

FEEDING OF PIKEPERCH, *STIZOSTEDION LUCIOPERCA* (L.) IN LAKE PEIPSI (ESTONIA)

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1. Introduction

Pikeperch as a fastidious fish inhabits the best eutrophic and hypertrophic lakes in Estonia, which are relatively large and deep, with a rather high pH and fish productivity. As the lakes are located mostly in cultivated areas, they are exposed to agricultural pollution. Pikeperch avoids closed lakes and is quite sensitive to winter anoxia (Pihu, 1993).

Pikeperch has become one of the most important valuable commercial fishes in Lake Peipsi. Owing to its high commercial value and vulnerability to fishery, pikeperch is at the same time the most endangered fish species in the lake.

Lake Peipsi (also L. Peipus in older German literature and L. Chudskoje in Russian) is one of the largest inland waterbodies in Europe (Fig. 1).

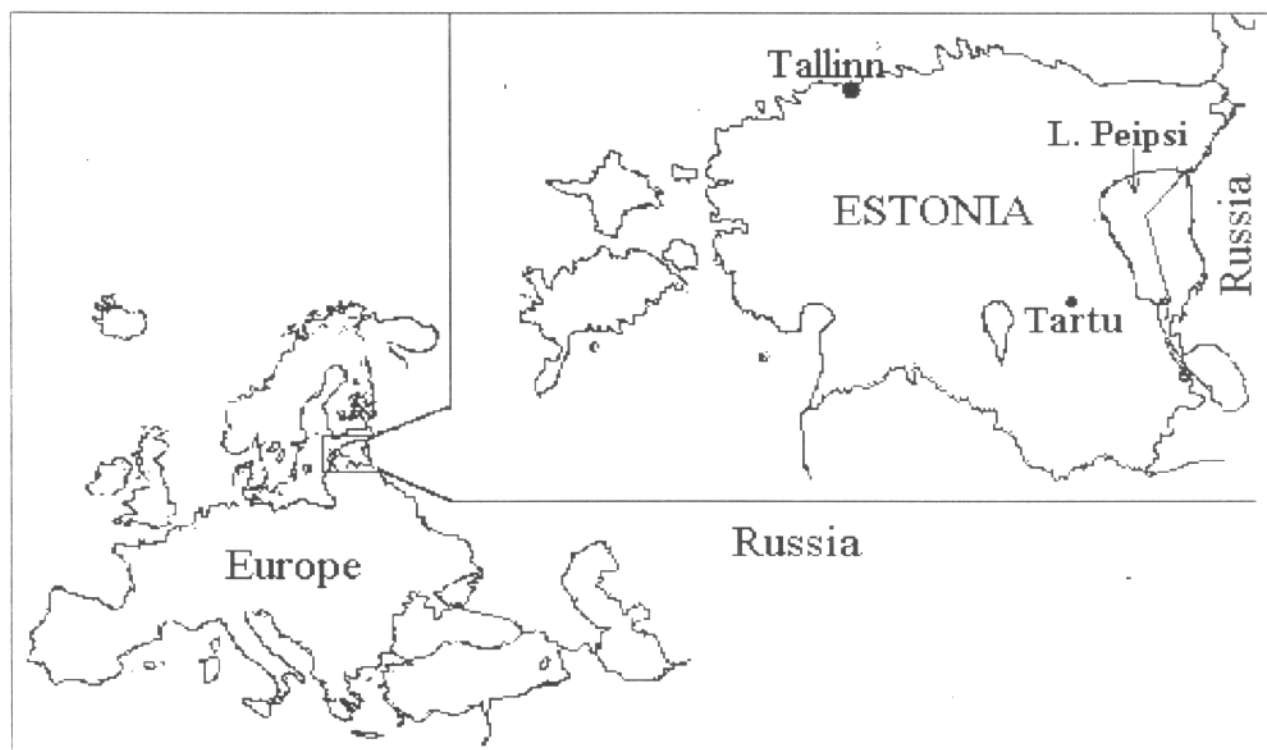


Fig. 1. Location of Lake Peipsi.

It occupies the fourth place after the lakes of Ladoga, Onega and Vänern and is shared between the territories of Estonia and Russia.

L. Peipsi belongs to smelt-bream lakes; due to eutrophication during the last decades it has obtained features of a pikeperch lake. Its fish productivity as well as catches (about 25-35

kg/ha/year) are high; in this respect L. Peipsi exceeds all the large lakes of North Europe (Pihu, 1983). About 2/3 of its surface area and about 60% of the catch of fish belong to Russia, the rest to Estonia.

The population of pikeperch was studied considering the composition of the diet. The frequency of occurrence and number of food items per individual are presented. Size-related changes in the diet of pikeperch are discussed.

2. Study area

The total surface area of L. Peipsi (in the broad sense) is 3,558 km², average depth 7.1 m, maximum depth 15.3 (Kupcov & Arukaëvu, 1983). The lake consists of three parts: the large and deep northern part, Lake Peipsi s.s.; the southern part, Lake Pihkva, and Lake Lämmijärv which connects them. This paper deals with L. Peipsi s.s. Its surface area is 2,670 km², average depth 8.3 m, maximum depth 12.9 m (Kupcov & Arukaëvu, 1983). It is a eutrophic waterbody with alkaline water (usually pH 7.6-8.4) (Timm *et al.*, 1994). Water transparency has not exceeded 1.2 -- 2.7 m in recent years (Timm, 1993). Ice appears usually in November and melts in April. The average temperature of the surface water layer during the ice free period is about 7.3⁰ C (Uleksina, Filatova, 1983).

According to the present data L. Peipsi and the streams falling into it serve as a habitat for 34 fish species. The occurrence of fish species typical of oligotrophic waterbodies such as lake smelt *Osmerus eperlanus eperlanus* m. *spirinchus* Pallas and vendace *Coregonus albula* (L.) is quite high. According to official data the total catch of fishes in the Estonian part of L. Peipsi made up 1,624 tons in 1994 and 2,132 tons in 1995. The principal fishes in commercial catches are lake smelt, perch *Perca fluviatilis* L., pikeperch, bream *Abramis brama* (L.) and pike *Esox lucius* L. (Fig. 2).

Fishes are caught from L. Peipsi mostly with Danish seines and large gill nets.

According to an official agreement between Estonia and Russia the number of Danish seines allowed to use in L. Peipsi in 1994--1995 was 40: 20 on the Estonian side, 20 on the Russian side. Mesh size in the cod-end of the commercial seine is 80 mm stretched, and mesh size of gill nets is 140 mm. The legal size of pikeperch in the lake is 40 cm.

3. Material and methods

The material was collected from the open part of L. Peipsi s.s. from April to October 1995. Fishes were caught with the experimental Danish seine (mesh size 18-22 mm in the cod-end) or experimental trawl (mesh size 10-14 mm) mostly in the morning hours and dissected immediately. A total of 342 fishes were examined during the study period (Table 1). All fishes were measured with the accuracy of 1 cm. Prey fishes or their remains were counted, identified and measured. Two different measures are used for the description of the stomach content: frequency of occurrence and abundance of prey fish. The frequency of occurrence (FO) is defined as the number of fishes in which a prey item occurs expressed as a fraction (%) of the total number of the examined predators. Fishes with empty stomachs were included.

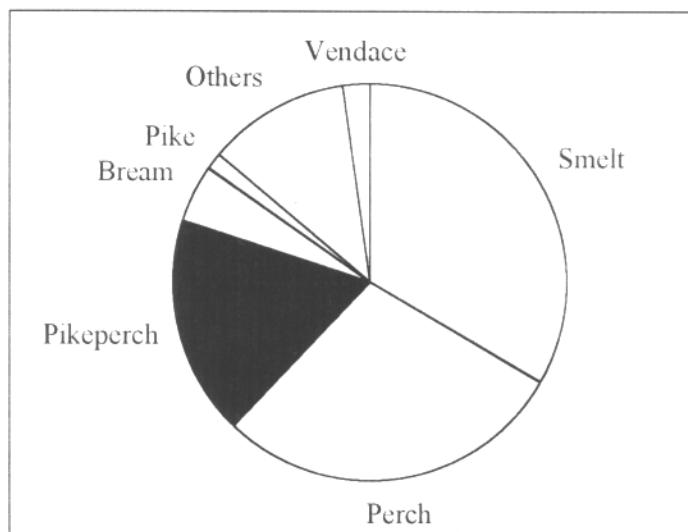


Fig. 2. Weight share of pikeperch and other valuable fishes in commercial catches from L. Peipsi in 1995.

Table 1. Number and measurements of examined pikeperch

Month	Standard length (Sl), cm				
	<19	20-29	30-39	40-49	50<
April			4	9	5
May			8	15	1
June			2	3	1
July		3	5	7	
August	80	2	1	28	5
September	69	27	15	43	6

4. Results

4.1. The composition of the diet

Pikeperch turns into a predator at the end of the first summer. The diet of pikeperch contained at least 6 species of prey fishes: smelt, ruffe, perch, vendace, roach, pikeperch. In addition, a shell of *Dreissena polymorpha* was found in the stomach of one pikeperch. More than half of the examined fishes had consumed smelt (FO = 51.5%), followed by ruffe (22.5%) and perch (9%). FO of other prey fishes was less than 2%. 20% of the dissected stomachs were empty.

4.2. Size-related changes

The first prey item for pikeperch is smelt fry. According to our data fishes with Sl < 15 had consumed only smelt (Table 2). With increasing body size the diet of pikeperch was enriched with ruffe and fry of perch. Fishes in the length group 15-19 cm began to take ruffe. Cannibalism occurred in the same length group. Two pikeperches (Sl = 19 cm and 19.5 cm) caught in September had both taken a pikeperch of Sl \cong 8 cm. The remains of perch occurred in the stomach of specimens with a length over 30 cm. The remains of vendace, roach and pikeperch were found in the stomachs of larger pikeperch too. A comparison of the diet of pikeperch of different size demonstrated a shift in prey choice.

Table 2. Frequency of occurrence (%) of several prey fishes in the diet of pikeperch from L. Peipsi in 1995

Pikeperch		Prey fish					
Length, cm	n	Perch	Ruffe	Smelt	Vendace	Others	Empty
<15	53			94.3			5.7
15-19	96		11.5	65.6		2.1	20.8
20-24	17		17.7	64.7			17.6
25-29	18		29.4	41.2			29.4
30-34	14	21.4	21.4	35.7			35.7
35-39	21	14.3	47.6	33.3	4.8		28.6
40-44	72	16.7	41.7	31.9	1.4	4.2	12.5
45-49	33	21.2	33.3	21.2	3.0	12.2	27.3
50-72	18	38.9	5.6	22.2	5.6	39.0	22.2
Average		9,4	22,5	51,5	1,2	2,0	19,9

With the increasing size of pikeperch the FO of smelt in its food decreased gradually. At the same time the FO of ruffe increased till the length of the predator reached 35-39 cm (FO_{max} = 48%).

while in larger length groups it decreased again noticeably, constituting only 6% in specimens $SI > 50$ cm. Predation pressure of pikeperch of $SI > 30$ cm on perch increased gradually with the growth of the predator. Large specimens ($SI > 50$ cm) consumed perch most frequently (Table 2). When comparing different pikeperch length groups, the share of fishes with empty stomachs is quite varied. Among young fishes (age 1+, $SI < 15$ cm) 95% of specimens had taken food. The most inactive consumers were fishes of $SI = 25-39$ cm.

The diet of pikeperch reveals evident size related changes: larger specimens prefer larger prey fish species, and their diet composition is more diverse. The maximum size of the prey caught appeared to be related mainly to predator gape dimensions.

4.3. Number and size of consumed prey fishes

Smelt was the most abundantly consumed species (Table 3), whereas all size groups of pikeperch feed on it. Ruffe is the second rate prey organism, and it was consumed most heavily by pikeperch of $SI = 40-44$ cm. The average number of prey fishes per one stomach in different predators size groups is different. As a rule, bigger specimens had consumed more prey items. For example, pikeperch of $SI = 15-19$ cm had engulfed on an average 0.13 ruffes or 0.77 smelts, whereas in the stomachs of fishes of $SI = 40-44$ cm we found the remains of 1.1 ruffes or 1.33 smelts.

Table 3. Number of engulfed prey fishes per one pikeperch

Length group, cm	Prey fish					
	Pikeperch	Roach	Vendance	Perch	Ruffe	Smelt
<15						0.98
15-19					0.13	0.77
20-24					0.29	0.76
25-29					0.28	0.56
30-34				0.36	0.43	0.86
35-39				0.24	0.62	0.67
40-44			0.01	0.26	1.10	1.33
45-49		0.09	0.03	0.24	0.64	1.03
50-72	0.06	0.28	0.00	0.50	0.06	2.06
Average	0,01	0,02	0,01	0,13	0,42	1,0

The size variation of consumed prey fishes was not very high. The smallest prey fish (ruffe) found in the stomach of pikeperch had a length of 3 cm, the largest one (perch and roach), 12 cm. There was a considerable correlation between measurements of the prey fish and the predator. As a rule, bigger pikeperch consumed bigger prey fishes.

4.4. Seasonal changes

According to our data there is no significant difference between the frequency of occurrence of prey fishes in the diet of pikeperch in April-June and July-September ($F_{calc.} \ll F_{tab.}$). A significant difference occurred neither between the number of empty stomachs of pikeperch in spring and autumn periods ($F_{calc.} \ll F_{tab.}$). In both cases the relative number of stomachs without food constituted about 20% (Table 3). Our data showed that the feeding intensity of pikeperch during the whole ice free period is approximately the same.

5. Discussion

Pikeperch is economically the most important species of both brakishwater bays and inland waterbodies in many Baltic areas. This species is heavily exploited all over L. Peipsi.

In L. Peipsi the main food of pikeperch fingerlings up to a length of 3-5 cm consists of *Leptodora*. Later, they start to prey on the larvae and fry of smelt. Larger pikeperch consumes almost all available fish: smelt, roach, perch, bleak, ruffe (Shirkova, 1966; Erm, 1981).

According to our data pikeperch in L. Peipsi fed mainly on smelt, ruffe and perch, whereas the diet of small specimens (SL < 15 cm) consisted only of smelt. With increasing body size the diet of pikeperch diversifies with ruffe and fry of perch being added. The fractions of other prey fish (roach, vendace, pikeperch) were small.

In lakes of southern Finland pikeperch consumed mainly smelt and perch, but they fed also on roach and bleak (Peltonen & Ruuhijärvi, 1995) like in L. Peipsi.

References

Erm, V., 1981. Koha. Valgus, Tallinn, 127 pp.

Kupcov, A.N. & K.M. Arukaëvu, 1983. Fiziko-geograficheskaja harakteristika ozera i ego bassejna. In A.A. Sokolov (ed.), Chudsko-Pskovskoe ozero. Gidrometeoizdat, Leningrad: 14-26.

Peltonen, H. & J. Ruuhijärvi, 1995. Prey selection and seasonal patterns in feeding of pikeperch (*Stizostedion lucioperca* (L.)) in Lake Vesijärvi, southern Finland. - PERCIS II. Vaasa: 58.

Pihu, E.H., 1966. Rybohozjaistvenno-biologicheskoe znachenie stuki, okunja, sudaka i nalima v Pskovsko-Chudskom ozere. In: Hydrobiology and fisheries of Lake Peipsi-Pskov, Hydrobiological Researches 4. Tallinn: 235-248.

Pihu, E.R., 1983. Gidrobiologicheskaja i rybohozjajstvennaja oценка. In A.A. Sokolov (ed.), Chudsko-Pskovskoe ozero. Gidrometeoizdat, Leningrad: 133-134.

Pihu, E., 1993. Distribution of fish species in Estonian lakes. Proc. Estonian Acad. Sci. Ecol. 3, 4: 181-186.

Shirkova, A.P., 1966. Sudak Pskovsko-Chudskogo vodoema. In: Hydrobiology and fisheries of Lake Peipsi-Pskov, Hydrobiological Researches 4. Tallinn: 213-220.

Timm, T., 1993. Peipsi järv. Lake Peipsi. In M. Pylvänäinen (ed.), Eesti jõgede ja järvede seisund. Water pollution and quality in Estonia. Environmental Report 7. Helsinki: 41-42.

Timm, T., A. Mäemets, E. Pihu & H. Starast, 1994. Peipsi järve seisund, kalamajandus ja kaitse. In A. Järvekülg, (ed.), Eesti jõgede ja järvede seisund ning kaitse. Teaduste Akadeemia Kirjastus, Tallinn: 7-15.

Uleksina, A. & T. Filatova, 1983. Termicheskij rezhim. In A.A. Sokolov (ed.), Chudsko-Pskovskoe ozero. Gidrometeoizdat, Leningrad: 53-69.