FISHERIES RESEARCH BOARD OF CANADA

Translation Series No. 2573

Feeding and trophic relations of fish in the basins of the Ilirnei-Anyui system (Chukchi peninsula)

by P. Ya. Tugarina, and V. M. Postnikov

Original title: Pitanie i pishchevye vzaimosvyazi ryb vodoemov Ilirneisko-Anyuiskoi sistemy (Chukotka)

From: Izvestiya Tikhookeanskogo Nauchno-Issledovatel'skogo Instituta Rybnogo Khozyaistva i Okeanografii (TINRO) (Proceedings of the Pacific Scientific Research Institute of Marine Fisheries and Oceanography), 71 : 259-282, 1970

Translated by the Translation Bureau(TTH)
Foreign Languages Division
Department of the Secretary of State of Canada

Department of the Environment
Fisheries Research Board of Canada
Biological Station
Nanaimo, B. C.

1973

51 **pages typescript**

FRB 2573

DEPARTMENT OF THE SECRETARY OF STATE
TRANSLATION BUREAU

MULTILINGUAL SERVICES DIVISION

CANADA

SECRÉTARIAT D'ÉTAT
BUREAU DES TRADUCTIONS

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TRANSLATED FROM – TRADUCTION DE	INTO – EN
Russian	English

AUTHOR – AUTEUR

P.Ya.Tugarina, V.M.Postnikov

TITLE IN ENGLISH – TITRE ANGLAIS

Feeding and trophic relations of fish in the basins of the Ilirnei-Anyui system(Chukchi peninsula)

TITLE IN FOREIGN LANGUAGE (TRANSLITERATE FOREIGN CHARACTERS)
TITRE EN LANGUE ÉTRANGÈRE (TRANSCRIRE EN CARACTÈRES ROMAINS)

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REFERENCE IN FOREIGN LANGUAGE (NAME OF BOOK OR PUBLICATION) IN FULL. TRANSLITERATE FOREIGN CHARACTERS.
RÉFÉRENCE EN LANGUE ÉTRANGÈRE (NOM DU LIVRE OU PUBLICATION), AU COMPLET, TRANSCRIRE EN CARACTÈRES ROMAINS.

IZVESTIYA TINRO

REFERENCE IN ENGLISH – RÉFÉRENCE EN ANGLAIS

Journal,
Pacific Research Institute of Fisheries and Oceanography

PUBLISHER – ÉDITEUR	DATE OF PUBLICATION / DATE DE PUBLICATION			PAGE NUMBERS IN ORIGINAL / NUMÉROS DES PAGES DANS L'ORIGINAL
TINRO	YEAR / ANNÉE	VOLUME	ISSUE NO. / NUMÉRO	259-282
PLACE OF PUBLICATION / LIEU DE PUBLICATION				NUMBER OF TYPED PAGES / NOMBRE DE PAGES DACTYLOGRAPHIÉES
Magadan, USSR	1970	71	-	51

REQUESTING DEPARTMENT / MINISTÈRE-CLIENT: Environment

TRANSLATION BUREAU NO. / NOTRE DOSSIER N°: 183165

BRANCH OR DIVISION / DIRECTION OU DIVISION: Fisheries Service, Office of the Editor

TRANSLATOR (INITIALS) / TRADUCTEUR (INITIALES): T.Th.

PERSON REQUESTING / DEMANDÉ PAR: Mr. R.J. LeBrasseur, Pacific Biol. Station, Nanaimo, B.C.

YOUR NUMBER / VOTRE DOSSIER N°: -

DATE OF REQUEST / DATE DE LA DEMANDE: 16 February 1973

UNEDITED TRANSLATION
For information only
TRADUCTION NON REVISEE
Information seulement

MAY 16 1973

SOS-200-10-6 (REV. 2/68)
7530-21-029-5333

DEPARTMENT OF THE SECRETARY OF STATE
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CLIENT'S NO. / N° DU CLIENT	DEPARTMENT / MINISTÈRE	DIVISION/BRANCH / DIVISION/DIRECTION	CITY / VILLE
	Environment	Pacific Biological Station	Nanaimo, B.C.
BUREAU NO. / N° DU BUREAU	**LANGUAGE / LANGUE**	**TRANSLATOR (INITIALS) / TRADUCTEUR (INITIALES)**	
183165	Russian	T.Th.	MAY 16 1973

Izvestiya Tikhookeanskogo Nauchno-Issledovatel'skogo Instituta Rybnogo Khozyaistva i Okeanografii / News of the Pacific Research Institute of Fisheries and Oceanography.

Volume 71 Magadan 1970

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Pitanie i pishchevye vzaimosvyazi ryb vodoemov Ilirneisko-Anyuiskoi sistemy (Chukotka).

Feeding and trophic relationship of fish in the basins of the Ilirney-Anyui system (Chukchi peninsula).

By: P.Ya. Tugarina
V.M. Postnikov

The largest tributaries of Kolyma river, i.e. Bol'shoi and Malyi Anyui, and the Ilirney system of rivers and lakes (69°N, Bilibino region, Magadan district) represent

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*Figures in the right-hand margin indicate the corresponding pages in the original. (Translator)

a considerable portion of water resources of the Chukchi peninsula (Fig. 1). This system has been little explored and is virtually undeveloped with regard to the organization of fisheries.

The first exploratory research was carried out in these basins (Nizhnii and Verkhnii Ilirney lakes, Yarakvaam, Pravyi Ilirney, Kameshkovaya rivers, lower course of the rivers Malyi and Bol'shoi Anyui--basin of Kolyma river) by the expedition of the Magadan branch of the TINRO* in 1964-1967. The purpose of their research project was to develop biological premises for the rational organization of fisheries in these basins (Postnikov, 1965, 1967).

In this paper the data on feeding patterns of fish (essentially Salmonoidea) in the rivers and lakes of the Ilirnei-Anyui basin are summarized, the conditions in the basins and the productivity of benthos are characterized in general lines. The growth and distribution of fish are examined in the light of their feeding habits and trophic interrelations.

The data from the analyses of 765 gastro-intestinal tracts of various fish species were collected by V.M. Postnikov, who was in charge of the research on fisheries in these basins. Laboratory processing of the materials

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*Pacific Research Institute of Fisheries and Oceanography. (Translator)

obtained on the feeding of fish, was carried out by P.Ya. Tugarina (Department of Vertebrate Zoology of Irkutsk State University according to the modern quantitative-gravimetric methods (Zenkevich, 1931; Brotskaya, 1934; Shorygin, 1952; Manual on the study of feeding habits of fish, 1961; and others).*

Ilirney lakes (Verkhnii Ilirney, Nizhnii Ilirney and their tributaries) are located in the eastern part of the Severnyi Anyui range. These lakes are of glacial origin, with an adequate water oxygen level and with outlets. They are interconnected by the river Pravyi Ilirney. Nizhnii Ilirney lake discharges through the tributary Ilirneika into Malyi Anyui, a right-hand tributary of Kolyma river.

Nizhnii Ilirney lake has a small rocky or pebbly-rocky littoral. The principal soils lining the bottom of the lake are muddy, sandy or muddy-sandy (Postnikov, 1967).

The habitat of hydrobionts from the rivers and lakes of the Ilirney system is determined by a long arctic winter, a long-lasting ice-cover, a short vegetative period and low water temperatures (varying in the course of the year within the limits of 0.5 and 10.8-14.4°C).

With regard to the oxygen content, the basins examined are steno-oxybiontic. The content of oxygen in Nizhnii

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*The authors wish to thank A.A. Tomilov, Yu.I. Zanekina-Dul'keit, E.A. Erbaeva, who were most helpful in the identification of the specific composition of the larvae of midges (Chironomidae), caddis fly (Trichoptera) and stonefly (Plecoptera).

Ilirney lake was 15.72 mg/liter at the end of May, at the depth of 18 m (under the ice) and 16.13 mg/liter in August, in the benthopelagic layer (Postnikov, 1967). Consequently,

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oxygen supply is here fully adequate for hydrobionts. This is further corroborated by the low content of carbon dioxide in the water: during the summer its content varies between 1.76 and 4.84 mg/liter. In the winter the content of carbon dioxide increases to 4.40-6.16 mg/liter. Transparency of water in August is 7-9 m, pH--6.6 to 7.1.

The animal kingdom of the lakes and rivers examined is qualitatively poor.

Ichthyofauna is represented essentially by salmonoids, among which Coregonus and Prosopium (Coregonus peled, broad whitefish / Coregonus nasus / Coregonus lavaretus pidschian, round whitefish / Prosopium cylindraceum) predominate, grayling (genus Thymallus) and char are found in abundance, cisco (fishes of the subgenus Leucichthys), lenok (Brachymystax lenok), inconnu (Stenodus Leuchchthys nelma), as well as burbot, redside sucker, minnow, sculpin (Cottus poecilops), perch and pike are found singly. All these fishes are in a direct trophic relationship with representatives of the zoobenthos, the mean biomass of which fluctuates in Nizhnii Ilirney lake between 0.22 and 10.46 g/m^2 in the winter, 20 and 30 g/m^2 in the summer. The zone at the depth of 3 to 10 m is particularly densely populated: the mean biomass of

zoobenthos is here 113 kg/hectare, at the depth of 10 to 20 m it is 15.7 kg/hectare. The density of zoobenthic groups such as oligochaetes amounts in August to 1160 specimens/m^2, that of molluscs--532 specimens/m^2, amphipods--153 specimens/m^2, caddis fly larvae--59 specimens/m^2, Chironomidae

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larvae--648 specimens/m^2 (Postnikov, 1967).

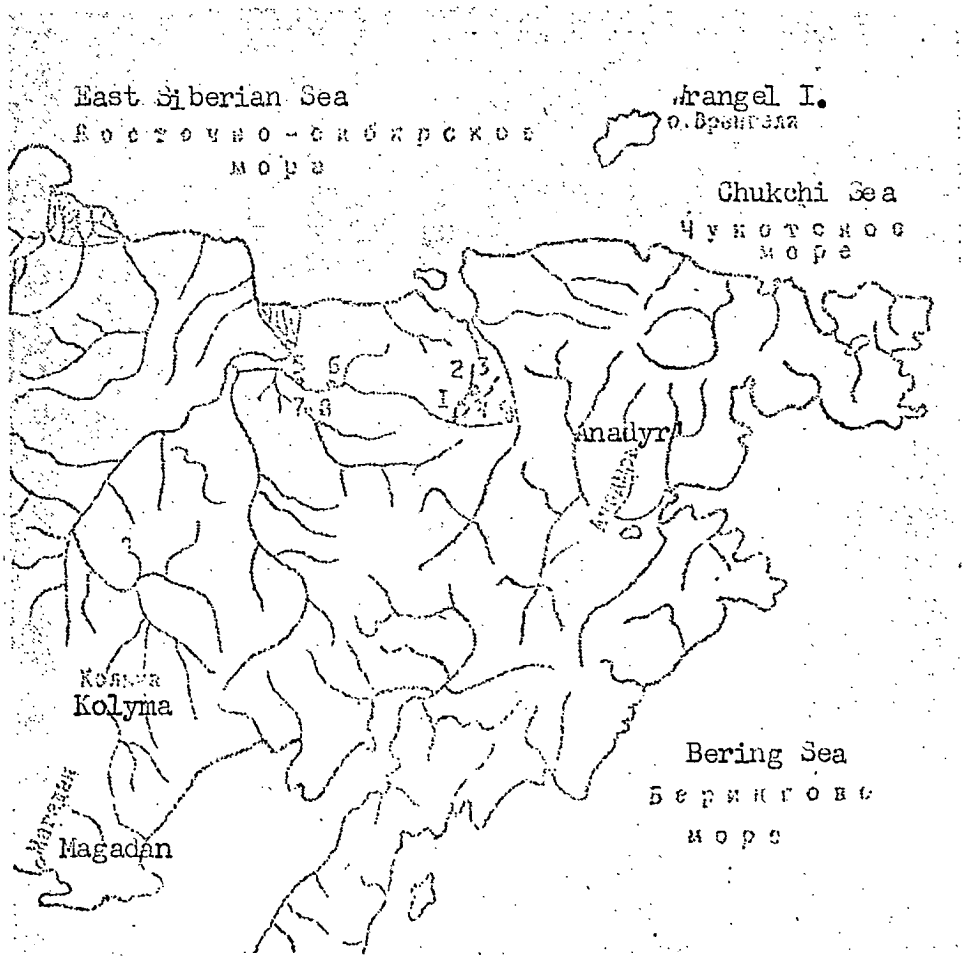


Figure 1

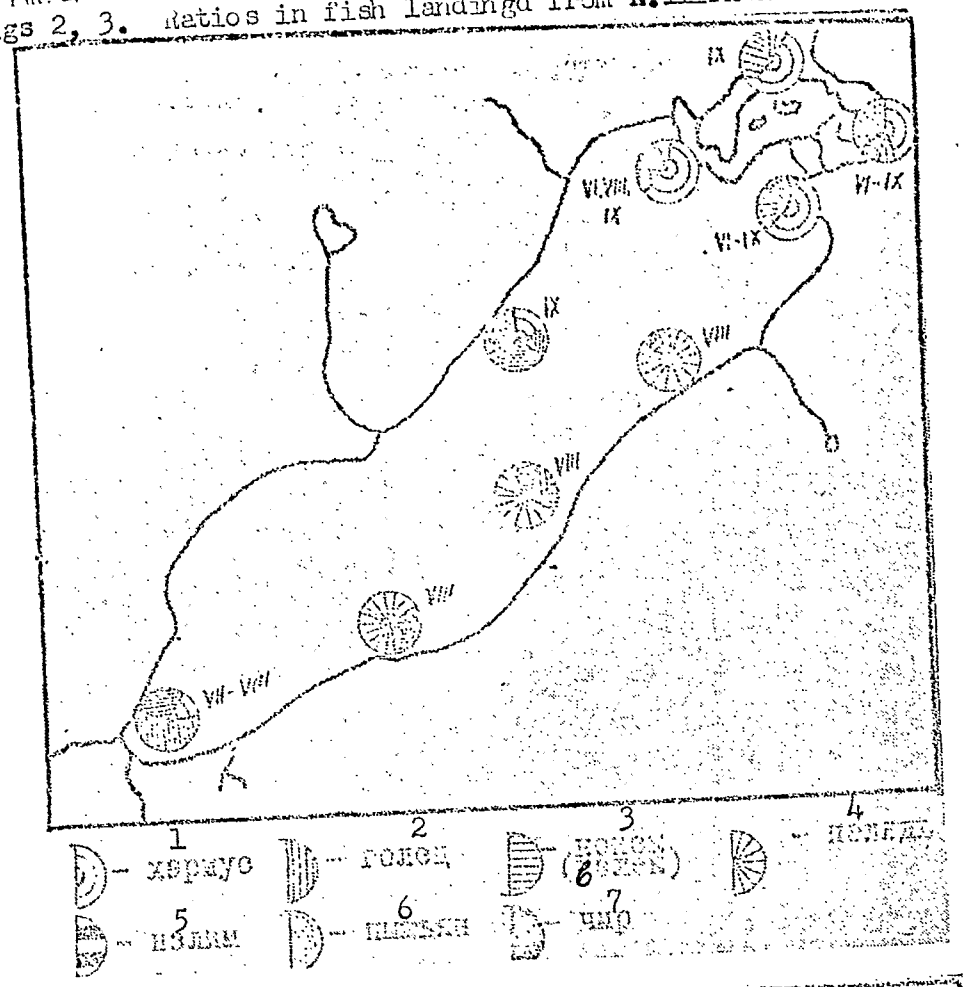
Places where materials were collected: 1--Nizhnii Ilirney lake; 2--Pravyi Ilirney river; 3--Verkhnii Ilirney lake; 4--Yarakvaam river; 5--Belonogovo lake; 6--M. Anyui river (Anyuisk settlement; 7--B. Anyui river (Pyatistennoe settlement); 8--Kameshkovaya river.

Concentration of food determines the distribution of salmonoids and their trophic migrations in the rivers and lakes of the Ilirney basin during the summer and autumn. In June, September 1964 major commercial concentrations of fish (grayling, Coregonus lavaretus pidschian, broad whitefish, Coregonus peled, char) were observed in the northern part of Nizhnii Ilernei lake and at the lower course of Yarakvaam river (Fig. 2). In the summer of 1964 "peled" foraged along the eastern shore of Nizhnii Ilernei lake, char in the southern and southeastern zone of the lake. In June 1965, "peled" migrated en masse into rivers, where it foraged and fed from June until September. During the summer grayling form feeding and foraging concentrations that are found mainly in the rivers. Moreover, feeding and foraging grounds of this fish coincide with those of C. lavaretus pidchian (Fig. 3). Broad whitefish is distributed fairly evenly over this entire system of lakes and rivers and does not form concentrations. Char, however, concentrates in the parts of Yarakvaam and Pravyi Ilirnei rivers just short of their mouths.

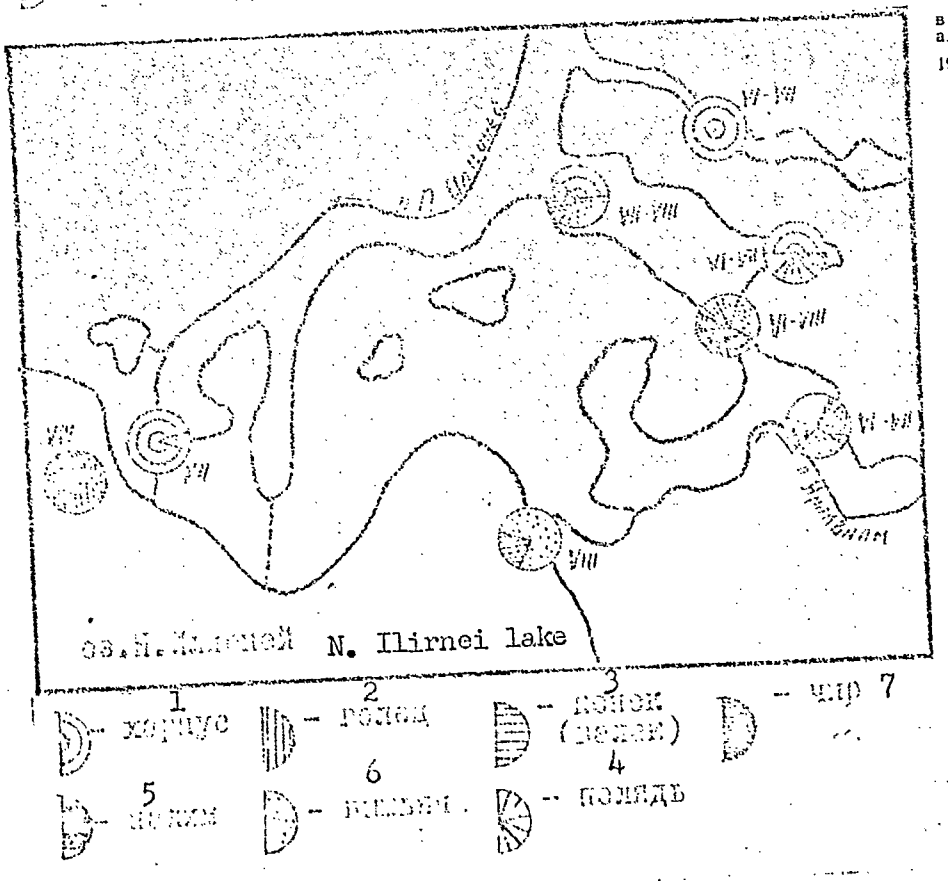
The qualitative composition of the food consumed by

Рис. 2, 3. Соотношение в уловах рыб оз. Н. Илирней и его бассейне.

Figs 2, 3. Ratios in fish landingd from N. Ilirnei lake and its basin.



в июле—сентябре 1964 г. July–September 1964



в июле—августе 1965 г. July–August 1965

1-Grayling; 2-Char; 3-Round whitefish; 4-"Peled"; 5-Burbot; 6-"Pidschian"; 7-broad whitefish.

Coregonus and Prosopium representatives in the lakes and rivers of the Ilirney-Anyui system during the summer and autumn periods of 1964-1967, is shown in Tables 1 and 2. The food spectrum of salmonoids in Nizhnii Ilirnei lake includes 3 to 6 groups of organisms (Table 1). Composition of the food found in the stomach of the fish living in the rivers, is more varied. For example, East Siberian grayling from Kameshkovaya river (Table 2) feeds on benthopelagic, benthic organisms, mainly on larvae of caddis fly. It gathers everything it finds on the water surface, seizes even water shrew and voles. Pike feeds in Kameshkovaya river on small forms of fish from a variety of taxonomic groups, as well as on amphibians, rodents (Muridae), even young water birds (Table 2).

The planktonic organisms representing trophic levels in the food chain of fish in the rivers and lakes of the Ilirnei-Anyui system, are phyllopods, copepods, chadocerans, crustaceans. Benthic organisms forming part of this trophic chain are larvae of Diptera (Chironomidae, Limoniidae, Tipulidae and others), molluscs, oligochaetes and larvae of other water insects (caddis fly, stonefly, dragonfly, mayfly). In addition to this, small mammals and insects of the air (Hymenoptera, Muscidae, Coleoptera and others), are included into the biological productivity of ichthyocoenoses through the food spectrum of East Siberian grayling.

Char (Salvenilus alpinus L.). Chironomidae larvae

are the principal component of the diet of East Siberian char (Savvaitova, 1961; Savvaitova, Reshetnikov, 1961). In the lakes of Lena delta they feed mainly on amphipods, mysids, larvae, pupae of Chironomidae and Trichoptera (Mina, 1962).

In July, in Nizhnii Ilirnei lake, char of age 7+, 9+ also fed on pupae of Chironomidae and consumed considerable quantities of Heterocope appendiculata. The food bolus of char at age 8+ also included the small crustacean Eurycercus lamellatus and Cottus poecilopus (29.8% of weight). In August the stomachs of the fish contained remains of whitefish (Coregonus and Prosopium species) and small crustaceans Heterocope (Table 3). In the autumn the content of crustaceans increases in the diet of char. Large char probably feed more on gobies. For example, in July 1964 the food bolus of a char measuring 522 mm in length and weighing 1700 g, consisted of Cottus poecilopus. The weight of the food bolus was 10,320 mg.

No differences due to age or sex have been observed in the feeding habits of char from Nizhnii Ilirnei lake during the summer and autumn period. The limited food spectrum, the index of fullness (Table 3), the rate of increase in length and in weight (Table 4) show that trophic conditions in this lake are favourable during the summer and autumn for the development of char.

"Peled" (Coregonus peled / Gmelin /). Data on the feeding habits of "peled" in the rivers and lakes of the

Siberian polar regions are presented in the works of G.P. Romanova (1948), M.P. Sal'dau (1949, 1953), E.V. Burmakina (1941, 1953), D.L. Venglinskii (1962), V.A. Krasikova (1961), and A.S. Novikov (1966).

Таблица 3. *Значение организмов* (в % по весу) *в питании гольца в оз. Нижний Илирней в летне-осенний период 1964—1965 гг.*

1 Состав пищи	2 Июнь	3 Июль	4 Август	5 Сентябрь
	6 Число рыб			
	1	23	4	9
Bosmina obtusirostris	—	0,73	0,05	0,30
Heterocope appendiculata	—	2,04	12,15	25,2
Chironomidae pupae	—	75,03	—	—
Cottus poecilopus	100,0	22,2	—	74,5
Coregonus sp.	—	—	87,80	—
7 Общий средний индекс наполнения желудков ‰	60,7	14,9	13,5	22,0

Table 3

Contents of various organisms (in % of weight) in the diet of char from Nizhnii Ilirnei lake during the summer and autumn of 1964-1965.

1--Composition of food: 2--June; 3--July; 4--August; 5--September; 6--Number of fish specimens; 7--Mean general index of fullness o/o oo

TABLE 1. Frequency of occurrence (in %) of various organisms in the food of the fishes from Nizhnii Ilirnei lake during the summer of 1964-1965.

Таблица 1. *Частота встречаемости (%) организмов в пище рыб оз. Нижний Илирней в летний период 1964—1965 гг.*

Состав Composition	June Июнь			July Июль			August Август						Сентябрь September
	Fish species Виды рыб												
	пелядь 1	валек 2	голец 3	пелядь 1	валек 2	голец 3	пелядь 1	валек 2	чир 4	пыжьян 5	хариус 6	чир 4	хариус 6
	Number of fish specimens Число рыб												
	42	12	1	12	10	22	13	10	17	10	2	6	10
Nematoda	—	—	—	—	—	—	—	—	17,7	—	—	—	—
Lynceus brachyurus O. F. Müller	—	—	—	—	—	—	—	—	5,9	—	—	—	—
Bosmina obtusirostris Sars.	2,44	—	—	8,33	—	—	—	—	—	—	—	—	—
Eurycercus lamellatus O. F. Müller	9,76	—	—	25,0	50,0	4,54	18,2	50,0	5,9	70,0	—	—	—
Heterocope appendiculata Sars.	—	—	—	8,33	—	13,62	45,55	—	—	—	—	—	—
Gammarus lacustris Sars.	—	—	—	—	—	—	—	—	5,9	0,5	—	16,6	—
Chironomidae,	—	50,0	—	50,0	—	—	—	—	53,10	10,0	—	33,2	60,0
larvae	70,76	50,0	—	—	70,0	100,0	27,3	—	—	10,0	100,0	—	20,0
pupae	—	50,0	—	—	—	—	—	—	5,9	—	50,0	—	20,0
Diptera, larvae	—	—	—	—	—	—	—	—	—	—	100,0	—	10,0
Plecoptera, larvae	—	—	—	—	—	—	—	—	—	—	50,0	—	—
Heptageniidae	—	—	—	—	—	—	—	10,0	—	—	—	—	—
Siphlonurus	—	—	—	—	20,0	—	—	—	—	—	—	—	20,0
Trichoptera, larvae	—	—	—	—	—	—	—	—	—	—	—	—	—
Molanna palpata Mc. L.	—	—	—	8,33	—	—	—	20,0	—	—	—	—	—
Agrypnia sp.	—	—	—	—	—	—	—	20,0	—	—	—	16,6	—
Mystacides sp.	2,44	50,0	—	—	—	—	—	10,0	—	—	—	—	—
Apatania sp.	—	16,6	—	—	—	—	—	10,0	—	—	—	—	20,0
Hydatophylax sp.	—	—	—	—	—	—	—	—	—	—	—	—	—
Hydracinellae	—	—	—	—	—	—	—	—	5,9	—	—	—	10,0
Coleoptera, larvae	—	—	—	—	—	—	—	—	—	—	50,0	—	30,0
Carabidae, imago	—	—	—	—	—	—	—	—	—	—	—	—	—
Formicidae	—	—	—	—	—	—	—	—	11,8	40,0	—	33,2	—
Valvata sibirica Midd.	—	—	—	—	—	—	—	—	5,9	—	—	—	—
Planorbis sp.	—	—	—	—	—	—	—	—	5,9	—	—	—	—
Sphaerium corneum L.	—	—	—	—	—	—	—	—	23,60	—	—	33,2	—
Sphaerium solidum Norm.	—	—	—	—	—	4,54	—	—	—	—	—	—	40,0
Cottus poecilopus	—	—	100,0	—	—	—	—	—	5,9	—	—	16,2	—
Nostoc	—	—	—	—	—	—	—	—	—	—	—	—	20,0
Растительно-детритная масса	—	—	—	—	—	—	—	—	—	—	—	—	—

Vegetable-detrital mass

1—"Peled"; 2—Round whitefish; 3—Char; 4—Broad whitefish; 5—"Pidschian"; 6—Grayling;

TABLE 2. Frequency of occurrence (in %) of various organisms in the diet of fish from the rivers during the summer-autumn period of 1964-1967.

Таблица 2. *Частота встречаемости организмов (%) в питании рыб в реках в летне-осенний период 1964—1967 гг.*

Состав Composition	1 р. Каменшковая			2 р. Малый Анюй				3 р. Большой Анюй		4 р. Правый Пильней		5 р. Яракчаам				
	Fish species Виды рыб															
	6 харпус		щука													
	1966	1967	7	плядь 8	чир 9	пыжьян 10	харпус 11	пыжьян 10	окунь 12	пыжьян 10	харпус 11	плядь 8	чир 9	пыжьян 10	налим 13	харпус 11
Nematomorpha	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10,5	—
Nematoda	—	—	—	—	25,0	—	—	—	—	—	—	—	—	0,86	—	—
Oligochaeta	—	—	—	—	10,0	14,3	—	3,6	—	—	—	—	—	—	—	6,6
Lyncens brachyurus O. F. Müller	—	—	—	11,0	10,0	—	—	—	—	—	14,2	75,8	—	6,02	—	—
Bosmina obtusirostris Sars.	—	—	—	16,6	—	—	—	—	—	—	—	—	—	0,86	—	—
Eurycercus lamellatus Müller	—	—	—	—	—	—	—	—	—	—	—	6,06	2,0	10,3	5,9	1,7
Heteroscope appendiculata Sars.	—	—	—	—	—	—	—	—	—	—	—	42,4	—	—	—	—
Gammarus lacustris Sars.	—	—	—	—	10,0	14,3	—	—	13,6	—	—	—	—	—	—	1,7
Chironomidae																
larvae	2,7	—	—	11,1	45,0	42,9	—	35,8	—	4,8	7,1	12,1	34,7	52,4	21,4	34,86
pupae	—	—	—	—	—	14,3	—	10,7	—	4,8	57,1	21,2	—	12,0	—	19,38
Eriopterinae (Limoniidae)	—	—	—	—	—	28,6	—	10,7	—	—	—	—	—	—	—	—
Tipulidae	—	—	—	—	10,0	—	—	21,5	—	—	—	3,03	2,04	—	—	2,32
Cryophilae	—	—	—	38,8	—	—	—	—	—	—	—	—	—	—	—	—
Heleidae	—	—	—	5,5	—	—	—	—	—	—	—	—	—	6,9	—	—
Muscidae	—	1,02	—	5,5	—	—	—	—	—	—	—	—	—	—	—	—
Tabanidae	—	1,02	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Diptera, imago	10,8	—	—	—	—	—	66,6	—	—	—	21,4	—	—	—	10,5	16,6
Plecoptera, larvae	10,8	—	—	—	—	—	33,3	10,7	—	—	28,6	—	6,12	1,72	—	33,2
Heptagenilidae	2,7	—	—	—	—	14,3	—	7,2	—	—	7,14	—	—	—	10,5	6,6
Agrypnia sp.	21,6	14,3	—	—	10,0	—	—	—	—	—	8,3	—	—	—	—	8,3
Molanna palpata Mc. L.	72,9	70,2	—	11,1	—	—	—	—	—	—	14,3	—	—	—	5,26	—
Mystacides sp.	—	10,2	—	11,1	—	—	—	—	—	—	14,3	—	—	—	5,26	1,66
Apatania sp.	10,8	38,8	—	—	—	—	—	—	—	—	7,14	—	2,04	—	10,5	1,66
Limnophilus stigma	—	5,1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Hydatophylax sp.	—	6,12	—	—	—	—	—	—	—	—	—	—	—	—	15,8	—
Oligoplectrodes sp.	—	4,08	—	—	—	—	—	—	—	—	—	—	2,04	—	—	—
Ryacophila sp.	—	—	—	—	10,0	—	—	—	—	—	—	—	—	—	—	—
Stenopsychae sp.	—	—	—	—	10,0	—	—	—	—	—	—	—	—	—	—	—
Trichoptera, pupae	—	—	—	—	—	—	—	—	—	—	7,14	3,03	—	1,7	—	6,6
Coleoptera, larvae	2,7	—	—	—	—	—	33,3	—	4,5	—	7,14	—	—	—	—	—
Carabidae	2,7	4,08	—	—	—	—	—	—	—	—	7,14	—	—	—	—	—
Dytiscidae	—	5,10	—	5,5	—	—	—	—	—	—	—	3,03	—	—	10,5	2,3

1-Kameshkovaya river; 2-Malyi Anyui river; 3-Bol'shoi Anyui river; 4- Pravyi Ilirnei river; 5-Yarakvaam river; 6-Grayling; 7-Pike; 8-"Peled"; 9-Broad whitefish; 10-"Pidschian"; 11-Grayling; 12-Perch; 13-Round whitefish

Oligoplectrodes sp.	—	4,08	—	—	10,0	—	—	—	—	—	—	—	—	—	—	—	—	
Fya ophila sp.	—	—	—	—	10,0	—	—	—	—	—	—	—	—	—	—	—	—	
Stenopsychae sp.	—	—	—	—	—	—	—	—	—	—	7,14	3,03	—	1,7	—	6,6		
Trichoptera, pupae	2,7	—	—	—	—	—	33,3	—	4,5	—	7,14	—	—	—	—	—		
Coleoptera, larvae	2,7	4,08	—	—	—	—	—	—	—	—	7,14	—	—	—	—	—		
Carabidae	—	5,10	—	5,5	—	—	—	—	—	—	—	3,03	—	—	10,5	2,3		
Dytiscidae																		

(Table 2, continued)

Staphylinidae, larvae	2,7	—	—	—	10,0	—	—	—	—	—	—	—	—	—	—	—	1,66	
Elateridae	—	1,02	—	—	—	—	33,3	—	—	—	—	—	—	—	—	—	—	
Byrrhidae	—	1,02	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Cerambycidae	—	1,02	—	—	—	—	—	3,6	—	—	—	—	—	—	—	—	1,66	
Chrysomelidae, larvae	—	—	—	—	—	—	33,3	—	—	—	—	—	—	—	—	—	—	
Curculionidae	—	1,02	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1,66	
Gyrinidae	—	—	—	—	5,0	—	—	—	—	—	7,14	—	—	—	—	—	—	
Hymenoptera, imago	—	2,04	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Siricidae	—	7,14	—	—	—	—	—	—	—	—	7,14	—	—	—	—	—	2,32	
Tenthredinidae	—	1,02	—	—	—	—	—	—	—	4,8	—	—	—	—	—	—	—	
Vespidae	—	6,06	—	—	—	—	—	—	—	—	7,14	—	—	—	—	—	1,66	
Formicidae	8,10	11,2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Oligolata, larvae, imago	8,10	8,16	—	—	—	28,6	—	10,7	—	—	7,14	—	—	0,86	—	1,66		
Sialidae, larvae	—	—	—	—	—	14,3	—	—	—	—	—	—	—	—	—	—		
Araneina	2,7	—	—	—	—	—	—	3,58	—	—	—	—	—	—	—	—		
Hydrachnellae	—	—	—	—	5,0	28,6	—	17,9	—	4,8	7,14	—	8,16	9,46	5,2	1,66		
Valvata sibirica Midd.	—	—	—	—	—	14,3	—	—	—	—	—	—	—	—	—	—		
Limnaea sp.	—	—	—	—	10,0	—	—	—	—	—	—	—	—	—	—	—		
Bithynia sp.	—	—	—	—	20,0	—	—	10,7	—	4,8	—	—	26,5	13,7	—	—		
Sphaerium solidum Norm.	—	—	—	—	—	—	—	—	4,8	4,8	—	—	—	0,86	—	2,32		
Pisces	2,7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
Coregonus peled Gmel.	—	—	8,70	—	—	—	—	—	13,6	—	—	—	—	—	—	—		
Cyprinidae	—	—	3,35	—	—	—	—	—	—	—	—	—	—	—	—	—		
Phoxinus sp.	—	—	8,70	—	—	—	—	—	—	—	—	—	—	—	—	—		
Thymallus arcticus pallasi.	—	—	17,4	—	—	—	—	—	—	—	—	—	—	—	—	—		
Esox lacustris L.	—	—	13,1	—	—	—	—	—	—	—	—	—	—	—	—	—		
Lota lota L.	—	—	4,35	—	—	—	—	—	13,6	—	—	—	—	—	—	—		
Perca fluviatilis L.	—	—	4,35	—	—	—	—	—	—	—	—	—	—	—	—	—		
Acerina cernua L.	—	—	8,70	—	—	—	—	—	27,4	—	—	—	—	—	—	—		
Cottus poecilopus Heckl.	—	—	17,40	—	—	—	—	—	—	—	—	—	—	—	—	—		
Hynobius keyserlingi (Dyb.).	—	—	8,70	—	—	—	—	—	—	—	—	—	—	—	—	—		
Sorex araneus L.	2,7	4,08	8,70	—	—	—	—	—	—	—	—	—	—	—	—	—		
Microtus oeconomus	—	—	8,70	—	—	—	—	—	—	—	—	—	—	—	—	—		
Microtus hyperboreus Vin.	—	8,16	4,35	—	—	—	—	—	—	—	—	—	—	—	—	—		
Aythya fuligula	—	—	4,35	—	—	—	—	—	—	—	—	—	—	—	—	2,32		
Перо птиц Feathers of birds	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
Nostoc	—	2,04	—	—	5,0	—	—	—	—	—	—	—	8,16	31,8	5,26	13,28		
* Растительно-детритная масса	10,8	9,18	—	—	5,0	28,6	—	39,38	—	4,8	14,28	—	8,16	—	5,26	5,0		
** Икра гольца	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		

* Vegetable-detrital mass; ** Roe of char.

Таблица 4. *Рост основных промысловых рыб Илирнейско-Анюйской системы в 1964—1966 гг. (длина — см, вес — г)*

Район лова	7 Показатели	17 Возраст 1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+	14+
	8. Пыжьян														
Илирнейская система	15 длина							27,2	30,4	32,8	34,0	36,0	40,0	42,5	43,3
	16 вес							101	284	309	412	465	669	810	889
Б. Анюй	15 длина				29,3	32,1	33,2	35,2	36,6	39,8					
	16 вес				272	389	442	515	601	773					
	9 Пелядь														
с. Белоногово	15 длина					40,5	40,1	43,2	42,4	45,5					
	16 вес					1 219	1 252	1 559	1 412	1 595					
Илирнейская система	15 длина				28,7	32,3	33,6	33,9	34,7						
	16 вес				256	373	417	447	470						
М. Анюй	15 длина		33,5	34,0	35,9	36,7	36,1								
	16 вес		380	389	547	623	671								
	10 Чир														
Б. Анюй	15 длина	31,0	36,7	39,2	42,4	42,3	53,3	54,9	56,5						
	16 вес	443	774	916	1 110	1 039	2 451	2 238	2 257						
М. Анюй	15 длина	32,4	33,1	36,9	40,2	45,3	—	47,7							
	16 вес	370	406	609	760	1 090	—	1 224							
Илирнейская система	15 длина					36,6	46,2	47,4	48,7	52,6	—	55,6			
	16 вес					969	1 351	1 380	1 588	2 172	—	2 276			
	11 Валек														
Илирнейская система	15 длина				22,1	27,9	31,5	34,8	36,9	39,7	41,9	43,2	43,8		
	16 вес				77	177	279	363	446	482	534	540	560		
	12 Харпус														
Илирнейская система	15 длина			22,3	28,6	31,7	33,0	35,3	35,9						
	16 вес			195	246	349	354	474	490						
Камешковая	15 длина			27,0	26,6	32,6	34,4	36,5	39,6	40,0					
	16 вес			222	213	354	421	489	700	695					
	13 Голец														
Илирнейская система	15 длина						25,2	27,6	30,4	30,0					
	16 вес						130	187	231	214					
	14 Окунь														
Б. Анюй	15 длина					22,2	—	20,0	27,0	24,0	25,0	25,5			
	16 вес					272	—	175	441	347	308	374			

Table 4

Rate of growth. Growth of the main commercial fishes from the Ilirnei-Anyui system in 1964-1965 (length in cm, weight in g).

1--Fishing region; 2--Ilirnei system; 3--B. Anyui river; 4--Belonogovo lake; 5--M. Anyui river; 6--Kameshkovaya river; 7--Indices: 8--Coregonus lavaretus pidschian; 9--Coregonus peled; 10--Broad whitefish (Coregonus nasus); 11--Round whitefish (Prosopium cylindraceum); 12--Grayling; 13--Char; 14--Perch; 15--Length; 16--Weight; 17--Age.

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In Nizhnii Ilirnei lake, in June, "peled" of age 6+, 7+ and 8+ fed essentially on Chironomidae pupae (98.0% by weight) with slight admixtures of stonefly and caddis fly larvae (Table 5). In July and August the content of Chironomidae pupae decreased in the diet of "peled" of these year-classes, and their food spectrum became somewhat enlarged with Heterocope appendiculata as its principal component.

It may thus be seen that by September the principal food items changed in the diet of peled from Nizhnii Ilirnei lake, and that its feeding habits during the summer and autumn period revealed no differences determined by age and sex.

The small crustacean Heterocope appendiculata was the main component of the food bolus in this fish from

Yarakvaam river in June. Larvae of Chironomidae and Lynceus brachyurus predominated in "peled" from Malyi Anyui river, pupae of Chironomidae--in"peled" from Nizhnii Ilirnei lake. In August "peled" from the rivers and lakes of the Ilirnei system fed on organisms of the same groups, but in different proportions. The principal components of the food bolus found in this fish were as follows: Bosmina obtusirostris in Yarakvaam river, Heterocope appendiculata in Nizhnii Ilirnei lake, Lynceus brachyurus in Belonogovo lake (Table 5). The latter amounts to as much as 56.5% of weight in the

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diet of "peled" from Kolyma river. It may thus be seen that local variations in the composition of food are characteristic of "peled" from the rivers and lakes of the Ilirnei system and M. Anyui basin. Furthermore, during the summer and in the autumn "peled" is here a plankton-eater to a considerably greater degree than in the lakes and rivers of Kolyma (Novikov, 1956) and Vilyui (Venglinskii, 1962) basins. The highest degree of satiation was observed in "peled" in June, in M. Anyui river (55.5 o/o oo) and in August in Belonogova lake (22.0 o/o oo). It is difficult to determine whether "peled" feeds all the year round in the lakes and rivers of the Ilirnei system (Burmakin, 1941), but it has almost the same rate of growth in length and in weight as "peled" from other basins (Table 4) (Kirillov, 1955; Kozhevnikov, 1955; Pirozhnikov, 1955; Novikov, 1966).

Таблица 5. *Значение организмов* (в % по весу)* *в питании пеляди в водоемах Илирнейской системы в летний период 1964—1965 гг. и в системе р. Малый Анюй в 1966 г.***

1 Состав пищи	3 Июнь			Июль 4	5 Август		
	р. Ярак-ваам 6	р. М. Анюй, 1966 7	оз. Н. Илир-кей 8	оз. Н. Илир-кей 9	р. Ярак-ваам 10	оз. Н. Илир-кей 11	оз. Бело-оозеро, 1966 12
Lynceus brachyurus	—	8,0	—	—	—	—	93,50
Bosmina obtusirostris	—	5,46	—	10,9	61,52	—	0,78
Eurycercus lamellatus	—	—	1,11	4,55	5,80	2,91	0,16
Heterocope appendiculata	62,50	—	—	30,30	26,86	90,51	—
Chironomidae,							
larvae	17,31	39,59	—	53,0	5,80	6,58	—
pupae	—	—	98,0	—	—	—	—
Diptera, larvae	9,15	14,20	—	—	—	—	0,13
Heleidae	—	0,05	—	—	—	—	—
Muscidae	—	0,29	—	—	—	—	—
Trichoptera, larvae	10,0	1,90	0,50	1,25	—	—	—
Dytiscidae	1,04	0,51	—	—	—	—	—
Plecoptera, larvae	—	—	0,59	—	—	—	—
Valvata sibirica	—	—	—	—	—	—	5,43
2 Общий средний индекс наполнения желудков, ‰	6,17	55,5	7,51	3,06	12,4	5,55	22,0

* Вес содержимого желудков по водоемам колеблется от 100 до 5 100 *мг*.
** Р. Малый Анюй — оз. Белоногово.

Table 5

Content of various organisms (in % of weight)* in the diet of "peled" from the lakes and rivers of the Ilirnei system during the summer period of 1964-1965, and in the system of Malyi Anyui river in 1966.**

1--Composition of food; 2--Mean general index of fullness, o/o oo; 3--June; 4--July; 5--August; 6--Yarakvaam river; 7--M. Anyui river, 1966; 8--N. Ilirnei lake; 9--N. Ilirnei lake; 10--Yarakvaam river; 11--Ilirnei lake;

12--Belonogovo lake, 1966.

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*The weight of the food bolus varies in different bodies of water between 100 and 150 mg.

**Malyi Anyu river--Belonogovo lake.

A landlocked (non-anadromous) lacustrine form of "peled" lives in Belonogoe lake. It is characterized by a high rate of increase in length and in weight. In August these fish feed mainly on phyllopods.

"Peled" from Nizhnii Ilirnei lake, where it feeds during the early summer on Chironomidae (larvae and pupae), also has satisfactory mean indices of length and weight.

Feeding of "peled" on planktonic and benthic organisms may be regarded as evidence of its extensive adaptation to trophic conditions.

Broad whitefish (Caregonus nasus / Pallas /). Broad whitefish is a typical Chironomidae-eater in the lakes and rivers of the Ilirnei system (Table 6). Up to 3,265 specimens of Chironomidae per stomach of broad whitefish were recorded in Yarakvaam river in June. The Chironomidae were represented by the following species: Prodiamesa bathyphila, Protanypus sp., Stictochironomus histrio, Procladius, Microspectra praecox, Orthocladinae gen. simulius, Orthocladius paratatcicus, Cardiocladius sp., Sergentia logiventris, Sergentia bathyphila, Lipeniella arenicola, Chironomus

nigricaus, Orthocladius bathophilus, Anatophynia trifascipenis, Cryptochironomus defectus Kieff, Cluniomarinus sp., Limnophyes sp.

Chironomidae and molluscs (Sphaerium solidum, Sphaerium corneum, Valvata sibirica) constituted the major portion of the food bolus in broad whitefish from Malyi Anyui river in June and in Nizhnii Ilirnei lake in August.

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In the lake broad whitefish changed to feeding on Gammarus lacustris only in September, but even then it continued to consume considerable quantities of molluscs (Table 6).

In June and July the composition of the food bolus in broad whitefish from the lower M. Anyui river is more varied than that recorded in the lakes and rivers of the Ilirnei system (Table 6). A.S. Novikov (1966) established a broader food spectrum (a spectrum including 32 designations) in other bodies of water of the Kolyma basin. In August the food bolus of broad whitefish from Yarakvaam river and Nizhnii Ilirnei lake consisted of planktonic organisms (furthermore, the assortment of food components recorded in the lake was greater than that observed in Yarakvaam river). The most limited food spectrum was observed for broad whitefish in July and August in Yarakvaam river. This is further corroborated by the data of E.A. Streletskaya (1962), who found only 3 groups of organisms in the food bolus of broad whitefish caught in the delta of Yana river in July and August.

Таблица 6. *Значение организмов* (в % по весу) *в питании чира в водоемах Илирнейской системы в летне-осенний период 1964—1965 гг. и р. Малый Анюй, 1966 г.*

1 Состав пищи	5 Июнь		6 Июль	7 Август		Сентябрь 8
	р. Ярак-ваам 9	р. М. Анюй 10	р. Ярак-ваам 11	р. Ярак-ваам 12	оз. И. Илирней 13	оз. И. Илирней 14
Nematoda	—	11,45	—	—	—	—
Oligochaeta	—	2,12	—	—	—	—
Lynceus brachyurus	—	6,01	—	37,21	1,19	—
Cladocera	5,50	—	—	—	0,45	—
Gammarus lacustris	—	6,15	—	—	1,85	61,00
Chironomidae	47,37	30,80	12,70	60,50	47,94	2,26
Tipulidae	—	6,25	—	—	—	—
Diptera, larvae	1,66	—	—	—	0,06	—
Trichoptera, larvae	1,35	3,37	—	—	—	15,13
Plecoptera, larvae	—	—	0.43	—	0,31	—
Staphilinidae	—	0,19	—	—	1,74	—
Gyrinidae	0,23	0,89	—	—	—	—
Mollusca	41,13	31,05	86,87	2,30	39,38	20,90
Nostoc	—	—	—	—	0,31	0,71
2 Растительно-детритная масса	2,67	1,36	—	—	6,15	—
3 Галька	—	0,36	—	0,49	0,62	—
4 Общий средний индекс наполнения желудков, ‰	16,9	35,0	18,7	4,05	10,4	10,9

Table 6

Contents of various organisms (in % of weight) in the diet of broad whitefish from the lakes and rivers of the Ilirnei system during the summer and autumn period of 1964-1965, and in Malyi Anyui in 1966.

1--Composition of food; 2--Vegetable-detrital mass; 3--Pebble; 4--General mean index of

fullness, o/o oo; 5--June; 6--July; 7--August; 8--September; 9--Yarakvaam river; 10--M. Anyui river; 11--Yarakvaam river; 12--Yarakvaam river; 13--N. Ilirnei lake; 14--N. Ilirnei lake.

The lowest intensity of feeding of broad whitefish was recorded in August in Yarakvaam river, a relatively high rate of feeding was observed in M. Anyui river (Table 6).

Feeding patterns of broad whitefish from the bodies of water mentioned above thus reveal neither local peculiarities, nor differences related to age or sex. The relatively high rate of increase in length and in weight of this fish (Table 4) results in an extensive dispersion of the species, as a result of which broad whitefish forms no concentrations during the foraging and feeding season.

"Pidschian" (Coregonus lavaretus pidschian Gmelin). Similarly to broad whitefish, C. lavaretus pidschian is a benthophage, i.e. a Chironomidae- and molluscs-eater in the lakes and rivers of the Ilirnei-Anyui system. The larvae of Chironomidae found in the stomachs examined, were represented by the following species: Chironomus pallidus, Lipeniella arenicola, Criptochironomus defectus Kieff., Sergentia longiventris, Orthocladius olivaceus, Stictochironomus histrio, Trichocladius inagualis. The molluscs were represented by Valvata sibirica, Sphaerium solidum (Table 7). In August the weight of the food bolus consisting of molluscs

exclusively, fluctuated in different individuals of this whitefish from Nizhnii Ilirnei lake between 1.5 and 1.7 g, whereas the food bolus of "pidschian" from B. Anyui river consisted for the most part of Valvata sibirica and weighed 3.7-5.5 g. "Pidschian" appears to be selective with regard to molluscs. Feeding patterns of this whitefish in the

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lakes and rivers of the Ilirnei-Anyui system revealed certain seasonal variations (Table 7), as well as peculiarities related to age (Table 8).

Таблица 7. *Значение организмов* (в % по весу) *в питании пыжьяна водоемов Илирнейской системы в летне-осенний период 1964—1965 гг. и рек Б. и М. Анюй в 1966—1967 гг.*

1 Состав пищи	5 Июнь			6 Июль		7 Август		8 Сентябрь	
	9 р. Ярак-ваам	10 р. М. Анюй	11 р. Б. Анюй	12 р. Ярак-ваам	13 р. Прав. Илирней	14 р. Ярак-ваам	15 р. Прав. Илирней	16 оз. Н. Илирней	17 р. Ярак-ваам
Lynceus brachyurus	0,14	—	—	—	—	3,72	—	—	—
Bosmina obtusirostris	—	—	—	—	—	0,89	—	—	—
Eurycercus lamellatus	0,79	—	—	17,10	—	17,90	6,87	20,40	41,80
Nemateda	0,09	—	—	—	—	—	—	—	—
Oligochaeta	—	4,20	3,48	—	—	—	—	—	—
Gammarus lacustris	—	1,23	—	—	—	—	—	—	—
Chironomidae									
larvae	67,37	19,70	17,40	18,71	63,15	51,10	13,25	3,86	7,55
pupae	6,20	0,15	8,55	0,69	—	10,6	3,74	1,03	—
Diptera, larvae	0,57	—	—	—	—	—	—	—	—
Tipulidae	—	—	4,38	—	—	—	—	—	—
Eriopterinae	—	67,0	2,10	—	—	—	—	—	—
Plecoptera, larvae	0,20	—	1,42	—	—	—	—	—	—
Heptageniidae	—	0,25	0,21	—	—	—	—	—	—
Apatania sp.	1,57	—	—	—	—	—	—	—	—
Trichoptera, larvae	0,20	—	—	—	—	1,69	—	—	—
Sialidae	—	0,19	0,59	—	—	—	—	—	—
Chrisomelidae	—	—	0,13	—	—	—	—	—	—
Formicidae	—	—	—	—	—	—	3,74	—	—
Araneina	0,09	0,81	—	—	—	—	—	—	—
Hydrachneilae	—	—	0,70	—	—	—	—	—	—
Valvata sibirica	6,30	1,48	32,81	38,25	31,40	3,0	19,71	74,35	38,65
Sphaerium solidum	1,44	—	11,15	12,9	—	11,10	37,40	—	—
Lymnaea sp.	—	0,15	—	—	—	—	—	—	—
Pisces	—	—	—	—	—	—	9,70	—	—
2 Растительно-детритная масса	15,04	4,84	13,60	12,35	—	—	5,59	0,36	12,0
3 Галька	—	—	3,48	—	5,45	—	—	—	—
4 Общий средний индекс наполнения желудков, ‰	19,6	50,35	23,19	11,5	10,2	8,45	9,20	16,50	12,6

Table 7

Content of various organisms (in % of weight) in the diet of Coregonus lavaretus pidschian from the lakes and rivers of the Ilirnei system during the summer and autumn of 1964-1965, and from B. and M. Anyui rivers in 1966-1967.

1--Composition of food; 2--Vegetable-detrital mass; 3--Pebble; 4--General mean index of fullness, o/o oo; 5--June; 6--July; 7--August; 8--September; 9--Yarakvaam river; 10--M. Anyui river; 11--B. Anyui river; 12--Yarakvaam river; 13--Prav. Ilirnei river; 14--Yarakvaam river; 15--Prav. Ilirnei river; 16--N. Ilirnei lake; 17--Yarakvaam river.

Таблица 8. *Значение организмов* (в % по весу) *в питании разновозрастного пыжьяна в июне 1965 г. р. Яракваам*

1 Состав пищи	3 Возраст					
	7+	8+	9+	10+	11+	12+
Eurycercus lamellatus	—	—	0,39	—	—	—
Lynceus brachyurus	9,5	0,24	—	—	—	—
Nematoda	—	—	—	0,61	—	—
Chironomidae						
larvae	90,5	55,92	53,2	60,20	49,5	49,0
pupae	—	6,11	0,24	6,15	13,5	—
Plecoptera, larvae	—	0,48	0,24	—	—	—
Trichoptera, larvae	—	0,68	—	—	—	—
Apatania sp.	—	—	—	—	7,60	—
Diptera, larvae	—	0,19	0,72	1,32	0,30	—
Araneina	—	0,29	—	—	—	—
Valvata sibirica	—	14,40	4,90	0,37	1,50	4,0
Sphaerium solidum	—	15,90	20,8	4,35	16,80	8,00
2 Растительно-детритная масса	—	5,79	19,6	27,0	10,80	39,0

Table 8

Content of various organisms (in % of weight) in the diet of C. lavaretus pidschian specimens of different age in June 1965, in Yarakvaam river.

1--Composition of food; 2--Vegetable-detrital mass; 3--Age.

Certain specimens of "pidschian" of age 7+ fed in Yarakvaam river only on Chironomidae larvae and on phyllopods. The food spectrum is broader in the specimens of age 8+ and 9+. It includes 9-10 components, among which Chironomidae larvae and molluscs (Sphaerium in particular) predominate.

Stomach contents (food bolus) of older specimens (of age 10+, 11+, 12+) consisted of Chironomidae and molluscs with negligible admixtures of caddis fly larvae (Apatania) and larvae of dipterous insects, and with a higher percentage of the vegetable-detrital mass. In B. Anyui river the food bolus of "pidschian" specimens of age 5+ included larvae of Eriopterinae (0.99%) alongside Chironomidae and molluscs (among which Valvata sibirica predominated). Food bolus of the individuals of age 6+ also contained larvae of beetles (0.58%), Heptageniidae (0.35%), Plecoptera (1.33%), Eriopterinae (3.5%) and a considerable amount of the vegetable-detrital mass. Certain changes were observed in the composition of the diet of "pidschian" at age 7+: Valvata sibirica--73%, oligochetes--12.75%, larvae of Tipulidae--7.85%, Hydrachnelae--2.62%.

While Chironomidae and molluscs remain the principal food items of these fish the qualitative composition of their diet reveals certain seasonal variations determined by

the availability of the dominant planktonic and benthic organisms. For example, in June the food bolus of "pidschian" from Yarakvaam and B. Anyui rivers included 11 to 14 different organisms; in July and August the content of planktonic organisms increases in Yarakvaam and Nizhnii Ilirnei rivers, and in September the food bolus of "pidschian" from Yarakvaam river consisted of Cladocera and molluscs. Benthic feeding pattern may give way to feeding on plankton (June, September in Yarakvaam river). This phenomenon has been observed in representatives of Coregonus and Prosopium from Karelian lakes (Pravdin, 1954), Lapland reserve (Reshetnikov, 1964), Sweden (Nilsson, 1958), Finland (Järvi, 1928). Certain authors (Kirillov, 1955, 1962; Moskalenko, 1955; Mikhin, 1955; Streletskaya, 1962) point out that fish of the genera Coregius and Proposium often feed on fry. We found fish remains only in a few instances in "pidschian" from Pravyi Ilirnei in July 1964.

The content of Chironomidae in the diet of "pidschian" from M. and B. Anyui rivers is one-third that recorded in Yarakvaam river. According to the data of E.A. Streletskaya (1962), at the lower course of Yana river this fish feeds in July and August mainly on caddis fly (30.3% frequency of occurrence) and stonefly (44.2%) larvae and on Chironomidae (27.3%). Insects of the air, molluscs and fish were found in equal amounts in the composition of the food bolus of "pidschian" from Yana river (13.9% frequency of

occurrence).

"Pidschian" from Kolyma is euryphagous (Novikov, 1966), however, on certain years this fish feeds only on the small crustacean Lynceus brachyurus, as depends on the biomass of the latter.

The intensity of feeding of "pidschian" varies in Yarakvaam river during the summer months between 8.5 and 19.5 o/o oo. Its feeding intensity is higher in M. and B. Anyui rivers.

The rate of growth in length and in weight recorded in "pidschian" (Table 4) gives us grounds to believe that its feeding conditions in the rivers and lakes of the Ilirnei-Anyui system were virtually the same as in other bodies of water of the Far North. According to A.S. Novikov's data (1966), in Kolyma river "pidschian" of age 8+ attains a length of 333 mm, in Indigirka river--a length of 312 mm, in Vilyui river--330 mm (Kirillov, 1955), in Lena river--272 mm (Sych-Averintseva, 1933), at the lower course of Enisei--335 mm (Neimai, 1961), in B. Anyui river--210 to 415 mm (on an average 315 mm), in the Ilirnei system--260 to 460 mm (the predominant group measures 330-360 mm).

Round whitefish (Coregonus cylindraceus / Pallas et Pennant /). In Nizhnii Ilirnei lake, in June, round whitefish fed on larvae and pupae of Chironomidae (24.6%), larvae of dipterous insects (7.35%) and, most of all, on larvae of

caddis fly of the genus Apatania (54.51%) (Table 9). In July the content of Chironomidae pupae increases (42.2%) in the diet of this fish and its food bolus consists essentially of these pupae and of Cladocera. In August the feeding spectrum of round whitefish is more varied: half of its food bolus consists of the small crustacean Eurycercus (50%), larvae of caddis fly Mystacides (2.72%), Molanna (14.72%), Hydathophylax (13.85%), Apatania (1.81%) and of mayfly (16.9%).

The satiation factor was 109.0 o/o oo in June, 20.6 o/o oo in July, 14.3 o/o oo in August.

In Yarakvaam river, in June, round whitefish of age 8+, 9+ and 10+ fed essentially on larvae of Chironomidae (30.4%) and caddis fly, among which Hydathophylax and Apatania predominated (23.40% and 26.45%, respectively). In July their food bolus consisted of Hydathophylax (73.2%) and Eurycercus (26.8%) larvae. In September the food spectrum of round whitefish included 12 names of different organisms, among them Hydathophylax (45.25%) and Chironomidae (13.45%) larvae, Valvata sibirica (5.82%) and others (Table 9).

The finding of char roe (5.71%) in the stomachs of round whitefish corroborates L.S. Berg's observations (1949) to the effect that during the spawning period of Coregonus and Prosopium representatives, whitefish consume considerable quantities of their eggs.

In Pravyi Ilirnei river, however, round whitefish fed at that time mainly on Valvata sibirica molluscs (70.59%) and on Eurycercus (24.43%).

Consumption of Cladocera virtually throughout the summer is a feature characteristic of round whitefish from the Ilirnei system, Nizhnii Ilirnei lake in particular.

Таблица 9. *Значение организмов* (в % по весу) *в питании валька водоемов Илирнейской системы в летний период 1964 г.*

1. Состав пищи	5. Июнь		6. Июль	7. Август		8. Сентябрь	
	оз. Н. Илирней 9.	р. Ярак-ъдам 10.	оз. Н. Илирней 11.	оз. Н. Илирней 12.	р. Ярак-ъдам 13.	р. Ярак-ъдам 14.	р. Пр. Илирней 15.
Nematomorpha	—	4,26	—	—	—	—	—
Eurycercus lamellatus	—	—	38,20	50,19	26,80	10,30	24,49
Chironomidae, larvae	13,70	30,40	—	—	—	13,45	—
pupae	10,90	—	42,00	—	—	—	—
Trichoptera larvae	—	—	19,80	—	—	—	—
Molanna palpata	—	—	—	14,72	—	1,17	—
Mystacides sp.	—	—	—	2,72	—	2,34	—
Apatania sp.	54,51	26,45	—	1,81	—	—	—
Hydathophylax sp.	—	23,40	—	13,85	73,20	45,25	4,92
Plecoptera, larvae	—	6,85	—	—	—	—	—
Heptageniidae	—	—	—	15,90	—	13,00	—
Diptera, larvae	7,35	1,38	—	—	—	2,34	—
Dytiscidae, larvae	—	7,45	—	—	—	0,58	—
Valvata sibirica	—	—	—	—	—	5,82	70,59
Икра гольца 2.	—	—	—	—	—	5,75	—
Растительно-детритная масса 3.	13,54	—	—	—	—	—	—
Общий средний индекс наполнения желудков 4.	109,0	25,10	20,6	14,3	9,20	19,0	27,0

Table 9

Contents of various organisms (in % by weight) in the diet of round whitefish from the rivers and lakes of the Ilirnei system during the summer of 1964.

1--Composition of food; 2--Roe of char; 3--Vegetable-detrital mass; 4--General mean index

of fullness; 5--June; 6--July; 7--August; 8--September; 9--N. Ilirnei lake; 10--Yarakvaam river; 11--N. Ilirnei lake; 12--N. Ilirnei lake; 13--Yarakvaam river; 14--Yarakvaam river; 15--Pr. Ilirnei river.

In contrast to the bodies of water examined, the composition of the food consumed by round whitefish in Kolyma river reveals a predominance of Chironomidae and caddis fly larvae (Novikov, 1966).

The weight of the food bolus of round whitefish varied in time within the limits of 130 and 4800 mg. On the whole its feeding patterns in the rivers and lakes of the Ilirnei system reveal during the summer only slight local variations reflected in the quantitative ratios of the dominant food items, but show no differences due to sex or age.

The rate of increase in length and in weight of round whitefish from the Ilirnei bodies of water is as high as that recorded for round whitefish from Kolyma (Novikov, 1966) and Indigirka (Kirillov, 1955). These data and the relatively great weight of the food bolus of round whitefish from

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the Ilirnei system of rivers and lakes evidence that trophic conditions are favourable in that basin.

East Siberian grayling (Thymallus arcticus pallasi

/ Valen /). East Siberian grayling from the Ilirnei-Anyui system is a typical euryphage, similarly to the other subspecies of arctic grayling (Tugarina, 1962, 1964).

Grayling's food spectrum in all the bodies of water examined includes during the summer 44 names of different organisms (Table 10). With regard to the assortment of food items, M. Anyui river offers the most favourable feeding conditions for grayling in June, Yarakvaam river in July and Nizhnii Ilirnei lake in August and September.

In Yarakvaam river (June) the feeding spectrum of grayling females is broader than that of male individuals. Larvae and pupae of Chironomidae and larvae of stonefly are the principal components of the food bolus in females. The percentage of insects of the air is negligible in their food bolus. The organisms predominating in the food bolus of males are, however, pupae of Chironomidae, caddis fly and insects of the air (Table 11).

In July Chironomidae pupae, larvae and pupae of caddis fly still constitute a considerable fraction of grayling's food bolus.

In August the food bolus of grayling females from Kameshkovaya river contained a somewhat larger assortment of food items than did the bolus of males of the same age, although in both instances it consisted essentially of caddis fly larvae belonging to the genera Molanna and Apatania. Food bolus of females of age 7+ and 8+ contained water shrew

(Soricidae), remains of which were also found in the stomachs of males of age 6+. Larvae and pupae of Chironomidae and larvae of stonefly are lacking in the diet of grayling of both sexes, and the qualitative composition of their diet reveals no significant differences.

The degree of similarity in the diet of males and females of the same age was estimated in Yarakvaam river in June as equal to 53.46%, that of grayling males and females of age 6+ from Kameshkovaya river was determined as 82.82%, of the individuals at age 7+ as 70.34%, at age 8+ as equal to 32.15%. Female grayling gather food organisms essentially from the surface of water. Differences that are due to sex are thus slight in the feeding habits of grayling from the lakes and rivers examined.

With time the food spectrum of the East Siberian grayling from the rivers broadens, particularly in the fish of age 7+ and 8+ (Table 11). Grayling of age 5+ fed in Yarakvaam river in June mainly on Chironomidae (45.10% of weight). Larvae of stonefly, dipterous insects of the air and Hymenoptera, as well as plants constituted a considerable percentage of the food bolus in this fish. At the same time the content of Chironomidae decreases almost to a half in the diet of grayling of age 6+ from Yarakvaam river, and larvae of stonefly and mayfly are the principal components of their food bolus (Table 11).

The degree of similarity in the food consumed by

grayling of different age in Yarakvaam river in June varies between 12.73 and 56.74%, in Pravyi Ilirnie river in July--from 31.08 to 45.0%, and in Kameshkovaya river in August--from 66.35 to 80.04%. Fish of age 7+ were characterized throughout the summer by a large assortment of food components in their diet. Moreover, in June and July Chironomidae and stonefly larvae were the principal items in the food bolus of grayling from Yarakvaam and Pravyi Ilirnei rivers. Differences due to age were observed only in secondary food components. Variations in the diet of grayling of age 5+ to 8+ were observed in August in Kameshkovaya river mainly in the composition of insects of the air and in the presence of small mammals. In Nizhnii Ilirnei lake graying fed in August and September on pupae of Chironomidae and caddis fly. They also consumed considerable quantities of Hymenoptera.

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Table 10

Contents of various organisms (in % by weight) in the diet of grayling from rivers and lakes of the Ilirnei-Anyui system in 1964-1967.

1--Composition of food; 2--Vegetable-detrital mass; 3--Feathers of birds; 4--Pebble; 5--June; 6--July; 7--August; 8--September; 9--Yarakvaam river; 10--Malyi Anyui river; 11--Kameshkovaya river; 12--Yarakvaam river; 13--Pravyi Ilirnei river; 14--Kameshkovaya river; 15--Yarakvaam river; 16--N. Ilirnei lake; 17--Kameshkovaya river; 18--N. Ilirnei lake.

TABLE 10.

Таблица 10. *Значение организмов (в % по весу) в питании хариуса водоемов Илирнейско-Анюйской системы в 1964—1967 гг.*

1 Состав пищи	5 Июнь			6 Июль		7 Август				8 Сентябрь	
	9 р. Ярак-ваам	10 р. Малый Анюй	11 р. Камен-ковая	12 р. Ярак-ваам	13 р. Ирак, Илирней	р. Каменковая 14 1966	1967	15 р. Ярак-ваам	16 оз. Н. Илирней	17 р. Камен-ковая	18 оз. Н. Илирней
Lynceus brachyurus	—	—	—	—	0,82	—	—	—	—	—	—
Eurycercus lamellatus	—	—	—	1,44	—	—	—	—	—	—	—
Gammarus lacustris	—	—	—	—	—	—	—	1,37	—	—	—
Chironomidae											
larvae	11,40	—	—	—	2,34	1,74	—	1,91	—	3,20	17,27
pupae	39,99	—	—	62,00	36,40	—	—	41,24	13,30	—	2,84
Diptera											
larvae	4,80	—	0,34	—	—	0,21	—	—	7,70	—	1,24
imago	0,57	21,8	—	—	7,60	—	0,27	—	—	—	—
Plecoptera, larvae	19,0	18,01	—	—	22,0	0,45	—	9,20	30,60	2,08	12,40
Heptageniidae	1,87	—	—	—	4,70	1,94	—	2,28	46,50	—	—
Agrypnia sp.	2,42	—	38,40	2,0	—	9,20	0,73	—	—	11,40	2,20
Molanna palpata	—	—	1,60	—	—	68,16	60,40	2,75	—	49,93	—
Mystacides sp.	0,71	—	—	—	0,92	—	5,30	—	—	—	—
Apatania sp.	—	—	—	3,75	3,20	—	20,20	6,15	—	16,65	—
Limnephilus stigma	—	—	3,38	—	—	—	—	—	—	—	—
Hydatophylax sp.	—	—	27,80	—	—	—	1,42	—	—	—	—
Oligoplectrodes sp.	—	—	—	—	—	—	0,30	—	—	—	—
Trichoptera, pupae	4,79	—	—	7,21	7,02	—	—	9,50	—	—	—
Coleoptera, larvae	—	—	0,13	—	0,47	—	—	—	—	—	—
Dytiscidae	0,89	—	0,42	—	—	—	0,30	4,38	—	—	—
Carabidae	0,23	42,30	2,76	—	0,38	0,17	0,08	—	1,90	—	1,08
Staphilinidae, larvae	—	—	—	—	—	4,15	—	—	—	2,12	—
Elateridae	0,26	7,50	—	—	—	0,12	0,03	—	—	0,61	—
Byrrhidae	—	—	—	—	—	—	0,07	—	—	—	—
Cerambycidae	—	—	—	—	—	—	0,05	—	—	—	—
Curculionidae	0,28	10,3	0,17	—	—	—	—	—	—	—	—
Hymenoptera	1,0	—	0,08	—	—	—	0,85	—	—	3,90	—
Siricidae	1,28	—	0,14	—	10,50	—	0,91	—	—	—	—
Tenthredinidae	—	—	—	—	—	—	0,07	—	—	—	—
Ichneumonidae	1,62	—	—	—	0,14	—	—	—	—	—	—
Vespidae	0,68	—	—	—	—	—	0,48	5,25	—	1,60	—
Formicidae	0,48	—	0,47	—	1,17	0,77	0,99	3,06	—	—	—
Odonata											

Trichoptera	1,0	—	0,08	—	—	—	0,85	—	—	3,90	—	
Sirícidae	1,28	—	0,14	—	10,50	—	0,91	—	—	—	—	
Tenthredinidae	—	—	—	—	—	—	0,07	—	—	—	—	
Ichneomonidae	1,62	—	—	—	0,14	—	—	—	—	—	—	
Vespidae	0,63	—	—	—	—	—	0,48	5,25	—	1,60	—	
Formicidae	0,48	—	0,47	—	1,17	0,77	0,99	3,06	—	—	—	
Odonata												

TABLE 10, continued.

18	larvae	0,17	—	21,60	—	—	2,66	—	—	—	3,20	1,21
*	imago	—	—	—	—	—	—	0,24	—	—	—	—
	Araneina	—	—	—	2,04	—	—	—	—	—	0,45	—
	Hydrachellae	—	—	—	—	—	—	—	—	—	—	0,36
	Valvata sibirica	—	—	—	—	0,28	—	—	0,36	—	—	—
	Oligochaeta	0,28	—	—	0,22	—	—	—	—	—	—	—
	Pisces	0,13	—	—	—	—	2,98	—	9,20	—	—	41,74
	Sorex araneus	—	—	—	—	—	4,63	5,60	—	—	—	—
	Microtus hyperboreus	—	—	—	—	—	—	1,22	—	—	—	—
	Nostoc	—	—	—	—	—	—	0,09	—	—	—	—
2	Растительно-детритная масса	6,67	—	2,71	3,34	2,06	2,82	0,40	3,33	—	4,86	9,65
3	Перо птиц	0,06	—	—	—	—	—	—	—	—	—	—
4	Галька	0,42	—	—	—	—	—	—	0,02	—	—	—

TABLE 11.

Таблица 11. *Значение организмов* (в % по весу) *в питании разновозрастного хариуса в реках Илирнейской системы в летний период 1964—1965 гг. и в р. Камешковая в 1966—1967 гг.*

1 Состав пищи	5 Яракваам, 8 июнь				6 Правый Илирней, 9 июль			7 Камешковая, 10 август			
	11 Возраст										
	5+	6+	7+	8+	4+	5+	7+	5+	6+	7+	8+
Lynceus brachyurus	—	—	—	—	—	3,0	—	—	—	—	—
Oligochaeta	—	—	0,62	—	—	—	—	—	—	—	—
Chironomidae	5,6	17,7	13,21	9,52	9,55	—	—	—	—	—	—
larvae	39,74	—	34,62	59,25	19,40	64,47	27,22	—	—	—	—
pupae	5,95	55,5	12,70	27,80	57,84	25,6	3,87	—	—	—	—
Plecoptera, larvae	1,30	12,35	—	—	9,55	—	4,82	—	—	—	—
Heptageniidae											
Diptera,	6,52	2,84	—	1,32	—	—	15,85	—	—	—	—
larvae	4,79	—	7,35	—	—	—	14,50	—	0,55	1,65	1,70
imago	—	6,0	3,74	—	—	—	—	83,15	61,80	49,65	35,27
Agrypnia sp.	4,80	—	0,35	—	—	—	1,91	3,20	0,40	10,50	12,69
Molanna palpata	—	—	1,53	—	—	—					
Mystacides sp.											

TABLE 11, continued

Продолжение табл. 11

Состав пищи	Яракваам				Правый Илирней			Камешковая			
	июнь				июль			август			
	Возраст										
	5+	6+	7+	8+	4+	5+	7+	5+	6+	7+	8+
Apatenia sp.	—	—	—	—	—	—	6,35	7,34	26,90	23,13	8,67
Limnophilus stigma	—	—	—	—	—	—	—	4,0	0,18	2,07	1,85
Oligoplectrodes sp.	—	—	—	—	—	—	—	0,40	0,43	0,23	—
Trichoptera, larvae	—	—	10,42	—	—	—	—	—	—	—	—
Coleoptera larvae	—	2,84	1,18	—	—	—	0,97	—	0,13	—	—
Carabidae, imago	0,77	—	—	—	—	—	—	—	—	—	0,46
Elateridae	—	—	0,54	—	—	—	—	—	—	—	—
Byrrhidae	—	—	—	—	—	—	—	—	—	0,12	—
Cerambycidae	—	—	—	—	—	—	—	—	0,09	0,14	—
Curculionidae	0,96	—	—	—	—	1,36	—	—	—	—	—
Hymenoptera	7,65	—	—	—	—	—	21,60	—	—	—	—
Siricidae	—	—	—	—	—	—	—	0,70	0,42	2,25	—
Tenthredinidae	—	—	—	—	—	—	—	—	—	—	1,30
Ichneumonidae	0,08	1,90	2,98	—	—	—	0,29	—	—	—	—
Vespidae	—	—	1,48	—	—	—	2,42	—	2,10	0,87	—
Formicidae	—	0,87	0,49	0,66	—	—	—	—	2,57	0,87	1,31
Odonata, larvae	—	—	0,37	—	—	—	—	—	—	—	1,89
Valvata sibirica	—	—	—	—	—	1,30	—	—	—	—	—
Pisces	—	—	0,27	—	—	—	—	—	—	—	—
Sorex araneus	—	—	—	—	—	—	—	—	3,65	6,65	26,75
Microtus hyperboreus	—	—	—	—	—	—	—	—	—	—	6,35
Nostoc	—	—	—	—	—	—	—	—	0,34	—	—
2 Растительно-детритная масса	21,12	—	7,53	1,12	3,66	4,27	—	1,21	0,04	1,87	0,76
3 Галька	0,46	—	0,62	—	—	—	—	—	—	—	—
4 Перо птиц	—	—	—	0,33	—	—	—	—	—	—	—

Table 11

Contents of various organisms (in % by weight) in the diet of grayling of different age-groups in the rivers of the Ilirnei system during the summer of 1964-1965, and in Kameshkovaya river in 1966-1967.

1--Composition of food; 2--Vegetable-detrital mass; 3--Pebble; 4--Feathers of birds; 5--Yarakvaam; 6--Pravyi Ilirnei; 7--Kameshkovaya; 8--June; 9--July; 10--August; 11--Age.

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Feeding patterns of grayling from the rivers and lakes of the Ilirnei-Anyui system thus reveal local variations determined in time and space by the concentration of food organisms. It has been also observed that grayling feed here on insects of the air, gathering from the surface the insects dropping into the water or flying over it. In order to do so, grayling may leap to a height of 1.0 m above the water surface, a feature characteristic of all the representatives of the genus Thymallus.

Grayling of different age feed at a varying rate during the summer and autumn in the rivers and lakes of the Ilirnei system, as well as in M. Anyui and Kameshkovaya rivers (Table 12).

Табл. 12.

Таблица 12. *Общий средний индекс (‰) наполнения желудков разновозрастного хариуса водоемов Илирнейской системы в летне-осенний периоды 1964—1965 гг. и реках Б. и М. Анюев* в 1966—1967 гг.*

Возраст 1	2 Июнь: р. Яраквaам 6	Июнь: р. М. Анюй 7	Июнь: р. Камешковая 8	3 Июль: р. Яраквaам 9	Июль: р. Пр. Илирней 10	4 Август: р. Яраквaам 11	Август: р. Камешковая 12, 1966	Август: р. Камешковая 12, 1967	5 Сентябрь: р. Камешковая 13	Сентябрь: оз. Н. Илирней 14
4+	—	71,5	—	29,6	114,6	—	—	—	61,0	—
5+	46,8	—	44,3	79,6	77,0	42,7	31,6	67,0	24,2	—
6+	103,0	47,0	90,4	—	—	48,1	41,5	46,7	29,6	58,6
7+	39,8	—	108,0	30,6	69,5	39,8	71,5	39,4	78,5	127,6
8+	30,9	—	66,5	—	—	73,5	—	20,6	—	24,2
9+	—	—	122,0	—	—	—	—	31,2	—	—
10+	—	—	29,4	—	—	—	—	—	—	—

* Б. Анюй — р. Камешковая.

Table 12

General mean index of fullness (o/o oo) of grayling of different age from the rivers and lakes of the Ilirnei system during the summer and autumn periods of 1964-1965, and in B. and M. Anyui* rivers in 1966-1967.

1--Age; 2--June; 3--July; 4--August; 5--September; 6--Yarakvaam river; 7--M. Anyui river; 8--Kameshkovaya river; 9--Yarakvaam river; 10--Pr. Ilirnei river; 11--Yarakvaam river; 12--Kameshkovaya river; 13--Kameshkovaya river; 14--N. Ilirnei lake.

*B.. Anyui-Kameshkovaya river.

In June the greatest length and weight were recorded in grayling from Kameshkovaya river; in July grayling of the same age from Yarakvaam and Pravyi Ilirnei rivers were equal

in length; the largest grayling of age less than 6+ was recorded in August 1967 in Kameshkovaya river, while grayling of older year-classes were here considerably smaller than grayling of age 6+ from Yarakvaam river.

With regard to the rate of growth in length and in weight (Table 4), grayling from the lakes and rivers of the Ilirnei system and from the tributaries of B. Anyui (Kameshkovaya river) differ but little from grayling found in Kolyma river (Novikov, 1966), Indigirka (Kirillov, 1955) and Chistoe lake (Degteva, 1965). It may thus be surmised that trophic conditions are as favourable for grayling in the Ilirnei-Anyui system as in other northern rivers and lakes.

Pike (Esox lucius / L. /). In Kameshkovaya river pike is a predator during the summer months. In June grayling, minnow, sculpin (Cottus poecilops) are the principal components of the food bolus in pike. In July the food spectrum of pike is larger and salmonoids are the principal food items in its diet (47.4% of weight) alongside perch, voles and young birds (Table 13). In August pike feeds on Coregonus peled, grayling, its own fry (30.91%), vole and water shrew (Table 13). Its food bolus weighs up to 178-195 g. The presence of insects and representatives of the family Muridae in the stomach of this fish shows that its feeding habits are similar to those of East Siberian grayling.

The maximum index of fullness was recorded in pike from M. Anyui river in June. The composition of its food bolus was similar to that observed in pike from Kameshkovaya river, but the dominant items in it were minnow, grayling, water shrew and Siberian tetradactylous newt (Table 13).

A.S. Novikov (1966) found 16 different components in the diet of pike from Kolyma river. Furthermore, the rate of occurrence of Coregonus lavaretus pidschian, broad whitefish, cisco (fishes of the subgenus Leucichthys) and fry of the fishes belonging to the genera Coregonus and Prosopium was here fairly high in the diet of pike.

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Таблица 13. *Значение организмов* (в % по весу) *в питании щуки и окуня в летний период 1966 г.*

1 Состав пищи	3 р. Камешковая			4 М. Анюй	5 р. Б. Анюй		
	6 Виды рыб						
	7 щука			8 окунь			
	9 июнь	10 июль	11 август	12 июнь	13 июль	14 июль	15 август
Lynceus brachyurus	—	—	—	—	—	26,2	—
Trichoptera, larvae	—	—	—	—	—	0,25	—
Gammarus lacustris	—	—	—	—	18,75	18,40	—
Coleoptera, larvae	—	—	—	0,93	6,25	—	—
Cyprinidae	—	2,50	—	—	18,75	—	17,25
Phoxinus sp.	42,30	—	—	60,52	—	—	—
Perca fluviatilis L.	—	21,40	—	—	18,75	—	14,7
Acerina cernua	—	—	9,40	—	—	—	—
Cottus poecilopus	8,35	—	1,29	2,42	37,50	55,05	68,05
Esox lucius L.	—	1,75	30,91	—	—	—	—
Lota lota L.	—	—	1,90	—	—	—	—
Coregonus peled Gmel.	—	39,20	31,80	—	—	—	—
Thymallus arcticus pallasi Val.	49,35	8,20	18,50	22,20	—	—	—
Cottus hyperboreus Vin.	—	—	—	6,95	—	—	—
Hynobius keyserlingi (Dyb.)	—	—	2,48	4,65	—	—	—
Sorex araneus	—	—	2,46	—	—	—	—
Microtus oeconomus	—	22,0	1,26	2,33	—	—	—
Aythya fuligula L. (juv.)	—	4,95	—	—	—	—	—
2 Средний общий индекс наполнения желудков, ‰	19,4	36,8	32,0	28,0	18,70	—	—

Table 13

Contents of various organisms (in % of weight) in the diet of pike and perch during the summer of 1966.

1--Composition of food; 2--General mean index of fullness, o/o oo; 3--Kameshkovaya river; 4--M. Anyui river; 5--B. Anyui river; 6--Fish species; 7--Pike; 8--Perch; 9--June; 10--July; 11--August; 12--June; 13--June; 14--July; 15--August.

1 Месяц	5 Длина, мм				6 Вес, г			
	7 р. Камешковая		8 р. М. Анюй		9 р. Камешковая		10 р. М. Анюй	
	11 средн.	12 колеб.	11 средн.	12 колеб.	11 средн.	12 колеб.	11 средн.	12 колеб.
2 Июнь	425	325—468	479	420—514	840	613—1 031	1 107	695—1 159
3 Июль	620	470—680	—	—	2 480	825—3 030	—	—
4 Август	500	463—640	—	—	2 350	695—2 832	—	—

Table 14

Mean length and weight of pike during the summer of 1966.

1--Month; 2--June; 3--July; 4--August; 5--Length, mm; 6--Weight, g; 7--Kameshkovaya river; 8--M. Anyui river; 9--Kameshkovaya river; 10--M. Anyui river; 11--Mean; 12--Range of variations.

The rate of growth in length and in weight (Table

14) of pike from B. and M. Anyui rivers is the same as the rate recorded for pike from other bodies of water (Efimova, 1949; Podlesnyi, 1945; Kirillov, 1962; Karantonis et al., 1956; Novikov, 1966).

Perch (Perca fluviatilis L.) from Bol'shoi Anyui river feed on goby, Cyprinidae and other perch (Table 13).

In June and August perch consumed equal quantities of amphipods and phyllopods (August). A.S. Novikov (1966) found planktonic organisms and amphipods in the stomachs of perch from Kolyma river. The mean length and weight of perch from B. Anyui river (Table 4) are somewhat smaller than those recorded for Kolyma perch of the same age.

Burbot (Lota lota L.). In B. Anyui river feeding habits of burbot are probably similar during the summer to those observed for pike, since the food bolus of the two burbots examined consisted exclusively of fish remains. The burbots were caught on June 21, 1966, had a length of 440 and 586 mm and a weight of 600 and 1300 g, respectively.

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CONCLUSION.

The three species of salmonoids, i.e. round whitefish, Coregonus peled and char, do not compete for food in Nizhnii Ilirnei lake in June. In July sexually immature round

whitefish feed and forage in this lake and compete for Chironomidae with both "peled" (36.1% by weight) and char (42%).

The degree of similarity in the composition of the food consumed by "peled" and round whitefish in August decreases in Nizhnii Ilirnei lake (2.91%), while the similarity between the diet of "peled" on the one hand, broad whitefish and "pidschian" on the other, is greater (Table 15).

Таблица 15. *Степень сходства пищи* (в % по весу) *лососевидных рыб в оз. Нижний Илирней в летне-осенний период 1964—1965 гг.*

1 Месяцы	6 Виды рыб	Пелядь 7	Чир 8	Пыжьян 9	Валек 10	Голец 11	Харпус 12
2 Июнь	13 Пелядь	—	—	—	—	—	—
	14 Валек	0	—	—	—	0	—
	15 Голец	0	—	—	0	—	—
3 Июль	16 Пелядь	—	—	—	36,1	6,59	—
	17 Валек	36,1	—	—	—	42,24	—
	18 Голец	6,59	—	—	42,24	—	—
4 Август	19 Пелядь	—	7,30	6,77	2,91	—	0
	20 Валек	2,91	0,45	20,4	—	—	0
	21 Чир	7,30	—	5,24	0,45	—	0,37
	22 Пыжьян	6,77	5,24	—	20,4	—	1,30
	23 Харпус	0	0,37	1,30	0	—	—
5 Сентябрь	24 Чир	—	—	—	—	—	4,46
	25 Голец	—	0	—	—	—	2,84
	26 Харпус	—	4,46	—	—	—	—

Table 15

1--Months; 2--June; 3--July; 4--August; 5--September; 6--Fish species; 7--"Peled"; 8--Broad whitefish; 9--"Pidschian"; 10--Round whitefish; 11--Char; 12--Grayling; 13--"Peled"; 14--Round whitefish; 15--Char; 16--"Peled"; 17--Round whitefish; 18--Char; 19--"Peled"; 20--Round whitefish; 21--Broad whitefish; 22--"Pidschian"; 23--Grayling; 24--Broad whitefish; 25--Char; 26--Grayling.

The highest degree of similarity was observed at that time in the composition of the diet of round whitefish and "pidschian", both of which fed on Chironomidae of all the growth stages. On the whole the degree of similarity observed in August in the composition of food of the fishes belonging to the genera Coregonus and Prosopium was slight in Nizhnii Ilirnei lake.

In the summer there is virtually no East Siberian grayling in the lake, since it migrates into the rivers and their tributaries earlier than the other fish.

Grayling is the most abundant species in the rivers and it competes here for food with all the salmonoids (Table 16).

Таблица 16. *Степень сходства состава пищи* (в % по весу) *рыб в р. Яракваам в летний период 1964—1965 гг.*

1 Месяц	5 Виды рыб	6 Пелядь	7 Чир	8 Пыжьян	9 Валек	10 Харпус
2 Июнь	11 Пелядь	—	21,35	18,08	29,73	24,92
	12 Чир	21,35	—	58,55	33,13	17,07
	13 Пыжьян	18,08	58,55	—	31,37	25,23
	14 Валек	29,73	33,13	31,37	—	28,35
	15 Харпус	24,92	17,07	25,23	28,35	—
3 Июль	16 Чир	—	—	63,85	—	0
	17 Пыжьян	—	63,85	—	—	13,04
	18 Харпус	—	0	13,04	—	—
	19 Пелядь	—	5,80	12,49	5,80	7,71
4 Август	20 Чир	5,80	—	54,82	0	43,30
	21 Пыжьян	12,49	54,82	—	19,59	42,93
	22 Валек	5,80	0	15,59	—	18,40
	23 Харпус	7,71	43,30	42,93	18,40	—

Table 16

Degree of similarity in the composition of the diet (in % of weight) of fish from Yarakvaam river

during the summer of 1964-1965.

1--Month; 2--June; 3--July; 4--August; 5--Fish species; 6--"Peled"; 7--Broad whitefish; 8--"Pidschian"; 9--Round whitefish; 10--Grayling; 11--"Peled"; 12--Broad whitefish; 13--"Pidschian"; 14--Round whitefish; 15--Grayling; 16--Broad whitefish; 17--"Pidschian"; 18--Grayling; 19--"Peled"; 20--Broad whitefish; 21--"Pidschian"; 22--Round whitefish; 23--Grayling.

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During the first ten days of June grayling enters the rivers of the Ilirnei system for spawning. This migration may be regarded as a spawning and feeding migration, since the index of fullness is then at the maximum level in both male and female grayling with ripe gametes. The general mean index varies during this period between 30.9 and 103.0 o/o oo (Table 12). After the spawning the intensity of feeding is even greater. The degree of similarity between the diet of this fish and of Coregonus and Prosopium representatives is fairly high. Between June and August grayling competes therefore for Chironomidae, dipterous insects, and caddis fly with "pidschian," "peled" and broad whitefish, which feed in the same tributaries, as well as with broad whitefish at the time of its migration to Verkhnii Ilirnei lake.

The diet of "peled" from Yarakvaam river also reveals a marked similarity to the diet of adult round whitefish, broad whitefish and "pidschian." It would scarcely be

justifiable to speak of competition between the two latter species, since broad whitefish is found nearly everywhere (Figs 2 and 3) and does not form large concentrations during the feeding and foraging period. Similarity in the food spectrum of broad whitefish and pidschian may be regarded as evidence in support of A.A. Shorygin's (1952) hypothesis that taxonomically affinitive species reveal a greater degree of similarity in the composition of their diets.

Pike in M. Anyui and Kameshkovaya rivers reduces the abundance of Cyprinidae, Percidae and salmonoids and competes with perch for sculpin (Cottus poecilops), with Coregonus and Prosopium--for crustaceans.

Generally speaking, trophic chains are short (i.e. consist of three or four levels) in the lakes and rivers of the Ilirnei-Anyui system. For example, the food chain of "peled" has three levels: phytoplankton $\rightarrow \begin{matrix}\text{zooplankton} \\ \text{zoobenthos}\end{matrix}$ "peled." "Peled" is a secondary consumer in this chain. The food chain of pike consists of four levels: phytoplankton → zooplankton → "peled" → pike.

Pike is a tertiary consumer. Trophic links between salmonoids from the lakes and rivers investigated, are realized through Chironomidae, molluscs and other organisms.

In spite of their narrow food spectrum, all the fish species from the bodies of water examined have a satisfactory rate of growth in length and in weight, a circumstance evidencing the presence of adequate food supplies.

During the summer and autumn months salmonoids feed essentially on various representatives of Phylopoda, Cladocera, Copepoda, Trichoptera, Diptera (Chironomidae, Limonidae), Mollusca.

Distribution of fish during the feeding and foraging period is determined by the concentration of these food organisms, a circumstance corroborated by the fact that in certain instances individual species or groups of fish may be monophagous.

No conspicuous variations determined by age or sex have been observed in the feeding patterns of salmonoids from the Ilirnei-Anyui system. Nearly all the species reveal, however, certain local and seasonal variations in their feeding patterns. Intensity of feeding of the fish is (according to our data) relatively low during the summer and autumn period.

The greatest degree of similarity in the composition of food has been observed in the fishes belonging to the genera Coregonus and Prosopium. In June grayling competes with these fishes in the rivers for Chironomidae, dipterous insects and caddis fly, later on during the summer--for Chironomidae of all the different growth stages.

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