A C T A I C H T H Y O L O G I C A E T P I S C A T O R I A
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THE USE OF THE CATCH PER UNIT OF EFFORT OF SEINE NETS TO ASSESS FISHERY RESOURCES IN VENDANCE LAKES

ZASTOSOWANIE WYDAJNOŚCI POŁOWOWEJ PRZYWŁOK DO SZACOWANIA ZASOBÓW RYBACKICH W JEZIORACH SIELAWOWYCH

Department of Fisheries Agricultural and Technical Academy in Olsztyn

Analyses of the fishing yield of seines revealed that catches obtained with this gear were predominated by vendace (28%) and roach (45%). Catch of these species per one seine fishing day amounted on the average to 59 and 93 kg respectively. Effectiveness of vendace catches showed positive correlation with stocking rates, and a negative one with the effectiveness of roach catches. High vendace catches were accompanied by relatively lower roach catches.

Share of bream in seine catches ranged from 1.5% in Lake Duża Woda to 19% in Lake Jelonek, of whitefish from 0.39% in Lake Jelonek to 16.75% in Lake Żelazne. Share of predators (perch, pike, eel) was form 5.78 to 17.88%.

INTRODUCTION

Catch per unit of effort and its variability are frequently used to assess qualitative and quantitative changes takig place in the exploited fish stocks (Dąbrowski, Leopold, Nowak 1964a,b, Kozłowska-Filar 1971, Nowak 1971, Carlander, Payne 1977, Bonar 1987a,b, 1989, Bonar, Kempa 1987a,b).

Seines are the most frequently used fishing gear in Poland. Similarly as other active gears, they are considered little selective and, thus, most suitable for the assessment of the fish resources in lakes (Dąbrowski, Leopold, Nowak 1964a, Bonar 1989).

The objective of the studies was to estimate the biomass and species composition of the fish stocks in five lakes of vendace type. The analyses were based on the fish catch statistics and catch per unit of effort of seine nets for the period 1983–1985.

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Table 1

Hydrobiological characteristics of the lakes

Specification	Units	Jelonek	Szeląg Duży	Duży Gil	Duża Woda	Żelazne
Area	ha	238.9	667.9	558.3	631.6	417.9
Maximal depth	m	27.4	35.5	22.1	34.7	54.5
Average depth	m	8.6	13.5	6.9	8.2	14.2
Transparency	m	3.0	8.5	2.6	4.5	7.0
Productivity according to the scale by Patalas		2.2	2.9	3.4	3.1	2.9
Littoral area	%	7.7	15.2	30.0	27.1	7.2

MATERIALS AND METHOD

Statistics of the Fishery Enterprise in Ostróda were the source of the materials. The information referred to fish exploitation in five vendace lakes: Jelonek, Szeląg Duży, Duży Gil, Duża Woda, Żelazne. The lake characteristics is presented in Table 1.

The materials embraced the period 1983–1985 and comprised the following information: number of days in which seines were used, weight of the fish caught with gear divided into the species and size classes. Catch per unit of effort (fishing yield) was obtained dividing the catch by the effort; it was expressed in kg per one day of seining (Leopold 1968). In the same way catch per unit of effort was calculated for particular fish species. This measure has been defined as gear catchability. According to Dąbrowski (1964) it is understood as catch of the given species obtained with the given gear in a unit of time.

Fishing yield (catch per unit of effort) of any fishing gear depends on the fish biomass and seasonal stock densities on the one hand, and type of the gear and its catchability on the other. This implies methodical consequences. In the analyses of the fishing efficiency, the following assumptions are made depending on the needs:

- that the biomass of the exploited fish stock is relatively constant;
- that the gear construction and the fishing methods do not change.

When the first condition is fulfilled, it is possible to analyse the relations between catch per unit of effort and gear construction and fishing method. When the second condition is true, it is possible to estimate changes taking place in the exploited fish stock (Bonar 1990).

Other fishing gear was also used in the five lakes under study: winter seines, fyke nets, gill nets, pound nets and hooks. However, the information on these gears was incomplete, so only the data on summer seines were used. Wing length of the seines was from 120 m to 180 m, mesh size in the bag was 22 mm. Characteristics of the materials is given in Table 2.

RESULTS

Catches obtained with summer seines, calculated for the five lakes, amounted on the average to 14.4 kg/ha yearly, this being 39% of the total fish catch from these lakes. The lowest catches were recorded for Lake Duży Gil (6.72 kg/ha), the highest for Lake Jelonek (22.29 kg/ha) (Tab. 2).

Fishing effort expressed as the number of seine-days per year varied from 22.67 days (Lake Jelonek) to 48 days (Lake Szeląg Duży) (Tab. 2). When lake area was taken into account (Tab. 1) it appeared, however, that the fishing intensity was the same in all lakes.

Table 2

Characteristics of the materials (average for 1983–1985)

Specification	Units	Żelazne (Isąg)	Duża Woda	Duży Gil	Szeląg Duży	Jelonek	Average for 5 lakes
Total catch	kg/ha	31.34	52.27	32.22	31.78	37.16	36.95
Catch with seines	kg/ha %	11.62 37.08	13.12 25.10	6.72 20.85	18.25 57.43	22.29 59.98	14.40 38.97
Other gear	kg/ha %	19.72 62.92	39.15 74.90	25.50 79.15	13.53 42.57	14.87 40.02	22.55 61.03
Fishing effort (seines)	number of seine-days	37.33	24.67	25.33	48.00	22.67	31.60
Fishing yield (seines)	kg/day of seining	122.17	338.10	143.30	187.56	238.73	205.97

Table 3

Relations between catch per unit of effort for seines and total fish catch

Lake	Fishing yield, kg/day of seining	Total catch kg/ha
Żelazne	122.17	31.34
Duży Gil	143.30	32.22
Szeląg Duży	187.56	31.78
Jelonek	238.73	37.16
Duża Woda	338.10	52.27

On the other hand, effectiveness of the exploitation, expressed as catch per unit of effort of seine nets, differed considerably. Average catch per unit of effort for seines estimated by Leopold (1968) for all Polish lakes amounted to 175 kg per day. Lower values were found for Lake Żelazne and Duży Gil, higher for lakes Duża Woda, Szeląg Duży and Jelonek. Average catch der pay of fishing in the five lakes amounted to 105.97 kg (Tab. 2).

No relationship was found between the fishing effort, the level of fish catches, and the catch per unit of effort of the seines (Fig. 1). On the other hand there was a noticeable relation between catch per unit of effort and total fish catches obtained with all gears in these lakes (Tab. 3).

Assuming after Dąbrowski, Leopold and Nowak (1964b) that in the case of seines the catch per unit of effort may be used to assess fish resources in the lakes, species composition of the catches was compared (Tab. 4). It was found that seines were most effective in Lake Duża Woda (the highest catchability). Roach dominated in the catches (69.75%), followed by vendace, whitefish and eel. Similar species composition of the catch was observed in Lake Żelazne, but the catch per day of fishing was lower (122.17 kg). Hence, the two extreme lakes with respect to the fish yield were characterized by similar species composition of the catch. In Lake Duży Gil roach also dominated in the catch, followed by vendace and perch, while in Lake Szeląg Duży vendace dominated, followed by roach and whitefish, and in Lake Jelonek it was vendace, bream and roach.

These results suggest that the noted differences in the catch per unit of effort might have been due to different fish resources in the lakes, as well as different species composition of the ichthyofauna. Notwithstanding the differences in the species composition of the catches obtained with seines as well as other gear (Tab. 4, 5, 6), there was a relationship between vendace and roach. High vendace catches

Table 4

Share of particular species in total fishing yield of the seines (1983–1985)

Species	Żelazne		Duża Woda		Duży Gil		Szeląg Duży		Jelonek		Averagin fishing yield	
	kg/day of seining	%	kg/day of seining	%	kg/day of seining	%	kg/day of seining	%	kg/day of seining	%	kg/day of seining	%
Vendace	3.42	2.80	30.43	9.00	21.41	14.94	86.44	46.07	151.15	63.31	58.57	28.44
Roach	66.75	54.64	235.81	69.75	81.51	56.88	58.53	31.21	21.35	8.94	92.79	45.05
Bream	14.10	11.54	5.14	1.52	3.20	2.23	13.60	7.25	46.07	19.29	16.42	7.97
Perch	5.32	4.35	3.22	0.95	16.00	11.17	3.13	1.67	8.93	3.74	7.32	3.55
Pike	3.52	2.88	9.11	2.69	4.97	3.47	5.44	2.90	0.79	0.35	4.77	2.32
Eel	4.96	4.06	14.32	4.24	4.07	2.84	2.26	1.21	3.88	1.63	5.90	2.86
Whitefish	20.46	16.75	30.26	8.95	6.42	4.48	17.83	9.51	0.94	0.39	15.18	7.37
Other	3.64	2.98	9.81	2.90	5.72	3.99	0.33	0.18	5.62	2.35	5.02	2.44
Total	122.17	100	338.10	100	143.30	100	187.56	100	238.73	100	205.97	100
Stocking with vendace thousand ind./ha	17.96		10.13		9.00		13.29		14.79			

Table 5

Level and species composition of seine catches

Species	Żelazne		Duża Woda		Duży Gil		Szeląg Duży		Jelonek	
	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%
Vendace	0.30	2.58	1.14	8.69	0.97	14.43	7.58	41.53	14.34	64.33
Roach	6.49	55.85	9.18	69.97	3.82	56.85	6.36	34.85	1.95	8.75
Whitefish	1.85	15.92	1.18	8.99	0.31	4.61	1.40	7.67	0.09	0.40
Bream	1.26	10.84	0.20	1.52	0.15	2.23	1.92	10.52	4.37	19.60
Perch	0.61	5.25	0.13	0.99	0.75	11.16	0.24	1.32	0.85	3.82
Eel	0.46	3.96	0.56	4.27	0.20	2.98	0.25	1.36	0.08	0.36
Pike	0.32	2.75	0.35	2.67	0.24	3.57	0.46	2.52	0.07	0.32
Other	0.33	2.84	0.38	2.90	0.28	4.17	0.04	0.23	0.54	2.42
Total	11.62	100.0	13.12	100.0	6.72	100.0	18.25	100.0	22.29	100.0

Table 6

Characteristics of total fish catches

Species	Żelazne		Duża Woda		Duży Gill		Szeląg Duży		Jelonek	
	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%
Vendace	2.96	9.44	13.25	25.35	6.29	19.52	10.99	34.58	22.31	60.04
Roach	13.39	42.72	23.02	44.04	9.26	28.74	10.91	34.33	2.48	6.67
Whitefish	5.67	18.09	3.49	6.68	1.40	4.35	2.57	8.09	0.10	0.27
Bream	3.68	11.74	4.88	9.34	9.71	30.14	4.35	13.69	4.76	12.81
Perch	1.17	3.73	0.44	0.84	1.73	5.37	0.58	1.82	1.58	4.25
Eel	1.22	3.89	4.69	8.97	1.96	6.08	1.22	3.84	4.91	13.21
Pike	2.71	8.65	0.93	1.78	0.88	2.73	1.09	3.43	0.17	0.46
Other	0.54	1.72	1.57	3.00	0.99	3.07	0.07	0.22	0.85	2.29
Total	31.34	100.0	52.27	100.0	32.22	100.0	31.78	100.0	37.16	100.0

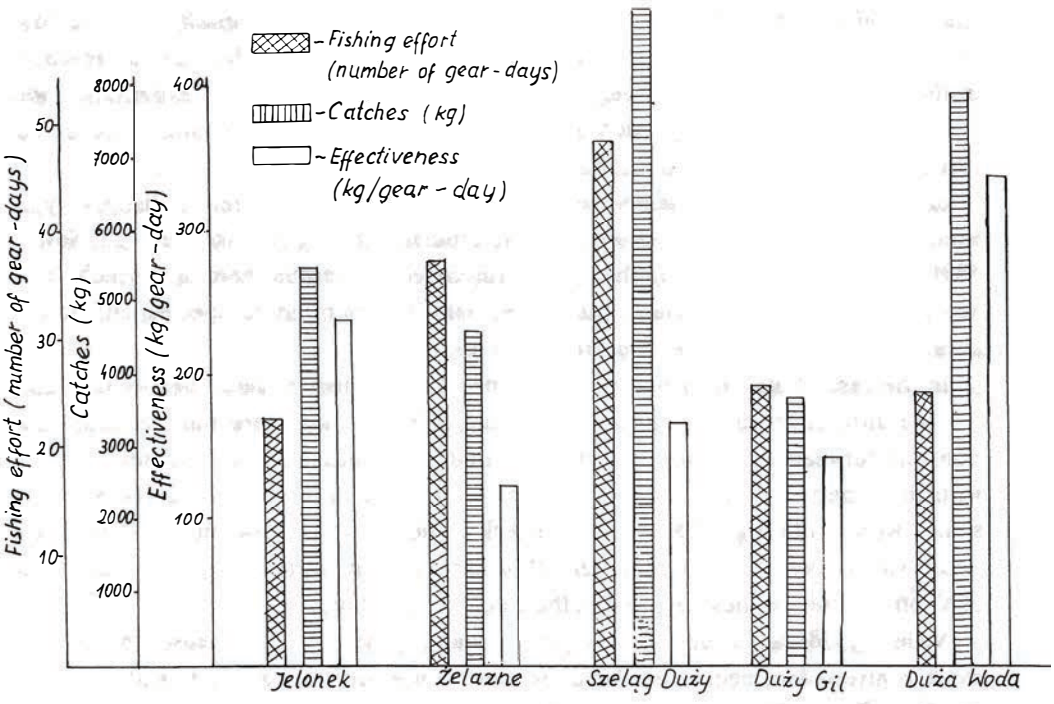

Fig. 1

vere usually accompanied by relatively low catches of roach and vice versa (Tab. 4). Considerable percentages of bream and whitefish were noted only in Lake Jelonek (Tab. 4, 5, 6).

Stocking rates of vendace in 1981, 1982 and 1983 were from 9 thousand ind./ha on the average in Lake Gil Duży to 18 thousand ind./ha in Lake Żelazne (Tab. 4). Rates of stocking usually conformed to the catch per unit of effort of seine nets. Only in Lake Żelazne high stocking rates did not correspond to the catches (Tab. 4, 5, 6).

Seines were of no greater significance in catching predatory fish (Tab. 5, 6). As found by Bonar (1977, 1989) this gear was more effective in the case of plankton-feeding and benthic fish, and less so in the case of predators (Tab. 5,6). Consequently, seines have limited application in regulating species composition of the fish stocks.

DISCUSSION

Level of commercial catches depends on the intensity of exploitation and the fish resources (Leopold 1969, Bonar 1977, 1990). Relation between the intensity of exploitation, level of catches, and effictiveness of exploitation was frequently described, both with respect to a multi-species stock and total intensity of the exploitation with all fishing gear (Leopold 1969, Bonar 1977) as well as to single species caught with

the gear of the same construction and used in the same way (Nowak 1971, Kozłowska-Filar 1971, Forney 1977, Johnson, Hale 1977, Bonar 1992). The results presented in these papers confirmed the regularity: increasing intensity of the exploitation was accompanied by increasing catches, but the effectiveness of exploitation decreased. Obviously, fishing decreased fish densities.

Similar results were obtained for seines used in lakes of different fishery type: vendace, pikeperch, bream, pike-tench, and crucian carp (Dąbrowski, Leopold, Nowak 1964a). Studies described in this paper embraced numerous materials which were analysed statistically. Consequently, they paid no attention to species characteristics of the fish communities in particular lakes.

In the case of this study it may be assumed that the fish communities in each lake showed different responces to the exploitation. Due to this there was no clear relationship between the fishing effort calculated for seines, level of catches obtained with these nets, and the catch per unit of effort (Fig. 1). Catches obtained with the seines were quite high (Tab. 2), and a lack of dependence between the parameters under study does not exclude the effect of fishing on quantitative relations, and most of all on qualitative ones reflected in the catch composition.

Nellen (1978) mentioned three types of changes that might be caused by fishing: stock rejuvenation, decreased densities due to intensive exploitation, and stock depletion due to ecosystem overexploitation. The last type results in a drastic decrease of the density of the exploited population and its substitution with fish more resistant to the exploitation stress. McQueen, Post and Mils (1986) and Bonar (1977, 1990, 1992) suggested that fishing caused changes in distribution of the food resources on different organization levels. This is usually reflected in changes of the catch composition. Fish stock may respond to fishing either directly, decreasing its density, or indirectly, by a change in the proportion between the biomass of particular species, reflected in different catch composition (Bonar 1992). Literature on the subject does not clarify which responce is stronger.

McLean and Magnuson (1977) underlined the interaction between the species, in form of predation, competition for food and parasitism. Competition and predation, were the problems that could not be separated. Catch level and species composition, expressed in kg per unit of area or kg per day of fishing, may both reflect these interactions and be their resultant (Bonar 1990).

Data presented in Table 6 show that the quantitative differences estimated using catch per unit of seine effort were accompanied by qualitative differences reflected in catch composition. Share of vendace and roach in total fish catch was a most pronounced responce. The two species determined the level of catches as well as the catch per unit of effort (Tab. 4, 5, 6).

Vendace stocks in the five lakes exploited by the Ostróda Fishery Enterprise were regularly enhanced by stocking. According to the managing staff, vendace has not

reproduced naturally since a number of years. On the other hand, there was a strict relation between stocking rates, level of vendace catches, and total fish catch. Only in Lake Żelazne level of vendace catches was the lowest notwithstanding high stocking rates (Tab. 5, 6).

It is possible that there are direct relationships between vendace and roach stocks. Causes for the negative dependence between these two species have not been explained as yet. According to the fishermen, roach feeds on vendace larvae in spring. Competition for food between the two species is also possible (Pouton, Gerdeaux 1988).

Summing up, it should be stressed that stocking and exploitation success in the lakes under study was a resultant value of species composition of the ichthyofauna, and especially roach densities, and of the exploitation intensity, which shaped quantitative relations between particular fish populations.

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ZASTOSOWANIE WYDAJNOŚCI POŁOWOWEJ PRZYWŁOK DO SZACOWANIA ZASOBÓW RYBACKICH W JEZIORACH SIELAWOWYCH

STRESZCZENIE

Badania dotyczyły analizy wysokości i struktury gatunkowej odłowów uzyskiwanych przywłokami w pięciu jeziorach klasyfikowanych jako sielawowe.

Stwierdzono, że w odłowach przywłokowych dominowały sielawa (28%) i płoć (45%). Pozyskanie tych gatunków przypadające na jeden dzień pracy przywłoki wynosiło odpowiednio 59 kg i 93 kg. Efektywność połowiania sielawy wykazywała związki z intensywnością zarybiania tym gatunkiem i z wielkością pogłowia płoci, którą szacowano wydajnością połowową przywłok. Wysokim odłowom sielawy towarzyszyły relatywnie niższe odłowy płoci. Udział leszcza w odłowach przywłokowych wynosił od 1,5% w jez. Duża Woda do 19% w jez. Jelonek. Pozostałe gatunki jak sieja, okoń, szczupak i węgorz większego znaczenia w odłowach uzyskiwanych przywłokami nie miały.

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