

On the seasonal migrations of the river-spawning whitefish,  
*Coregonus pidschian* (GMELIN), in an arctic watercourse

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With 9 figures and 2 tables in the text

## 1. Introduction

This study deals with the seasonal migrations of a river-spawning whitefish, *Coregonus pidschian* (GMELIN), from Lake Iijärvi. It is a part of a larger fishery survey on the Näättämonjoki watercourse in Finnish Lapland which flows into the Arctic Ocean. The work was started in 1972 by the Finnish Game and Fisheries Research Institute, Fisheries Division. In 1973, whitefish were caught with a trap-net in the largest river flowing into Lake Iijärvi to obtain information on the timing of the migrations. Continuing studies, designed to determine the extent of migrations and population size, will include tagging and recapture experiments on larger whitefish.

## 2. Study area

The study was carried out in the upper part of the Näättämonjoki watercourse, near the mouth of the Vaijoki River which flows into Lake Iijärvi, the central lake of the watercourse (Figs. 1 and 2). The Vaijoki River, about 27 km long, flows from Lake Vaijärvi (259 msl) in the upper part of the birch zone to Lake Iijärvi (193 msl) in the birch zone. The area of Lake Iijärvi is 35.2 km<sup>2</sup> (OLIN 1936), its catchment area (F) 750 km<sup>2</sup> and the lake percentage 13.3 (National Board of Waters 1972).

Fig. 3 shows the fluctuation of the water level, indicating the flow, at the mouth of the Vaijoki River in 1973 according to the observations by the Hydrological Office, Board of Waters. In Tab. 1 some observations on surface water quality in the watercourse in 1972—1973 are given. As can be seen, the watercourse is oligotrophic and oligohumous. Figs. 4 and 5 give the air and water temperatures at the mouth of the Vaijoki River in 1973. According to observations from 1910—1950, the lakes of the area are ice free in average about 150 days per year; from about May 30 to October 28 (LÖNNFORS 1960).

Because the study area is located north of the Polar Circle, there is a period without night in the summer (Fig. 6).

The Näättämonjoki watercourse upwards from Lake Iijärvi contains, in addition to various species or groups of whitefish, other native fishes such as brown trout, grayling, burbot, pike, perch, tenspined stickleback and minnow and also have been introduced lake trout and char.

## 3. Methods

The fishing was carried out with a fyke-type trap-net, which was set in the Vaijoki River as illustrated in Fig. 7. The net was located about  $\frac{1}{2}$  km upstream from the mouth of the Vaijoki River. In 1973 the trap was set from June 19 to August 4 with its mouth opening upstream and from August 4 to October 17 with its mouth opening downstream. On September 8—15 (8 days), September 19—27 (9 days) and October 1—8 (8 days) the pot was left open to allow ascending fish to pass through. The mesh size of the pot and funnels of the trap was 12—14 mm and that of the wings was 16—25 mm.

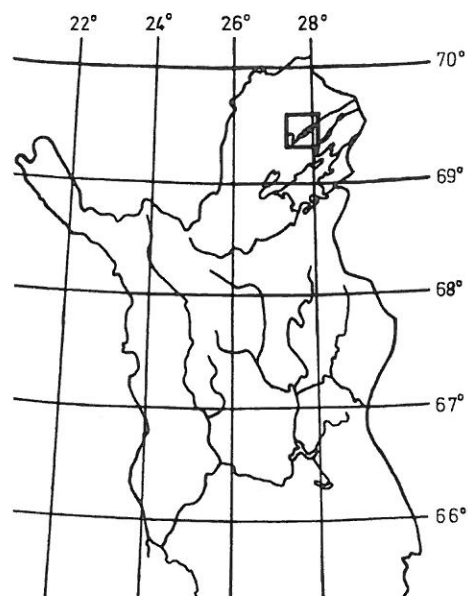


Fig. 1. The location of the study area.

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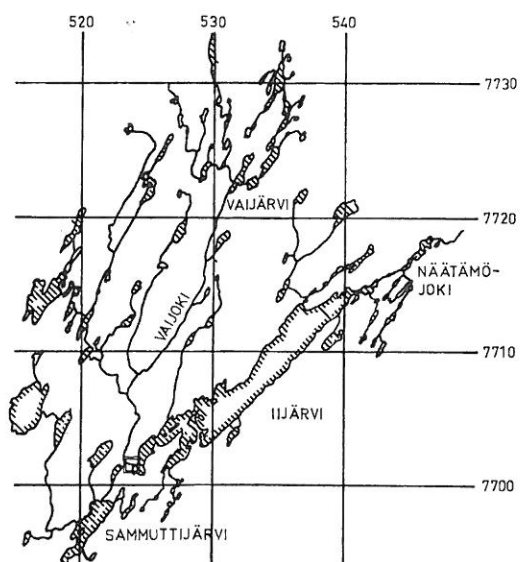


Fig. 2. The upper part of the Näämönjoki watercourse, Finnish Lapland. The main lakes and rivers are named.

#### 4. Taxonomy

On the basis of the material caught from Lake Iijärvi in 1973 there are three or four species or separate groups of whitefish in the lake. The count of gill rakers of mature fish is given in Tab. 2. The catch of mature whitefish from the Vajoki River consisted mainly of the group which had 16–26 (usually 19–23) gill rakers and total

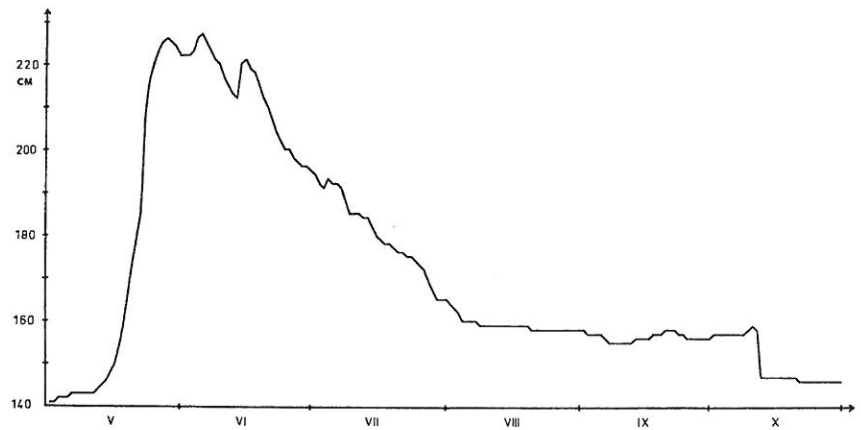


Fig. 3. The fluctuations of the water level in centimeters indicating the flow at the mouth of the Vaijoki River in 1973 according to the observations by the Hydrological Office, Board of Waters.

Tab. 1. Observations on the surface water quality in the Näättämonjoki watercourse in 1972–1973.

Place	Date	pH	Colour Pt mg/l	Conduct- ivity $\mu$ S	KMnO <sub>4</sub> con- sumption mg/l	Total N mg/l	Total P mg/l	Alkalinity mval/l	Total hardness °dH	Ca hardness °dH	Fe mg/l
Lake Vaijärvi	15. 5. 1972	6.6	40	63	19	0.22	0.003	0.50	1.54	0.97	1.33
Outlet of											
Lake Vaijärvi	11. 8. 1972	6.7	30	51	28	0.60	0.047	0.27	0.80	0.62	0.25
Mouth of the											
Vaijoki River	15. 5. 1972	6.7	30	52	22	0.24	0.012	0.24	1.16	0.69	0.57
Mouth of the											
Vaijoki River	16. 8. 1972	6.8	30	28	26	0.36	0.006	0.15	0.59	0.21	0.10
Mouth of the											
Vaijoki River	16. 10. 1972	6.8	40	30	25	0.69	0.004	0.21	1.01	0.48	0.17
Lake Iijärvi	4. 7. 1973	6.6	50	22	31	0.52	0.046	0.17	0.69	0.63	0.38
Näättämonjoki River	15. 10. 1972	6.8	25	28	15	0.84	0.004	0.22	1.12	0.60	0.04

lengths of 25–35 cm. These were identified as *Coregonus pidschian* (GMELIN) (see BERG 1962; HIMBERG 1970; BEHNKE 1972). Some of these fish spawn in the Vaijoki River. There are also whitefish with the same characteristics which spawn in Lake Iijärvi. Thus, the situation is the same as in nearby Lake Inarinjärvi (cf. TOIVONEN 1966). In the catch from the Vaijoki River there were also a few mature small (under 25 cm) whitefish with higher counts (26–42) of gill rakers.

### 5. Catches

Average daily catches are given in Fig. 8 and the average weights of the whitefish caught in Fig. 9. The trap also caught brown trout, grayling, burbot, pike and perch. A total of 471 kg of fish were caught, 450 kg of which were whitefish.

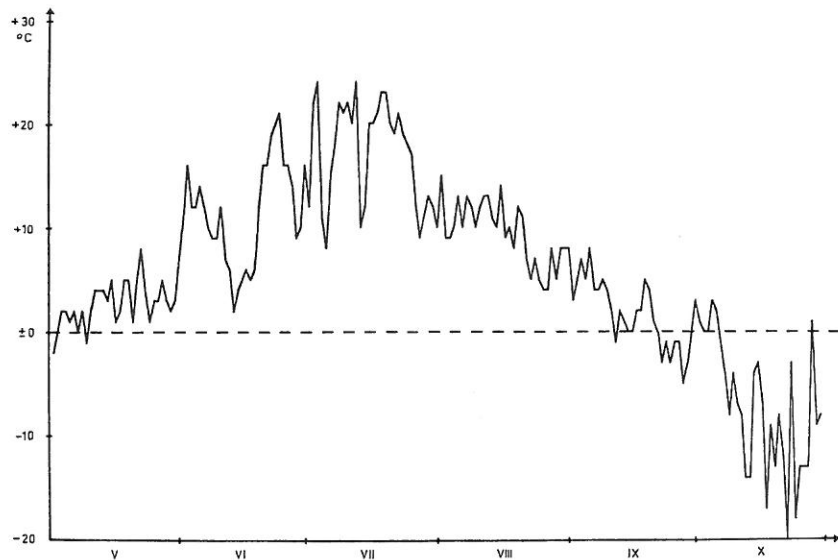


Fig. 4. Air temperatures (at 8.00 A. M.) at the mouth of the Vaijoki River in 1973.

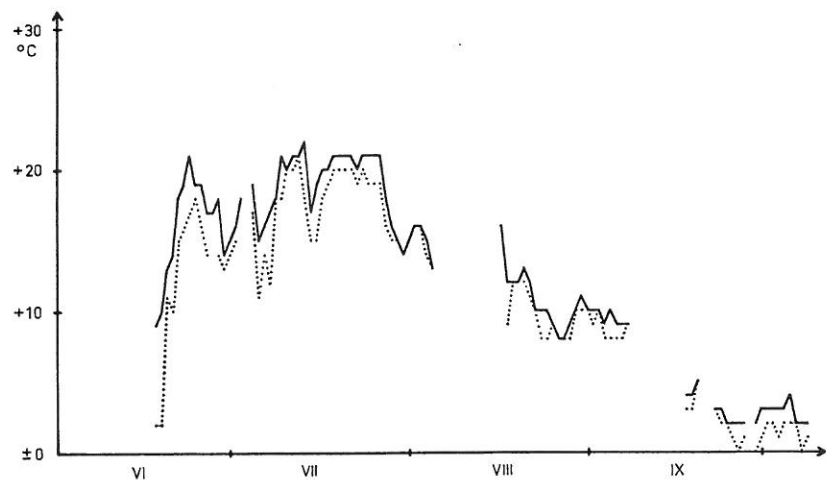


Fig. 5. Observations on water temperatures at the mouth of the Vaijoki River in 1973. Solid line (—) the maximum, dotted line (....) the minimum of the day.

The range in total length of the whitefish caught and tagged from the Vaijoki River was 23–39 cm. About 70 % were 28–32 (mean 29) cm. Correspondingly, ages varied from 5+ to 12+ years, about 85 % being 7+ to 10+ (mean 8+) years. In the catches of October 10–12, 1973 few males and females were ready to spawn but on October 16–17, 1973 almost all whitefish caught were ripe.

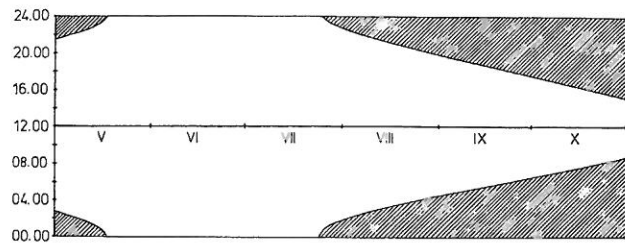


Fig. 6. The duration of the light and dark (shadowed) parts of the day in the study area in 1973 according to the observations made by the nearby Kevo meteorological station, Utsjoki, Finland.

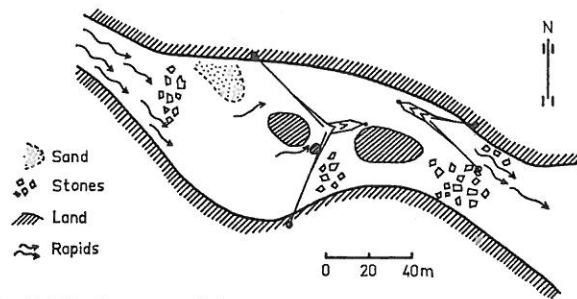


Fig. 7. The location of the trap-net in the Vaijoki River in 1973.

#### 6. Migrations of whitefish in light of the catches

As can be seen in Fig. 8, the migration from the Vaijoki River to Lake Iijärvi continued until the second half of June but ceased almost entirely by the beginning of July. In midsummer, only a few small whitefish moved in the river (see Fig. 9).

The spawning migration into the river started about the middle of August and continued intensively at least until mid-October when freezing conditions forced the removal of the net. The timing of the return migration to the lake was also unobserved because the net could not be reset in the river until the spring floods had abated.

#### 7. Relationship of migrations to some environmental factors

It is well known that the spawning of Coregonids is dependent on temperature (JÄRVI 1919; HART 1931; DAHR 1947; FABRICIUS 1950; SVÄRDSON 1950; LAWLER 1965; LINDSTRÖM 1970). The initiation of spawning migrations also bears some relationship to temperature (cf. HART 1931; DAHR 1947; FABRICIUS 1950).

FABRICIUS (1950) widely discussed the question of releasing mechanisms in the spawning activities of fish in relation to heterogenous stimulus summation. He thought that the spawning migration might be triggered when the tem-



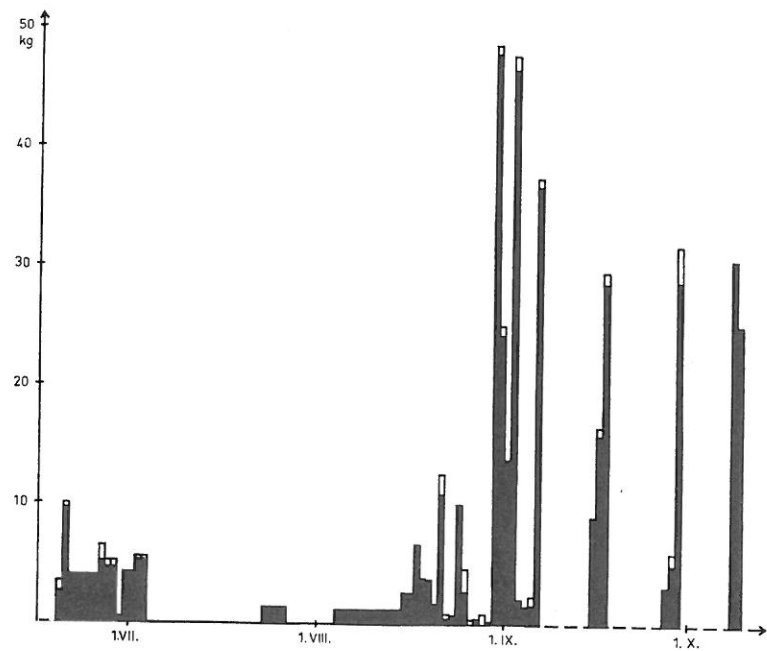


Fig. 8. Average daily catches from the Vajoki River in 1973. The shaded portion of the columns indicate whitefish and the white parts other fish species.

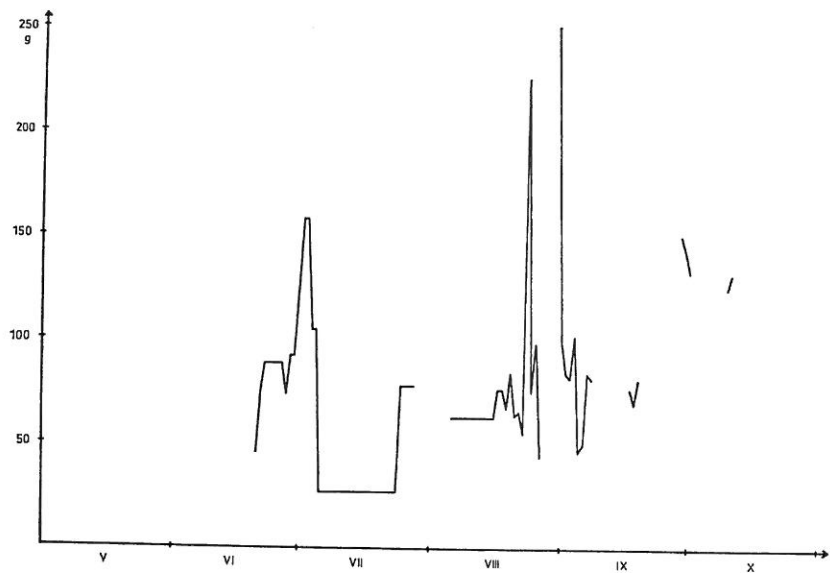


Fig. 9. The mean weights of whitefish caught from the Vajoki River in 1973.

perature neared, but had not yet reached the spawning temperature. He also mentioned that day length (light) might play an important role.

From the data obtained in this study it is difficult to determine, with certainty, the environmental factors which cause or affect the migrations. Because of heterogenous stimulus summation no abrupt change in the environment is necessarily needed. The flood may play some role in the spring migration because, as can be seen in Figs. 3 and 8, the end of the migration coincides very well with the end of the spring flood. At the same time the water temperature rose to the level of 20—22 °C. At the beginning of the spawning migration in August there was no significant change in the flow of the Vajoki River. Here the temperature seems to have the most pronounced effect. The spawning migration started when the water in the river had cooled down to 10—12 °C.

The significance of daily illumination in the migrations cannot be determined on the basis of these observations.

Finally it must be stated that the above results represent just one year, which makes it difficult to draw very firm conclusions concerning the effects of the factors observed.

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