

Fish zones of the River Dunajec upper catchment basin

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Abstract — The distribution of fish species in the River Dunajec upper catchment basin is described. The division of the basin into two ecological fish zones, that of the trout and that of the barbel, was observed. Within the trout zone there occurs a zone of *Cottus poecilopus* which is a useful indicator of the value of waters for rearing trout and grayling fry.

Key words: Carpathian rivers, fish zones.

1. Introduction

The earliest description of the distribution of fish in the River Dunajec upper catchment basin was given by Nowicki (1866, 1867), who also presented a map of fish zones from the year 1883. Almost a hundred years later the ichthyofauna of the River Dunajec catchment basin was examined by Kolder (1961, 1964, 1967) and Bieniarz and Epler (1972). The last authors investigated the conditions of the fish population in the River Dunajec within the boundaries of the Pieniny Mountains National Park.

The present study was carried out in the years 1975—1980. Its aim was to find changes in the distribution of species known from the literature, which might occur under the influence of the increasing pollution of the water with sewage from towns and villages developing in the Dunajec basin.

2. The area of the investigation

2.1. Description of the investigated river basin

The River Dunajec (fig. 1, 2a) originates in Nowy Targ at the junction of the Czarny and Biały Dunajec streams. It flows east across the Vale of Nowy Targ (Kotlina Nowotarska), down to the Pieniny Mts (fig. 1). There it crosses the Pieniny Mts in a deep gorge and turns north-west. The northerly direction only shifts to the east in a short sector at the mouth of the Kamienica Łącka stream. The river basin of the Dunajec reaches 706 km² in Nowy Targ and increases to 4300 km² in Nowy Sącz above the Rożnów dam reservoir. It covers the area of the Tatra Mts, the Podhale region, the Beskid Mts, and the Vale of Sącz (Kotlina Sądecka). Owing to great differences in the vertical configuration and altitude above sea level, the basin has a widely varied climate (Figura 1957). In the greater part of the basin the mean annual temperatures are around 5–6°C, in the Tatra Mts reaching 4–5°C and in the Vale of Sącz



Fig. 1. Map of fish zones of the River Dunajec upper catchment area. Region 1 — *Salmo trutta m. fario*; region 2 — *Barbus barbus*; region 3 — *Collus poecilopus*; region 4 — *Thymallus thymallus*

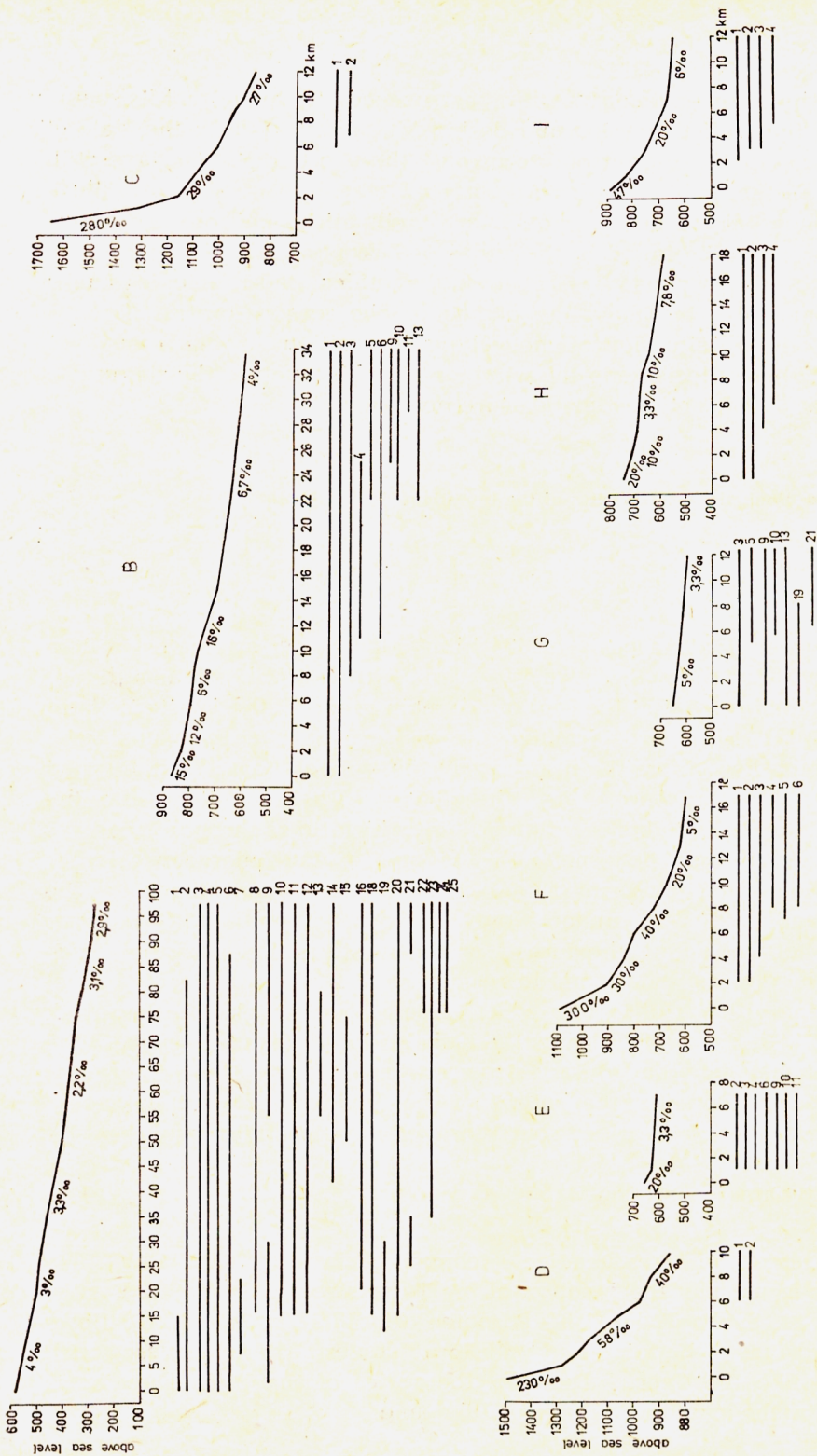


Fig. 2. The distribution of fish species of the River Dunajec upper catchment area. a — the River Dunajec; b — the Czarny Dunajec stream; c — the Siwa Woda stream; d — the Kirowa Woda stream; e — the Piekelnik stream; f — the Lepietnica stream; g — the Rogoźnik stream; h — the Biały Dunajec stream; i — the Cichy stream. 1 — *Cottus poecilopus*; 2 — *Salmo trutta*; 3 — *Phoxinus phoxinus*; 4 — *Nemachilus barbatulus*; 5 — *Barbus meridionalis*; 6 — *Thymallus thymallus*; 7 — *Salmo gairdneri*; 8 — *Hucho hucho*; 9 — *Gobio gobio*; 10 — *Leuciscus cephalus*; 11 — *Chondrostoma nasus*; 12 — *Barbus barbus*; 13 — *Cottus gobio*; 14 — *Leuciscus leuciscus*; 15 — *Alburnoides bipunctatus*; 16 — *Alburnus alburnus*; 17 — *Aspius aspius*; 18 — *Rutilus rutilus*; 19 — *Abramis brama*; 20 — *Anguilla anguilla*; 21 — *Esox lucius*; 22 — *Perca fluviatilis*; 23 — *Vimba vimba*; 24 — *Acerina cernua*; 25 — *Lucioperca lucioperca*.

6—7°C. The number of days with frost exceeds 80 in Tatra Mts, being 70—80 in the Podhale region and Beskid Mts, and 60—70 in the Vale of Nowy Targ. In the region of Szczawnica there occur 50—60 days with frost and in the Vale of Sącz 40 days. However, in a number of valleys and mid-mountain sheltered spots specific climatic conditions are observed. They are to be found in the Vales of Zakopane and Nowy Targ, in the valleys of the Łopuszna, Grajcarek, Ochotnica, and Kamienica Łącka streams, and also in the valley of Łącko. The reason for this climatic variability is the situation of the valleys in relation to the prevailing winds, this being decisive in the wind force and frequency, the stagnation of cold air, and sometimes temperature inversion.

2.2. The hydrological characteristics of the investigated river basin

The Czarny Dunajec stream

This stream, with a basin of 464.4 km² (figs 1, 2b), originates in Roztoka at the junction of the Siwa Woda and Kirowa Woda streams (figs 1, 2c, 2d) which flow out at the foot of the main range of the Western Tatra Mts. It flows northward, draining the western part of the Gubałówka Plateau, and then across the peat bogs of the Vale of Nowy Targ, forming wide overflow-arms there. Above the village of Długopole it receives the waters of the Piekielek stream (figs 1, 2e) which flows through meadows over a muddy-sandy bottom. In the village of Ludźmierz two larger streams flow into the Czarny Dunajec, the Lepietnica and Rogoźnik. The former (figs 1, 2f) rises under Mount Turbacz and initially flows over a rocky bottom among the forests of the western slopes of the Gorce Range. Then, in its middle and lower course, it flows over coarse gravel through the villages of Obidowa, Klikuszowa, and Lasek. The Rogoźnik stream (figs 1, 2g), which drains the Gubałówka Plateau, arises from the joining of the Cichy and Bystry streams (figs 1, 2i, 3a). Similarly as that of the Czarny Dunajec, the bottom of the Rogoźnik stream is stony, becoming in the middle river course gravelly and partially muddy.

The Biały Dunajec stream

The area of the Biały Dunajec catchment basin reaches 221.9 km². The stream is formed by the junction of the Tatra streams Strążyski, Bystry, Zakopianka, Sucha Woda, and Poroniec (figs 3a, 3b, 3c, 3d). It flows northward over a bottom lined with large stones partially covered with algae. Unlike the Czarny Dunajec, the water of the Biały Dunajec is polluted by the municipal wastes of Zakopane.

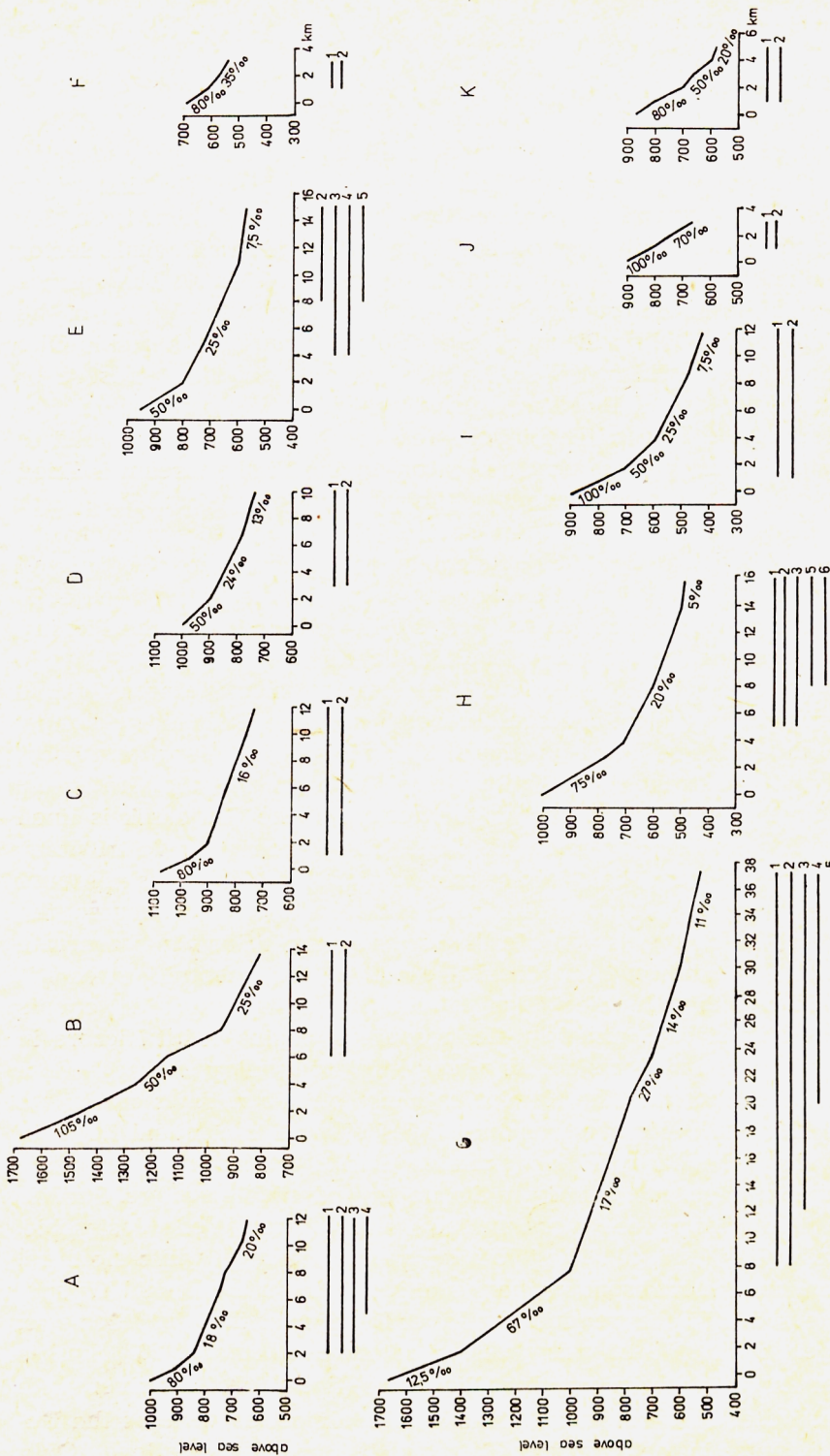


Fig. 3. The distribution of fish species of the River Dunajec upper catchment basin. a — the Bystry stream; b — the Sucha Woda stream; c — the Zakopianka stream; d — the Pronic stream; e — the Leśnica stream; f — the Łopuszanka stream; g — the Białka stream; h — the Łapszanka stream; i — the Grajcarek stream; j — the Homole stream; k — the Kaletniczy stream. 1—25 — as in fig. 2

The River Dunajec

This river is formed at the junction of the Czarny Dunajec and Biały Dunajec streams in Nowy Targ. The Leśnica stream is its first right affluent and the Łopuszanka stream the first left one (figs 1, 3e, 3f). However, the largest tributary of the River Dunajec in its Podhale sector is the Białka stream (figs 1, 3g) with its basin of 234.4 km². The springs of this stream lie in the granite part of the Tatra Mts in the Valley of the Five Polish Lakes (Dolina Pięciu Stawów Polskich) at Lake Morskie Oko and at the Żabie Stawki Lakes on the Slovakian side of the Tatras. After receiving the waters of the Jaworzynka, which drains the eastern Slovakian part of the Tatras, the Białka stream flows northward parallel to the Biały and Czarny Dunajec. The bottom of the Białka stream is lined with rounded granite stones swept by the rapid water current. The fourth and last affluent before the Pieniny sector, is the Łapszanka stream with its mouth at Niedzica (figs 1, 3h). Its catchment basin covers 138 km² and its bottom is lined with gravel. The next sector of the River Dunajec is a deeply cut gorge in the Pieniny Mts. On the other side of the Pieniny the river receives the waters of the Grajcarek stream (figs 1, 3i) with a catchment area of 85.5 km². This leads waters from the area of the Małe Pieniny Mts and of the southern slopes of the Radziejowa Range, fed through the Homole stream (figs 1, 3j) and the Kaletniczy (figs 1, 3k) and Biała Woda streams, the latter being the source of the Grajcarek. Apart from the upper stony sector, the bottom of the Grajcarek is lined with gravel, partially covered with slime. The next right side tributary of the River Dunajec is the Krośnica stream (figs 1, 4a). It begins at Mount Lubań and joins the Dunajec at Krościenko. In its upper course the discharge of the stream is poor. In the lower sector it flows in a concrete channel. At Tylmanowa, 11 km from Krościenko, the Ochotnica stream is discharged into the Dunajec (figs 1, 4b). Its catchment area covers 109.1 km². This stream, rich in water resources, begins at Mt Kiczora in the Gorce Range and flows across a well insulated valley, over a bottom lined with large stones. The Kamienica Łącka stream with its catchment basin of 128.5 km² originates on the slopes of Mt Turbacz and flows in a deep valley shaded by high mountains (figs 1, 4c), having a primitive and wild character, particularly in the upper and middle sectors. Further left side tributaries of the River Dunajec are the Czarna Woda, Jastrzębie, and Słomka (figs 1, 4d, 4e). The two first streams are small while the third, with abundant water resources, begins at Mt Ostra in the Beskid Wyspowy Range and is discharged into the River Dunajec at the 23rd kilometre. The largest right side tributary with a catchment basin of 2073 km² is the River Poprad with its mouth at Biegonice (figs 1, 4f). This river, with abundant water resources and, at its mouth, almost as wide as the Dunajec, originates in the Slovakian Tatras at 1945 m above sea level. Only

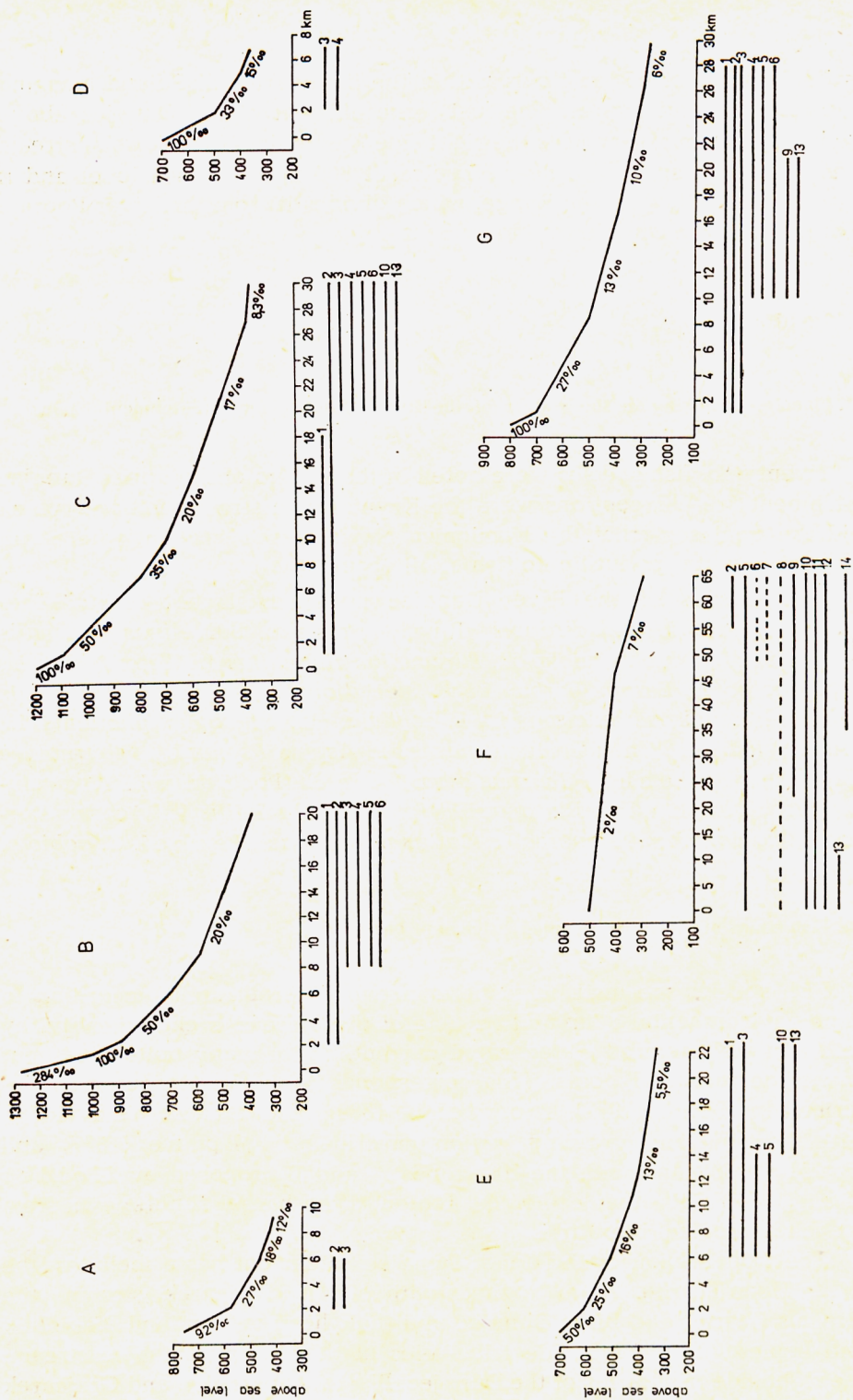


Fig. 4. The distribution of fish species of the River Dunajec upper catchment area. a — the Krošnica stream; b — the Ochotnica stream; c — the Kamienica Łącka stream; d — the Czarna Woda stream; e — the Słomka stream; f — the River Poprad; g — the Kamienica Nawojowska stream. 1—25 — as in fig. 2

its final sector of 65 km flows within the boundaries of Poland, forming many curves and gorges. The last large affluent of the Dunajec above the Rożnów dam reservoir is the right side Kamienica Nawojowska stream (figs 1, 4g). Its spring lie near Krynica at 800 m above sea level and it flow along the Jaworzyna Range, which divides it from the River Poprad. It drains into the Dunajec at Nowy Sącz.

3. Results

3.1. Species occurring in the waters of the River Dunajec upper catchment basin

Twenty six fish species were noted in the waters of the upper Dunajec catchment area. Exceptions were the Kryniczanka stream below Krynica and the final sector of the Kamienica Nawojowska stream where, on account of water pollution no fish at all occur.

Fish species of the River Dunajec upper catchment basin: *Salmo trutta m. fario* L., *S. gairdneri* (Richardson), *Salvelinus fontinalis* (Mitchill), *Hucho hucho* L., *Thymallus thymallus* L., *Esox lucius* L., *Gobio gobio* L., *Barbus barbus* L., *B. merydionalis* Petenyi, *Abramis brama* L., *Leuciscus leuciscus* L., *L. cephalus* L., *Phoxinus phoxinus* L., *Vimba vimba* L., *Chondrostoma nasus* L., *Aspius aspius* L., *Alburnoides bipunctatus* (Bloch), *Alburnus alburnus* L., *Rutilus rutilus* L., *Nemachilus barbatulus* L., *Anguilla anguilla* L., *Perca fluviatilis* L., *Acerina cernua* L., *Lucioperca lucioperca* L., *Cottus poecilopus* Heckel, *C. gobio* L.

3.2. Fish zones of the Dunajec upper catchment basin

Fish species are distributed here in two different areas according to their environmental adaptability. One of these areas is characterized by cold and well aerated water, rapid current, and a stony bottom without any large marginal pools. This corresponds with the trout region described by Frič (1872), Nowicki (1889), and Starmach (1956), with the trout and grayling region described by Borne (1877) and Staff (1950), and with the fish zones A and B proposed by Kolder et al. (1974). The other ecological region is the barbel zone known from the ichthyological literature.

The trout region of the upper Dunajec catchment basin includes the River Dunajec (fig. 1) up to the mouth of the Grajcarek stream, the streams Czarny and Biały Dunajec and their head waters, and Piekielek and Lepietnica, the left side tributaries of the Czarny Dunajec stream; the right side tributaries of the Dunajec, Białka, Łapszanka, and Grajcarek

with its affluents and Kamienica Nawojowska, besides the left side affluents of the Dunajec Łopuszanka, Krośnica, Ochotnica, Kamienica Łącka, Czarna Woda, Jastrzębia, and Słomka. The following species of fish occur in these waters: *Salmo trutta m. fario*, *Cottus poecilopus*, *Phoxinus phoxinus*, *Thymallus thymallus*, *Nemachilus barbatulus*, *Barbus merydionalis petenyi*, *Gobio gobio*, *Leuciscus cephalus*, *Cottus gobio*, and in some river sectors even *Alburnoides bipunctatus*, *Chondrostoma nasus*, and *Esox lucius*. The distribution of the species mentioned above does not always agree with the occurrence of *Salmo trutta m. fario*, the leading species of the discussed fish zone. Some species differ from the trout, and also vary among themselves, in adaptability potential with regard to environmental conditions, hence they appear or are absent in the trout waters depending upon the character of the given stream or river.

Of the discussed group, *Cottus poecilopus* Heckel is the most stenotopic species, accompanying the trout, even occurring in higher sectors of mountain streams than the latter. It only appears in cold, pure, and well aerated waters, on bottoms lined with stones washed by a rapid water current, without slimy stagnant parts (Starmach 1972). Thus, in the River Dunajec catchment area *C. poecilopus* occurs only in streams characterized by such features, i.e. in the streams Czarny and Biały Dunajec and their head waters, in the Białka, Grajcarek with its tributaries, Kamienica Łącka and Nawojowska, Lepietnica, Łopuszanka, Ochotnica and Jastrzębia (fig. 1). *C. poecilopus* and the trout form a two-species fish community in the head waters of the Czarny and Biały Dunajec (Siwa Woda, Kirowa Woda, Zakopianka, Poroniec, and Sucha Woda) in Łopuszanka and in upper sectors of the Czarny Dunajec, Leśnica, Łapszanka, Ochotnica, and Kamienica Łącka (figs 1, 2c, 2d, 3b, 3c, 3d, 3f, 2b, 3g, 3e, 3h, 4b, 4c).

Phoxinus phoxinus is another species associated with the trout, though it is more eurytopic than *Cottus poecilopus*, occurring both in mountain streams characterized by a high unit gradient and in stagnant waters of old river-beds. *Ph. phoxinus*, *Salmo trutta m. fario*, and *C. poecilopus* form a three-species fish community in the streams Białka, Bystry, Lepietnica, and Cichy (figs 1, 3g, 3a, 2f, 2i).

Besides the three species discussed above, which occur in higher sectors of streams, in the region of decreasing unit gradients fish communities of the trout zone include further species typical for this region: *Thymallus thymallus*, *Nemachilus barbatulus*, *Barbus merydionalis petenyi*, *Leuciscus cephalus*, *Gobio gobio*, and *Cottus gobio*. The lower line of their occurrence lies below the trout zone.

The other fish region of the River Dunajec catchment basin, known as the barbel zone, includes the Dunajec from Sromowce to the Rożnów dam reservoir, and the entire sector of the river Poprad. This is the region of

fish with wide thermal tolerance. They can live in poorly transparent waters and tolerate slimy bottoms. The following fish species were noted here: *Phoxinus phoxinus*, *Barbus barbus*, *B. meridionalis petenyi*, *Leuciscus cephalus*, *L. leuciscus*, *Chondrostoma nasus*, *Gobio gobio*, *Rutilus rutilus*, *Abramis brama*, *Alburnus alburnus*, *Alburnoides bipunctatus*, *Vimba vimba*, *Lucioperca lucioperca*, *Perca fluviatilis*, *Acerina cernua*, *Esox lucius*, *Anguilla anguilla*, and *Thymallus thymallus*, whose limits of occurrence and near Nowy Sącz. Apart from the species mentioned above, small numbers of *Salmo trutta m. fario* and of *Hucho hucho*, which was artificially introduced in the River Dunajec catchment basin, can be found in these waters.

Between the two described ecological zones there is a wide area of mutual infiltrations of their leading species (fig. 1). This is most distinctly

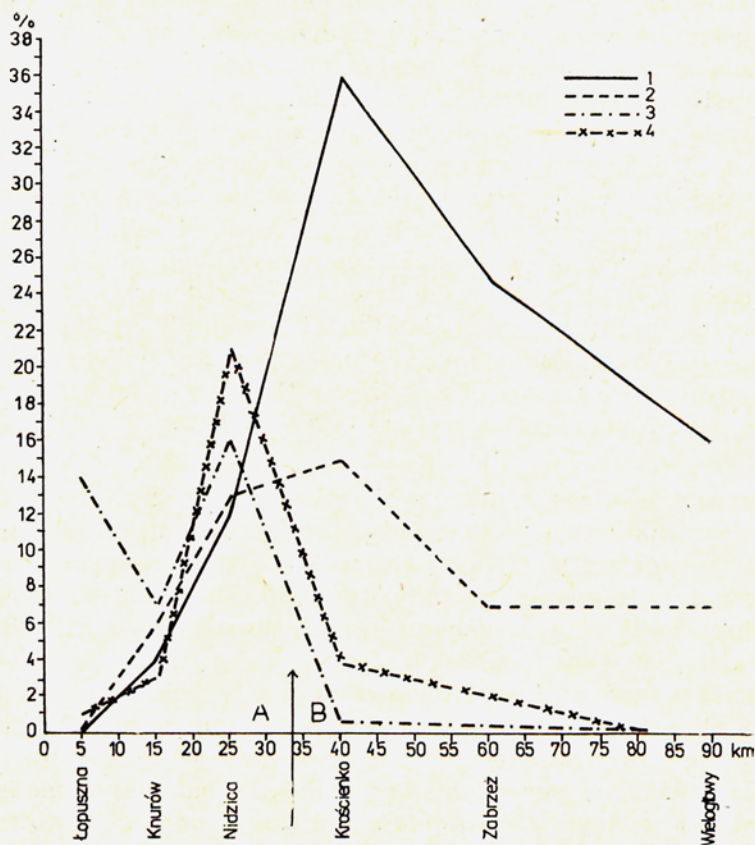


Fig. 5. Percentage of the leading species in the total number of fish caught from two fish zones of the River Dunajec upper catchment basin. 1 — *Barbus barbus*; 2 — *Chondrostoma nasus*; 3 — *Salmo trutta m. fario*; 4 — *Thymallus thymallus*. A — the zone of stenothermal and rheophilous fish; B — the zone of eurythermal and rheotolerant fish

to be seen in fig. 5 where in the total number of fish caught in a given Dunajec sector, the percentage of representatives of the two fish zones was calculated for *Salmo trutta m. fario*, *Thymallus thymallus*, *Barbus barbus*, and *Chondrostoma nasus*.

4. Discussion

In relation to the division of the River Dunajec upper catchment basin into two fish zones presented by Nowicki (1883), i.e. the regions of the trout and of the barbel, no changes were found in the distribution of the different fish species, except for the rivers Dunajec and Poprad. This was in spite of the fact that the Biały Dunajec and Dunajec in the sector from Nowy Targ to the mouth of the Białka stream are polluted with the municipal wastes of the towns of Zakopane and Nowy Targ (fig. 1). However, the trout zone described by Nowicki (1883) as reaching the mouth of the River Poprad, was considerably shifted upwards, its lower line now lying between Niedzica and Krościenko. This was manifested by the results of catches in the years 1975—1980, when in the total number of fishes the percentage of *Salmo trutta m. fario* and *Thymallus thymallus* rapidly decreased while that of *Barbus barbus* and *Chondrostoma nasus* decidedly increased.

At present the Polish sector of the River Poprad, the largest affluent of the River Dunajec, constitutes a barbel zone almost without salmonides. During the catches made in the years 1975—1980, the numbers of *Salmo trutta m. fario* and *Thymallus thymallus* calculated per 1 ha of the water surface, were 1 and 7, respectively. According to information given by anglers, also the huchen appears sporadically in the Poprad.

Similarly as in other Carpathian rivers, no separate grayling zone can be determined in the River Dunajec catchment area (Nowicki 1888, 1889, Starmach 1956), therefore the zone or region of the trout includes the River Dunajec up to the mouth of the Grajcarek stream and all the right and left side tributaries of the Dunajec upper course, except for the River Poprad. However, this zone is not uniform with regard to the species composition of its fish population (figs 2—4). Two different sectors of streams can be determined there, i.e., those settled or not settled by *Cottus poecilopus* (fig. 1). The former streams or their parts are characterized by cold and pure waters and a stony bottom without slimy stagnant pools. The latter group is composed of the following streams of the investigated catchment area: Piekielnik, Rogoźnik, Leśnica, Krośnica, Czarna Woda, and Słomka, the lower sectors of the Kamienica Łącka and Nawojowska, and also the River Dunajec between Łopuszna and Krościenko. In spite of the high unit gradient in these water course and, therefore, their rapid current (figs 2e, 2g, 2c, 4a, 4d, 4e), the

rivers and streams of this region do not meet the requirements of *Cottus poecilopus*. This species can be classified as the most stenotopic fish occurring in the Carpathian rivers. The partial sliming of the bottom probably contributes to the elimination of this species in the streams mentioned above.

C. poecilopus is a small fish of no economic importance, though its occurrence or absence plays an important indicatory role in evaluating the usefulness of a given water body for salmonides. The requirements revealed by the organism of *C. poecilopus* with respect to habitat (Starmach 1962, 1965, 1970, 1971, 1972) are similar to those of eggs, larvae, and young specimens of salmonides. Hence, the occurrence of *C. poecilopus* in a water body is the best indication that the living conditions of the environment are suitable for the breeding and development of the fry of such economically important species as the trout and grayling.

5. Polish summary

Strefy rybne górnego dorzecza Dunajca

W celu porównania aktualnego rozmieszczenia poszczególnych gatunków w dorzeczu Dunajca z danymi z literatury (Nowicki 1883, Kołder 1964) przeprowadzono w latach 1975—1980 badania, których celem było ustalenie aktualnego rozmieszczenia ryb w tym dorzeczu. Wyniki tych badań przedstawione na ryc. 1-4 wykazały, że dorzecze Dunajca dzieli się na dwie różniące się ekologicznie strefy rybne, a mianowicie na strefę pstrąga i strefę brzany (ryc. 1) oraz mieszczącą się w granicach krainy pstrąga strefę *Cottus poecilopus* Heckel. Sądząc po ustalonych wcześniej wymaganiach tej ryby względem warunków środowiska zewnętrznego (Starmach 1962, 1965, 1968, 1970, 1971, 1972), wody te są najodpowiedniejszym miejscem do rozrodu i wychowu larw oraz młodzieży ryb łososiowatych.

W porównaniu z przedstawionym przez Nowickiego (1883) podziałem górnego dorzecza Dunajca na dwie krainy rybne, krainę pstrąga i brzany, rozmieszczenie poszczególnych gatunków, z wyjątkiem rzek Dunajca i Popradu, nie uległo zmianie. W Dunajcu jednak kraina pstrąga, sięgająca dawniej do Starego Sącza, obecnie przesunęła się znacznie w górę i jej dolna granica przebiega między Niedzicą i Krościenkiem (ryc. 4). Poniżej natomiast znajduje się już strefa brzany, podobnie jak w całym polskim odcinku Popradu.

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