

## **Diet and foraging Behavior in the Notch-Eared Bat *Myotis emarginatus* (Chiroptera: Mammalia) in Filfila (Skikda) Eastern Algeria**

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### **Abstract**

To live and develop, the bat, like any other animal, must eat. An animal's diet corresponds to all of the food it takes from its environment. Most often, animals belonging to the same species have the same diet, *Myotis emarginatus* is an insectivorous species and it makes enormous services by consuming insects harmful to agriculture and human health. In Algeria its diet indicate the presence of 26 different Taxa belonging to 3 classes: (96.62%) of Insects, (1.13%) of Arachnids and (0.90%) of Chilopods as well as unidentified fragments with a rate of (0.23%),

**Keywords:** *Myotis emarginatus*; diet; Algeria; Insecta; Arachnida; Pseudoscorpionidae

### **Introduction**

Diet can be directly involved in the decline of the species because the quality and quantity of prey are paramount parameters for the survival and reproduction of individuals. Indeed, if the prey is contaminated by toxic substances or if their abundance decreases the populations of predators like bats will be threatened, therefore knowing the diet of bats is essential to improve their conservation [1].

For Goiti., *et al.* [2] Geoffroy's bat *M. emarginatus*, which suffered a significant population decline between the 1960s and 1990s, has recently made an important recovery, populating new areas and forming stable populations, so it is now classified as Least Concern at a European scale [3,4]. In Iberia the species is found throughout the peninsula inhabiting mountainous areas and/or woody landscapes ranging over both the Mediterranean and Atlantic regions. Its status there, however, is irregular and affected by local factors, mostly the lost of roosts (mainly buildings); so overall *M. emarginatus* is considered vulnerable [5].

### **Materials and Methods**

According to Beck [6] on analyzing fecal pellets of bat species in term of quality and quantity we obtain the evidence for the food and the favourite group of prey. Those confirm that this method perfectly lends to obtain detailed information about the food compounds, preferred prey, regional and seasonal differences as well as indirect conclusions with respect to the hunting habitats and strategy.

### **Study area**

The area selected for the study is located in the region of Filfila, in wilaya of Skikda. The protocol used consisted of a sampling of guano in the different sites used by the species and the identification of remains of insects under microscope. These are expressed as percentage of frequency to allow comparison with other studies in other countries. Our study area is located on the biogeographical east of the Numidia, which is a natural region of northeastern Algeria. It is a coastal region and the topography.

An old mine of iron was explored and some old houses used by the workers permit as to found a colony of *M. emarginatus*.

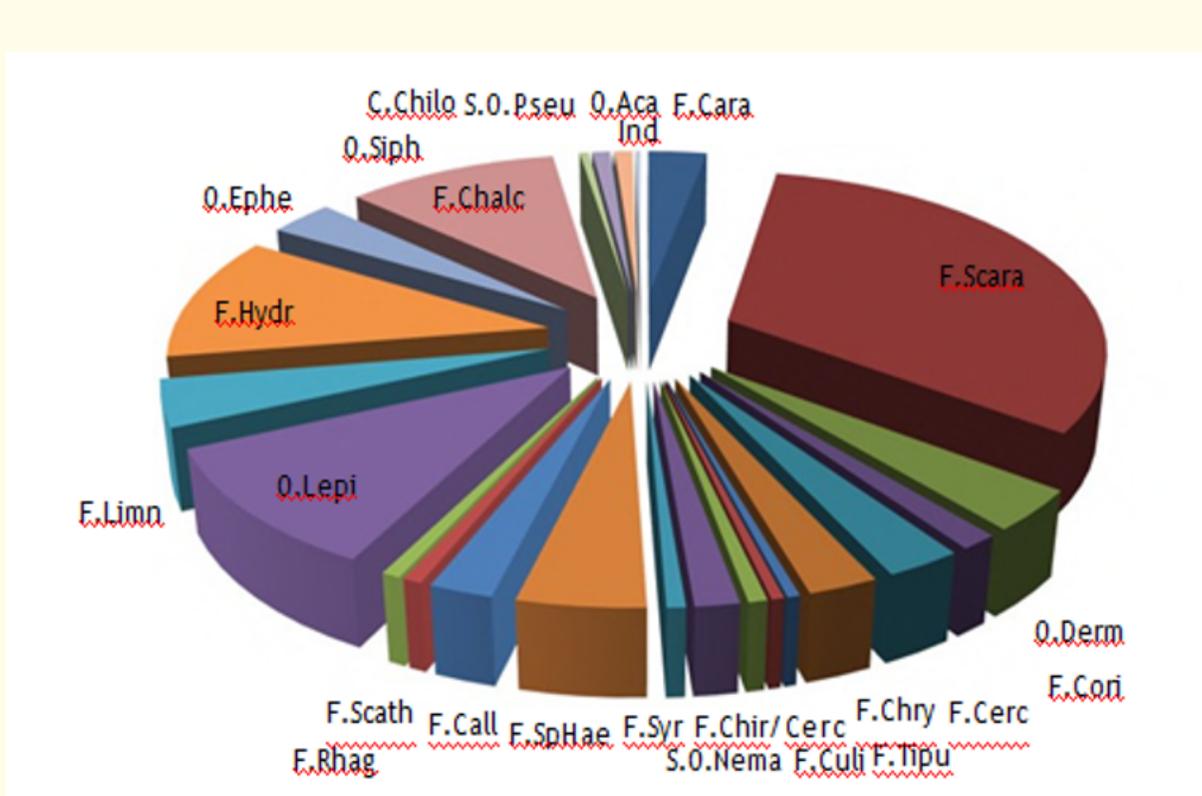
**Collect and analysis of the samples of guano**

The field trips were conducted between the months of January 2014 to July 2014, at a rate of one event every 1 month or about every week for each list according to the weather. Thus, throughout the study period, 102 samples were collected after 43 outputs, each sample is represented by 10 pellets of guano, so 1020 pellets were analyzed in total. Kervyn [7] stated that a sample of 100 annual dung is sufficient to identify the prey consumed only to identify but not specify its composition and the annual changes of composition. For analysis, samples of guano have been soaked at least one hour in 70% alcohol before being dissected using forceps under a binocular magnification 400× and the determination was made with a help of the identification key by Shiel, *et al* [8]. Several methods of expressing results are used by the authors but their definition is not always harmonized thoroughly publications. I referred the diet composition in accordance with Vaughan [9]; the results are expressed as percentage frequency of occurrence, i.e. the number of taxa equals the number of samples containing divided by the total number of occurrences, multiplied by 100 [10].

**Results and Discussion**

The results obtained during the analysis of 15 guano samples to characterize the diet of *Myotis emarginatus* indicate the presence of 26 different Taxa belonging to 3 classes: (96.62%) of Insects, (1.13%) of Arachnids, and (0.90%) of Chilopods as well as unidentified fragments with a rate of (0.23%).

Figure 1 and table 1 clearly show the predominance of the order of Coleoptera with 34.91% which occupies the first position or it has been determined that the Scarabeidae family is the most represented with 31.98%, followed by the Carabidae family with 2.93%.



**Figure 1:** Frequencies of the different arthropods found in the guano of *Myotis emarginatus*.

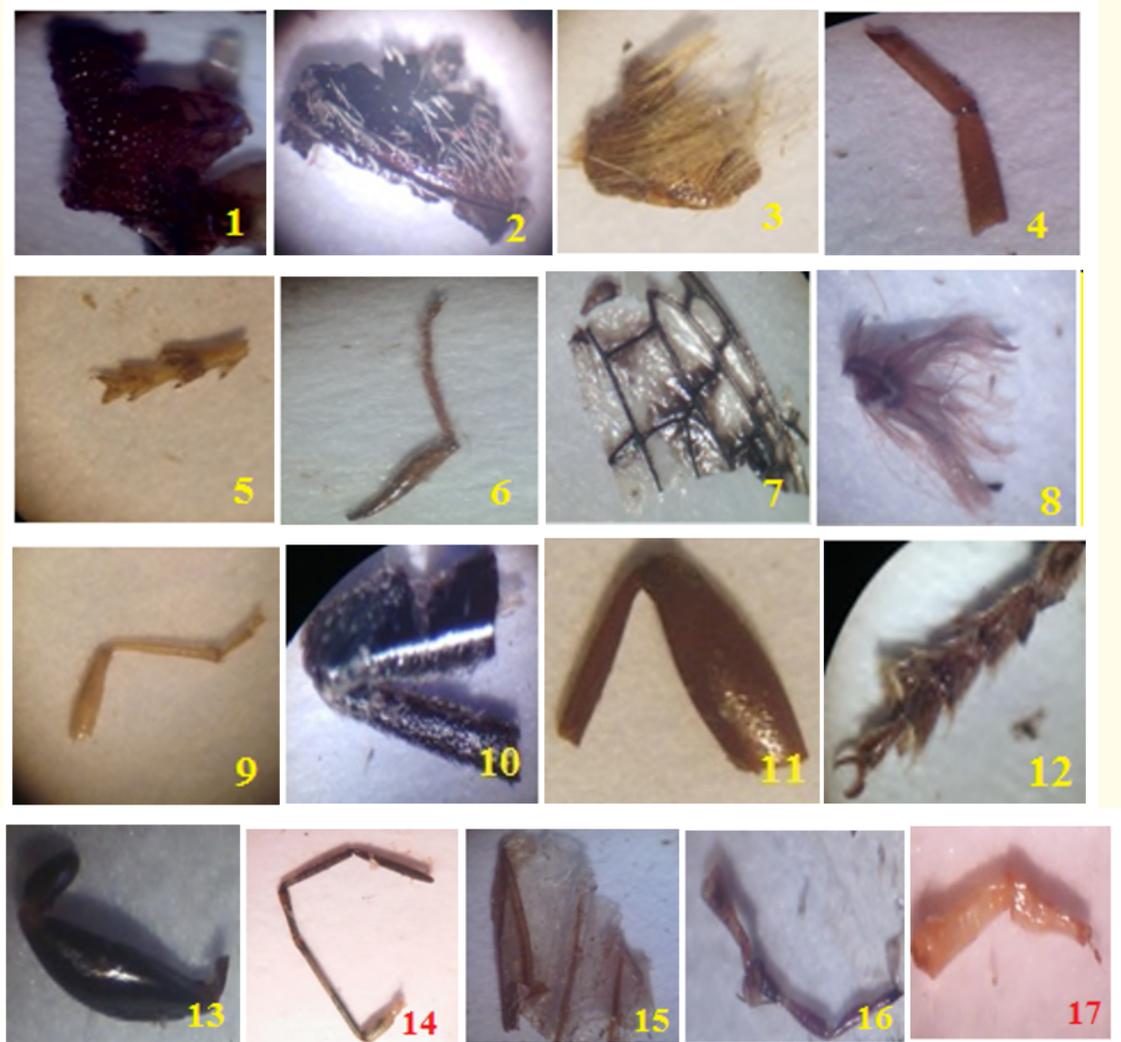
Class	Order	Sub-order	Super family and family	Number	Frequency %	
Insect	Coleoptera	Adephaga	Carabidae	13	2,93	
		Polyphaga	Scarabidae	142	31,98	
	Total			155	34,91	
	Dermaptera			16	3,60	
	Hemiptera	Heteroptera	Corixidae	06	1,35	
		Homoptera	Cercopidae	12	2,70	
	Total			18	4,05	
	Neuroptera		Chrysopidae	11	2,47	
	Diptera	Nematocera	Tipulidae	02	0,45	
			Culicidae	02	0,45	
			Chironomidae/Ceratopogonidae	03	0,67	
		Nematocera			07	1,57
		Cyclorrhapha	Syrphidae	03	0,67	
			Sphaeroceridae	20	4,50	
			Calliphoridae	10	2,25	
Scathophagidae			03	0,67		
Brachycera		Rhagionidae	03	0,67		
Lepidoptera		Limnephilidae	46	10,57		
		Hydropsychidae	18	4,13		
Trichoptera		Unknown	49	11,03		
Ephemeroptera			14	3,21		
Hymenoptera	Symphyta	Chalcidoidea	47	10,58		
Siphonaptera			02	0,45		
Total				429	62	
Chilopoda				04	0,90	
Total				04	0,90	
Arachnidae	Pseudoscorpionida		Pseudoscorpion	01	0,23	
			Acari	04	0,90	
Unidentified				01	0,23	
Total				444	100	

**Table 1:** Frequency of the different fragments of arthropods found in the guano of *Myotis emarginatus*.

The second position is occupied by the order of Diptera (15.63%) which are represented by 08 Families of three Sub-orders with the predominance of the Families of Sphaeroceridae (4.50%) and Calliphoridae (2.25%), as well as the order of Trichoptera (15.40%) which is represented by 02 Families with rates that vary between 4.13% and 11.03%.

The third position is occupied by The Chalcidoidea family of the order of Hymenoptera with a percentage of 10.58 and by the order of Lepidoptera with 10.57%.

Other insect orders were found in small percentage, it is Dermaptera; Neuroptera; Siphonaptera; Ephemeroptera; Rhagionidae; Hemiptera.



**Figure 2:** Samples of Preys found in the diet of *Myotis emarginatus*.

Classe Insecta (1- Coleoptera Carabidae; 2-3 - Coleoptera Scarabeidae; 4- Hemiptera Corixidae; 5- Hemiptera Cercopidae; 6- Diptera Tipulidae; 7- Neuroptera Chrysopidae; 8- Diptera Chironomidae/Ceratopogonidae; 9- Diptera Sphaeroceridae; 10- Diptera Calliphoridae; 11- Diptera Scathophagidae; 12- Diptera Rhagionidae; 13- Trichoptera Limnephilidae; 14- Ephemeroptera; 15- Hymenoptera Chalcidoidea, Classe Arachnida (16 - Acari) Classe Chilopoda (17).

From the results obtained we see that this species has a varied diet. Studies made in Germany by Bauerova (1986) revealed the presence in the diet of *Myotis emarginatus* 15 taxa in 3 Classes. *M. emarginatus* consumes a lot of spiders in Germany with a high percentage (14.3%), as well as Lepidoptera with 14.3% and Neuroptera with 14%.

For Beck [6] in Europe 93% of Diptera and 56% of Arachnida where the most frequently identified groups of prey. The other groups appeared only occasionally. As for Diptera, almost exclusively Muscoidea (in 93%) were identified, while also Hemerobiidae (Neuroptera)

were found. This gives rise to assumption that *M. emarginatus* picks its food mainly from surfaces and probably seldom catches flying prey. These results basically correspond to those of the investigations made by Bauerova [11] and Krull, *et al* [12].

According to Goiti, *et al.* [2] for the 23 species of bats of the Mediterranean region spiders constituted the bulk of the diet by both volume and frequency. Overall the mean of individuals percentages reached 79% (SD = 22.5) by volume. Following far behind in importance were moths, with a mean of consumption of 7%, Dipteran (flies and midges) constituted 6.3%; and the Hemerobiidae with 4.4%. For other Arthropods categories were found, non-reaching a mean of 2%: earwings, harvestmen, wasps and beetles.

In Algeria (Filfila), this species consumes 26 taxa distributed over 3 Classes: Insecta with 96.62%, Chilopoda with 0.90% and Arachnida with 1.13%. Note that Indeterminate fragments represent 0.23% of the prey.

In the Beetle order we were able to determine the presence of 2 families which together constitute the highest frequency percentage (34.91%).

The presence of Pseudoscorpions in small numbers (0.23%) of the Order of Arachnids, raises a number of questions. Are they captured on vegetation, on the ground, on their canvas or during their aerial movements?

These animals, also named false scorpions, resemble scorpions in morphological aspects like shape and presence of chelated pedipalps, but differ strongly in size, being smaller and by the absence of the elongated metasoma with the sting in distal portion [13,14].

This species also frequently captures prey such as the Chironomids above the water surface [12]. Pseudoscorpions, in the Old and the New World, are predominantly solitary animals that can live in the ground substratum, in the vegetation, or in both; they use one or other ways to find a better ecological resource. In spite that the most common species lives in the leaf litter, rock crevices, or bark trees, there are also species that inhabit unexpected places like rosettes of Bromeliaceae [13,15] and other vegetation in coast [16], bat guano [17], ant and bee nests [18,19] and the body of birds and mammals [20].

Due to its small size, Pseudoscorpions present restrictions to disperse or to migrate to other environments. The most common way to explore a new site is, indeed, to walk from one place to another [21].

## Conclusion

In Filfila *M. emarginatus* consumes 26 taxa distributed over 3 Classes: Insecta with 96.62%, Chilopoda with 0.90% and Arachnida with 1.13%. Note that Indeterminate fragments represent 0.23% of the prey.

The presence of Pseudoscorpions of the Order of Arachnids in the diet of *M. emarginatus* (0.9%), raises a number of questions. Are they captured on vegetation, on the ground, on their canvas or during their aerial movements?

Pseudoscorpions are small arachnids (2 - 8 mm) that live in cryptic environments, being in general solitary predators of other invertebrates. Knowing therefore they live on the ground we deduce that *M. emarginatus* proceeds to gleaning. This aptitude of foraging can allow us to conclude that its mode of hunting probably developed according to the habitat where it lives.

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