

**SOME CONCLUSIONS ON THE TREND OF THE STAND OF THE PIKE-
PERCH (STIZOSTEDION LUCIOPERCA L.) IN THE MIDDLE AND
LOWER SECTIONS OF THE DANUBE
(RELYING ON THE DATA OF FISHERY CONDUCTED THERE)**

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The concerned states entered into an agreement for elaborating a uniform regulation of fishery pursued in the Hungarian, Yugoslavian, Romanian, Bulgarian and Soviet sections of the river Danube in 1958, and from that time on they have recorded the data about their catches of fish from the river more or less uniformly and made them available to each other. The following study was written founded on these data.

The values referring to the pike-perch (*Stizostedion lucioperca* L.) among the said data on catches of fish from the Danube also include in each instance the fished up quantity of *Stizostedion volgensis* Gmelin which gradually extends from the east to west. — The quantity of the latter species in the whole recorded data of catches of pike-perch varies between 6–12%.

In the zoogeographic sense pike-perch is a fairly frequent species in the whole Danube, moreover, the subfamily *Luciopercinae* — to which it belongs — originated in the Ponto-Caspic and Pannonian waters (Lindberg 1961). According to professional fishermen it is ranked among the most valuable fish everywhere. Only *Acipenserides* precede it in value. Its fishery is significant in the whole Danube basin although its share in the annual absolute catches is generally low and but seldom exceeds 5%.

For a comparative analyses the *areas* of the Danube sections of the countries need to be know. — However, such information is not available, so the *percentages of the lenghts of the banks* belonging to the sovereignty of the riparian states are presented in the following Table:

Table I.

Hungary 20%,	Jugoslavia 26%,	Bulgaria 11%,
Romania 39%,	Soviet Union 4%,	Altogether 100%

Table II.

Catches of pike-perch kg	Hungary	Jugoslavia	Bulgaria	Romania	Soviet Union	Total	%
1958.	13 028	43 500	61 300	1 447 200	26 800	1 591 828	12.6
1959.	17 281	39 900	22 557	942 000	16 400	1 038 138	8.2
1960.	15 531	39 100	13 393	662 000	13 100	743 124	5.9
1961.	15 817	33 000	10 962	757 000	14 700	831 479	6.6
1962.	16 488	27 200	34 088	1 020 000	19 400	1 117 176	8.9
1963.	11 557	61 300	47 634	1 323 000	25 800	1 469 291	11.6
1964.	9 472	39 600	20 959	1 020 000	10 300	1 100 331	8.7
1965.	111 960	34 600	23 196	778 000	7 700	855 456	6.9
1966.	24 480	77 800	30 893	902 000	16 900	1 052 073	8.3
1967.	34 863	127 000	31 382	872 000	17 700	1 082 945	8.6
1968.	25 359	83 000	25 952	857 400	17 200	1 008 911	8.0
1969.	13 690	47 600	12 310	639 400	11 500	724 500	5.7
Total:	209 526	653 600	334 626	11 220 000	197 500	12 615 252	100%
Yearly average:	17 460	54 467	27 885	935 000	16 458	1 051 271	
%	1.7	5.2	2.6	88.9	1.6	100%	

Table III.

Percentage of pike-perch from the yearly total catches by countries	Hungary	Jugoslavia	Bulgaria	Romania	Soviet Union	Total catches of pike-perch
1958.	1.7	3.4	5.7	5.1	1.0	4.7
1959.	2.1	3.3	3.6	7.3	0.8	6.2
1960.	1.9	3.6	3.3	6.8	1.3	5.7
1961.	1.9	2.7	2.0	6.1	0.9	5.0
1962.	1.9	2.3	3.5	5.5	1.2	4.8
1963.	1.3	3.6	6.4	6.0	1.2	5.4
1964.	1.1	4.4	3.9	7.0	0.5	5.8
1955.	1.2	2.0	2.1	3.4	0.5	3.0
1966.	2.0	3.0	5.0	4.0	0.8	3.6
1967.	3.0	5.9	4.3	3.7	0.7	3.6
1968.	2.3	5.8	4.8	4.9	1.1	4.6
1969.	1.5	5.5	3.0	3.4	0.9	3.3
Average:	1.9	4.6	4.8	5.0	0.9	4.5

Table II. includes the data of the catches of pike-perch in kilogrammes by countries and in total between the years 1958 – 1969. The Table comprises the yearly average catch of pike-perch calculated for the past 12 years and the percentage distribution among the discussed Danubian sections.

The distribution is rather disproportionate to the advantage of Romania. The Romanian data about catches of pike-perch are explained by the relatively wide area (hardly made perceptible by the figure in Table I which affords information but on the distribution of length), the great number and extent of branches (e. g. Borgia or Macin) and lakes in the inundation area. In Table III. we indicate the percentage by which *pike-perch* is represented in the yearly *total catch* in the years 1958 – 1969.

As it appears from these data, the Romanian figures for pike-perch are the highest of all also in this respect, and values of some tenth per cent mean considerable weight in absolute quantity.

To our knowledge no such data as in the Tables concerning so extensive an area of the river Danube have been published so far in works dealing with the subject. Various conclusions can be drawn from these figures. In the subsequent parts of this paper we will make but a few statements permitting generalized inferences, we shall not discuss the proportion of the pike-perch to other predatory or peaceful fish.

The most important question arising when one evaluates the data of any statistical tabulation on fishery is whether the changes ensuing in the data of the catches are consequences of modification in the stands or if they indicate alterations in the intensity of fishing. In smaller natural lakes the biological and biometric examination of the fish population living there as a rule affords an adequate possibility of solving the above dilemma. However, in the case of more extensive natural waters, especially if they consist of ecologically different parts like the discussed section of the Danube, the question cannot be solved in this way either. With respect to the there are no biological and biometric data to be considered characteristic of all parts of this about 1600 km. long section of the river for an opinion to be given. Therefore, to solve the problem we started from the published statistical data.

When elaborating and comparing the data, we applied the graphic system as below, described in several other works (T ó t h 1960, T ó t h – M i k u s k a 1971). Having reliable data about the catches of the years 1958 to 1969 at our disposal, we calculated the yearly average catch of pike-perch of the single countries along the Danube and considering it 100%, we could find out the percentage represented by the actual data of the catches in each year. (For example, all in all 209 526 kg. pike-perch were caught in Hungary's Danube section between 1958 and 1969,

that is $\frac{209\ 526}{12} = 17\ 460$ kg. on a yearly average. Considering this 100%, compared with it catches of pike-perch amounted to 75% in 1953, to 99% in 1959 and to 89% in 1960, etc. in the Hungarian Danube section.)

With this method the trend and degree of the deviation from the average were determined. We performed the calculation for each of the discussed Danube sections (Table IV).

Table IV.

Catches of pike-perch in the single years compared with the yearly average	Hungary	Jugoslavia	Bulgaria	Romania	Soviet Union	Total catches of pike-perch
1958.	75	80	220	155	163	151
1959.	99	73	80	101	99	99
1960.	89	72	48	71	80	71
1961.	91	61	39	81	89	79
1962.	95	50	122	109	118	106
1963.	66	113	171	141	157	140
1964.	54	73	75	109	63	105
1965.	69	64	83	83	47	81
1966.	140	143	110	97	103	100
1967.	200	233	112	93	108	103
1968.	145	152	93	95	104	96
1969.	78	87	44	68	70	69
Yearly average catches	100%	100%	100%	100%	100%	100%

Table V.

Percentual distribution of pike-perch by years and countries	Hungary	Jugoslavia	Bulgaria	Romania	Soviet Union	Total catches of pike-perch
1958.	0.8	2.7	3.9	90.9	1.7	100%
1959.	1.7	3.8	2.2	90.7	1.6	100
1960.	2.1	5.3	1.8	89.1	1.7	100
1961.	1.9	4.0	1.3	91.0	1.8	100
1962.	1.5	2.5	3.1	91.3	1.7	100
1963.	0.8	4.2	3.2	90.0	1.8	100
1964.	0.9	3.6	1.9	92.7	0.9	100
1965.	1.4	4.1	2.7	90.9	0.9	100
1966.	2.4	7.4	2.9	85.7	1.6	100
1967.	3.7	11.7	2.9	80.5	1.7	100
1968.	2.5	8.2	2.6	85.0	1.7	100
1969.	1.9	6.6	1.7	88.2	1.6	100
Average	1.7	5.2	2.6	88.9	1.6	100

For the sake of completeness and perspicuity, making use of the data of Table II we have calculated and present in Table V the distribution of catches of pike-perch by years and countries.

The data presented in Tables V and VI prove our earlier finding in detail, that the distribution of catches of pike-perch is disproportionate to the advantage of Romania. The data in Table IV and the graphs plotted relying on them afford an opportunity to make an interesting comparison. As can be seen, independently from the absolute values of the catches, with the countries situated near one another the changes ensuing in the data on the catches of pike-perch are rather similar. The first resemblance which strikes the eye is that of the graphs representing the data of the Jugoslavian and Hungarian Danube sections. The other observed circumstance is the similarity of the graphs referring to the lower basin of the Danube and their considerable deviation from those of the middle, Hungarian—Jugoslavian basin of the river.

When evaluating these data and diagrams, the circumstance should be taken into consideration that in certain instances the graphs of the Danubian countries with quite dissimilar organizations of fishery and differing as to the catches of pike-perch still resemble one another to a high degree. The graphs representing the changes in the catches of pike-perch in Romania and Bulgaria scarcely differ although in the Romanian Danube section there are state-owned enterprises of fishery at work,

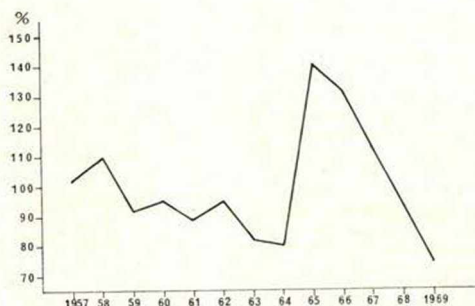


Fig. 1. Average daily water yield at Budapest. 100% = average of 1957—1969

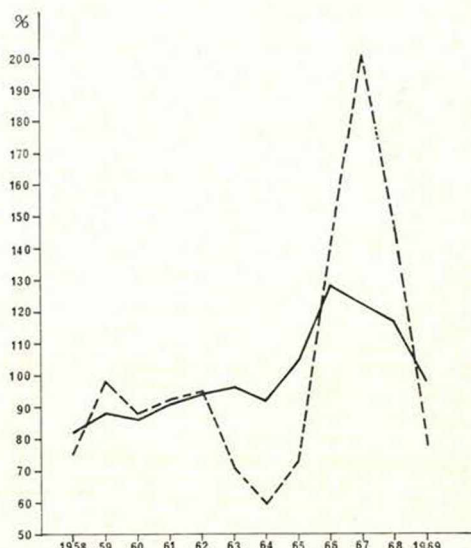


Fig. 2. Annual percentage changes of pike perch and of total catch in the Hungarian section of Danube. 100% = average. Total catch ———, pike perch catch - - -

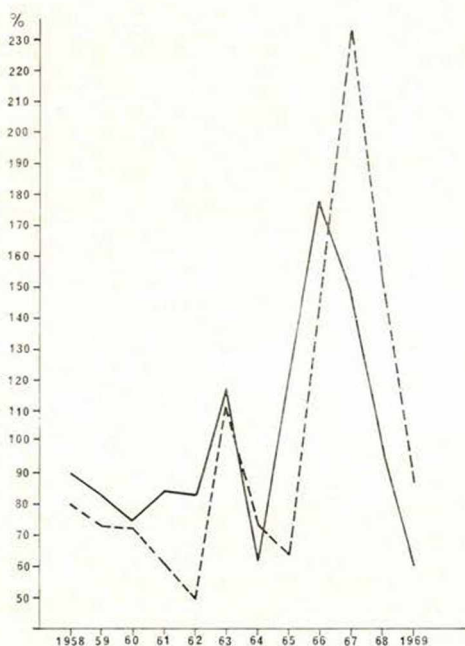


Fig. 3. Annual percentage changes of pike perch and of total catch in the Yugoslavian section of Danube. 100% = average. Total catch ———, pike perch catch - - -

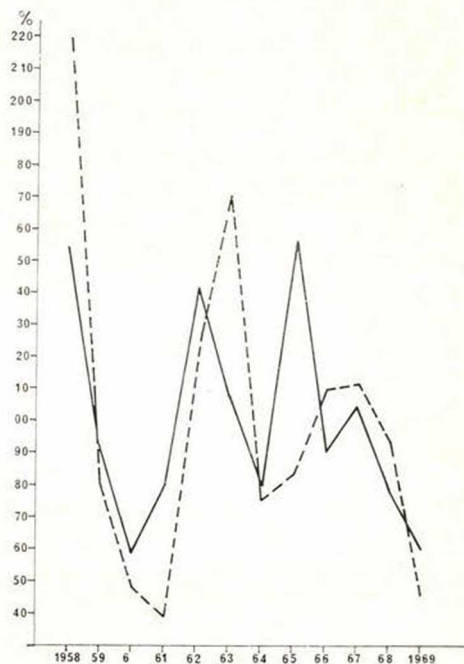


Fig. 4. Annual percentage changes of pike perch and total catch in the Bulgarian section of Danube. 100% = average. Total catch ———, pike perch catch - - -

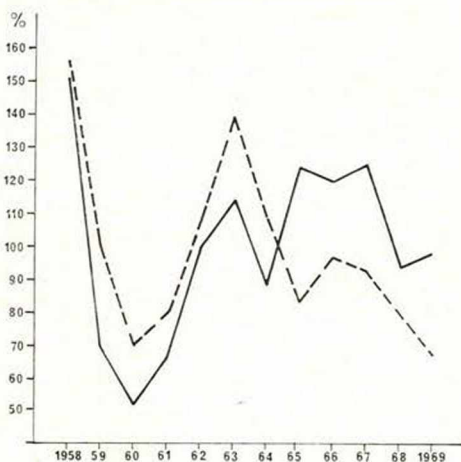


Fig. 5. Annual percentage changes of pike perch and of total catch in the Romanian section of Danube. 100% = average. Total catch ———, pike perch catch - - -

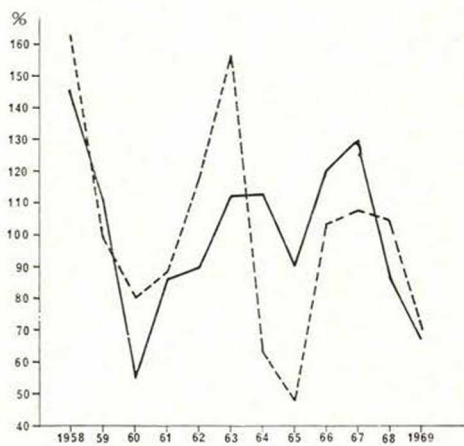


Fig. 6. Annual percentage changes of pike perch and of total catch in the USSR section of Danube. 100% = average. Total catch ———, pike perch catch - - -

and on a yearly average these catch nearly 90% of the pike-perch fished, up in the discussed five Danube countries together. On the other hand in Bulgaria, where fishery is organized in co-operatives, these catch all in all only 2.6% of this quantity on a yearly average. Naturally, the circumstance offers itself as an acceptable explanation that the fishermen of the two countries work at two opposite banks of the same Danube section, after all. The more remarkable is the fact the similarity of the Hungarian and Yugoslav graphs, although the two countries are not parallelly situated on two banks of the Danube but in succession, one below the other along the river.

When examining the graphs, the firm conviction was formed in us that the changes each year in the catches of pike-perch are for the most part consequences of a fluctuation in the stand of that fish. If the presented data reflected changes in the intensity of fishery then – in consequence of the dissimilar conditions of organization and economy – they would markedly differ in the single countries.

The other fact reliably indicated and unconditionally proved by the graphs is that the stands of pike-perch of the middle- and lower Danube basins develop and change differently from and independently of each other. May we call attention to the circumstance that in the examined period the Iron Gate Water Power Station was not yet working, consequently at that time this man-made structure did not separate the stands of pike-perch of the middle- and lower Danube basins in a physical sense.

The varying data of the catches do not refer either to a tendentious fall or to a tendentious rise. Most of all, the changes seem to be connected with the characteristic yearly values of water discharge. Rises in the data of catches of pike-perch generally follow upon the maximum discharges and highest water levels with a two years' delay. A series of years of low water calls forth a decrease in the stand and catches of pike-perch.

The stands of fish of smaller waters – in the first place of minor lakes – are usually considered closed units. Lundbeck's (1954) generally accepted definition can be referred to them without reservation. According to it a mass of living beings, belonging to an identical species, living in a definite area if they feed and reproduce in a community and are forming in this way a unity is called stand. However, this definition of stands and, relying on it, their differentiation is by far not as simple if one tries to apply it to the Danube. – Doubtlessly, as regards species formation and wider spaces of time also in the case of the Danube we may say that the stand of pike-perch living in it is a unit. Still, then this unit is significant in the first place in the genetic sense. However, taking shorter periods into consideration and in view of the ecological differences to be studied along the Danube nowadays, one arrives at the conclusion that the said unit has become disproportionated, and even if there are no differences, to be found as to the formation of the species, there still do exist disparities in the density and growth of the individuals and these differences indicate that the better course to be followed in the economic

exploitation of fishing is not to speak about the stand of pike-perch in the entire Danube but about those of the single sections. This divergence is manifested in the course of the graphs representing the stands of pike-perch in the middle- and lower basins of the Danube. The barrage of the Iron Gate Water Power Station separates the stand of pike-perch living above and below it also in the physical sense nowadays. Still, the data of the discussed years indicate that this separation existed also before the construction of the barrage.

Pike-perch is generally not considered a migrating species. Although Salniko v (1961) and Ristič (1970) do mention individuals of pike-perch marked by them which wandered over considerable distances, we still mean that the trend of the stand of pike-perch is affected in the first place by local factors, and its compensation is not a consequence of diffusion produced by the migration of the individuals of the species. The administration of fishery keeps inquiring about the artificial possibilities at disposal for increasing the stand. The rules and provisions of fishery issued in each country and integrated in the Danube Fishery Agreement fix the minimum measurements of pike-perch caught up. Generally, these arrangements are taken seriously in each concerned country and observed by the local organs of controlling fishery. Over and above this, both in the middle- and in the lower Danube basin fertilized spawn of pike-perch was placed more or less systematically into the river and/or the waters connected with it. However, at the time of spawning of pike-perch a close season in fishery is in force only in the middle basin of the Danube at present (in Hungary and Yugoslavia). In the lower basin of the river the spawning of pike-perch is not protected by a close time now, neither was it protected by one during the 12 years discussed in this paper. It is due to more intense river regulation and higher contamination in the middle Danube basin that, in spite of the protective measures, the density of the stand of pike-perch and the data about the catches of this fish are still considerably lower here than in the lower basin of the river.

A generally known characteristic of pike-perch is that they are rather exacting as regards environmental factors, in the first place as to the purity and oxygen content of the water. Presumably the best we can do for preserving and increasing the stand of pike-perch of the Danube at present is to aggravate the measures passed about the clarity of the water.

In Hungary, the pike-perch are of high economic significance in the Balaton, a lake belonging to the basin of the Danube. For this reason important research work has been conducted there on that fish (W o y n a r o v i c h 1959, 1961; B í r ó 1970, 1972). Although the stand of pike-perch of Lake Balaton is a separate question complex, the studies of the said authors permit making a general statement — which also holds for the Danube — that in the formation of the stand of pike-perch the period of plankton-feeding of the hatched young fish has an important

part. If the young fish get at a due quantity and quality of food at that time then they will change over to the predatory way of feeding relatively early — otherwise they remain underdeveloped and become the food of other carnivorous fish themselves — maybe of their own species.

The highly regulated condition of the Danube section of the middle basin, the inundation areas narrowed down in its lower basin are unfavourable for the young fish at the period of plankton-feeding. This situation cannot be altered by placing out fertilized spawn or hatched larvae. Following years in which no sufficient quantity of plankton food is formed during the summer months owing to this low water-level, a decrease in the catches of pike-perch is to be observed. Under favourable conditions the stand regenerates, moreover, one can even notice outstanding results. A phenomenon of this kind could be observed in the Hungarian and Yugoslavian Danube sections in 1967, following the flood year 1965.

Summary

The stand of pike-perch of the Danube is a significant economic asset. As it appears from the statistics of fishery, the quantity of pike-perch is greater in the lower than in the middle basin of the Danube, both in the absolute and relative sense. The changes in the data about catches of pike-perch refer to modifications in the stand, and the latter take place in a different manner in the lower and middle basins. The causes of the changes are, most probably, hydrologic factors. In the middle basin of the Danube the spawning of pike-perch is protected by a close time, no such measures are in force in the lower basin of the river at present.

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