Feeding habits of *Smicridea (Rhyacophylax) dithyra* Flint, 1974 (Trichoptera: Hydropsychidae) larvae in the Los Molles stream (San Luis - Argentina)

Hábitos alimentares de larvas de *Smicridea (Rhyacophylax) dithyra* Flint, 1974 (Trichoptera: Hydropsychidae) no arroio Los Molles (San Luis - Argentina)

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Abstract: The aim of this work was twofold: to determine the feeding habits of *Smicridea* (*R.) dithyra* larvae using gut content analysis and to establish if there were differences between high and low water periods. The study was carried out in the Los Molles Stream (2nd order) located in the Potrero River basin at 1,000 m a.s.l. in a semiarid region. Forty-one larvae were captured with Surber sampler of 0.09 m^2 and 300 μm mesh. The entomologic material was fixed with formalin at 4% and alcohol at 70%. The gut content was analyzed under microscope with 625x lens. Nine categories of food items and their percentages were determined: leaves fragments, unicellular algae, filamentous algae, amorphous material, inorganic matter, hyphae, invertebrates remains, pollen and fine sediment (<2.5 μm). When comparing high and low waters, diets did not show significant differences. However, in both periods the highest percentage (70%) was represented by invertebrates and amorphous substances, and the rest included filamentous algae, leaves fragments, inorganic matter and unicellular algae. *Smicridea* (*Rhyacophylax*) *dithyra* was found to be a filterer collector organism that processes fine particulate organic matter (FPOM), ultrafine particulate organic matter (UFPOM) and coarse particulate organic matter (CPOM). The similarities in the seasonal trophic structure might indicate the constant food availability.

Keywords: aquatic insect, gut content, stream.

Resumo: Os objetivos deste trabalho foram estabelecer o hábito de alimentação de larvas de *Smicridea (R.) dithyra* por meio da análise do conteúdo estomacal e estabelecer se existem diferenças entre os períodos de águas altas e baixas. O estudo foi feito no arroio Los Molles (2ª ordem) a 1000 m a.n.m., situado na bacia do rio Potrero, compreendida dentro da zona semi-árida. Coletaram-se 41 larvas com um amostrador de Surber de 0,09 m^2 e 300 μm de abertura de malha. O material entomológico foi fixado com formalina a 4% e álcool a 70%. O conteúdo estomacal foi analisado sob microscopico com aumento de 625x. Reconheceram-se nove categorias de itens alimentares: fragmentos de folhas, algas unicelulares, algas filamentosas, material amorfo, matéria inorgânica, hifas, restos de invertebrados, pólen e sedimento fino (<2,5 μm) e calculou-se a porcentagem de cada fração. A dieta entre os períodos de águas altas e baixas não apresenta diferença significativa, nos dois períodos de maior porcentagem, aproximadamente 70% dos itéms foram representados por fragmentos de invertebrados e substância amorfa e o restante composto por: algas filamentosas, fragmentos de folhas, matéria inorgânica e algas unicelulares. *Smicridea (Rhyacophylax) dithyra* é um organismo coletor filtrador que processa além da MOPF (Partículas de Matéria Orgânica Fina) e MOPUF (Partículas de Matéria Orgânica Ultra Fina), a MOPG (Partículas de Matéria Orgânica Grossa). As similaridades na estrutura trófica estacional poderiam indicar a disponibilidade constante dos recursos alimentares.

Palavras-chave: insetos aquáticos, conteúdo estomacal, arroio.

1. Introduction

Aquatic insects exhibit a considerable flexibility in their feeding habits making them adaptable to seasonal changes in relation to the availability of food items in a given environment. The importance of insects in the trophic structure of rivers has been widely recognized. However, there are few studies in relation to their feeding habits (Motta and Uieda, 2004). The determination of feeding habits and the functional classification of particular species of aquatic insects permit to understand many ecological processes of the lotic ecosystems (Albariño, 2000). Aquatic insects are classified within different Food Functional Groups (FFG) by Cummins (1973) in relation to feeding mechanism, and type and size of the consumed food item. Several studies on morpho-behavioural mechanisms have shown the consumption of a wide range of food items, which constitute herbivory, detritivory and carnivory. A change in food items can be expected according to the season, different habitats and growth stage (Merritt

and Cummins, 1984; Palmer and O`Keeffe, 1992; Palmer et al., 1993a; Palmer et al., 1993b).

Hydropsychid caddisflies are extremely important in the ecology of running water systems because of their usually ubiquitous occurrence, high abundance and large biomass, and they are important participants in energy flow and nutrient dynamics in the aquatic environment (Sganga and Fontanarrosa, 2006).

Trichoptera studies in low order streams in San Luis are scarce and fragmentary (Vallania et al., 1998), especially as regards feeding habits (Gil et al., 2006). *Smicridea* McLachlan is the only genus belonging to the subfamily Smicrideinae (Hydropsychidae) found in the Neotropical region where it is varied and generally abundant (Schefter, 1996; Flint et al., 1999; Sganga and Angrisano, 2005). In Argentina, of the 33 species in this genus, 23 belong to the subgenus *Rhyacophylax* and the remaining 10 species belong to the *Smicridea* (Sganga, 2005). In the Los Molles stream, *Smicridea (Rhyacophylax) dithyra* was identified (Sganga and Fontanarrosa, 2006).

The aim of this work was twofold: to determine the feeding habits of *S. dithyra* larvae using gut content analysis and to establish if there were differences between high and low water periods.

2. Materials and Methods

The province of San Luis located within the country semiarid region has scarce hydric resources. Summer rainfalls predominate from October to March with an annual rainfall average between 500 and 650 mm.

The Potrero River basin formed by the Los Molles and the La Bolsa Streams covers an area of 42 km^2. It belongs to the vegetal formation called pasture ground and isolated forest (Anderson et al., 1970). The sampling site was established in the Los Molles Stream (2nd order) at 1,000 m a.s.l. The stream has ritronic characteristics and riparial vegetation, mostly represented by *Lithraea ternifolia* (Gillies) Barkley (Figure 1).

The samplings were carried out in 2003 during the low water (May-June) and high water (November-December) periods. To estimate the hydraulic parameters of the river bed, two transversal transects were done to measure width and depth every 30 cm. Surface current velocity was measured using floater, and the flow was also calculated. Water temperature, conductivity and pH were measured in situ using portable sensor. The dominant substrate was classified according to the granulometric composition (Ward, 1992). Samples of benthic macroinvertebrates were obtained using Surber samplers (with an area of 0.09 m^2 and 300 µm net mesh size) and were revised under a stereoscopic microscope. Twenty-one larvae from the high water period and twenty from the low water period, all of them with gut content, were isolated, fixed in formol (4%) and then preserved in laboratory in alcohol (70%).

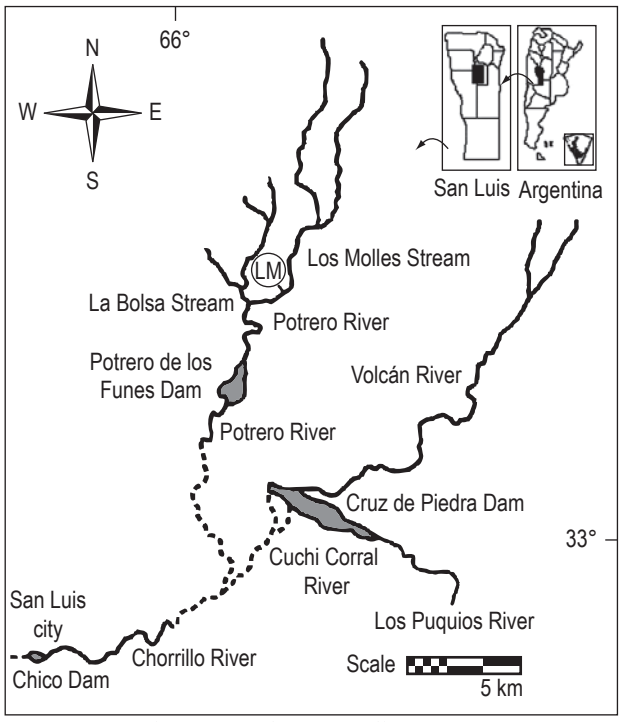

Figure 1. Sampling site in the Los Molles Stream.

On the basis of the methodology proposed by Palmer and O'Keeffe (1992) and Palmer et al. (1993a; 1993b) and modified by Albariño (2000), the content of the last portion of the stomodeum and the mesenteron obtained by dissection and subsequent homogenization with distilled water was analyzed. The diet composition was observed under a 625x objective with graded ocular. Fifteen fields in the microscope grid were selected at random, and 9 categories of food items were identified: leaves fragments, unicellular algae, filamentous algae, amorphous material, inorganic matter, hyphae, invertebrates remains, pollen and fine sediment (<2.5 µm). The quantification of each item was carried out considering the covered grid surface of the ocular. The items percentage composition was determined for high and low waters.

The comparison between both sampling periods was carried out using Mann Whitney Test ($p < 0.05$, reliability level 95%).

3. Results

The annual average hydrological characteristics were: width, 8.6 m; depth, 0.2 m; velocity, 0.6 m/s; and flow, 0.2 m^3/s. The physico-chemical variables were: water temperature: 16.1 °C; conductivity, 140.1 µS.cm^{-1} and pH, 7.6. The dominant substrate included blocks of stone (45%), pebbles (15%), coarse and fine gravel (30%) and sand (10%).

When comparing high water and low water periods by Mann Whitney test in relation to the gut content items of each larva, no significant differences were observed ($p > 0.05$). During both periods the most representative

items were invertebrates and amorphous substance constituting about 70% of the diet (Table 1). The food items average in *S. dithyra* between both periods was: amorphous material (37.4%), invertebrate remains (32.6%), filamentous algae with five genera of Clorophyta (11.5%), leaves fragments (6.3%), inorganic matter (5.9%) and unicellular algae with 10 genera of Bacillariophyceae (4.8%). Hyphae, fine sediment and pollen were found in small percentages between 0 and 0.7%. Chaetas of oligochaeta, eggs, legs and tegument of mayflies and antennas, among others, were observed in the invertebrate remains.

4. Discussion

The classification in Food Functional Groups (FFG) is partially based on the species morphology. However, there is a considerable flexibility in the feeding habits of all aquatic insects (Cummins, 1973). Most of the Trichoptera larvae are opportunists, and they rarely consume a definite type of food. In fact, few species depend on an only trophic level (McShaffrey and McCafferty, 1988). Genera can be classified within a determined trophic category (Cummins, 1973) which is defined by the kind of food consumed or by the way

Table 1. Gut content of *Smicridea dithyra* larvae, considering the covered grid surface of the ocular for each food item, expressed as percentage in the high (HW) and low (LW) water periods.

Larvae	Leaves fragments	Unicellular algae	Filamentous algae	Amorphous material	Inorganic matter	Hyphae	Sediment <2.5 µm	Pollen	Invertebrates remains	Period
1	-	0.02	-	2.15	0.18	-	0.05	-	59.53	L W
2	-	1.75	-	6.23	0.28	-	0.10	0.07	-	L W
3	0.66	0.42	1.73	1.43	1.57	-	0.07	-	26.85	L W
4	-	0.61	-	3.75	0.38	-	0.12	-	35.35	L W
5	0.82	0.95	-	1.82	0.38	-	0.12	-	0.27	L W
6	12.07	0.17	-	9.50	0.27	0.35	0.37	-	-	L W
7	0.60	0.85	1.08	5.48	0.50	0.20	0.15	-	0.03	L W
8	20.23	0.88	22.33	3.27	0.22	-	0.05	-	0.03	L W
9	0.55	0.43	3.57	5.83	0.20	0.18	0.08	-	1.78	L W
10	-	0.38	-	0.77	0.08	0.27	0.12	-	1.15	L W
11	-	0.38	0.65	6.15	0.43	1.17	0.13	-	0.38	L W
12	-	0.43	-	1.35	1.40	-	0.07	-	0.30	L W
13	-	0.45	5.00	16.70	2.50	0.17	0.07	-	0.80	HW
14	-	0.12	6.62	11.85	2.07	1.67	0.22	-	2.17	HW
15	-	-	-	0.13	0.13	-	0.08	-	-	HW
16	-	2.17	3.02	15.28	1.15	0.03	0.02	-	3.37	HW
17	0.18	0.32	0.03	11.58	2.62	0.02	0.67	-	0.80	HW
18	1.83	0.70	8.70	23.83	4.68	-	0.08	-	0.07	HW
19	0.80	0.77	-	23.53	0.85	0.42	0.08	-	9.63	HW
20	4.47	0.38	0.10	4.30	0.05	0.20	0.03	-	0.92	HW
21	0.17	0.17	-	2.33	0.83	-	0.05	-	2.23	HW
22	-	0.65	1.75	24.80	2.20	-	0.05	-	5.78	HW
23	-	0.02	0.17	-	-	-	-	-	5.66	HW
24	-	1.70	0.45	14.87	1.05	-	-	-	43.03	HW
25	-	1.78	3.02	2.67	1.17	-	0.23	-	0.20	L W
26	0.27	0.65	2.78	0.05	0.92	-	0.13	-	1.32	L W
27	0.08	0.33	-	0.67	0.28	0.02	0.05	-	0.07	L W
28	0.30	0.92	0.35	0.92	0.22	-	0.02	-	-	L W
29	0.17	0.17	-	2.02	0.62	-	0.07	-	0.35	L W
30	-	2.65	0.03	4.52	0.98	-	0.02	-	-	L W
31	-	1.25	1.17	6.00	1.18	-	0.03	-	-	LW
32	-	1.50	0.53	2.85	0.27	-	0.07	0.07	-	LW
33	-	0.18	4.80	4.53	1.88	-	0.05	-	6.12	HW
34	-	0.07	-	0.38	0.08	-	0.07	-	-	HW
35	-	0.68	1.98	6.97	1.52	-	0.13	-	1.35	HW
36	-	0.38	0.30	1.42	0.37	-	0.12	-	-	HW
37	-	1.42	-	0.92	0.07	-	-	-	-	HW
38	-	1.17	-	5.80	1.20	-	0.08	-	-	HW
39	0.45	0.23	3.28	4.97	2.37	-	0.27	-	-	HW
40	-	4.12	-	12.97	1.83	-	0.08	-	-	HW
41	-	0.88	5.83	3.03	1.75	-	0.27	-	-	HW

they obtain it. The classification of taxa within a certain FFG is more significant if the morphological characteristics, gut content and feeding behaviour are analyzed together (Palmer et al., 1993b; McShaffrey and McCafferty, 1988).

Merritt and Cummins (1984) have described *Smicridea* as being filterer collectors. Palmer and O´Keefe (1992) have suggested a classification of filterer collectors according to the way they eat: those which feed on seston moved by a current, using silk nets or body parts (passive), and those which resuspend deposits which are filtered using silk nets or body parts (active). Gayardo-Mayenco et al. (1998) have described the feeding habits of Hydropsychydae in relation to the different net sizes which can be related to the larvae development stage; in both cases, breeding in the laboratory might be necessary.

The dietary composition observed in *S. dithyra* obtained from the Los Molles stream is in agreement with the genus description due to the variety of ingested food items. Considering the size of the items found in the digestive tracts of *S. dithyra* larvae, the definition given for filterer collectors might be extended since they have been traditionally described as processors of fine particulate organic matter (FPOM) and ultrafine particulate organic matter (UFPOM). However, in some cases, coarse particulate organic matter (CPOM), such as complete preys or fragments of big filamentous algae, was found.

The similarities found in the seasonal trophic structure might indicate the constant availability of the food resource. This possibility is reinforced by some studies carried out with coleopterans and dipterans, which showed that a change in the trophic group involved a change in the proportion of items consumed during the dry and wet seasons (Motta and Uieda, 2004). Further research will be done on food preferences in relation to the larvae size and feeding behaviour.

Acknowledgements

This study was financed by PROICO 9401 Secretaría de Ciencia y Técnica (UNSL). We are grateful to Elisa Angrisano (UBA) for her help during taxonomic determination of the studied species.

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Received: 24 October 2007
Accepted: 12 February 2008