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SEASONAL CHANGES IN THE TESTES OF COMMON BREAM *ABRAMIS BRAMA* L. IN LAKE VÕRTSJÄRV

Developmental processes of the reproductive system of fishes — gametogenesis and sexual cycles — form the basis of their reproduction. They reflect the connections between the developing organism and its environment, and play a role in the formation of fecundity, in the quality of sexual products, in the times of breeding, etc. The data on the development and function of the reproductive system of bream in Estonian waterbodies are inadequate. In the present work the attention concentrated on the investigation of seasonal changes in the testes of bream.

Material and methods

A total of 545 adult male bream were caught monthly during a period of four consecutive years (1975—1978) from L. Võrtsjärv. The standard length and body weight were stated. Both testes were removed, cleared from connective tissue and weighed. The size of the testes was expressed by gonosomatic index (GSI). It was computed for each fish by taking the body weight as the denominator. For histological study the pieces were cut from the cranial end of the left testis, fixed in Bouin's and Baker's fluids and processed by the conventional paraffin technique. Sections of 5—7 μm were cut and stained with haematoxylin-eosin according to Mayer. Glycogen was revealed by PAS reaction. Frozen sections were stained for lipids by Sudan black B and Sudan red. The amounts of glycogen and lipids were estimated visually on the histological preparations according to the 4-degree (0, 1, 2, 3) scale. Maturation stages of the testes were determined according to the widely used 6-degree scale (Сакун, Буцкая, 1963).

Results and discussion

As mentioned before (Пиху, 1963; Нооритс, 1978a) there is no noticeable change in the GSI of immature bream throughout the annual cycle. It forms approximately 0.28 in the males of a length of 26—30 cm. The GSI of mature fishes undergoes great seasonal changes (Fig. 1). It increases abruptly at the beginning of September in connection with the start of spermatogenesis. From November to April the GSI changes are negligible. Before spawning the GSI of males may vary on a large scale — up to 5.1 times (Нооритс, 1978a). After spawning the GSI falls to the minimum and during the summer period it is impossible to differentiate the mature bream from immature ones or from the specimens maturing in the same year. Remarkable inter-year differences occur in the seasonal dynamics of the GSI (Fig. 1) induced mainly by the influence of various ecological factors. The GSI of males increases with the length and weight

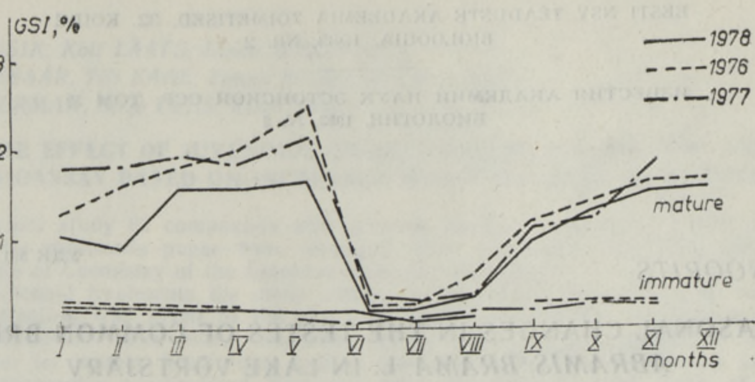

Fig. 1. Seasonal dynamics in the GSI of male bream.

of fishes, e. g. the bigger and heavier specimens have relatively bigger gonads. As the data characterizing the connection of the GSI with the length of fishes were published previously (Hooритс, 1978a), we present here only the data on the dependence of the GSI upon the weight of fishes throughout the annual cycle (Table).

In July the testicular tissue of the males maturing for the first time is compact, expressed mainly by the spermatogonia of the latest generations. Only a few cysts contain spermatogonia in the reproducing phase. Lobules have considerably large lumina in the testes of the repeatedly maturing specimens. At the side of lobules there occur cysts with spermatogonia of early generations. Mitosis of single big spermatogonia can also be seen. Interlobular partitions are thicker in the testes of the repeatedly maturing specimens than in the firstly maturing males (Fig. 2). By the state of gonads, the testes of the firstly maturing males in this period belong to the 2nd stage of maturity.

In August the lobules become filled with spermatogonia of the latest generations. Cysts with reproducing spermatogonia are presented numerously. Interlobular partitions are thin. In September the weight of the testes is steeply enlarged. especially great increases are in the GSI (Table). This is caused by start of an intensive spermatogenesis. The predominant cell types present in the lobules are spermatogonia in the

The GSI dependence on the weight of fishes throughout the annual cycle

Weight groups, g	Months											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
300					2.22	0.28		0.73				
n					1	2		1				
300—500	1.44	1.68	1.64	1.94	2.17	0.34	0.30	0.67	0.93		1.02	
n	1	6	8	4	110	11	2	14	14		4	
500—700	1.61	1.71	1.83	2.03	2.21	0.37	0.24	0.68	1.06	1.01	1.17	1.55
n	7	7	9	3	130	15	2	9	17	5	9	3
700—900	1.10	2.07	1.97		2.23	0.42		0.81	1.22	1.01	1.41	2.06
n	1	1	4		34	3		3	5	1	7	2
900—1100			1.82		2.20	0.45			1.36	2.19	1.71	1.49
n			1		3	2			5	2	8	1
1100—1300	2.83	3.02			2.52						1.88	
n	1	1			2						3	
average	1.66	1.80	1.79	1.98	2.20	0.36	0.27	0.67	1.07	1.30	1.41	1.71
n	10	15	22	7	280	33	4	28	41	8	31	6

reproducing phase and primary spermatocytes (Fig. 3). The GSI increases until November, attaining the third and fourth stage of maturity. The histological structure is characterized by the presence of germ cells in all stages of spermatogenesis except the sperms (Fig. 4). No remarkable changes are found in the GSI and in the histological structure of the testes between late November and early March; the male breams hibernate with immature testes (Hooритс, 1978b). Gradual increase of the GSI in early March indicates a continuing spermatogenesis. In the single parts of seminiferous lobules sperms are found (Fig. 5). Spermatogenesis does not come to an end before spawning, this happens only in a few cysts. The breeding period extends from the first decade of May to the first decade of June, usually. In the testes of spawning males a great number of cysts containing sperm cells in various stages of development are found. The ripening of those cells is protracted throughout the whole breeding period. Side by side with sperm discharge during spawning, intensive spermatogenesis continues in gonads. Such a situation is characteristic of the testes in the 4th—5th stage of maturity (Fig. 7). The post-spawning stage of maturity, the 6th in number, arrives in the middle of June. The testes are formed of completely spent lobules. The few remaining sperms are placed under phagocytosis by follicular cells (Никольский, 1974).

The annual cycle of the development of testes is presented in Fig. 6.

The breams, like many other species, have gradients of maturity and usually the more intensive ripening occurs in the posterior parts of the testes (Буцкая, 1959, 1975; Турдаков, 1972; Белова, 1975). The type of gametogenesis described before in male breams is connected with the spawning type in the females. In the testes of a number of species (bream, vimba, chub, and others),whose females spawn over a prolonged period of time, sperms mature asynchronously and with the same guarantee of a prolonged use of the sexual products (Сакун, 1954). But there exists a certain incoordination of spawning between the males and females. In water-bodies of the north and temperate latitudes, where the female breams are simultaneous spawners, one can find males together with gonads having a continuing spermatogenesis, already when the females have finished spawning. An incoordination like this may be connected with the statement that breams have an intermediate type of spawning (Дрягин, 1949).

It is supposed that spawning becomes simultaneous in the northward direction. This is connected with changes in the gametogenesis and in the nature of the growth of oocytes during vitellogenesis. At the same time, the type of gametogenesis of the males remains the same, demonstrating great conservatism (Буцкая, 1975).

Among the material investigated by us, some testes with pathological features were found. Two males (aged 9 and 10 years, with a body length of 26.8 and 33.8 cm) captured during the breeding time, had gonads with an overgrown connective tissue (Fig. 8). Features of spermatogenic activity were absent. In gonads of one male (9 years of age, with body length of 29.2 cm), among the testicular tissue immature oocytes were located (Figs 9, 10). In natural water-bodies, such an intersexuality of bream arises obviously from a spoiled hormonal regulation during the period of sex differentiation.

During the annual cycle of testes development, certain dynamics may be observed in the content of glycogen and lipids (Fig. 11). In the biodynamics of cells, glycogen and lipids play the role of energetic reserves (Даниленко, 1967). They both occur in the shape of little grains and droplets in the histological structure (Figs 12, 13). Inter-year differences may occur in the dynamics of glycogen and lipids as well (Figs 14, 15), but they are statistically insignificant.

A visual estimation of seasonal dynamics of energetic reserves is seldom used. K. Laugaste's investigations (Лаугасте, 1970, 1978, etc.) into the liver of cyprinids belong to the few instances of a successful use of that method. But we should mention that the seasonal dynamics of energetic reserves is revealed in the liver particularly intensely thanks to its leading role in the metabolism of fishes.

Summary

Seasonal changes in the GSI and in the contents of energetic reserves in the testes are noteworthy. The general course of these changes is repeated from year to year; the existing interannual differences are caused by varying ecological conditions. In the article the sexual cycle of the male bream is described according to the histological analysis; the duration of each stage of maturity is likewise determined. There occur some specimens having pathological gonads (intersexuality, testes with overgrown connective tissue).

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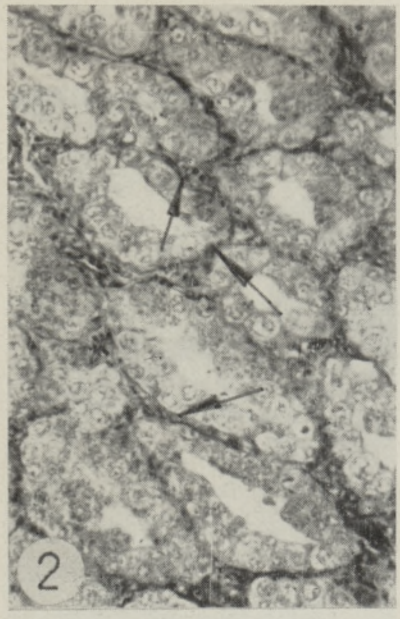
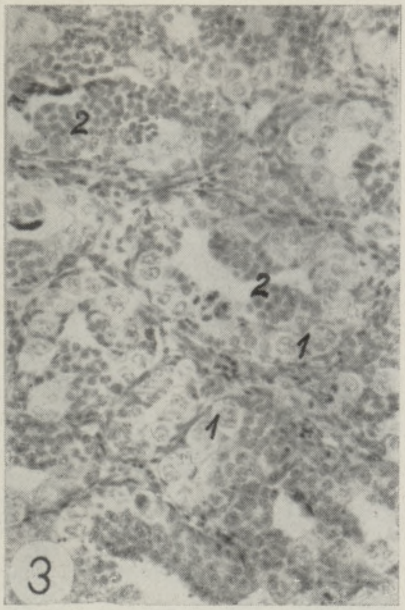
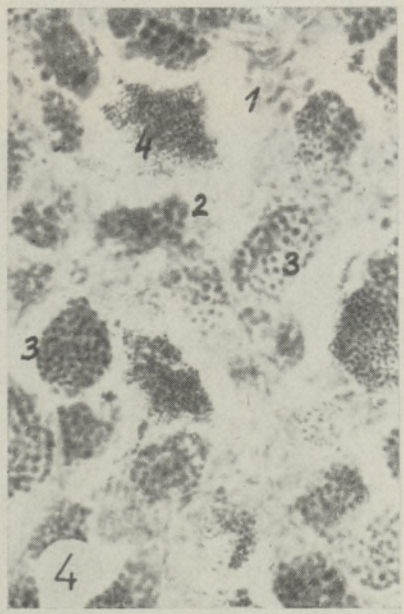






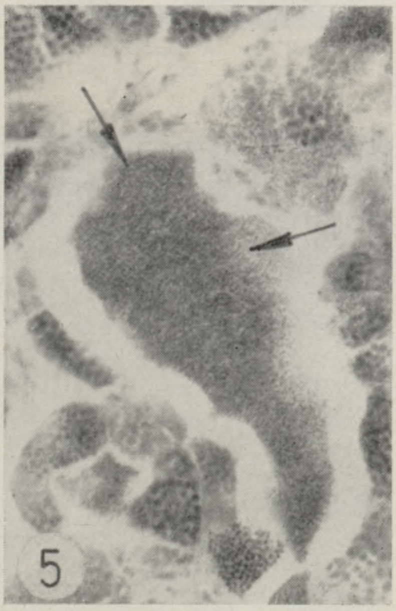


Fig. 2. Testis of repeatedly maturing male. Thicker interlobular partitions (the arrow) are seen (late July). Haematoxylin-eosin; × 280.

Fig. 3. Spermatogonia (1) and primary spermatocytes (2) in the testis (late August). Haematoxylin-eosin; × 280.

Fig. 4. Testis in the III—IV stage of maturity. Spermatogonia (1), primary (2) and secondary spermatocytes (3), spermatids (4) are seen (November). Haematoxylin-eosin; × 280.

Fig. 5. Sperms (the arrow) maturing in single parts of seminiferous lobules (late March). Haematoxylin-eosin; × 280.

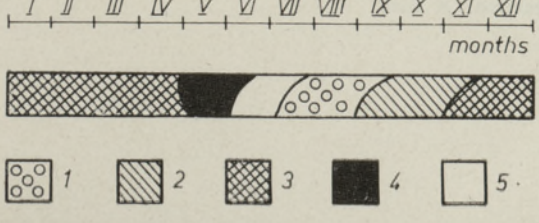
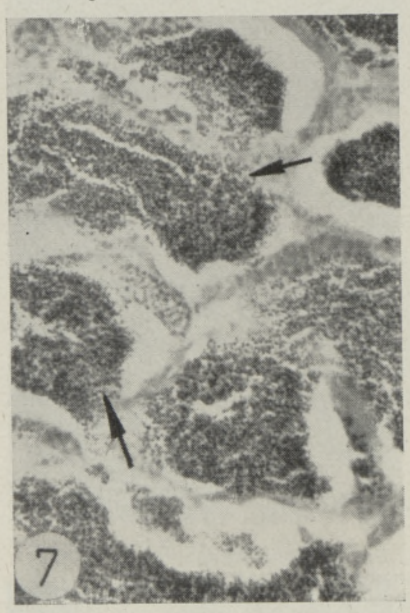
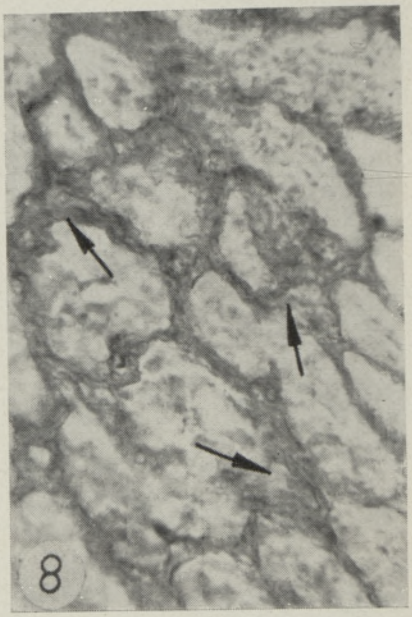
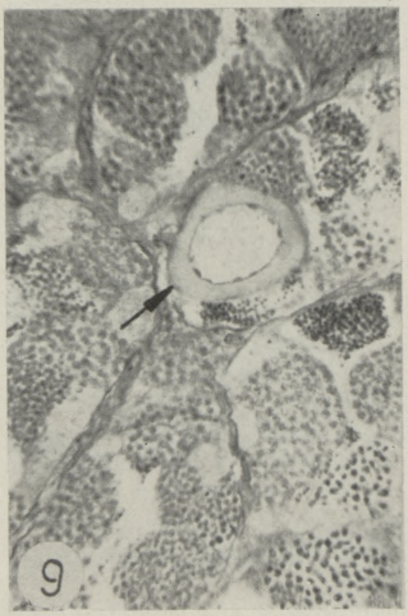


Fig. 6. The annual reproductive cycle of bream testes in Lake Võrtsjärv: 1 — II, 2 — III; 3 — III—IV; 4 — IV—V; 5 — VI stages of maturity.







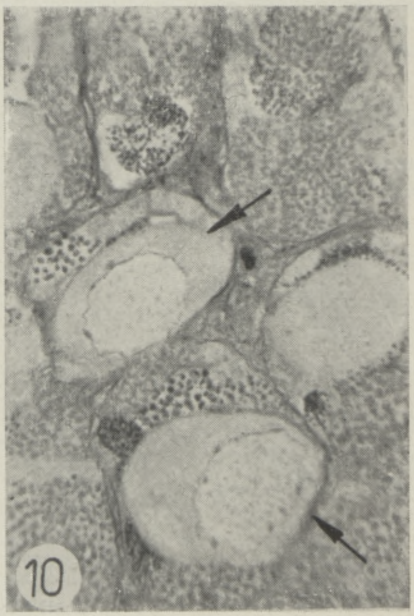


Fig. 7. Sperms (the arrow) in the testis lobules (April). Haematoxylin-eosin; × 280.
Fig. 8. Testis with overgrown connective tissue (the arrow) (May). PAS reaction; × 310.
Figs 9, 10. Immature oocytes (the arrow) among the testicular tissue (May). PAS reaction; × 310.

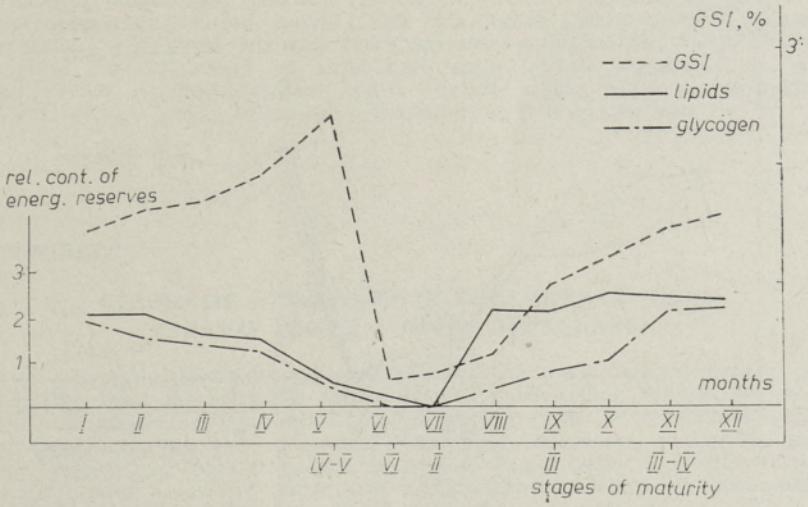
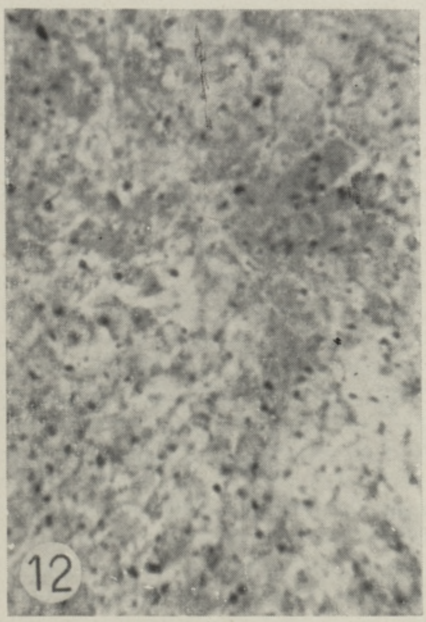


Fig. 11. Seasonal dynamics in the relative-content of lipids and glycogen in the bream testis.



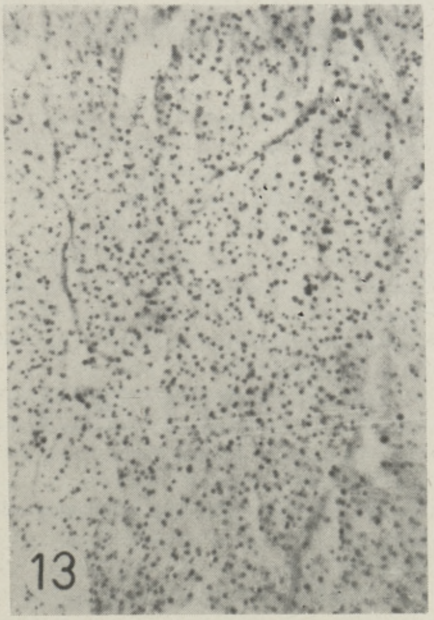


Fig. 12. Lipids in the shape of droplets in the bream testis (September). Sudan black B; × 675.

Fig. 13. Glycogen in the bream testis (December). PAS reaction; × 310.

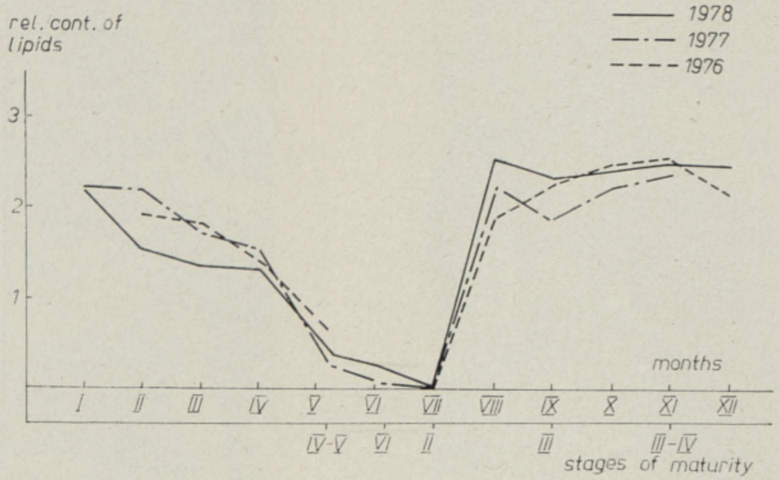


Fig. 14. The inter-year differences in the seasonal dynamics of lipids.

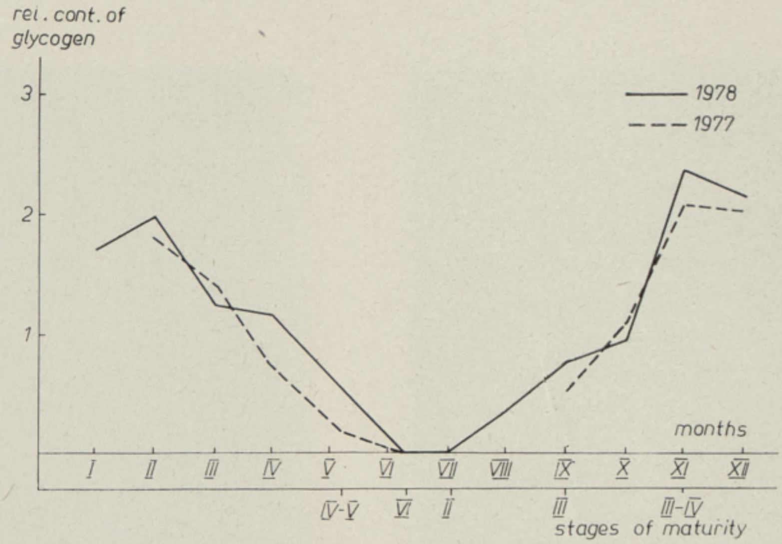


Fig. 15. The inter-year differences in the seasonal dynamics of glycogen.

Tõnu NOORITS

SESOONSED MUUTUSED VÕRTSJÄRVE LATIKA *ABRAMIS BRAMA* L. TESTISTES

Artikkel käsitleb Võrtsjärve latika raigades toimuvaid sesoonseid muutusi. Küpsuskoefitsiendi, samuti energeetiliste reservide (glükogeen, lipiidid) suhtelise sisalduse sesoonsed muutused on märkimisväärsed. Nende üldine käik kordub aastast aastasse, olemasolevad aastatevahelised erinevused johtuvad muutuvaist ökoloogilistest tingimustest. Gonaadide histoloogilise analüüsi alusel on kirjeldatud isaste latikate sugutsüklit ja määratud kindlaks üksikute suguküpsusastmete kestus. Uuritute hulgas leidus ka mõningaid patoloogiliste raigadega isendeid (gonaadi sidekoestumine, interseksuaalsus).

Тыну НООРИТС

СЕЗОННЫЕ ИЗМЕНЕНИЯ В СЕМЕННИКАХ ЛЕЩА *ABRAMIS BRAMA* L. ОЗЕРА ВЫРТСЪЯРВ

Сезонные изменения коэффициента зрелости (КЗ), а также энергетических резервов в семенниках леща значительные. Общий ход этих изменений повторяется из года в год, при этом межгодовые различия обусловлены разными экологическими условиями. На основании изучения гистологических препаратов семенников описан половой цикл самцов и выявлена продолжительность отдельных стадий зрелости. Обнаружены семенники с признаками патологии (зарастание соединительной тканью, интерсексуальность).