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

Vol. XXIV, Fasc. 2 **Szczecin 1994**

Jarosław *KARABANOWICZ*, Andrzej *KOMPOWSKI*

Fish biology

ON BIOLOGY OF REPRODUCTION OF BLUE BREAM, *ABRAMIS BALLERUS* (L., 1758), IN THE LOWER PART OFRIVER ODRA, LAKE DĄBIE AND SZCZECIN LAGOON *

O BIOLOGII ROZRODU ROZPIÓRA, *ABRAMIS BALLERUS* (L., 1758) W DOLNYM ODCINKU RZEKI ODRY, JEZIORZE DĄBIE I ZALEWIE SZCZECIŃSKIM

Department of Biological Marine Resources, Agricultural University of Szczecin, Poland

The present paper demonstrates results of examinations on seasonal course of gonads ripening, localisations of spawning places, spawning process, sex ratio in the spawning stock, eggs diameter, as well as investigation on fecundity of blue bream. The spawning places being found out were situated in shallow, sheltered waters of canals of „Międzyodrze".

INTRODUCTION

Blue bream, fish inhabiting the lower part of bigger European rivers from Rhine to Volga and from Scandinavia to Danube, occurs also in the lower part of river Odra as well as in the estuarium of this river, including lake Dąbie and Szczecin Lagoon. There is a lack of detailed information on occurence and catch of this fish in the regions mentioned before the Second World War. In the detailed monography by Zimdars (1941) concerned the fishery of Szczecin Lagoon there was not paid any attention to blue bream, albeit some fish of small significance (like Amur bitterling *Rhodeus sericeus*) were described. In much earlier work of Neubaur (1926) on the bream from Szczecin Lagoon the author stated by the way the occurence of blue bream in this area: „...the closest relatives of bream met in Szczecin Lagoon are vimba *Abramis vimba* L. and blue bream, *Abramis ballerus* L.". Vimba is hardly of commercial significance, whilst blue bream plays insignificant role at all.

* This work was made as a part of the scientific project PB 2556/5/91, supported by a grant of the KBN in the years 1991–1994.

The earliest documented note on catches of this species in the river Odra was found by authors of this paper in the reports of fishermen's co-operative in Gryfino. As can be seen there, 160 kg of blue bream was caught in March, 1962. Since 1966 the blue bream has become to be treated as a separate position in statistics in the Maritime Bureau in Szczecin.

Biology of blue bream inhabiting Polish waters is still feebly known. Hitherto performed investigations have concerned food and feeding, some of meristic characters, catches and parasitic fauna (Kompowski 1971a, 1971b, 1991; Wierzbicka 1977). Present work was aimed at finding spawning places, observation of the spawning process and studying on fecundity of the blue bream in the lower Odra and its estuarium.

MATERIALS AND METHODS

Fish to be studied were captured in April and May, 1991. Some of blue breams purposed for fecundity examinaton were caught in April, before the spawning period. They were collected from commercial catch in Szczecin Lagoon (being unloaded in the fishing base in Stołczyn) and in lake Dąbie (unloaded in the bases in Dąbie and Stołczyn). Furthermore, during the localization of spawning places - performing by direct observation from the boat - some catches were made with the aid of the seine setting in presumable spawning places in „Międzyodrze" canals. The obejctive of it was to providing the direct proofs for spawning in these areas - by presence of ripening fish, half-spent or just having spawned ones, as well as study on structure of the spawning population. Mesh size in the seine amounted to 55 mm. Additionally in the work presented the observations concerning relative gonads size of blue bream from lake Dąbie during the vegetation period 1974 - 1977 were utilised.

Weight of fish investigated (eviscerated) was estimated to 5 g, body length (l.c.) was measured to 1 mm; age of fish was read from the scales collected from the first or second row over the lateral line beneath the first ray of dorsal fin. Stages of gonads maturity were determined according to 8-stage of Maier's scale. Weight of just sampled gonads (in the period of 1974 - 77) was estimated to 1g.

Females with gonads at IV stage in Maier's scale were chosen for examination on fecundity. Gonads were preserved in the solution of formalin; from some of them 29 - 50 eggs were taken, then their diameters were measured to 0.01 mm under a microscope fitted with a micrometric screw. After measurements performed, the sample was joined back to the gonads. Fecundity was assessed by weight. Following a thorough cleansing in the running water, eggs were separated from the ovary tissue and dried on blotting paper. After a careful drying all eggs from one individual were weighed to 0.001 g, next three 0.1 g samples were weighed with the same accuracy and the number of eggs were counted under a stereo mi-

croscope. The number found in three samples being then converted to the whole number of eggs per one individual, proportionally to its weight.

Coefficients of relative gonads size (RGS) were calculated using the formula:

$$RGS = \frac{g100}{w_2}$$

where RGS - coefficient of relative gonads size; g - weight of gonads (not preserved previously); w_2- weight of eviscerated fish

Number of examinations made are demonstrated in Table 1.

Table 1

Number of blue bream examined

Kind of examination	Site of capture					Total
	Lake Dąbie	Szczecin Lagoon	Regalica*	Stara (Old) Regalica	Canal Kurowski	
1974 - 1977 (vegetation period						
Measurement of body length	62	-	-	-	-	62
Weighing of fish body	766	-	-	-	-	766
Weighing of gonads	766	-	-	-	-	766
Determination of sex	766	-	-	-	-	766
Spring 1991						
Measurement of length	249	144	3	-	-	369
Weighing of fish body	65	31	3	-	-	99
Determination of sex and stage of maturity	249	144	3	51	22	469
Estimation of fecundity	65	31	2	-	-	98
Determination of age	70	51	3	-	-	424
Measurement of egg diameter	1337	534	-	-	-	1871
Number of females	36	18	-	-	-	54

* date of capture: 17 October 1991.

RESULTS

Development of gonads

Figures 1 and 2 show a seasonal variability of relative gonads size coefficient (RGS) of blue bream, being caught in lake Dąbie during the vegetation period within 1974 - 77. Generally, seasonal changes of the coefficient in females can be described as follows: its values increases considerably in the period of April/May - just before the spawning, while the lowest values are found in the period from June to August - what is adequate for resting stage of gonads after spawning. In the end of August values of the coefficient began to grow again. When the seasonal variability of RGS in males is taken into account, it seems to be less clear, owing to less weight of testes in relation to the body weight comparing to ovaries. Only data from 1976 showed characteristic process of changes - with the well-marked

minimum in summer - corresponding with the resting stage (Fig. 2). Mature individuals of both sexes overwinter with gonads at IV stage of Maier's scale.

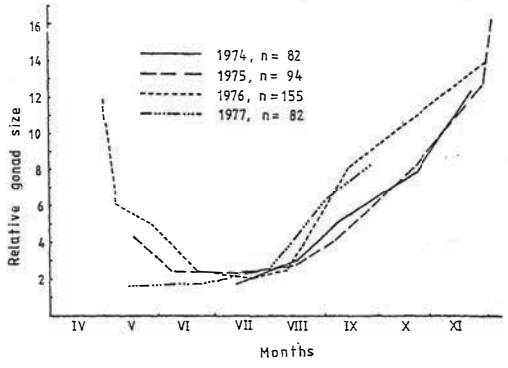

Fig. 1. Seasonal variability in relative gonad size (RGS) of the Lake Dąbie blue bream females within 1974-77 period

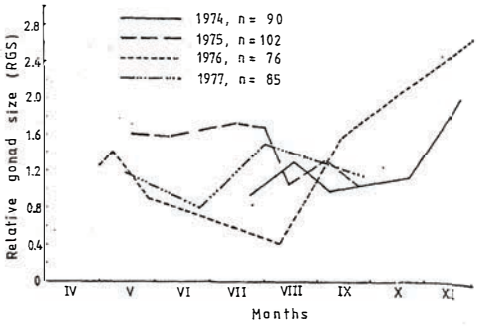

Fig. 2. Seasonal variability in relative gonad size (RGS) of the Lake Dąbie blue bream males within 1974-77 period

Table 2 demonstrates data concerning the relative gonads size (RGS) of mature blue breams captured just before the spawning in spring, 1976 in the lake Dąbie. Ovaries contributed from 9.5 to 17.8%, on the average 12.9% to the eviscerated fish weight. The weight of ovaries of exceptionally large female (body length 36.8 cm, total length 44.0 cm, weight - 970 g) caught on 17 October, 1991 in the river Regalica, constituted 18.3% of body weight. The length of mature females covered the range from 22.3 to 30.1 cm, with the mean value of 27.0 cm. Weight of testes of males mature constituted considerably less part of the body weight, ranging from 0.4 to 3.3% (mean value 1.32%). The length of mature males ranged from 21.0 to 32.3 cm, with the identical mean as in females, amounting to 27.0 cm.

Table 2

Relative gonads size (RGS) in mature blue bream from lake Dąbie in the pre-spawning period (30.04. and 7.05.1976)

Indicator		Males	Females
Body length (l.c. - cm)	Range of variability	21.1 - 32.3	22.3 - 30.1
	Mean	27.07	26.96
	Standard deviation	± 1.72	± 1.61
Relative gonads size (RGS)	Range of variability	0.4 - 3.3	9.5 - 17.8
	Mean	1.32	12.90
	Standard deviation	± 0.50	± 2.41
Number		39	23

Table 3

Ratio of blue bream males and females caught in Szczecin Lagoon and lake Dąbie within the pre-spawning period 1991

Class of length (cm)	Szczecin Lagoon 18.04.1991						Lake Dąbie 27.04.1991					
	females		males		Total		females		males		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
< 20.0					7*	100.0						
20.0 - 22.0					2*	100.0						
22.1 - 24.0	7	28.0	18	72.0	25	100.0	7	35.0	13	65.0	20	100.0
24.1 - 26.0	12	27.3	32	72.7	44	100.0	13	23.6	42	76.4	55	100.0
26.1 - 28.0	19	38.8	30	61.2	49	100.0	15	28.3	38	71.7	53	100.0
28.1 - 30.0	6	54.5	5	45.5	11	100.0	17	43.6	22	56.4	39	100.0
> 30.0	5	83.3	1	16.7	6	100.0	8	66.7	4	33.3	12	100.0
Total	49	36.3	86	63.7	135**	100.0	60	33.5	119	66.5	179	100.0

* Immature individuals with gonads at I stage in Maier's scale with sex unidentified,
** without immature individuals.

Ratio of males and females in the pre-spawning period; age of the individuals mature.

As can be seen from Table 3, in 1991 - in the period previous to the spawning, males of blue bream dominated in catches. The relation between females and males was nearly identical as amongst the fish from Szczecin Lagoon (63.0% - males) and from lake Dąbie (66.5% - males). In smaller fish (22.1 - 24.0 cm) and moderate-sized (24.1 - 28.0 cm) males predominated markedly, while in big fish (28.1 - 30.0 and above 30.0 cm) sex ratios were equal or females were prevailing. Table 3 shows, too, that the smallest mature females and males occured in the length class 22.1 - 24.0 cm.

Age of fish mature was ranging from 3 to 8 years (Tab. 4). Both in blue breams captured in lake Dąbie and Szczecin Lagoon, individuals belonging to VI age group were more abundant. The average length of mature females from lake Dąbie was identical as length of females from Szczecin Lagoon, amounting to 27.9 cm. Males (from Szczecin Lagoon) were slightly smaller, with the mean length of 26.0 cm (Tab. 4).

Table 4

Length and age of mature females and males of blue bream captured in the pre-spawning period in lake Dąbie and Szczecin Lagoon

	Age groups						Total
	III	IV	V	VI	VII	VIII	
Lake Dąbie, 12, 13, and 27.04.1991 - females							
n	-	-	10	40	17	3	70
%	-	-	14.3	57.1	24.3	4.3	100.0
Mean length l.c. (cm)	-	-	26.2	27.9	30.0	34.0	27.9
Szczecin Lagoon, 18.04.1991 - females							
n	-	1	7	17	6	1	32
%	-	3.1	21.9	53.1	18.0	3.1	100.0
Mean length l.c. (cm)	-	25.5	26.2	27.6	30.1	32.0	27.9
Szczecin Lagoon, 18.04.1991 - males							
n	4	1	6	7	1	-	19
%	21.0	5.3	31.6	36.8	5.3	-	100.0
Mean length l.c. (cm)	22.9	25.0	25.5	27.6	31.5	-	26.0

Localization of spawning grounds and process of spawning in spring, 1991

Our own observations, as well as information obtained from fishermen from Gryfino and Dąbie, allow to infer that blue bream from lake Dąbie and, presumably, from Szczecin Lagoon take the spawning migration up the river. First individuals at V stage of gonad maturity (in Maier's scale) were captured in April/May, 1991. The intensive penetration of branches and canals being situated in the region of Międzyodrze - meadow and swampy areas between the eastern branch of Odra (Regalica) and western Odra resulted in finding

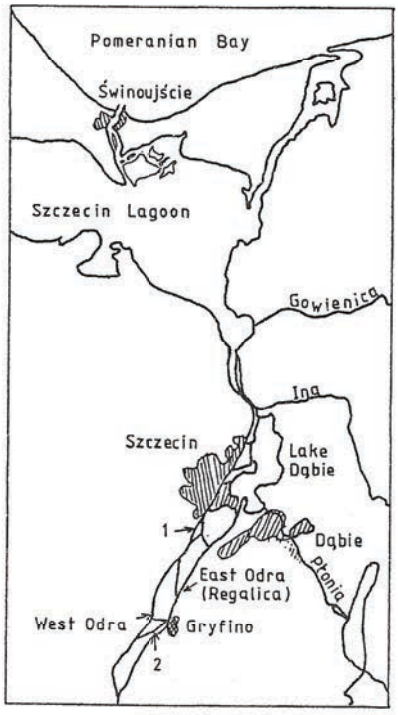

Fig. 3. A sketch map of the Odra river estuarium
1. Canal Kurowski; 2. Stara (Old) Regalica.

two localisations of the spawning places in the river Stara (Old) Regalica and in the Canal Kurowski (Figs 3-5).

In the Stara (Old) Regalica the spawning started on 19 May. Water temperature was 12°C, while its depth ranged within 20 - 50 cm. The riversides covered with osier-beds (*Salix* sp.) were adjoining to immense meadows of sedge (*Carex* sp.). The bottom of the river in this place was sandy and muddy, rarely covered with nuphars, *Nuphar luteum* (see Fig. 6). Fishes showed the most activity in the evening. Eggs were laid on underwater rhizomes of plants just next to the riverside, the colour of eggs being yellow and orange. Sunny weather was until 21 May (however with the strong NE wind),

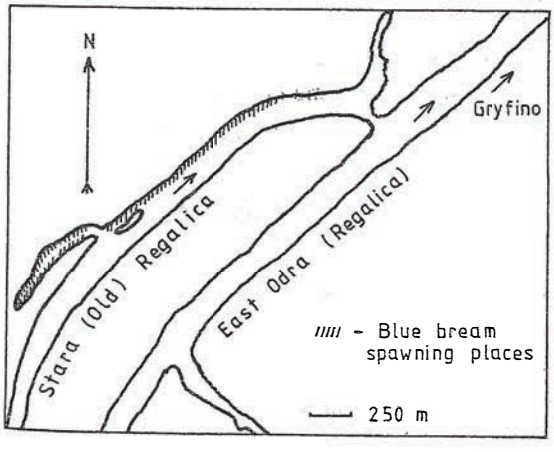

Fig. 4. The localization of the blue bream spawning places in Old Regalica

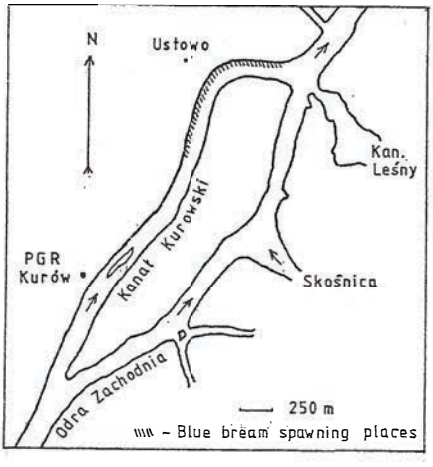

Fig. 5. The localization of the blue bream spawning places in Canal Kurowski

Fig. 6. The typical place of spawning of blue bream in Old Regalica
Photo by J. Karabanowicz

Fig. 7. The typical place of spawning of blue bream in Canal Kurowski
Photo by J. Karabanowicz.

next on 22 May the decreasing of spawning activity was observed due to getting cool. In Canal Kurowski (Fig. 3, 5) on 25 May half-spawned individuals were collected, but no fish spawning at the bank was recorded. Catches in two following days gave no results. Presumably the spawning in Canal Kurowski took place in the same time as in Stara (Old) Regalica. On 25 May the temperature of water in Canal Kurowski amounted to 13°C. Half-spawned fish were captured close to the riverside, covered with manna-grass (*Glyceria* sp.), sedge (*Carex* sp.), reed (*Phragmmites communis*) and osier-beds (*Salix* sp.) (see Fig. 7). The bottom was muddy and sandy.

The males to females ratio in spawners captured was close to 1 : 1 (Tab. 5). As can be concluded from the interview with fishermen from Stołczyn station, blue bream probably has also its spawning places in Iński Nurt (the strait connecting north part of lake Dąbie with river Odra). However attempts made in order to confirm this information (by catches performing with the seine) in the end of May gave no results; it could be possible that the spawning had taken place earlier.

Table 5

Sex ratio in the ripening blue bream captured in the spawning places

Date of capture	Number of fish captured					
	Males		Females		Total	
	n	%	n	%	n	%
Stara (Old) Regalica						
19.05.1991	8	47.1	9	52.9	17	100.0
20.05.1991	7	53.8	6	46.2	13	100.0
21.05.1991	10	47.6	11	52.4	21	100.0
Total	25	49.0	26	51.0	51	100.0
Canal Kurowski						
25.05.1991	12	54.5	10	45.5	22	100.0

Diameter of mature eggs

The diameter of mature eggs (when preserved) ranged within 1.01 - 1.86 mm with the mean value of 1.38 mm. Frequency of distribution of different - diameter eggs showed clearly in examined individuals the single maximum - as can be distinctly seen in Fig. 8. Therefore a conclusion can be drawn on the phenomenon of a single portion spawning to be existed.

Still the material collected does not allow to draw a conclusion on existing or lacking a relationship between the egg diameter and body length of female. The correlation calculated (Fig. 9) is slightly significant ($r = 0.387$) resulting from the data being considerably scattered.

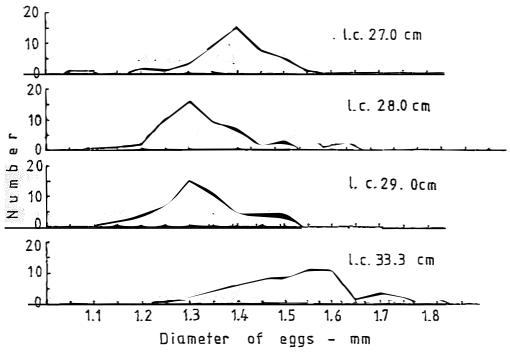

Fig. 8. Egg diameter frequency distribution of the blue bream from Lake Dąbie and Szczecin Lagoon

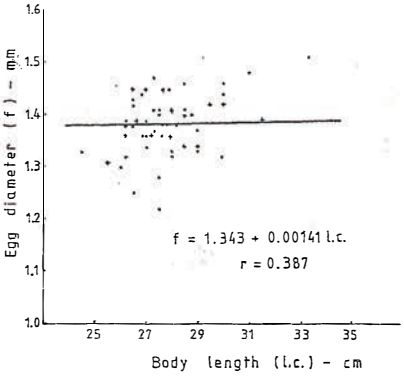

Fig. 9. Body length (l.c.) - egg diameter relationship in the blue bream from Lake Dąbie (dots) and Szczecin Lagoon (crosslets)

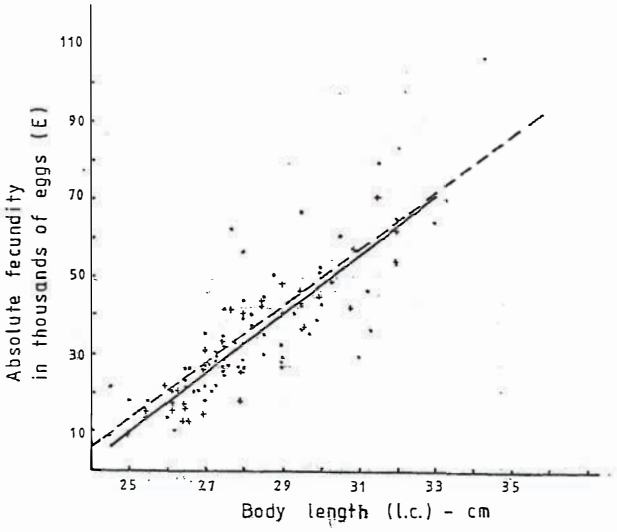

Fig. 10. Body length (l.c) - absolute fecundity relationship in the blue bream from lake Dąbie (dots, broken line; $E = -171.958 + 7.354$ l.c., $r = 0.812$, $n = 65$; or $E = 7.685\ 10^{-7}$ l.c.$^{5.260}$, $r = 0.799$) and from Szczecin Lagoon (crosslets, solid line; $E = -191.95 + 0.003$ l.c., $r = 0.902$, $n = 31$).

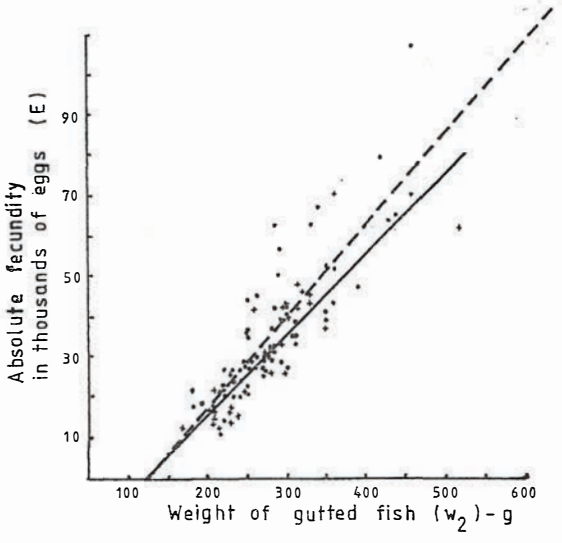

Fig. 11. Absolute fecundity - weight of gutted fish relationship in the blue bream from lake Dąbie (dots, broken line; $E = -27.685 + 0.225\ w_2$, $r = 0.826$, $n = 65$) and from Szczecin Lagoon (crosslets, solid line; $E = -22.595 = 0.194\ w_2$, $r = 0.863$, $n = 31$).

Fecundity

The absolute fecundity of the blue bream captured in lake Dąbie ranged from 10 468 eggs in 26.2 cm long female to 106 945 eggs in 34.3 cm long one. The mean absolute fecundity from lake Dąbie amounted to 36 284 eggs. The absolute fecundity of blue bream from Szczecin Lagoon covered the range from 12 602 eggs in 26.6 cm long female to 70 807 eggs in 31.5 cm long one, with the mean value of eggs count being 30 387. The absolute fecundity of two females of blue bream with body length 30.9 and 32.0 cm caught in the river Regalica was 67 618 and 54 461 eggs, respectively.

The absolute fecundity was increasing along with female length (Fig. 10). The relationship between these two parameters is nearly linear and can be expressed by linear equation. These equations are very similar for the blue bream from two water bodies under investigation, and lines described by them are nearly convergent. The linear correlation is pretty significant, the coefficient of correlation (r) amounting to 0.812 and 0.902 for blue breams from lake Dąbie and Szczecin Lagoon, respectively. In other species of fishes

the relationship discussed is, as usual, curvilinear (parabolic) and can be expressed by the exponential formula $E = a\ l^n$, where E = absolute fecundity, l - length of fish, a and n - coefficients (see, among others, in: Załachowski 1961; Brylińska 1971). Therefore the attempts were made to fit this equation to the data obtained in blue bream from lake Dąbie. The equation being found by the method of the least squares, had for its logarithmic form feebly lower coefficient of correlation (0.799), when comparing to a previously calculated linear equation; it resulted in very plain parabol. It is likely to be that this nearly linear relationship can result from the short range of length of the fish studied.

Absolute fecundity in blue bream both from the lake Dąbie and Szczecin Lagoon was linear correlated with the body weight (of fish eviscerated) - Fig. 11; high coefficient of correlation (0.826 for lake Dąbie and 0.863 for Szczecin Lagoon) indicate for pretty significant correlation. The difference in the run of regression lines in blue bream from lake Dąbie and Szczecin Lagoon is inconsiderable (Fig. 11).

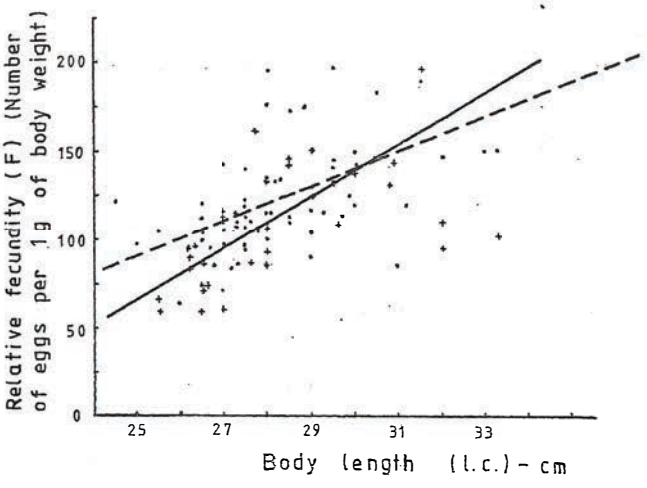

Fig. 12. Absolute fecundity - body length relationship in the blue bream from lake Dąbie (dots, broken line; F = -159.188 + 10.005 l.c., r = 0.523, n = 65) and from Szczecin Lagoon (crosslets, solid line; F = -298.113 + 14.562 l.c., r = 0.734, n = 31).

The relative fecundity of blue breams from lake Dąbie and Szczecin Lagoon was found to range from 47.5 eggs/g of body weight in female 26.2 cm long to 232.5 eggs/g in female 34.3 cm long. Mean relative fecundity in fish from this water body amounted to 124 eggs/g. Relative fecundity of Szczecin Lagoon blue breams covered the range from 58.2 eggs/g in female 25.5 cm long to 196.7 eggs/g in 31.5 cm female. Mean relative fecundity in fish from Szczecin Lagoon amounted to 106.4 eggs/g.

Relative fecundity is correlated positively with the length of blue breams (Fig. 12). Linear equations fitted to the empirical data by the method of the least squares are slightly different for both water bodies (Fig. 12).

DISCUSSION

Blue bream plays role rather of minor importance in the estuarine part of Odra fishery. According to Kompowski (1991), within 1966 - 1988 in the waters of Szczecin Lagoon and lake Dąbie being under the management of Maritime Bureau, the average annual catches of blue bream amounted to about 59 t, contributing only 2.2% to all fish caught. However the blue bream was found to be a commercially significant fish in the dam reservoires in large rivers of ex - Soviet Union - where is the only species feeding on plankton during the all life span, with no competitors among adult fish of other species. The catches of blue bream amounted there sometimes to over 30% of joined catch of all species. For instance, in Cymlanski Reservoir in 1950-ties, according to Lapickij (1958) this species was the most important one, owing to its high contribution in catches - as much as 36.9%. Therefore it was no wonder when trying to set up the legal size for the blue bream (Syrovatskij and Syrovatskaja 1956); there were even some experiments carried out on breeding and rearing of hatch in ponds for stock purposes (Ginzburg 1958a). Hence the biology of blue bream reproduction in this region was fairly well known, providing a large comparative material.

Data concerning the relative gonad weight in pre-spawning period are available in the papers of Siergiejev et al. (1955). According to these authors ovaries of blue bream from the Rybinski Reservoir constituted 6.8 - 17.3% of body weight, what seems to agree closely with our findings, with the RGS increasing along with the fish length. The smallest mature females in the water bodies under investigation measured slightly over 22.0 cm. As can be seen from the great deal of data available in the literature (among others: Rojenko and Špilevskaja 1962; Smirnov 1966; Chašem 1969; Konstantinova and Vavilova 1969) age and length at first maturity of blue bream depend on water reservoir and ranging within ca 15.0 cm - l. c. (upper Dnieper) to 24.0 cm (males) and 25.0 cm (females) in Rybinski Reservoir. The length at first maturity of the blue bream can change in the particular reservoir from year to year. It was found out, that better feeding condition affecting the higher growth rate resulted in higher age and length at first maturity. Damming the rivers as well as constructing artificial reservoirs improved feeding conditions of planktophagous fish like blue bream, considerably enlarging the length at its first maturity (Rojenko and Špilevskaja 1962; Smirnov 1966; Špilevskaja 1967; Chašem 1969; Konstantinova and Vavilova 1969). Males became for the first time mature at slightly shorter length than females. The difference is inconsiderable, amounting to ca 1.0 cm (Rojenko and Špilevskaja 1962; Chašem 1969), what is confirmed by our observations. The sex ratio in the pre-spawning concentrations as well as during the spawning period may vary markedly. Amongst the younger fish males predominated, whereas in older ones - females (Zacharova 1955; Tkačeva 1958) - what is in agree with our data.

Most of the scientists investigated the blue bream reproduction, share the view of authors of the work presented, concerning the spawning places of this species being situated in the littoral zone, in shallow places covered with plants or in the meadows flooded in the spring - and a blue bream is a phytophil (Kozin 1949; Zacharova 1955; Ginzburg 1958b; Bănărescu 1964 (by Antipa); Aleksandrova 1966). Balon (1959) only, basing on one adult specimen with the ripening sexual products captured during the migration from the tributary of Danube to the main river bed - concluded, that blue bream is a littophil fish.

Measurements of egg diameter as well as direct observations allowed to find the spawning of blue bream as being a single event, lasting for a relatively short time. The statements seem to agree with data reported by other authors (Siergiejev et al. 1955; Zacharova 1955; Žukov 1965). This short period of spawning (in Stara (Old) Regalica it lasted 3 days) unable to penetrate the whole area of „Międzyodrze" and to find out if any other spawning places do exist in the region examined. It is of interest to note, that in 1991 during the investigation being carried out, there was an exceptionally late and cold spring. Thus the spawning of blue bream was late for 2 - 3 weeks (it concerned other species, too - for example a bream, with the spawning taking place in middle May, in the lower part of river Odra - according to Neubaur (1926), spawned not before the first decade of June).

The diameter of eggs of blue bream from the regions studied is close to the data found in the literature (Siergiejev et al. 1955; Bănărescu 1964). In some species, e.g. in trout, the eggs diameter increases along with the body length (among others: Szczerbowski 1966; Chełkowski et al. 1985; Chełkowski et al. 1990). According to Siergiejev et al. (1955) such phenomenon occurs in the blue bream from Reservoir Rybinski. However the analysis of material examined did not allow to draw a similar explicit conclusion when consider the blue bream from the regions under study.

Table 6 demonstrates the comparison of the absolute and relative fecundity of blue bream from different water bodies. First of all the distribution of length in the spawning stock, as well the length at first maturity may affect the mean values in particular populations. Therefore the comparison of the run of curves showing the correlation fecundity with the length or weight of fish is the most advantageous treatment; however it was not possible owing to lack of a such data presentation in the papers mentioned.

Kompowski (1991), basing on the similarity of growth rate of blue bream from lake Dąbie and Szczecin Lagoon, as well as on the distribution of seasonal catches up, among other, the hypothesis on existing one stock of blue bream in the region of „Międzyodrze". The similarity of dependence: absolute fecundity - body length supports the hypothesis. Tagging experiment could definitively solve the problem.

Table 6

Comparative list on blue bream fecundity in different water bodies: variations / mean

Water body	Absolute fecundity (thous. eggs)	Relative fecundity (eggs/g of body)	Source
Lake Dąbie	10.5 – 106.9 / 36.3	47.5 – 232.5 / 124.0	Karabanowicz and Kompowski - the present work
Szczecin Lagoon	12.6 – 70.8 / 30.4	58.2 – 196.7 / 106.4	Karabanowicz and Kompowski - the present work
Reservoir Rybinsk in river Volga	13.6 – 133.0 / –	-	Zacharova, 1955
Reservoir Rybinsk in river Volga	7.1 – 51.2 / –	39.7 – 116.3 / –	Chašem, 1969
Reservoir Kujbyšev in river Volga	4.7 – 66.9 / –	-	Smirnov, 1966
Kiev Reservoir in river Dnieper	8.7 – 93.8 / –	-	Konstantinova and Vavilova, 1969

ACKNOWLEDGEMENTS

The authors are very thankful to all persons who made possible to carry out the examinations; especially our thanks are due to Mr Kazimierz Chrzczanowicz, the chief of fishermen's co-operative „Regalica" in Gryfino, Mr Witold Drozdowski, the manager of catchment department in the fishermen's co-operative „Certa" in Szczecin as well as to Mr Wojciech Pieńkowski, the director of Department of Fishery Protection in Szczecin Maritime Bureau.

REFERENCES

Aleksandrova T.N., 1966: O since Vedlozera. [Blue bream from Lake Vedlozero]. Tr. Karelsk.Otd. GOSNIORCh, 4, 1 :148-152. (In Russian).

Balon E., 1959: Die embryonale und larvale Entwicklung der Donau Zoppe (Abramis ballerus sb sp.). Biologicke Prace S.A.V. Bratislava, 5, 6 : 5-78.

Bănărescu P., 1964: Fauna Republicii Populare Romîne. Bucureşti.

Brylińska M., 1971: Factors regulating individual absolute fecundity as well as absolute fecundity of bream population (Abramis brama L.). Zesz. Nauk. WSR Olsztyn, ser. C, Supl. 2 : 3-103. (In Polish)

Chašem M.T., 1969: Polovoje sozrevanije i plodovitost sinca, Abramis ballerus (L.) Rybinskogo vodochranilišča. [Sexual maturation and fecundity of blue bream, Abramis ballerus (L.) from the Rybinsk Reservoir]. Vopr. Icht., 9, 3 (56) : 489-496. (In Russian).

Chełkowski Z, J. Domagała, R. Trzebiatowski, Z. Woźniak, 1985: The effect of size of sea trout (Salmo trutta L.) females from Rega river upon the size of eggs. Acta Ichth. Pisc., 15, 1 : 31-71.

Chełkowski Z, J. Domagała, Z. Woźniak, 1990: The effect of size of sea trout (Salmo trutta L.) females from Pomeranian rivers on the size of eggs. Acta Ichth. Pisc., **20**, 1 : 59-71.

Ginzburg J.J., 1958a: O razvedenii sinca v Cimlanskom nerestovyrastnom chozjajstve. [On breeding of blue bream in the Cimlansk fish breeding farm]. Rybn. Choz., 8/1958. (In Russian).

Ginzburg J.J., 1958b: O biologii i urožajnosti molodi ryb v Cymlanskom vodochranilišče (po nabludenijam 1953 - 55 g). [On biology and the abundance of the juvenile fish in the Cimlansk reservoir (according to 1953 - 1955 observations)]. Izv. VNIORCh, 45. (In Russian).

Kompowski A., 1971a: The study on blue bream Abramis ballerus (L.) from the Dąbie Lake. Zesz. Nauk. WSR Szczecin, **35** : 35 - 51. (In Polish).

Kompowski A., 1971b: Food of blue bream Abramis Ballerus (L.) in lake Dąbie. Zesz. Nauk. WSR Szczecin, **35** : 53-68. (In Polish).

Kompowski A., 1991: catches and growth rate of Abramis ballerus (L., 1758) from Lake Dąbie and Firth of Szczecin. Acta Ichth. Pisc., **21**, 2 : 17-28.

Konstantinova N.A., N.A. Vavilova, 1969: Tiemp rosta i plodovitost sinca Abramis ballerus (L.) vierchnego Dniepra, Kijevskogo i Kremenčugskogo vodochranilišča. [Growth rate and fecundity of the blue bream, Abramis ballerus (L.) from the upper Dnepr river and Kiev, and the Kremenčug reservoir]. Vopr. Icht., **9**, 3 (56) : 565-571. (In Russian).

Kožin N.J., 1949: Siniec - Abramis ballerus (Linne). [Blue bream - Abramis ballerus (Linne)] In: Promyslovyje ryby SSSR [Commercial fishes of the USSR]. Piščepromizdat. : 418-419. (In Russian).

Lapickij I.J., 1958: Formirovanije stad i sostojenije zapasov osnovnych promyslovych ryb Cymlanskogo vodochranilišča. [Stock formation and state of the resources of main commercial fishes in the Cymlansk reservoir]. Izv. UNIORCh, 45. (In Russian).

Neubaer R., 1926: Biologischers und Wirtschaftliches vom Blei (Abramis brama L.) im Stettiner Haff und seinen Nebengewässern. Zeitschr. f. Fisch., **24** : 163-193.

Rojenko O.V., G.V. Špilevskaja, 1962: Siniec Volgogradskogo vodochranilišča. [Blue bream from the Volgograd reservoir]. Tr. Saratov. Otd. GOSNIORCh, 7. (In Russian).

Siergiejev R.S., I.E. Permitin, A.A. Jastrebkov, 1955: O plodovitosti ryb Rybinskogo vodochranilišča. [On fecundity of the fishes from the Rybinsk reservoir]. Tr. Biol. Stancji „Borok", **2** : 278-300. (In Russian).

Smirnov G.M., 1966: Siniec Kujbyševskogo vodochranilišča. [The blue bream of the Kujbysev reservoir]. Uč. Zap. Kazanskogo Univ., **123**, 7 : 103-131. (In Russian).

Szczerbowski J.A., 1966: Relation between the body length of salmon trout females (Salmo trutta m. lacustris L.) and the diameter of their eggs. Zool. Pol., **16**, 3-4 : 195-201.

Špilevskaja G.V., 1967: Osobennosti rosta i sozrevanija sinca (Abramis ballerus L.) Volgogradskogo vodochranilišča. [Peculiarities of growth and maturation of blue bream (Abramis ballerus L.) Volgograd reservoir]. Vopr. Icht., 7, 3 : 496-499. (In Russian).

Syrovatskij I.J., N.J. Syrovatskaja, 1956: Siniec - cennaja promyslovaja ryba vodochranilišč. [The blue bream - a valuable commercial fish in water reservoirs]. Ryb. Choz., 1, 1956 : 52-53. (In Russian).

Tkačeva N.S., 1958: Vozrast i temp rosta sinca v Cimlanskom vodochranilišče. [Age and growth rate of the blue bream in the Cimlansk reservoir]. Izv. VNIORCh, **45**. (In Russian).

Wierzbicka J., 1977: An attemt to explain affinities between Blicca bjoerkna (L.), Abramis brama (L.) and A. ballerus (L.) on the grounds of their parasitic fauna. Acta Ichth. Pisc., 7, 1 : 3-11.

Zacharova L.K., 1955: Materialy po biologii razmnoženija ryb Rybinskogo vodochranilišča. [The materials concerning reproduction biology of the fishes of the Rybinsk reservoir].]. Tr. Biol. Stancji „Borok", **2** : 200-265. (In Russian).

Załachowski W., 1961: Fecundity of roach (Rutilus rutilus L.) from Masurian lakes. Zesz. Nauk. WSR Olsztyn, **11**, 116 : 225- 244. [In Polish].

Zimdars U., 1941: Die Fischerei des Stettiner Haffs und seiner Nebengewässern, geographisch betrachtet. Jahrb. Pommerschen Geograph. Ges., 59/60 : 15-136.

Žukov P.J., 1965: Ryby Belorusi. [The fishes of Belorussia]. Minsk, 282-287. (In Russian).

Translated by: mgr inż. B. Więcaszek

Jarosław *KARABANOWICZ*, Andrzej *KOMPOWSKI*

O BIOLOGII ROZRODU ROZPIÓRA, *ABRAMIS BALLERUS* (L., 1758) W DOLNYM ODCINKU RZEKI ODRY, JEZIORZE DĄBIE I ZALEWIE SZCZECIŃSKIM

STRESZCZENIE

Sezonowy przebieg zmian współczynnika względnej wielkości gonad (RGS) rozpióra wskazuje, że tarło odbywa się w początkach maja (rys. 1 i 2). Wiosną 1976 r. - bezpośrednio przed tarłem, jajniki rozpióra z jez. Dąbie stanowiły od 9,5 do 17,8, średnio 12,9 masy ciała bez wnętrzności. Długość dojrzałych samic wynosiła od 22,3 do 30,1; długość dojrzałych samców 21,0 - 32,3 cm (tab. 2). Wczesną wiosną 1991 r. w skupiskach przedtarłowych, wśród ryb małych i średnich przeważały samce, wśród ryb dużych proporcja obu płci była wyrównana lub przeważały samice tab. 3). Wiek dojrzałych płciowo ryb wynosił od 3 do 8 lat (tab. 4). Tarło, które jest jednorazowe, w 1991 r. było opóźnione z powodu chłodnej pogody i odbywało się w drugiej połowie maja. Wykryte tarliska znajdowały się w płytkich osłoniętych wodach Starej Regalicy i Kanału Kurowskiego - w strefie przybrzeżnej (rys. 3-7). Średnica dojrzałej ikry (konserwowanej w formalinie) wahała się w granicach od 1,01 do 1,86 mm; średnio 1,38 mm (rys. 8). Na podstawie posiadanego materiału nie można wyciągnąć wniosku o istnieniu lub braku zależności między średnicą ikry a długością ciała (rys. 9). Płodność absolutna - w zależności od długości samicy - wynosiła w jez. Dąbie od 10,4 do 106,9 tys. jaj; średnio 36,3 tys. W Zalewie Szczecińskim płodność absolutna rozpióra wynosiła od 12,6 do 70,8 ; średnio 30,4 tys. jaj (rys. 10 i 11). Płodność względna u rozpióra z jez. Dąbie zawierała się w granicach 47,5 - 232,5 jaj/g ciała; średnio 124,0. W Zalewie Szczecińskim płodność względna wahała się od 58,2 do 196,7 jaj/g ciała; średnio 106,4 (rys. 12).

Received: 1992.07.03

Author's address:

Prof. Tit. D.Sc. Andrzej Kompowski, M.Sc. Jarosław Karabanowicz
Department of Biological Marine Resources
Agricultural University of Szczecin
Kazimierza Królewicza 4, 71-550 Szczecin Poland