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Features of changes in the internal organs of the golden grey mullet *Chelon auratus* (Risso, 1810)

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Abstract. The purpose of the study is to analyze the changes in the internal organs of golden mullet specious caught in May 2022 in the scientific expeditions to the western part of the Caspian Sea. Mature mullets were examined. The caught species were weighed and measured. There were made 152 histological sections of 10 species (liver, spleen, gills, ovaries, muscles). The studied species were 3-4 years old. The collected samples were processed by classical histological techniques. According to the results of the conducted histological research, there have been found the numerous changes in the studied organs that indicate the adaptive capabilities of the fish: microcirculatory disorders (extensions of different sizes and durations in time), different abnormalities in the gills structure (proliferation of multilayer non-keratinizing epithelium of filaments and lamellae usually met in different species in the Volga river today), fatty hepatic degeneration to some degree, hemosiderosis of the spleen. Changes in the epithelium of the gills were estimated as 2.8 points, changes in the spleen – as 3.1 points. Hemosiderosis was also detected in the liver parenchyma; the changes made 2.5 points. Some skeletal muscle fibers were segmented; their change was estimated as 2.5 points. Cardiomyocytes had different thickness; their changes were estimated as 2.3 points. In general, the studied tissue and cell changes of the gill apparatus, liver, spleen, skeletal muscles and ovary indicated the morphological rearrangement caused by the adaptive response of the fish organisms to the environmental conditions.

Keywords: golden mullet, liver, spleen, gills, muscles, changes

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Научная статья

Особенности изменений внутренних органов кефали-сингиля *Liza aurata* (Risso, 1910)

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Аннотация. Целью данной работы является анализ изменений внутренних органов кефали сингиля, выловленной в мае 2022 г. в западной части Каспийского моря во время научных экспедиций. Были исследованы половозрелые кефали. Выловленных рыб взвешивали и измеряли длину. Для изучения состояния внутренних органов рыб было изготовлено 152 гистологических среза от 10 особей (печень, селезенка, жабры, яичники, мышцы). Возраст рыб составлял 3-4 года. Материал обрабатывали классическими гистологическими методами. По результатам проведенных гистологических исследований в отобранных органах кефали был выявлен комплекс изменений, которые указывали на адаптивные способности этих рыб, в том числе микроциркуляторные расстройства – это различные расширения разной величины и продолжительности во времени, разнообразные по степени нарушений строения жабр – разрастания многослойного неороговевающего эпителия филаментов и ламелл, что обычно встречается у разных видов волжских рыб в современных условиях, разные степени жировой дистрофии клеток печени, гемосидероз селезенки. Изменения эпителия жабр были оценены в 2,8 балла, изменения в селезенке в 3,1 балла. Гемосидероз выявлен и в паренхиме печени; оценка изменений составляет 2,5 балла. Отдельные скелетные мышечные волокна были сегментированы; их оценка составила 2,5 балла. Кардиомиоциты были разной толщины; их изменения оценены в 2,3 балла. В целом наблюдаемые тканевые и клеточные изменения жаберного аппарата, печени, селезенки, скелетных мышц, яичника свиде-

тельствовали о морфологических перестройках, возникающих при адаптивных реакциях организма рыб на воздействие факторов окружающей среды.

Ключевые слова: кефаль сингиль, печень, селезенка, жабры, мышцы, изменения

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Introduction

The golden grey mullet is distributed in the Atlantic Ocean off the coasts of Europe and Africa, in the Mediterranean, in the Black and Azov Seas. In 1980, it was acclimatized in the Caspian Sea, naturalized and became widespread. In winter it feeds in the Southern Caspian, in spring it rises in the Middle and partly in the Northern Caspian.

Golden grey mullet is detritophagus, also feeds on benthos and algae. It spawns in the Black Sea from mid-July to mid-October, in the Caspian Sea – mainly in September-October; at a distance from the shore up to 30 m meters [1].

Currently, it is an important object of commercial fishery [1-3]. The Russian mullet fishery is concentrated in the Caspian fishery subdistrict on the Dagestan coast of the Caspian Sea. For the period from 2011 to 2020, commercial catches varied from 257.1 to 1 022.9 tons. The average catch was 661.4 tons [2, 3].

Material and methods of research

The material was collected and processed according to generally accepted methods [4, 5]. The object of the study was adult individuals of mullet caught in the western part of the Northern Caspian Sea during a scientific expedition in May 2022. The average length and weight of the fish were, respectively, 35.1 ± 0.42 cm; 0.6 ± 0.14 kg. 10 individuals were selected to assess the condition of internal organs and tissues. A 10% solution of neutral formalin was used to fix histological preparations, poured into paraffin, sections were made 5 micrometers thick, and stained with hematoxylin-eosin. Histological alterations were estimate according to recommendations described by Lesnikov L. A., Chinareva I. D [6]. Microscopy was carried out using an Olympus VN-2 light microscope. Micrography of organ sections was performed using the Soni DC N7 photo nozzle.

Results and discussions

Liver. The trabecular architectonics of the liver has not been preserved. There is a noticeable polymorphic difference in the size of the nuclei of hepatocytes and the cells themselves. But the boundaries between individual cells have not been revealed due to swelling of the parenchyma of the organ. Separate large light nuclei with 1-2 nucleoli were found; there were smaller dense dark-colored nuclei. In 10% of the studied fish, lipoid liver dystrophy of varying severity was found, up to lipoid degeneration with subsequent necrosis.

Microcirculatory disorders were found in the liver: small hemorrhages, very small areas of necrosis were noted, many hepatic capillaries were dilated, filled with plasma and shaped blood elements. Rare small granules of hemosiderin are observed (Fig. 1).

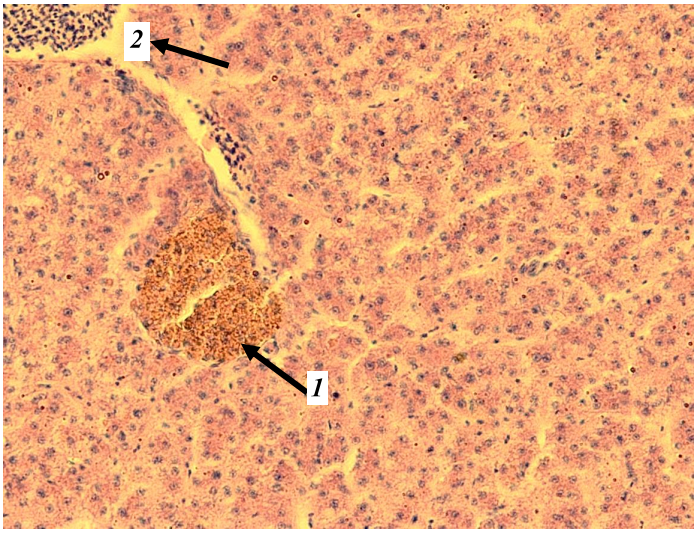

Fig. 1. Fragment of golden gray mullet liver. Hematoxylin-eosin. Magnification: 880x:
1 – hemosiderin granules; *2* – blood vessels

The spleen. The borders between the white and red pulp are almost not contoured. Relatively large formations of hemosiderin (hemosiderosis) of various sizes and shapes are scattered over the entire surface

of the organ. It should be noted that the total area of the white pulp exceeds the area of the red one. The entire pulp of the spleen consists of reticular tissue, it contains erythrocytes, lymphocytes, macrophages. The white pulp is interspersed with the red one in the form of rounded, oval and longitudinal islands (Fig. 2).

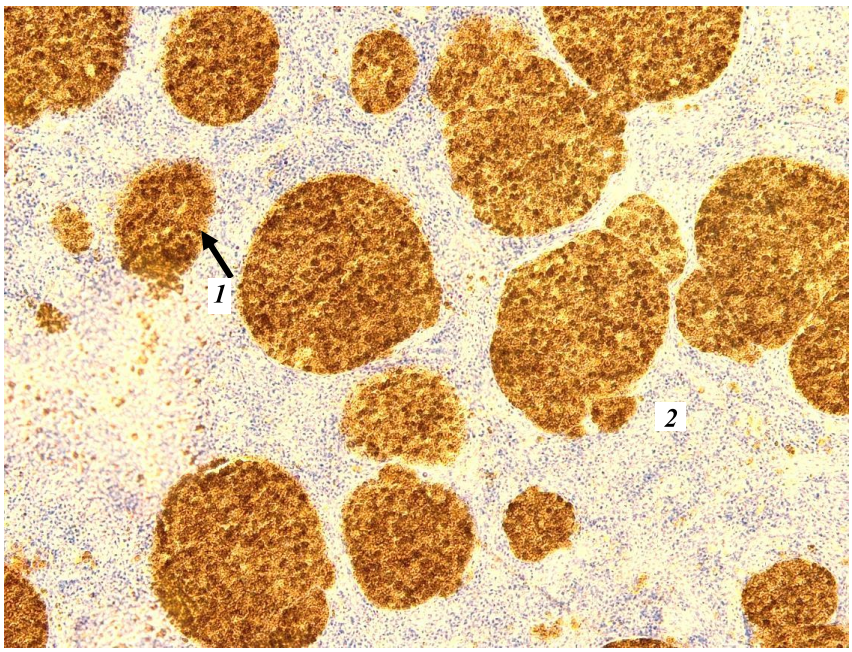

Fig. 2. Fragment of the mullet spleen. Hematoxylin-eosin. Magnification: 220x:
1 – hemosiderin granules; *2* – white pulp

The central parts of the white pulp are defined as lighter areas. It is there that the so-called central arteries are located, in the course of these formations, intense accumulations of lymphocytes of different stages of development are observed. A significant hemorrhage was found in one of the studied individuals.

Gills. There were 110-120 paired lamellae on each filament; sometimes 4-6 neighboring filaments had no lamellae at all; their surfaces were covered with a continuous layer of multilayered non- horned epithelium, that is, these areas of the gills did not participate in respiratory function. The lamellae themselves were mostly curved. Rounded growths of the respiratory epithelium were noticeable on their tops. Moreover, such an overgrowth was found not only on the tops of lamellae, but also on the lateral surfaces (Fig. 3).

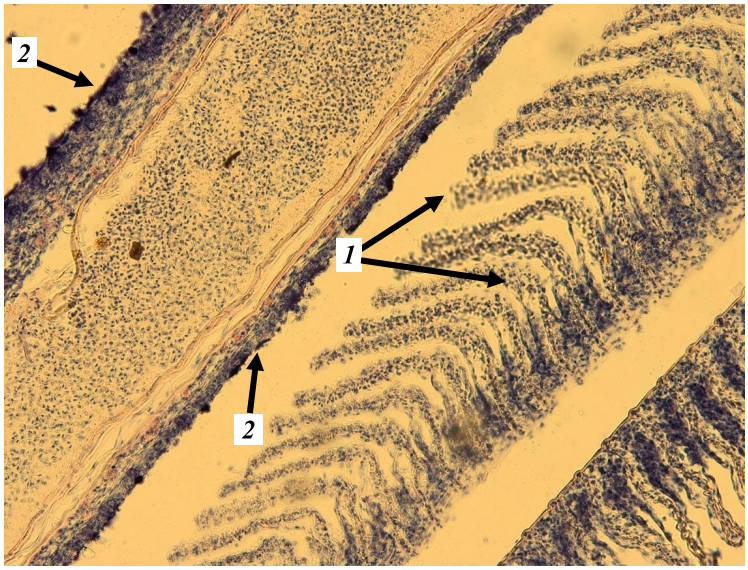

Fig. 3. Fragment of a mullet gill. Hematoxylin-eosin. Magnification: 440x:
1 – proliferation of single-layer respiratory epithelium of lamellae;
2 – proliferation of the multilayer non-horned epithelium of the filament

It should be noted that the lamellae on neighboring filaments differed significantly from each other in length. Sometimes on one filament there were parts with curvature of lamellae or their atrophy, on other parts of this filament there were only epithelial plates without lamellae. Changes were also noted in hyaline plates, which were the basis of filaments, in their thickness and length.

Dorsal skeletal muscles. Long, but not of the same size, muscle fibers were noted, which were located very close to each other. There was a barely noticeable transverse striation and numerous nuclei in these muscle fibers. In some areas of muscle mass, fragmentation of muscle fibers was observed, gaps between individual muscle fibers were noticeable, apparently associated with edema of skeletal tissue (Fig. 4).

Ovaries. The ovaries were in the II stage of maturity (Fig. 5).

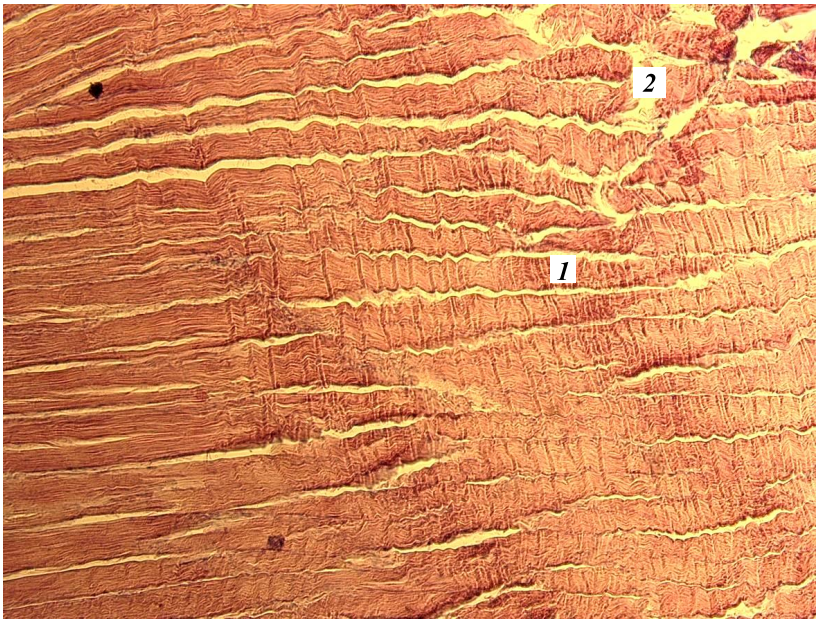

Fig. 4. Fragment of mullet muscle. Hematoxylin-eosin. Magnification: 220x:
1 – transverse striation; *2* – fragmentation of muscle fibers

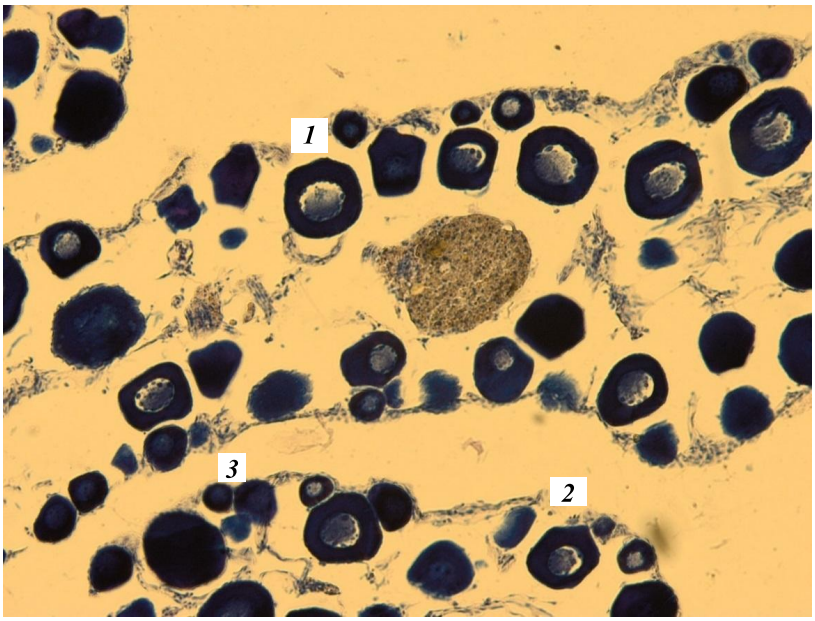

Fig. 5. Fragment of the mullet ovaries. Hematoxylin-eosin. Magnification: 440x:
1 – oocytes of the II growth period; *2* – oocytes of the I stage of maturity; *3* – oogonia

The bulk of germ cells in the ovaries are oocytes of protoplasmic growth. There is a group of cells of the reserve fund for future spawning: oocytes of the 1st order and oogonia.

Conclusion

As a result of the study, it was noted that the greatest changes were detected in the gills, where the respiratory epithelium is replaced by a multilayer flat non-corneal. Hemosiderosis was found in the spleens of all the studied fish; moreover, there was a predominance of white pulp over red. Polymorphism of both nuclei and hepatocytes themselves is mainly found in the liver.

The examined fish had various adaptive changes in internal organs (swelling of the tissues of internal organs, overfilling of blood vessels with shaped elements of blood, necrosis of hepatocytes of the liver of fish, hemosiderosis of the spleen and liver, proliferation of the epithelium of the gills). Changes in the gill epithelium were estimated at 2.8 points, intense hemosiderosis was registered in the spleen, which was characterized by numerous accumulations of hemosiderin on all surfaces of the organ; the assessment of changes was 3.1 points. Hemosiderosis was also detected in the liver parenchyma; the assessment of changes was equal to 2.5 points. Individual skeletal muscle fibers were segmented; their score was 2.5 points. Cardiomyocytes were of different thickness; their changes were estimated at 2.3 points.

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