Seasonal Changes of Diet Consumed by *Pipistrellus tenuis* (Temminck, 1840) in Laymyethna Township, Hinthada District

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Abstract

The study on the diet of *Pipistrellus tenius* (Temminck, 1840) was carried out at Laymyethna Police Station, Hinthada District from April 2005 to December 2008. The faecal analysis resulted in nine insect orders were consumed by *P. tenuis* with respective percent volume as followed; Lepidoptera (30.6%), Homoptera (28.4%), Diptera (18.6%), Coleoptera (13%), Heteroptera (6%), Hymenoptera (1.6%), Odonata (0.1%) and Ephemeroptera (0.03%) indicating Lepidoptera, Homoptera, Diptera and Coleoptera were found as highest percent volume and percent frequency in the diet and most component of the diet for several months of the study period. The contents of the faecal pellets (the number of orders) slightly varied to be nine, eight, eight and eight orders in 2005, 2006, 2007 and 2008 respectively. The order of Heteroptera comprised the second dominant proportion of the diet although it was not found throughout the year. The minor prey items of Orthoptera, Odonata, Hymenoptera and Ephemeroptera were the least components found in the diet and were found sporadically during study period.

Key words: faecal analysis, *Pipistrellus tenius,* percent volume, percent frequency

Introduction

Bats (Chiroptera) comprise the second largest order of mammals, with 177 genera and 925 species. The Chiroptera are subdivided into two orders: the Megachiroptera (the Old World fruit bats) and the Microchiroptera (all other bats). At present there are 1100 recognized species of bats world wide, which including the Megachiroptera and the Microchiroptera constitutes about a quarter of all known mammal species (Huston *et al.,* 2001) and approximately one fifth of the living species of mammals as recorded by Wilson & Reeder (2003). Bats are found throughout the tropical, sub-tropical and temperate latitudes (Hill & Smith, 1984).

Bats have a number of trophic roles; some species feed on insects, other on fruit and leaves, nectar, and blood (Bhat, 1995). The feeding behavior of bat species can generally be categorized as primarily fruit (frugivorous), nectar and pollen (nectarivorous), insect (insectivorous), blood (sanguivorous), small mammals, birds, lizards and frogs (carnivorous) or fish (piscivorous). Bats are great importance due to their roles in pollination, seed-dispersal and pest control. Approximately 70% of the living species of bats and the majority of those known as fossils are or were insectivorous. All microchiropteran families prey upon insects to some extent. In addition, they use a variety of habitats both for roosting and feeding. Some species have adapted well to urban environments and bats can be found feeding and roosting within major conurbations (Huston *et al.*, 2001).

Insectivorous bats have been suggested as the primary consumer of nocturnal insects (Kunz & Pierson, 1994). They are found throughout the tropical and temperate zones and are thought to play an important role in the regulation of many insect populations (Barlow, 1999). Thus large colonies of insectivorous bats may be responsible for the large scale depletion of pest insects in surrounding farmlands. Most insectivorous bats exhibit marked temporal variation in the types and diversity of prey in their diet (Whitaker, Jr. & Rodriguez-Duran, 1999). However, relatively little is known about the factors influencing dietary variation in insectivorous bats.

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Most dietary studies of insectivorous bats have reported lists of prey items consumed based on insects identified from faeces or stomach contents, and expressed as percent frequency. Some species consume very large quantities of insects (Kurta *et al.*, 1989; Kunz *et al.*, 1995). Bats are predators on a number of economically important insects on crops such as corn, cotton, and potatoes (Whitaker, Jr., 1993).

The food habits of insectivorous bats can be influenced by several factors, including the times of nightly emergence (Erkert, 1982), seasonally changing energy and nutrient demands (Kunz *et al.*, 1995), temporal and spatial distribution of their prey (Wolda, 1988), and prevailing climate and meteorological condition (Anthony *et al.*, 1981).

Vespertilionids are the largest group among the bats comprising about 350 species. Nineteen genera of vespertilionids are known to be in the Indian subcontinent (Bates & Harrison, 1997). One of the small size vespertilionids, the genus *Pipistrellus* is geographically widespread. Of the 51 species of *Pipistrellus* currently recognized by Koopman (1993), 14 species occur in Myanmar (Bates *et al.*, 2005). *Pipistrellus tenuis* is the smallest pipistrelle found in the Indian Subcontinent including Myanmar with an average forearm length of 28.67 mm and body weight about 2 g. It was recorded from Rakhine State (Pearch *et al.*, 2003), Kachin State and Sagaing Division (Carter, 1943) and Shan State (Ryley, 1914). This species may prove to be abundant in agricultural and heavily disturbed landscape (including cities) (Borassenko & Kruskop, 2003). The diet composition of *P. tenuis* was studied in different regions of India and reported that its diet varies according to the seasonal availability of food.

In Myanmar, no study on feeding ecology of this species has been conducted although its distributional record extends from North to South. Therefore, the present work is aimed to focus with the objectives as (1) to use contents of faecal pellets to ascertain what items were ingested by *P. tenuis* at intervals throughout its annual activity period, (2) to document diet variation among sampling seasons and (3) to determine the seasonal prey selection based on frequency and volume of each dietary item.

Materials and Methods

Study area and Study period

Laymyethna Township (17º 35.965' N 95º 10.401' E), approximately 37.01 km far from Hinthada Township (17° 39.173´ N 95° 27.088´E). The climate is characterized by tropical monsoon. The study site of *P. tenuis*, Police Station of Laymyethna is located close to the main road (Figure 1). Study period lasted form April 2005 to December 2008.

Collection of faecal pellet

To study feeding ecology of *P. tenuis*, 10 faecal pellets were monthly collected beneath its roosting site. Faecal pellets collected were dried and stored separately in 70 percent ethanol in plastic containers.

Identification

Identification of insect remains to taxonomic order was determined, when possible, using keys and descriptions in Whitaker, Jr. (1988), Shiel *et al.*, (1997).

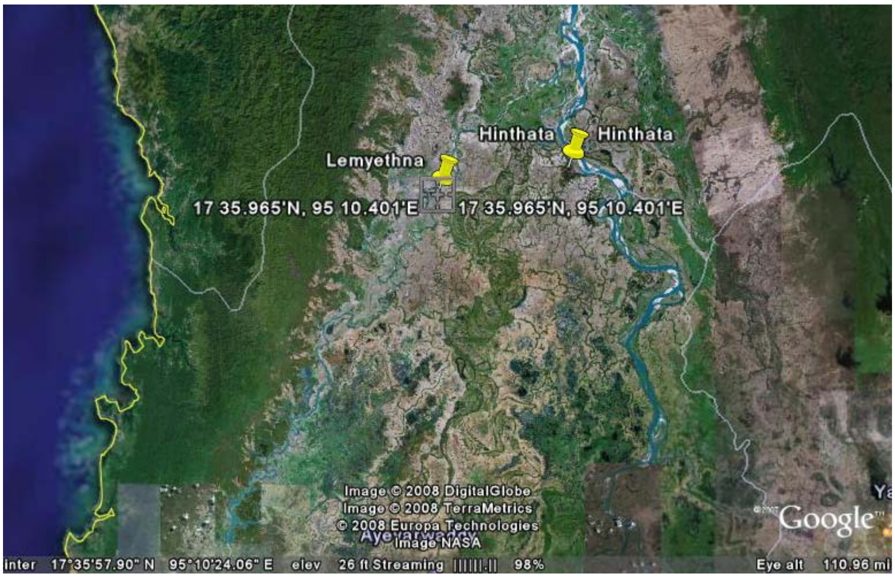

Figure 1 Study area in Hinthada Township, Ayeyarwady Division
Source: Google Earth

Results and Discussion

Prey items recorded in faecal analysis

Faecal analysis showed nine orders of insect preys which were consumed by *P. tenuis* during the study period. The recorded items include Coleoptera (beetles), Lepidoptera (moths), Heteroptera (true bugs), Hymenoptera (bees, ants, and wasps), Homoptera (leafhoppers, planthoppers), Odonata (dragonflies and damselflies), Orthoptera (grasshoppers, crickets, walking sticks and mantis), Diptera (true flies) and Ephemeroptera (mayflies).

In respect of the method of faecal analysis, Black (1972) suggested that diets of insectivorous mammals are evaluated by analysis of stomach and gut contents, or by analysis of faecal materials. Advantages of faecal analysis are twofold: animals need not to be killed, and invertebrate fragments are more compact in faeces than in the gut, thus reducing the time the investigator spends searching for recognizable parts. However, disadvantage of this analysis is that both small and soft-bodied insects may be overlooked, thus under-represent the contribution of these to the diet. However, McAney *et al.* (1991) agreed the advantage of the faecal analysis as a reliable method for measuring occurrence of insects in the diet because insect fragments are unlikely to be overlooked and consist of readily identifiable structures such as wings, legs, and antennae. According to the results from the present analysis the insect fragments observed in the pellets of *P. tenuis* appear to be similar as those of *P. minus minus* that analyzed by Advani (1981) in Rajasthan Desert, India. It could thus be disclosed that faecal analysis is an acceptable and dependable method to be used for further research.

Dietary components as shown by percent volume

A total of 480 faecal pellets was collected from the roost of *P. tenuis*, located in the police station of Laymyethna Township during the study period. Faecal analysis indicated that *P. tenuis* fed on nine insect orders. In overall it showed the highest percent volume in Lepidoptera (30.6%), followed by Homoptera (28.4%), Diptera (18.6%) and Coleoptera (13%) in the faeces. These four orders of insects formed the majority (90.6%) of the diet. The remaining items were Heteroptera, Hymenoptera, Orthoptera, Odonata and Emphemeroptera with the percent volume of 6%, 1.6%, 1.6%, 0.1% and 0.03% respectively.

Dietary components as shown by percent frequency

The percent frequency of prey items found in the diet of *P. tenuis* was also Lepidoptera with the maximum percent frequency of 25%, followed by Homoptera (21.8%), Diptera (19.3%) and Coleoptera (28.4%). The other items (Heteroptera, Hymenoptera, Orthoptera, Ephemeroptera and Odonata) found in the faeces had the respective frequencies of 11%, 2.2%, 2%, 0.2% and 0.1%.

The analyses of diet consumed by *P. tenuis* indicate that there are some variation in diet both by volume and frequency. However, the predominant order of insects in the diet was observed to be Lepidoptera although Homoptera, Diptera and Coloeptera were also consumed in appreciable amounts. Best *et al.* (1997) found in the diet study of *Myotis grisescens* (gray bat) in Alabama that there are more Lepidoptera in the samples of potential prey. Perhaps, it took longer for scales and other body parts of Lepidoptera to pass through the digestive tract of the bats, and these remains were not defecated until the evening emergence. This might account for the high incidence of Lepiodoptera in faecal pellets obtained early in the evening.

Monthly dietary composition as shown by Percent Volume

In 2005, the main constituent was Lepidoptera as the greatest percentage volume with 33.3%, 29.5%, 53.6% and 45.5% in April, July, November and December respectively among the recorded orders. Homoptera with the maximum percent volume of 57% found in October. Diptera was found throughout the study period although the greatest percent volume was shown in May (27.2%) and June (31.7%). In August (34.4%) and September (37%), Coleoptera was found as the highest percent volume and also recorded in the remaining months. The other items, Heteroptera, Orthoptera, Hymenoptera, Odonata and Ephemeroptera were observed sporadically in the faecal pellets (Figure 2).

In 2006, Lepidoptera as the maximum percentage volume in January (50.2%), May (41%), August (50%) and October (31%) and again in the majority of the months of 2007 with 36.7% (January), 56.2% (February), 37.5% (May), 46.7% (June), 53.2% (July), 41.2% (October) and 35.8% (November) (Figure 4, 6).

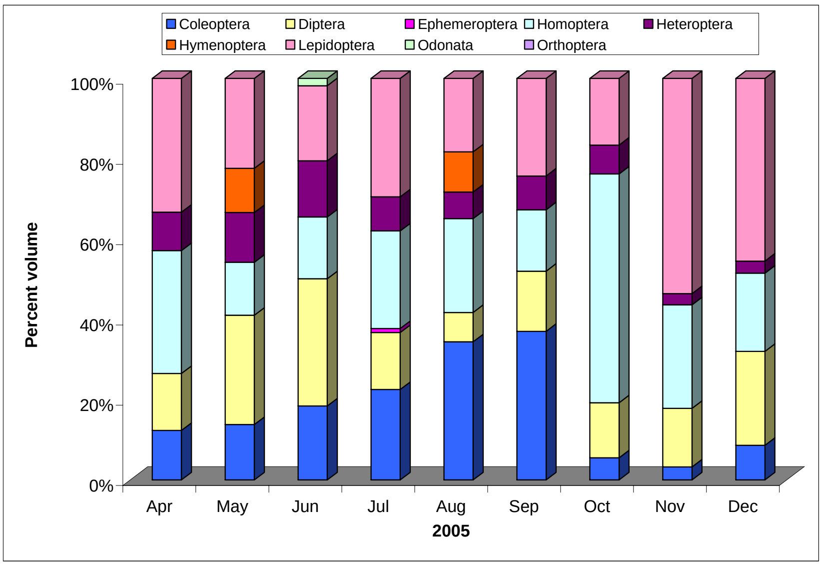

Figure 2 Percent volume of monthly dietary composition of *P. tenuis* in 2005

During 2008, the maximum percent volume was observed in different order (Homoptera) with 61.3%, 48.8%, 52.4%, 46.5%, 37.8% and 36% in January, February, March, April, May and October respectively. The two orders of Orthoptera and Hymenoptera were recorded with the average percent volume of 8.75% within 11 months and 2.86% within only five months respectively (Figure 8).

Monthly dietary composition as shown by Percent Frequency

Lepidoptera was observed as the maximum percent frequency throughout the months of 2005. Odonata (6.2% in June), Hymenoptera (5.6% in May and 7.8% in August) and Ephemeroptera (4.4% in July) with as the least component (Figure 3).

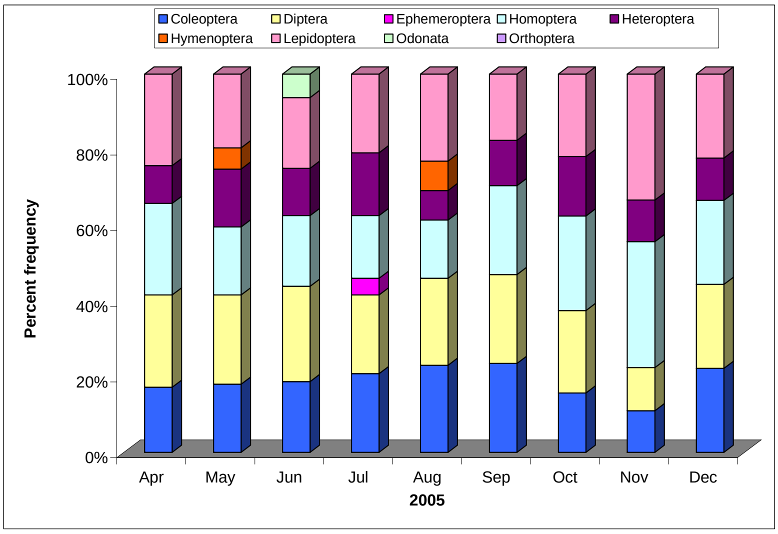

Figure 3 Percent frequency of monthly dietary composition of *P. tenuis* in 2005

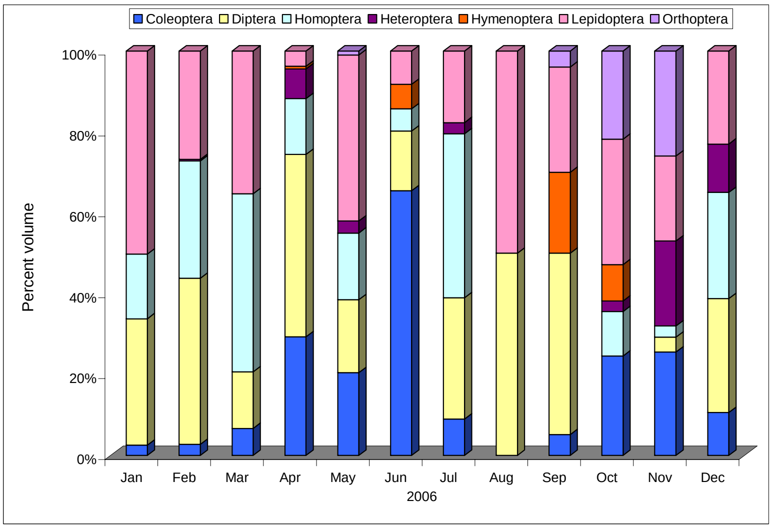

Figure 4 Percent volume of monthly dietary composition of *P. tenuis* in 2006

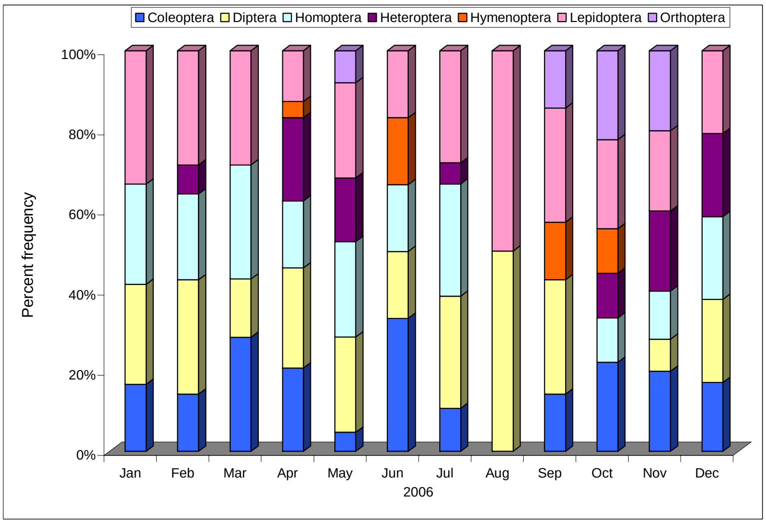

Figure 5 Percent frequency of monthly dietary composition of *P. tenuis* in 2006

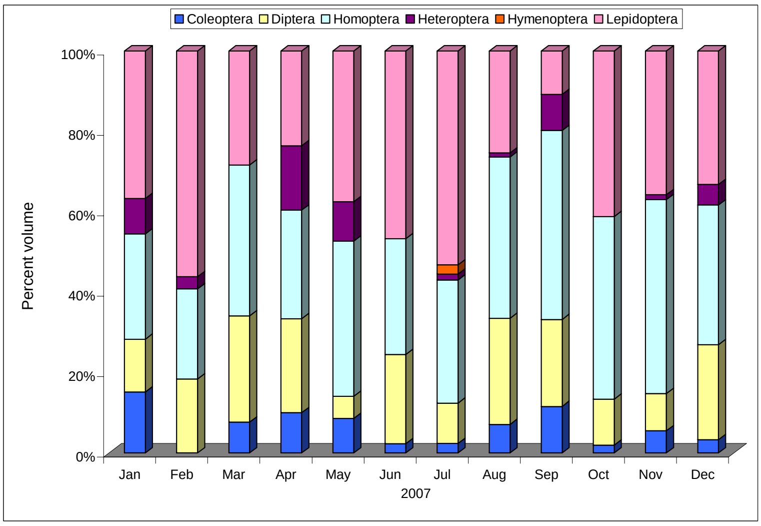

Figure 6 Percent volume of monthly dietary composition of *P. tenuis* in 2007

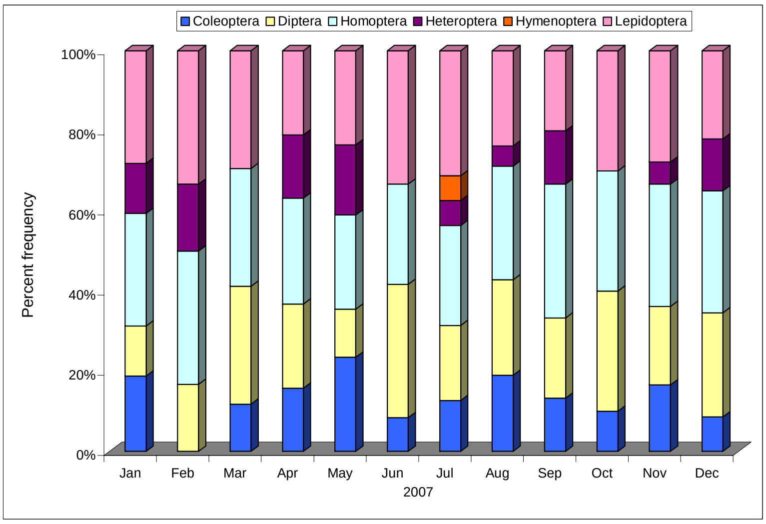

Figure 7 Percent frequency of monthly dietary composition of *P. tenuis* in 2007

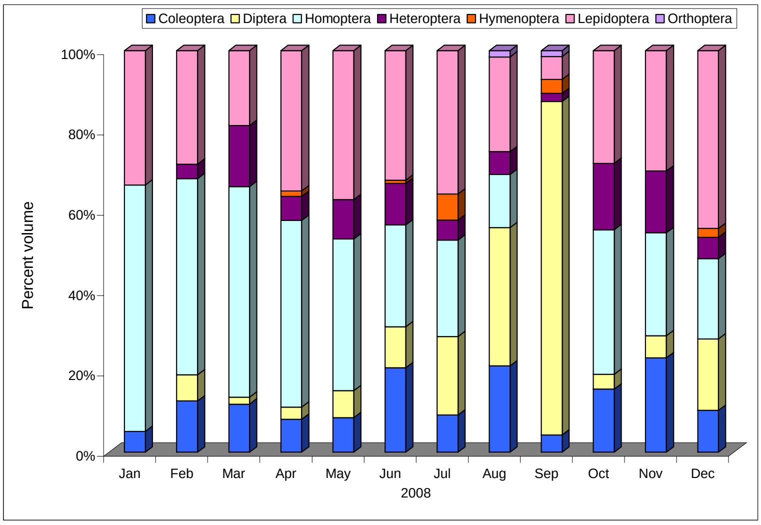

Figure 8 Percent volume of monthly dietary composition of *P. tenuis* in 2008

In 2006, Lepidoptera with the average maximum percent frequencies of 25.7% followed by Diptera (24.1%). In 2007, Lepidoptera, Homoptera and Diptera were found almost throughout the year also with the highest average percent frequency (27%, 28.6% and 21.9%). Slight changes of dominant order was recorded in 2008 with Lepidoptera (23.7%), Homoptera (21%) and Coleoptera (21.2%) (Figure 5, 7, & 9).

In general, food categories consumed by *P. tenuis* exhibited marked variation among sampling seasons. Concerning this aspect, Pereira *et al.* (2002) reported seasonal variation in the diet composition and prey selection by *Myotis myotis* and they also found that food was far more abundant in the spring than in the summer and autumn; the diet of bats is related to food availability. However, Best *et al*. (1997) found in the diet study of *Myotis grisescens* (gray bat) in Alabama that there was significant variation in diet over time, but bats did not select prey in proportion to availability.

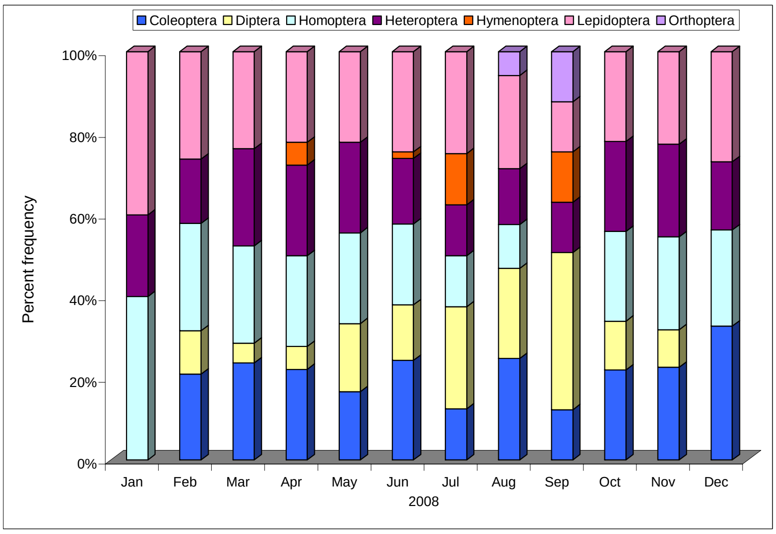

Figure 9 Percent frequency of monthly dietary composition of *P. tenuis* in 2008

Fenton & Morris (1976) pointed out that most insectivorous bats would be opportunistic feeders since opportunistic foraging means a strong positive correlation should occur between incidence of a particular prey in the diet, and its abundance in the environment. This finding was agreed by Barclay & Brigham (1994) who reported that insectivorous bats, in the field, attacked any moving target of an appropriate size and appeared not to make fine-detailed discriminations based on shape and texture of target that occurred in the laboratory. This lack of discrimination may be due to rapid flight of bats and short range at which prey can be detected by echolocation. Best *et al.* (1997) also found in the analysis of the diet of Gray bat that Lepidoptera, Coleoptera and Diptera as recorded to be the primary components of the diet were not consumed in proportion to their availability at other site. Therefore, they suggested the gray bats to be opportunistic in the sense that they probably took advantage of emergences of these taxa and also because they consumed a variety of other taxa in small quantities.

Nonetheless, Whitaker, Jr. *et al.* (1996) suggested that interpretations of food habits may be biased unless samples from all nightly feeding bouts are involved in analyses. In fact, further research is required to determine how the diet of *P. tenuis* correlates to food availability in the study area and to record the insect availability in the vicinity of the study area on seasonal basis. The present findings on the diets of *P. tenuis* would certainly be useful for the bat ecologists to provide the additional information on the natural history of tropical bats.

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