HELMINTH FAUNA OF *Tadarida (Chaeraphon) nigeriae* (THOMAS, 1913) (MICROCHIROPTERA: MOLOSSIDAE)

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ABSTRACT

A checklist of helminth parasites isolated from Tadarida (Chaeraphon) nigeriae is presented. Out of 857 bats examined 658 (76.78%) were infected by helminth parasites. Details of the taxa presented show that 2 were trematodes; 2 were cestodes; and 5 were nematodes. Observation on the distribution of the worms within the host shows that they were found mainly in the alimentary canal and peritoneal cavity. Rictularia was the predominant helminth parasite of these bats in this study with 49.59% of the bats examined found infected with this parasite. Female bats were found with higher infection rates with the helminths than the males. There are similarities in the type of parasites infecting bats collected from Nsukka and those collected from other places. Significant levels of positive associations exist between the parasites. Food habits based on stomach content analyses revealed that in volume and in actual numbers, beetle (Coleoptera) and moths (Lepidoptera) comprised the major prey items in the diet.

Key words: Helminths; *Tadarida,* Prevalence, Similarities, Associations, Foods.

INTRODUCTION

The prey community on which an organism depends on for its food may be a potential source of health problems for the organism and for other organisms that share its environment. This happens because very often the prey species are stable hosts of the intermediate stages of some parasites. Most helminth parasites of wild insectivorous vertebrates are acquired through prey-predator relationships in the given micro ecological setting. From West Africa there are reports of the occurrence of as many as 106 bat species. Some of these are fruit bats and the others are insectivorous bats (Rosevear, 1965; Aderounmu, 1973; Okon, 1974). Many of the latter are house dwelling while all of the former are predominantly found in the wild. For house dwelling bats, which here is exemplified by *Tadarida,* the prey community from where they source their foods is a great assemblage of arthropod species of different sizes and behaviours. These bats have been known to show some forms of food partitioning according to defined taxonomic groupings (Fenton 1970). This partitioning of food resources limits each bat species to only a certain group of prey species. In *Tadarida* most of its preys are efficient intermediate hosts of helminth parasites. Very extensive literature exists on the parasites of higher vertebrates including bats. Some of the contributions to our knowledge of the parasite fauna of bats include:Watanabe,1950;Douvres, 1956; Yeh, 1957; Hurkova, 1959; Skrjabin, 1961; Rhodes, 1964; Cain, 1966; Riding, 1968; Fenton, 1970; Zdzitowiecki, 1970; Webster, 1971; Kunz, 1973, 1974; Kagei et al 1979, 1985; and Edungbola, 1981. Salem (1971) updated the increasing knowledge of the helminth fauna of bats when he recorded some trematodes from *Tadarida aegypthiaca.* The other bat species that have been examined include *Tadarida brasiliense;Eptessicus fuscus; Nycteris borealis; Myotis lucifugus; M. bocagie; Pipistrellus nanus; P. abramus; Rhinolophus ferrumequinum nippon; R. cornutus; R. malayanus; Nyctalus maximus; Hipposideros Turpis and H. (caffer) tephrus*. In all these and other species of bats all helminth groups have been isolated mostly from the small intestine. A nematode *Spirura Spinicaudata* and a trematode *Maxbraunium nigeriense* were found in the stomach of some Nigerian bat species (Edungbola, 1981) among other parasites..The present study examines *Tadarida (Chaerophon) nigeriae* for helminth parasites. It is aimed at providing a check list of the helminth parasites; and at examining some of the ecological factors relating to their occurrence in parts of southeast Nigeria.

MATERIALS AND METHODS

Study Area: Location: This study is based on insectivorous bats *Tadarida Chaeraphon nigeriae* (Thomas) collected between 1986 and 2003 from Nsukka, Enugu-Ezike, Nnobi and Nsugbe in southeastern Nigeria. The bats were collected from well built houses which they infested.

Climate: The climate of the study areas is the same and is tropical, with heavy rain fall which is seasonal, falling a little more in Nsugbe and Nnobi than Nsukka and Enugu-Ezike.
The rainy season is divided into 2 periods, separated by a short dry period in August. Most of the rains fall between April and July and between August and October. The areas lie within a large belt that experience mean temperature of between 22 ^{0}C to 24 ^{0}C and annual maximum temperature of between 28 ^{0}C to 32 ^{0}C.

Vegetation: The towns are located in the tropical rain forest belt. Some areas have developed into a Guinea Savannah forest mosaic due to human activities. Palm trees abound in these areas and form a major source of revenue for the rural communities.

Capture of bats: The bats were captured alive from residential houses in the 4 towns using long handled large sweep nets. Usually capture is effected as the bats leave the roost or as they return from their foraging flights. Trapped animals were transported to the laboratory where data on sex, age, capture dates, locality, and physical conditions were taken after anaesthesia using chloroform. Aging was done using the method recorded in Mutere (1968).

Examination for helminth parasites: (a) Blood was usually drawn from the branchial artery with a syringe, this is mixed with physiological saline and thick smears made of them. These were used to screen for microfilariae. (b) Anaesthesized animals from which the blood samples had been examined were then dissected and the different portions of the gut isolated and cut from each other. These gut parts were then placed in Petri dishes containing saline. The peritoneal cavity of each was also scrapped into a Petri dish. The gut parts were then cut open and their contents and scrapings from their walls examined microscopically for helminthes (either whole worms or ova). (c) About 2 cm square section of diaphragm of each bat was examined microscopically in a muscle press for *Trichinella* sp larvae.

Treatment of Collected Helminths: All the helminth parasites collected from each bat were treated similarly. They were first transferred into watch glasses, washed in physiological saline and later killed by placing them in Petri dishes containing warm water at 40^{0C}. These worms die fully stretched. Subsequently the nematodes and trematodes amongst them were fixed in hot 70 % alcohol and then preserved in 5 % formalin. A few drops of glycerin were added to give a concentration of about 5ml of 5% formalin and 0.5 ml glycerin. Cestodes were compressed between two slides and tied up with a cotton sewing thread and in this position fixed in Bouin's fluid for 16 hours. This was later washed off with 70% alcohol. The slides separated and the worms stored in an alcohol, formalin and acetic acid mixture (AFA).

Staining: Nematodes and trematodes were cleared in cotton blue lactophenol for 5 minutes and then stained after washing in Erlich Haematoxylin for 20 minutes, and counterstained with Eosin following the usual procedures for H/E staining. The cestodes were stained with acetocarmine.

Foods of bats: Samples of bats collected upon return from foraging flights were anaesthesized immediately and the stomachs dissected out and preserved in 10% formalin. The contents were later examined in Petri dishes under the microscope after soaking in 50 % isopropyl alcohol for 12 hours. Thereafter, further volumes of 50 % isopropyl alcohol were added and stirred, then left to evapourate. After the alcohol had evapourated the contents were examined under the low power of a microscope. Identification of animal parts was made by comparison of fragments with collections of comparable field materials. Some of the more characteristics parts of the insects e.g. wings, legs, antennae and mouthparts were searched for in the samples. By these comparisons the prey identities were determined. The unidentified objects were classified as 'unidentified matter'.

Table 1: Prevalence of helminth parasites in *Tadarida*

Species of parasite	Number of infected Bats	Prevalence of infection (%)	Total worm load	Mean number of worms per host
Nematodes				
Rictularia chaeraphoni	425	49.59	3846	9.05
Histostrongylus coronatus	295	34.42	1415	4.80
Capillaria annulosa	158	18.44	923	5.84
Cheiropteronema globocephalus	65	7.58	648	9.97
Litosoma pujoli	45	5.25	92	2.04
Trematodes				
Posthodendrium panouterus	30	3.50	266	8.87
Castroia nyctali	22	2.56	64	2.91
Cestodes				
Hymenolepis kerivoulae	15	1.75	29	1.93
Oochoristica agamae	35	4.08	156	4.46

Analysis: The isolated parasites were subjected to analyses with Simpson's index (C =ln (Y/N)), where Y = % hosts infected with each helminth species; and N = the sum of all Y values; and was used to determine the dominant species. Fager's index (Southwood, 1966) was used to determine the level of association between the parasites. Sorensen's Index was used to analyse similarity of fauna in the study areas S = (2j/(An + Bn) where An and Bn are the number of species in areas A and B respectively, j is the number of helminth species common to both areas (Greig-Smith, 1964).

RESULTS

A total of 857 bats were examined these consisted of 429 males and 428 females. The result obtained showed that there is a rich helminth fauna in *Tadarid*a. The frequency of occurrence of the helminth parasites was found to show that *Rictularia lucifigus* is the dominant species. Altogether nine Parasites were isolated and these are presented in Table 1 and Figures 1 - 5. They include 5 nematodes (*Rictularia chaeraphoni; Histostrongylus coronatus; Capillaria annulosa; Cheiropteronema globocephalus; Litomosa pujoli),* 2. Trematodes (Posthodendrium) *panouterus; Castroia nyctali),* and 2 cestodes (*Hymenolepis kerivoulae; Oochoristica agamae).*

The prevalence of these parasites among the examined bats is also shown in Table 1. A total of 658 bats were found infected with helminth parasites giving a prevalence rate of 76.78%. Examinations of the musculature and the blood show no helminth parasites.

Whereas *Rictularia* is the most common helminth parasite of these bats,

Table 2: Sorensen's Indices of similarity used to compare the helminth fauna from the bats in different towns

Towns	Sorensen's Index of similarity
Nsukka and Enugu Ezike	0.876
Nsukka and Nnobi	0.561
Nsukka and Nsugbe	0.379
Enugu Ezike and Nnobi	0.581
Enugu Ezike and Nsugbe	0.439
Nnobi and Nsugbe	0.628

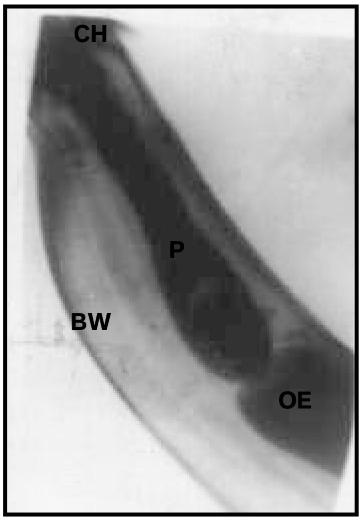

Figure 1: Head region of *Histostrongylus coronatus* showing BW – body wall, OE – oesophagus, P – pharynx and CH – crown of hooks

Cheiropteronema occurs with the highest mean worm load per host (9.97). The infected bats had between 2 to 9 helminth species. Analysis of the result using Simpson's Index for all the helminth species confirm that *Rictularia (C=-0.39)* is the dominant helminth species within the populations of Tadarida.

Table 3: Relationship between sex, age, weight and helminth infections

	Number examined	Number infected	Parasite species prevalence (number infected)								
			Rit.	Hist.	Cap.	Lit.	Chae	Post	Cast	Hyman	00CH
Young bats M	140	29	19	6	-	-	-	2	-	-	2
Young bats F	105	96	65	12	-	-	-	2	5	4	8
Old bats M	289	224	180	72	68	29	11	10	9	4	13
Old bats F	323	319	161	205	90	36	34	16	8	7	12
Total M	**429**	**253**	**199**	**78**	**68**	**29**	**11**	**12**	**9**	**4**	**15**
Total F	**428**	**415**	**226**	**217**	**90**	**36**	**34**	**18**	**13**	**11**	**20**
TOTAL			**425**	**295**	**158**	**65**	**45**	**30**	**22**	**15**	**35**

M =Males; F = F emales; Rict. =Rictularia; etc.

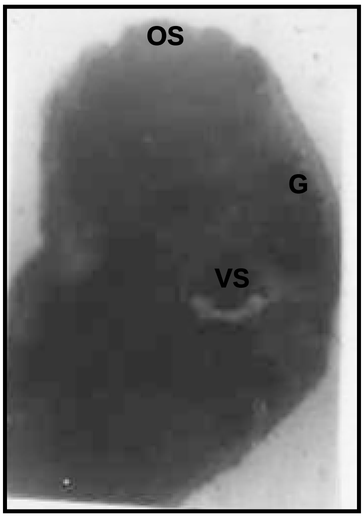

Figure 2: Whole mount of *Postodendrium panouterus* showing VS – ventral sucker, OS – oral sucker and G – Gut caeca

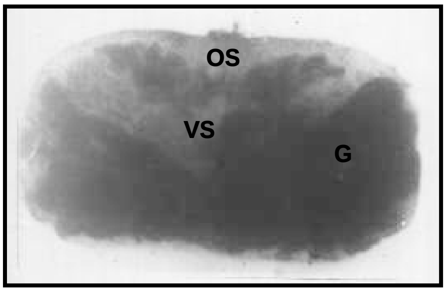

Figure 3: Whole mount of *Castroia nyctali* showing OS – oral sucker, VS – ventral sucker and G – gut.

The cumulative Index was low(C=0.99) indicating a diverse fauna of helminth species. Association between species in terms of frequency of occurrence showed no significant association of the parasites. None significance in terms of occurrence was further confirmed using Fager's Index of association (F=>+1). Calculated Sorensen's Indices of similarity are presented in Table 2.

Table 4: Insect orders isolated from the stomach of bats anaesthesized immediately after foraging flight (80 stomachs examined)

Insect order	Number of stomach in which it is found	% occurrence
Lepidoptera	14	17.50
Hemiptera	11	13.75
Coleoptera	70	87.50
Diptera	48	60.00
Orthoptera	3	3.75
Trichoptera	5	6.25
Siphonaptera	6	7.50
Neuroptera	10	12.50

The Indices in comparing the helminth fauna from different towns reflected similarities between them based on the number of shared species.

Observation on the organs of the bats where the parasites were found showed that the small intestine seemed to be the most preferred site, as most of these worms were found in the duodenum and the jejenum. One trematode *Castroia* was found in the bile duct and another parasite *Litomosa pujoli* was found in the peritoneal cavity. No filarial worm was found in the blood and no *Trichinella* sp was found in the sections of the diaphragm.

Analysis of the prevalence of the worms in terms of each animal's sex, age and weight show that, female Bats had higher percentage of occurrence. Using Chi square test on the raw data presented in Table 3 shows no significant difference in infection between the sexes (Chi square=68.15; P > 0.05). Young Bats had lower infection rates and in those infected a very low worm load per host. The weights of infected bats were not much lower than the weight of bats free of helminth parasites.

Data summarized in table 4 indicate that these bat species eat mainly members of the insect orders Coleoptera, Homoptera, Diptera, Lepidoptera and Hemiptera. The other insects' orders Orthoptera, Neuroptera,

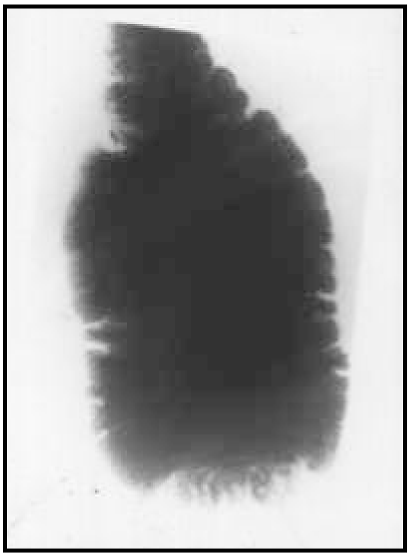

Figure 4: Proglottids of *Oochoristica agamae*

Figure 5: Head region of *Hymenolepis kerivoulae*

Trichoptera, and Siphonaptera, are occasionally found but cannot be the main food items.

DISCUSSION

Bats are generally known to play host to a lot of parasites (Rosevear, 1965). Many factors influence this phenomenon. Prominent among these are climatic factors which favour the existence of parasites and their intermediate hosts. In this case, the long wet season during which insect population is usually preponderant. The result of this survey confirms the incidence of a large number of helminthes in Tada*rida*. The most outstanding observation is that the number of nematode parasites in this bats species is high in the areas studied and this must be related to the high reproductive efficiency ascribed to this group (Anya 1976).

The common nematode of this bat species *Rictularia* would also be assumed to have a common insect intermediate host, that is also favoured (by this species) as food organism to achieve the enormous load recorded in this study. Further analysis of these insects would reveal which of them is playing this dual role.

The higher prevalence of helminth infection among the females may be due to the fact that adult females consume greater quantity of food than adult males. Kunz (1973) reported that female consumption of food is greater than that of the male with females able to consume 25-30% of their body weight while males consume only 20 – 25% of their body weight. They achieve this greater quantity and weight by having higher period of foraging activity than the males thus being more exposed to the risk of infection.

The reason for the small intestine containing a higher number of helminthes parasites is understandable from a physiological point of view, as this region is rich in freshly digested food. Thus adequate nutrients and metabolites required for growth, development and maintenance of these helminths are easily available in the small intestine. The occurrence of *Litomosa pujoli* in the peritoneal cavity can not be explained and repeated finding of this parasite in this region rules out contamination or sampling error. Thus further studies on the migratory behaviour and life history of this parasite is required to fully understand what is going on. For the intestine dwelling forms, it has also been shown that the quality and quantity of gases in the intestinal lumen is of particular importance in the distribution of the parasites as it affects their various metabolic pathways (Hirsch and Gier, 1974).

Loss of weight in infected bats recorded here is similar to what happens on other vertebrates. Mettrick and Podesta (1974) attributed this to host nutritional deprivation by parasites. They indicated that the deprivation is both in quality of nutrients and quantity of food.

As for the observation on the different insect orders found in the stomach or freshly fed bats, it only suggests that these bats are opportunistic feeders and they select food from a wide variety of prey species. Their diet seems to reflect the season of feeding, the location of food and diversity of insects (also governed by the two earlier factors). Their feeding ranges also seem to overlap with some other vertebrate insectivores such as *Agama agama* so that it is not surprising that they also share parasite with this group e.g. *Oochoristica agamae* whose similarity with those isolated from *Agama* has been described in this area (Okafor, 1990).

The closeness of these bats to human beings and the level of contamination of cooking utensils with faecal droppings in infested homes is a potential sources of health risks. Although only a few parasites of bats have been recorded in human zoonoses, it is important to keep monitoring the list with time, and to reduce the bat-human contact as much as possible. Thus these bats could be classified as pests and effort to control them stimulated at every level (i.e. house hold, local government, state and country).

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