

Variation in the diet of the greater horseshoe bat (*Rhinolophus ferrumequinum*)

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Abstract

The variation in the diet of *Rhinolophus ferrumequinum* was investigated through analysis of feces collected before and after parturition. The results shows a high use of Coleoptera, which accounted for 30–77% in diet. Diptera (total 27.38%), and Lepidoptera (total 13.31%) was also consumed for the most part. Prey types recovered also included small numbers of Hymenoptera, Neuroptera. The diet of *R. ferrumequinum* varies before and after parturition. In lactating period, Coleoptera was mainly consumed (77%), but the use of Diptera significantly increased in post-lactating period. (51%)

Introduction

Knowledge of an animal's diet is important for interpreting its ecological role as a predator and its impact on local environments. Such knowledge is especially important as natural habits are being altered owing to increased urbanization, modern agricultural practices, and deforestation. (Whitaker et al., 1994) In addition, knowledge of the diet may reveal where, when, how, and how often an animal forages. (MacKenzie and Oxford, 1995)

Most bats are insectivorous and they show significant temporal variation in the types and diversity of prey in their diets. (Jones, 1990 and many others) A number of studies have examined prey selection by bats by comparing the abundance of insects in the diet with the abundance of insects caught on the nights when fecal samples were collected in various traps. (Anthony and Kunz, 1997 and many others)

The greater horseshoe bat, *Rhinolophus ferrumequinum*, belongs to the family Rhinolophidae and is one of the medium-sized species of the genus. *R.*

ferrumequinum is distributed through Europe to about 52°N in western Europe and 48°N in eastern Europe, south to parts of North Africa and east to China, Japan, and Korea. (Ransom and Hutson, 2000) The greater horseshoe bats mainly forage in woodland-related habitats such as woodland edge, hedgerows and it is also known to use a variety of other habitat types like pond, river, and lake in UK (Entwistle et al., 2001), little is known about its local condition, distribution, and diet.

I examined variation in the diet of *R. ferrumequinum* comparing with prey abundance before and after parturition.

Study area and methods

This study was conducted at an abandoned mine (N 36° 55' 51.9" E 127° 21' 27.1"), which is located nearby Jincheon town, in North Chungcheong Province, once a month from June to August in 2007. Prior to the study, it was observed that this mine had been used by about 10 horseshoe bats as a maternity colony in summer and a hibernaculum in winter.

Bats were captured in a mist nets set in front of the mine entrance, because its foraging sites were not known. Then, each bat was placed in a cotton pouch for 1 hr to collect feces. Sex, forearm length (mm), and body mass (g) were recorded for each individual. After that, bats were released at the site of capture.

A light trap was set up on the nights that feces were collected to sample prey items at a random spot within a radius of about 4 km of maternity roost, its possible foraging ranges.

In the laboratory, a fecal sample was selected at random and softened for about 12 hr in 70% alcohol in a petri dish. After softening, each fecal sample was placed in a small clean petri dish marked with 1 mm grid. A few drops of glycerine added to ensure that individual items were well separated and the fecal sample teased apart with two fine dissecting needles under a binocular microscope. Identification of prey remains to taxonomic order was determined

using keys and description in Whitaker and Borror et al. and by comparison with a sample of whole insects captured by a light trap. For fragments of insects, per cent frequency and per cent volume were calculated. Per cent frequency is the percentage of bats eating food type, it was calculated which remains of insects occurred in each fecal sample. Per cent volume is the average percentage by volume of each food type in the total sample, it was obtained by dividing the total volume by each individual volume, then multiplying this number by 100. (Whitaker, 1988)

Results and Discussion

Seasonal variation in prey abundance

Seasonal trends in insect availability are shown in Fig. 1. Throughout the research period, Diptera constituted a major portion of these insect sample with largest catch in August. Lepidoptera was also common. Coleoptera was collected

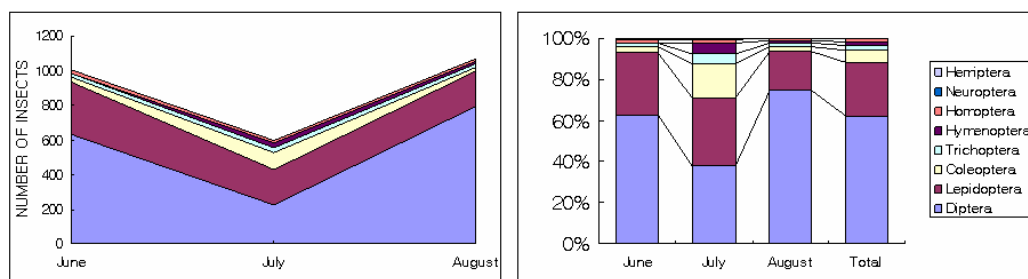


Fig. 1. Seasonal trends in insect availability at the greater horseshoe bat's foraging site. (a) the number of insects captured, (b) relative percentage.

relatively in small numbers but captured continuously. Trichoptera, Hymenoptera, Homoptera, Neuroptera, Hemiptera were also sampled but constituted only a small percentage of the total fauna.

Body condition

A total of 15 individuals of *R. ferrumequinum* were captured for fecal collection

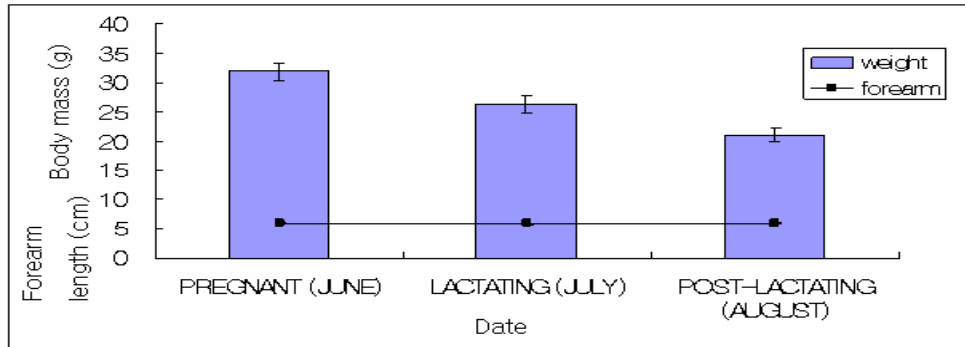


Fig. 2. Changes in body condition. Body mass (g) and Forearm length (mm)

in June. Among them, 6 individuals were pregnant. Pregnant females were larger (body mass 31.9 ± 1.5 g; forearm 60.2 ± 0.08 mm) than non-pregnant females (23.8 ± 3.2 g; 59.7 ± 0.07 mm).

In July, a total 5 individuals captured were lactating females.

9 individuals were captured in August. Variation of body condition was shown in Fig. 2.

Analysis of fragments in feces

A total of 15 fecal samples were analyzed, one for each individual, thus 5 for each pregnant, lactating and post-lactating female. Data on the per cent frequency and the per cent volume are shown for three stages of body conditions. (Table 1. and Fig. 3)

Beetles (Coleoptera) are by far the most important prey items between 30 and 77% of the total volume(Fig. 3), average per cent volume is 51.87% and frequency. Fragments

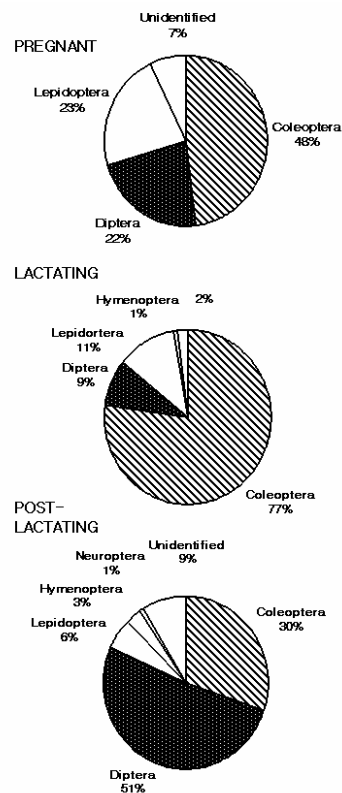


Fig. 3. The seasonal variation in the diet of *R. ferrumequinum* expressed by per cent volume.

Table 1. per cent volume and per cent frequency of fragments in feces.

Order	June (n=5)		July (n=5)		August (n=5)	
	Per cent Volume(%)	Frequency(%)	Per cent Volume(%)	Frequency(%)	Per cent Volume(%)	Frequency(%)
Coleoptera	48.16	100	77.18	100	30.27	100
Diptera	22.11	100	8.60	60	51.43	100
Lepidoptera	22.62	100	11.47	100	5.83	100
Hymenoptera	0	0	0.83	20	3.10	100
Neuroptera	0	0	0	0	0.62	20
Unidentified	7.20	100	1.91	100	8.75	100
Total	100		100		100	

of Coleoptera from feces comprise antennae, legs, elytra, wing, and body parts. A whole intact head was recovered. Particularly in lactating period, the use of Coleoptera increases significantly.

The second most important prey item is Diptera, which represented 9–51% of the volume.

Remains were antennal fragments, legs, wings, eggs, and body parts. Diptera was discovered in all time, it increases considerably in post-lactating period.

Lepidoptera also appears in all three periods, mainly scales were recovered from feces.

It is appeared that Coleoptera, Diptera, Lepidoptera are the major prey items of the greater horseshoe bat, it also consume Hymenoptera and Neuroptera. Hymenoptera found in feces was only Ichneumonidae. legs and part of wing were recovered. Remains of Neuroptera were just wing.

Prey use vs absolute abundance

A significant positive relationship was found between the per cent volume of Coleoptera from feces and absolute abundance of Coleoptera. (Fig. 4a.) There was a negative relationship between per cent volume of Diptera in the diet and absolute abundance of Coleoptera. (Fig. 4b.) Similarly, absolute abundance of Diptera has a positive relationship with per cent volume of Diptera, (Fig. 4c.) and there was a negative relationship between absolute abundance of Diptera and per cent volume of Coleoptera.

The population of the greater horseshoe bat in Korea has not been

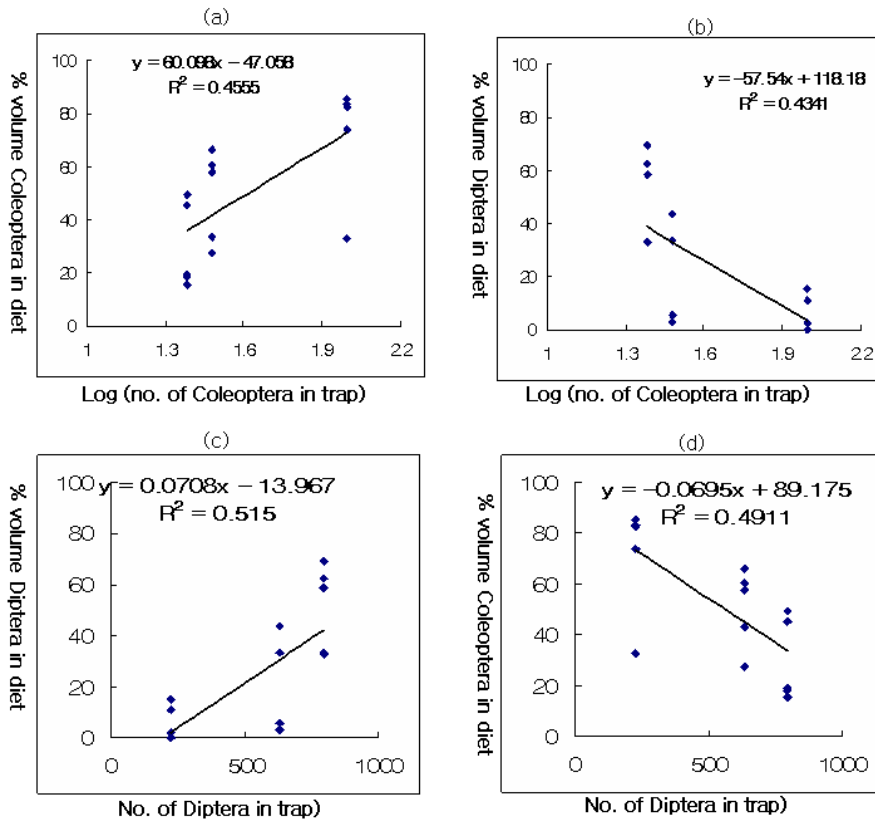


Fig. 4. Relationship between absolute abundance of insects and per cent volume of major prey items recovered from feces.

estimated at all, and little is known about its ecology. So, persistent research would be needed to conserve its population.

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