

## The adult diet of *Xanthoperla apicalis* and *Siphonoperla torrentium* (Plecoptera, Chloroperlidae) in the Danube basin (Slovakia)

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**Abstract:** The gut contents of adult *Xanthoperla apicalis* and *Siphonoperla torrentium* were analysed. *X. apicalis* females eat mainly pollen, while males feed principally on detritus and pollen. Adults of *S. torrentium*, regardless of sex, eat mainly pollen. The presence of animal remains (claws and leg and antennae segments of Arthropoda) in the gut of several individuals of both species was observed and discussed.

**Key words:** Plecoptera; stoneflies; feeding; Slovakia

### Introduction

Although the knowledge on European Systellognathan Plecoptera adult feeding is very incomplete and sometimes misleading (because it was traditionally assumed that they do not ingest food during this stage), nowadays we have a wider information about this topic. Thus, up to date, we know that only some big-sized Perlodidae and Perlidae do not feed (Fenoglio & Tierno de Figueroa 2003), while the other members of the group (many Perlodidae and every studied Chloroperlidae) feed actively (Tierno de Figueroa & Fochetti 2001). Even variations in the diet along the flight period have been detected for two species (Tierno de Figueroa & Sánchez-Ortega 1999). In Chloroperlidae, Brinck (1949) reported a few individuals of *Siphonoperla burmeisteri* (Pictet, 1842) with food in their gut, but the absence of food in females carrying eggs made him suppose that feeding was not a requisite for egg maturation as in Nemouroidea. Rotheray & Liston (1985) observed a *Chloroperla tripunctata* (Scopoli, 1763) that seemed to feed on a sawfly (Tenthredinidae). More recently, Rupperecht (1990) demonstrated that *Siphonoperla torrentium* (Pictet, 1842) can metabolize food ingested during the adult stage and Zwick (1990) pointed out that this species gains weight during its adult life by ingesting food (consisting in Pinaceae pollens). Tierno de Figueroa & Sánchez-Ortega (1999) showed that *Chloroperla nevada* Zwick, 1967 adults change the proportion of dietary components over the flight period in relation to their availability. Finally, Derka et al.

(2004) studied the *Isoptena serricornis* (Pictet, 1842) adult diet and found that pollen grains are the main component.

The aim of the present work is to describe the adult diet of *Xanthoperla apicalis* (Newman, 1836), which is the only non-studied European Chloroperlidae genus in relation to feeding, and to contribute new information on *Siphonoperla torrentium* adult diet. *X. apicalis* is a widely distributed species, in Central Europe usually associated to lowland rivers and streams up to 500 m a.s.l. (Aubert 1946). However, it has disappeared from a great part of its original distribution area and has become rare with scattered distribution in Central Europe (Zwick 1992). Krno (2001) placed *X. apicalis* between critically endangered species in Slovakia. Adults collected by the authors can be therefore considered the first record of this species in the Slovak section of the Danube River after one century of absence. *S. torrentium* is a relatively common species, widely distributed in Europe (Tierno de Figueroa et al. 2003), and in Slovakia it is widely distributed in mountain and submountain streams (Winkler 1957).

### Study sites and methods

The material used in this study was collected at three different sites:

1. Danube River (Bratislava, Slovakia) (48°08'39.1" N, 17°04'22.8" E, 130 m a.s.l.), 15.V.2006: 9 ♂♂ and 8 ♀♀ of *Xanthoperla apicalis*, leg. M.J. López-Rodríguez.

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Table 1. Absolute and relative percentages of gut content of *Xanthoperla apicalis* adults.

	Females					Males				
	N	Mean	Min.	Max.	SD	N	Mean	Min.	Max.	SD
% absolute	25	28.36	3	95	31.21	17	6.12	0	15	4.4
% detritus	25	10.52	0	70	17.22	16	44.37	5	100	34.73
% pollen (Pinaceae)	25	8.96	0	90	20.3	16	10	0	50	14.83
% pollen (Angiospermae)	25	53.12	5	100	31.64	16	23.75	0	90	29.24
% non-identifiable vegetable matter	25	20.2	0	90	25.47	16	17.19	0	85	24.49
% fungi	25	0.8	0	4	1.44	16	0.31	0	5	1.25
% diatoms	25	0.04	0	1	0.2	16	0	0	0	0
% animal remains	25	3.16	0	60	12.23	16	4.06	0	65	16.25
% lichen	25	3.32	0	80	15.99	16	0	0	0	0

Table 2. Absolute and relative percentages of gut content of *Siphonoperla torrentium* adults.

	Females					Males				
	N	Mean	Min.	Max.	SD	N	Mean	Min.	Max.	SD
% absolute	14	40.36	8	80	28.39	2	2.5	0	5	3.54
% detritus	14	1.43	0	5	1.7	1	0	0	0	–
% pollen (Pinaceae)	14	0	0	0	0	1	0	0	0	–
% pollen (Angiospermae)	14	88.79	43	100	14.9	1	75	75	75	–
% non-identifiable vegetable matter	14	2.5	0	10	3.59	1	15	15	15	–
% fungi	14	1.86	0	8	2.93	1	5	5	5	–
% algae	14	1.29	0	15	4.03	1	0	0	0	–
% animal remains	14	2.64	0	30	8.09	1	0	0	0	–

2. Danube River, Petržalka (Bratislava, Slovakia) (48°07'14.7" N, 17°08'40.3" E, 130 m a.s.l.), 21.VI.2006: 8 ♂♂ and 17 ♀♀ of *X. apicalis*, leg. T. Derka & I. Krno.

3. Bystrica, Šramková (Malá Fatra Mts., Slovakia) (49°03'39.0' N, 18°48'11.5" E, 600 m a.s.l.), 23.VI.2002: 2 ♂♂ and 14 ♀♀ of *Siphonoperla torrentium*, leg. T. Derka

For the study of the gut content, we followed the methodology used by Tierno de Figueroa & Sánchez-Ortega (1999), Tierno de Figueroa & Fochetti (2001) and Derka et al. (2004), i.e., we introduced every individual in a vial with Hertwig's liquid (a variation of Hoyer's liquid) for 20–24 hours and put them into an oven at 65°C. Afterwards we put the specimens already transparent on a slide glass with a cover glass on, and we estimated the absolute content percentage (measured as percentage of occupied area) at 40× and the relative percentage of each component present in the gut at 400× in an Olympus microscope.

## Results and discussion

*Xanthoperla apicalis* females eat mainly pollen while males feed principally on detritus and pollen (Table 1). *Siphonoperla torrentium*, both males (although the number of individuals is not significant) and females, eat mainly pollen (Table 2). Outstanding are: 1) the high percentage of individuals with gut content; 2) a higher absolute percentage in females (each with eggs) than in males; and 3) the presence of animal remains (claws and leg and antennae segments of Arthropoda) in the gut of several individuals and, sometimes, occupying a considerable percentage of the total content.

Our results (particularly the high percentage of pollen grains in the diet) agree with the general pat-

tern shown for other Chloroperlidae adults (Zwick 1990; Tierno de Figueroa & Sánchez-Ortega 1999; Derka et al. 2004), but the presence of animal suggests an interesting and new finding. Up to now, data about animal feeding in adult stoneflies were limited to scarce observations and almost every time in Nemouroidea (Frison 1929; Salveit 1977; Rotheray & Liston 1985; Luzón-Ortega & Tierno de Figueroa 2003). As pointed out for *Nemoura fulviceps* Klapálek, 1902 by Luzón-Ortega & Tierno de Figueroa (2003), the animal matter could probably be a nutritional support in these species.

The high quantity of gut content found in the analyzed species (and also in other Chloroperlidae previously studied) is comparable to that found in many Nemouroidea species with similar size (e.g., Tierno de Figueroa & Sánchez-Ortega 2000). This fact contrasts with the usually accentuated necessity of maturing eggs of Nemouroidea females after emergence, while Perlodea eggs usually mature at the end of nymphal development (Hynes 1976). Thus, this wide nutritional support will be used by females for other adult activities as mating, oviposition flights, drift compensation flights, etc. Although in a lower quantity, males would need food for their adult activities (mate searching behaviour, drumming call production, etc.).

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