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The composition of the food of the European grayling and the character of its feeding has been studied fully enough, but this knowledge is scattered in the literature and often contradictory. The sole compendium work devoted to data on the topic is that of J. Dahl (1962), but it is incomplete (about 30 names, out of which only 2 are Soviet authors), and does not contain, with rare exceptions, analysis of the results of different investigations. Therefore the proposed short outline of the history of the study of the problem with a description of the basic data on the feeding of the grayling in different geographical areas is presented as expedient and opportune, primarily in relation to the determination of immediate problems and the trend of research.

Judging by the antiquity of the method of catching grayling on larval and adult insects (Elian et al., cited by Castel, 1802), some features of its feeding were familiar to people in ancient times. Nevertheless the first brief information known to the author on the food spectrum of grayling appeared in the last century (Castel, 1802; Yarrell, 1836; Gunther, 1853; Heckel & Kner, 1857; Siebold, 1863; Kessler, 1864; Warnimont, 1870; Seeley, 1886; Couch, 1887; Day, 1887; Smitt, 1895 and others). Already then F. Day (1887) could say that the grayling consumes all food which it can find moving around on the bottom, counting it, consequently, as an omnivorous fish. Besides the usual components of the food, as attested by W. Yarrell (1836) and J. Couch (1887), it often swallows sand and pebbles, and J. Couch mentions even grains of gold and diamonds found in the stomach of the grayling. Many publications containing materials on the feeding of the grayling appear in the current century (Bade, 1902; Trybom, 1907; Antipa, 1909; Sabaneev, 1911; Navozov, 1912; Jääskeläinen, 1913, 1917; Huitfeldt-Kaas, 1917; Smolian, 1920; Willer, 1924; Vladykov, 1926; Malzan, 1931; Zinova, 1933; Birulya, 1934; Probatov, 1934, 1936; Chernov, 1934; Somme, 1935; Platts, 1936; Scheuring, 1936, cited by Dahl 1962; Svetovidov, 1936; Ehnholm, 1937; Nerescheimer, 1937; Gerrish, 1938, 1939; Margreiter, 1938; Dyk, 1938, 1939, 1951, 1956, 1958, 1960; Seez, 1939; Limbert, 1939; Krasnovskaya, 1939; Redforth, 1940; Alm, 1942; Teplov, 1943; Nikol'skii with coauthors, 1947; Schindler 1953; Dunn, 1954; Mel'yantsev, 1954; Müller, 1954a,b, 1961; Ostroumov, 1954; Ivasik, Kulakovskaya, 1954; Solovkina, 1956, 1962, 1966; Vladimirskaya, 1957; Derendyaev, 1957; Vlasova, 1959; Mikhin, 1959; Jankovic, 1960, 1964; Dahl, 1962; Zakharenko, 1962; Kir'yanova, 1962; Kuchina, 1962; Bukirev & Zinov'ev, 1962; Solewski, 1963; Shaposhnikova, 1964; Zhirkovich, Kasanskii, 1965 and others). We consider the feeding of different populations of the species in various geographical locations, travelling from west to east.

In water-bodies of Great Britain the grayling feeds on insects, their larvae (Plecoptera, Phryganea, Ephemera, Libellula), small molluscs (Physa, Neritina), crustaceans (Yarrell, 1836; Day, 1887), and does not overlook eggs of trout (Gerrish, 1936). According to the data of J. Limbert (1939), the predominant food of the species is not uniform for different water-bodies. A population from the River Tweed feeds on the main forms of chironomid larvae and pupae (50% of all food), with the Derbyshire grayling the basic food consists of Planorbis, in Hampshire of Gammarus pulex. The same author suggests a decrease in the importance of gammarids in the food ration of the species in a direction from north to south and more intensive feeding in spring than autumn. On the variety of food and the leading role of benthic food in grayling of the British Isles attention is given also by Platts (1936), Radforth (1940) and Dunn (1954).

The basic food of grayling in the waters of Luxembourg in the middle of the last century consisted of invertebrate animals : adult insects, their larvae and molluscs (Limnea, Succinea; Warnimont, 1870). Similar data on the feeding of grayling in the water-bodies of Germany (larval and adult insects, worms, molluscs, small fish and fish-eggs) are given by Bade (1902), Vogt & Hofer (1909), Smolian (1920), Malzan (1931), Seez (1939), Schindler (1953), Dunker (1960), and other authors. This information differs a little from reports of studies of the last century. Sheuring (1936, cited by Dahl, 1962) determined that the topography of the habitat of the grayling is responsible for the character of its feeding, and suggested the idea of primary benthophagy for the species, based on the facts of low utilization as food of falling insects in the presence of a rich benthos. The composition of the food of grayling in small rivers of Denmark was analysed in detail by Dahl (1962).

It appears that the food of the grayling changes during the year, and these changes are connected chiefly with biological fluctuations of the food organisms. Independently of the character of the habitat in Danish water-bodies the grayling is based preeminently on the bottom fauna. The most important food items (by numbers and frequency) appear to be Amphipoda, Gastropoda, mayfly nymphs, caddis larvae, chironomids, and also pupae and larvae of Simulium. With age and growth are increased in feeding: the role of obligate benthic animals and the mean dimensions of the consumed food. The author ascertained that the grayling changed over to enforced feeding on terrestrial insects in a case where the bottom fauna and organic drift of aquatic and semi-aquatic origin were inadequate either in quality or quantity.

Benthic forms dominate also in the feeding of Norwegian populations of the species (molluscs, stonefly larvae - Huitfeldt-Kaas, 1914; Somme, 1935) and in fish of the Gulf of Bothnia (caddis larvae, Gammarus, molluscs, Mesidothea and others - Ehnholm, 1937). It is noteworthy, that gammarids constitute a significant part of the ration not only of the young, but also of adult individuals (28 - 52 cm) of brackish-water grayling. The general character of feeding of the grayling in water-bodies of Sweden is described in the work of Smitt (1895) and Triboma (1907). Especially is this problem dealt with by K. Müller (1961), studying the stomach contents of 848 fish from the basin of the River Lule-älv. Müller discovered that in the food of fingerlings (August - October) living in rivers emerging from lakes, plankton was dominant (Gammarus), whereas in a river at a large distance from a lake chironomid larvae prevailed. The consumption of Simulium larvae and pupae, especially in July, appears as the characteristic feature of the feeding of 2 - 9 year old fish, whereas in June Ephemeroptera and Chironomidae prevail. In October, November and February the basic food comprises larvae of Trichoptera with a small quantity of Ephemeroptera and Plecoptera larvae. On the whole benthic animals appear as the main food also in Swedish populations of the species although in summer airborne insects also are eaten up by the latter. Feeding is different not only by season and age-group (one- to eight-year are considered together by the author, but separately from fingerlings), but also in different rivers of the Lule-älv basin. In this case Müller definitely speaks in favour of the preference of grayling for molluscs and beetles.

In the food of grayling of the R. Kema are found the larvae of caddis, midges, stoneflies, chironomids (Jääskeläinen, 1914). Judging by frequency, the basic food of the grayling from the Rogoznik stream (Poland, Solevskii 1963) consists of insects - Diptera (midges, chironomids), Plecoptera, to a lesser degree Ephemeroptera. At the same time by weight about 70% of the food consists of Coleoptera. In the feeding of the grayling in Czechoslovakian water-bodies (R. Laba system, Danube), a leading role is played by the bottom fauna-caddis larvae, chironomids, molluscs, whereas terrestrial insects have less importance (Dyk, 1939, 1951, 1956). In Carpathian rivers and streams

the main place in the food of this fish is also taken by caddis larvae, chironomids, molluscs (*Ancylus*), on warm days not infrequently ants, ichneumon wasps, small beetles (*Elateridae*, *Curculionidae* and others), midges (Dyk, 1958). According to E.K. Vlasova (1959), the Carpathian grayling consumes larvae of insects - 41% by weight (37.1% due to caddis's share), adult insects - 24.5% by weight of the food (of these more beetles and Orthoptera, less Diptera and Hymenoptera), molluscs - 22%, gammarids - 8.9% and plants - 0.6%.

Fairly important investigations of the food spectrum of grayling in water-bodies of Yugoslavia were made by D. Jankovic (1960). Thus, in the R. Lucha (the most southerly population in Europe, at a height above sea level of about 1000 m) the main food objects in all seasons were Ephemeroptera, Trichoptera, Plecoptera and Diptera. Saltatoria, Odonata, Hemiptera, Neuroptera, Lepidoptera, Coleoptera, Hymenoptera and Araneina (in the work, data and species list) were usually found in small quantities. Judging by the data of Zivkovitch & Kasanski (1965), the grayling in rivers of Bosnia and Herzegovina appear to have as their basic food larvae of midges in the period of their maximal growth (May - June).

The feeding of lacustrine grayling of Volchya and Monchetundra is based on larvae of stoneflies, caddis, and imagines of Coleoptera (Zinova, 1933). Of little importance are gammarids, mosquitoes, ants, fish and other groups of animals. There are various foods of grayling in lakes of the Imandra basin (Vladimirskaya, 1957), although they basically comprise insects, especially larvae of caddis and midges. In winter the filling of the stomach is poor (of one or two components, principally caddis larvae), in spring it increases. According to quantity of components and the visual fullness of the stomach, the maximal intensity of feeding in lacustrine fish is found in summer, at this time the major role is of adult stages of insects. In autumn the feeding again becomes varied. Of interest are the observations of V.K. Chernov (1934) on the feeding of the grayling of the R. Oredez and a series of other rivers of the basin of lakes Ladoga and Onega. The author noted that 2 - 3 months old fry already feed on the same organisms as adult fish. After 5 - 6 years "surface" and "bottom" feeding are distinguished in the grayling, with the first confined to the evening hours and the second to the morning. During spawning the grayling are weak and then do not feed at all, and the period of maximal intensity of feeding in the diel aspect does not remain constant throughout the year.

The chief food for Mezen populations of the species consists of caddis (larvae), but in 60% of stomachs were found aerial insects and in 40%, larvae of mayflies (Ostroumov, 1954). The grayling of one of the most northerly populations in the territory of the USSR - of the River Mezen consumes basically crustaceans - Amphipoda, chironomids and caddis. Isopoda, Coleoptera, Hymenoptera and other groups of organisms are rare in the food (Svetovidov, 1936). Following many other authors the non-discrimination of the grayling in relation to food and the leading role of the benthos in it is noted also by A.N. Probatov (1936) for populations from the River Kara. In the middle course of the river they prefer larvae of caddis and mayflies, in the mouth a significant place is taken by an amphipod (*Pontoporeia affinis*) and the marine isopod *Mesidothea entomon*. Mixed food in summer (at the bottom and the surface) and the seasonal changes in it are noted by L.N. Solovkina for the tundra Vashutkin lakes. In summer (July-August) here molluscs are dominant (*Radix ovata*, *Giraulus acronicus*), in September the role of chironomids (18% by weight) and algae increases, in October the ration consists almost entirely of fish (95% of weight of food in large individuals of length 33.3 - 49.4 cm). The best-studied among the native water-bodies in relation to feeding of grayling is the Upper Pechora (Krasnovskaya, 1939; Teplov, 1943; Nikol'skii et al., 1947)

with its tributaries (Solovkina, 1956, 1962; Kuchina, 1962). For Pechora grayling are revealed the seasonal fluctuation of the qualitative composition of the food, differences in feeding of fish from different parts, size-age changes, the universal prevalence in the food of benthic invertebrates (larvae of caddis, mayflies, chironomids) with a significant role, especially in autumn, of fish and small mammals (Teplov, 1943), the almost complete absence in the ration of young fish of crustaceans, and a number of other points.

In the feeding of the grayling from the basins of the rivers Beloye and Ural the chief place is taken by the larvae of caddis (especially Limnophilidae) and chironomids, although not infrequently in the stomach of the fish are found beetles, mayflies, midges and other insects, molluscs and, less commonly, spiders, leeches, worms, crustaceans and algae (Shaposhnikova, 1964). For fish of the R. Berezova especially the peculiar feeding is on caddis larvae, in the fry more often small forms of chironomids and mayflies are found (Krasnovskaya, 1939). In the composition of the food of grayling of the Kama basin are numbered 25 groups (orders) of animal and plant organisms, but usually 2 - 4 groups dominate. In all water-bodies of the Kama area, besides streams, where more than 50% of the food of grayling by weight comprises terrestrial insects, the benthic type of feeding prevails (Zinov'ev, 1967, 1969). The qualitative composition of the food of males and females, according to the data of Dahl (1962), somewhat differs. The maximal intensity of feeding of fish of both sexes and all ages (except 0+ year) is observed in summer. In the feeding of Vishera grayling is traced the diel rhythm, the seasonal, age, biotope and yearly variability (Zinov'ev, 1967). In the majority of cases two peaks of feeding activity are noted: morning and evening (the hours are different for separate ages), of which the more important in summer and autumn is the latter (in May - the morning). The features of the food spectrum and consumption of single-type food in streams, small rivers and rivers are described in one of the papers of the author in the present symposium. On the whole, the basic food for Kama populations of the species comprises insects, almost all larvae and imagines of caddis, mayflies, dipterans, hymenopterans, beetles and Homoptera.

Many authors note that the grayling swallows eggs of salmon (Castel, 1802; Smitt, 1895; Bade, 1902; Sabaneev, 1911; Gerrish, 1936; Mikhin, 1958; Dunkev, 1960; Müller, 1961, and others), nelma [*Stenodus* sp.] (Kuchina, 1962), trout (same authors), smelt, taimen [*Hucho*], whitefish (Dryagin, 1960), Nase [*Chondrostoma*] (Penaz, Lusk, 1965), and its own. In the food of grayling of the Kama basin eggs of fish are found very rarely (in 6 out of 151 stomachs in the spawning period), while its own and taimen eggs were discovered in the stomach of the grayling only once (3-4 eggs), and eggs of minnow in 5 cases. Inasmuch as the grayling gathers eggs from the surface of the bottom, then it is unlikely that it brings significant damage to the salmon stock, as was thought long ago (with the exception of some "Atlantic salmon" rivers).

A rather common component of the food of the species is fish. Thus, in waters of the Gulf of Bothnia, the grayling eats sticklebacks (Rosen, 1920; Segerstrale, 1947), sculpins (Huitfeldt-Kaas, cited by Dahl, 1962), gudgeon (Ehnholm, 1937), in rivers of Germany minnows (Dunker, 1960), in Sweden whitefish, perch, roach, sculpins, (Tribom, 1907), brook lamprey, minnows, sticklebacks (Müller, 1961). K. Müller reckons that the grayling changes to fish food in lakes and ponds sooner than in rivers, and usually at an age not younger than 6 years. The ration of the grayling varies from minnows in Lake Ladoga (Jääskelainen, 1917) to sticklebacks in lakes of Monchetundra and the River Oredezh (Zinova, 1933; Chernov, 1934), stickleback, ruff, grayling, young salmon in the basin of L. Imandra (Vladimirskaya, 1957). In Carpathian rivers

the grayling also occasionally catches small fish, especially Cottus poecilopus (Dyk, 1958). In the River Kara young whitefish, gobies, and sticklebacks are found in grayling stomachs (Probatov, 1936). In Pechora populations of the species are found in their stomachs sculpins, Nemachilus, minnows and lamprey larvae. The Kama grayling eats the same fish as the Pechora, excepting lampreys (Zinov'ev, 1967), and occasionally catches spiny loach. Consequently, a fish diet of European grayling in various geographical locations is not less rich and varied than food from insects, molluscs, worms, crustaceans and other groups of animals.

In the food of large grayling of the Pechora a significant place is taken by terrestrial vertebrates - shrews (Teplov, 1943), in rivers and lakes of the Kol'sk peninsula - voles and lemmings (Berg & Pravdin, 1964), in rivers of the Kama basin - sometimes shrews. Evidently grayling can be called polyzoophagous in spite of the fact that in most water-bodies remnants of plant food are found in their stomachs. Here Margreiter (1938) recognises berries, leaves and seeds of grasses as of definite food value, whereas other authors count plants as incidental and inadvertent food.

It is impossible not to mention that the quantitative-weight method in the study of the feeding of grayling found its application chiefly in our country, abroad it was used only in latter years (moreover, usually instead of % by weight was calculated % of number of examples of the different components - Müller, 1954, 1961; Dahl, 1962). The most full and detailed study of the food of the grayling is in the rivers of Sweden, Denmark and Jugoslavia, and the basins of the Pechora and Kama.

Summarising the foregoing, we come to the following conclusions:

1. The appearance of polyphagy in the grayling is most likely connected with a deficiency of the preferred food and indicates the high adaptive potential of the species.
2. The predominant food for populations is determined by the local composition of the fauna. In most cases the basic food of grayling consists of benthic animals. Terrestrial insects and fish enter into the composition of "supplementary" food. There are observed sexual, size-age, diel, seasonal, annual, local and inter-population variability in feeding. To the primary problem of investigation of the feeding of the grayling, apart from the establishment of regional and population characteristics, one must attribute: more exact definition of the diel rhythm and diel ration, detailing of the size-age changes and sexual differences (qualitative and quantitative characters), establishment of the calorificity and assimilability of the different components, determination of the selectivity of feeding and speed of digestion of various foods in relation to the age of the fish and the season of the year.

REFERENCES

Нельзя не отметить, что количественно-весовая методика при изучении питания хариуса нашла применение главным образом в нашей стране, за рубежом она используется лишь в последние годы (к тому же обычно вместо % по весу, подсчитывается % числа экземпляров отдельных компонентов — Мюллер, 1954, 1961; Даль, 1962). Наиболее полно и подробно изучено питание хариуса в реках Швеции, Дании и Югославии, в бассейне Печоры и Камы.

Резюмируя вышесказанное, приходим к следующим выводам: 1. Явление полифагии у хариуса скорее всего связано с недостатком излюбленной пищи и свидетельствует о высокой адаптивной способности вида. 2. Доминирующую пищу для популяции определяет местный состав фауны. В большинстве случаев основой питания хариуса служат бентические животные. Наземные насекомые и рыба входят в состав «добавочного» корма. 3. Наблюдается половая, размерно-возрастная, суточная, сезонная, годовая, локальная и межпопуляционная изменчивость в питании. К первоочередным задачам исследования питания хариуса, помимо установления региональных и популяционных особенностей, следует отнести: уточнение суточной ритмики и суточного рациона, детализацию размерно-возрастных изменений и половых различий (качественная и количественная характеристика), выявление калорийности и усвояемости отдельных компонентов, определение избирательности питания и скорости переваривания разного корма в связи с возрастом рыбы и сезоном года.

ЛИТЕРАТУРА

- Берг Л. С., Правдин И. Ф. 1964. Рыбы рек и озер Кольского полуострова. Сб. «Природа Мурманской области». Мурманск.
- Бирюля А. А. 1934. Материалы для изучения пищевого режима промысловых рыб реки Кары и Карской губы. Материалы научно-промыслов. обслед. Карской губы и р. Кары. Изд. ВНИРО.
- Букирев А. И. и Зиновьев Е. А. 1962. Хариус Средней Камы. Уч. зап. Пермск. гос. ун-та, т. XXII, вып. 4.
- Владимирская М. И. 1957. Хариус из озер северо-западного участка бассейна озера Имандра. Зоол. журн., т. XXXVI, вып. 5.
- Владыков В. 1926. Рыбы Подкарпатской Руси и их главнейшие способы лова. Ужгород.
- Власова Е. К. 1959. Лесосеменные рыбы (Salmonoidei) рек Закарпатья. Науч. зап. Ужгород. гос. ун-та, т. 40.
- Дерендяев П. Г. 1957. К вопросу о распространении хариусов в Удмуртии. Уч. зап. Удмуртск. гос. пед. инст.
- Дрягин П. А. 1960. Хариусы. Рыбоводство и рыболовство, № 6.
- Дых В. В. 1958. Хариус в Карпатских реках. Природа, 10.
- Захаренко В. Б. 1962. Водные жуки бассейна р. Усы и их значение в питании рыб. Сб. «Рыбы бас. р. Усы и их корм. ресурсы». АН СССР.
- Зинова А. Д. 1933. Питание рыб из озер Монче и Волчьей тундр. Тр. отд. гидрол. Ленингр. обл. гидр. упр. Мат-лы Мончез. лимн. экс.
- Зиновьев Е. А. 1967. Хариус бассейна реки Камы. Диссерт. на соиск. уч. степ. канд. биол. наук. Фонд каф. зоол. позв. Пермск. гос. ун-та.
- Зиновьев Е. А. 1969 а. Материалы по суточной ритмике питания европейского хариуса. Уч. зап. Пермск. гос. ун-та, № 163.
- Зиновьев Е. А. 1969 б. Характеристика питания хариуса в разнотипных водоемах бассейна р. Камы. В настоящем сборнике.
- Ивасик В. М., Кулаківська О. П. 1954. До вивчення умов схування лососевих Закарпатської області УРСР. Науков. зап. Львівськ. природозн. музею, т. III.
- Кесслер К. Ф. 1864. Описание рыб, которые встречаются в водах С.-Петербургской губернии. СПб.
- Кирьянова Е. С. Нематоды (Nematodes) и волосатики (Nematomorpha) в пище рыб. Сб. «Рыбы бассейна р. Усы и их кормовые ресурсы», Изд. АН СССР, М.
- Красновская М. П. 1939. Хариус реки Березовой как объект промысла. Тр. Уральск. отд. ВНИОРХ, т. I.
- Кучина Е. С. 1962. Ихтиофауна притоков р. Усы. Сб. «Рыбы бассейна р. Усы и их кормовые ресурсы». Изд. АН СССР, М.

- Мельянцева В. Г. 1954. Рыбы Пяозера. Тр. Карело-Финск. гос. ун-та, т. V, 1953, Петрозаводск.
- Михин В. С. 1959. Рыбы р. Варзуги и их взаимоотношения с молодько семги. Изв. ВНИОРХ, т. 48.
- Навозов Н. П. 1912. Материалы к ихтиофауне бассейна р. Урала. Вестн. рыбо-пром., № 8—10.
- Никольский Г. В. с соавторами. 1947. Рыбы бассейна Верхней Печоры. Мате-риалы к позн. флоры и фауны СССР. Изд. МОИП. Нов. сер., вып. 6.
- Остроумов Н. А. 1954. Рыбы реки Мезени. Изв. Коми фил. Всесоюз. геогр. общ-ва, вып. 2.
- Пробатов А. Н. 1934. Материалы по научно-промысловому обследованию Кар-ской губы и р. Кары. Сев. краев. отд. ВНИОРХ.
- Пробатов А. Н. 1936. Харнус р. Кары. Изв. Пермск. биол. инст. при Пермск. гос. ун-те, т. V, вып. 9—10.
- Сабанеев Л. П. 1911. Рыбы России. Изд. 3.
- Световидов А. Н. 1936. Европейско-азиатские харнусы (genus *Thymallus* Cuvier). Тр. Зоол. инст. АН СССР, т. III.
- Соловкина Л. Н. 1956. Материалы по ихтиофауне реки Усы, Тр. Коми фил. АН СССР, № 4.
- Соловкина Л. Н. 1962. Рыбы среднего и нижнего течения р. Усы. Сб. «Рыбы бассейна р. Усы и их кормовые ресурсы». Изд-во АН СССР, М.
- Соловкина Л. Н. 1966. Рост и питание рыб Вануткиных озер. Сб. «Гидробио-логическое изучение и рыбохозяйственное освоение озер Крайнего Севера». М.
- Теллов В. П. 1943. Значение обыкновенной землеройки и некоторых других позвоночных в питании харнуса. Зоол. журн., т. XXII, вып. 6.
- Черянов В. К. 1934. Материалы по биологии харнуса. Тр. Бородин. биол. стян. в Карелии, т. VII, вып. 2.
- Шапошникова Г. X. 1964. Биология и распределение рыб в реках уральского тива. М.
- Alm G. 1942. Harrsläktät, *Thymallus* Cuvier. In: Fiskar och fiske i Norden. Bd. 2. Sthlm.
- Antipa G. 1909. Fauna Ichtiologica a Romaniei. Bucuresti.
- Bade E. 1902. Die mitteleuropaischen Süßwasserfische. B. 2.
- Castel R. R. 1802. Histoire naturelle des poissons. T. Y, YI. P-s.
- Couch J. 1877. History of the fishes of the British Islands. IV. London.
- Dahl J. 1962. Studies of the biology of Danish stream fishes. I. The food of Grayling (*Thymallus thymallus* L.) in some Jutland streams. Medd. Danmarks fisk.-og havundersogelser, 3, N. 8.
- Day F. 1887. British and Irish Salmonidae. London.
- Dunker G. 1960. Die Fische der Nordmark. Hamburg.
- Dunn D. R. 1954. The feeding habits of the fishes and some members of the bottom fauna of Llyn Tegid (Bala lake), Merionethshire. I. Animal. Ecol., v. 5, N. 2.
- Dyk V. 1938. Srovnací studie o prirocene potravě lipana obecneho. Sbornik SAV, 13.
- Dyk V. 1939. Über die natürliche Nahrung der Asche (*Thymallus vulgaris* Nilss.). Arch. Hydrobiol., 35, N. 4.
- Dyk V. 1951. Prirözena potrava lipana ve vztahu k zivotnimi prostredi. Spisy Vysoke Skoly Veler., XYIII, 6.
- Dyk V. 1956. Nase ryby. Praha.
- Dyk V. 1958. Lipan podhorni v ruzných nadmorských polonach Cs. a Zakarpatske Ukrajiny SSSR. Biol. prace SAV, 4, 2.
- Ehnholm G. 1937. En undersökning ow skärgårdsharren *Thymallus thymallus* L. i Kvarken. Acta Soc. Fauna et Flora Fennica, 60.
- Gerrish C. S. 1938 and 1939. Scales of Avon trout and grayling. Ann. Rep. Avon Biol. Res., 5 and 6.
- Günther A. 1853. Die Fische des Neckar. Stuttgart.
- Heckel J. und Kner R. 1858. Die Süßwasserfische der Oesterreichischen Mo-narchie. Leipzig.
- Huittfeldt-Kaas H. 1914. Vekst og aldersundersökkelser hos vore ferskvandssal-menider. Fiskeriinspektörens indberetning for 1911 (1913).
- Huittfeldt-Kaas H. 1917. Mjosens fisker og fiskerier. Det. Kgl. Norske videnskabers selskabs skrifter, 1916, N. 2. Trondhjem.
- Jääskeläinen V. 1913. Anteckningar om Kemiäls fiskfauna. Finland Fiskerier, 2.
- Jääskeläinen V. 1917. Om fiskarna och fisket i Ladoga. Finlandsk fiskerier, 4.
- Jankovic D. 1960. Sistematika i ekologija lipljena Jugoslavije. Beograd.
- Jankovic D. 1964. Synopsis of biological data on European grayling *Thymallus thymallus* (Linnaeus) 1758. FAO Fish. Synopsis, N. 24. Roma.
- Limbirt J. 1939. A comparative study of the food of freshwater fishes with special reference to the Tweed. Adv. Sci., v. 1.

Malzan M. 1931. Der Mageninhalt einiger Isar—Aschen. Fisch.-Ztg., 34.

Margreiter H. 1938. Der Asch (Thymallus thymallus L.). Die Fische Tirols und Vorarlbergs, 11, N 1.

Müller K. 1954a. Investigations on the organic drift in North Swedish streams. Report Inst. Freshwater Res., N 35. Drottningholm.

Müller K. 1954b. Produktionsbiologische Untersuchungen in Nordschwedischen Teil: 2. Untersuchungen über Verbreitung, Bestandsdichte, Wachstum und Ernährung der Nordschwedischen Waldregion. Ibid..

Müller K. 1961. Die Biologie der Asche (Thymallus thymallus L.) in Lule Älv (Schwedisch Lappland). Z. Fischerei, 10, N 1—3.

Neresheimer E. 1937. Die Lachsartigen (Salmonidae). I. Handbuch der Binnenfischerei Mitteleuropas, Band 111, 5. Stuttgart.

Penaz M., Lusk S. 1965. K poznani pricin vysoké umrtnosti jiker oslroretky stehovave (Chondrostoma nasus L.) pri prirodzenom rozmnozováni. Zool listy, 14, N 2.

Platts W. C. 1936. Grayling. 11. Life history and habitat. Salmon and Trout Mag., 82. London.

Radforth J. 1940. The food of grayling, flounder, roach and gurdeon with special reference to the Tweed Watershed. J. Animal. Ecol., 9.

Rosen N. 1920. Om Norbottens saltsjöomrades fiskar och fiske. Meddel. fr. Kgl. Lanbruksstyrelsen, N 223.

Schindler O. 1953. Unsere Süßwasserfische. München.

Seeley H. G. 1886. The fresh-water fishes of Europe. London.

Seez R. 1939. Über das Alter und Wachstum der Aesche. Allgemeine Fischerei Zeitung, 64 (2, 3).

Seegerstrale C. 1947. Bidrag k ämedomen om harrrens tillväxt och voda. Fiskodling och fiskevard. Helsingfors.

Siebold C. Th. E. von. 1863. Die Süßwasserfische von Mitteleuropa. Leipzig.

Smitt F. A. 1895. A history of Scandinavian fishes. P. 11. 2 ed. Stockholm.

Smolian K. 1920. Merkbuch der Binnenfischerei. 1. Berlin.

Solewski W. 1960. Die Asche (Thymallus thymallus L.) des Flussgebiets der Sola. Acta Hydrobiol., 2, N 3—4.

Solewski W. 1963. Lipien (Thymallus Thymallus L.) poloku Rogoznik. Acta Hydrobiol., 5, N 2—3.

Somme S. 1935. Vekst og nering hos harr og orret (Thymallus thymallus L. og Salmo Trutta L.). En sammelnående studie. Nytt. Mag. f. Naturvid., 75.

Trybom F. 1907. Ichthyologische Beobachtungen auf den Laichplätzen der Lachse und Meerforellen in Unterlauf des Flusses Dalefl in Schweden. Hydrografisk Biologiska Komis. Skrifter, III.

Vogt K. und Hofer B. 1909. Die Süßwasserfische von Mitteleuropa. Leipzig.

Warnimont J. 1870. A detailed account of the natural history of the grayling. Publicat de l'Institute de Luxembourg, T. XI.

Willer A. 1924. Die Nahrungsliere der Fische. Hand. d. Binnenfisch. Mitteleur. 1.

Yarrell W. 1836. A history of British fishes. London.

Zivkovitch V., Kasanski D. 1965. Der Anteil der Kriebelmücken (Diptera, Simuliidae) in der Ernährung der Fische. Z. Fischerei, 13, N 3—4.

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Notice

Please note that these translations were produced to assist the scientific staff of the FBA (Freshwater Biological Association) in their research. These translations were done by scientific staff with relevant language skills and not by professional translators.