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STRUCTURE OF FISH GROUPINGS IN THE RIVERS AND STREAMS OF THE RIVER NIDA DRAINAGE BASIN

(Ekol. Pol. 20: 327–344). A collection of 16, 005 fish and suckers collected at 117 fishing sites from the River Nida drainage basin was arranged with the help of cenological methods. Similar river zones were distinguished on the basis of dominating and other fish species. These zones are different from the zones or reaches distinguished on the basis of river fall or on other morphological elements used to characterize the rivers and streams. The problems of combined or separated occurrence of fish species and the degree of their ecological relations were also investigated. An attempt was made to distinguish the characteristic, transistory and eurytopic fish species in the studied area.

The recent ichthyological faunistic papers give more or less precise quantitative estimation of the fish stock with real or relative quantitative relation (numbers or weight dominance), apart from the list of species.

In such papers the species are listed according to the systematics. In ecological papers the species are grouped according to various assumptions as e.g. ecological spawning group, trophy of environment, hydrographic conditions, etc.

In the present paper the collection of fish from the drainage basin of Nida was arranged according to common or separate occurrence of the fish species, talking into the consideration their ecological environment.

The previous paper based on the same fish collection was a faunistic one with the elements of ecology. In that paper the material was ordered according to certain more commonly used assumptions chosen from the morphological characteristic of rivers, but the species in diagrams and tables were arranged according to their ecological group (Penczak 1971). The division of hydrographically not much devastated drainage basin of Nida to the fish regions has certain practical meaning, as the regions distinguished on the basis of the river fall and other factors are often inhabited by proper groups of fish species with proper dominance structure, or groups similar to such ones. However, an application of cenological methods for this material leads to more adequate remarks and conclusions.

MATERIAL AND METHODS

A total of 24 rivers (counting separately rivers Lubrzanka and Biała Nida) were investigated in the drainage basin of River Nida. The majority of them or their parts could be reconed in the barbel region according to the assumption of Huet (1959) and Starmach (1956). Hydrography of the River Nida drainage basin and a detailed description of fishing sites were given in previous publication (Penczak 1971).

Totally 16,005 fish and suckers specimens caught at 117 fishing sites were determined. The catches were performed with the help of an electrical shocker driven by an engine (on big rivers, from the boat), and with battery operating shocker (streams and brooks). A catch covered one synusia if it was only possible.

During the electrofishing on big rivers the shocker operated for 15 min non stop, and in this time the boat moved some 300 m. In streams and brooks the battery shocker was handled by man walking for some 150 m. The above distances were estimated separately according to the rule that the length of the investigated reach is sufficiently long when new species are not caught in further fishing (Penczak 1967, 1969a).

The groups of similar fishing sites were distinguished on the basis of the definition of similarity $s = \frac{w}{a + b - w} \times 100\%$ (Marczewski and Steinhaus 1959), where s – similarity of two compared collections, w – number of individuals of species common for these collections, a – number of individuals of species in collection A, b – number of individuals of species in collection B.

The shortest dendrite of fishing sites was made by joining with by a line a site with the one closest to it, basing on the highest value of similarity (s). Then the next site was joined with another site with lower value, and so on. The dendrite for species occurring in common or separately in the fishing places was constructed on the same basis. In both of these dendrites the values of similarity were replaced with the distance values calculated from the following formula: $r = \frac{a + b - 2w}{a + b - w} \times 100\%$, or simply $r = 100 - s$ (similarity).

As the dendrite of fishing sites or the dendrite of species separately do not show the degree of relative connection of a fish with the environment, thus these dendrites were transformed into linear ones, with the smallest possible deformation (Romaniszyn 1970). A synthetic diagram was arranged on the basis of linear dendrites according to the supposition of Romaniszyn (1970). The numerical values from the final table[1] are shown by the area of squares in the synthetic diagram – the square root of the number n of individuals of a species in the given grouping of sites equals to the side of a square in the diagram.

The habitats were at first grouped according to the previously presented basis to prevent the monstrous size of the synthetic diagram. The sites from the same rivers or streams were grouped if the value of $s > 50\%$; the relative quantity of a species in such grouping equals the arithmetical mean of the determined number of samples.

The detailed data on the chosen method of cenological investigations (the examples on given material, the rules of constructing the linear and not linear dendrites, way of the arrangement of final table and of synthetic diagram) are given in the quoted paper by Romaniszyn (1970).

CENOLOGICAL ANALYSIS OF ICHTHYOFAUNA OF THE INVESTIGATED WATERS

The previously described 117 fishing sites were initially grouped in 59 groups or units to estimate their relative similarity on the basis of the caught fish, and segments proportional to the value of the distance in per cent were drawn among them (Fig. 1). Such dendrite divides itself in a natural way into 33 groups, as a marked lack of continuity of biological meaning occurs when the value of the quotient of neighbouring segments (r = 56.1 and r = 55.0) equals 1.02. The quotients among the decreasing and increasing from this division segments are equal 1.00 Florek and others 1951).

The discussed final dendrite of the rivers in drainage basin of Nida consists of 7 large and 26 separated groups of habitats. Among these 26 elements, 19 are single stations, while 6 are two stations groups, and 1 consists of 3 stations.

Certain characteristic types of habitats can be distinguished on the basis of the constructed dendrite.

[1] Due to the large size of the final table it is included in the unpublished materials stored in the Department of Comparative Anatomy and Animal Ecology of the University of Łódź.

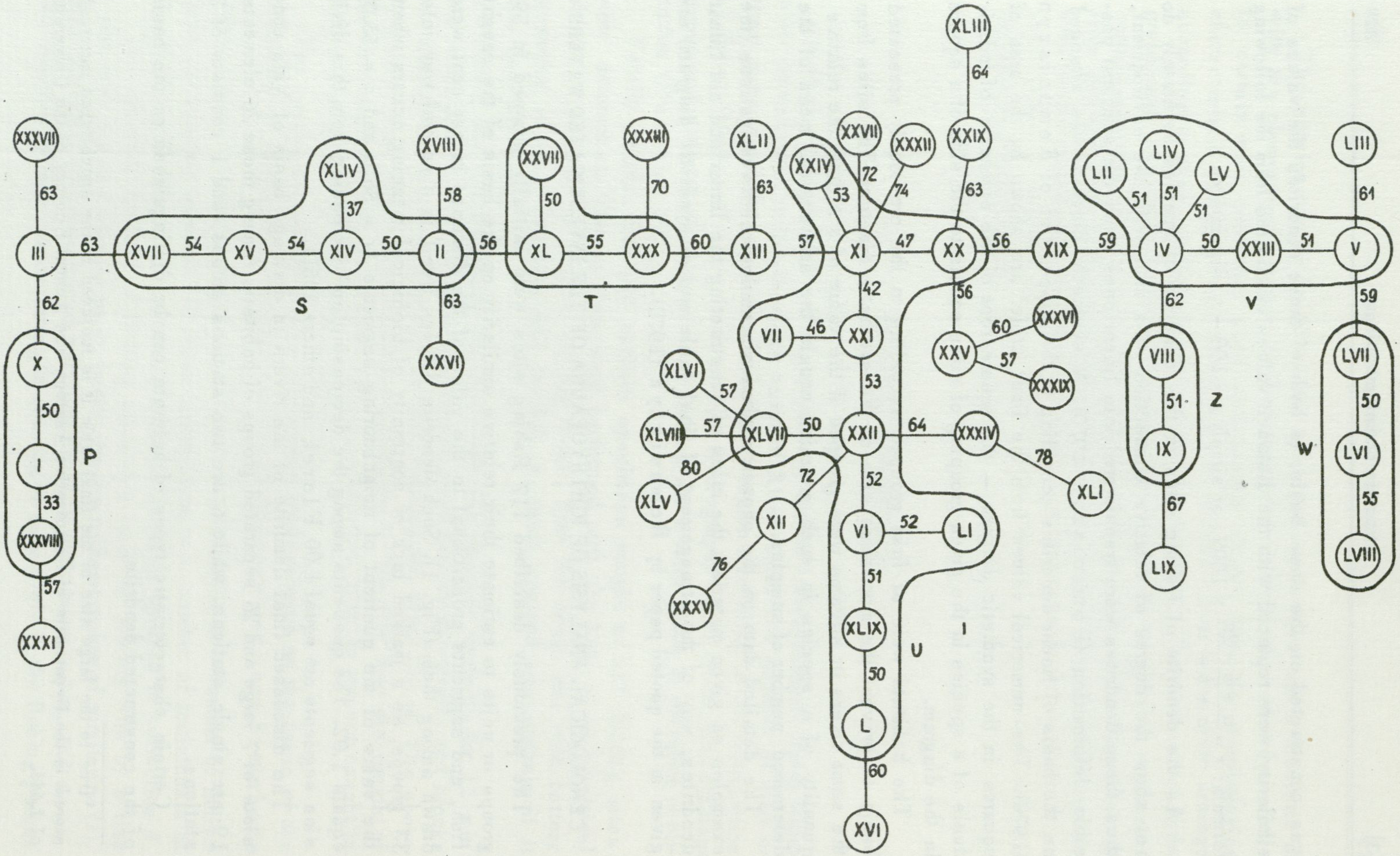
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Fig. 1. The shortest dendrite of fishing sites and groupings of sites against a background of ichthyofauna of the River Nida drainage basin

Groupings of sites and the sites (roman numerals) with electrical catches (= fishing sites – arabic numerals), which characteristics given by Penczak (1971) were calculated according to the composition of linear dendrite: XLV – 503, XLI – 586, XXXV – 568, XXXII – 562, XII – 557, 569, XXVII – 594, XXXIII – 565, XXXIV – 567, XLIII – 501, XXIX – 607, XLII – 500, XXVI – 589, XXXI – 616, XXXVIII – 573, I – 588, 590, 591, 593, 595, 596, 598, 599, 611 to 615, X – 574 to 577, III – 600, 605, XXXVII – 572, XVIII – 585, 601, XVII – 552, 597, XV – 561, 566, XLIV – 502, XIV – 560, 564, II – 592, 602, 603, 606, XXVIII – 604, XL – 581, XXX – 610, XIII – 559, 563, XVI – 583, 584, XLVI – 505, XLVIII – 509, L – 513, XLIX – 511, VI – 512, 516, 521, 534, 543, LI – 518, XXII – 510, 558, XLVII – 507, XXIV – 520, 582, XI – 553 to 555, XXI – 504, 556, VII – 506, 508, XX – 587, 609, XIX – 526, 551, 608, XXV – 578, 580, XXXIX – 579, XXXVI – 570, LII – 519, LIV – 529, LV – 539, IV – 514, 522, 524, 525, 527, 528, 530, to 532, 536, 537, 540, XXIII – 533, 571, V – 538, 542, 544, 549, 550, LIII – 523, LVII – 546, LVI – 545, LVIII – 547, VIII – 515, 517, IX – 535, 541, LIX – 548

The zones with the fall of 3‰ (2–6‰) and numerous rapids dominate in the streams and spring sections of rivers in the region of Świętokrzyskie Mountains. The water, shadowed in majority by alders, is cold and its temperature do not change much during the whole year. The mean width there is 3 m (1–6 m), depth near the concave bank is 0.5 m (0.1–1.0 m). Sandy bottom, mixed with gravel and rocky one, is covered by small patches of *Myriophyllum* sp., *Callitriche* sp. and rare *Potamogeton* sp. (Fig. 1. grouping – *P*[2]: XXXVIII, I, X – 18 similar sites).

Streams and spring parts of the rivers of Wyżyna Krakowsko-Częstochowska, Niecka Nidziańska and of surroundings of Świętokrzyskie Mountains are characterized by the fall of 2‰ (1–4‰), smaller amount of rapids, the majority of zones with sandy bottom although gravel and stones are still often found there. The mean width there is 4 m (1.5–8 m), depth in the current – 0.5 m (0.3–1.0 m). The submerged macrophytes are poorly abundant (*Callitriche* sp., filamentous algae, *Fontinalis* sp.) or lacking. The banks are densely overgrown by alders, water is cold (Fig. 1, grouping – *S*: XVII, XV, XLIV, II – 11 similar sites).

The middle size rivers Łośna, Biała Nida, Czarna Nida and River Nida itself between the two last inlets, belong to one of the two largest groups of similar habitats in studied drainage basin (Fig. 1, grouping – *U*: L, XLIX, VI, LI, XXII, XLVII, XXIV, XI, XXI, VII, XX – 22 sites). These rivers are characterized by the fall of 1‰ (0.5–2‰), width – 12 m (3–30 m), depth in the current – 0.8 m (0.3–2.0 m). Sandy bottom with rapids, and in the case of regulated parts – falls and stony steps. *Potamogeton* sp. and sometimes *Myriophyllum* sp. form elongated patches in the current; *Potamogeton* sp. covers up to 60% of the bottom surface in the regulated parts of Biała Nida. The current cannot be always well distinguished, and small shallows and beaches were occasionally noticed. The banks were slightly overgrown with alder, sometimes with osier or willow, or were lacking the tree cover in parts regulated with fascine.

The other largest group of similar zones separated in the dendrite was made of the sites in the River Nida and in the mouth part of the River Mierzawa, situated in the area of Niecka Nidziańska (Fig. 1, grouping – *V*: LII, LIV, LV, IV, XXIII, V – 22 sites). The dominating and similar zones of the River Nida are characterized by a fall 0.3–0.5‰, mean width of the river bed 22 m (8–40 m), depth in the current 1.3 m (0.5–3.0 m). The bottom of meandering and differentiated river is covered with sand; gravel and stones are found only in some places in the current. Small patches of emergent vegetation occur there, and also the elongated stands of submergents in the current. Single alder trees are met on the banks, which are overgrown by dense stands of osier shadowing the water with overhanging branches (80% of sites).

A separated group in a dendrite is formed by 50 to 100 m long rapids of the River Nida, inhabited aut of litophilous species mainly by barbel and hotu

[2] Explained under Fig. 3.

(Fig. 1, grouping – *Z:* VIII, IX – 4 sites), or only by hotu (Fig. 1, site LIX). The bottom of rapids is covered by stones (mainly lime flints) occasionally emerging above the water surface, and poor vegetation is formed by algae and pond weeds with filamentous leaves.

The sites of the meandering among the meadows River Nida, with foundering peat and cly banks without trees, and with the river width 18–20 m, and depth in the current 1.5–2 m, are characterized by slightly different composition of fish species (Fig. 1, grouping – *W:* LVII, LVI, LVIII – 3 sites).

The elements of the diagram formed by one, or more seldom by three sites, were characterized more precisely in previous publication on the hydrography of fishing sites in the drainage basin of River Nida (Penczak 1971).

The dendrite illustrating the similarities among fish species in the studied drainage basin, as far as their common or separated occurrence was concerned, was arranged according to analogous principles (Fig. 2). In this case the fish species were treated as groups and the sites as elements.

The analyzed dendrite of 36 species divides itself, against the background of rivers in drainage basin of River Nida, in 4 groups of species and 8 separate species with the value of quotient of neighbouring segments (r = 85.8 and r = 82.3)equal 1.04. The second proper division showing even stronger cenological connections of species can be observed with the value of quotient of neighbouring segments (r = 68.8 and r = 66.7) equal 1.03. In this case 3 small groups of species and 26 separated species can be distinguished.

When the continuity between the distance values 68.8 and 66.7 is lacking, there is a high probability of the common occurrence of roach, chub, pike, burbot and perch in the investigated rivers. A group second in size is formed by bleak and ide, the common occurrence of *Cobitis* (*Sabanajewia*) *aurata* (Filippi), common bullhead and *Aspius aspius* (L.) is not understood by the author, as these species have various environmental sequirements.

When analyzing the species in the lack of continuity between the distance values 85.8 and 82.3, a possible grouping of carp, tench, mudfish, stickleback and crucian carp is noticed (group *A*, Fig. 2 and 3). This common occurrence of the above species is explained by their similar development demands (phytophilous). A common occurrence of spirlin and *Barbus meridionalis petenyi* (Heckel), which are typical rheophilous species is quite obvious (grouping – *B*, Fig. 2 and 3).

In the largest group of species (grouping *C*) the following ones were included, taking into consideration the smallest distances among them and thus the largest similarity: stoneloach, gudgeon, roach, chub, pike, burbot, perch, ide, bleak, barbel, hotu, dace, bullhead, eel, bream, white bream and sheatfish. The psammophilous species, inhabiting small and middle rivers and the shallows of larger ones were found on the one of the ends of the linear dendrite, separated by eurytopic species. The rheophilous species inhabiting the current

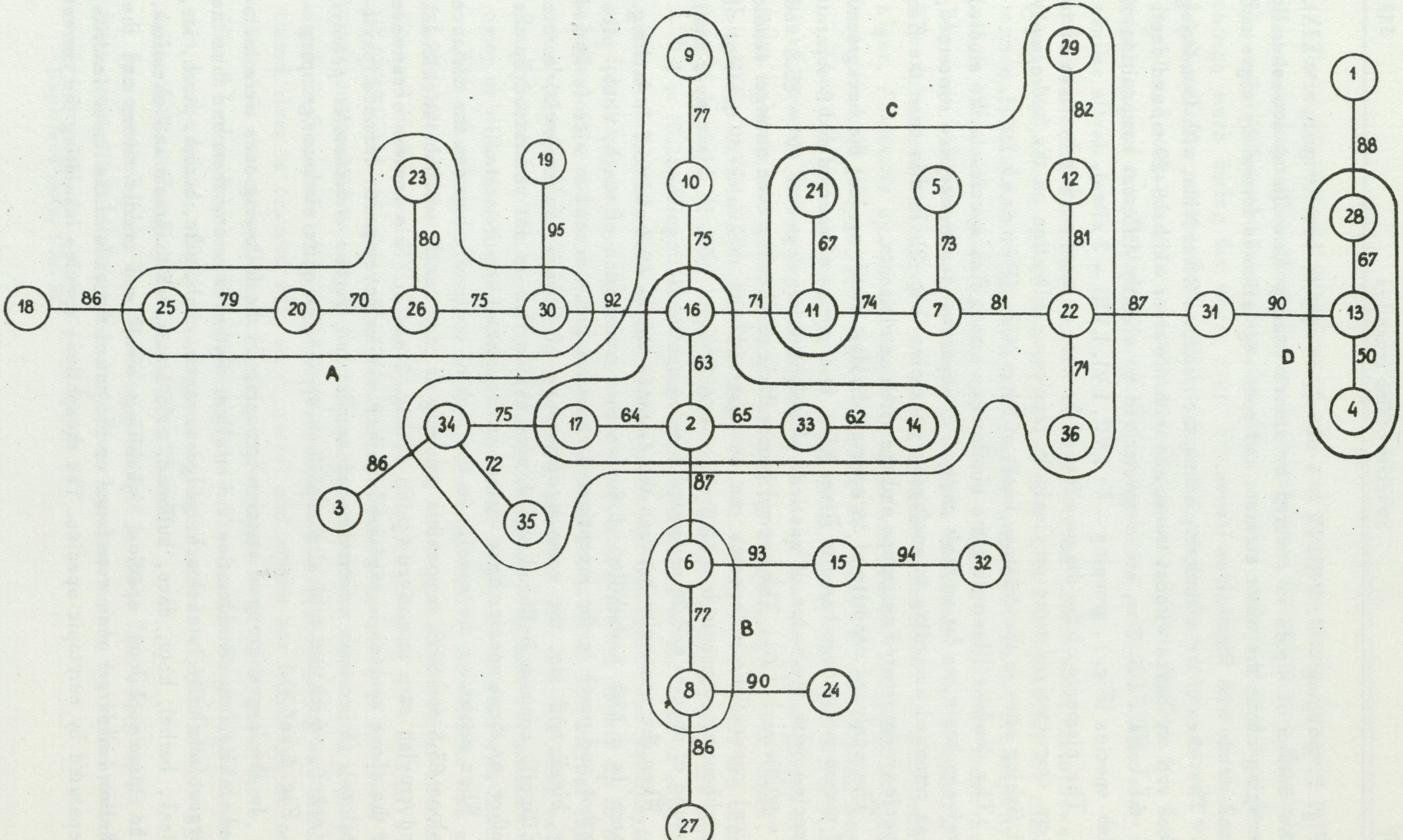

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Fig. 2. The shortest dendrite of ichthyofauna against the background of sites and groupings of sites of the rivers in the River Nida drainage basin

Names of species and their numbers (arabic numerals) are according to the composition of linear dendrite: *Leucaspius delineatus* (Heckel) – 19, *Scardinius erythrophthalmus* (L.) – 18, *Carassius carassius* (L.) – 23, *Cyprinus carpio* L. – 25, *Tinca tinca* (L.) – 20, *Misgurnus fosslis* (L.) – 26, *Gasterosteus aculeatus* L. – 30, *Cobitis taenia* L. – 27, *Barbus meridionalis petenyi* (Heckel) – 8, *Alburnoides bipunctatus* (Bloch) – 6, *Phoxinus phoxinus* (L.) – 3, *Noemacheilus barbatulus* (L.) – 35, *Gobio gobio* (L.) – 34, *Rutilus rutilus* (L.) – 17, *Leuciscus cephalus* (L.) – 2, *Esox lucius* L. – 16, *Lota lota* (L.) – 33, *Perca fluviatilis* (L.) – 14, *Leuciscus idus* (L.) – 11, *Alburnus alburnus* (L.) – 21, *Barbus barbus* (L.) – 7, *Chondrostoma nasus* (L.) – 5, *Leuciscus leuciscus* (L.) – 10, *Cottus gobio* L. – 9, *Anguilla anguilla* (L.) – 36, *Abramis brama* (L.) – 22, *Blicca bjoerkna* (L.) – 12, *Silurus glanis* L. – 29, *Stizostedion lucioperca* (L.) – 31, *Aspius aspius* (L.) – 4, *Ictalurus nebulosus* (Le Sueur) – 13, *Cobitis* (*Sabanejewia*) *aurata* (Filippi) – 28, *Lampetra planeri* (Bloch) – 1, *Rhodeus sericeus amarus* (Bloch) – 32, *Acerina cernua*(L.) – 15, *Carassius auratus gibelio* (Bloch) – 24. Solid line surrounds a strong division, thin line – the weeker one

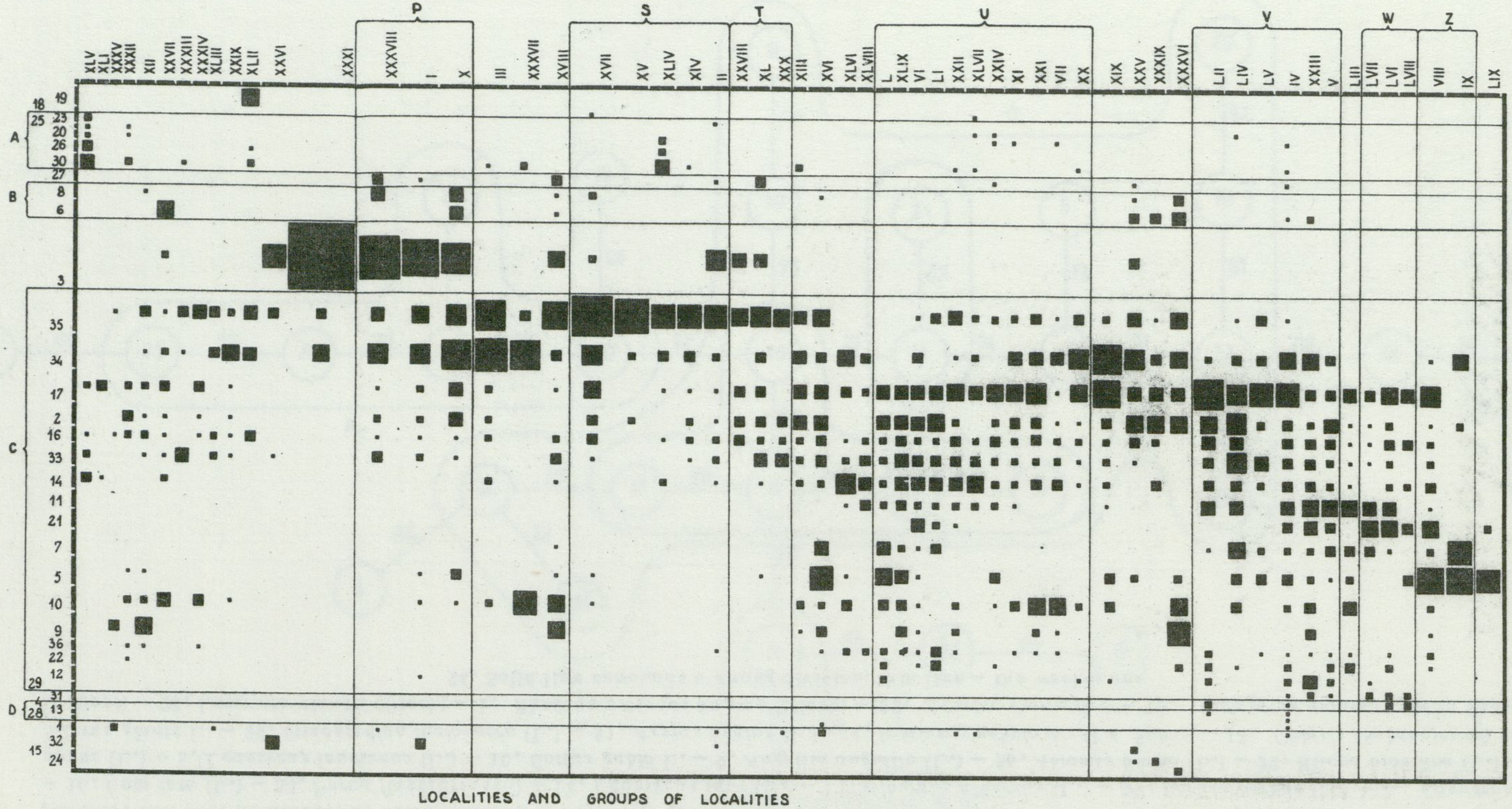

Fig. 3. Synthetic diagram of the mutual dependences among the fish species and rivers in the River Nida drainage basin drawn according to the linear composition of both dendrites – the one on the fishing sites, and the one on fish species

Side of the smallest square equals – $\sqrt{1} = 1$. The groupings of fishing sites distinguished in dendrite (Fig. 1) were called with letters *P–Z* in a synthetic diagram, distinguished groupings of species (Fig. 2 – weeker division) – with letters *A–D* were grouped together: barbel, hotu, dace and bullhead. The species of stagnant waters, i.e. eel, bream, white bream and sheatfish, the closesiet each other in the grouping not only can occur in the same place, but they can also breed in the same synusia, excluding of course the eel.

An answer to the question which grouping of species and which separate species are connected with groupings of sites and with particular sites in the rivers of the investigated drainage basin can be found in the synthetic diagram (Fig. 3). This figure joins adequately both analyzed dendrites in a linear way, and it was obtained with the possible smallest changes of non linear dendrites (Fig. 1 and 2).

The linear dendrite of sites is on the ordinate of the synthetic diagram, the dendrite of species is on abscissa, lines are the boundar of previously distinguished groupings of species and sites. Saying in the other way, the final synthetic diagram shows which groupings of species are characteristic for groupings habitats of the investigated drainage basin (taking into account the degree of the dominance of particular species).

The synthetic diagram (Fig. 3) shows clearly that rivers of the River Nida drainage basin differ considerably as far as the composition and quantity of inhabiting them fish and suckers are concerned. A gradual, although with certain disturbances, replacement of species suggests various pressure of environmental factors. The similarity among particular rivers also can be noticed, and it can be two-directional. It can be due to the occurrence of eurytopic species, occurring ,,everywhere water is present'', or due to the presence of species with specific environmental demands, independent from the distinguished fish regions nor the river zones. These species are, however, usually not numerous in such not typical environment, and are over-dominated by characteristic species.

Grouping *P* (Fig. 1 and 3) made of the majority of sites from small rivers and streams from the region of Świętokrzyskie Mountains was distinguished on the basis of domination of minnow and the occurrence of subdominats from psammophilous group (stone-loach, gudgeon). The analyzed ecosystems are always inhabited by not numerous roach, chub, pike and burbot, but any species from grouping *A* was never found there (Fig. 2 and 3). Other litophilous species, i.e. spirlin, hotu and *Barbus meridionalis petenyi* (without bullhead) also occur there. The above allow to suggest some zones of streams and small rivers of Świętokrzyskie Mountains for introduction and culture of certain species of salmon.

The zones of small rivers and streams with a large fall of Wyżyna Krakowsko-Częstochowska, Niecka Nidziańska and surroundings of Świętokrzyskie Mountains, which form grouping *S* (Fig. 1 and 3) are characterized by the domination of stone-loach and the occurrence of gudgeon. The position of the latter varies from subdominant to additional species. Among the litophilous species *Barbus meridionalis petenyi*, hotu, bullhead and more often the minnow are found there. Also eurytopic species for studied drainage basin occur there: roach, chub, pike and burbot, although they are usually small. The occurrence of limnophilous species from grouping *A* is there also possible (Fig. 2 and 3).

Groupings sites made of the middle rivers and River Nida (*U*, *V*, *W*, *Z*) are characterized both by the absence of minnow, limited quantity of psammophilous species, especially of stone-loach and by the common dominance of roach and subdominance of chub, perch and burbot.

The sites of grouping *U* which is made of zones of average size rivers were not inhabited by the fish species from groupings *B* and *D*, and some limnophilous species from grouping *A* dominated there. The dominants or subdominants there were roach, chub, pike, burbot and perch, with the value of the constance index close to 100%. Also psammophilous species were found there, and sometimes they were even in large numbers: barbel, hotu, dace, bleak and even bullhead. Many of these rivers, and especially these from the Świętokrzyskie Mountains and their surroundings could be artificially populated with rainbow trout. The naturally occurring species of economical value ought to be also strengthen there.

The fish population of the River Nida grouping *V* which is characterized in this reach by willow brakes with overhanging branches, is formed by roach and ide mainly. The subdominants or even dominants there are: chub, burbot, bleak or barbel.

In the River Nida two separated zones were distinguished: *W* – with foundering peat and clay banks, and *Z* – the rapids. The former one is abundantly inhabited by roach, ide and bleak with absence of psammophilous species and poor fauna of litophilous. The latter zone is abundantly inhabited by hotu, also barbel, roach or gudgeon occur there alternatively in large numbers. In some of the rapids, and especially in larger rivers with lime flints at the bottom, or numerous hiding places formed in the banks by alder roots or fascine, bullhead takes place of the minnow.

DISCUSSION

The concept of fish regions was proposed by Frič (1872), Borne (1877) and Nowicki (1889), and recently developed by Huet (1946, 1949, 1954, 1959, and many others). On the basis of fall, width and depth of rivers, the fish regions inhabited by proper groups of species can be distinguished only in certain biogeographic regions. It can be noticed that with the advancing knowledge of new regions a large per cent of rivers or their reaches is not included to any of these regions (Müller 1953, Backiel 1964a, Penczak

1969a). The place of a boundary between well distinguished regions is also often impossible to find out (Ribaut 1966).

Several research workers try to protect the idea of fish regions by changing Huet's assumptions for newly studied waters by introducing additional elements of rivers hydrography, or by changing the meaning of already estabilished elements (Starmach 1956). However, these changes are lacking the universal application even in the same drainage basin (Backiel 1964a, 1964b).

The second often discussed reason, giving only historical significance to this concept, is the influence of man on waters, i.e. mainly the pollution or wrongly applied meliorative and regulative techniques (Kulmatycki 1936, Mikulski and Tarwid 1951, Marczak and Zieliński 1954, Larsen 1955, Kaj 1959, Libosvarsky and Zelinka 1964, Rembiszewski 1964, Danilkiewicz 1965, Stangenberg 1966, Penczak 1969a, 1969b and others).

The lack of dominant and additional species, killed by pollution or by melioration, makes the name of a fish region an empty word. That is why certain research workers as e.g. Illies (1961) create new names for these habitats, basing the classification of rivers on many other zoological groups.

The division of rivers into the fish regions in places where it has no confirmation in the nature, or replacing old names with the new ones of more general meaning do not give any practical solution for fisheries. Backiel (1964a, 1964b) and Ribaut (1966) evaluated this situation in a right way. First of these authors proposes the division of river zones on the basis of species domination, as the biocenotic relations are influenced not only by hydrographic factors (mainly by fall), but also in a large extent by biocenotic factors as the fish catch and stocking with fish (Backiel 1964a). Ribaut (1966) analyzed the material in two ways: a) on the basis of hydrography of rivers, i.e. according to Huet's assumptions, and b) on the basis of the occurrence in common of fish species although this author did not know cenological methods, as seen from the quoted literature. This last approach of Ribaut (1966) seems to be the best one, although the way of realization of this concept seems not to be based on any method.

With reference to papers by Backiel (1964a, 1964b) and Ribaut (1966) I suggest that the consideration of hydrographic factors do not lead to the objective picture of the investigated biocenosis while the realy significant factors are shown by objective synthetic diagram, which joins the groupings of sites against the background of groupings of species which were separated on the basis of the highest values of similarity. The real character of the investigated river is created by occurring there numerous species, and this agrees with supposition of Balogh (1953), and in these the main potential energy of ichthyocenosis is included.

The basis for obtaining of objective relations from the synthetic diagram and from dendrites is a right way of collecting the material. The principles allowing to treat a sample as a representative one, presented in „Material and methods" can be treated as the right ones. The doubts on the real representativeness of samples are possible because of the usage of electrical shocker, which is treated by many authors as a selective tool (Pratt 1952, Larsen 1955, Webster and others 1955, Hartman 1959, Backiel 1964a, Penczak 1967, 1969a and others).

The doubts on the representativeness of samples will be even stronger after the evaluation of works by Sakowicz (1961), Draganik and Szczebrowski (1963), Iwaszkiewicz (1964), Ribaut (1966) and others, which clearly point out that the fish stock of the investigated reach differs quantitatively and qualitatively in successive catches with the shocker, carried out one just after the other, or carried out in various seasons.

Undoubtedly many samples of this investigations bare a quantitative, and possibly qualitative errors. This is suggested by too large per cent of sites which were not placed in any grouping. Also the sides of squares showing on the axes the number of species (along the abscissa) and species in samples (along the ordinate) have not a pyramid composition, and the exchange of species in transistory ecosystems has generally a clinal character in relation to the compared separated habitats. The above discussion do not deal of course with small rivers and streams, as the efficiency of electrofishing there is supposed to be very high (Smith and Elson 1950, Larsen 1955, Backiel 1964a), and the migration of species are observed in rivers inhabited mainly by salmonids.

The problem of common occurrence of species in connection with the habitat needs the analysis of large material because of its complicated nature and not perfect fishing tools. In the doubtful cases of the representativeness of samples the conclusions should be drawn only for sites and species clearly similar and occurring in large numbers, what was realized in present paper.

The zonation of fish species in rivers is a separate and worth discussing problem. In small rivers and streams the number of species correlates much better with the width of the river than with any other hydrographic factor. This problem was discussed by Backiel (1964a, 1964b) on the basis of papers by Müller (1953), Larsen (1955) and by Żarnecki and Kołder (1956). Similar regularities can be found in materials of Solewski (1965) and in my previous publications (Penczak 1969a, 1971). Small rivers and streams with the width of about 1 m are generally inhabited by 3 species with one real dominant. In the rivers of the average width of 3 m, the number of species increases to 6 or more, and there are 2 or even 3 dominant species. In much broader rivers (above 15–20 m) the factor of the living area is replaced by the river fall, type of bottom and other hydrological conditions which influence the composition of groupings of the fish species (Starmach 1956, Backiel 1964a, Lelek and Lusk 1965, Ribaut 1966).

The practical conclusions from present paper and from the literature data are the introduction of salmonids (rainbow trout or brown trout), and the strengthening of economically important fish populations, which quantities were limited by pollution and regulation works. The rainbow trout or brown trout could be introduced to small rivers and streams of Świętokrzyskie Mountains region and in the clean parts of Czarna Nida, after the precise temperature measurements and chemical analyses of water as it was suggested by Sakowicz (1955). After the reduction of present fish population by 60–80% with the help of electrofishing as adviced by Backiel (1964a), the suitable reaches could be stocked with a large number of chosen salmonid species.

Nida from Czarna Nida affluent to the mouth to Vistula has the richest fish stock of all larger rivers in central Poland. Its bed is nearly natural and water is clean. That is the reason why the fish there should be carefuly protected, and populations of economically important fish should be brought up to their previous quantity (barbel, hotu and *Vimba vimba* (L.)). *Vimba vimba* natio *carinata* (L.) could be also introduced there, as Wajdowicz (1970) suggested a real possibility of acclimatization of this species in Baltic basin.

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STRUKTURA ZGRUPOWAŃ RYB W CIEKACH DORZECZA NIDY

Streszczenie

Celem pracy było wyodrębnienie w dorzeczu Nidy podobnych środowisk w oparciu o zasiedlające je ryby oraz poznanie zgrupowań gatunków na podstawie łącznego lub rozdzielnego ich występowania.

Na 117 stanowiskach w 24 ciekach dorzecza Nidy, stosując do połowu agregaty, określono przynależność gatunkową 16005 ryb i smoczkoustych; ryby poławiano agregatem spalinowym (rzeki spławne) oraz bateryjnym (strumienie, potoki). Jednym elektropołowem obejmowano podobny morfologicznie odcinek rzeki, przestrzegając ustalonych uprzednio znormalizowanych kryteriów połowu (Penczak 1967, 1969a).

Stanowiska i gatunki podobne łączono w zgrupowania na podstawie definicji podobieństwa Marczewskiego i Steinhausa (1959). Stosując metody „taksonomii wrocławskiej" wykonano dendryty linearne według supozycji Romaniszyna (1970). Wykonany w oparciu o obydwa dendryty (fig. 1 i 2) diagram syntetyczny (fig. 3), zawiera odpowiedź na postawione w pracy pytania: 1) jakie zgrupowania gatunków i gatunki oddzielne powiązane są ze zgrupowaniami stanowisk i pojedynczymi stanowiskami w ciekach dorzecza Nidy, 2) jakie gatunki występują łacznie a jakie rozdzielnie i 3) które gatunki typować można na charakterystyczne, przejściowe i wybitnie eurytopowe.

W drobnych ciekach regionu Gór Świętokrzyskich przeważają strefy z dominacją strzebli potokowej oraz na przemian śliza i kiełbia. Wyodrębniające się środowiska

zasiedla ponadto zawsze, chociaż w niewielkich ilościach, płoć, kleń, szczupak i miętus. Nie spotyka się tu natomiast limnofilnych gatunków zgrupowania *A* (fig. 3). Jako gatunki towarzyszące lub dodatkowe występują tu inne gatunki litofilne jak szweja, świnka, brzanka, co w sumie pozwala na typowanie wyodrębnionych i dominujących stref strumieni i potoków regionu Gór Świętokrzyskich do introdukcji i hodowli niektórych gatunków ryb łososiowatych.

W drobnych ciekach regionu Wyżyny Krakowsko-Częstochowskiej Niecki Nidziańskiej i obrzeży Gór Świętokrzyskich dominuje śliz oraz w wielu przypadkach kiełb. Omawiane strefy zasiedlają eurytopowe gatunki dorzecza Nidy jak płoć, szczupak, miętus, natomiast gatunki z litofilnej grupy rozrodczej: brzanka, świnka, głowacz białopłetwy i strzebla potokowa, pełnią rolę adominantów.

W samej Nidzie (odcinek środkowy i dolny), w oparciu o dominację gatunków, wyodrębniły się jako oddzielne trzy zgrupowania stref: 1) szypoty (z dominacją świnki), 2) strefy z osuwającymi się ilasto-torfiastymi, niezadrzewionymi brzegami (dominacja płoci, ubóstwo litofilów i brak psammofilów) i 3) strefy o brzegach zwarcie zadrzewionych wikliną (najliczniejsze), której gałęzie tworzą „nawisy" nad lustrem wody, zasiedlane głównie przez płoć i jazia (gatunki towarzyszące: kleń, ukleja, miętus, brzana).

W dorzeczu Nidy przeważają wody czyste lub prawie czyste, ponadto jest ono mało zdewastowane na skutek zabiegów melioracyjnych i regulacyjnych i dzięki temu obserwuje się tu stosunkowo duże bogactwo gatunków właściwych dla określonego spadku czy elementów morfologicznej charakterystyki cieków. Ponadto stwierdzono możliwość introdukcji do niektórych stref dorzecza ryb łososiowatych, co w sumie jest już dostatecznym powodem aby Nidę, a także jej dopływy regionu Gór Świetokrzyskich otoczyć opieką oraz racjonalną gospodarką. Głównym jej celem byłoby ograniczenie ścieków Kielc, Białogonu i Tokarni, o czym pisałem uprzednio (Penczak 1971), a także ochrona tarlisk, wzbogacenie nieco zachwianych w swej liczebności populacji brzany i świnki oraz odbudowanie populacji certy.

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