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Feeding relationships of trout *Salmo trutta* L., Perch *Perca fluviatilis* L. and Roach *Rutilus rutilus* (L.) in Lough Sheelin, Ireland

by

P.G. Gargan and M. F. O'Grady

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Feeding relationships of trout *Salmo trutta* L., Perch *Perca fluviatilis* L. and Roach *Rutilus rutilus* (L.) in Lough Sheelin, Ireland

by

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ABSTRACT

Samples of trout, perch and roach were collected by gill netting from eight sampling stations over the period February 1982 — March 1984 to assess competition for food between the three species. At each of the sampling stations quantitative collections of benthic invertebrates were taken in order to examine the relationship between feeding and food availibility. Results indicate a significant correlation in diet between trout and perch, little correlation in diet between trout and roach and moderate correlation between perch and roach. The most important competitive interaction between all three fish species is likely to be at their juvenile stage for a cladoceran diet.

INTRODUCTION

Lough Sheelin, in the Upper Shannon catchment, has had an international reputation as a prime brown trout fishery since early in the 20th century. During the early 1970's the lake began to exhibit signs of eutrophication. Throughout the 1970's persistent algal blooms and abnormally high nutrient levels were recorded (Champ, 1977). Direct discharge and run-off from pig slurry, spread on adjacent land during the winter months were identified as contributing the bulk of the nutrient load to the lake.

The condition of Lough Sheelin continued to deteriorate up to the establishment of "The Lough Sheelin Slurry Transport Scheme", in the autumn of 1980. The purpose of this scheme was to transport slurry, by tanker, out of the L. Sheelin catchment area to be used as fertilizer. The introduction of this scheme had the immediate effect of greatly reducing the annual nutrient loading in 1981 and 1982 and resulted in significant improvement in water quality in 1983 and 1984, (Champ, pers. comm.). In 1981, one year after the transport scheme began, a four-year study to examine the biology of the fish and faunal communities began. At that time roach represented a small but expanding population having been recorded in the lake for the first time in 1976, (Fitzmaurice, 1981). Many aspects of the biology of the four main fish species, trout, perch, roach and pike were examined and details of the results are given in Gargan (1986).

Moriarty (1963) has investigated the diet of trout and perch in an Irish reservoir and Fitzmaurice (1977) has compared the cladocoran diet of trout and perch in Irish waters. Because of the recent introduction of roach to the majority of Irish lakes, no published information exists on their feeding habits and the dietary overlap between roach, perch and trout. This paper uses the data in Gargan (1986) to investigate the comparative dietary habits of the aforementioned three species in L. Sheelin. Although much work has been carried out elsewhere on the feeding of trout and perch, (Campbell, 1955, Thorpe, 1974a) and perch and roach (Eie and Borgstrom, 1981, Persson, 1983) these studies have generally highlighted the principal items important in the diet of each species and have described seasonal feeding patterns but have not applied statistical analysis to the data. During the present study the diet of three fish species, captured at eight locations over a three year period was analysed statistically.

Pedley and Jones (1978) note that measurement of the degree of similarity in diet is no test of competition and any feeding relationship must therefore be considered together with a knowledge of the abundance of the food items in question. Few feeding studies to date have contained information on food availability.

Thorpe (1974a) showed that all the principal items in the diet of perch were important in the diet of trout in Lough Leven. However data on the availability of the food organisms were not available. The relative abundance of the benthic fauna at sampling sites during each month was available during the present study. These data allowed food selection by each fish species as well as direct competition for food between species to be examined.

Pedley and Jones (1978) examined the feeding behaviour of trout and stocked Atlantic salmon in Llyn Dwythwch, Wales. Data were analysed using Spearman's rank correlation to determine the degree of correlation between diets. Data were available on food availability and in order to assess quantitatively selective feeding, Ivlev's electivity index was used.

Spearman's rank correlation was also used in the present study to determine the degree of correlation between diets. However Ivlev's electivity index was not used as Bagenal (1978) stresses that while indices may emphasise trends in the data, only standard statistics can reveal significance of the observed trends. He recommends the use of a Chi-squared test (Sokal and Rholf, 1969). Pearre (1982) reviewed the many indices based on Chi-square statistics and proposed a 2 × 2 contingency table formulation as a prey-selection index. The procedure of Pearre (op.cit.) was followed in the present study.

MATERIALS AND METHODS

Lough Sheelin, a lowland lake (surface level 63.68m OD) is situated in the Irish midlands in the headwaters of the Inny, a tributary of the R. Shannon bordering Counties Cavan, Meath and Westmeath. The catchment covers an area of approximately 24,282 hectares of which the lake occupies some 1,900 hectares. The water is alkaline and buffered to a pH exceeding 7. The dominant submerged vegetation consisted of *Chara* spp., *Potamogeton lucens* (L.) and *Elodea canadensis* Michx. At the start of the present study 25% of the lake bed supported floral colonies.

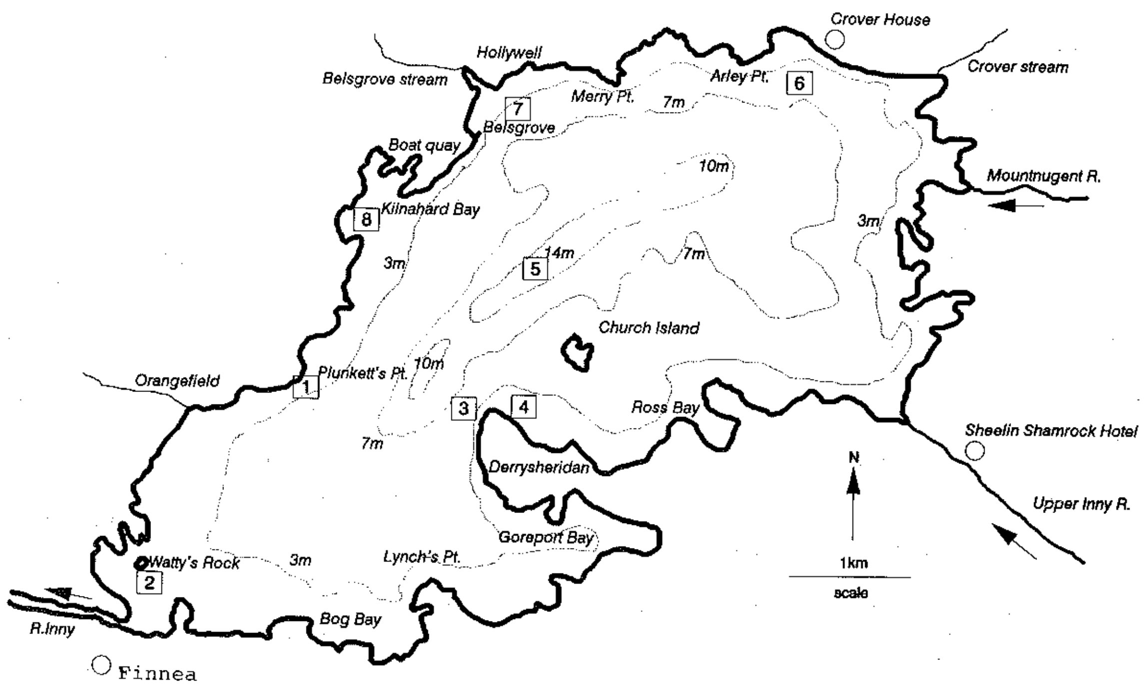
The lake can be described as being culturally eutrophic having had annual average chlorophyll "a" levels in excess of 15mg/m^3 since 1973 (Gargan 1986). Secchi disc readings during the study period varied between 1 and 3m and total phosphate concentrations in excess of 0.05mg/l were recorded up to the commencement of the study (Champ, pers. comm.).

The principal fish species present in the lake during the study period were brown trout, perch, roach, pike and eel *Anguilla anguilla* (L.). Small numbers of bream *Abramis brama* L., tench *Tinca tinca* (L.), three spined stickleback *Gasterosteus aculeatus* L., rudd *Scardinius erthropathalamus* L., stoneloach *Noemacheilus barbatulus* (L.) and cyprinid hybrids have also been recorded in recent years (O'Grady, 1981a).

Sampling

Eight sampling stations were selected, ranging in depth from 1.25–14.0m (Table 1, Fig. 1), representing the principle biotypes in the lake. Fish were collected over the period February 1982 to March 1984. Some additional net-caught fish were available over this period from Central Fisheries Board operations on the lake. Each station was sampled with one set of seven bottom fishing gill-nets. The gill netting technique described by O'Grady (1981b) was employed.

Figure 1 Location of sampling sites (1-8), Lough Sheelin.



A gang of nets consisted of seven nets (each 27.5 m in length and 2.0 m in height) ranging in mesh size from 51 mm by intervals of 12.7 mm to 127 mm. The seven nets, one of each mesh size, were arranged randomly within each gang and set for a twenty-four hour period. In March of each year, netting was carried out in conjunction with the annual Central Fisheries Board fish stock survey, thus allowing many additional fish to be examined. A total of between 60 and 80 randomly selected sites were fished in each annual survey.

The Central Fisheries Board stocked trout into Lough Sheelin over the study period. O'Grady (1981a) has shown that recently introduced fish do not feed at the same rate or necessarily on the same dietary items as resident trout for up to twelve months post-stocking. All fish farm trout stocked into Lough Sheelin over this period could be easily identified as such because of fin damage marks. Consequently trout captured with these characteristics during the course of this study were excluded from the dietary analysis.

At each of the eight sampling stations quantitative collections of the benthic invertebrates were taken on the same day as gill-netting was carried out in order that the relationship between fish feeding and food availability could be examined. A weight trigger operated Eckman grab covering a sampling area of 0.06m^2 was used. Grab contents were sieved through a 250 μ mesh sieve, sorted and identified, (Gargan 1986).

Qualitative zooplankton samples were collected between June 1982 and September 1983 at the midlake station, (Station 5). Samples were obtained by drawing a 0.515mm mesh plankton net vertically for a distance of 2.0m through the upper water column.

Stomach Examination

The contents of stomachs containing food were examined from 469 trout, 458 perch and 264 roach. The "standard stomach" (Ball, 1961) was removed from trout and perch. As the family Cyprinidae are characterised by the lack of a distinct stomach (Kapoor et al, 1975) the entire alimentary canal was taken in the case of roach. Food items were classified into thirteen categories as follows; perch fry, *Asellus aquaticus, Gammarus* sp., Chironomidae larvae, Chironomidae pupae, Chironomidae adults, Trichoptera larvae, Trichoptera adults, Gastropoda, Plankton, terrestrial Diptera, Ceratopogonidae and Corixidae/Coleoptera.

Presentation of Results

The occurrence of all thirteen categories of food items, in each of the three fish species is expressed as the number of stomachs in which each food item occurred as a percentage of all stomachs containing food.

Direct comparison of the diet between species and between months was made using frequency of occurence data compared using Spearman's rank correlation coefficient (Pedley and Jones, 1978).

The diet of each fish species in relation to available food was analysed using the procedure of Pearre (1982). Relative abundance in the environment (% occurrence of taxa in faunal samples) is taken as the expected frequency and relative abundance in stomach samples (% frequency of occurrence) as the observed frequency to test the null hypothesis that both are equal. The greater the difference between each, the greater the χ^2 value calculated.

Pearre (op.cit.) suggets the use of a selectivity index derived from

$$\text{the } \chi^2 \text{ value, } v = \pm \frac{(\chi^2)^{\frac{1}{2}}}{N}$$

Where v varies between + 1 (no organisms in the environment) and −1 (no organisms in fish stomachs). Figures were calculated when more than two dietary items occurred in each of three or more stomachs per species per station. A value of −1 is given whenever an organism was absent from the stomach but constituted more than 10% of the fauna at a particular site. A value of +1 accompanied by a percentage in brackets indicates that the organism was not present in the faunal samples but contributed that percentage to the diet.

RESULTS

Numbers of each species captured

Details of the size of the monthly samples are given in Table 2. The total numbers of trout, perch and roach captured during Central Fisheries Board annual stock surveys are presented in Table 3. Over the study period perch were the most numerous species encountered. The numbers of roach captured increased significantly over the study period.

Comparison of diets

The seasonal occurrence of the 13 main food taxa recorded is given in Tables 4 to 6. Details of the species of Chironomid larvae and Cladocera are given in Tables 7 and 8 respectively. A selectivity index was not used with plankton-feeding fish as fish were not captured at the plankton sampling site. The composition of the plankton sampled is given in Table 9.

Comparison of diet between species within months is shown in Table 10. Periods greater than one month were used to give a minimum sample size of 11 specimens. Comparison between species within stations (Table 11) was made whenever 5 or more individuals of two or more species are present. Significant correlations between all species according to three size groups are shown in Table 12.

Predation by all three fish species on the six most common chironomid larval taxa was analysed. These were *Chironomus plumosus* (L.), *Chironomus anthracinus / thummi, Endochironomus* spp., *Microtendipes* spp., *Procladius* spp. and *Tanytarsidae* spp. As the greater part of fish predation on chironomid larvae occurred in winter and early spring, comparison was made between samples from November 1982 – January 1983 and during March of each year. As fish predation by each species on chironomid larvae was found to be similar during March of each year, results were combined, (Table 13). The annual distribution of each fish species at the eight sampling stations was examined on a monthly basis in an attempt to assess movement throughout the lake in response to the seasonal availability of food (Tables 14 and 16). Numbers of each fish species available to compile these data are less than those available for the monthly dietary data as additional fish, not captured at any of the eight sampling stations, were available to compile the latter data.

Trout and Perch

A significant correlation was apparent between the diet of both species during all seven month groupings examined, (Table 10) and in the diet of trout and perch captured together at six of the seven March stations, (Table 11). A similar correlation in diet was seen to exist between small trout and all sizes of perch (Table 12). Medium sized trout shared a common diet with medium and large sized perch. A significant correlation existed in chironomid larval predation between trout and perch during both month groupings examined (Table 13). Both species fed mainly on the larger species *C. plumosus* and *C. anthracinus*.

Trout and Roach

Only during March 1982 did a significant correlation in diet exist between trout and roach (Table 10) when both species fed on the abundant *A. aquaticus* population. During the other four periods examined, no correlation in diet was shown. Trout and roach captured at the same time and place on all three occasions during March also showed no correlation in diet (Table 11). A significant correlation in diet was only recorded between small trout and medium and large sized roach (Table 12). Predation by trout and roach on chironomid larvae revealed no similarity (Table 13). Roach consumed *C. anthracinus* and the smaller larvae *Procladius* and *Microtendipes* to a greater extent, (Table 7).

Perch and Roach

There was a significant correlation in diet between perch and roach during March 1982, when both species consumed *A. aquaticus* and chironomid larvae, and in August/September 1982 when both preyed on plankton. Four other periods revealed no similarity in diet (Table 10). Perch and roach shared a common diet in two out of three years during March sampling, (Table 11). A significant similarity in diet was evident between small perch and all sizes of roach and between large perch and large roach (Table 12).

Although no significant correlation was evident, the diet of perch and roach revealed higher correlation coefficients than those recorded for trout and roach, with regard to chironomid larval predation, (Table 13).

Predation on Plankton

The percentage frequency of occurrence of zooplankton in fish stomachs is shown, (Table 8). The composition of zooplankton species at the midlake station is given in Table 9.

Bythothropes longimanus Lilljeborg and *Daphnia hyalina* var. *galeata* (Sars) were the only cladoceran component of the trout diet. Predation on *D. hyalina* was very low despite its great abundance. In contrast trout appeared to select *B. longimanus* actively despite its paucity in the plankton (Table 9).

Perch and roach fed to a greater extent on *D. hyalina* than did trout. As recorded for the trout population, the only other plankton species consumed in significant numbers by perch and roach was *B. longimanus*.

Calanoid and Cyclopoid copepoda were not consumed by trout or roach. Copepoda were recorded from only one perch stomach during the survey.

Distribution of fish and prey species

Trout were well represented at all eight stations at some period throughout the year (Table 14). However, particular concentrations did occur and can be related to availability of fauna as evidenced by dietary results. Trout were recorded in highest numbers at Stations 2 and 8, shallow productive areas with a charophyte flora harbouring large populations of *A. aquaticus*.

In spring 1982 highest trout numbers were recorded in the charophyte areas, after which trout were well represented at all stations, feeding inshore and in open water on chironomid larvae and their emerging pupae and on perch fry.

A concentration of trout was seen at the midlake station in March 1983, feeding on the abundant *Chironomous plumosus* larvae. Lowest numbers of trout were recorded at Stations 6 and 7, muddy areas of intermediate depth and low productivity. The biennial spawning habit of the trout stock in L. Sheelin (O'Grady 1981a) was reflected in good numbers of non-spawning adults being recorded throughout the winter period.

The perch population in L. Sheelin congregated in the deeper areas (Station 5) during the winter months (Table 15). From March on, perch became more or less evenly distributed throughout the lake, feeding on perch fry and plankton.

A larger number of perch were recorded at charophyte sites in spring 1982 than in subsequent years and at the midlake deep station (Station 5) in March 1983, feeding on the abundant resources, as was the case with the trout population. However a seasonal distribution of perch closely following the seasonal distribution of the lake fauna was less well defined and was complicated by a spawning migration in spring, a period of sex segregation in summer, a period of pelagic plankton feeding, and a winter migration to deep water.

Roach were very restricted in their lake distribution despite the fact that their numbers had increased over the study period (Tables 3, 16). No change in habitat with changing food availability was evident. Roach were most widely dispersed throughout the lake during the August/September period while feeding on plankton (Tables 8, 16).

Diet in relation to available food

The diet of each fish species at sampling stations is compared to the food items available at these stations and results are presented in the form of Pearre's electivity values, Tables 17–19. On many occasions fish contained food alien to their site of capture. This was particularly evident at Station 1, a shallow unproductive area with a substrate of sand, lacking in vegetation. With the exception of Station 1, trout generally consumed food items available at their site of capture (Table 17). However, one notable exception was the degree of selectivity for *A. aquaticus* in spring 1982. The proportion of this organism in trout stomachs was much greater than its representation in the fauna. Although numbers of trout captured per station were insufficient to calculate v values, trout dietary results and results of invertebrate sampling (Gargan 1986) indicated that trout continued to feed on the declining population of adult *A. aquaticus* through April, May and June 1982, until they essentially disappeared from the population. A similar selectivity was seen with the perch population.

With the exception of Gastropoda, perch in general did not contain food items alien to their site of capture, Table 18.

At seven out of nine stations examined, roach contained food alien to their site of capture, (Table 19, mainly Gastropoda and *A. aquaticus*). Dietary results indicate that these roach also contained plankton, (Gargan, 1986). From these results it would appear that the roach population undergo a diel feeding migration, feeding inshore and also moving to the deeper midlake stations to feed on larvae or to the pelagic to feed on plankton.

DISCUSSION

The gill-netting technique employed was efficient at capturing a random cross-section of brown trout in the length range 19.8–47.7cms, (O'Grady, 1981b). The technique may have been less efficient at capturing perch and roach and the observation of Weatherley (1972) that gear selectivity suggests a population structure that lacks one or more of the age classes of the actual population is evident for the perch and roach populations as very few 0+ and 1+ fish were captured. Therefore the relative numbers of perch and roach recorded is an under-representation of the abundance of these species in the lake. Juvenile trout migrate to the lake primarily during their second year and are capable of being captured efficiently as 2+ fish with a mean length of 21.79cm (Gargan, 1986).

Results from the present study indicate a significant correlation in diet between trout and perch, little or no correlation in diet between trout and roach and moderate correlation between perch and roach. A major overlap in diet between trout and perch has also been noted by Moriarty (1963) and Thorpe (1974a). Lindstrom and Nilsson (1962) note that "measurements of the degree of similarity in diet is no test of competition in sympatric fish species, but rather a sign of super-abundance of a food item". Any feeding relationship must therefore be considered together with a knowledge of the abundance of the food items in question.

Keast (1977) notes that considerable overlap due to feeding on a new resource that is becoming temporarily abundant (e.g. simultaneous consumption of Isopoda), indicates not an increased but rather a lessening of competition. During the present study, a number of food items were at times very abundant, namely *A. aquaticus* in early spring 1982, perch fry in summer and *Chironomus* larvae in spring 1983. Dietary results revealed that trout and perch were consuming these organisms in similar proportions. It is only when they become scarce that direct evidence of competition can be gained.

Strong indications of such competition were apparent during late spring 1982 when trout and perch continued to feed on *A. aquaticus* until it was no longer available in significant numbers. Roach at this time fed on more abundant prey and generally showed a much diminished tendency to become specialized feeders. Likewise there was a significant correlation in the diet of trout and perch during summer and early autumn 1982 when little invertebrate food was available due to severe algal blooms and stratification, (Gargan 1986). At this time roach turned to feeding on plankton and small gastropoda.

Werner et al (1981) note that availability of a suitable food supply is important for the spatial distribution of fish because they will feed in the richer habitat and shift station when the profitability of feeding in one habitat drops below that of another. This appeared to be true in the case of trout in L. Sheelin, feeding in charophyte areas in spring 1982 and on *Chironomus* larvae at the midlake station in March 1983. In general, trout consumed food items available at their site of capture. This finding is in agreement with those of Frost and Brown (1967), Thorpe, (1974a) and Tytler and Holliday, (1984), who comment that analyses of stomach contents of brown trout in lake habitats indicate that they are omnivorous and that the composition of their diet varies seasonally according to the availability of food. Perch were also recorded feeding in charophyte areas in spring 1982 but this was less well defined in the perch population and complicated by spawning, winter migrations and periods of pelagic feeding. Roach in Lough Sheelin appear to undergo a diel feeding migration. Eie and Borgstrom (1981) also observed a diel feeding migration in roach in Lake Arungen and Bohl (1980) reported diel patterns of distribution and feeding in roach populations in Bavarian lakes. Although demonstrating evidence of a diel feeding pattern, roach were much more restricted in their lake movements in Lough Sheelin. This spatial separation of the roach population further reduces competition for food with the other two species.

The most important competitive interaction between roach, trout and perch may be at the young stages for a cladoceran diet. Plankton dietary results suggest that when the large cladocerans *B. longimanus* and *D. hyalina* are present, all fish species concentrate their feeding on these relatively large prey items. Trout were seen to select actively *B. longimanus* despite its paucity in the plankton, a finding also reported for L. Sheelin trout by Fitzmaurice (1979). Many plankton feeding studies suggest that when the larger Cladoceran species become unavailable, trout and perch will switch to alternative sources of food, (Klemesten 1973; Persson 1983; Haraldstad and Jonsson 1983). Fitzmaurice (1977) has shown that in conditions where competition for food would deplete the cladoceran population, in Irish waters, it appears that the roach are capable of switching their diet to one of Copepoda with greater ease than do either bream or rudd. Linfield (1980) has recorded roach feeding extensively on Cladocera, Copepoda and Ostracoda in a South Lancashire Lake and Eie and Borgstrom (1981) record roach feeding on Copepoda as well as Cladocera in eutrophic Lake Arungen.

Persson (1983) noted that the zooplankton fauna in Sovdeborgssjon was dominated by Copepoda and small Cladocera such as *Bosmina longirostris*. Large zooplankton were only represented by *Daphnia cucullata* in low numbers. This is typical of lakes with a heavy fish predation, (Hrbacek, 1962; Brooks and Dodson, 1965; Andersson et al, 1978). In terms of individuals, cyclopoid copepods were the dominating group. Roach were responsible for this heavy predation. The shortage of large zooplankton forced juvenile (0+) perch to change from a zooplankton diet to a diet of macroinvertebrates at an earlier stage of life and this must have resulted in intensified intraspecific competition. At the time of the present study, it is unlikely that there was severe competition between fish species for plankton in Lough Sheelin, because of the predominance of large cladocera in the plankton population. As the roach population expands competition may become important, particularly as the young of the year perch and one and two year old

trout are known to feed extensively, at times, on *D. hyalina,* (Fitzmaurice, 1977). Such predation could deplete the numbers of larger Cladocera and force perch and trout to feed on alternative food sources while roach would continue to exploit the Copepoda population.

Because of the close similarity in diet between trout and perch and because perch were the most numerous species encountered during annual stock surveys, it is possible that perch may limit the quantity of food available to trout in Lough Sheelin. This possibility has been reported previously by Moriarty (1963) for stocks in Poulaphuca Reservoir.

The number of roach captured during annual March stock surveys increased significantly over the study period and the roach population in Lough Sheelin has continued to expand at a rapid rate since this study was completed in 1984 (O'Grady, 1989). An analysis of the data suggests that they may compete seriously with both trout and perch particularly in relation to zooplankton. Until such time as the roach population stabilises the longterm effects of this competition on all fish stocks cannot be ascertained.

It has been possible in the present study to compare in detail for the first time, the diet of trout, perch and roach captured at the same time and place over a three year period. It has also been possible to relate food selectivity to food availability. This has been an advance on previous fish dietary studies, i.e. Pedley and Jones (1978), where data was restricted to a one year study of littoral feeding and where standard statistics were not used to reveal significance in food selection.

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REFERENCES

Anderson, G. Berggren, U., Cronberg, G., and Gelin, C. (1978) Effects of planktivorous and benthivorous fish on organisms and water chemistry in eutrophic lakes. *Hydrobiol,* 59 (1), 9-15.

Bagenal, T.B. (1978) *Methods for assessment of fish production in freshwater.* International Biological Programme (3). Edited by W.E. Ricker. Blackwell Scientific Publications, Oxford.

Ball, J.N. (1961) On the food of Brown Trout of Llyn Tegid. *Proc. Zool. Soc. London.* 137, 600-620.

Bohl, E. (1980) Diet patterns of pelagic distribution and feeding in planktivorous fish. *Oecologia.* 44: 368-375.

Brooks, J.L. and Dodson, S.I. (1965) Predation, body size, and composition of plankton. *Science,* 150: 28-35.

Campbell, R.N. (1955) Food and feeding habits of Brown Trout, Perch and other fish in Loch Tummel. *Scottish Naturalist* 67: 23-28.

Champ, W.S.T. (1977) Trophic status of fishery lakes. In, *Lake Pollution Prevention by Eutrophication Control,* eds. Downey, W.K. and Ni Uid, G., 67-78. Stationery Office, Dublin.

Eie, J.A. and Borgstrom, R. (1981) Distribution and food of roach and perch in the eutrophic Lake Arungen. *Verh. Intent. Vereis. Limnol.* 21, 1257-1263.

Fitzmaurice, P. (1977) *The Freshwater Cladocera of Ireland and their relative importance in the diet of fishes.* Ph.D. Thesis. National University of Ireland.

Fitzmaurice, P. (1979) Selective Predation on Cladocera by Brown Trout. *J. Fish Biol.* 15: 521-525.

Fitzmaurice, P. (1981) The spread of roach *Rutilus rutilus* (L.) in Irish waters. *Proc. 2nd Brit. Freshw. Fish. Conf.* 154-161.

Frost, W.E. and Brown, M.E. (1967) *The Trout.* 2nd ed. London. Collins, 286pp.

Gargan, P.G. (1986) *The biology of the fish and faunal communities in Lough Sheelin, Co. Cavan, a eutrophic lake in the Irish midlands.* Ph.D. Thesis. National University of Ireland.

Haraldstad, O. and Jonsson, B. (1983) Age and sex segregation in habitat utilization by brown trout in a Norwegian lake. *Trans. Am. Fish. Soc.* 112, 27-37.

Hrbacek, J. (1962) Species composition and the amount of zooplankton in relation to the fish stock. *Nakladatelsvi Ceskoslvenske Akademie.* Ved. V. 72: 1-10.

Kapoor, B.G., Smit, H. and Verighina, I.A. (1975) The alimentary canal and digestion in teleosts. *Advances in Marine Biology,* 13, 109-239.

Keast, A. (1977) Diet overlaps and feeding relationships between the year classes in the yellow perch *Perca flavescens. Environmental Biology of Fishes,* 2: 53-70.

Klemetsen, A. (1973) Pelagic, plankton-eating perch. *Astarte,* 6, 27-35.

Lindstrom, T. and Nilsson, N.A. (1962) On the competition between white-fish species. In *The Exploitation of Natural Animal Populations,* (Eds. E.D. Le Cren and M.W. Holdgate) 326-340 : Oxford University Press.

Linfield, R.S.J. (1980) Ecological changes in a lake fishery and their effects on a stunted roach *Rutilus rutilus* population. *J. Fish. Biol.* 16, 123-144.

Moriarty, C. (1963) Food of perch *Perca fluviatilis* L. and trout *Salmo trutta* L. in an Irish Reservoir. *Proc. R. Irish Acad.* 63B, 1-31.

O'Grady, M.F. (1981a) *A study of brown trout* Salmo trutta *L. populations in selected Irish lakes.* Ph.D. Thesis. National University of Ireland.

O'Grady, M.F. (1981b) Some direct gill-net selectivity tests for brown trout *Salmo trutta* L. populations. *Irish Fish Invest.* A. 22, 9pp.

O'Grady, M.F. (1989) The development and management of Irish brown trout fisheries. *Proceedings of the Institute of Fisheries Management 20th. Annual Study Course.* Galway September 1989, 41-53.

Pearre, S. (1982) Estimating Prey Preference by Predators. Uses of various indices, and a proposal of another based on χ^2. *Canadian J. Fish. Aquat. Sci.* 39, 914-923.

Pedley, R.B., and Jones, J.W. (1978) The comparative feeding behaviour of brown trout, *Salmo trutta,* and Atlantic salmon, *Salmo salar* in Llyn Dwythwch, Wales, *J. Fish Biol.* 12: 239-256.

Persson, L. (1983) Effects of intra- and interspecific competition on dynamics and size structure of a perch *Perca fluviatilis* and a roach *Rutilus rutilus* population. *Oikos* 14: 126-132.

Sokal, R.R. and Rholf, F.J. (1969) *Biometry, The principles and practice of statistics in Biological Research,* San Francisco: W.H. Freeman & Co. 776pp.

Thorpe, J.E. (1974a) Trout and perch populations at Loch Leven, Kinross. *Proc. Roy. Soc. Edinb.* B, 74, 297-313.

Thorpe, J.E. (1974b) The movements of brown trout *Salmo trutta* L. in Loch Leven, Kinross, Scotland, *J. Fish Biol.* 6, 153-180.

Tytler, P., and Holliday, F.G. (1984) Temporal and spatial relationships in the movements of loch dwelling brown trout *Salmo trutta* L. recorded by ultrasonic tracking for 24 hours. *J. Fish. Biol.* 24 (b): 69-102.

Weatherley, A.M. (1972) *Growth and ecology of fish populations.* Academic Press, London and New York, 293pp.

Werner, E.E., Mittleback, G.G. and Hall, D.J. (1981) The role of foraging profitability and experience in habitat use by the bluegill sunfish. *Ecology.* 62: 116-125.

Table 1. Location and description of sampling sites.

Station	Location	Depth (m)	Substratum	Vegetation
1	Plunkett's Point	2.75	Sand	—
2	Finnea	1.8	Marl/Mud	*Chara contraria, Elodea canadensis*
3	Derrysheridan	4.9	Soft Mud	—
4	Rusheen	2.0	Marl/Gravel	*Chara contraria*
5	Midlake	14.0	Black Mud	—
6	Crover	4.5	Soft Mud	—
7	Belsgrove	3.6	Soft Mud	Plant detritus
8	Kilnahard Bay	1.25	Marl/Mud	*Chara hispida*

Table 2. Numbers of fish captured at sites 1 to 8 and supplied by the Central Fisheries Board (C.F.B.).

Site No.	1	2	3	4	5	6	7	8	CFB	Total
February 1982										
Trout	1	8	4	4	—	1	—	6	—	24
Perch	—	7	—	1	—	5	4	—	—	17
Roach	—	—	—	—	—	—	—	—	—	—
March 1982										
Trout	8	16	11	8	11	3	—	9	59	125
Perch	4	13	17	1	21	26	5	6	11	104
Roach	—	—	—	—	—	12	—	—	15	27
April 1982										
Trout	2	6	4	5	—	—	1	8	6	32
Perch	—	—	6	—	6	4	—	6	—	22
Roach	—	—	—	—	—	—	—	—	—	—
May 1982										
Trout	1	3	3	—	1	3	—	3	—	14
Perch	6	4	1	7	1	5	6	4	—	34
Roach	1	2	—	—	—	4	—	1	—	8
June 1982										
Trout	8	7	—	2	—	1	9	1	—	28
Perch	4	5	8	9	8	9	7	2	—	52
Roach	—	—	—	—	—	—	—	—	—	—
July 1982										
Trout	2	6	2	6	5	1	—	5	—	27
Perch	8	—	6	8	7	7	6	6	—	48
Roach	—	—	—	—	—	—	—	—	—	—
August 1982										
Trout	1	5	—	3	2	1	—	5	—	17
Perch	15	9	8	5	12	9	10	8	—	76
Roach	—	6	—	2	—	—	—	7	—	15
September 1982										
Trout	6	4	7	—	1	—	2	4	—	24
Perch	8	1	10	2	7	7	7	1	—	43
Roach	—	—	—	—	2	7	—	—	—	9
October 1982										
Trout					No Sample					
Perch					No Sample					
Roach	—	—	—	—	17	7	—	—	22	46
November 1982										
Trout	6	7	2	3	—	3	2	4	9	36
Perch	—	—	—	—	6	4	—	6	7	23
Roach	—	—	—	—	—	—	—	—	6	6
December 1982										
Trout	—	—	—	—	—	—	—	—	—	—
Perch	—	—	—	—	5	2	—	—	5	12
Roach	—	—	—	—	6	6	—	—	16	28
January 1983										
Trout	1	3	4	1	4	4	2	1	—	20
Perch	—	2	—	—	4	—	—	2	—	8
Roach	—	—	—	—	7	5	5	—	—	17
February 1983										
Trout	2	2	—	—	4	1	1	6	—	16
Perch	—	—	—	—	9	—	—	—	—	9
Roach	—	—	—	—	—	—	—	—	—	—
March 1983										
Trout	3	4	3	2	11	—	2	3	65	93
Perch	—	—	—	—	30	1	1	—	46	78
Roach	—	—	—	—	22	3	—	—	73	98
May 1983										
Trout					No Sample					
Perch									23	23
Roach	—	—	—	—	6	5	1	1	—	13
July 1983										
Trout					No Sample					
Perch					No Sample					
Roach	—	—	—	—	—	4	2	1	—	7
March 1984										
Trout	2	13	2	—	13	8	—	9	72	119
Perch	4	—	2	—	25	16	—	6	36	89
Roach	—	—	—	—	28	31	—	—	—	59

Table 3. Total numbers of fish captured during annual March stock surveys

Year	Trout	Perch	Roach
1982	148	414	27
1983	111	78	98
1984	172	242	205
Total	431	734	328

Table 4. Trout food as percentage of stomachs containing food in which items were present.

	Feb. '82	March	April	May	June	July	August	September	November	Dec. '82– Jan. '83	Feb. '83	March	March'84	Total
Perch Fry	9	1	8	—	50	63	63	83	58	69	36	34	18	
Asellus aquaticus	73	91	63	25	8	11	—	—	4	31	57	25	59	
Gammarus sp.	32	25	38	8	—	11	—	—	4	13	14	4	30	
Chironomid larvae	14	17	25	—	25	21	6	17	21	25	28	61	11	
Chironomid pupae	—	2	29	58	38	21	—	17	8	—	—	—	—	
Chironomid adults	—	—	20	41	29	—	19	17	4	—	—	—	—	
Trichopteran larvae	18	23	8	—	—	—	—	—	—	6	—	5	16	
Trichopteran adults	—	—	4	—	—	—	—	—	—	—	—	—	—	
Gastropoda	32	33	21	8	8	—	—	—	—	31	7	7	13	
Plankton	—	—	—	—	—	5	—	11	13	—	—	—	—	
Terrestrial Diptera	5	—	4	50	—	—	38	—	4	6	—	1	1	
Ceratopogonidae	—	—	—	—	—	—	—	—	—	—	—	—	—	
Corixidae/Coleoptera	9	2	8	—	25	5	—	—	13	—	—	—	—	
No. of Stomachs Containing Food	22	108	24	12	24	19	16	18	24	16	14	76	96	469
No. of Stomachs Examined	24	125	32	14	28	27	17	24	36	20	16	93	119	575

Table 5. Perch food as percentage of stomachs containing food in which items were present.

	Feb. '82	March	April	May	June	July	August	September	November	Dec. '82–Jan. '83	February	March	May	March'84	Total
Perch Fry	—	8	6	3	14	21	84	54	30	25	89	16	9	11	
Asellus aquaticus	100	93	82	63	16	13	71	—	—	—	—	2	27	—	
Gammarus sp.	45	34	—	7	—	—	2	—	—	—	—	—	9	13	
Chironomid larvae	27	18	24	33	33	32	11	8	40	33	11	63	60	61	
Chironomid pupae	—	3	24	53	39	55	18	11	—	—	—	—	55	—	
Chironomid adults	—	—	12	13	25	10	7	—	—	—	—	—	27	—	
Trichopteran larvae	9	—	—	3	5	5	5	—	—	—	—	—	9	2	
Trichopteran adults	—	—	—	—	—	3	—	—	—	—	—	—	—	—	
Gastropoda	—	8	—	—	7	—	5	—	10	—	—	—	9	4	
Plankton	—	1	—	—	48	—	4	41	20	25	—	6	—	—	
Terrestrial Diptera	—	—	—	—	—	—	—	—	—	—	—	—	—	2	
Ceratopogonidae	—	—	—	—	2	—	—	—	—	—	—	—	—	—	
Corixidae/Coleoptera	—	1	12	—	2	3	—	—	30	8	—	—	—	2	
No. of Stomachs Containing Food	11	79	17	30	44	38	56	37	10	12	9	43	18	54	458
No. of Stomachs Examined	17	104	22	34	52	48	76	43	23	20	9	78	23	89	638

Table 6. Roach food as percentage of stomachs containing food in which items were present.

	March '82	May	August	September	October	November	December	January '83	March	May	July	March '84	Total
Perch Fry	—	—	—	—	3	—	—	—	—	—	—	—	
Asellus aquaticus	70	—	—	—	—	17	—	11	28	—	—	6	
Gammarus sp.	4	—	—	—	—	—	—	—	3	—	—	2	
Chironomid larvae	50	28	33	—	34	67	75	88	75	45	20	64	
Chironomid pupae	—	—	33	—	7	—	—	—	—	36	20	—	
Trichopteran larvae	4	42	—	—	6	—	8	—	—	18	—	4	
Trichopteran adults	—	—	—	—	3	17	8	—	1	9	—	—	
Gastropoda	—	—	41	22	44	17	—	—	1	—	20	11	
Plankton	—	14	50	88	16	50	33	—	16	36	60	15	
Terrestrial Diptera	—	—	—	—	—	—	—	—	—	—	—	—	
Ceratopogonidae	—	—	—	—	16	17	17	88	16	—	—	9	
Corixidae/Coleoptera	4	28	—	—	—	—	8	—	—	28	40	—	
No. of Stomachs Containing Food	24	7	12	9	32	6	12	17	82	11	5	47	264
No. of Stomachs Examined	27	8	15	9	46	6	28	17	98	13	7	59	333

Table 7. Percentage frequency of occurrence of Chironomid larvae in stomachs. "0" indicates absence of species from stomachs sampled: "—" indicates no fish available.

		1982 Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	1983 Dec/Jan	Feb.	March	1984 March
Chironomus plumosus	Trout	9.0	13.8	16.0	0	20.8	5.2	6.2	5.5	—	0	12.5	28.4	53.9	10.3
	Perch	18.2	8.8	11.8	23.3	27.2	15.8	7.1	2.7	—	10.0	16.6	11.1	58.1	38.8
	Roach	—	8.3	—	28.5	—	—	25.0	0	—	10.0	16.6	11.1	58.1	38.8
Chironomus anthracinus	Trout	0	1.8	0	0	4.1	0	0	5.5	—	4.1	12.5	7.1	9.2	2.0
	Perch	27.3	2.5	0	0	0	7.9	3.6	2.7	—	30.0	8.3	0	16.3	18.5
	Roach	—	25.0	—	0	—	—	0	0	12.5	33.3	67.0	—	38.2	19.1
Endochironomus sp.	Trout	0	1.8	0	0	8.3	5.2	0	5.5	—	8.2	6.2	0	3.9	0
	Perch	0	0	0	0	0	0	0	2.7	—	0	8.3	0	4.6	0
	Roach	—	0	—	0	—	—	0	0	2.5	0	0	—	3.7	0
Procladius sp.	Trout	4.5	0	0	16.6	8.3	0	0	0	—	8.2	0	0	2.6	0
	Perch	9.1	6.3	11.8	0	9.1	15.8	1.6	2.7	—	10.0	16.6	0	4.6	0
	Roach	—	4.1	—	0	—	—	0	0	6.2	16.6	94.1	—	27.1	44.7
Microtendipes	Trout	0	0	0	0	0	0	0	0	—	0	0	0	5.2	0
	Perch	0	0	0	0	4.5	0	0	0	—	0	0	0	0	0
	Roach	—	16.6	—	0	—	—	8.3	0	3.1	0	8.3	—	3.7	0
Other Chironomid Species	Trout	0	1.8	8.2	0	4.1	0	0	5.5	—	0	6.2	7.1	0	1.0
	Perch	0	3.8	0	9.4	4.5	10.5	3.6	2.7	—	0	0	0	9.3	7.4
	Roach	—	0	—	0	—	—	—	0	6.2	0	0	—	7.4	4.2

Table 8. Percentage frequency of occurrence of Cladocera in fish stomachs.

Cladocercan Species	Fish Species	1982 May	June	July	Aug	Sept.	Oct.	Nov.	Dec '82 Jan '83	Mar	1983 May	July	March
Daphnia hyalina	Trout			5.2		5.5							
Bythotrephes longimanus				5.2		11.0		13.0					
Dyphnia hyalina	Perch		47.7			29.7		20.0	25.0	4.6			
Bythotrephes longimanus					3.6	27.0				2.3			
Bosmina longirostris			9.1										
Alona rectangula			2.2										
Copepoda					1.8								
Daphnia hyalina	Roach	14.3			50.0	88.8	15.6	50.0	33.3	14.8	36.3	40.0	14.9
Bythotrephes longimanus					8.3	22.2	3.1			1.2		20.0	4.2
Bosmina longirostris						11.1				1.2			

Table 9. Percentage composition of zooplankton species in the total plankton at Mid-Lake Surface Station. + = (less than 1.0%)

Cladocercan Species	1982 June	July	August	September	October	1983 February	April	May	June	August	September
Daphnia hyalina	86.2	78.7	63.0	68.3	68.5	56.4	46.6	61.1	83.1	63.0	65.4
Cyclopoid Copepoda	11.3	19.2	34.0	25.1	22.0	26.0	17.2	27.3	15.3	32.2	18.2
Calanoid Copepoda	1.5	+		3.6	9.0	16.0	24.0	10.1	1.0	+	16.0
Leptodora kindti	1.0	2.2	3.0	+		+		+	+	3.3	
Cyclops-naupilius larvae				1.5			12.0			1.5	
Bosmina longirostris				+					+		+
Bosmina coregoni	+					+				+	
Alona rectangula										+	
Diaphanosoma brachyurum										+	
Bythotrephes longimanus				+			+	+	+		+

Table 10. Comparison of diet between species within months using Spearman's Rank Correlation coefficient.

	Numbers	Correlation co-efficient	Significance
March 1982			
Trout/Perch	108/79	0.66	*
Trout/Roach	108/24	0.63	*
Perch/Roach	79/24	0.56	*
April and May			
Trout/Perch	36/47	0.60	*
June and July			
Trout/Perch	43/82	0.71	*
August and September			
Trout/Perch	34/93	0.52	*
Trout/Roach	34/21	0.28	N.S.
Perch/Roach	93/21	0.57	*
November 1982 and January 1983			
Trout/Perch	40/22	0.73	**
Trout/Roach	40/35	0.01	N.S.
Perch/Roach	22/35	0.39	N.S.
March 1983			
Trout/Perch	76/43	0.66	*
Trout/Roach	76/82	0.32	N.S.
Perch/Roach	43/82	0.46	N.S.
May			
Roach/Perch	11/18	0.41	N.S.
March 1984			
Trout/Perch	96/54	0.86	**
Trout/Roach	96/47	0.18	N.S.
Perch/Roach	54/47	0.46	N.S.

Table 11. Comparison of diet between species within stations in March using Spearman's Rank Correlation Coefficient.

Year	Station	Species	Numbers	Correlation co-efficient	Significance
1982	6	Trout/Roach	3/10	0.42	N.S.
	6	Perch/Roach	22/10	0.59	*
	6	Trout/Perch	3/22	0.7	*
	3	Trout/Perch	8/14	0.92	**
	5	Trout/Perch	10/13	0.95	**
	2	Trout/Perch	16/9	0.22	N.S.
	8	Trout/Perch	9/4	0.53	*
1983	5	Trout/Perch	11/15	0.67	*
	5	Trout/Roach	11/14	0.35	N.S.
	5	Perch/Roach	15/14	0.6	*
1984	6	Trout/Perch	6/9	0.62	*
	6	Trout/Roach	6/24	0.33	N.S.
	6	Perch/Roach	9/24	0.21	N.S.
	5	Perch/Roach	10/15	0.08	N.S.

Table 12. Comparison of the diet between size groups of species by Spearman's Rank Correlation Coefficient.

	Numbers	Correlation coefficient	Significance
Small trout/small perch	64/49	0.85	**
Small trout/medium perch	64/314	0.71	**
Small trout/large perch	64/95	0.52	*
Medium trout/medium perch	247/314	0.62	*
Medium trout/large perch	247/95	0.52	*
Small trout/medium roach	64/88	0.52	*
Small trout/large roach	64/45	0.55	*
Small perch/small roach	49/103	0.57	*
Small perch/medium roach	49/88	0.62	**
Small perch/large roach	49/45	0.62	**
Large perch/large roach	95/45	0.59	*

Length Group (cm)

	Small	Medium	Large
Trout	$\leqslant 25$	25–45	$\geqslant 45$
Perch	$\leqslant 19$	19–31	$\geqslant 31$
Roach	$\leqslant 19$	19–28	$\geqslant 28$

Table 13. Comparison of predation by fish species on chironomid larva using Spearman's Rank Correlation Coefficient.

		Numbers	Correlation coefficient	Significance
March	Trout/Perch	47/61	0.82	**
	Trout/Roach	47/64	−0.3	N.S.
	Perch/Roach	61/64	0.22	N.S.
November '82 -January '83	Trout/Perch	12/9	0.61	*
	Trout/Roach	12/24	−0.03	N.S.
	Perch/Roach	9/24	0.47	N.S.

Table 14. Numbers of trout captured at sampling stations throughout the study period.

Station Number	February-March 1982	April/May	June/July	August/September	November '82 January '83	February/March '83	March '84	Total
1	9	3	10	7	7	5	2	43
2	24	9	13	9	10	6	13	84
3	15	7	2	7	6	3	2	42
4	12	5	8	3	3	2	—	33
5	11	1	5	3	4	15	13	52
6	4	3	2	1	7	1	8	26
7	—	1	9	2	4	3	—	19
8	15	11	6	9	5	9	9	64

Table 15. Numbers of perch captured at sampling stations throughout the study period.

Station Number	February-March 1982	April/May	June/July	August/September	November '82 January '83	February/March '83	March '84	Total
1	4	6	12	23	—	—	4	49
2	20	4	5	10	2	—	—	41
3	17	7	14	18	—	—	2	58
4	2	7	17	7	—	—	—	33
5	21	7	15	19	15	39	25	141
6	31	9	16	16	6	1	16	95
7	9	6	13	17	—	1	—	46
8	6	10	8	9	8	—	6	47

Table 16. Numbers of roach captured at sampling stations throughout the study period.

Station Number	February-March 1982	April/May	August/September	October	November '82 January '83	February/March '83	March '84	Total
1	—	—	—	—	—	—	—	—
2	—	2	6	—	—	—	—	8
3	—	—	—	—	—	—	—	—
4	—	—	2	—	—	—	—	2
5	—	—	2	7	13	22	28	72
6	12	4	7	17	11	3	32	86
7	—	—	—	—	5	—	—	5
8	—	1	7	—	—	—	—	8

Table 17. Pearre's electivity value (V) for diet of trout. Values in parentheses are percentage occurrence of taxon when V = +1.

	Asellus aquaticus	*Gammarus* sp.	*Chironomus plumosus*	*Chironomus anthracinus*	*Endochironomus* sp.	*Stictochironomus* sp.	*Dicrotendipes* sp.	*Microtendipes* sp.	*Procladius* sp.	Gastropoda	Trichoptera	Oligochaetae
February 1982												
Station 2	.11	+1(24)	–.08				–1		–1	.22		
3	.65		+1(12)					–1	–1	.07		
4	–.1	.09							–1	.58	.01	
8	0	.2						–1	–.04	–.02		
March 1982												
Station 1	+1(77)	+1(7)				–1			–1	+1(3)	+1(2)	–1
2	.27	.02	.05		–1		–1			.13	.04	
3	.69	.30						–1	–1	+1(4)		
4	.08	–1	–1						–1	+1(8)		
5	+1(83)	+1(8)	–1						–1	+1(2)	+1(3)	
6	.66	+1(4)	–.15	–1					–1			
8	.15	–.02	–.04				–1					–1
May 1982												
Station 6	+1(32)	+1(18)							–1	+1(6)		–1
3	+1(2)								–1			
June 1982												
Station 1	.11								–1			
2			.28						.01			
7			–1	–1					–1			
July 1982												
Station 2	–1											
4	–.11			–1					–1			
5	+1(27)			–1					–1			–1
August 1982												
Station 8			–1		–1		–1		–1			
2						–1			–1			–1
November 1982												
Station 2									–1			
8	–1	.11	.05									
February 1983												
Station 5	+1(33)		.001	–1					–1			–1
8	.11		–1							.04		
March 1983												
Station 1			+1(97)			–1			–1			–1
2	.2		.13				–1	.06	–1			
3			.2	–1					–1			–1
5	+1(8)		.19	.03					–.07			–1
7			.37	–1					–1			
8	–1		.22	.03								
March 1984												
Station 2	.24	.04							–1	.01	–.15	
5	+1(69)	+1(13)	–1							+1(16)		–1
6	+1(31)		.05	–1					–1	+1(18)		–1
8	.01	.04	–.06							.1	.01	

Table 18. Pearre's electivity value (V) for diet of perch. Values in parentheses are percentage occurrence of taxon when V = +1.

	Asellus aquaticus	*Gammarus* sp.	*Chironomus plumosus*	*Chironomus anthracinus*	*Endochironomus* sp.	*Stictochironomus* sp.	*Dicrotendipes* sp.	*Microtendipes* sp.	*Procladius* sp.	Gastropoda	Trichoptera	Oligochaetae
February 1982												
Station 2	.18	+1(5)					–1					
6	.75	+1(7)	.06	–.24				–1	–.14			–01
7	.45	+1(2)	–.09						–1			
March 1982												
Station 1	+1(87)	+1(1)	+1(1)			–1			–1	+1(8)		–1
2	.19	01	–.068		–1		–1		–1			
3	.68	.07	.06						–1			
5	+1(96)	+1(4)	–1					–1	–1			
6	.81	+1(8)	–.07	–.29					–1			
7	.72	+1(3)	–1	–1					–1			–1
8	.12	–.03				–1			–1			
May 1982												
Station 1	+1(76)		+1(2)			–.01			–1			–1
2	.002		–.11			–1			–1			
4	.17		.02						–1			
6	+1(87)	+1(2)							–1			
7	.33								–1			
8	.07		–.08			–1			–1	+1(9)		
June 1982												
Station 2	0		.12					–1	.06			
3				–1					–1	+1(8)		
4	–1											
6				–1					–1			–1
7			–1	–1	+1(15)				–1	+1(15)		
July 1982												
Station 1	–.01		+1(15)			–1					+1(20)	–1
3			.005	–1					–1			
4	.05		+1(3)	–1					–1			
5				–1					–1			–1
6			.56	–.22					–.05			
7			–1	–1					.10			–1
8	.04		–.04						–.02			
August 1982												
Station 1	.37		+1(29)			–1			–.09			–1
2			.56				–1		–.27	+1(4)		–1
3				–1					–1			–1
4	–1			–1					–1			–1
5				–1					–1			
6			–1	–1					–1			
7				–1					–1			
8			–1		–1		–1		–1			
November 1982												
Station 6			.06	–1					–.008			–1
February 1983												
Station 5			.03	–1					–1			
March 1983												
Station 5			.01	.15								–1
March 1984												
Station 1	+1(38)	+1(5)	+1(51)									
5	+1(9)	+1(4)	.03									
6	+1(6)		.17	.07					–1			–1
8	–1	.05	.06							+1(27)		

Table 19. Pearre's electivity value (V) for diet of roach. Values in parentheses are percentage occurrence of taxon when V = +1.

	Asellus aquaticus	*Gammarus* sp.	*Chironomus plumosus*	*Chironomus anthracinus*	*Endochironomus* sp.	*Stictochironomus* sp.	*Dicrotendipes* sp.	*Microtendipes* sp.	*Procladius* sp.	Gastropoda	Trichoptera	Oligochaetae	Ceratopagonidae
March 1982													
Station 6	.41		.14	–1				.02	–1				
August 1982													
Station 5	–1		.14				–1		–1	+1(59)		–1	
8			.01		–1		–1		.04				
October 1982													
Station 5			.03	–1	+1(17)			+1(10)	–.02	+1(10)		–1	+1(10)
6			–.1	–1	.17			.27	.03	+1(15)		–1	+1(7)
March 1983													
Station 5	+1(10)		.07	.07								–1	
6	+1(18)	+1(2)	.15	–.14		+1(2)			.038			–1	+1(4)
March1984													
Station 5			.003					+1(3)	.20	+1(6)		–1	+1(3)
6	+(3)		.16	.01					–.01	+1(1)	+1(2)	–1	+1(4)

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