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Data on the feeding biology of otter (*Lutra lutra* L.) in the lakes Balaton and Kis-Balaton in Hungary

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Abstract. Feeding biology of otter was studied at Balaton and Kis-Balaton, using scat analysis. On Balaton eel *(Anguilla anguilla)*, bleak *(Alburnus alburnus)* and various Cyprinidae are the most important species in the food composition of otter, while in Kis-Balaton Cyprinidae are dominating. Ruffe *(Gymnocephalus cernuus)* and various Percidae were more important at both locations as prey item compared to previous investigations. Amphibians are represented only in trace amounts in the diet of otter, while birds appear as new prey items. Comparing the seasonal changes of prey composition of otter, the pattern may reflect some difficulties of fishing in winter.

Otters (Lutrinae) are flagship species of nature preservation throughout the world. In Europe, only one species of the family, the common or Eurasian otter *(Lutra lutra)* is indigenous. It is a kind of symbol of nature, for example as the emblem of the Bern Convention. Not only for being an attractive species, but also for being in great danger, otter deserves attention. Dramatic decline of this species has been reported since the early 60's, but the major causes are still debated (Foster-Turley et al., 1990). Hungary has been in a fortunate position that the population of otter has been strong and viable throughout these decades. This pattern has two reasons. First, otter was declared to be a protected species, and strictly protected quite early, in 1974. Second, fishing ponds formed an important part of the agriculture of the past, they were subsidised, and so otters could survive and expand. Indeed, their damage to fish stock could be indirectly refunded through these subsidies. For almost a decade fishing ponds have become primarily privately owned. Therefore the protected status of otters, despite the strong legal background, seems instable. Illegal hunting, unsustainable cultivation methods and changing agricultural status of wetlands are increasing problems for nature protection, and so also for otters. Illegal hunting originating from real or presumed damages to fishing ponds could be suppressed by a hopefully soon establishing compensation fund, or other economically relevant methods (tax, credit or other state relief; Gera, 2001). Judgement of these types of claims should be supported by scientific research.

Diet of otters is an aspect of their ecology that has been studied intensively in Western Europe (Erlinge, 1967; Mason & MacDonald, 1986; Kruuk, 1995), and this is the most frequent field of interest for the few Hungarian otter researchers, too (Lanszki & Kõrmendi, 1996; Lanszki et al., 2001). Even less work has been published in this area on habitats of Lake Balaton and Kis-Balaton so far (Kemenes & Nechay, 1990; Kemenes, 1993). Hungarian fish composition and different types of habitats (shallow lakes, as most fishing ponds and Balaton itself) justify new investigations on otter feeding.

In addition, Balaton and Kis-Balaton (Lesser Balaton) are important wetland areas of Hungary. Understanding the feeding biology of otter, as one of the top predators of wetlands may lead us to learn more about these lakes. Also, biologists have adequate information on the communities of Balaton and Kis-Balaton, especially fish stocks, so these areas could be good model systems for research on the feeding of otters. Unfortunately very few publications were issued about the role of otter at community level, even in Western Europe (Kruuk et al., 1991; Kruuk et al., 1993).

Otter is considered as fish specialist. Prey other than fish usually forms only a smaller part of the diet. Occasions, when food consists mainly of non-fish specimens (for example Sulkava, 1996;

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Lanszki & Körmendi, 1996), can be declared as exceptions. This occurs when there is too little fish mass in the habitat and otter should stay resident (for example migration is not possible because of the distance and barriers or occupied territories), and it occurs probably temporarily.

The composition of fish in diet in different places gives room to some generalisation (Kruuk, 1995). Otter usually feeds on small, bottom living, eel shaped, slow moving, frequent species. This picture is an idealised one, and can be modified by the composition of the fish community, characteristics of water, etc. Consumption is sometimes adjusted by profitability or energy value (Kruuk, 1995) and vulnerability of prey, for example pike (in this publication) and salmon (Carrs et al., 1990) after breeding. Adult males or females with cubs more frequently take larger fish, but even then they reject > 1000 g prey.

The first data about diet of otter on Balaton and Kis-Balaton was published by Kemenes and Nechay (1990). In their opinion, available food resources determine the otters' food-compositions, preference was not detectable. Fish was the prevalent food (87 %). Fish composition of diet was dominated by bleak *(Alburnus alburnus)*. Other Cyprinids were also important, as rudd *(Scardinius erythrophthalmus)*, bream *(Abramis brama)*, Prussian carp *(Carassius auratus)*. Eel *(Anguilla anguilla)* was also frequent. It was a tendency that otter consumed smaller pike *(Esox lucius)*, Cyprinidae, and medium sized eel. Remains of mammals or insects were rare (3.6 % and 3.9 % respectively). Birds were not detectable. On Kis-Balaton Cyprinids were more important, especially carp *(Cyprinus carpio)* and rudd. Bleak was less important than in Balaton. Kemenes (1993) found similar results. Altogether, fish was predominant (91 %), mainly Cyprinids in the food of otters in Balaton. Bleak was predominant (69 %), followed by rudd. Pikeperch *(Stizostedion lucioperca)* was not detectable, but eel was important. In Kis-Balaton also Cyprinids dominated, rudd was the most frequent prey (39 %), followed by bleak (18 %). Carp and other economically important species appeared in the diet of otter with fewer specimens, but in significant weight.

In the present investigation I would like to describe the pattern of the diet of otters in Balaton and Kis-Balaton. Repeating the investigations of Kemenes (1993) and Kemenes and Nechay (1990) makes sense in terms of the changing composition of fish communities of the two lakes, for example decay of eel in Balaton, Prussian carp in Kis-Balaton (Bíró, 1993). Previous investigations was based on autumnal-winter data, hereby I add annual data in terms of Balaton.

MATERIAL AND METHODS

Diet of otter was studied by analysis of scats (spraints) being the most frequent method for examining the prey composition of otters (for example: Erlinge, 1967; Wise, 1980).

Samples from Balaton were collected at Badacsony near the pier, towards Tomaj, from Kis--Balaton at Reservoir I, around the "cassette" (central pool), towards "4T" and "2T" crosses on the dam.

There was at least monthly sampling at Badacsony. I collected and processed 128 spraints between 1998 February and 1999 April, and 35 from Kis-Balaton between the autumn of 1998 and winter of 1998/99.

I collected spraints in small paper envelopes. Scats could dry in these containers, but if this was not satisfactory, they were owen-dried at 70° C. Dry spraints were taken apart into identifiable pieces. Remains of fish were identified using compendiums (Kemenes, 1993; Knollseisen, 1996) and a reference collection. When possible, remains were identified on the species level. Family level identification was only used when there were no species-specific bones (skull bones), only scales or vertebrae. Size of fish was determined by using methods and data developed by Wise (1980) and the data of Pintér's handbook (1989). Data on fish of Balaton and Kis-Balaton were collected from Paulovits et al. (1998); Bíró (1994, 1997); Bíró et al. (1998).

RESULTS

The results according to prey composition in frequency and bulk percent can be found in the Fig. 1 for annual data and Fig. 2 for data according to seasons.

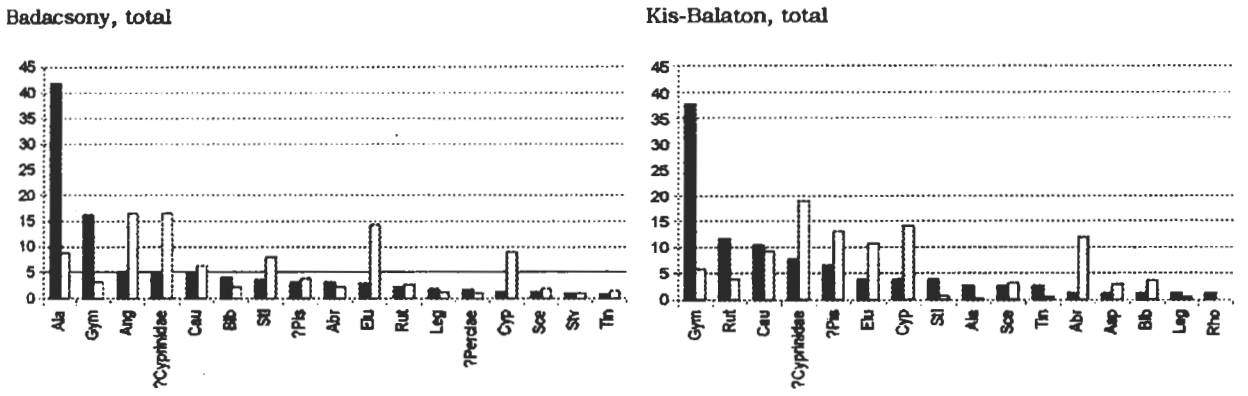


Figure 1. Annual fish composition of diet of otters at Balaton (February 1998 – April 1999, n = 128) and Kis-Balaton (1998 autumn and winter, n = 35). Filled bars: frequency; open bars: weight percent. (List of abbreviations: Ala – *Alburnus alburnus*, bleak; Ang – *Anguilla anguilla*, eel; Asp – *Aspius aspius*, asp; Blb – *Blicca bjoerkna*, white bream; Cyp – *Cyprinus carpio*, carp; Pef – *Perca fluviatilis*, perch; Rho – *Rhodeus sericeus amarus*; Rut – *Rutilus rutilus*, roach; Sce – *Scardinius erythrophtalmus*, rudd; Stl – *Stizostedion lucioperca*, pikeperch; Stv – *Stizostedion volgense*; Tin – *Tinca*; ? Cyprinidae – unidentifiable cyprinids; ? Percidae – unidentifiable Percidae; ? Pis – unidentifiable fish)

Comparing the annual data of both waters, it is clear that the fish composition of food of otter shows similarity. The most frequent species are rather small size fishes: bleak and ruffe *(Gymnocephalus cernuus)* at Balaton and ruffe, roach *(Rutilus rutilus)* and Prussian carp (*Carassius* spp.) at Kis-Balaton, although they were less important in weight. Larger species such as carps, pike and unidentifiable Cyprinids (mainly heavier ones) produced the bulk of prey in biomass. Whereas eel was highly significant in the diet of otters at Balaton, some unidentifiable fish species (heavier ones, similar to Cyprinids) composed the diet at Kis-Balaton. Bream shows significant level in bulk percent of consumed fish at Kis-Balaton, but this was resulted by a few, really big specimens (as only 35 spraints were processed, it could be a biased result). Another similarity is, that amphibians were represented only in trace amounts. The most important difference between the data of Balaton and Kis-Balaton was that bleak was in insignificant proportion at Kis-Balaton. Another, but smaller difference was that Percidae (and Centrarchidae, maybe Gobiidae, except for ruffe could be found in smaller proportion at Kis-Balaton.

Considering the seasonal variation of feeding, I mention the results of Balaton, because the data from Kis-Balaton covers only a single autumn–winter period. However, summer results of Balaton may be biased, due to the small sample size of collected spraints (Fig. 3).

Otter catches pike mainly in spring (probably due to the breeding of pike). Carp is the most important species by weight in winter, but not by frequency. This means that otters catch larger carp in wintertime. Eel is very important by consumed mass throughout the year, except in winter. The frequency of bleak seems quite stable throughout the year (over 40 %), but in winter it reaches nearly 15 % in weight (compared to ca. 5 % in other times).

Median weight is between 10-15 g in the whole sample and seasonally in both waters. Average weights of identified fish differ according to seasons, smaller in winter in both lakes, also do deviations, which are quite high (Fig. 3). Birds reach 5.2 % at Kis-Balaton (in autumn nearly 10 %) and 3.9 % at Badacsony (Fig. 4). This result can be also significant in terms of weight. Determination of taxa of bird remains is under preparation.

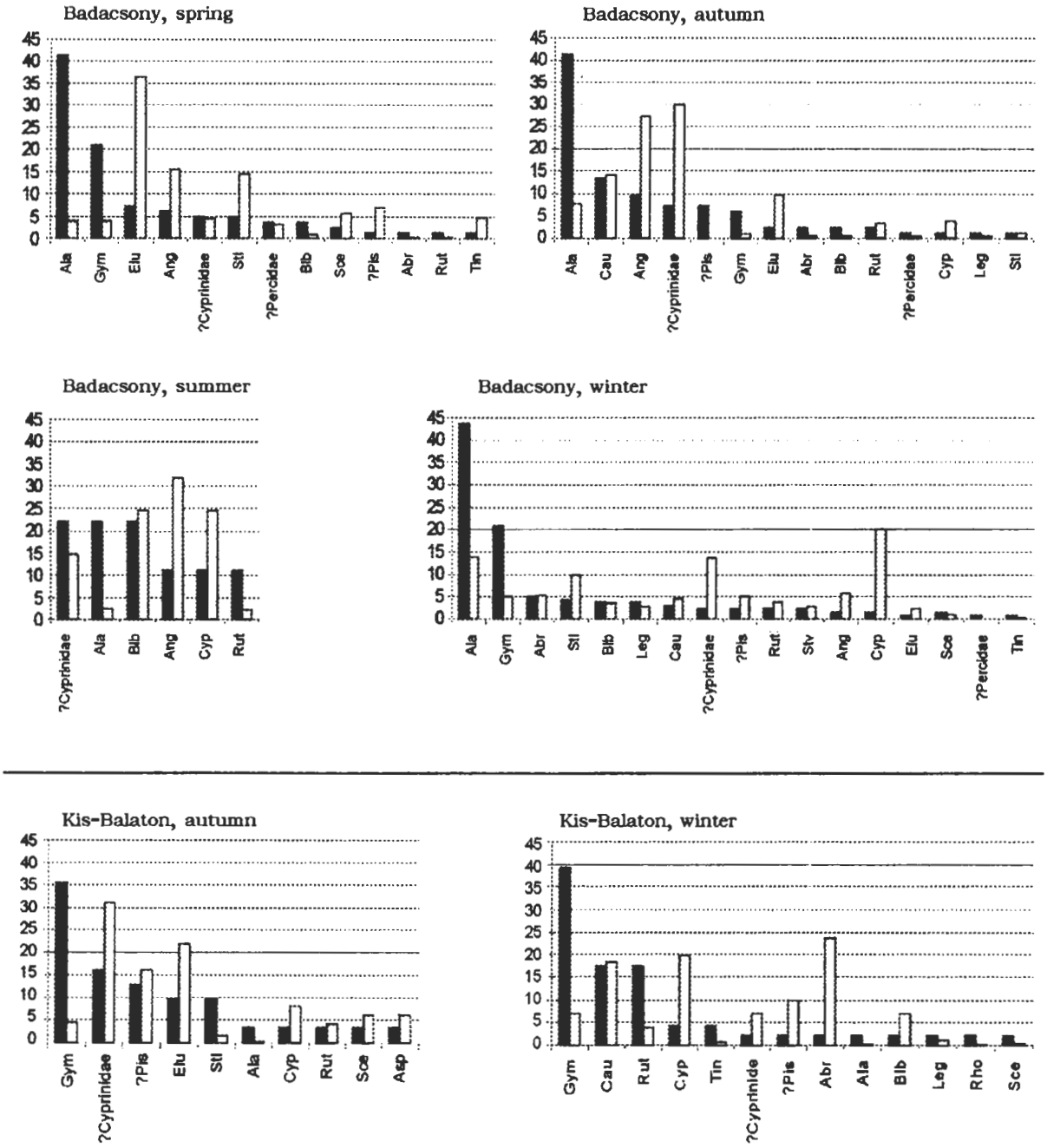
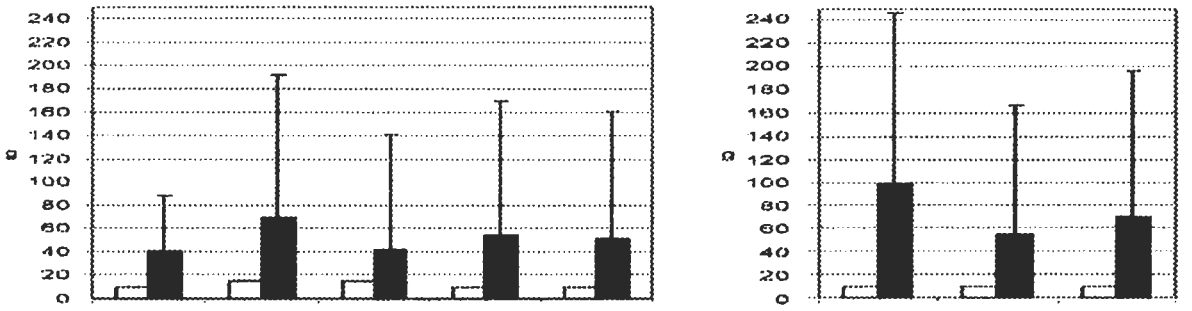


Figure 2. Seasonal fish composition of diet of otters at Balaton (February 1998 – April 1999, n = 128) and Kis-Balaton (1998 autumn and winter, n = 35). Filled bars: frequency; open bars: weight percent. For abbreviations see Fig. 1



	summer	autumn	winter	spring	total	autumn	winter	total
n	5	35	57	31	128	21	15	36
number of identified preys	10	75	132	81	298	25	46	71
number of fish taxa	5	11	14	10	14	8	11	14
prey items/spraints	2.00	2.49	2.63	2.87	2.64	1.62	3.33	2.33

Figure 3. The average (filled bars) and median weight (open bars) of fish consumed by otter in Balaton (left) and Kis-Balaton (right). Standard deviation of mean was calculated from individual weight of fish preys. On the diagrams there are data on fish is presented. In the tables below the diagrams *n* means collected number of spraints. *„Prey item / spraints"* includes, whereas *„number of identified preys"* excludes non-fish prey items

DISCUSSION

The distribution of spraints by season was similar to other authors' data (Kemenes, 1993; Mason & Macdonald, 1986; Lanszki & Kőrmendi, 1996; Harna, 1993): in winter the collectable number of spraints was about ten times higher than in summer (Fig. 3). This pattern causes the overrepresentation of the winter season in the annual data. This bias can be compensated later, on a longer time-scale, provided that the data are homogeneous (sample collections have been consecutive since 1998). However, the number of taxa as function of sample number reached plateaux in every season except for summer data gained at Badacsony (Nagy, 1999).

Comparing my data with those on fish composition of the two lakes presented by the earlier mentioned authors, one can find both similarities and differences. In lake Balaton the presence of bleak – with 47 % frequency and 8.7 % weight – differs little from the composition of diet of otters in my investigation (41.7 % and 8.7 %). Despite of their high abundance in the lake, bream and white bream do not appear in the diet of otter in significant proportion. However, these species can appear in the Cyprinidae and in the unidentifiable category (these categories make up important entities in weight composition). Carp reach 4-5 % in frequency and 35 % in weight at reeds (where otters probably fish intensively), but appears with 1.3 % and 9 % respectively in the food of otter. Still, we must consider, that carp can also appear in the Cyprinidae and unidentifiable category. Ruffe forms 2.3 % of fish in Balaton, but I can report it as high as 16.2% in frequency (although only 3.2 % in weight due to the small individual mass) among the prey of otter. According to faunistical investigations (Biró et al., 1997), pikeperch makes up 2 % in frequency. Its consumption of 4 % by the otter seems realistic. Unfortunately, I could not find any data on eel..

The data on fish stocks of Kis-Balaton seems problematic. Data are published on independent

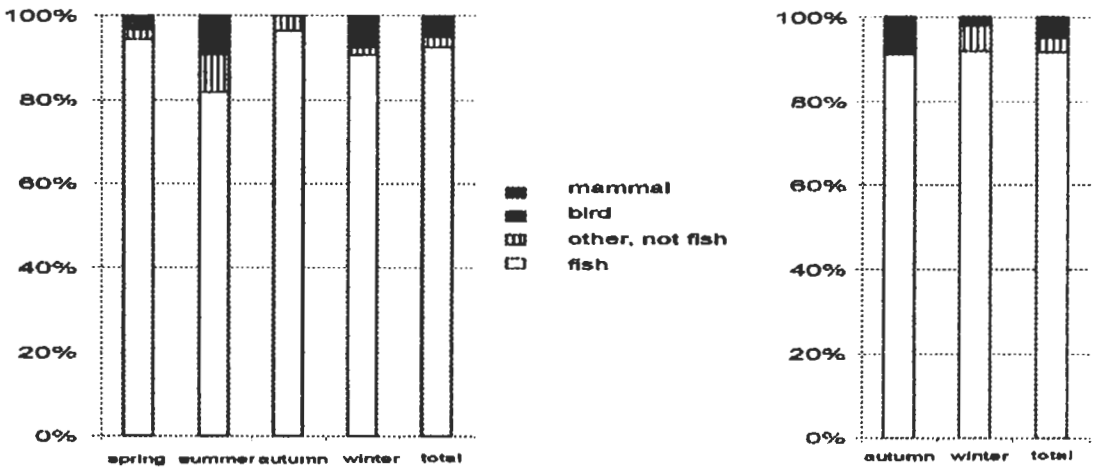


Figure 4. Frequency of prey categories according to seasons in Balaton (left) and Kis-Balaton (right)

cassettes, moreover these data differ according to years and authors (Bíró, 1994). Since reservoirs are independent, data on fish do not match to the feeding habits of otter, which can travel between the cassettes. Considering the mean of data of 1990 (Bíró, 1994), it can be concluded that the abundant *Carassius* spp. *(C. auratus)* takes part in a lower proportion (around 10 % in both frequency and weight) among the prey of the otter. However, Cyprinidae group may consist of *Carassius* spp, which group is significant in frequency and the largest in weight. Roach and pike appear in the food of otter similarly to their natural frequency and biomass. Bleak, as mentioned above, is underrepresented in the composition of feeding of otter in Kis-Balaton, although it was described as a frequent species in fish stock (Bíró, 1994) and as a prey item (Kemenes, 1993). This pattern may occur because of the different (changing) habitat structure (less reed) and/or different behaviour of this species (bleak probably become more pelagic in Kis-Balaton).

Carp is important in weight but less significant in frequency in the fauna of Kis-Balaton. Species, other than Cyprinids are rare in both waters, but a little more frequent in Balaton (Bíró et al., 1998; Bíró, 1994). These patterns also can be found in the diet composition of otter.

Interesting is that the mean weight of prey items (and the deviation of mean) is the smallest in winter (if we reject summer data of Badacsony because of the sample size). This pattern may reflect some difficulties of fishing in winter (Kruuk, 1995). The winter of 1998/99 was quite cold, there was regularly ice cover on the water for longer periods of time.

It can be concluded that there are many similarities with the previous investigations (Kemenes & Nechay, 1990; Kemenes, 1993). On Balaton eel, bleak and various Cyprinidae are the most important species in the food composition of otter, while in Kis-Balaton Cypriniae are dominating. Another similarity is, that amphibians are represented only in trace amounts in the diet of otter. However, species composition of consumed fish is different in some aspects. Ruffe is important in frequency in both lakes (even it is less significant in weight). This prey item is an "ideal" one as being a small, bottom-living, slow moving species (Kruuk & Hewson, 1978). Percidae appear more frequently than in the previous investigations (Kemenes & Nechay, 1990; Kemenes, 1993) (for example *Stizostedion* spp. turn up in the food of otters of both lakes). This result seems surprising, because Kemenes and Nechay (1990) studied autumnal and winter prey of otters, when, according to my investigation, the role of these taxa becomes significant. This new result needs revising based on recent data on changes in fish stock. Presence of Percidae in the food of otter

can be high according to other authors (Lanszki, 1993; Skarén, 1993; Wise et al., 1981; Erlinge, 1972).

Birds are new prey items in both waters, compared to the previous investigations. The accurate determination of bird remains will hopefully discover its relevance.

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