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# A NOTE ON FAILURE OF LENGTH COMPOSITION ASSESSMENT OF BREAM AND ROACH

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A b s t r a c t. Data on catches per unit of effort of different mesh gill nets in Zegrzynski and Wloclawski Reservoirs and body measurements of bream and roach in these catches were used for length selectivity estimations and for the assessment of length composition of these fishes at large. It is shown that the estimations although in some cases consistent, may be fictitious.

Key words: SELECTIVITY OF NETS, LENGTH COMPOSITION, CPUE, BREAM, ROACH

## INTRODUCTION

One of the important traits of a fish population is its size composition. Estimation of that requires either unselective fishing gear or knowledge of selectivity of the gear in use. Bream *(Abramis brama* L.) and roach (*Rutilus rutilus* L.) are most common species in almost any kind of fresh and brackish water of central and eastern Europe but size selection of the fishes by widely used gill nets had been very seldom assessed (Dahm 1987). These species are also dominating in the majority of reservoirs in Poland where they are being commercially exploited (Backiel 1985, Mastyński 1985) and therefore assessment of their stocks which includes size composition seems important. This communication is an attempt to employ available data for estimation of gill net selectivity and, subsequently, of size composition of the two species in two reservoirs: Zegrzyński and Włocławski. Indirect estimates of size selectivity of gill nets require that such nets of different mesh sizes operate on the same fish stock (Hamley 1975). Collections from the two reservoirs violate this requirement to some extent, having been procured over a period of a few month and not always at the same fishing ground by different nets. The aim of this communication is therefore to evaluate utilization of that kind of material.

## MATERIAL AND METHOD

All data and information were collected by the team of the River Fisheries Department in Żabieniec of the Inland Fisheries Institute under the leadership of R. Sych. Respective details of projects concerning reservoir fisheries are to be found in the final reports of this Department for the years 1981-1985 and 1986-1990.

Data on the catches per unit of effort (CPUE) i.e. per standard commercial gill net fishing ca. 24 h and on weight fish of were collected from the Zegrzyński Reservoir during autumn of 1986, 1987 and 1988. Length of most fish specimens was recorded. In this paper data on bream and roach only are used (Table 1.). Out of similar data obtained from the Włocławski Reservoir during 1982 and 1983 those used here concern summer (June-August) and autumn (October-November) collections of bream only (Tab.1).

TABLE 1

Data on gill net catches used in this paper

| Mesh mm | Mean CPEU (number) | Number of fish measured | Mesh mm | Mean CPEU (number) | Number of fish measured |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 1 | 2 | 3 |
| Zegrzyński Reservoir | | | | | |
| Bream | | | Roach | | |
| 25 | 7.89 | 55 | 25 | 99.28 | 328 |
| 65 | 18.49 | 82 | 35 | 57.50 | 213 |
| 70 | 51.78 | 318 | 45 | 197.00 | 50 |
| 80 | 19.77 | 361 | 50 | 18.00 | 14 |
| 85 | 27.47 | 294 | 65 | 1.89 | 13 |
| 90 | 10.80 | 48 | 70 | 1.33 | 16 |
| 100 | 10.24 | 87 | | | |
| Włocławski Reservoir, bream | | | | | |
| Summer collection | | | Autumn collection | | |
| 50 | 17.00 | 47 | 60 | 12.13 | 239 |
| 55 | 16.50 | 59 | 70 | 11.19 | 89 |
| 60 | 15.74 | 893 | 75 | 9.80 | 46 |
| 70 | 15.08 | 517 | 80 | 8.50 | 34 |
| 80 | 8.46 | 67 | | | |

The first method adopted here was based mainly on the papers by Gulland and Harding (1961) and Jensen (1977) and consisted of:

1. adjusting length distribution in subsamples to the mean number of fish caught (CPUE) and, because of small number measured in some meshes (Table 1) ,

adjusting the distributions to the skewed-normal using Charlier equation,

2. plotting relative numbers of fish in each length class (j) (taking maximum number in respective classes equal 1) in subsequent mesh sizes (i) i.e. relative efficiency of retention of fish S(j,i) versus the respective ratios R(j,i) of the mesh size used (i) to that with maximum number of fish i.e. best mesh for each length class (j).
3. drawing by eye a dome shaped curve which represents best the scattered points and approximates the selectivity curve ( Fig.1).
4. estimating regression of best mesh (i.e. in which the greatest number of fish of a particular length class was captured) on length.

The curve (which is of Type B, Hamley 1975) and the regression were used to assess length composition of fish in the exploited area.

TABLE 2

Relationships of measurements used in estimations of selectivity by means of Secin (1969 a,b) method

| | regr. coeff. | intercept | correl. coeff. |
|---|---|---|---|
| | Bream: N= 70, range of l.tot. 10.2 ... 60.6 cm | | |
| max. girth/l.tot. | 0.82069 | -2.99845 | 0.9956 |
| head girth/l.tot. | 0.59222 | -1.68188 | 0.9956 |
| | respective standard deviations vs. length : | | |
| | SD 1 | 0.01603 | 6.000 |
| | SD 2 | 0.0304 | 2.103 |
| (body length/l.tot. | 0.84589 | -1.20029 | 0.9988 ) |
| | Roach : N = 64, range 10.7...36.6 cm | | |
| max. girth/l.tot. | 0.84299 | -3.4780 | 0.9842 |
| head girth/l.tot. | 0.60027 | -1.8878 | 0.9776 |
| | SD 1 | 0.0458 | 0.2017 |
| | SD 2 | 0.0392 | 0.1750 |
| (body length/l.tot. | 0.83514 | -0.16674 | 0.9971) |
| | Gill nets: SD of mesh = 0.034· (mesh size)+ 0.354 | | |

In October 1987 several body measurements of bream and roach were made and they served also for estimation of head girth and of maximum girth versus total length, and of respective variances (Table 2.). These parameters served for estimation of gill net selectivity by means of the method of Secin (1969 a,b). In brief this author assumed that probability (P (L)) of retaining a fish of a certain length L in mesh size M (knot-to-knot) is a function of two cumulative normal frequency distributions (FI):

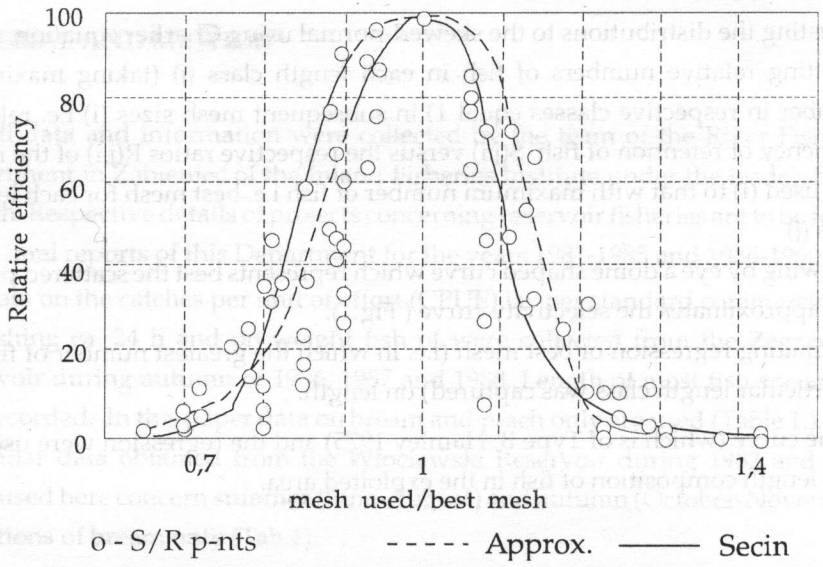


Fig. 1. Selectivity of gill nets for bream caught in the Zegrzyński Reservoir. Circles are relative efficiencies of retaining fish of particular length class versus the ratio of mesh used to best mesh irrespective of mesh, broken line is a smoothed master selectivity curve. Continuous line is such a

$$F(1) = FI\,[Head\ girth - 4 \cdot M)/\ Standard\ deviation\ of\ girth\ \&\ mesh]$$

$$F(2) = FI\,[(Max.\ girth - 4 \cdot M)/\ Respective\ SD]$$

$$i.e.\ P(L) = F(1)\ \cdot (1 - F(2))$$

## RESULTS AND DISCUSSION

### SELECTIVITY ESTIMATES

The plot of efficiency (=selectivity) against mesh used/best mesh ratio for bream of Zegrzyński Res. enabled drawing a master curve (Fig. 1) that approximates scattered points. This curve differs from that obtained by means of the Secin's method, the latter being platykurtic. Selectivity curves based on data from Włocławski Res. (Fig. 2) differ from the former ones. Especially summer collection produced a rather dissimilar curve. These four estimates differ not only with respect to the shape and range of R values but also in regressions of best mesh on length, the coefficients (regression and intercept) of which are:

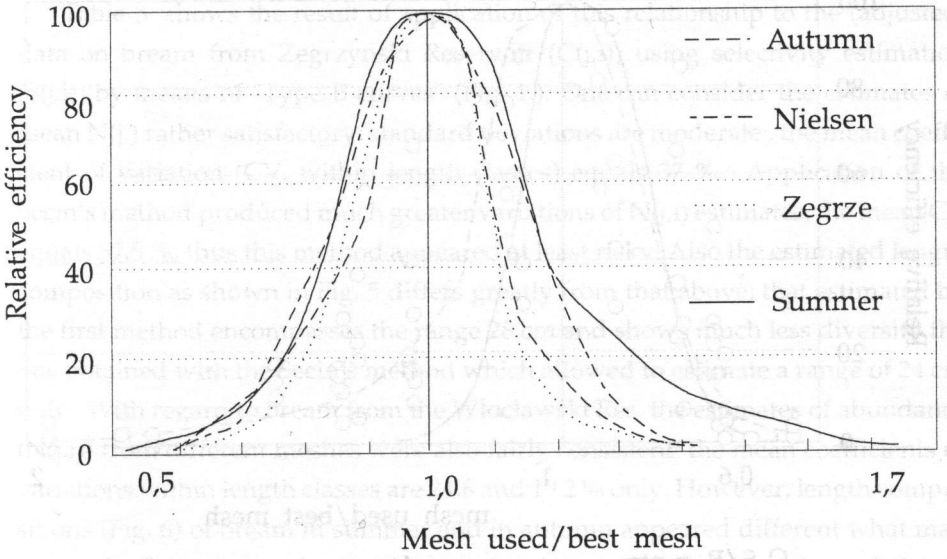


Fig. 2. Selectivity master curves of gill nets for bream in Włocławski Reservoir caught in two seasons (autumn, summer), added curves for Zegrzyński Res. and from Nielsen (1984) drawn for bream in a Danish lake

| | | | |
|---|---|---|---|
| Zegrzyński , type B | 0.183 | and | -0.15 |
| Zegrzyński, Secin | 0.173 | and | -4.84 |
| Włocławski, summer | 0.232 | and | -30.98 |
| Włocławski, autumn | 0.184 | and | -3.37 |

The only Type B selectivity of gill nets for bream found in literature (Nielsen 1984) is again different ( Fig. 2.)

Estimation of selectivity of the nets for roach of Zegrzyński Res. appears even less consistent; S/R points are widely scattered (Fig. 3) and the approximated curve differs greatly from that obtained with the aid of Sechin method. The regressions of best mesh on length are also quite dissimilar with coefficients 0.245, -24.40 , and 0.175 , -6.27 , respectively.

Backiel and Korycki (1972) and Pivnicka, Liška and Johal (1984) applied different methods for selectivity estimations of gill nets for roach and that is why the curves (Fig. 4) show efficiency against body length. There are marked differences especially at lengths smaller and larger than modal. Besides, the modal length versus mesh size differ: for the mesh of 27.9 to 28.6 mm according to Pivnicka, Liška and Johal (1984) the modal body length was 183 mm, from data of Backiel,

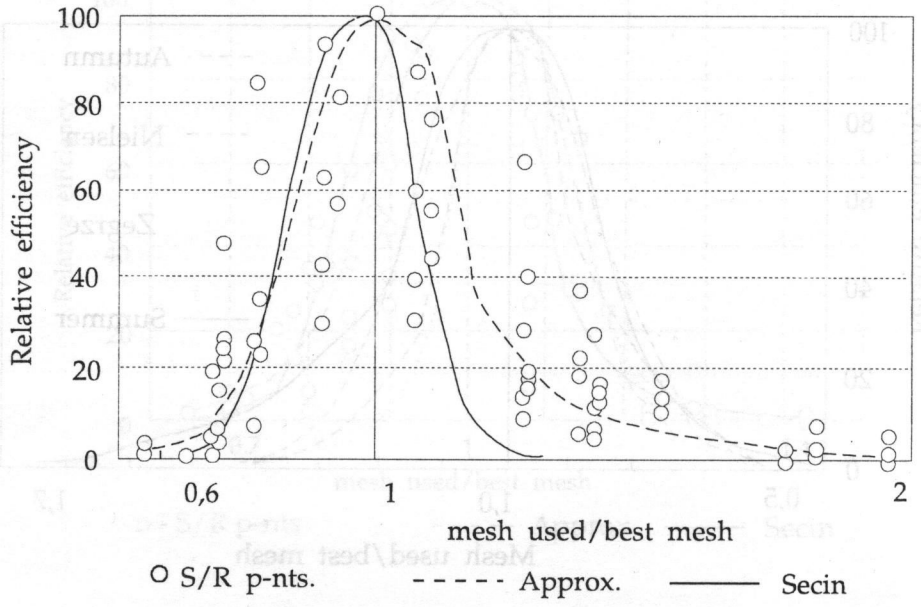


Fig. 3. Selectivity of gill nets for roach from Zegrzyński Res. Explanations as in Fig. 1

Korycki (1972) it was 176 mm and data analyzed here resulted in 178 or 163 mm respectively from the Type B curve or from the Secin method.

There is no reason for such discrepancies of selectivity estimates for the, apparently, same stocks and same gear. No plausible explanation can be offered for the striking difference between "Type B" estimate and the method of Sehin who proved it credible (1969b). One has to accept the outcome of the estimations as simply biased and/or erroneous.

## LENGTH COMPOSITION OF THE STOCKS

Length composition of fish of catchable length classes (j) can be estimated from the numbers of fish (i.e. catch per unit of effort) C(j,i) caught by gill nets of certain mesh sizes (i) and from their selectivity with respect to these length classes S(j,i). If the catches by several nets are performed over the same stock and the selectivity is estimated without bias then estimated abundance N(j,i) of a length class (j) should be the same irrespective of mesh size (i). That is:

$$N(j,1) = N(j,2) = ..... N(j,i)$$

where:

$$N(j,i) = C(j,i)/S(j,i)$$

Table 3 shows the result of application of this relationship to the (adjusted) data on bream from Zegrzyński Reservoir (C(j,i)) using selectivity estimation (S(j,i)) by means of "Type B curves" (Fig. 1.). One can consider the estimates of mean N(j.) rather satisfactory; standard deviations are moderate , the mean coefficient of variation (CV, within length classes) equals 37 %. Application of the Secin's method produced much greater variations of N(j,i) estimates, the mean CV equals 57.5 %, thus this method appeared at least risky. Also the estimated length composition as shown in Fig. 5 differs greatly from that above; that estimated by the first method encompasses the range 28 cm and shows much less diversity the one obtained with the Secin's method which allowed to estimate a range of 24 cm only. With regard to bream from the Włocławski Res. the estimates of abundance (N(j,i)) from different meshes were also fairly consistent; the mean coefficients of variations within length classes are 24.8 and 19.2 % only. However, length compositions (Fig. 6) of bream in summer and in autumn appeared different what may be a reflection of true changes but, in detail, may have resulted from different selectivity curves (Fig. 2) which, provided that rigorous sampling had been performed, should not be so dissimilar.

TABLE 3

Length composition of bream in the fishing area of Zegrzyński Reservoir assessed from catches by six gill nets using selectivity master curve as in Fig. 1, approx.

| Length class | Relative number of fish in mesh size | | | | | | Mean number | C.V.* % |
|---|---|---|---|---|---|---|---|---|
| | 65 | 70 | 80 | 85 | 90 | 100 | | |
| 330 | 525 | 558 | | | | | 541 | 4.3 |
| 350 | 656 | 526 | 273 | | | | 484 | 40.0 |
| 370 | 738 | 528 | 507 | 300 | | | 518 | 34.5 |
| 390 | 716 | 602 | 573 | 448 | 260 | | 519 | 33.4 |
| 410 | 585 | 587 | 366 | 546 | 382 | | 493 | 22.4 |
| 430 | 532 | 503 | 389 | 308 | 434 | | 434 | 20.7 |
| 450 | 605 | 444 | 385 | 299 | 245 | 238 | 369 | 38.1 |
| 470 | 608 | 394 | 345 | 305 | 224 | 195 | 345 | 43.0 |
| 490 | 547 | 426 | 303 | 273 | 231 | 197 | 330 | 40.2 |
| 510 | | 420 | 250 | 244 | 212 | 100 | 245 | 46.8 |
| 530 | | | 211 | 198 | 186 | 99 | 174 | 29.2 |
| 550 | | | 180 | 164 | 154 | 97 | 149 | 24.3 |
| 570 | | | 138 | 133 | 136 | 88 | 124 | 19.5 |
| 590 | | | | 105 | 108 | 75 | 94 | 18.8 |
| 610 | | | | 77 | 76 | 61 | 71 | 12.1 |

Within length classes (between meshes) mean coeff. var.= 37.0

*N.B.* * *- coefficient of variation*

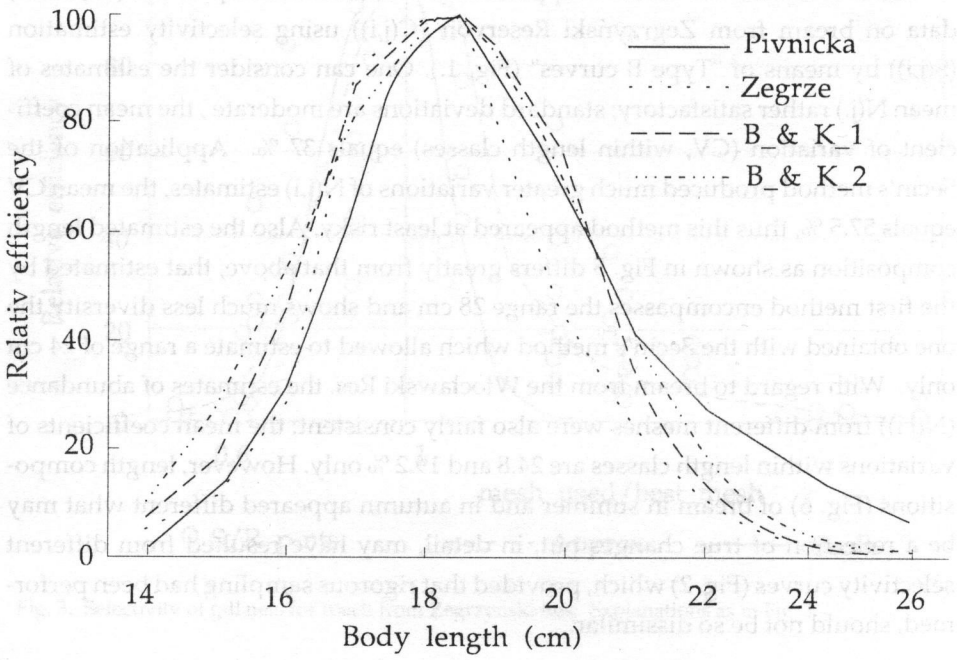


Fig. 4. Selectivity curves adjusted to the curve of Pivnicka, Liška and Johal (1984), curve 1., with the modal body length =183 mm: curve 2 -based on data from Zegrzyński Res., 3- based on data from Backiel and Korycki (1972) recalculated, 4- based on the above using original estimates

Moderate variations of abundance estimates within length class could induce an optimistic conclusion that they reflected length composition of the stocks of bream. This outcome, however, is brought about by consistency of application of the selectivity within one set of data and does not necessarily mean the likely composition of fish at large.

With respect to the roach from Zegrzyński Res. the two methods of selectivity estimation resulted in such very different curves (Fig.3) that calculations of the length composition of stock was meaningless. One trial of applying Type B selectivity to catch adjusted catch composition resulted in very large variability (CV) of abundance estimates (within length classes) ranging from 2 to 143 % of the means and averaging 78 %.

In conclusion one has to admit that without rigorous sampling design estimations of gill net selectivity and, consequently, assessment of size composition of fish stocks is at least very risky. Monitoring of stocks in the reservoirs should be best carried out by means of somehow standardized gangs of gill, as what has been

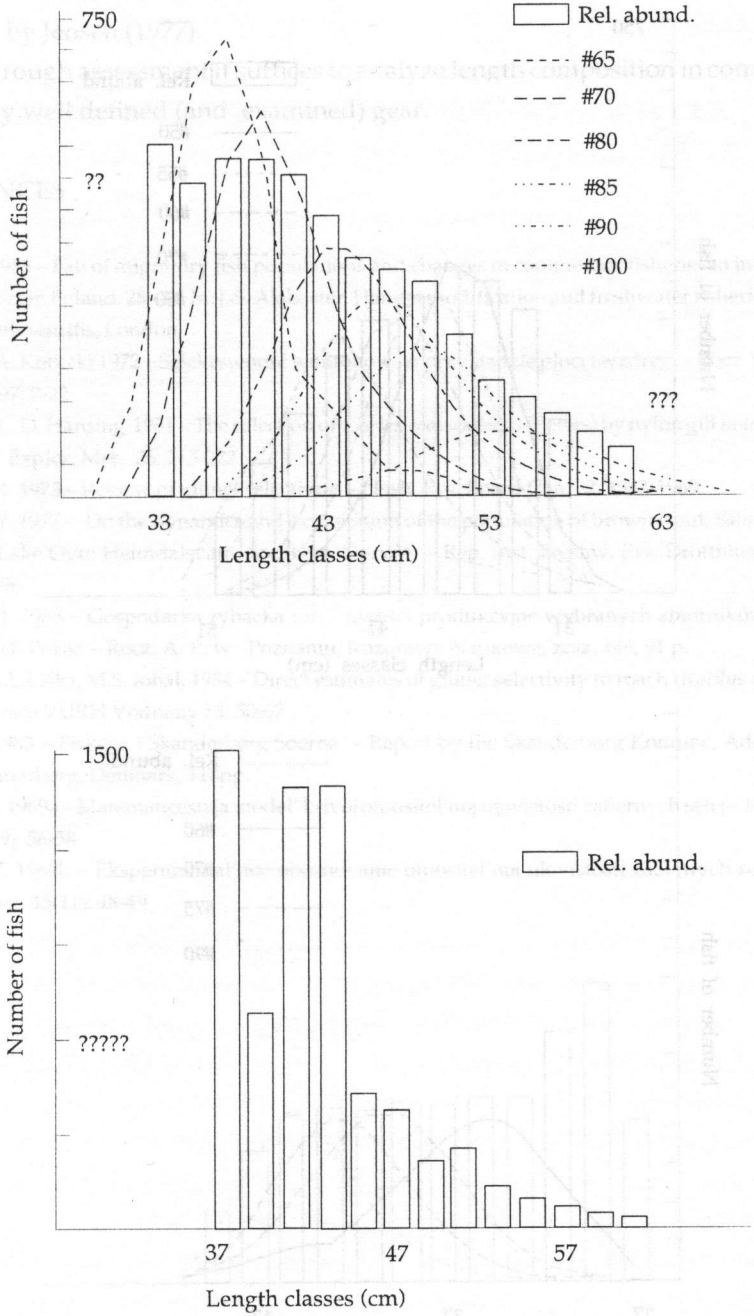


Fig. 5. Length composition of bream in Zegrzyński Reservoir; upper part shows length composition in catch by respective gill nets adjusted to their CPUE (lines) and the composition in the fishing area (bars) estimated by Type B master curve, lower part shows results of application of Secin method

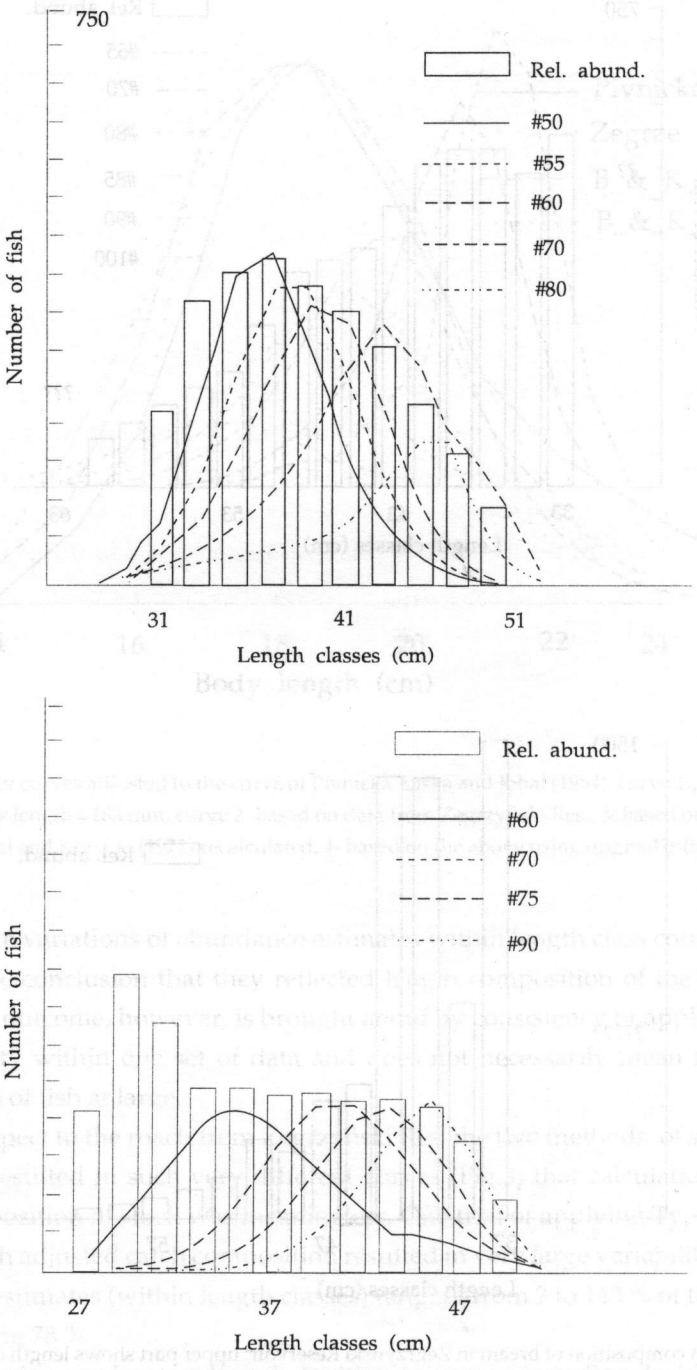


Fig. 6. Length composition of bream in Włocławski Reservoir estimated by Type B selectivity curves for summer (upper) and autumn (lower part) seasons (bars) and catch compositions by respective gill nets (lines)

done e.g. by Jensen (1977).

For a rough assessment it suffices to analyze length composition in commercial catches by well defined (and examined) gear.

## REFERENCES


Backiel T. 1985 – Fall of migratory fish populations and changes in commercial fisheries in impounded rivers in Poland. 28 - 41. In: J. S. Alabaster, Habitat modification and freshwater fisheries – FAO, Butterworths, London

Backiel T., A. Korycki 1972 – Selektywność wontonów na przykładzie płoci i wzdręgi – Rocz. Nauk Rol. H, 97: 7-22

Gulland J.A., D. Harding 1961 – The selection of *Clarias mossambicus* (Peters) by nylon gill nets – J. Cons. Int. Explor. Mer. 26: 215-222

Hamley J.M. 1975 – Review of gillnet selectivity – J.Fish. Res. Board Can. 32: 1943-1969.

Jensen K.W. 1977 – On the dynamics and exploitation of the population of brown trout, *Salmo trutta* L. in Lake Ovre Heimdalsvatn, Southern Norway – Rep. Inst. Freshw. Res.,Drottningholm, 56: 18-96

Mastynski J. 1985 – Gospodarka rybacka i możliwości produkcyjne wybranych zbiorników zaporowych Polski – Rocz. A. R. w Poznaniu, Rozprawy Naukowe, zesz. 146, 91 p.

Pivnicka K.,L.Liška, M.S. Johal. 1984 – Direct estimates of gillnet selectivity to roach (*Rutilus rutitlus* L.) – Prace VURH Vodnany 13: 50-67

Nielsen J. 1983 – Fiskene i Skanderborg Soerne – Report by the Skanderborg Komune, Adelgade 44, Skanerborg, Denmark, 118pp.

Secin Yu. T. 1969a – Matematicestaja model' krivoj otnositel'noj ulovistosti zabernych setej – Ryb. Choz. 45(9): 56-58

Secin Yu. T. 1969b – Eksperimental'noe obosnovanie otnositel'noj ulovistosti zabernych setej – Ryb. Choz. 45(11): 48-49

## STRESZCZENIE

UWAGI O NIEPOWODZENIU OCEN SKŁADU WIELKOŚCIOWEGO LESZCZA I PŁOCI

Strukturę wielkościową populacji leszcza i płoci w Zegrzyńskim i Włocławskim zbiorniku zaporowym oraz selektywność warunków określono na podstawie pomiarów długości ciała ryb i danych o odłowie na jednostkę wysiłku połowowego wontonów o różnej wielkości oczek. Stwierdzono, że oceny dokonywane tymi metodami mogą być nieprawdziwe nawet wówczas, gdy otrzymane wyniki są pozornie zborne. Postawiono wniosek, że selektywność wontonów pod względem długości poławianych ryb, a tym samym i oceny struktury wielkościowej populacji są bardzo ryzykowne, jeśli nie opierają się o rygorystyczny schemat poboru prób. Zasugerowano, że monitoring pogłowaia ryb w zbiornikach powinien opierać się o stosowanie stadardowych zestawów wontonów.



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