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The Lesser Mouse-tailed Bat (*Rhinopoma hardwickii*)– A Potential Bio Control Agent in Suppression of Insect Pests in Rice

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ABSTRACT: Insectivorous bats are highly effective generalist predators, and studies have documented the presence of many agricultural pest species in their diet. Hence an attempt was made to know the role of insectivorous bats in suppression of insect pests in rice crop. During the period a survey was conducted in rice growing areas of Rangareddy district and also identified roosting sites of lesser mouse-tailed bat near these locations. A total of 18 bat pellets were collected from the roosting site and analysed by using standard protocols and images were taken by stereo micro scope. Similarly light traps were placed in rice fields and collected data in respective locations. The insect data available in the light trap was correlated with the occurrence in bat pellets. Analysis of 18 pellets resulted in to 437 prey items as bat foods. Among the 437 prey items highest prey items were recorded by Coleopteran insects (112) followed by Diptera (98), Lepidoptera (62), Orthoptera (38), Hymonoptera (35) Hemiptera (26), Homoptera (14) and unidentified with 52 prey items. The light trap data showed that the diet of the bat closely related to availability of prey in the study area. This relationship represents opportunistic hunting by bats in rice habitats as reasonably characterized by prey availability. The presence of 88% insects found in the diet of bat pellets in the present study indicates their potential in regulating insect populations in crop fields as one of the component in Integrated pest management. By providing adequate roosting sites in preserving mature tree species and creating awareness among the public would enhance the population and conservation of insectivorous bats.

Keywords: Insectivorous, Bats, Paddy ecosystem, Bio-control agent, Insect pests and Survey etc.

INTRODUCTION

The rice crops have a significant role in human nutrition; this graminaceous plant of Asian origin serves as the primary source of nutrition for about half of the world's population (Fukagawa and Ziska 2019). India, China, Japan, Indonesia, Thailand, Burma, the Philippines, and Bangladesh are the top nations for rice production (FAO 2020). India is amongst the top most rice producers in the world, second only to China. Rice contributes more than 40 per cent of the country's total food grain production (Anonymous, 2018) the annual production of rice in India is 127.93 million ton during 2021–22 (Second Advance Estimates of Production of Major Crops for 2021-22). In Telangana, it is grown around 62.12 lakh acres and it yields 1.6 crore tonns. Reduction in the rice yield is due to many biotic and abiotic stresses such as, pests, diseases, soil fertility, rainfall, water logging and climatic conditions. Among the major yield limiting factors pests are an important one. Pest causes 30 % production loss in India (Sachan *et al*., 2006; Dhaliwal *et al*., 2010). Rice crop is attacked by more than 100 species of insects and 20 of them cause economic damage (Basit and Bhattacharya 2001). To control these pests pesticides are using which causes human health hazard, degrade ecosystem function, upset the integrated pest management (IPM) programs, and devastate populations of natural insect predators and parasitoids. In addition, they have evolved some degree of pesticide resistance.

To limit pesticide and includes the use of biological control agents, which are living organisms that prey upon pest species. Native generalist predators can effectively serve as agents of biological control. Insectivorous bats are highly effective generalist predators, and studies have documented the presence of many agricultural pest species in their diet. Especially during the summer months, when bats are raising young, female bats consume a significant proportion of their body weight in insects per day. Because they feed within a few kilometers of their roost site and return to the same roost every day, bats may play an important role in local suppression of agricultural insect pests. The existence of the bats from a single locality in Dwarka, Delhi from a relatively green region with intermixing of many medium to high rise residential as well as educational buildings is enigmatic and requires further surveys (Dookia and Mishra 2018). Kolkert *et al.* (2020) indicated that insectivorous bats are selective predators that exploit a narrow selection of preferred

pest taxa and potentially play an important role in controlling lepidopteran pests on cotton farms.

In Telangana a total of five species of insectivorous bats were reported and their roosting sites are caves. Among these five species, lesser mouse-tailed bat is most common. The lesser mouse-tailed bat is a small bat with a long thin tail resembling that of a mouse, hence its name. Lesser mouse-tailed bats are insectivorous bats with beetles making up about 50% of their diet. They also feed on moths, but their overall diet is much less diverse than other bats (Whitaker Jr. and Yom-Tov 2002). Lesser mouse-tailed bats swoop and glide at 5 to 10 meters off the ground when in search of food (Davis, 2007; Whitaker Jr. and Yom-Tov 2002). As bats are now becoming threatened, their conservation is of major importance; understanding its role in the sustenance of ecosystem (Paliwal and Bhandarkar 2021). Hence the present study hypothesis envisages dietary evaluation of lesser mouse-tailed bat in relation to availability of insect pests in rice crop and roosting locations.

MATERIAL AND METHODS

The survey was conducted in five locations of major Paddy growing areas in Rangareddy district to find out the roosting sites and their feeding activities of lesser mouse tailed bat. Guano samples were collected from a foil lying under individuals in five locations where bats are roosting. A long term monitoring of bats has been carried out in all locations. Clusters were always checked for the species composition directly at the roost or later in photographs and confirmed as lesser mouse-tailed bat. Bat pellets were collected roughly twice per month, between June 2021 and Nov 2021 (18samples in total). Each sample comprises 60–120 guano pellets collected randomly from the foil surface. 18 faecal droppings were further analyzed at in the office of All India Network Project on Vertebrate Pest Management Laboratory (Table 1). The foil was changed after each pellet sampling. Pellets were stored in 96% alcohol in microtubes and later examined with a stereo microscope. Prey categories were identified using comparative slides, methodological works and entomological keys as per the McAney *et al*. (1991); Whitaker *et al*. (2009); Chinery (1977). Expressing the proportion of items identified in analysed pellets, percentage volume (vol.%) was used as per the Whitaker *et al*. (2009). Similarly two light traps per acre were placed in rice fields during the transplanted stage near the location of bat roosting site and collected data in respective locations up to harvesting stage of the crop in weekly intervals. The collected insects in light trap were identified by using keys and categorized up to order level and correlated with the occurrence in bat pellets.

Table 1: Surveyed villages along with number of pellet samples collected.

Sr. No.	Villages	Samplings
1.	Jinnaiguda	3(182)
2.	Tukkuguda	6(354)
3.	Raviryal	4(220)
4.	Kongara	3(194)
5.	Ibrahimpatnam	2(132)
6.	**Total**	**18 (907)**

Fig. 1. Roosting site along with bats, bat pellets and light trap.

RESULTS AND DISCUSSION

During the period a total of five rice cultivating locations were surveyed in Rangareddy district and collected pellet samples of lesser mouse-tailed bat, similarly light traps were placed in rice fields and collected data in respective locations. The insect data available in the light trap correlated with the occurrence in bat pellets. The pellet analysis was done using standard protocols and images were taken by

using stereo micro scope. Analysis of 18 pellets resulted in to 437 prey items as bat foods. The diet of the bat was predominantly with insects (88.1%) followed by unidentified material (11.9%) (Fig. 2). Among the insects (88.1%) the composition of orders recorded include Coleopteran insects (112) followed by Diptera (98), Lepidoptera (62), Orthoptera (38), Hymonoptera (35) Hemiptera (26), Homoptera (14) and unidentified with 52 prey items. The analysis data revealed that the dietary composition of lesser mouse-tailed bat *(Rhinopoma hardwickii)* showed high occurrence of Coleopteran insects (26%) followed by Diptera (23%), Lepidoptera (15%), Orthoptera (8.7%), Hymenoptera (8.01%) Hemiptera (5.95%) Homoptera (3.2%) and unidentified with 12%. Further molecular analysis is required to identify the diet composition up to species level.

The light trap analysis showed that the diet of the bat closely related to availability of prey in the study area. The occurrences of these insect orders were dominant in bat pellets. This relationship represents opportunistic hunting by bats in rice habitats as reasonably characterized by prey availability. The overall analysis showed that the bat diet consists of predominantly insects and played significant role in reducing the rice pests in the study range.

Table 2: Dietary composition of Lesser mouse-tailed bat.

Sr. No.	Name of the order	No. of insects as a prey	Percentage of diet composition
1.	Coleoptera	112	25.63
2.	Hemiptera	26	05.95
3.	Hymenoptera	35	08.01
4.	Orthoptera	38	08.70
5.	Diptera	98	22.43
6.	Homoptera	14	3.20
7.	Lepidoptera	62	14.19
8.	Unidentified material	52	11.90

The presence of 88% insects found in the diet of bat pellets in the present study indicates their potential in regulating insect populations in crop fields as one of the component in Integrated pest management. By providing adequate roosting sites in preserving mature tree species and creating awareness among the public would enhance the population and conservation of insectivorous bats.

In Thailand bats act as efficient biological control agents of rice pests reported by Leelapaibul *et al.* (2005); Wanger *et al*. (2014). Against Lepidopteran pests, bats play a significant role in defending economically valuable crops. Numerous kinds of bats have been observed to consume insects that are regarded as pests and often congregate in huge proportions in cultivated environments. Installing artificial roosts (sometimes known as "bat boxes") can be a very effective approach to safeguard bats and be very beneficial to agriculture (Riccuci and Lanza 2014). Our findings are in lined with earlier reports the rice striped borer, *Chilo suppressalis*, one of the most destructive pests, is effectively controlled by the *Soprano pipistrelle, Pipistrellus pygmaeus,* in the Ebro Delta (Spain) reported by (Flaquer *et al*., 2011). Yara *et al.* (2019) also confirmed that availability of abundant feeding areas provided by the rice fields to aerial insectivorous bats, together with presence of artificial and natural roosts to these bats, could ensure year-round permanence of a rich ensemble of insectivorous bats in the rice field-forest landscape in the north western Llanos of Venezuela. We consume less pesticides when there are less pesticides applied on crops. One of the greatest friends for organic farmers is the bat. They play a part in pest management, and luring bats to farms can significantly benefit farmers who choose to employ biological pest control over chemical pesticides that may be hazardous to our environment and health.

CONCLUSIONS

Supporting nearby caves and other non-crop habitat is a bat-friendly agriculture practice. Maintaining tree lines and forest patches with a variety of plants can aid in creating habitat for species that live in caves. Additionally, keeping existing dead trees in place and refraining from demolishing ancient buildings (such as barns) where bats may be roosting will assist sustain the availability of bat habitat. Installing bat houses all throughout a farm gives these kinds of bats a great environment and can generate significant maternity colonies. So it is high time to conserve the bats which are act as a potential natural biocontrol agent in suppressing the agricultural important pests in field & horticultural crops.

FUTURE SCOPE

In the present study, insects identified in pellet analysis are upto order level based on morphological characters. Molecular work is required to identify the insects upto species level.

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Conflict of Interest. None.

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