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## SEX DIFFERENTIATION IN PIKEPERCH, *Stizostedion lucioperca* (L.)

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**A B S T R A C T.** Morphological and histological development of gonads during the early ontogeny of pikeperch was examined. The fish were reared in fiberglass tanks and fed *ad libitum* with live zooplankton. Histological observations of pikeperch gonads were carried out every seven days in the period between 35 to 140 days after hatching. Body length of fingerlings at that time ranged from  $3.66 \pm 0.23$  to  $8.92 \pm 0.28$  cm, and weight ranged from  $0.32 \pm 0.05$  to  $4.59 \pm 0.36$  g. Female gonads were for the first time observed on the 126th day after hatching. No evidently male gonads were noticed during the course of the experiment. However, in some fishes smaller volume of their gonads, and fewer mitotic divisions of primordial germ cells in the gonads suggested that sex differentiation in these cases was proceeding in the male direction.

**Key words:** *STIZOSTEDION LUCIOPERCA* L., PRIMORDIAL GERM CELLS, SEX DIFFERENTIATION, OOCYTES

## INTRODUCTION

The use of androgenic steroids is a successful method for obtaining all-male population of many economically important teleosts. A critical factor determining the success is the administration of the hormone throughout the period of the gonadal differentiation. Fishes must be provided with hormones prior to, during, and after sex differentiation for successful sex reversal (Yamanoto 1969). Hence, accurate developmental information is essential for understanding the effects of hormone treatment. Sex differentiation may occur in different stages of the ontogenesis, depending on the fish species (Takahashi 1974, Kuhlman 1975, Malison et al. 1986). Several environmental factors may influence the process of gonadal development. The most important are: temperature (Lebrun 1977), food (Persov 1975), population density (Harrington 1975), and growth rate of the fishes (Epler and Bieniarz 1981, Malison et al. 1986, 1990).

It the present study morphological and histological development of gonads was examined during early ontogeny of pikeperch, *Stizostedion lucioperca* (L.).

## MATERIAL AND METHODS

Juvenile pikeperch was reared in earthen ponds to an average body length of 3.66 cm and weight of 0.32 g. The ponds were drained after 35 days and the fingerlings were harvested, brought into the laboratory, and stocked into 150-l fiberglass tanks at a rate of 1000 individuals per tank. The tanks were equipped with internal lighting (constant lighting) and air-stone aeration, and provided with heated water ( $22\pm 1^\circ\text{C}$ ) at 6 l/min. Fish were fed with live zooplankton *ad libitum*.

Histological observations of pikeperch gonads were carried out every seven days from the 10th June to 24th September 1993. In total, 160 specimens were examined.

For histological study fish were killed, measured (total length, TL to the nearest 0.01 cm), weighed (wet weight, W to the nearest 0.01 g) and fixed in Bouin's solution. Small fish were left intact for paraffin embedding, and serial cross sections were taken from midbody to anus. For bigger fish, only middle part of the body (from pectoral fins to anus) was embedded. Sections (4-6  $\mu\text{m}$  thick) were cleared, stained with Mayer's hematoxyline and eosin (Zawistowski 1986), mounted on glass slides and examined by light microscopy.

## RESULTS

Total body length of the examined pikeperch fingerlings ranged from  $3.66\pm 0.23$  to  $8.92\pm 0.28$  cm TL and their body weight ranged from  $0.32\pm 0.05$  to  $4.59\pm 0.36$  g W (Fig. 1, 2). The fishes reached 6.78 cm TL and 2.24 g W after 9 weeks of rearing in the laboratory. At that time their gonads consisted of two separate strands of tissue, each suspended by a ligament connected to the swim bladder, and contained primordial germ cells, PGC (Fig. 3A). From 10 to 12 weeks of the study the fish had no sex-distinguishing features, too. But in some specimens the gonads were relatively larger, and more numerous mitotic divisions of PGC were observed. Oogonia, meiotic divisions and single oocytes were observed for the first time in 13-week course of the rearing in the ovaries of pikeperch females that were 7.71-8.33 cm TL and 3.12-3.91 g W. These ovaries were characterized by a medially located ovocell (Fig. 3B). Two distinct gonad types were present in fish in the last week of the study. The ovaries of females contained oogonia and oocytes in previtellogenesis stage and a well-devel-

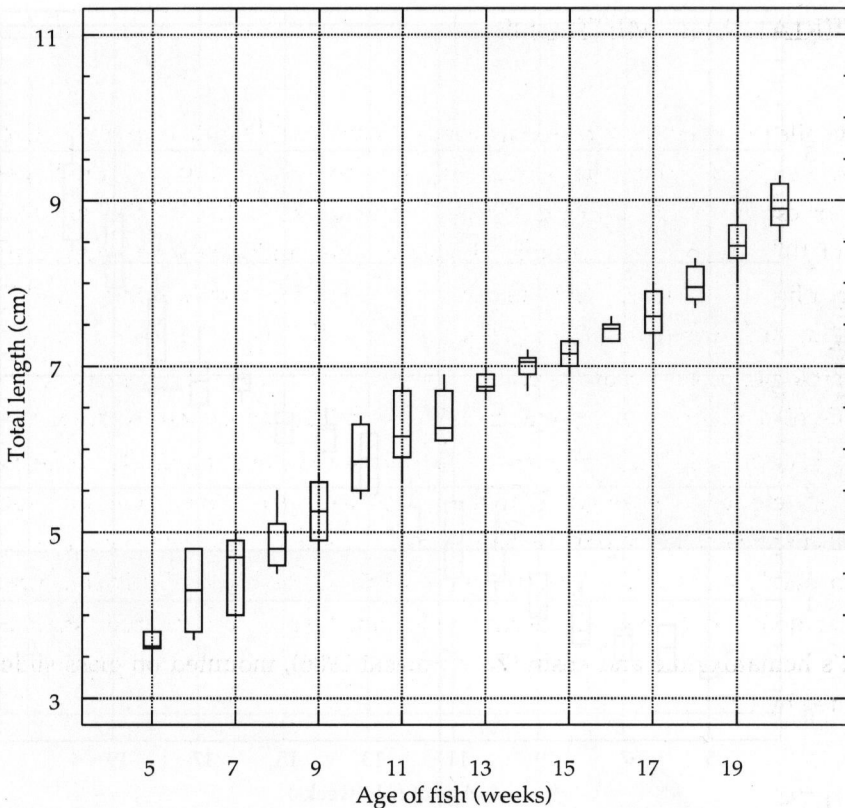


Fig. 1. Weekly changes in total length of pikeperch fingerlings reared in laboratory.

ped ovocell (Fig. 3C). At that time, the other gonad types contained PGC or/and gonio. The germ cells were arranged in distinct lobules (Fig. 3D).

## DISCUSSION

Depending on the fish species, sex differentiation may be observed in various stages of their ontogeny (Davies and Takashima 1980, Długosz and Demska-Zakęś 1992). Histological examination of the gonads of pikeperch, shorter than 7.0 cm TL and lighter than 2.0 g W, revealed no-distinguishing characteristics. The sex of 2.0-3.5 g W pikeperch could be distinguished by differences in size of the gonads and in the intensity of mitotic divisions of PGC. A number of observations on possible anatomical differentiation of fish gonads have been described. Many authors (Harrington

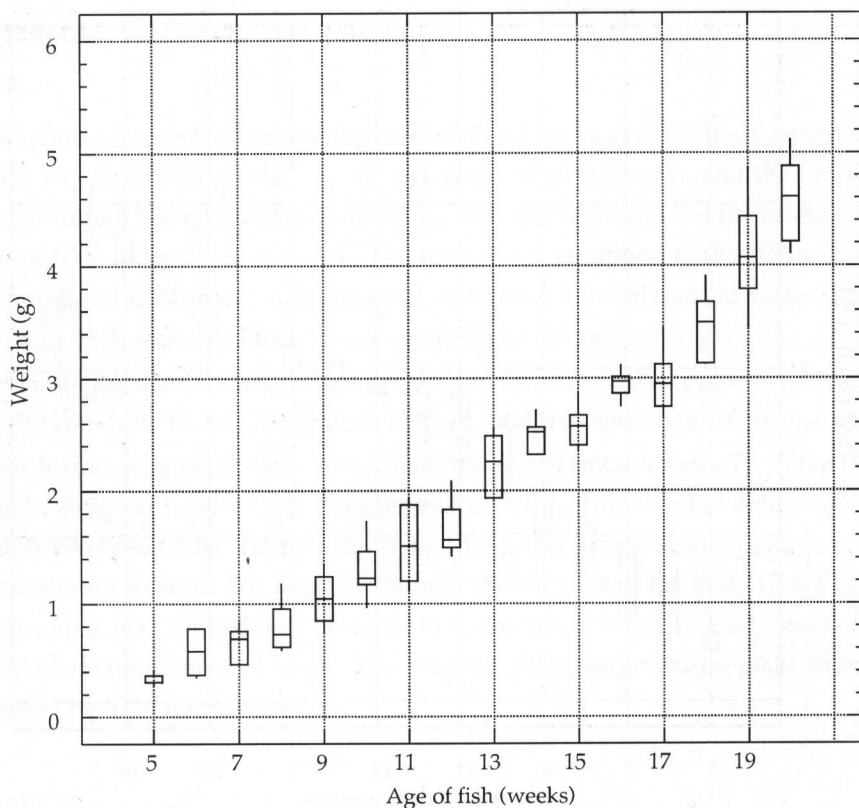


Fig. 2. Weekly changes in body weight of pikeperch fingerlings reared in laboratory.

1975, Persov 1975, Reshetnikov and Mukhachev 1989, Długosz and Demska-Zakęś 1992) observed differences in the circulatory system, intensive development of connective tissue, and differences in gonad size and shape between females and males. Lebrun (1977) noted that female gonads were larger due to increased mitotic activity.

The first histological sign of pikeperch female sex differentiation was the appearance of oogonia and single oocytes in fish at 8.0 cm TL and 3.5 g W. Clear indications of gametogenesis in males were not observed during the course of the experiment. Similar developmental pattern for walleye, sauger and their hybrids, in which oogenesis began earlier (at a smaller body size) than spermatogenesis, was observed by Malison et al. (1990). This author stated that ovaries of walleyes and walleyes x sauger hybrids at 75 mm TL contained mostly oocytes in the stage of previtellogenesis. Lobate gonads were presumed to be testes, but in these ones spermatogenesis was not



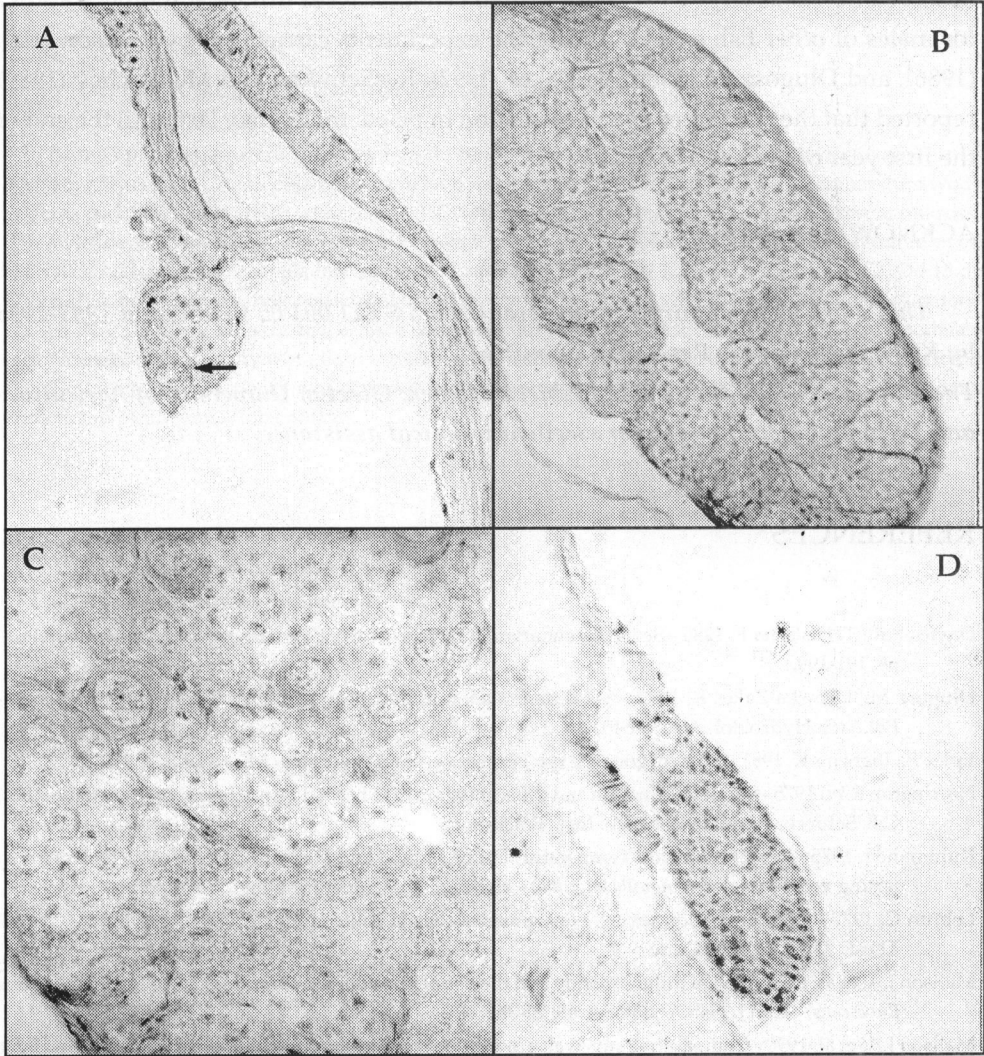


Fig. 3. Cross sections of gonads from juvenile pikeperch. A - Primordial germ cell, PGC (arrow) in the gonadal anlage from a 1.7 g W fish; B - Ovary from a 4.1 g W fish; C - Oogonies and oocytes in previtellogenesis stage in the ovaries from a 4.6 g W females; D - Testis from a 4.5 g W pikeperch.

observed in fish as large as 150 mm TL. No cytological sex differentiation was found for males of other fish species during the experiments carried out by Malison et al. (1986), and Długosz and Demska-Zakęś (1992). Reshetnikov and Mukhachev (1989) reported that the process of gonad formation in peled males may last until the end of the first year of life.

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## STRESZCZENIE

### DYFERENCJACJA PŁCI U SANDACZA *Stizostedion lucioperca* (L.)

Badano przebieg procesu różnicowania się płci u sandacza europejskiego (*Stizostedion lucioperca* L.) podchowyanego w obiegu półzamkniętym na pokarmie naturalnym (zooplankton). Temperatura wody podczas podchowu była stała i wynosiła  $22\pm 1^{\circ}\text{C}$ . Od 14 do 20 tygodnia po wylęgu, przy użyciu mikroskopu świetlnego, prowadzono obserwacje histologiczne gonad narybku sandacza. W 14 tygodniu życia wszystkie badane gonady wyglądały podobnie i zawierały pierwotne komórki płciowe (PGC). Od 15 do 17 tygodnia po wylęgu zaczęły pojawiać się różnice w wielkości gonad i intensywności podziałów mitotycznych PGC. Gonady żeńskie zawierające owogonia, komórki rozrodcze w okresie profazy I podziału mejotycznego oraz owocyty w stadium wzrostu protoplazmatycznego obserwowano od 18 tygodnia życia ryb. Do końca trwania podchowu u części osobników obserwowano zawiązki gonad z pierwotnymi komórkami płciowymi i/lub goniami.

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