

BAT PREDATION ON ODONATA¹

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A list of 24 taxa of Odon., including a minimum of 19 spp., eaten by 2 spp. of leaf-nosed bats (Phyllostomatidae) is given. These prey, taken in Costa Rica and the West Indies, are compared with Odon. in other bat food studies. Odonates are apparently not an important part of the diet of aerial insectivore bats, but are a regular though small fraction of the food of foliage-gleaning insectivore bats.

INTRODUCTION

Bats, and mammals in general, are not generally recognized as predators of Odonata. This report summarizes present knowledge of the extent of bat predation on odonates, and is the first attempt to show the diversity of these insects taken by bats.

MATERIAL AND METHODS

Our odonate specimens consisted of wings or wing pieces recovered from beneath the feeding roosts of 2 species of leaf-nosed, foliage-gleaning bats (Chiroptera: Phyllostomatinae), *Micronycteris megalotis* (Gray) and *Macrotus waterhousii* Gray. Wings determined to Odonata used in the study of *Micronycteris megalotis* by LAVAL & LAVAL (1980) at Finca La Selva, Heredia Province, Costa Rica, were kindly donated to us by those authors. One of us (J.J.B.) collected wings of insects from under night roosts of *Macrotus waterhousii* in caves on Grand Cayman Island, British West Indies, in April and July 1980. A.R. Richter supplied us with insect wings found under night roosts of *M. waterhousii* in Jamaica in December 1975.

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and M.K. Langworthy gave us prey of this species from Haiti collected on 1 December 1980.

Within each sample, the number of individuals of each odonate taxon was identified by grouping right and left forewings and hindwings into sets. Right wings were differentiated from left wings by the concave fluting pattern of the veins. Wings were identified by placing them in transparent envelopes and superimposing them directly over the wings of complete specimens. While it might have been possible to determine more of the Costa Rican specimens to species, we considered that the fauna of that country is not well enough known to justify the attempt.

Anax amazili (Burm.) and *A. junius* (Dru.) have identical venation, although the wings of *A. amazili* are hyaline while those of *A. junius* are clouded with yellow. The *Anax* wings from Grand Cayman Island were hyaline and *A. amazili* was the only *Anax* recorded from there by ASKEW (1980). Most of the *Anax* wings from Jamaica were flavescent, and only *A. junius* has been recorded from Jamaica (WHITEHOUSE, 1943). Thus, *Anax* wings were assigned to *A. amazili* on Grand Cayman Island and to *A. junius* on Jamaica.

RESULTS

A list of the Odonata found under night roosts of *Micronycteris megalotis* and *Macrotus waterhousii* is given in Table I. *Archaeogomphus* has not been recorded previously from Central America, although the genus has been collected in southern Mexico (G.H. Beatty, pers. comm.). The wings of a minimum of 47 individual odonates were recovered from feeding roosts of *Micronycteris megalotis* in Costa Rica, including at least 3 species of Zygoptera and 12 species of Anisoptera. *Macrotus waterhousii* on Grand Cayman Island, Hispaniola, and Jamaica had eaten a minimum of 47 Anisoptera of 9 species.

In Table I, Anisoptera form the bulk of the prey items taken by the bats. Libellulidae compose 48.9% of the overall prey, Aeshnidae 37.2%, and Gomphidae 4.3%. These proportions are probably similar to the relative availability of members of these families as prey, based on personal collecting experience (S.W.D.). Thus, there is no indication that the bats were hunting a species or group of odonates in particular, with the possible exception of the *A. junius* taken by *Macrotus waterhousii* on Jamaica.

The Zygoptera in Table I constitute 19.2% of the odonates preyed on by *Micronycteris megalotis* in Costa Rica, but none were taken by *Macrotus waterhousii* in the West Indies. Zygoptera may be under-represented in Table I because their wings are often small and fragile, and likely to be eaten or dispersed by scavenging arthropods under bat roosts.

DISCUSSION

Insectivorous bats are believed to capture odonates in one of 2 ways. First, aerial insectivores (WILSON, 1973), such as those in the family Vespertilionidae, use echolocation to locate insects in flight (SIMMONS et

Table I

Odonata recovered from leaf-nosed bat night roosts. Numbers specify minimum individual odonates present in samples. Costa Rican prey were taken by *Micronycteris megalotis* (Gray), West Indian prey were eaten by *Macrotus waterhousii* Gray

Taxa	Costa Rica	Grand Cayman Island	Haiti	Jamaica
ZYGOPTERA sp.	1			
Platystictidae				
<i>Palaemnema</i> sp.	1			
Coenagrionidae sp.	1			
Calopterygidae				
<i>Hetaerina</i> sp.	6			
ANISOPTERA				
Gomphidae sp.	1			
<i>Archaeogomphus</i> sp.	1			
<i>Erpetogomphus</i> sp.	1			
<i>Phyllocycla volsella</i> (Calv.)	1			
Aeshnidae				
<i>Anax amazili</i> (Burm.)		1		
<i>A. junius</i> (Dru.)				25
<i>Gynacantha</i> sp.	4			
<i>G. nervosa</i> Ramb.		4		
<i>Triacanthagyna</i> sp.	1			
Libellulidae				
<i>Brachymesia furcata</i> (Hag.)		2		
<i>Cannaphila insularis</i> Kirby	3			
<i>Dythemis</i> sp.	15			
<i>Erythrodiplax</i> sp.	1			
<i>E. umbrata</i> (L.)		1		
<i>Macrothemis</i> sp.	2			
<i>M. celeno</i> (Sel.)			1	
<i>Micrathyria</i> sp.	3			
<i>M. didyma</i> (Sel.)		7		
<i>Orthemis</i> sp.	3			
<i>O. ferruginea</i> (Fabr.)		2	1	
<i>Tramea</i> sp.	2	2		1
Total individuals (94)	47	19	2	26

al., 1979). The odonates captured by these bats are primarily dusk-flying Anisoptera. WHITE et al. (1979) reported little brown bats, *Myotis lucifugus* LeConte, in South Carolina attacking *Anax junius* during the hour before dusk. Similarly, one of us (S.W.D.) witnessed unidentified bats capturing a few *Neurocordulia virginensis* Davis at nightfall over a Florida river. In general, studies of the food habits of aerial insectivores record

few, if any, odonates (e.g., ANTHONY & KUNZ, 1977; BELWOOD & FENTON, 1976; BUCHLER, 1976; WHITAKER, 1972; WHITAKER et al., 1977). Spontaneous, normal, nocturnal activity of odonates has not been confirmed, and crepuscular Anisoptera cease flying as bats begin to fly in the evening (S.W.D., pers. obs.). Thus, odonates are available as prey for aerially foraging bats for only a short period of time each day.

Second, insectivorous foliage-gleaning bats (WILSON, 1973), such as those in the subfamily Phyllostomatinae, are believed to rely less on echolocation and more on prey-produced sounds to locate prey (BELL, 1981; BELWOOD, 1981). These bats may also hunt by sight (ROSS, 1967; BELL, 1981). In dense vegetation, such as that used for foraging by the bats in this study (J.J.B., pers. obs.), foliage-gleaning bats apparently listen for prey from perches in a manner similar to that described for another foliage-gleaning bat in Africa (VAUGHAN, 1976). Prey are plucked from the ground or vegetation rather than caught in flight.

How the bats in this study locate odonates is unknown, especially since *Macrotus waterhousii* leaves its day roost to forage approximately 1 hr after sunset (BARBOUR & DAVIS, 1969), well after odonates cease to fly. Possibly the bats prey on odonates that are caused to move in vegetation, and thus produce detectable sounds, by ants or other animals. Unlike aerially foraging bats that feed in flight, foliage-gleaning bats consume their prey at night roosts, and cull the more chitinous portions of their insect prey, which allows their feeding habits to be studied easily. WILSON (1971) reported that Aeshnidae comprised 2.0% of the diet of *Micronycteris hirsuta* (Peters) during a 7 month period in Panama. Odonates made up 2.2% of the diet of *M. megalotis* during the 10 month study period of LAVAL & LAVAL (1980, tab. 1). FENTON et al. (1981) list 1 libellulid taken by an African foliage-gleaning bat that is largely carnivorous on vertebrates.

We conclude that Odonata form an insignificant part of the diet of aerial insectivore bats, but a small and regular portion of the food of some foliage-gleaning insectivorous bats. However, the aerial insectivores are probably such efficient predators of night-flying Odonata that they have selected against nocturnal odonate activity in the evolutionary past. The odonate taxa eaten by foliage-gleaning bats are apparently taken at random, but the possibility exists that selection for secretive roosting habits may result from predation by these bats.

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