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Production biological examination of some aquatic Peracarida species (Crustacea: Malacostraca)

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Abstract. We observed the nutrient consumption of four crustacean species: *Gammarus roeseli* Gervais, 1838, *Synurella ambulans* Müller, 1846, *Niphargus valachicus* Dobreanu & Manolache, 1933 (Amphipoda) and *Asellus aquaticus* (Linnaeus, 1758) (Isopoda) in vitro. We can conclude from the results, that the examined species can be arranged into two groups according to their nutritional habits. *G. roeseli* and *A. aquaticus* shred decaying materials, while *S. ambulans* and *N. valachicus* probably consume floating grains of nutrient. *G. roeseli* prefers litter of softer construction to the oak leaves which are harder and have higher tannin content. The microbiological decay in the water impoverishes the utilisable nutrients of the litter, therefore the examined Amphipoda prefer leaves which have been soaking in the water only for a few weeks. Nevertheless, we suppose that the degree of digestion is influenced by the time spent in the alimentary canal.

The nutritional habits of the amphipods which frequently occur in high quantity in various streams of Hungary, are little-known. In our country, only Ponyi (1955) made nutrition biological experiments with these animals, when he arranged the Hungarian species into two groups according to their nutritional habits (shredders and filters). Some of the researches concentrate on the process how the litter is consumed (Essafi et al., 1994; Malicky, 1985; Qian Rong et al., 1995) while the others deal with the consumption of the fungi settled on the litter (Bärlocher & Kendrik, 1973; Graca et al., 1993 and 1994). These researches concentrate on the quantity of the consumption without analysing the quantity of the FU material (faeces and urine) or the utilisation of the nutrient which derives from the two values.

We were eager to know how the dominant species in our waters take part in the disintegration of the litter fallen into the water.

MATERIALS AND METHODS

First of all, we examined the most frequent species, *Gammarus roeseli* Gervais, 1838, which was collected from the Majki Stream in the northern part of the Vértes Mountains. Its activity was compared to *Synurella ambulans* Müller, 1846, *Niphargus valachicus* Dobreanu & Manolache, 1933 (Amphipoda) and *Asellus aquaticus* (Linnaeus, 1758) (Isopoda).

We used 10 individuals for each experiment, first we weighed them, then put them into a cylindrical plastic vessel (base: 10 cm in diameter, height: 8.5 cm). The vessel was filled up with 300 cm^3 water taken from the living place of the amphipods. The Amphipoda were fed with leaves which had been decaying in the Majki Stream and then had been air-dried. These leaves were collected immediately after falling, then they were placed into the stream for different intervals (one, two, three weeks, and one month) to observe the effect of the stage of decay on the nutrition. The vessels were placed into a LMC EUROCOLD SV230 type of thermostat (12-hours lighting, 12° and 15° C). After the interval of experiment we weighed the animals again, then air-dried the nutrition left, the amphipods and the FU material and weighed them again. We used T-test, F_{max}-test, ANOVA and Turkey-test to evaluate the data.

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RESULTS

Experiment 1. Utilisation of leaves in different stages of decay – *G. roeseli*

In this experiment we worked with 15° C and 12-hour-long lighting. As nutrition we used the leaves of all four types of alder (*Alnus glutinosa*). Both the quantity of the consumption (Table 1) and the FU material (Table 2) were examined by the help of ANOVA, because the F_{max}-test doesn't rule out the possibility of its usage (consumption: F_{max}: 5,64, P <0,05, T_{table}: 7,11; FU material: F_{max}: 1,08, P <0,05, T_{table}: 7,11).

As can be seen in Table 1, ANOVA showed significant difference between the leaves in different stages of decay (F_s: 9,05, P <0,05, T_{table}: 2,84), though there wasn't any significant difference between the consumption of leaves which were left in the stream for 1 and 2, 2 and 3 and 1 and 3 weeks (Turkey-test: P <0,05, MSD: 0,0046). The other comparisons resulted in significant differences.

It can be evaluated from Table 2 that ANOVA showed significant difference between the leaves in different stages of decay (F_s: 7,21, P <0,05, T_{table}: 2,84). The rate of the utilisation decreased and the quantity of FU material increased if the leaves were in more decayed stage (Table 3). It may be deduced from the data that the more utilisable nutrients dissolve out very fast. It causes deterioration in quality which doesn't influence the consumption for the first few weeks. However, the animals found the one-month-old leaves unsuitable for consumption, therefore their consumption decreased significantly. Examining the nutritional habits of the animals, we found that they hasten the decay of the leaves, which have been soaking in the stream only for 1-2 weeks. We found that the rate of the FU material of *G. roeseli* was lower than woodlice and millipedes (Gere, 1962 a, b) which also consume litter, though *G. roeseli* can't utilise it as well as some homoiotherm species (Andrikovics et al., 1997; Gere & Kontschán, 2000).

***Table 1.** The consumption (mg) of one individual of G. roeseli*

Time leaves spent in the water	1 week	2 weeks	3 weeks	1 month
Averages	9.6	12.4	12.3	4.5
SD	±1.7	±1.9	±2.85	±1.2

***Table 2.** The quantity of FU material (mg) of one individual of G. roeseli*

Time leaves spent in the water	1 week	2 weeks	3 weeks	1 month
Averages	6.7	8.6	10.7	3.9
SD	±1.6	±1.6	±1.6	±1.2

***Table 3.** Productional biological rates (C: consumption, A: assimilation, FU: feces and urine)*

Time leaves spent in the water	1 week	2 weeks	3 weeks	1 month
$\frac{A \times 100}{C}$	30.21	30.65	13.22	12.31
$\frac{FU \times 100}{C}$	69.79	69.35	86.78	87.69

Experiment 2. Comparison of *G. roeseli* and three other aquatic Peracarida species

In this research, we compared the productivities of *G. roeseli* and the above mentioned three species. The Amphipoda were fed with litter decayed for two weeks, on 12° C and under 12-hour-long lighting. In case of *S. ambulans* and *N. valachicus* we didn't find any measurable consumption, so we think that these species lead a filtering way of life. This result is supported by the habitat preference: these species occur in slow-flowing or still waters. Ponyi (1955) also mentioned their inclination to filtering, though he suggested that these species are both filters and shredders. We think that they prefer shredding only in the lack of floating nutrient. *G. roeseli* and *A. aquaticus* have the same nutritional habit (shredders), but here were significant differences between the quantity of their consumption and FU material (consumption: T: 6,6, P <0,05, T_{table}: 2,1; FU material: T: 6,6, P <0,05, T_{table}: 2,1). The individuals of *G. roeseli* consumed 10 times as much as *A. aquaticus* and a similar trend could be seen in connection with FU material (Table 4).

We have to notice the different sizes of the two species. While one dried individual of *G. roeseli* weighs 9.34 mg (±3.65), one dried individual of *A. aquaticus* weighs only 2.1 mg (±1.85). If we take 1 g of dried body weight as a base of comparison, the consumption is three times as much as that of *A. aquaticus*. So the difference is still considerable, especially in case when we observe the law of surface. Therefore, we assume that different types of food (plants and carcasses) are dominant in the nutrition of *A. aquaticus*. On the other hand, the utilisation rates of the consumed nutrients are very similar in the two species (Table 5).

***Table 4.** The quantity of consumption and FU material of one individual*

	Consumption		FU material	
Species	*G. roeseli*	*A. aquaticus*	*G. roeseli*	*A. aquaticus*
Averages	9.05	0.62	6.76	0.44
SD	±2.00	±0.17	±1.50	±0.12

***Table 5.** Productional biological rates*

	G. roeseli	*A. aquaticus*
$\frac{A \times 100}{C}$	25.30	29.03
$\frac{FU \times 100}{C}$	74.70	70.97

***Table 6.** The quantity of consumption and FU material of one individual*

	Consumption		FU material	
Food	Alder	Oak	Alder	Oak
Averages	9.05	0.64	6.76	0.34
SD	±2.00	±0.15	±1.50	±0.25

Experiment 3. Examination of the nutrient utilisation of *G. roeseli* feeding on litter from two different species of trees

In this experiment some animals were fed by alder (*Alnus glutinosa*) leaves, while the others got oak (*Quercus cerris*) leaves. Both types of leaves had been soaked for 2 weeks. The experimental temperature was 12° C, the lighting time was 12 hours a day. The results – both the consumption and FU material – showed significant differences (consumption: T: 6,6, P <0,05, T_{table}: 2,1; FU material: T: 6,68, P <0,05, T_{table}: 2,1).

Comparing the consumption of the alder and oak litter, the consumption of oak litter was significantly lower than the alder's (Table 6). The utilisation of nutrient can be evaluated by the help of Table 7. The utilisation of the oak litter was better; we only have an assumption as an explanation. We suppose that the animals assimilate better the food they like less, because it passes through the alimentary canal slower as a result of less consumption. The same observation was made by Gere (1962 a, b) concerning Diplopoda and Isopoda living in forest litter.

***Table 7.** Productional biological rates*

	Alder	Oak
$\frac{A \times 100}{C}$	25.30	46.88
$\frac{FU \times 100}{C}$	74.70	53.12

DISCUSSION

We can conclude from the results that two of the examined species are shredders (*G. roeseli* and *A. aquaticus*) and the other two are filters (*S. ambulans* and *N. valachicus*). *G. roeseli* prefers litter of softer construction to the oak leaves which are harder and have higher tannin content. The microbiological decay in the water impoverishes the utilisable nutrients of the litter, therefore the examined Amphipoda prefer those leaves which have been soaking in the water only for few weeks. Nevertheless, we suppose that the degree of digestion is influenced by the time spent in the alimentary canal.

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