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Wiesława KOPIEJEWSKA

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GERM LINE OF WHITE BREAM, *BLICCA BJOERKNA* (L.)FEMALES IN WŁOCŁAWEK RESERVOIR

CYKL PŁCIOWY SAMIC KRĄPIA *BLICCA BJOERKNA* (L.) W ZBIORNIKU WŁOCŁAWSKIM

Chair of Zoology, University of Agriculture and Technology, Olsztyn, Poland

Studies were performed on the ovaries of 58 females of white bream, *Blicca bjoerkna* (L.), from Włocławek Reservoir to determine the character of spawning. Oocyte vitellogenesis in the germ line commenced at the beginning of April, fish reproduction in June – July. The examined females laid eggs in one or two portions.

INTRODUCTION

White bream is not a subject of commercial fisheries and is fairly abundant in dam reservoirs (Brylińska 1983; Grudniewski 1983, 1990; Zalewski and Sumorok 1984; Fiet 1985). Biology of its reproduction in Polish waters is not fully known. Observations of white bream reproductionin the Danube River delta revealed that the females laid eggs in two or three portions (Papadopol and Iancu 1970). The same was observed by Statova (1970) in Kučurganskij Liman. In Kahovski Reservoir white bream females also laid two eggs portions (Spivak 1987). In the Volga River delta there were females characterised by both; single-portion and batch spawning (Trjapicyna 1975).

Preliminary ichthyobiological studies in Włocławek Dam Reservoir were carried out in 1981–1982 in order to determine the fish stock numbers and population dynamics. They comprised, among others, reproductive potential of the four species most frequent in the fish catch: bream, roach, white bream and pikeperch (Brylińska 1983). Scraps of white bream ovaries were then collected to determine the character of spawning.

MATERIAL, METHODS AND STUDY AREA

White bream females were collected in 1981–1984, from April till September. A total of 58 females was collected. Scraps of the ovaries were preserved in buffered formalin; paraffin immersed scraps were stained with Delafield's haematoxylin and eosine.[1]

Włocławek Dam Reservoir was constructed in 1970, on the lower stretch of the Vistula River. Its surface area is 75 km^2, average depth 5.5 m, maximal depth 15 m. Variations of the water level are small (Żytkowicz et al. 1990). The reservoir is polluted with urban wastes from Płock, brought into it with the waters of Brzeźnica River; it also receives heated effluents and drainage and rain waters from Refinery and Petrochemical Masovian Enterprise. In 1973 the reservoir was classified into class II of water purity, with the exception of the part below Płock which was classified as class III (Birwagen 1973).

RESULTS

In 1981 the first sample of white bream females was collected on May 7. Ovaries of the three examined females contained two oocyte groups: vitellogenetic oocytes (filled with yolk granules), and oocytes in which the vacuolisation had been completed. Ovaries of one female contained also oocytes in which vacuolisation had been complete and vitellogenesis commenced (Fig. 1).

The ovaries collected from three females caught on June 16 contained post-ovular follicles of ejected oocytes, and single vitellogenetic oocytes (not spawned). There were no oocytes in the vacuolisation stage. A few oocytes in which vacuolisation had only begun were also observed (Fig. 2).

Two females were collected on July 14. Ovaries on one of them contained loosely distributed pre-vitellinogenic oocytes; cytoplasm in the larger oocytes was vacuolised in 1/2–3/4 of the oocyte diameter (Fig. 3). Ovaries of the other female contained single vitellogenetic oocytes with bigger diameter, numerous vitellogenetic oocytes with smaller diameter, and oocytes in the stage of vacuolisation. Vitellogenetic oocytes of bigger diameter were resorbed (Fig. 4).

In 1982 the first sample was collected on April 20. Two oocyte groups could have been distinguished in the ovaries of three white bream females: bigger oocytes filled with yolk granules, and smaller oocytes in which vacuolisation has not been completed.

Ovaries of three females collected on May 31 also contained two oocyte groups: oocytes filled with yolk and those with completed vacuolisation.

[1] Photographs of the ovary sections presented in this paper have been taken by A. Koryzno.

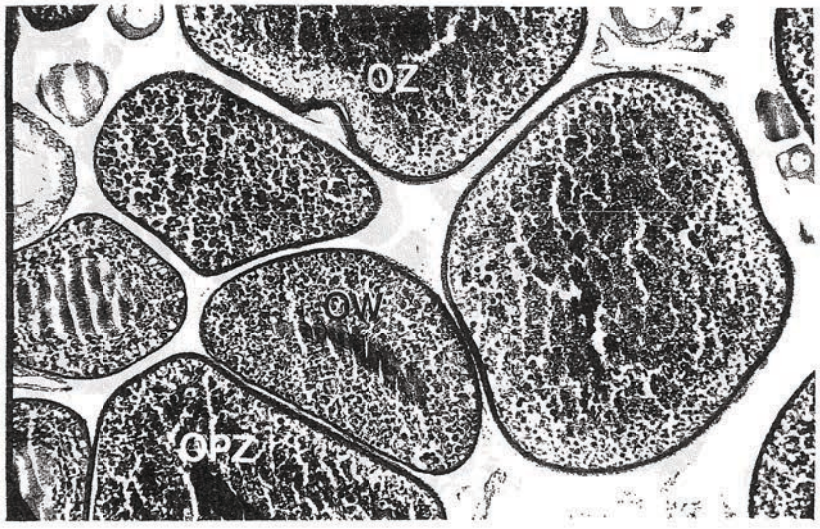

Fig. 1. Section of the ovary of a white bream female with multiple-batch type of spawning, prior to spawning , (Magn. 100×). OŻ—oocyte filled with yolk granules; OW—oocyte in the stage of vacuolisation; OPŻ—oocyte in the initial stage of filling with yolk granules

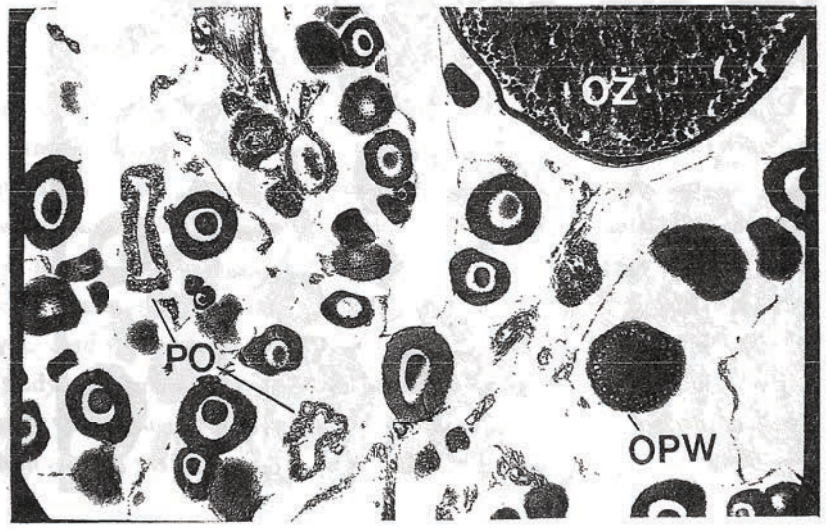

Fig. 2. Section of the ovary of a white bream female with single portion spawning, after spawning, (Magn. 100×). PO—post-ovulatory follicles; OŻ—oocyte filled with yolk granules; OPW—oocyte in the initial stage of vacuolisation

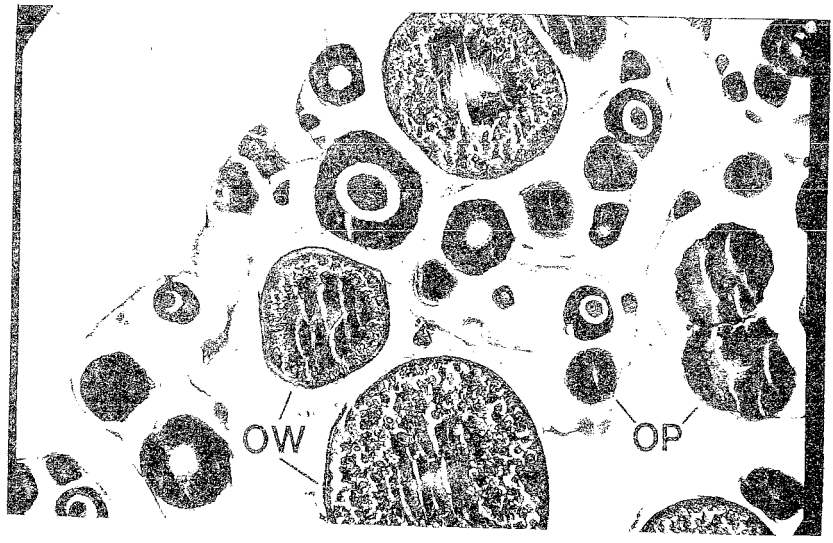

Fig. 3. Section of the ovary of a white bream female with multiple-batch type of spawning, after spawning, (Magn. 100×). OP—oocytes in the previtellogenetic stage; OW—oocyte in the stage of vacuolisation

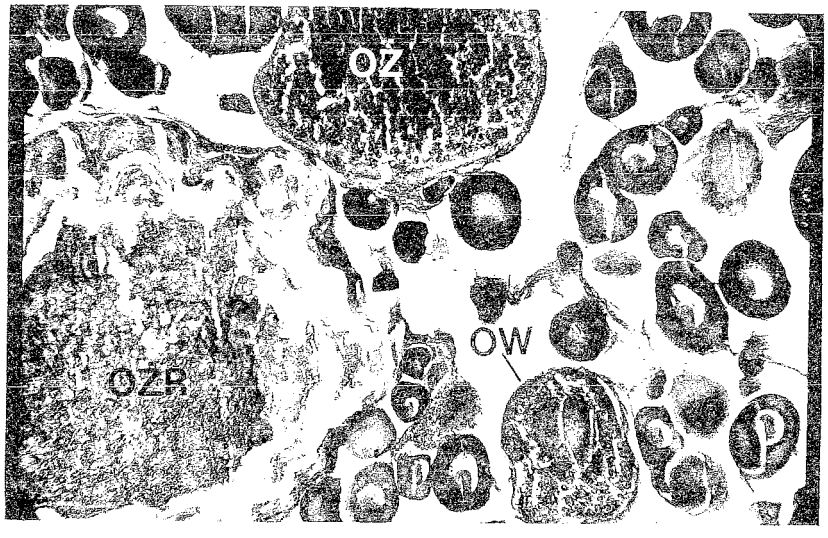

Fig. 4. Section of the ovary of a white bream female with multiple-batch type of spawning (during vitellogenic of the second egg portion), (Magn. 100×). OŻR—yolk-filled oocyte in the stage of resorption; OŻ—oocyte filled with yolk granules; OW—oocyte in the stage of vacuolisation

Two oocyte groups were observed in the ovaries of three females collected on 28 April 1983: oocytes filled with yolk granules and smaller ones in the final stage of vacuolisation.

In the period of 18–20 may 1983 seven females were collected. Oocytes filled with yolk granules were present in all ovaries, as well as those in the stage of vacuolisation. Yolk appeared in vacuolised of one female.

Five females were collected on June 8, 1983. Ovaries of the three of them had oocytes filled with yolk and oocytes in the course of vacuolisation. The other two had already spawned egg portions. Ovaries of one of these females contained post-ovulatory follicles, some unspawned vitellogenetic oocytes, and a few oocytes with a single ring of vacuoles at the oocyte periphery, similarly as in the case of female collected on 16 June 1981 (Fig. 2). In the other female, single vitellogenetic oocytes were resorbed. Numerous resorption places were present in the ovary. A few oocytes in the stage of vacuolisation possessed the cytoplasm vacuolised in 1/3–1/2 (Fig. 5).

Three females were collected on July 6, 1983. One of them did not spawn as yet, the other two had already laid eggs on the spawning grounds. Ovaries of the pre-spawning female contained vitellogenetic oocytes, but no oocytes in the stage of vacuolisation (Fig. 6). In one post-spawning female there were single vitellogenetic oocytes which had not been spawned, some oocytes in the stage vitellogenesis, and a few in the stage of vacuolisation. Oocytes in different stages of the vitellogenesis were being resorbed (Fig. 7). Mass oocyte resorption was observed in the other female (Fig. 8). As regards the oocytes of trophoplasmatic growth, there were single vitellogenetic oocytes, oocytes in initial stage of vitellogenesis, and oocytes in the stage of vacuolisation.

The first sample of 1984 was collected on April 10. Seven white bream females were caught. In the ovaries of four of them the oocytes of older generations were in the stage of vacuolisation (Fig. 9). The degree of cytoplasm vacuolisation differed in particular females. In two fish the oocytes bigger in their diameters were totally filled with the vacuoles, while those with smaller diameters were filled in 1/2 to 3/4. In the other two females, bigger oocytes were vacuolised in 3/4, smaller in 1/2. In three of the seven females collected for this study, yolk granules had appeared in the bigger oocytes (Fig. 10). As regards smaller oocytes, vacuolisation was completed in one female, while in the other two the oocyte cytoplasm was not yet fully vacuolised.

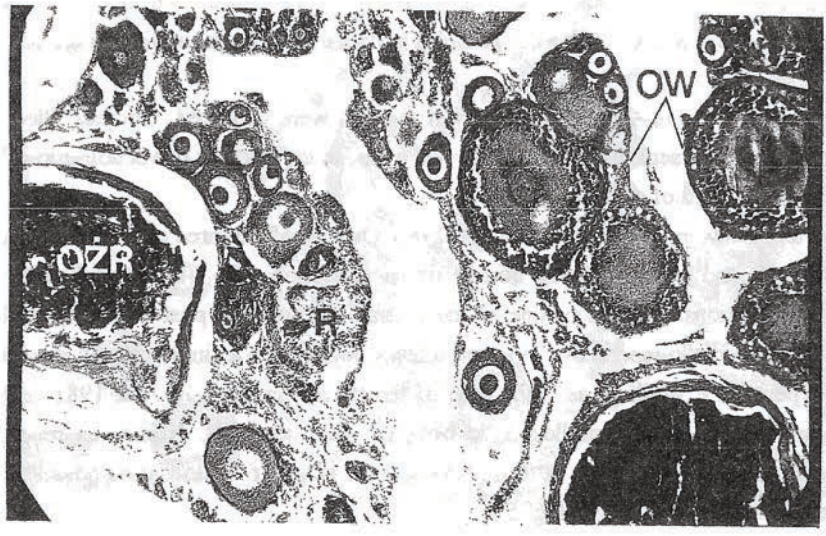

Fig. 5. Section of the ovary of a white bream female with multiple-batch type of spawning, after spawning. Numerous resorption places (Magn. 100×). OŻR—yolk-filled oocyte in the stage of resorption; OW—oocyte in the stage of vacuolisation; R—resorption

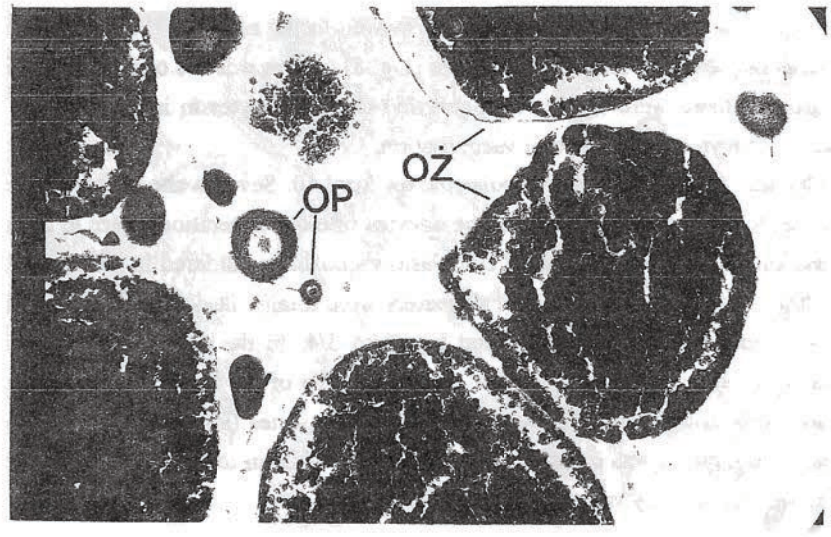

Fig. 6. Section of the ovary of a white bream female with single-portion spawning, before spawning (collected on 6 July 1983), (Magn. 100×). OŻ—oocyte filled with yolk granules; OP—oocytes in the stage of previtellogenesis

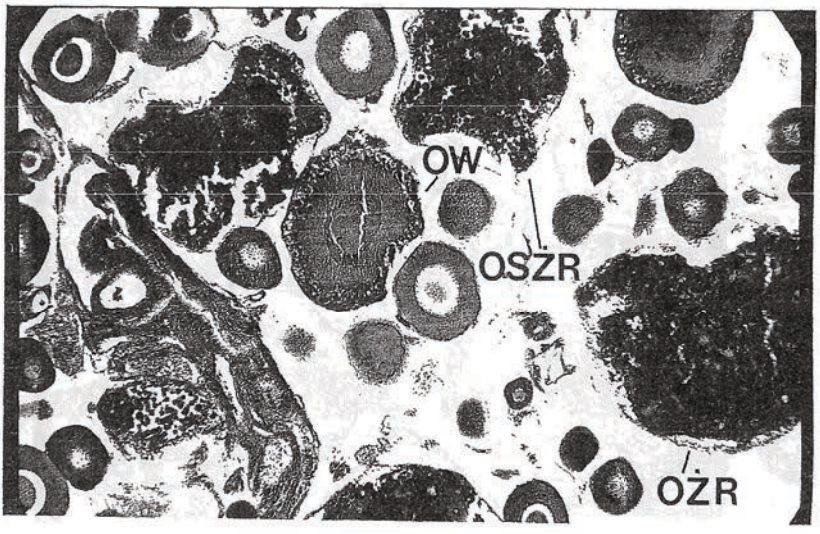

Fig. 7. Section of the ovary of a white bream female with multiple-batch type of spawning, after spawning. Noticeable resorption of oocytes in the initial stages of vitellogenesis (Magn. 100×). OŻR—yolk-filled oocytes in the stage of resorption; OSŻR—yolk-filling oocyte in the stage of resorption; OW—oocyte in the stage of vacuolisation

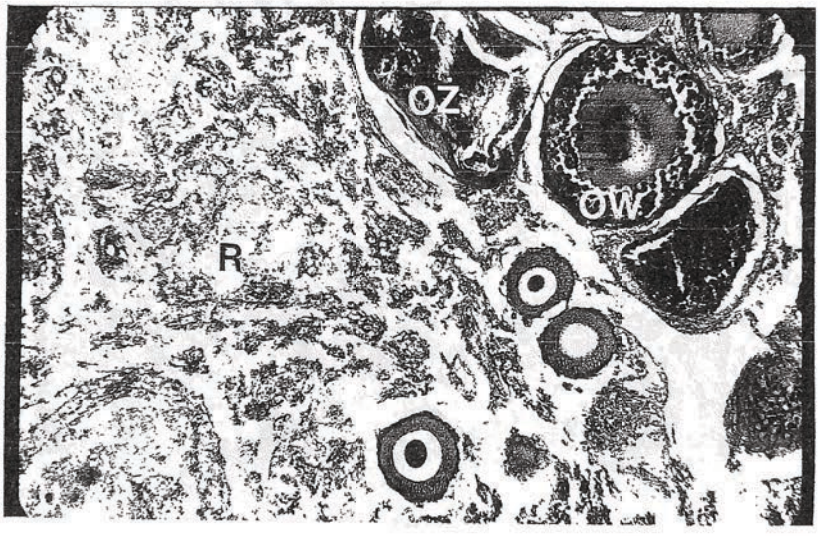

Fig. 8. Mass oocyte resorption in the ovaries of a white bream female with a multiple-batch type of spawning, after spawning. (Magn. 100×). OŻ—oocyte filled with yolk granules; OW—oocyte in the stage of vacuolisation; R—resorption

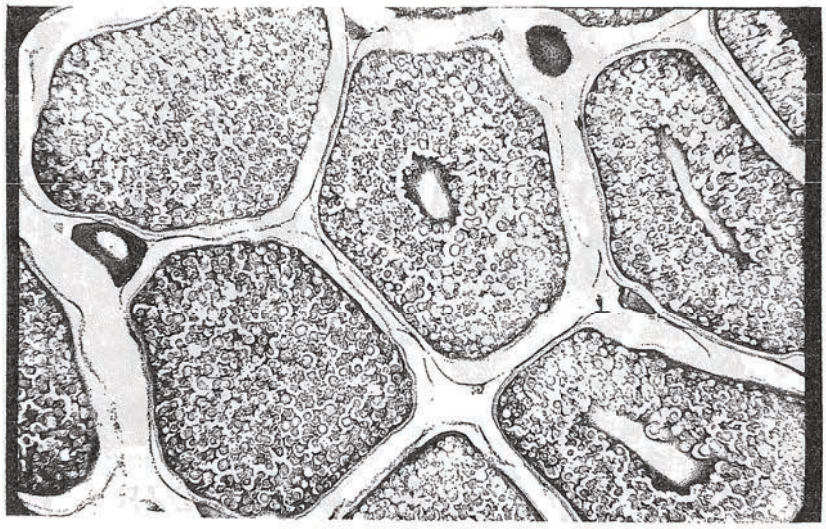

Fig. 9. Section of the ovary of a white bream female during oocyte vacuolisation, collected on 10 April 1984. (Magn. 100×)

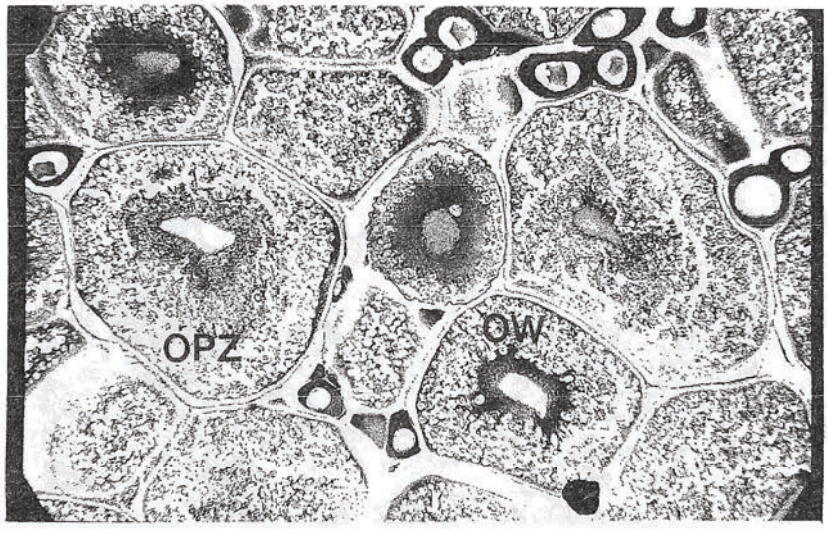

Fig. 10. Section of the ovary of a white bream female at the beginning of vitellogenesis in the oocytes. (Magn. 100×). OPŻ—oocyte in the initial stage of filling with yolk; OW—oocyte in the stage of vacuolisation

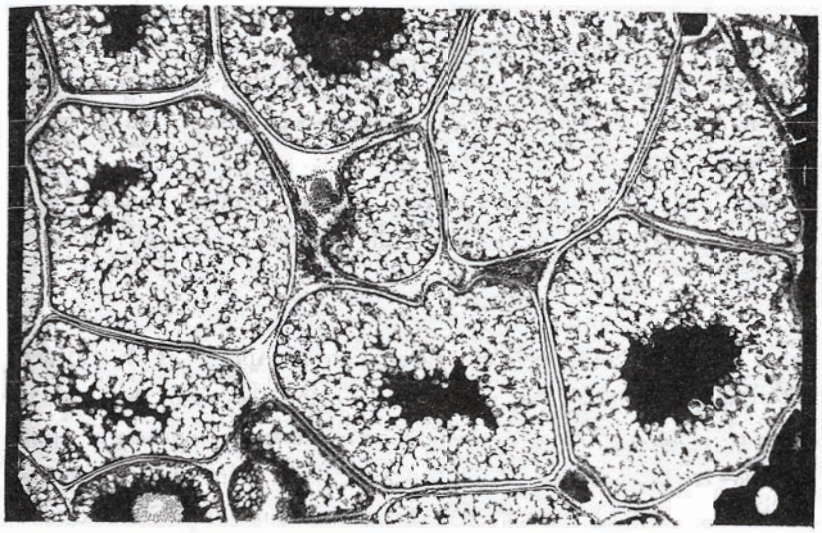

Fig. 11. Section of the ovary of a white bream female before commencement of the vitellogenesis in the oocytes, collected on 15 May 1984. (Magn. 100×)

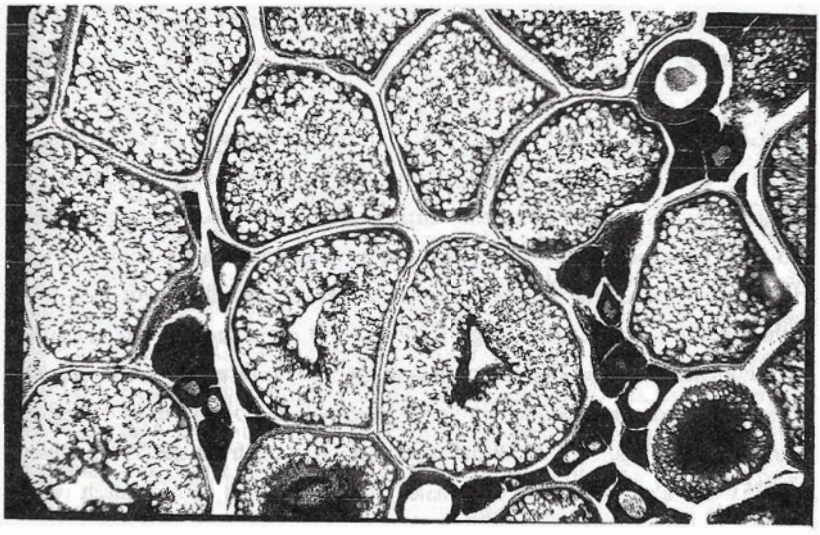

Fig. 12. Section of the ovary of a white bream female during oocyte vacuolisation, collected on 17 September 1984. (Magn. 100×)

On 15 May 1984 seven females were collected for the examination. Ovaries of six females contained oocytes filled with yolk granules, and oocytes in the stage of vacuolisation. In three of these fish, the vacuolisation process was completed, in the other three the oocyte cytoplasm was half vacuolised. In the ovaries of one female, the oocytes of the older generation were still in the vacuolisation stage. The vitellogenesis process still did not begin in the ovaries of this female (Fig. 11).

On 17 September 1984 ovaries of twelve females contained oocytes vacuolised to a different extent, in some fish the biggest oocytes had totally vacuolised cytoplasm (Fig. 12).

DISCUSSION

Examination of the white bream females collected on 10 April (Figs. 9, 10) and 17 September 1984 (Fig. 12) revealed that vitellogenesis of the oocytes of these fish in Włocławek Reservoir took place in spring. In 1984 it commenced at the beginning of April, but also on 15 May 1984 the vitellogenesis still did not begin in one of the collected females (Fig. 11), although the process was very intensive in all other fish. Statova (1970) studied in germ lines of different fish species in Kučurganskij Liman, which received a discharge of heated effluents from a power plant, and found that in the case of white bream and rudd the effect of water temperature could result in displacing the vitellogenesis period and in its shortening. Before this reservoir was thermally polluted the white bream females underwent intensive vitellogenesis in mid-April. An increase of water temperature due to the discharge of heated effluents accelerated the vitellogenesis, so that it took place already by the end of March, and at the beginning of April the vitellogenetic oocytes already attained their final diameter.

Oocyte composition in the ovaries of the white bream females collected before (Figs. 1, 6) and after (Figs. 2, 5, 7, 8) spawning revealed that spawning population in Włocławek Dam Reservoir was composed of the females which spawned the eggs in one batch only, but also of those which were able to produce a consecutive egg portion. In the pre-spawning period the ovaries of the first females contained only vitellogenetic oocytes, and no oocytes in the stage of vacuolisation (Fig. 6). Ovaries of these females did not contain oocytes in the vacuolisation stage also after spawning (Fig. 2). Ovaries of the females spawning in portions contained also the oocytes in the stage of vacuolisation, both before spawning (Fig. 1) and after it (Figs. 5, 7, 8). White bream population from the Volga River delta (Trjapicyna 1975) was also composed of females which spawned in one batch only, and their ovaries had no oocytes in the vacuolisation stage, and of the females spawning in batches, th eovaries of which contained oocytes in the vacuolisation stage.

Statova (1970) stated that in the case of white bream females laying two or three egg portions, the fish ovaries contained post-ovulatory follicles after consecutive spawning, but

also oocytes in the initial stages of vitellogenesis, and oocytes in the stage of vacuolisation. After the reproduction period, ovaries of the white bream contained oocytes in the vacuolisation stage, rarely oocytes in the initial phase of vitellogenesis; the latter were always resorbed. Also these oocytes in which vacuolisation had been completed were resorbed. Only in one female collected from Włocławek Reservoir in June–July there was a consecutive egg portion in the ovary (Fig. 4). Ovaries of one female collected on 14 July 1981 (Fig. 4) contained single vitellogenetic oocytes with bigger diameters, which were resorbed, and numerous smaller oocytes in the final phase of vitellogenesis. This suggests that this female had already laid an egg portion, while smaller oocytes (with smaller diameters) represented the next egg portion. In the other females collected in June–July, the ovaries of which contained the oocytes in the stage of vacuolisation also after spawning, there were also places of oocyte resorption (Fig. 5), and resorption was observed of the oocytes in the initial vitellogenesis (Figs. 7, 8). Ovaries of a female collected on 8 June 1983, i.e. at the begining of the spawning period (Fig. 5), contained oocytes in the stage of vacuolisation and numerous resorption places. Ovaries of this female had no oocytes with fully vacuolised cytoplasm, nor oocytes in the initial stage of vitellogenesis. Oocytes in these two stages formed a consecutive egg batch. It seems that in Włocławek Reservoir white bream females with the features of portion spawning did in fact lay only one egg portion, similarly as the females of one-portion spawning. White bream spawning took place in June–July. In 1981 it took place in mid-June and mid-July, in 1983 in the first decade of June and the first decade of July. In Kahovskij Reservoir (Spivak 1987) white bream females of two-batch spawning laid the first egg portion at the beginning of May, and the second one in the second half or at the end of May. In Kučurganskij Liman two or three batch spawning of white bream began in mid-April and lasted till mid-June, with 20–25 day intervals (Statova 1970) between egg batches. Based on the materials collected for this study and on the literature data it can be assumed that in Włocławek Dam Reservoir white bream females with the features of portion-spawning in reality laid either one or two egg portions. This is suggested by oocyte resorption in the ovaries of the females collected at the beginning of the spawning period as well as at its end. Oocyte resorption in early phases of the spawning period (Fig. 5) lack of the oocytes in the final stages of vacuolisation and early stages of vitellogenesis (Figs. 3, 5) are the characters observed in the females with portion spawning which, however, had spawned only one egg portion. Oocyte resorption observed in the ovaries of females collected in July 1983 (Figs. 7, 8) suggests that these females had already gone through the reproduction period. Vitellogenesis in the oocytes belonging to subsequent portions lasts about 20–25 days in white bream (Statova 1970; Spivak 1987). Hence, it can be assumed that the egg portion observed in the ovaries of the female collected on 14 July 1981 (Fig. 4) was a second egg batch.

CONCLUSIONS

1. In the sexual cycle of the white bream females from Włocławek Dam Reservoir the oocyte vitellogenesis commenced at the beginning of April, while the fish spawning took place in June and July.
2. Spawning population of white bream was composed of females with the features of single-portions well as multiple-portion spawning.
3. The females possessing the features of multiple-portion spawning laid either only one, or two egg portion.

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REFERENCES

Birwagen H., 1973: Ocena wpływu zanieczyszczeń organicznych, powstających przy przerobie ropy naftowej, na jakość wody Wisły [Determination of the effect of organic pollution produced in course of petroleum processing on water quality in the Vistula River]. IMGW, Oddział Gospodarowania Wodą, Zakład Chemii i Biologii Wody, Warszawa. (In Polish).

Brylińska M., 1983: Płodność wybranych gatunków ryb w zbiorniku zaporowym na rzece Wiśle k. Włocławka [Fecundity of selected fish species in a dam reservoir on the Vistula River near Włocławek]. In: Informacja na naradę organizowaną przez Instytut Ekologii PAN oraz AR-T, IRŚ Olsztyn: 5–7. (In Polish).

Fiet W., 1985: Charakterystyka połowów wędkarskich na Sulejowskim Zbiorniku Zaporowym, w latach 1982–1983 [Characteristics of anglers' catches in Sulejów Dam Reservoir in 1982–1983]. MSc Thesis, University of Łódź. (In Polish).

Grudniewski C., 1983: Badania nad ustaleniem liczebności ryb nieeksploatowanych gospodarczo we Włocławskim Zbiorniku Zaporowym [Studies of the numbers of fishes not being a subject of commercial fisheries in Włocławek Dam Reservoir]. In: Informacja na naradę organizowaną przez Instytut Ekologii PAN oraz AR-T, IRŚ Olsztyn: 22–27. (In Polish).

Grudniewski C., 1990: Próba ustalenia składu gatunkowego ryb małych rozmiarów w litoralu Zbiornika Zegrzyńskiego [An attempt to determine species composition of small fishes in the littoral zone of Zegrzyński Dam Reservoir]. In: Funkcjonowanie ekosystemów wodnych, ich ochrona i rekultywacja. Cz. I. Ekologia zbiorników zaporowych i rzek. SGGW-AR, Warszawa: 86–95. (In Polish).

Papadopol M., R. Iancu, 1970: Contributi la studial biologiei reproducerii si cresterea batcai – *Blicca bjoerkna* (L.) – din Dunarea inferiora. Buletunul de cercetari piscicole, **29**, 3: 77–91. (In Romanian).

Spivak E.G., 1987: Osobennosti razmnoženija gustery *Blicca bjoerkna*.(L.) v zalivach Kachovskogo vodochranilišča [Specificity of the reproduction of white bream, *Blicca bioerkna* (L.), in lagoons of Kahovskij Reservoir]. Vopr. Ichtiol., **27**, 1: 101–105. (In Russian).

Statova M.P., 1970: Godičnyje polovyje cikli u ryb Kučurganskogo limana [Annual sexual cycles in fishes from Kučurganskij Lagoon]. In: Biologičeskije resursy vodoemov Moldavii. AN MSSR, Kišinev: 53–60. (In Russian).

Trjapicyna L.N., 1975: Ekologija krasnoperki i gustery del'ty Volgi v uslovijach zaregulirovanego stoka [Ecology of rudd and white bream in the Volga Delta in the conditions of regulated river flow]. Izdat. Nauka, Moskva: 1–179. (In Russian).

Zalewski M., J. Sumorok, 1984: Charakterystyka połowów wędkarskich w Sulejowskim Zbiorniku retencyjnym [Characteristics of anglers' catches in Sulejów Dam Reservoir]. Gosp. Ryb., 2: 22–23. (In Polish).

Żytkowicz R., L.A. Błędzki, A. Giziński, A. Kentzer, R. Wiśniewski, J. Żbikowski, 1990: Zbiornik Włocławski. Ekologiczna charakterystyka pierwszego zbiornika zaporowego plano wanej kaskady dolnej Wisły [Włocławek Dam Reservoir. Ecological characteristics of the first reservoir of the planned cascade of the lower Vistula]. In: Funkcjonowanie ekosystemów wodnych, ich ochrona i rekultywacja. Cz. I. Ekologia zbiorników zaporowych i rzek. SGGW-AR, Warszawa: 201–225. (In Polish).

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Wiesława *KOPIEJEWSKA*

CYKL PŁCIOWY SAMIC KRĄPIA *BLICCA BJOERKNA* (L.) W ZBIORNIKU WŁOCŁAWSKIM

STRESZCZENIE

W cyklu płciowym samic krąpia, *Blicca bjoerkna* (L.), w Zbiorniku Włocławskim witellogeneza oocytów rozpoczynała się na początku kwietnia, tarło odbywało się w czerwcu-lipcu. W populacji samic występowały samice o cechach jednorazowego tarła i samice o cechach porcyjnego tarła. Samice o cechach porcyjnego tarła składały ikrę w jednej lub dwóch porcjach.

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Authors' address:

Wiesława Kopiejewska PhD
Chair of Zoology
Olsztyn University of Agriculture and Technology
Oczapowskiego 5, 10-957 Olsztyn, Poland