

SCIENTIFIC NOTE

Stomach Content Analysis of Potential Predators of Simuliidae (Diptera: Nematocera) in Two Lowland Forest Streams, Central Amazonia, BrazilYAMILE B. ALENCAR^{1, 2}, NEUSA HAMADA² AND SANDRA MAGNI-DARWICH³¹PIBIC/CNPq/INPA/UA scholar.²Instituto Nacional de Pesquisas da Amazônia, Entomologia, Caixa postal 478, 69.011-970, Manaus, AM.³Escola Técnica Federal do Amazonas, Avenida 7 de Setembro n. 1975, 69.020-120, Manaus, AM.

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Análise do Conteúdo Estomacal de Possíveis Predadores de Simuliidae (Diptera: Nematocera), em Dois Igarapés de Terra Firme na Amazônia Central, Brasil

RESUMO - O conteúdo estomacal de insetos (Plecoptera e Odonata), crustáceos e peixes foi analisado por meio de dissecação para se verificar a predação sobre imaturos de simulídeos e identificação dos outros itens alimentares. O trabalho foi realizado em dois igarapés da Reserva Florestal Adolpho Ducke (Sabiá-I), Manaus - AM, pertencente ao Instituto Nacional de Pesquisas da Amazônia (INPA), com espécimes coletados mensalmente no período de abril de 1992 a maio de 1993 e nos meses de novembro de 1993 e junho de 1994. As coletas foram realizadas por meio de cestas-armadilhas (contendo folhas de jambeiro, *Eugenia malaccensis* L., Myrtaceae) e rapiché. Constatou-se a predação de imaturos de Simuliidae por um exemplar de peixe (*Microcharacidium gnomus*, Characidae), Plecoptera (Perlidae) e Odonata (Gomphidae, Agrionidae, Libellulidae, Dicteriadidae e Coenagrionidae). Outros itens alimentares observados nos organismos analisados foram Diptera (Chironomidae), Trichoptera (Hydropsychidae, Hydroptilidae), Coleoptera (Elmidae), Hymenoptera (Formicidae), Ephemeroptera (Baetidae, Leptophlebidae), outros insetos, ovos de insetos, Hydracarina, Crustacea, Nematoda, detritos e restos vegetais.

PALAVRAS-CHAVE: Insecta, fauna aquática, Odonata, Plecoptera, predação, *Simulium*.

Predation can have a strong influence on community structure, affecting reproduction, feeding, adaptation to abiotic factors and defense, which are the four basic requirements of animals for survival and perpetuation

(Peckarsky 1984). Many studies have been done on predators of aquatic insects with economic, medical or veterinary importance, such as Chironomidae, Culicidae and Simuliidae (e.g. Bay 1974, Davies 1981, Crosskey 1990).

In Brazil, few workers have studied predators of black flies, and much of the existing information has been published in abstracts of papers presented at meetings or theses that are not widely circulated. Predation on black-fly larvae by larvae of Hydropsychidae (Trichoptera), Pyralidae (Lepidoptera), Libellulidae, Agrionidae (Odonata), Perlidae (Plecoptera) and Corydalidae (Neuroptera) has been detected by means of stomach dissection and serological tests (precipitine and immunodiffusion) (Gorayeb & Pinger 1978, Gorayeb & Mok 1982, Andrade 1992, Ferreira 1996). Hamada (1993) suggested that *Hemerodromia* sp. (Diptera, Empididae) may prey on black-fly pupae and she observed (Hamada, 1998) spiders (immatures Tetragnathidae) and ants, *Solenopsis saevissima* (Fr. Smith), preying upon black flies. Organisms such as fish (Py-Daniel & Py-Daniel 1984, Strieder 1986, Sato 1987, Andrade 1992), Decapoda and Gastropoda also have been observed preying on immature black flies (Darwich *et al.* 1989, Magni & Py-Daniel 1989).

The objectives of the present study were: 1) to determine which groups of organisms are predators of black-fly immatures, 2) to quantify the frequency of predation by each group (number of specimens observed preying on black flies) and 3) to determine, by means of dissection, the other dietary components of the observed organisms.

The present study was conducted in the Adolpho Ducke Forest Reserve, located in Manaus county, AM, Brazil. The Ducke Reserve belongs to the National Institute for Research in Amazonia (INPA). The reserve has four entrances; the two streams studied, which are unnamed, are located near the entrance named Sabiá-I (03°00'S; 59°56'W). Both of the two lowland streams (0.50-1.0 m wide) flow under primary forest. However, they differed from each other because one had its headwaters running through a deforested area, carrying sediments resulting from soil erosion. The organisms were collected using two methods: basket traps and aquatic nets. The baskets were made of galvanized wire

(5'15'20 cm) enclosed in nylon bags (2-cm mesh). Each basket contained four leaves of pomerak or mamei apple (*Eugenia malaccensis* L., Myrtaceae); this plant was selected because of its leaf size, resistance to decay under water and year-round availability. In each stream, six baskets were introduced monthly in riffle areas, and, simultaneously, the basket that had been at each sampling site during the previous one-month period was removed and the organisms it contained were collected and preserved in a plastic container with 70% ethanol. In the laboratory, they were identified and the potential predators of black flies were dissected under a stereoscopic microscope and the diet items were identified and preserved in 70% ethanol together with the dissected specimens. The diet items were identified by the body fragments, such as head capsule (*e.g.* Simuliidae, Chironomidae, Trichoptera, Crustacea), abdominal parts with gills or terminal filaments (Trichoptera, Ephemeroptera, Odonata) or the whole body (*e.g.* Hemiptera, Hymenoptera, Coleoptera, Hydracarina). Insect fragments that were not possible to identify were placed in the "other insects" category.

Basket-trap sampling was done from April 1992 to May 1993. In November 1993 and June 1994 sampling was done using an aquatic net. These collections were done in each stream in the same six riffle areas that had previously been sampled with basket traps. Aquatic-net collections consisted of two to three scoops of the net (30 × 40 cm) in each riffle area.

A total of 827 organisms (Table 1) was examined. The black-fly species present in the study area were *Simulium goeldii* Cerqueira & Nunes de Mello, *Simulium quadrifidum* Lutz, and *Simulium* "6-B1" (Dellome Filho 1978). Predation on black-fly immatures was observed by Plecoptera (12.4%), Odonata (2.2%) and one fish (5.2%). The other food items present in the stomach contents of the studied organisms were: Diptera (Chironomidae), Ephemeroptera (Baetidae, Leptophlebiidae), Trichoptera (Hydropsychidae, Hydroptilidae), Odonata,

Table 1. Stomach content items observed in aquatic organisms collected in two streams in the Adolpho Ducke Forest Reserve, Central Amazonia, Brazil.

Organisms examined	Number of specimens analyzed	Sim.	Chir.	Odon.	Hemip.	Ephe.	Tric.	Coleo.	Hym.	Other insects	Insect eggs	Hydr.	Crust.	Nema.	Plant remains	Detritus	Empty stomach
Insecta																	
Plecoptera																	
Perlidae	615	76	119	-	-	32	4	1	-	13	7	2	-	-	-	30	341
Odonata																	
Agrionidae	70	18	8	-	-	5	1	-	-	4	-	-	-	-	-	-	34
Coenagrionidae	7	1	-	-	-	1	-	-	-	-	-	-	-	-	-	1	4
Gomphidae	13	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
Dictyodidae	6	2	-	-	-	1	-	-	-	1	-	-	-	-	-	-	2
Polythoridae	8	-	3	-	-	1	-	-	-	-	-	-	-	-	-	-	4
Libellulidae	7	2	1	-	-	2	-	-	-	-	-	-	-	-	-	-	1
Crustacea																	
Palaemonidae																	
<i>Macrobrachium nattereri</i>	9	-	-	-	-	-	-	1	-	-	3	-	-	4	-	-	-
<i>Macrobrachium cf. nattereri</i>	2	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
<i>Macrobrachium inpa</i>	33	1	-	-	-	-	-	-	-	8	-	-	-	1	2	14	7
<i>Macrobrachium</i> sp.	15	-	-	-	-	-	-	-	-	2	-	-	-	1	1	7	4
<i>Pseudopalaemon amazonensis</i>	23	-	4	-	-	-	-	-	-	6	-	3	-	-	-	9	2
Osteichthyes																	
Characiformes																	
Characidae																	
<i>Microcharacidium</i> sp.	4	-	1	-	-	2	-	-	-	1	-	-	-	-	-	-	-

<i>Microcharacidium eletrioides</i>	3	-	3	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-
<i>Microcharacidium gnomus</i>	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Erythrinidae																			
<i>Erythrinus erythrinus</i>	2	-	-	1	1	-	-	-	1	-	-	1	1	-	-	-	-	-	-
Lebiasinidae																			
<i>Nahnostomus marginatus</i>	3	-	3	-	-	1	1	-	-	-	-	1	-	-	-	-	-	-	-
<i>Pyrulina</i> sp.	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siluriformes																			
Cetopsidae																			
<i>Hetogenes marmoratus</i>	1	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-
Perciformes																			
Cichlidae																			
<i>Bujurquina</i> sp.	1	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
<i>Aequidens pallidus</i>	1	-	1	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-
Gymnotiformes																			
Gymnotidae																			
<i>Gymnotus angularis</i>	1	-	1	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-
Cyprinodontiiformes																			
Rivulidae																			
<i>Rivulus poey</i>	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

Notes: Sim.=Simuliidae, Chir.=Chironomidae, Odon.=Odonata, Hemip.=Hemiptera, Ephe.=Ephemeroptera, Tric.=Trichoptera, Coleo.=Coleoptera, Hym.=Hymenoptera, Hydr.=Hydracarina, Crust.=Crustacea, Nema.=Nematoda.

Coleoptera (Elmidae), Hemiptera, Hymenoptera (Formicidae), other insects, insect eggs, Hydracarina, Nematoda, plant remains and detritus. Approximately 50% of the observed Plecoptera and Odonata had empty stomachs. Ferreira (1996) reported 26-31% of Perlidae nymphs to have empty stomachs; this could be an indication that these predators may have periods of non-feeding, perhaps due to a low frequency of prey capture or simply due to the moulting process. The main components of the diet of the observed predators (Table 1) may reflect the abundance of the prey, since Chironomidae and Simuliidae were the most abundant families in the basket traps (52% and 31%, respectively).

Plecoptera (Perlidae, *Anacroneuria* and *Macrogynoplax*) and Odonata (Agrionidae and Libellulidae) have been previously reported as predators of black-fly immatures (Andrade 1992, Ferreira 1996). Fishes in the families Loricariidae, Pimelodidae, Trichomycteridae, Characidae and Cichlidae also have been reported as predators of black flies (Py-Daniel & Py-Daniel 1984, Strieder 1986, Andrade 1992, Sato 1987). This is the first report of Coenagrionidae, Gomphidae and Dictyrididae (Odonata) and the fish *Microcharacidium gnomus* (Characidae) as black-fly predators in Brazil. Understanding trophic relationships among stream organisms is very important if one is to determine their role in community structure, which has rarely been studied in macroinvertebrates of Amazonian streams. Studies on black-fly predators are needed to provide information for future integrated methods of controlling these insects, since some species in this family are of medical and veterinary importance in the region.

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