) were recorded in July 2018. It was found that *S. kuhlii* roosted at the artificial roost with high population during the rainy season. It could be suggested that the incomplete cover could not provide as a good quality shelter for roosting bats during the rainy season. Seasonal variations of bat population were found in all study sites. The lower and unstable condition of bat population was found in hot and cool seasons and it could be concerned with their foraging activities, reproductive strategies and disturbance by the natural enemies. The present study showed that in all study sites, bat populations were not constant every month. Bats were moved away foraging areas and good roosts seasonally.

Min Min Win (2012) stated that *S. kuhlii* was found in toddy palm tree leaves in Bago Township, Taungoo Township and Maubin Township. Thus it was noted that *S.kuhlii* could roost in available roosting places of toddy palm tree leaves and artificial roosts. Mackay (2008) stated that some bats use only one type of roost, for example caves, while others may vary the roost type seasonally. In many cases, even bats that consistently use one type of roost site will frequently change sites. In Brooks and Bickham (2014), it was described that some yellow house bats may have more than just one roosting site around the foraging areas. Some biologists stated that this behavior serves as a mechanism of avoiding predation.

The population size of *S. kuhlii* was found to be larger in the rainy season and smaller in the cold season at artificial bat roost of rural area as the roosts were maintained regularly by its owners. The complete covering of these roosts could be protected well from heavy rain and the adverse weather. In the present study, it could be related that the reproductive timing of *S. kuhlii* coincided with the rainy season and thus bats had to need good shelter. The observation of falling off bat population during the hot and cold season could be due to the seasonal migration regionally. Fenton (1997) described that temperate zone bats may have a variety of movement ranging from short distances between roosts and foraging areas to long-range migrations between seasonally occupied sites. This may also be agreed with above findings of tropical bats.

Tuttle (2003) stated that estimates of bat fecal deposition (e.g., guano) have been used as an index to bat population size. Kunz *et al.*, (2009) described that this indirect index to population abundance assumes a consistent relationship between the guano accumulation under a roosting colony and the number of bats present. There was a relation between bat population and guano production in all study sites. Recent findings were agreeable with above statements since the guano deposition of *S. kuhlii* could be an indication of their population. According to the present finding, awareness amongst developers and planners of the need to consider bats and their roosts, their migration route and feeding areas when constructors are assessing applications to build artificial bat roosts for organic fertilization.

Conclusion

The present finding highlighted on the higher bat population and guano production was related with good shelter for roosting bats. If the number of artificial bat roosts can be more practiced and constructed with good quality, rebuilding and maintaining of bat roosts regularly by using good materials, and protection from heavy rain and adverse weather condition to shelter and rest well in rainy seasons, it will provide to be higher bat population and to collect the enormous of guano production with better quality by local people. Nowadays, it finds out application of guano as bio-fertilizer is more effective in the cultivation of economically important plants (betel plant, flowering plant and egg plant) in this study area.

Acknowledgements

We would like to express our gratitude to Dr Nilar Myint and Dr Mar Lar, Pro-Rectors of Hinthada University, for their permission of do this research work. We also thank to Dr Yi Yi Win, Professor and Head, and Dr Htay Htay, Professor, Department of Zoology, Hinthada University, for their valuable suggestions.

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