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PEIPSI WHITEFISH, *Coregonus lavaretus maraenoides* Poljakow, IN LAKE PEIPSI

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Abstract. A descriptive overview is given of the morphology, ecology, and fishery of Peipsi whitefish (*Coregonus lavaretus maraenoides* Poljakow). Peipsi whitefish is an endemic subspecies that evolved in L. Peipsi after the last Ice Age. The lifetime of Peipsi whitefish is up to 15 years; the biggest specimens are 60 cm long (Fl) with a total weight of 3.5 kg. Age groups 6–8 predominate in commercial catches. Peipsi whitefish spawns in autumn in the southern part of L. Peipsi *s.s.*, where the condition of its spawning places is continuously deteriorating. Its mean absolute fecundity is 23 000 eggs. Peipsi whitefish is an euryphagous fish, consuming different food objects from zooplankton to fish. In L. Peipsi whitefish is seriously infected with *Tetracotyle intermedia*. In the 1990s catches of whitefish in L. Peipsi were 30–70 t, being limited by the close season and quota. Peipsi whitefish is caught with gill nets mainly at the end on June and at the beginning of July. The catch of whitefish accounts for 1% of the total annual fish catch in L. Peipsi.

Key words: morphology, growth and age, reproduction, feeding, parasites, catches.

INTRODUCTION

Following the last Ice Age (8000–10 000 years ago), a freshwater subspecies of whitefish, *Coregonus lavaretus maraenoides* Poljakow, evolved in L. Peipsi (Reshetnikov, 1980). Peipsi whitefish, also known by its Russian name as Chudskoj whitefish, looks similar to sparsely-raked whitefish (*Coregonus lavaretus widegreni* Malmgren) inhabiting the coastal waters of the Baltic Sea. The important distinctive character of these two whitefish forms is the number of gill rakers, ranging from 36 to 45 in Peipsi whitefish (Mikelsaar, 1984) but from 15 to 28 in sea spawning whitefish (Svärdson, 1979; Reshetnikov, 1980).

Whitefish is a valuable commercial fish in L. Peipsi. Information on this fish is relatively scarce. The majority of studies published on Peipsi whitefish are in Russian, some in Estonian, and only a few in English. The current study presents an overview of the state of Peipsi whitefish in its native lake and summarizes previously published data.

MORPHOLOGY AND ECOLOGY

The morphometric characters of whitefish in the Russian part of L. Peipsi *s.s.* presented in Table 1 after Kontsevaya (1985) and Kontsevaya & Mednikova (1994) are based on a sample including different age groups (ages 2+ to 12+), which causes variability of these characters. The sample from the Estonian part of L. Peipsi near Kallaste includes commercially caught age groups 4+ to 7+.

Two-Sample Analysis showed the difference between the two samples studied not to be statistically significant (in all cases $t_{diff} < 2$; $P > 0.1$). Sexual dimorphism has not been detected in Peipsi whitefish (Kontsevaya & Mednikova, 1994).

As several researchers have shown, Peipsi whitefish grows faster in years with cold water (Shirkova, 1966, 1974; Reshetnikov, 1980). One of the main factors suppressing its growth rate is infection with *Tetracotyle coregoni* (= *intermedia*) larvae (Shirkova, 1957). In regions where Peipsi whitefish has been introduced (Lake Sevan in Armenia, Ukraine, etc.) and where its usual parasites do not occur, its growth characteristics surpass considerably those in L. Peipsi (Reshetnikov, 1980).

Table 2 presents data on length and weight at age of this species in Estonian waters. As determined from scales the lifetime of Peipsi whitefish does not exceed 14–15 years. In 1998 the biggest whitefish in L. Peipsi was caught with a gill net. Its fork length (Fl) was 58 cm and total weight (Tw) 3.39 kg. Data from the Estonian part of L. Peipsi corroborate the assertion published earlier that the total weight of individuals of the same age varies highly depending mostly on the extent of infection with parasites (Shirkova & Kogteva, 1967; Shirkova, 1974).

The spawning of whitefish begins at 5 °C (usually in late October or early November), and continues till the water temperature falls to 0.5 °C. Common age at maturation is five years (Kontsevaya, 1985). The main spawning places of whitefish are located in the southern part of L. Peipsi *s.s.* near Meerapalu and Piirissaar Island in Estonia and near Podborov'e and Ostrovtsy in Russia (Kovalev, 1962). In the northern part of the lake only small spawning sites are found. The number of suitable spawning places has continuously diminished as gravelly bottom is replaced with eutrophic mud (Shirkova, 1974). Peipsi whitefish spawns at a depth of 1.5–5 m (Shirkova, 1974), usually at 2–4 m (Lebedeva, 1981) on gravelly or sandy bottom.

At the age of 4–8 years the mean absolute fecundity (AF) of whitefish is 23 000 (9000–82 000) eggs (Shirkova, 1966). Data on the fecundity of Peipsi whitefish are presented in Table 3.

Table 1. Morphometric characters of Peipsi whitefish in the Russian (Kontsevaya, 1985; Kontsevaya & Mednikova, 1994) and Estonian parts of L. Peipsi

Character	Russian part ($n = 40$), $\bar{x} \pm S_{\bar{x}}$	Estonian part ($n = 20$), $\bar{x} \pm S_{\bar{x}}$	t_{diff}
	Meristic characters		
Lateral line scale count	95.40 ± 1.04	93.54 ± 1.07	1.16
Unbranched rays of dorsal fin	3.43 ± 0.60	3.47 ± 0.11	0.05
Branched rays of dorsal fin	10.43 ± 0.72	10.23 ± 0.17	0.18
Unbranched rays of pectoral fin	n.d.	1.00 ± 0.00	n.d.
Branched rays of pectoral fin	n.d.	14.69 ± 0.32	n.d.
Unbranched rays of ventral fin	n.d.	1.00 ± 0.00	n.d.
Branched rays of ventral fin	n.d.	10.00 ± 0.00	n.d.
Unbranched rays of anal fin	2.95 ± 0.74	3.59 ± 0.14	0.60
Branched rays of anal fin	12.49 ± 0.81	11.46 ± 0.23	0.88
Vertebrae	57.00 ± 0.22	n.d.	n.d.
Branchial spines	38.01 ± 2.53	n.d.	n.d.
Pyloric caeca	23.91 ± 1.73	n.d.	n.d.
	Plastic characters		
% of fork length:			
Maximum body depth	24.68 ± 1.87	26.51 ± 0.40	0.61
Minimum body depth	7.50 ± 0.35	7.62 ± 0.10	0.24
Length of dorsal fin	11.32 ± 0.69	11.79 ± 0.18	0.48
Depth of dorsal fin	14.57 ± 0.98	15.82 ± 0.29	0.90
Length of pectoral fin	14.86 ± 1.11	16.31 ± 0.26	0.92
Length of ventral fin	14.98 ± 0.95	14.63 ± 0.26	0.26
Depth of anal fin	11.63 ± 0.81	11.08 ± 0.16	0.48
Distance between pectoral and ventral fin bases	27.97 ± 1.26	31.23 ± 0.39	1.82
Distance between ventral and anal fin bases	24.70 ± 1.51	26.19 ± 0.28	0.72
Predorsal distance	43.65 ± 1.20	45.73 ± 0.55	0.74
Postdorsal distance	48.21 ± 2.22	41.89 ± 0.36	1.98
Length of head	19.61 ± 0.81	19.42 ± 0.31	0.16
% of length of head:			
Head depth at nape	70.79 ± 5.08	75.63 ± 1.78	1.86
Preorbital distance	n.d.	24.06 ± 0.68	n.d.
Horisontal diameter of orbit	22.31 ± 1.76	18.87 ± 0.31	1.76

n.d., not determined.

Table 2. Mean length and weight at age of Peipsi whitefish in L. Peipsi (July 1998; $n = 437$)

Parameter	Age groups, in years												
	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+
Fl, cm	14.5	25.6	32.1	38.4	41.0	43.3	44.8	46.6	48.6	50.1	53.6	54.0	56.5
Tw, g	26	215	451	814	1022	1204	1350	1536	1762	1939	2223	2477	2878
n	32	8	2	10	35	94	90	70	35	29	18	10	4

Table 3. Mean absolute and relative fecundity (AF and RF, respectively) of Peipsi whitefish in L. Peipsi *s.s.*, autumn 1982 (Kontsevaya, 1985)

Parameter	Age groups, in years							
	3+	4+	5+	6+	7+	8+	9+	10+
AF	21 900	27 500	33 300	37 300	43 900	50 400	52 200	66 100
RF	42	40	37	36	39	39	33	33
n	5	13	25	35	25	15	6	1

Hatching starts at a water temperature of 6–8 °C at the end of April. In spawning places the eggs are endangered by ruffe, burbot, and whitefish itself (Shirkova, 1966, 1974).

Peipsi whitefish consumes mainly bottom invertebrates and zooplankton, but it feeds also on algae. Larger specimens take also small fishes, above all smelt; in spawning places they eat their own and vendace roe. In July the food spectrum of juvenile whitefishes included *Daphnia cucullata*, *Bosmina coregoni*, and *B. longirostris*. Besides zooplankton Peipsi whitefish consumes a limited amount of the juvenile stages of Copepoda, Leptodora, Mollusca, Oligochaeta, and Chironomidae larvae (Domrachev, 1929; Shirkova, 1966; Tikhomirova, 1974).

The heart of whitefish in L. Peipsi is heavily infested with *Tetracotyle intermedia* larvae (infection rate 100%) (Shirkova, 1974). The parasite fauna of this fish has been studied insufficiently. According to A. Turovski (unpublished data) since 1978 *Henneguya zscokkei*, *Myxobolus muelleri*, *Diphyllobothrium dendriticum* pl., and *Proteocephalus exiguus* have been found in occasional analyses of adult whitefish. *Trichodina domerguei*, *T. nigra*, *Diplostomum spathaceum* m., and *D. baeri* m. have been detected in yearlings.

DISTRIBUTION, STOCK AND ITS USE

Peipsi whitefish is of commercial importance in the larger and deeper northern part of L. Peipsi. Although whitefish inhabits the lakes closely connected with L. Peipsi (Kalli, Koosa, and Lahepera), it is not able to spawn there (Mäemets,

1977). In Estonia, Peipsi whitefish has been introduced either as larvae or as fingerlings into about 45 lakes (Riikoja, 1934; Reinvaldt, 1941; Mäemets, 1985). It has occasionally been captured in seven lakes (Karujärv, Kooraste Suurjärv, Rõuge Suurjärv, Vagula, Saadjärv, Õisu, and Pühajärv) thereafter. Peipsi whitefish has been introduced into Poland (in the 1860s), Germany, The Netherlands, Japan, Romania, Russia, Ukraine, Belarus, Armenia (Lake Sevan), Moldova, Latvia, and other countries (Andrushaitis, 1963; Shirkova, 1963; Reshetnikov, 1980).

The stock of whitefish has always been small in L. Peipsi. It is suppressed by overcatch, high water temperature in summer, shortage of spawning places, eutrophication, and parasites. In previous decades it was common to replenish the natural stock by introducing annually from 0.5 to 1.5 million captivity reared larvae or yearlings into the lake (Reinvaldt, 1937, 1941; Mäemets, 1977).

Peipsi whitefish is mainly caught in summer with gill nets (mesh size 55 mm). Approximately 80% of the total annual catch comes from the central part of L. Peipsi during the second half of June and July. The rest of the catch can be attributed to ice fishing and vernal fyke netting, while whitefish serves as bycatch along with perch. The catch of Peipsi whitefish constitutes 1% of the total fish catch in L. Peipsi ranging from 40 to 90 t and amounting to 130 t in the most favourable years (Reshetnikov, 1980; Kontsevaya & Dorozhkina, 1982; Pihu, 1990). Annual catches of Peipsi whitefish from Estonian waters are shown in Fig. 1. Gill net catches of Peipsi whitefish consist of individuals of age groups 3+ to 13+, with the age groups 6 to 8 dominating (2/3 of all specimens). Individuals

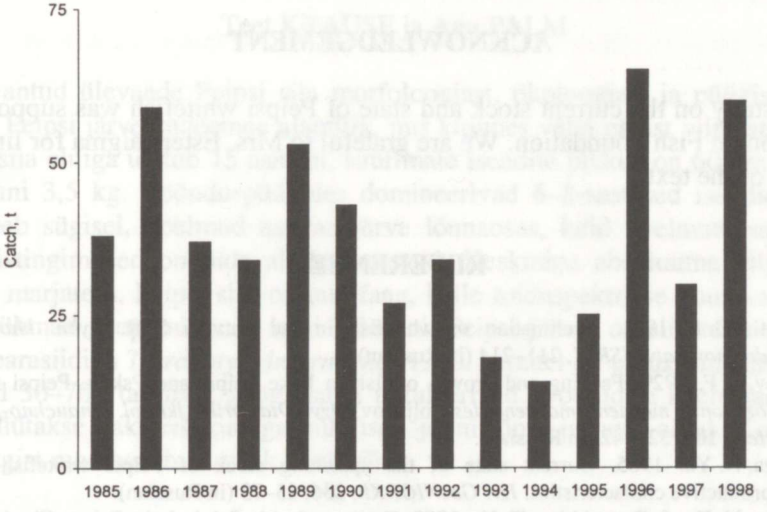
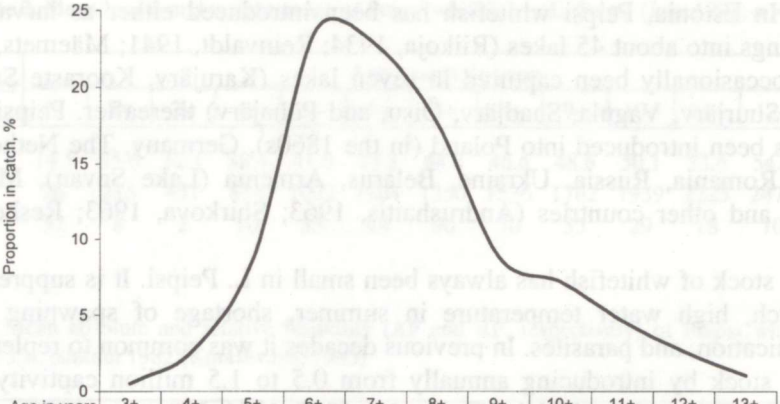


Fig. 1. Annual yields of Peipsi whitefish from Estonian waters (1985–98).



Age in years	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+
Percentage	0.5	2.6	8.8	23.7	22.7	17.5	8.8	7.2	4.6	2.6	1.0
n	2	10	35	94	90	70	35	29	18	10	4

Fig. 2. Age group distribution of Peipsi whitefish in commercial catches (July 1998).

older than 10 years and weighing 2 kg or more make up 15% of the total catch (Fig. 2). To protect Peipsi whitefish a minimum size (Fl) of 30 cm has been established. In summer the use of gill nets is allowed for catching Peipsi whitefish only from June 15 to July 15. Restrictions have been imposed on commercial catch in both countries.

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SIIG (*Coregonus avaretus maraenoides* Poljakow) PEIPSI JÄRVES

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On antud ülevaade Peipsi siia morfoloogiast, ökoloogiast ja püügist. Peipsi siig on Peipsi järve endeemne alamliik, mis kujunes välja pärast viimast jääaega. Peipsi siia eluiga ulatub 15 aastani, suurimate isendite pikkus on 60 cm ja kehakaal kuni 3,5 kg. Tööndusрüükides domineerivad 6–8-aastased isendid. Peipsi siig koeb sügisel, koelmud asuvad järve lõunaosas, kuid koelmute seisund ja kudemistingimused on pidevalt halvenenud. Keskmine absoluutne viljakus on 23 000 marjatera. Peipsi siig on eurüfaag, kelle toiduspektrisse kuuluvad paljud loomarühmad zooplanktonist kuni kaladeni. Peipsi järves on siig tugevalt nakatunud parasiidiga *Tetracotyle intermedia*. 1990. aastatel on peipsi siia aastasaagid püsinud 30–70 t tasemel, püügimahtu reguleerivad kvoodid ja keeluajad. Peipsi siiga püütakse nakkevõrkudega põhiliselt juuni lõpul ja juuli algul. Kogu järve kalasaagist moodustab siiasaak kuni 1%.