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# THE COMPOSITION AND SEASONAL CHANGES IN THE DIET OF RUFFE (*GYMNOCEPHALUS CERNUUS*) IN LAKE VÕRTSJÄRV, ESTONIA

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**Abstract.** From May till November 1994 the diet of ruffe was investigated in the shallow eutropic Lake Võrtsjärv, South Estonia. A total of 187 ruffes of standard length (Sl) of 4.3—12.0 cm were examined. In addition, 35 ruffes were examined in September—October 1995. Ruffes of Sl over 4.5 cm (age 1+ and older) are typical benthophagous fish consuming mainly chironomid larvae and pupae (over 95% of the weight of their food). *Chironomus plumosus* (91%), *Einfeldia carbonaria* (36%), and *Microchironomus tener* (31%) had the highest occurrence frequency. The most important food item was *C. plumosus* (about 98% of the chironomid biomass in stomachs). Smaller ruffes consume mainly zooplankton.

Chironomids are also the main prey items for eel (*Anguilla anguilla*) and bream (*Abramis brama*) in L. Võrtsjärv. Overlap in their diets appeared mostly in respect of *C. plumosus* larvae and pupae.

**Key words:** ruffe, diet, seasonal changes, amount of food organisms.

## INTRODUCTION

Ruffe (*Gymnocephalus cernuus* (L.)) is a small bottom living shoal fish. For many years, it has been considered to have little or no value for commercial or recreational fisheries throughout its natural range in Europe. As a result, the species has been relatively neglected by fish biologists and literature data on it are scanty and little reviewed or collated (Winfield & McCulloch, 1995).

In Estonia ruffe is found in at least 150 lakes (Mikelsaar, 1984). L. Võrtsjärv was previously regarded as a ruffe lake because in the 1950s and 1960s the bulk of the fish caught there consisted of ruffe, young perch, and roach. Owing to the rearrangement of the fishing strategy a rapid replacement of rough fishes by commercial fishes has taken place.

From May to November 1994 ruffe made up about 35% of the total experimental catch (Fig. 1). Trawling (twelve times) was carried out in the open water of the southern and central parts of the lake. No recent data on its commercial catch is available because ruffe is recorded together with other small fishes.

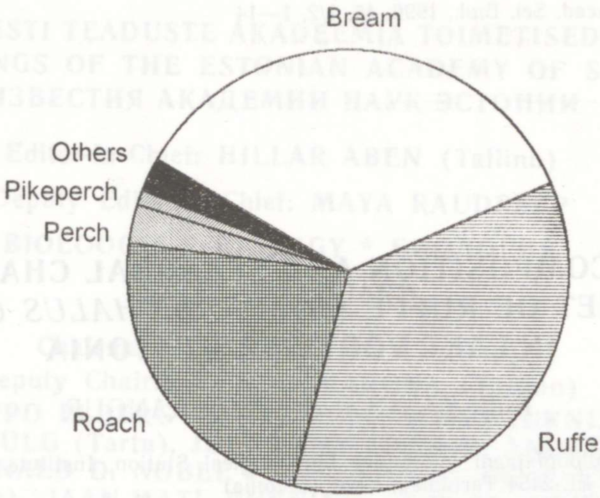


Fig. 1. Composition of experimental fish catches in L. Võrtsjärv in 1994.

The earliest data on the feeding of fishes in L. Võrtsjärv were published by Schneider (1920), who found out that ruffes consumed mainly little yellow and green chironomid larvae and pupae. In 1966—67 Kangur and Tõlp (Кангур, 1968; Kangur, 1969; Кангур & Тыльп, 1974) studied seasonal and size-related changes in the feeding of ruffe and established that zooplankton predominated in the diet of one-summer-old (0+) ruffe fry. With an increase in the size of ruffe the role of zooplankton decreased, while the share of benthic invertebrates and fishes grew. The authors presented the occurrence frequency and the number of food objects per individual, as well as the general index of filling. However, none of the papers dealt with the biomass of food animals in the diet of ruffe.

When discussing the diet of fishes it is important to know both the type and availability of food organisms. The diet must be related to the size of the fish and the availability (density, size distribution, visibility, etc.) of food (Lammens & Hoogenboezem, 1991).

We have studied the diet of ruffe and its relation to the benthic community in L. Võrtsjärv since 1994. This paper describes the composition as well as seasonal changes of the diet of ruffe. An attempt is made to quantify food consumption. The proportion of the number and biomass of food organisms eaten by ruffe is compared with their abundance and biomass in the bottom substrate. A possible competitive interaction with eel and bream in respect of food organisms is discussed.

## STUDY AREA

L. Võrtsjärv is a large (270 km$^2$) and shallow (mean depth 2.8 m, maximum depth 6 m) lake in South Estonia. It is a strongly eutrophic waterbody, characterized by average concentrations of total N 2 g $\cdot$ m$^{-3}$ and total P 53 mg $\cdot$ m$^{-3}$. The water is alkaline (pH 7.5—8.5) with a great buffering capacity and a high seston content (Haberman et al., in press). The water is practically homothermic and, due to the wind action, very turbid in summer. In winter oxygen deficiency sometimes occurs. Macrophytes cover at least 15% of the whole aquatory on the lake and this area is increasing. About 2/3 of the lake bottom is covered with mud lying on

*Table 1*

**Average abundance and biomass of macrozoobenthos of L. Võrtsjärv in 1973—93 and 1994**

| Main animal groups | 1973—93 | | 1994 | |
|---|---|---|---|---|
| | ind · m⁻² | g · m⁻² | ind · m⁻² | g · m⁻² |
| Chironomidae | 576±51 | 5.68±1.15 | 646 | 12.07 |
| among them *C. plumosus* | 179±40 | 4.84±1.14 | 303 | 11.29 |
| Oligochaeta | 242±31 | 0.45±0.06 | 468 | 0.84 |
| Mollusca | 13±1 | 0.41±0.04 | 10 | 0.25 |
| Others | 39±7 | 0.23±0.03 | 36 | 0.23 |
| Total (without big clams) | 870±70 | 6.77±1.20 | 1160 | 13.4 |

marl. The mean macrozoobenthos abundance and biomass ($870+70$ ind $\cdot$ $m^{-2}$ and $6.8+1.2$ g $\cdot$ $m^{-2}$ in 1973—93) are considerably lower than in other neighbouring eutrophic lakes. The low quantity of zoobenthos in L. Võrtsjärv is probably caused by its availability to a large number of fishes feeding on benthos (mainly ruffe, bream, and eel.) In 1994 the macrozoobenthos of the lake was extraordinarily rich: on an average 1160 ind $\cdot$ $m^{-2}$ and 13.4 g $\cdot$ $m^{-2}$ (Table 1). In the benthic community of the lake the dominant group was Chironomidae; among them *C. plumosus* formed over 84% (long-term average 71.5%) of the total biomass of macrozoobenthos (Table 1).

According to the fishery typology L. Võrtsjärv belongs to the pikeperch lakes, although recently it has acquired some qualities of a bream lake. Bream, eel, pikeperch, and pike are the main commercial fishes in the lake.

## MATERIAL AND METHODS

In the period from May to November 1994 and September—October 1995 ruffe samples were collected once or twice a month by experimental trawl in the open water of the southern and central parts of the lake.

The collected ruffes were weighed with an accuracy of 0.1 g and measured with an accuracy of 1 mm (Table 2). Thereafter the ruffes were dissected and their sex determined. The stomachs were removed and examined immediately or preserved in the frozen condition till the next day. Before analysis the samples were thawed slowly. The content of 187 stomachs (in 1994) and 35 stomachs (in 1995) was analysed in detail.

*Table 2*

**Measurements of examined ruffes**

| Month | Number of fishes | Standard length, cm | | Weight, g | |
|---|---|---|---|---|---|
| | | average | range | average | range |
| May | 36 | 7.9 | 5—10.5 | 8.9 | 2—19 |
| June | 30 | 8.7 | 6—12 | 12.2 | 4—28 |
| July | 25 | 8.0 | 5.8—11 | 9.5 | 3—22 |
| Aug. | 31 | 8.3 | 6—10.3 | 10.9 | 4—21 |
| Sept. | 21 | 8.1 | 5—11 | 9.9 | 2—18.5 |
| Oct. | 22 | 8.4 | 7—10 | 10.7 | 6—17 |
| Nov. | 22 | 7.4 | 4.3—10.5 | 8.3 | 1.4—19.2 |

The prey items or their remains were counted and identified under the microscope to the lowest possible taxonomic level. Then their reconstructed fresh weight was calculated. The mean live weight of chironomid larvae and pupae was calculated according to the data on macrozoobenthos samples collected monthly in 1993 from a profundal sample station of the lake (Kangur & Tuvikene, in press). The reconstructed weight of the stomach content was calculated and expressed as fresh weight (mg) per one ruffe. The larval instars of *C. plumosus* were identified by the width of their head capsules (Кангур & Кангур, 1978).

*Table 3*

**Composition of the diet of ruffe in L. Võrtsjärv in 1994**

| Taxon | OF*, % | Mean number per stomach |
|---|---|---|
| Oligochaeta cocoons (indet.) | 5 | + |
| Zooplankton (Cladocera + Copepoda) | 26 | 2.4 |
| Ostracoda (indet.) | 5 | 1.0 |
| Malacostraca | | |
| *Asellus aquaticus* L. | 0.5 | + |
| Trichoptera (indet.) | 0.5 | + |
| Diptera | | |
| *Chironomus plumosus* (L.) pupae | 38 | 0.7 |
| IV instar | 80 | 3.8 |
| III instar | 29 | 1,2 |
| II instar | 16 | 0.6 |
| *Cladotanytarsus* gr. *mancus* | 1 | + |
| *Cricotopus* gr. *sylvestris* | 0.5 | + |
| *Einfeldia carbonaria* (Meig.) pupae | 2 | + |
| IV instar | 29 | 0.7 |
| III instar | 12 | 0.2 |
| *Endochironomus albipennis* (Meig.) | | |
| IV instar | 3 | + |
| III instar | 1 | + |
| *Glyptotendipes glaucus* (Meig.) | 1 | + |
| *G. paripes* Edw. | 0.5 | + |
| *Procladius* spp. | 20 | 0.3 |
| *Microchironomus tener* (Kieff.) | | |
| pupae | 4 | + |
| IV instar | 32 | 0.9 |
| III instar | 3 | + |
| *Paratanytarsus* spp. | 0.5 | + |
| *Stictochironomus rosenschoeldi* Zett. | 0.5 | + |
| Chironomidae (indet.) | 6 | + |
| Pisces (ovae) | 2 | + |
| Plants | 2 | + |
| Algae | | |

* OF, occurrence frequency; stomachs without food are included.
\+ Less than 0.1 items per stomach.

## RESULTS

### 1. The composition of the diet

The fry of ruffe feeds on zooplankton; in autumn it begins to take also zoobenthos. According to Kangur (1969), the main food for the fry of ruffe in L. Võrtsjärv was benthopelagic zooplankton (Cladocera: *Alona affinis*, *Chydorus sphaericus*, *Bosmina coregoni*, *Daphnia cucullata*, and Copepoda: Cyclopoida, Harpacticoida, Calanoida) as well as Ostracoda. The role of zoobenthos in the food of 0+ ruffes is comparatively small.

According to the present data young ruffes in L. Võrtsjärv continue feeding on zooplankton until they are about 4.5 cm long. With the increasing size ruffe turns gradually into a benthos-feeder.

The diet of bigger ruffes (1+ and older) contains, in addition to zooplankters, chironomids, Oligochaeta cocoons, crustaceans, fish eggs, pieces of macrophytes, and algae (Table 3). Detritus is also commonly found in the ruffe's stomach. In particular, ruffe is specialized in feeding on chironomids, the most important benthic food resource in L. Võrtsjärv (Kangur et al., in press). At present the larval instars and pupae of different chironomid species are heavily predated by ruffe but the main food object is still *Chironomus plumosus* (Table 3). The larvae and pupae of this species have the highest occurrence frequency (91%) in the stomachs. *Einfeldia carbonaria* (36%) and *Microchironomus tener* (33%) are also characterized by a high occurrence frequency in the food of ruffe.

Unlike eel, who takes mainly large fourth instar larvae and pupae of *C. plumosus* (Kangur, 1989a), ruffe and bream eat also large amounts of small third- and second-instar larvae of this species as well as other small chironomids.

Large pupae of *C. plumosus* are heavily predated by ruffe, which indicates that it feeds chiefly in the surface layer of the bottom substrate of the lake. Obviously, ruffe takes pupae also during its ascent to water surface.

Other groups of invertebrate food items have rarely been found in the stomach of ruffe (Table 3). Fish eggs were found only in 2% of the stomachs. The share of plants in the food was also insignificant.

The composition of the diet shows that ruffe prefers an open water zone with a soft bottom substrate as a feeding place.

### 2. Seasonal changes in feeding

In L. Võrtsjärv the abundance of macrozoobenthos and its qualitative composition change essentially during the year depending on the life cycles and population dynamics of different species (Fig. 2). These changes are reflected on the feeding conditions of ruffe. Fish may shift their diet and feeding modes from day to day when the availability of food changes (Lammens & Hoogenboezem, 1991).

Unlike eel, whose intensive feeding period in L. Võrtsjärv is summer, ruffe continues to take food in late autumn (in October—November) when water temperature decreases to 2—0.2 °C. However, as Kangur noted, the general index of filling in the case of ruffe was the lowest in winter and early spring (Кангур, 1968).

Changes in the feeding of ruffe during summer are in accordance with the peculiarities of the life cycles of chironomids, first of all *C. plumosus*. All larval instars and pupae of the chironomids are heavily predated by ruffe. Their proportion in the stomachs depends on larval densities in the bottom substrate at a certain time.

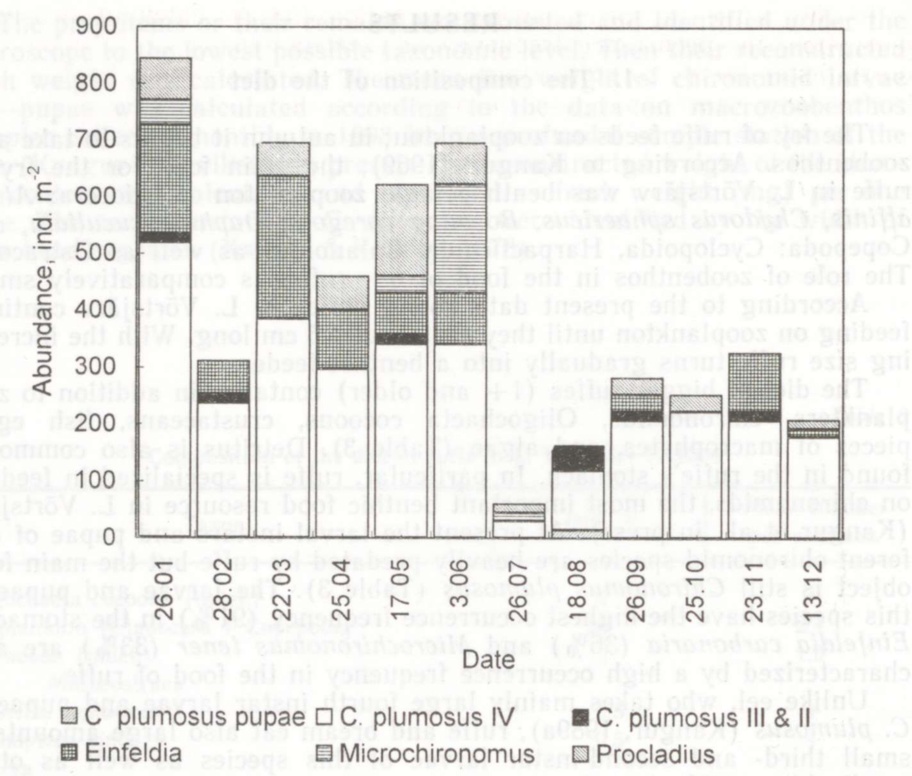


Fig. 2. Abundance of Chironomidae species in the profundal mud bottom of L. Võrtsjärv in 1994.

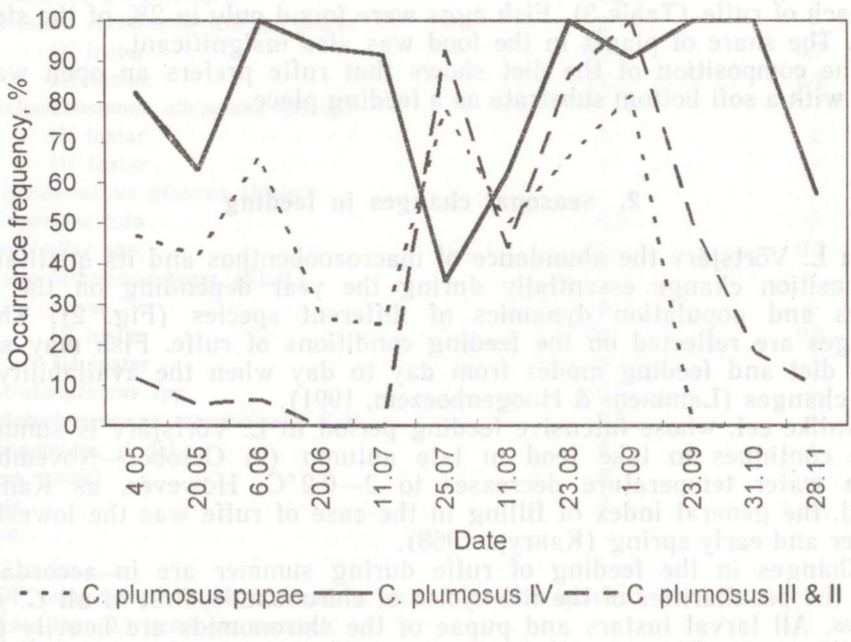


Fig. 3. Occurrence frequency of different instars of *Chironomus plumosus* in the food of ruffe in L. Võrtsjärv during the vegetation period of 1994.

In July, after the spring emergence period and the hatching of a new generation, the occurrence frequency and mean number of *C. plumosus* fourth-instar larvae in ruffe stomachs decreased noticeably (Figs. 3, 4). At the same time pupae and third-instar larvae became more frequent being the most numerous food items for ruffe at that time. Pupae disappeared from the food of ruffe in late September, at the end of the emergence period; the occurrence frequency of third-instar larvae, too, decreased in autumn.

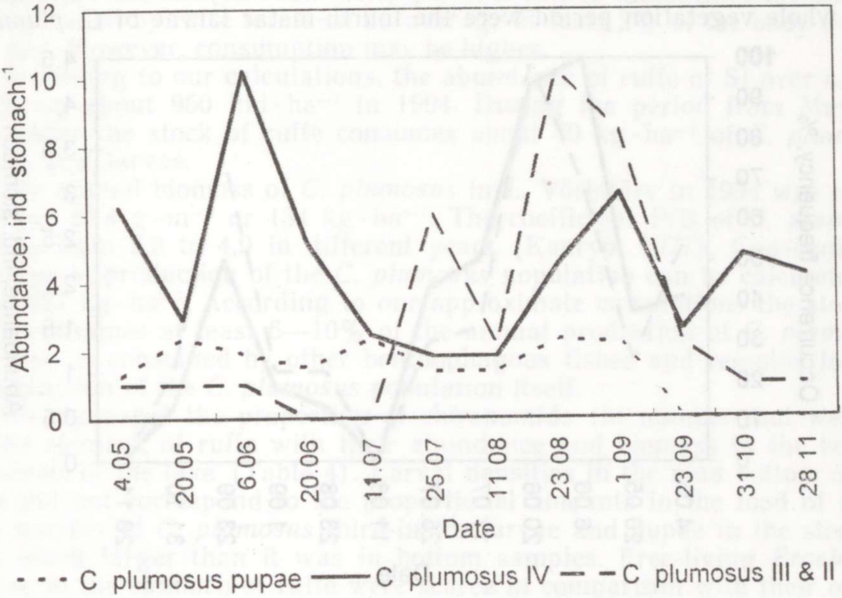


Fig. 4. Mean number of different instars of *Chironomus plumosus* in the food of ruffe in L. Võrtsjärv during the vegetation period of 1994.

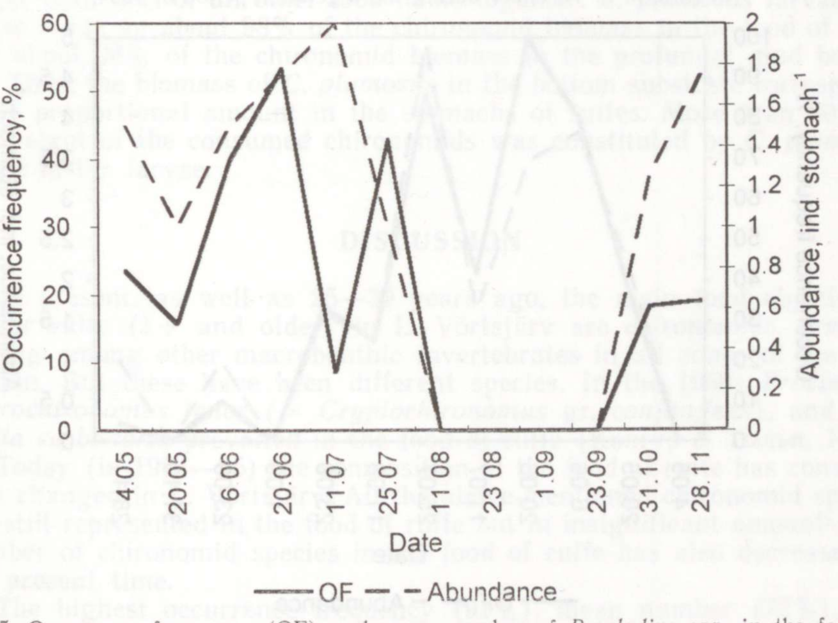


Fig. 5. Occurrence frequency (OF) and mean number of *Procladius* spp. in the food of ruffe in L. Võrtsjärv during the vegetation period of 1994.

Emergence periods were noticeable also in the consumption of other chironomid species (Figs. 5—7), whose proportions in the stomachs varied during summer too. *Procladius* disappeared from the stomachs in August —September, *Einfeldia* in August, and *Microchironomus* decreased in autumn months.

This demonstrates clearly that ruffe compensates for the disappearance of one food object by another, abundant item, and always eats the most abundant prey found in the benthos.

Considering weight, the most important food objects for ruffe during the whole vegetation period were the fourth-instar larvae of *C. plumosus*.

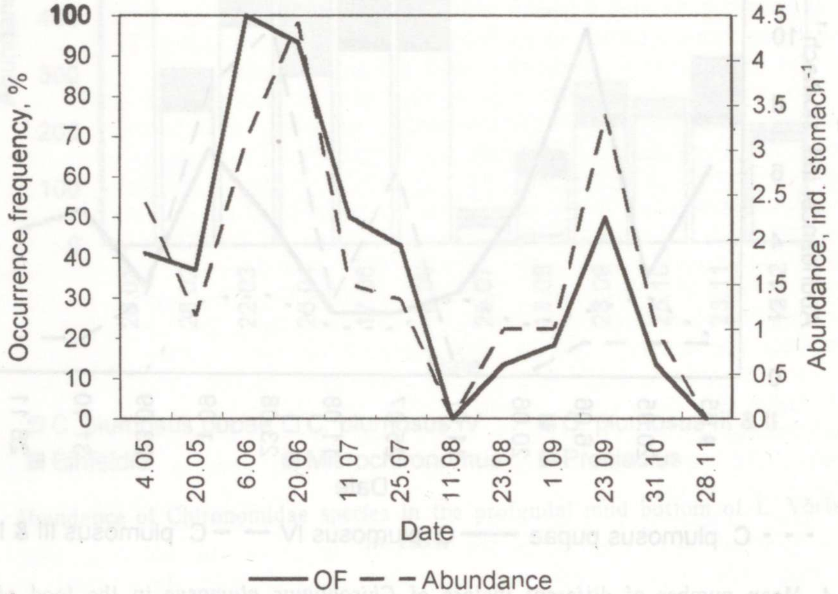


Fig. 6. Occurrence frequency (OF) and mean number of *Einfeldia carbonaria* in the food of ruffe in L. Võrtsjärv during the vegetation period of 1994.

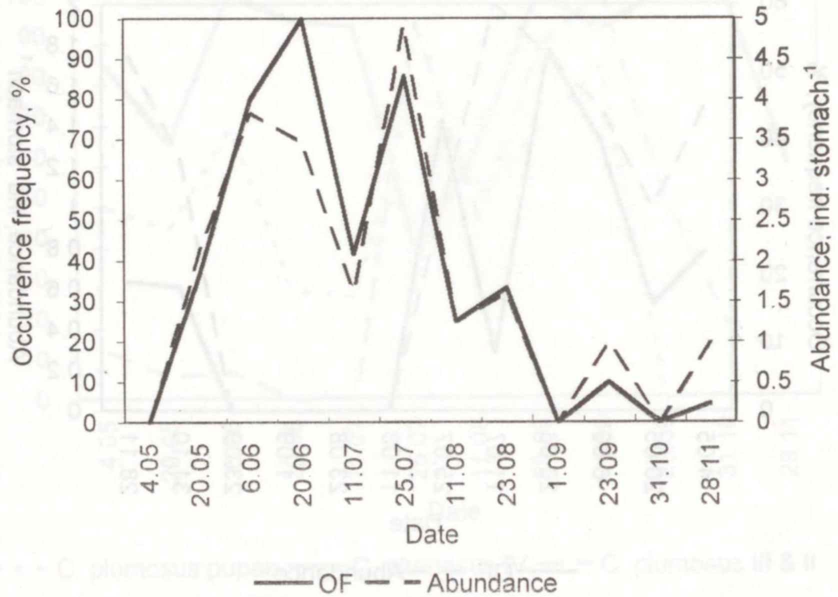


Fig. 7. Occurrence frequency (OF) and mean number of *Microchironomus tener* in the food of ruffe in L. Võrtsjärv during the vegetation period of 1994.

### 3. Utilization of the main food items

In summer 1994 chironomids formed more than 95% of the food of ruffe of Sl over 4.5 cm both in number and biomass. The mean total weight of consumed chironomids was about 0.2 g per stomach (Table 4). The estimates of consumption depend on the supposed daily ration per population biomass. Considering the mean weight of the examined ruffes (10.2 g, Table 2) and assuming that their reconstructed stomach content is equal to their daily ration (Nie, 1987), it can be stated that the amount of food taken by ruffe forms on an average at least 2% of the body weight per day. However, consumption may be higher.

According to our calculations, the abundance of ruffe of Sl over 4.5 cm made up about 950 $ind \cdot ha^{-1}$ in 1994. During the period from May till November the stock of ruffe consumes about 40 $kg \cdot ha^{-1}$ of *C. plumosus* pupae and larvae.

The annual biomass of *C. plumosus* in L. Võrtsjärv in 1994 was on an average 13.4 $g \cdot m^{-2}$ or 134 $kg \cdot ha^{-1}$. The coefficient P/B of *C. plumosus* ranges from 2.9 to 4.9 in different years (Кангур, 1977). Consequently, the annual production of the *C. plumosus* population can be calculated as 389—657 $kg \cdot ha^{-1}$. According to our approximate calculations the stock of ruffe consumes at least 6—10% of the annual production of *C. plumosus*. The rest is consumed by other benthophagous fishes and remains for the reproduction of the *C. plumosus* population itself.

We compared the proportion of chironomids (in number and weight) in the stomach of ruffe with their abundance and biomass in the bottom substrate of the lake (Table 4). Larval densities in the mud bottom of the lake did not correspond to the proportional amounts in the food of ruffe. The number of *C. plumosus* third-instar larvae and pupae in the stomach was much larger than it was in bottom samples. Free-living *Procladius* larvae in the stomach of ruffe were scarce in comparison with their occurrence in bottom samples.

The relative weight of *C. plumosus* in the food of ruffe of Sl over 4.5 cm as well as in the profundal mud bottom of the lake was several times larger than that of all other food items together. *C. plumosus* larvae and pupae made up about 98% of the chironomid biomass in the food of ruffe and about 98% of the chironomid biomass in the profundal mud bottom too. Thus, the biomass of *C. plumosus* in the bottom substrate corresponds to its proportional amount in the stomachs of ruffes. More than 80% of the weight of the consumed chironomids was constituted by *C. plumosus* fourth-instar larvae.

## DISCUSSION

At present, as well as 25—30 years ago, the main food objects for bigger ruffe (1+ and older) in L. Võrtsjärv are chironomids, predominating among other macrobenthic invertebrates in all zones of the lake bottom. But these have been different species. In the 1960s *Procladius, Microchironomus tener* (= *Cryptochironomus* gr. *conjungens*), and *Einfeldia carbonaria* prevailed in the food of ruffe (Кангур & Тыльп, 1974).

Today (in 1994—95) the composition of the food of ruffe has considerably changed in L. Võrtsjärv. All the above-mentioned chironomid species are still represented in the food of ruffe but in insignificant amounts. The number of chironomid species in the food of ruffe has also decreased by the present time.

The highest occurrence frequency (91%), mean number (72%), and biomass (98%) in the stomach of ruffe belong to *C. plumosus* larvae and pupae (Figs. 8, 9). In the 1960s they occurred only in 19% of the stom-

*Table 4*

**The proportions of chironomids in the profundal mud bottom and in the food of ruffe in L. Võrtsjärv in 1994**

| Species | Mean values in the profundal* | | | | Mean ind. live weight, mg | Mean values per stomach | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Abundance | | Biomass | | | Number | | Weight | |
| | ind · m$^{-2}$ | % | g · m$^{-2}$ | % | | ind. | % | mg | % |
| *Chironomus plumosus* pupae | 1.2±1.2 | 0.3 | 0.1±0.1 | 1.0 | 42.2±3.8 | 0.7 | 8.0 | 29.5 | 15.7 |
| IV instar | 255.6±37.7 | 62.3 | 10.2±1.5 | 97.1 | 39.7±1.1 | 3.8 | 43.7 | 150.9 | 80.1 |
| III instar | 9.9±3.8 | 2.4 | <0.1 | 0.1 | 2.9±0.3 | 1.2 | 13.8 | 3.5 | 1.9 |
| II instar | 0 | 0 | 0 | 0 | <0.1 | 0.6 | 6.9 | 0.1 | 0 |
| *Einfeldia carbonaria* | 76.7±23.0 | 18.7 | 0.1±0.0 | 1.0 | 2.7±0.6 | 0.9 | 10.3 | 2.4 | 1.2 |
| *Microchironomus tener* | 23.4±15.9 | 5.7 | <0.1 | 0 | 0.6 | 1.0 | 11.5 | 0.6 | 0.3 |
| *Procladius* | 43.4±13.6 | 10.6 | 0.1±0.0 | 0.8 | 3.9±2.2 | 0.3 | 3.5 | 1.2 | 0.6 |
| Other chironomids | 0 | 0 | 0 | 0 | <1 | 0.2 | 2.3 | 0.2 | 0.1 |
| Total | 410.2±71.9 | 100 | 10.5±1.5 | 100 | | 8.7 | 100 | 188.4 | 100 |

* Data of monthly samples (three identical grabhauls at a time in one profundal station).

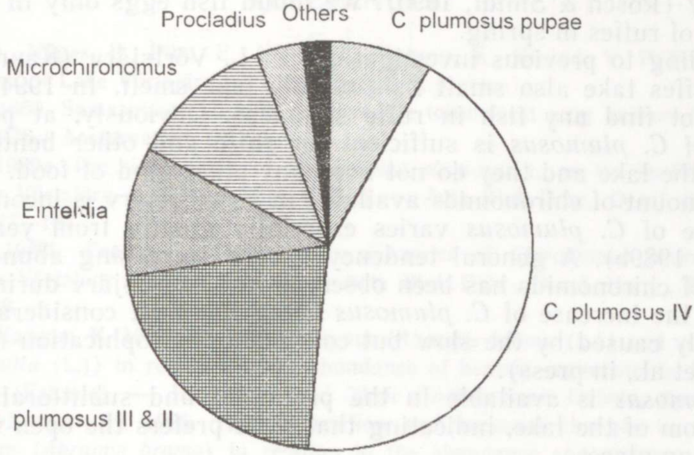


Fig. 8. Composition of the diet of ruffe (mean number of food items per stomach) in L. Võrtsjärv during the vegetation period of 1994.

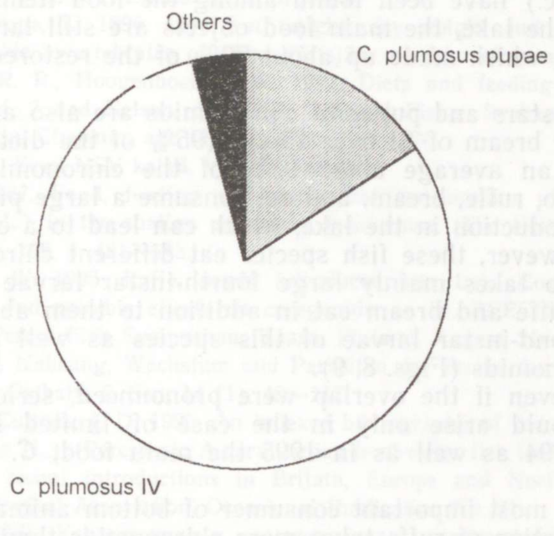


Fig. 9. Composition of the diet of ruffe (mean restored weight of food items per stomach) in L. Võrtsjärv during the vegetation period of 1994.

achs (Кангур & Тыльп, 1974). Thus, at present the main food of ruffes of Sl over 4.5 cm in L. Võrtsjärv is *C. plumosus*; ruffe tends to become monophagous in the lake, consuming only one type of food organism depending on its availability.

Likewise, *C. plumosus* is the most important food item for ruffe in several other eutrophic lakes in Europe, for example in L. Peipsi (Антипова, 1981; Антипова & Концевая, 1988).

In Estonian lakes, ruffe eats the roe of other fishes, if available, on their spawning grounds: lake smelt's roe in spring (Антипова & Концевая, 1988) as well as vendace's and whitefish's roe in late autumn and winter (Пиху & Пиху, 1974). In other European lakes, for example in L. Constance, ruffe is a bottom feeder during the vegetation period, preying mainly on chironomids and detritus. However, during the coregonid spawning season in December ruffe switches to coregonid eggs as the main prey (Rösch & Smidt, 1995). We found fish eggs only in 2% of the stomachs of ruffes in spring.

According to previous investigations in L. Võrtsjärv (Кангур, 1968), bigger ruffes take also small fish, mainly lake smelt. In 1994 and 1995 we did not find any fish in ruffe stomachs. Obviously, at present the amount of *C. plumosus* is sufficient for ruffe and other benthophagous fishes in the lake and they do not need any other kind of food.

The amount of chironomids available in L. Võrtsjärv is inconstant. The abundance of *C. plumosus* varies especially greatly from year to year (Kangur, 1989b). A general tendency toward increasing abundance and biomass of chironomids has been observed in L. Võrtsjärv during the last 30 years, the increase of *C. plumosus* being the most considerable, which is probably caused by the slow but continuous eutrophication of the lake (Kangur et al., in press).

*C. plumosus* is available in the profundal and sublittoral mud and marl bottom of the lake, indicating that ruffe prefers the open-water zone as a feeding place.

Chironomid species, first at all *C. plumosus*, are also the main prey items for eel (Kangur, 1989a) and bream (Kangur & Kangur, 1994, 1995) in L. Võrtsjärv. Although 11 fish species (chiefly ruffe, roach, young perch, smelt, etc.) have been found among the food items of eels of Sl over 30 cm in the lake, the main food objects are still larvae and pupae of *C. plumosus*, which made up about 70% of the restored weight of all food items.

All larval instars and pupae of chironomids are also among the main food objects for bream of Sl over 15 cm (95% of the diet). *C. plumosus* constituted on an average about 97% of the chironomids biomass in bream's food. So, ruffe, bream, and eel consume a large proportion of the *C. plumosus* production in the lake, which can lead to a competition between them. However, these fish species eat different chironomid instars. Unlike eel, who takes mainly large fourth-instar larvae and pupae of *C. plumosus*, ruffe and bream eat in addition to them abundantly small third- and second-instar larvae of this species as well as other small profundal chironomids (Figs. 8, 9).

Obviously, even if the overlap were pronounced, serious competitive interactions would arise only in the case of limited food resources. However, in 1994 as well as in 1995 the main food, *C. plumosus*, was plentiful.

Ruffe is the most important consumer of bottom animals in L. Võrtsjärv. The population of ruffe takes more chironomids than bream and eel together. Ruffe's consumption of food per unit of body weight (2%) is larger than that of bream (1%) or eel (0.8%).

Thus, ruffe, who utilizes the valuable food benthos, is usually considered as an unwanted fish. At the same time, ruffe is an important food object for eel, pikeperch, and pike.

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## ĶIISA (*GYMNOCEPHALUS CERNUUS*) TOIDU ĶOOSSEIS JA SELLE SESOONSED MUUTUSED VÕRTSJÄRVES

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1994. aasta maist kuni novembrini ning 1995. aasta septembris ja oktoobris uuriti kiisa toitumist Võrtsjärves. Ķokku analüüsiti 187 (1994. a.) ja 35 (1995. a.) 4,3—12 cm pikkuse kiisa toidu koosseisu. Väiksemad kiisad söövad peamiselt zooplanktonit. Üle 4,5 cm pikkused kiisad (1+ ja vanemad) on tüüpilised bentosetoidulised kalad. Hironomiidivastsed ja -nukud moodustasid enam kui 95% kasutatud toidu massist, kusjuures suurima esinemissagedusega olid *Chironomus plumosus* (91%), *Einfeldia carbonaria* (36%) ja *Microchironomus tener* (33%). *C. plumosus* moodustas 72% neelatud hironomiidide arvust ja 98% biomassist. Ķiisa toidutarbimist võrreldi kättesaadava toidu hulga muutustega järves. Samuti võrreldi kiisa toidu koosseisu angerja ja latika omaga.

## СОСТАВ И СЕЗОННЫЕ ИЗМЕНЕНИЯ ПИЩИ ЕРША (*GYMNOCEPHALUS CERNUUS*) В ОЗЕРЕ ВЫРТСЪЯРВ (ЭСТОНИЯ)

Ķюлли ĶАНГУР, Анду ĶАНГУР

С мая по ноябрь 1994 г. и в сентябре—октябре 1995 г. исследовалось питание ерша в оз. Выртсъярв. Всего было проанализировано 187 ершей в 1994 г. и 35 ершей в 1995 г., которые были длиной 4,3—12 см. Младшие особи питаются главным образом зоопланктоном. Рыбы длиной более 4,5 см и возрастом 1+ и старше являются типичными бентофагами. Более 95% массы пищевого комка составляли личинки и куколки хирономид, причем чаще встречались *Chironomus plumosus* (91%), *Einfeldia carbonaria* (36%) и *Microchironomus tener* (33%). *C. plumosus* составил 72% числа и 98% биомассы проглоченных хирономид. Интенсивность потребления пищи сравнивалась с изменениями доступного количества пищи в водоеме. Также сравнивался состав пищи у ерша, угря и леща.