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Feeding of small-sized European perch, *Perca fluviatilis*, in a littoral zone of a restored lake

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Abstract

The study focuses on the feeding of small-sized European perch, *Perca fluviatilis*, in a lake after stocking with predatory fish and their effect on zooplankton in view of ongoing lake restoration. It has been assumed that predator-prey interactions should lead to increased trophic activity of perch in the littoral zone. The studies were carried out from June to October 2008. The results of catches indicated that small perch were eliminated from open water and were recorded only in the littoral zone of the lake. In their diet, a total of 19 food items were found, primarily represented by invertebrates: Cladocera, Copepoda, Diptera and sporadically Rotifera. Herbivorous forms, i.e. Calanoida or *Daphnia* sp., were frequently picked as food items (F = 40-50%). The most important food component was zooplankton, which accounted, on average, for 90% of the total numbers of consumed animals and nearly 65% in terms of food mass. Cladocera constituted for a larger part of the selected food items than Copepoda, but only in late spring and partly in summer. Significant feeding pressure on large filter-feeders of the genus *Daphnia* is expected only periodically.

Key words: zooplankton, biomanipulation, fish feeding, meromictic lake.

1. Introduction

A positive effect of lake restoration can be seen in the improvement of the physicochemical conditions in the water body, a reduction of algal biomass and the development of large forms of zooplankton, which can be disturbed by the trophic activity of natural populations of zooplanktivorous fish. Zooplankton biomass can be effectively reduced by juvenile fish of different species, for which zooplankton are a natural source of food during the early phases of their lives. It has been shown that even small fry (> 20 mm of total length) can limit the growth of larger zooplankton species (Mehner, Thiel 1999).

The feeding pressure of planktivorous fish on zooplankton is limited by predatory fish. The most common predatory species in Europe include pike (*Esox lucius* L.), pikeperch (*Sander lucioperca* (L.) and perch (*Perca fluviatilis* L.) (Willemsen 1977). Mature perch are a common, effective predator, which usually prey in groups (Dziekońska 1954).The juvenile stadia of the species, soon after hatching, make use of the feeding resources of the pelagic zone, feeding actively on zooplankton. During later stages of their lives, perch frequently move to the littoral zone due to the planktonic resources in the open waters diminishing or to growing pressure from predatory fishes (Wang, Eckman 1994). In the littoral, they can supplement their zooplankton-based diet with organisms inhabiting the bottom of the littoral zone. Perch are an opportunistic species (Rask 1986). It was observed that the diet of individuals of size classes periodically overlapped and depended on the food availability at a specific moment (Elrod *et al.* 1983; Akin *et al.* 2011). Diet overlap can be eliminated in more complex environments, where it has been observed that similar size classes of perch exploit different food resources when they co-exist, which is referred to as food segregation (Rask 1986; Horpilla *et al.* 2000). Another compensation mechanism performed by perch is habitat segregation – when littoral zone vegetation is well developed, smaller individuals frequently exploit the vegetation zone, whereas larger individuals move to the pelagic zone (Sandheinrich, Hubert 1984). The spatial segregation may also occur in a vertical profile in open water zone (Kratochvil *et al.* 2008). This specific feeding and behavior flexibility of the species can be useful in lake management as perch quite early can search for food resources other than zooplankton, even preying on fry of other fish species as early as during the first year of their lives. This can contribute to a reduction in the populations of juvenile cyprinids (Beeck *et al.* 2002) and, consequently, their future generations as, over time, the effect of perch on the development of Cyprinidae in a lake will increase (Kasprzak *et al.* 2002). Moreover, perch can be an important predatory species even in winter. Their activity level is similar throughout the year and wintertime foraging may result in reductions of stocks of planktivorous fishes (Jacobsen *et al.* 2002).

Natural populations of piscivorous fishes in eutrophic lakes are usually not able to control the development of planktivorous fish and stocking with predatory fish, known as biomanipulation, is recommended. Biomanipulation should not be used as the only tool to improve water quality, because it usually brings only short-term benefits (Lammens 1999). Similarly, technical methods of lake restoration may not be completely successful when applied alone. Both biological and technical methods were applied in Lake Starodworskie which has been undergoing restoration for many years, initially involving artificial aeration and, subsequently, precipitation of phosphorus by its inactivation (e.g. Tandyrak 2005; Tandyrak *et al.* 2001). The application of these technical methods resulted in an improvement of water quality, but the positive effect was not usually long-lasting. Among the many factors that could be the cause of the short-lived benefits, there is some evidence for the negative impact of fish feeding. It has been observed that a deterioration of environmental conditions coincided over time with a strong reduction of zooplankton density in the lake. Therefore, in recent years, with a view to maintaining the results of the restoration, Lake Starodworskie has been stocked with predatory fish in order to control the populations of planktivorous species (Wziątek *et al.* 2011). The presence of predatory fish in the open water frequently forces zooplanktivorous species to move to alternative habitats (Hölker *et al.* 2002) which is often manifested as increased use of refugia in the littoral zone (Jacobsen, Berg 1998; Sass *et al.* 2006). In the case of small-sized, opportunistic perch, exploitation of the near-shore, more structurally complex environment usually results in a shift of diet from that based on zooplankton to that based on benthic fauna (Persson, Eklov 1995). In Lake Starodworskie, intensified interspecies relations in the pelagic zone should lead to increased trophic activity of perch in the littoral zone, resulting in a diet based on benthic animals and reduced pressure on pelagic zooplankton. The aim of this study was to determine the effect of feeding of small-sized perch on zooplankton in view of the restoration measures being implemented to improve water quality.

1.1. Description of the study site

Lake Starodworskie is situated within the administrative borders of Olsztyn (Poland). It is a small water body (6 ha), but is relatively deep (maximum depth 23 m). Low susceptibility to mixing and the eutrophic character of the lake affect its thermal and oxygen regimes. For example, in spring 2003, the circulolimnion extended down only to 13 m. In summer, the epilimnion encompassed only a 2 m thick layer of water, and oxycline was at the depth of 5 m; no oxygen was found at the depth of 6 m (Lossow *et al.* 2005).

The littoral zone of the lake is covered by vegetation. The dominant emergent plant is the common reed (*Phragmites australis* (*Cav*.) Trin. ex Steud.) which covers the entire shoreline of the lake with a belt with a width of 1-10 m. Submerged vegetation is dominated by patches of Canada waterweed (*Elodea canadensis* Michx.) mixed with scarce patches of *Ceratophylum* sp. and *Potamogeton sp*.

The most common planktivorous fish which inhabited the lake prior to the experiment included: sunbleak (*Leucaspius delineatus* Heckel, 1843), roach (*Rutilus rutilus* (L.) and European perch. As a result of biomanipulation, the natural population of predatory fishes (pike, large perch) in the lake was supplemented by other species, such as pikeperch, asp (*Aspius aspius* L), catfish (*Silurus glanis* (L.) and eel (*Anguilla anguilla* (L.) (Wziątek *et al.* 2011).

2. Material and methods

Fish catches were conducted in the littoral and pelagic zones. Two sets of 25 m-long gill nets (a 10 mm mesh) were used at each zone. The nets were placed in the lake from dawn to dusk. The relative density of perch (CPUE) was estimated as the average number of individuals collected in a single use of a set. Fish were counted for each catch and for each gill-net. Then an average number of fish caught by means of a single net was calculated. A total of 120 perch were randomly selected for further studies (30 individuals at each sampling date). The composition of the perch food organisms was analysed based on the contents of the stomachs of fish caught. The lengths of the fishes were measured in the laboratory (l.c.) to an accuracy of 0.1 cm and the fishes were weighed on electronic scales to an accuracy of 0.01g. The fish abdomens were then incised in order to extract the stomach contents which were fixed with 4% formalin. The material was analysed under a microscope in order to identify, count and measure the particular food items. The importance of each component in the perch diet was determined by methods suggested by Hyslop (1980): the contribution by number (CN), the contribution by weight (CW) and frequency of occurrence (F; i.e. the percentage of stomachs filled with a particular item).

Water samples for zooplankton analysis were taken at the same time as the ichthyological samples (24 June, 11 August, 09 September and 23 October 2008). Material was collected with a 5-litre Patalas sampler in the littoral zone, from the surface to the bottom (25 litres). Water samples were strained through a plankton net with a 30 μm mesh, fixed with Lugol's liquid, and then with 4% formalin. In open water, zooplankton was collected during concurrent sampling for hydrobiological research. Some of the results of these studies have been already published (Bowszys *et al.* 2009).

A quantitative analysis of zooplankton was performed according to Hillbricht–Ilkowska and Patalas (1967) and Bottrell *et al.* (1976). The biomass of zooplankton and food items was estimated by the indirect method based on the body length (Dumont *et al.* 1975; Mackey 1977; Hawkins, Evans 1979; Rosen 1981; Meyer 1989).

The importance of selected animals groups in fish diet was tested using Statistica pl. software. A test of the difference between two proportions (two side test) was used to evaluate the null hypothesis that the two population proportions are equal ($p > 0.05$).

3. Results

Only a few species of Crustacea and development stages of copepods (nauplii and copepodites) were found to occur in the littoral zone of the lake (Table I). The total zooplankton density in the zone ranged from 36 to 296 indiv. dm^{-3}. The density of animals of a particular taxa was low. Among the cladocerans, the highest density was observed for *Bosmina longirostris* (O.F. Müller 1785) (45 indiv. dm^{-3}), but the species was found to be present only in June. The other two representatives of Cladocera, *Daphnia cucullata* (G.O. Sars, 1862) and *Chydorus sphaericus* (O.F. Müller 1785), appeared as just a few individuals per litre of the lake water during June and October, respectively. A higher density of crustaceans in the littoral zone was recorded only for juvenile Copepoda, which occurred throughout the entire research period. The highest density was observed for larval copepods – nauplii (285 indiv. dm^{-3}). The density of another development stage of Copepoda – copepodites – was lower, having a maximum of 14 indiv. dm^{-3}. The low density of planktonic animals resulted in generally low biomass estimates for crustacean zooplankton, which ranged from 0.1 mg dm^{-3} to 0.302 mg dm^{-3}. The maximum value of this parameter was observed in June, and the minimum was observed in October. These results indicated limited food resources for zooplanktivorous fish.

Pelagic catches showed no small-sized perch in the open water. They were recorded only in the littoral zone at average number of 100.25 individuals (CPUE data of the gill-net catches). Despite the low level of the zooplankton food base, the stomachs of most perch in the study were filled (90 to 100% of individuals on each date). The body lengths of the fishes caught ranged from 7.2 to 14 cm, and their weights ranged from 3.6 to 26 g (Table II).

A total of 19 food categories were found, represented by invertebrate species in the analyzed material. The taxa found represented Cladocera, Copepoda, Diptera and sporadically Rotifera. The diet of perch, both in terms of frequency of occurrence and the contribution in number and weight, was clearly dominated by crustacean zooplankton (Fig. 1, 2, 3). *Daphnia* were found in every second stomach (F = 53%) (Fig. 1). The frequency of occurrence was also high (about 40%) in the case of the other two food items; i.e. *D. cucullata* and Calanoida. The larvae of Chironomidae were found in nearly every third stomach, along with zooplanktonic organisms such as *Daphnia hyalina* (Leydig 1860) and *Eudiaptomus graciloides* (Lilljeborg 1888) Other frequently occurring food items included: *Bosmina* sp., *Alona* sp., and copepodite Calanoida. The remaining taxa (included in the "other" category) appeared sporadically.

Increased exploitation of the littoral zone did not resulted in the utilization of benthic fauna as the main source of food. The dominant role of

Crustacea in the diet of perch was evidenced by the general analysis of the food composition (in terms of numbers and weight) (Fig. 2, 3). The highest contribution in numbers throughout the study period was observed for copepods (their total average contribution was nearly 55%). It was similar for their contribution in weight, where Copepoda accounted for nearly 50% of the prey. The next group of food items, Cladocera, made up nearly 40% of the total number of items found in perch diet. They were represented mainly by the genus *Daphnia*. However, water-fleas accounted only for about 15% of the total mass of consumed food; i.e. three times less than the Copepoda group. Another important food item was insect larvae. In total, they constituted nearly 4% of the number of consumed invertebrates. However, due to the considerable individual weight of the Chironomidae larvae, their contribution to the total food mass consumed by perch was significant (35% on average). It is noteworthy that, of all the available food items, large-bodied species (*Daphnia*, *Eudiaptomus*, Chrironomidae larvae) were most frequently picked, whereas species of a smaller body-size (e.g. *Bosmina, Alona, Chydorus*, copepodites)

Table I. Zooplankton denisty (indiv. dm^{-3}) [D] and biomass (mg. dm^{-3}) [B] in the littoral of Lake Starodworskie.

Species	Jun 2008		Aug 2008		Sep 2008		Oct 2008	
	D	B	D	B	D	B	D	B
Bosmina longirostris	45	0.108	-	-	-	-	-	-
Chydorus sphaericus	-	-	-	-	-	-	4	0.01
Daphnia cuculata	2	0.002	-	-	-	-	-	-
copepodite Calanoida	-	-	-	-	1	0.01	-	-
copepodite Cyclopoida	11	0.155	14	0.069	10	0.063	8	0.08
nauplius	92	0.037	80	0.032	285	0.114	24	0.01
Total	150	0.302	94	0.101	296	0.187	36	0.1

Table II. Summary of gill-net catches of perch (total number of fish selected for further studies: 120).

Date	TL (cm) of fish caught (range; average)	Weight (g) of fish caught (range)	% of full digestive tracks
Jun 2008	7.3-14; 9.3	3.6-26.1	90
Aug 2008	7.5-11.5; 9.5	3.9-12	95
Sep 2008	7.3-8.7; 8	3.8-6.5	95
Oct 2008	7.2-9.2; 8.1	4-8	100

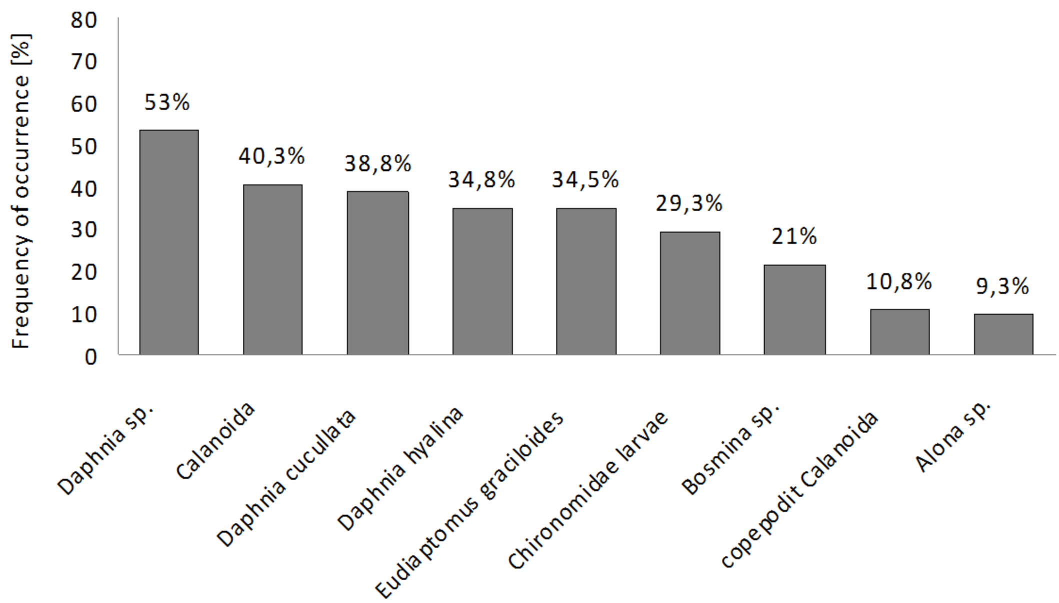

Fig. 1. Occurrence of the most frequent food item in perch stomachs. The frequency of other taxa (*B. longirostris*, *Ceriodaphnia sp.*, *Ch. sphaericus*, *L.kindtii*, *P. uncinatus*, Cyclopoida, Harpacticoida, copepodite Cyclopoida, *K. cochlearis*, nauplius) in fish diet was low.

accounted for a lower portion of the number and mass of consumed zooplankton having the lowest frequency of occurrence in the examined stomachs.

This tendency in feeding selectiveness was observed throughout the study period although some seasonal qualitative and quantitative fluctuations in the diet of juvenile perch were observed. In the initial part of the study, during June, Cladocera accounted for the majority of the diet of juveniles in terms of the contribution in numbers (over 60%), with *D. cucullata* (27.4%) and *D. hyalina* (22%) being consumed most intensively. During this month, Copepoda made up 25.9% of the food organisms by number (Fig. 3), with a considerable additional contribution comprised of copepodites (16.3%), *E. graciloides* and Cyclopoida at several percent. Chironomidae larvae were not significant in terms of numbers, but they dominated by weight (91.3%) (Fig. 2, 3).

The share of cladocerans in the diet of juvenile perch during August was still significant. In this month they accounted for about 60% of the total number of consumed prey (Fig. 2), with *D. cucullata* (31%) and *Daphnia sp*. (23.3%) being the most readily-chosen food items. The importance of Copepoda at that time was similar to that recorded in the preceding month, with the majority of the identified animals being representatives of the Calanoida. At the same time, copepods were the major food component in terms of weight (41.3%) (Fig. 3).

A significant change in the diet of perch was observed at the end of summer and in autumn (September and October). First of all, it is noteworthy that Insecta were almost never found in the stomachs examined during this period, with the fish diets being based mainly on Copepoda. At that time, copepods accounted for as much as 73.4% (October) to 88.2% (September) of the total number of identified prey organisms in the gut content and from 84.5% to 80.1% (September and October, respectively) of contribution by weight in the total consumed food (Fig. 2 and 3). Calanoida, and particularly *E. graciloides*, were the major food components in terms of both food parameters calculated.

The elimination of zooplankton, especially cladocerans, is not desirable for successful lake restoration. The test of the difference between the two population proportions showed that the contribution of cladocerans and copepods in perch food on particular sampling dates was usually different. It was found that the proportion of Cladocera and Copepoda in food was similar only during June and August ($p = 0.1064$). Significant differences in the proportions of both animal groups ($p < 0.05$) were recorded when comparing months: June-September, June-October, August-September, August-October and September-October. These findings indicated that Cladocera were more intensively selected as perch food in late spring and summer. In subsequent months fish pressure on filter-feeding zooplankton decreased (being the weakest in September) and the diet of small-sized perch was based on Copepoda (Fig. 2).

4. Discussion

Zooplankton in the littoral zone of the reservoir were poor. There were only 3 species (cladocerans) recorded. Each of them occurred only once during the period of the study, and usually at a low density. In comparison to the data on the zooplankton of the pelagic zone, the littoral zone populations were greatly reduced. Studies carried out in 2007-2008 have shown that in open water the zooplankton community was represented by 11 species (copepods and cladocerans) which achieved higher densities (Bowszys *et al.* 2009). The difference can be clearly seen when comparing the results for June 2008. In

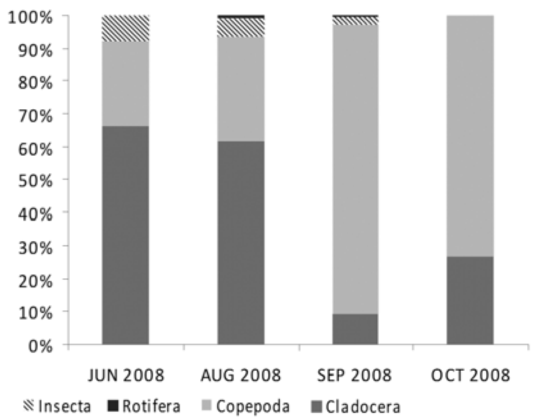

Fig. 2. The contribution (by number) of prey in the diet of perch in Lake Starodworskie determined in 2008.

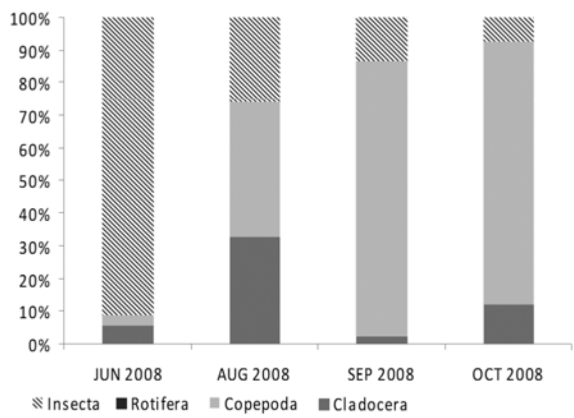

Fig. 3. The contribution (by weight) of prey in the diet of perch in Lake Starodworskie determined in 2008.

that month, samples of the littoral and pelagic studies were collected on the same day. In open water, the density of *D. cucculata* was 110 indiv. dm^{-3}. and *B. longirostris* was 126 indiv. dm^{-3}, while in the littoral the two species reached densities of 2 and 45 indiv. dm^{-3}, respectively.

The impact of zooplanktivorous fish, including small-sized perch, should be considered as the main reason for the limited numbers of zooplankton in the littoral waters. The results showed that zooplankton were the most important food items in the perch diet. Persson and Eklov (1995) analysed the composition of the small-sized perch food under different variations of habitats: a system with no refuge and systems offering partial or complete refuge, each environmental variant with or without a predator present. Their results showed that the perch diet in a system with refuges and predators consisted mostly (80%) of macroinvertebrates (mainly Chironomidae larvae), whereas zooplankton dominated in the diets of perch in systems where the numbers of refuges were limited, both in ones with and without predators. The contributions of zooplankton in the diet with the former option ranged from 30 to 80%. The results of the present study indicated that zooplankton accounted for over 90% of the diet of the fishes in terms of numbers and nearly 65% in terms of consumed mass. This fact, according to Persson and Eklov (1995), may suggest that the environment is structurally-simplified, which prevents perch from feeding alternatively on macroinvertebrates. In Lake Starodworskie, the belt of rushes and submerged plants offers a potential shelter. Thus not just the presence of a refuge, but rather the quality of a shelter should be considered. In this lake, submerged vegetation is created by randomly distributed, almost homogenous, dense patches of *Elodea* sp. that could discourage fish from exploiting these stands. There is evidence that fish had difficulty in penetrating dense macrophyte cover (Engel 1988). Moreover, the meromictic character of the lake diminished the possibility of feeding on benthic invertebrates. The limited ranges of oxygen occurrences in reservoirs of this kind affect the development of the benthic fauna and reduce the possibility of its consumption by fish (Rask 1986). Thus it is expected that small-sized perch searching for shelter congregate within the emergent vegetation. Moreover, increasing stem density has no impact on the zooplanktivorous perch foraging rate when compared to that of zooplanktivorous perch foraging in open water, but it decreases the feeding efficiency of other species, including roach (Winfield 1986). This makes perch an effective competitor in littoral waters. Fish may supplement their zooplankton-based diet with plant-associated benthic or epiphytic invertebrates. But perch will switch to them if these animals are easier to find and catch than mobile animals (Petr 2000). In Lake Starodworskie emergent plants are dominated by common reed. This species is moderately attractive for macroinvertebrates in terms of their colonisation in comparison to other plants (Kornijów, Gulati 1992). So probably therefore small-sized perch remain mainly zooplanktivorous.

In the studied lake, the introduction of predatory fishes induced a habitat shift in small-sized perch which resulted in their elimination from open water. The latter effect could be intensified by interspecies competition with roach, which, outside the littoral zone, are a superior competitor to perch for pelagic zooplanktonic resources (Persson, Greenberg 1990). However, some facts suggest that the elimination of perch may not be complete. Among food items selected by small-sized perch, there were zooplankton species which did not occur in the littoral zone during the period of the study; i.e. *E. gracilloides*, *M. leuckartii*, *Diaphanosoma brachyurum* (Liévin 1848) and *D. hyalina*. These species, however, were common in the pelagic waters of the lake (Bowszys *et al.* 2009). It seems plausible that small-sized perch were forced to take the risk of migrating towards the open water in search for food, to compensate for their lack of ability to forage on pelagic crustaceans during the day. Diel horizontal migrations of small-sized perch between the littoral and pelagic zones also have been reported in studies by other authors (Horppila *et al.* 2000; Pekcan-Hekim 2007). Daytime vertical migrations were not expected in this lake on account of the disadvantageous oxygen conditions in the reservoir (Tandyrak *et al.* 2009) and the low temperatures in the hypolimnion which were recognized as unfavourable for the growth of the perch (Kratochvil *et al.* 2008).

Fish feeding on pelagic zooplankton are not to be desired, because reducing the mortality rate of *Daphnia* is one of the main aims of biomanipulation. The diet of small-sized perch inhabiting this restored lake is based on zooplankton, with the species with largest body size being consumed most frequently, which is a commonly observed phenomenon (Lammens 1999), consistent with the classic *size-efficiency* model of fish feeding (Brookes, Dodson 1965). Consequently, the negative effects of fish feeding seem to be limited, as small-sized perch fed in open water mostly at night when insufficient lighting reduced their feeding efficiency. It has been shown that the efficiency of perch in feeding on zooplankton is reduced when lighting is poor (Estlander *et al.* 2010). To more accurately evaluate the role of perch in eliminating cladocerans from the waters of Lake Starodworskie, the contributions of Cladocera and Copepoda in the diets of the species at particular dates were compared. The former significantly dominated the perch diet in spring and summer. However, strong feeding pressure on *Daphnia* sp. appeared when the abundance of these crustaceans in the lake was high, which could minimise their potential loss. In June 2008, *Daphnia* accounted for nearly 50% of prey, but, at that time, they achieved an open water maximum density for the season of over 120 indiv. dm^{-3} (Bowszys *et al.* 2009). It is reported that, if the density of *Daphnia* in water is high, the percentage of biomass eliminated by zooplanktivorous fish is not significant (Wojtal *et al.* 2004). Additionally, it is presumed that during the late-spring peak in the cladoceran populations, when the fish fry biomass is still low, their effect on zooplankton is limited. Conversely, in summer, when the biomass of zooplanktivorous fish increases, the elimination of large Cladocera from the biocenosis may be expected (Meijer *et al.*1990). The density of *Daphnia* species in Lake Starodworskie during August 2008 dropped to 60 indiv. dm^{-3} (Bowszys, unpublished data), but the individuals of this genera still constituted about 50% of the total number of prey organisms. The role of fish in eliminating large filter-feeders from the biocenosis may have increased at this time. However, it should be remembered that the summer reduction in the *Daphnia* population is largely a natural phenomenon, and that the impact of fish in reducing the crustacean population in the water could be overestimated. The mid-summer decline, which is commonly observed in lakes, may be inevitable, even though the population of zooplanktivorous fish is maintained at a lower level than the critical level. This decline may be caused by a drop in food availability, concurrent aging and deaths of the spring cohort of Cladocera (Kasprzak *et al.* 2002 after Hulsmann, Voigt 2002) and the activity of predatory invertebrates (Lunte, Luecke 1990).

In late summer and in autumn, perch grazing in Lake Starodworskie was aimed at copepods (the main food item at that time). Copepoda can be an important component of the diets of various fish species (eg. Jachner 1991; Horppila *et al.* 2000; Estlander *et al.* 2010; Kratochvil *et al.* 2008). Under some conditions, perch may prefer to feed on non-grazing zooplankton such as copepods. This occurs when the number of cladocerans is low or their community is composed of small-sized species (Perrow *et al.* 1999). In our study, water-fleas were completely eliminated from littoral waters in late summer and autumn while small-bodied species dominated in pelagic waters. However, feeding on vigorous copepods is not beneficial and it may negatively affect the growth rates of perch (Romare 2000). On the other hand, of the species present in the zooplankton of Lake Starodworskie, such as *E. graciloides*, *M. leuckartii*, and *T. oithonoides* (Bowszys *et al.* 2009), the species with the largest body sizes, such as *Eudiaptomus,* were more readily selected. Such feeding selectiveness could partly compensate for the disadvantageous feeding of fishes on Copepoda.

Conclusions

A general idea and the need for the present study was to evaluate the feeding of small-sized perch and their influence on zooplankton in terms of ongoing lake restoration and management strategies. Small-sized perch was a size category which included not only juveniles, but also other size classes that were expected to feed facultatively on zooplankton as opposed to large, predatory individuals. This size of perch is able to react to predatory fish introductions by effecting a habitat shift from the pelagic to the littoral due to their feeding flexibility. Our results indicated that perch diet was based on zooplankton. The group of animals which prevailed in the food were copepods (over 50% by number and by weight). Large-bodied herbivorous taxa i.e. *Daphnia* sp. and Calanoida (*Eudiaptomus*) were most frequently picked. The species of the genus *Daphnia* are commonly known as efficient filter-feeders able to reduce algal growth and their elimination by fish may have negative impact on water quality. However, water-fleas accounted only for about 15% of the total mass of consumed food, i.e. three times less than the Copepoda group. Moreover, the reducing effect of fish feeding on daphnids in the lake seems to be limited as small-sized perch was recorded only in the littoral zone. Significant feeding pressure on large filter-feeders of the genus *Daphnia* was expected only periodically as their population in the lake pelagial was relatively abundant. Thus supporting strong perch populations in Lake Starodworskie is to be desired, especially in view of the prospective limiting effect of the species on the development of zooplanktivorous fish.

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