

Қамыстыбас көлін балық шаруашылығы мақсатында одан әрі пайдалану үшін, ихтиофаунаның өсімін молайту процестеріне түсетін салмақты азайту қажет. Жалпы алғанда, гидрофауна тіршілігінің қолайлы қалыптасуына, олардың табиғи қоректік базасы үшін, сондай-ақ бағалы балық түрлерімен балықтандыруға, балық өсіру-мелиорациялық және балық қорғау жұмыстарын орындауға баса бағыт қойып, назар аудару қажет.

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APPLICATION OF THE ULTRASOUND SCANNING METHOD IN STURGEON BREEDING

ANNOTATION

The use of non-traumatic methods is relevant in sturgeon breeding for sturgeon's sex and gonad's maturity stages determination. One of these methods is ultrasound scanning. This method was applied when carrying out bonitation works with sturgeon species in the recirculating aquatic system (RAS) of LLP «Educational and scientific complex of experimental-industrial production of aquaculture» (LLP «ESCEIPA») in West Kazakhstan region. As a result of ultrasound diagnostics the sexual structure and gonads' development data to Siberian sturgeon (*Acipenser baerii*) aged 6+, 7+, 12+ also industrial hybrids of sturgeon fish – bester and ROLO 12+ were obtained. 15% of Siberian sturgeon aged 6+ were at the III transitional stage of maturity. As a result of the evaluation of the age group 7+, using ultrasound scanning, females promising for use in the broodstock were identified. The stages of maturity of oocytes were determined for sturgeons aged 12+ from the broodstock, which are at the final stage of caviar maturation. At the end, a group of fish was identified, aimed at artificial wintering in order to obtain caviar.

Key words: *ultrasound scanning, siberian sturgeon, hybrids, gonads, oocytes, maturity stages, sex determination.*

Introduction. Sturgeon fish, which have a high nutritional value, have long been the objects of intensive fishing, which eventually became the reason for their world reserves [1;2]. Pollution of natural reservoirs, which are their habitat, also affected the excessive reduction of sturgeon. The construction of hydraulic structures also prevents the free passage of fish to spawning places [3;4].

In this regard, inability to provide a complex process of sturgeon's reproduction in natural conditions, the development of sturgeon's reproduction in artificial conditions of enterprises is considered relevant, as well as development of commercial sturgeon growing, as a means of compensating for the damage caused and removing the pressure from the populations of natural reservoirs [5;6].

At the moment, one of the most technologically advanced and promising areas of modern industrial aquaculture is recirculating aquatic system (RAS), which allow increasing productivity and production efficiency. As scientific works and world experience in the operation of closed systems have shown, the use of RAS can successfully solve most problems faced by modern aquaculture [7;8;9;10].

For the autonomy of such enterprises, on the basis of the RAS, repair brood stock are constantly being formed in order to produce fish planting material to ensure their own commercial production [11;12]. Comprehensive knowledge of the reproductive cycle of sturgeon is necessary for optimal management of the reproductive process and the repair brood stock's formation at the enterprise, and the development of diagnostic methods for determining sex is fundamental for the successful reproduction of sturgeon and caviar production [13;14]. In the conditions of sturgeon enterprises it is necessary to apply the most effective methods of sex determination which importantly will be fast in operation, since it is necessary to create the least stressful conditions for fish. Noninvasive ultrasound determination of the stage of gonads' maturity and sex of sturgeon fish species and their hybrids meets these criteria [15;16;17].

Currently, enterprises in Kazakhstan are taking a course for the wide application use of lifetime methods of taking caviar from females for this purpose a repair brood stock is formed in each species group. The group of brood stock includes the "leaders": individuals with the largest mass indicators in their age group, females are able to regularly give caviar. The repair group includes males and females with average indicators, they are necessary for the regulation of the sexual structure in herd.

Materials and research methods. The research was carried out on the basis of LLP "Educational and scientific complex of experimental and industrial production of aquaculture " (LLP "ESCEIPA").

The objects of the study are different-aged individuals of the repair brood stock (RBS) Siberian sturgeon (*Acipenser baerii*), a hybrid of beluga with sterlet – "bester", a hybrid of Russian and Lena sturgeon – ROLO.

The purpose of the research is to carry out bonitization work taking into account their sex and sorting the RBS of sturgeon fish by stages of gonad maturity.

For research an ultrasound device for animals of the Mindray DP-Vet brand with a frequency of 50-60 Hz was used. Scanning was carried out in the longitudinal and transverse directions, the moment of finding an exact image of the gonads was recorded on the monitor. To describe the stages of gonads' maturity of sturgeon fish the maturity scale of V. Z. Trusov was used [18; c. 147].

Determination of the stages of gonad maturity was carried out for fish aged 12+. Fish with stage IV caviar development were biopsied with a probe, inserting a needle into the muscles above the abdominal shields. The selected caviar samples were fixed by boiling in saline, cut and calculated the oocyte maturity index – the polarization coefficient (K_p) [19; c. 70] using a micrometer of the MBS – 10M microscope.

$$K_p = I/L;$$

where I – distance from the animal pole to the upper edge of the nucleus (germ bubble);

L – greatest distance from the animal to the vegetative pole.

Results and its discussion. Special stretchers made of soft materials were used for ultrasound diagnostics. On a stretcher the fish was fixed in a position on its side and held manually to avoid injury. The ultrasound machine was located to the left of the operator, the acoustic lens of the sensor was tightly pressed to the surface of the fish body in the area of 3-4 abdominal shields (counting starts from the pectoral fins) and longitudinal and transverse scanning was performed alternately until the exact image of the gonads was fixed (picture1).

The assessment of the gonad maturity stage and the identification of the fish's sex were carried out according to a specially developed technique [20; c.1–115]. During ultrasound diagnostics tissues, including gonads, are clearly distinguished on the image (picture 2). The stage of gonad maturity, as well as sex identification of sturgeon fish, was determined visually by characteristic features. Stage IV maturity is characterized by the presence of rounded, large, homogeneous spawns.

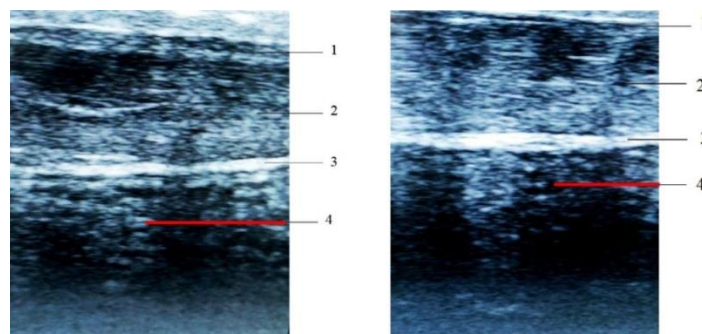
At the third transitional stage, individual spawns are visible in the form of rounded, heterogeneous inclusions, contrasting against the background of dark adipose tissue.



Picture 1 – Ultrasound scanning of a female Siberian sturgeon (*Acipenser baerii*)

For Siberian sturgeon individuals, the main task was to determine the sex with further sorting and culling of males into a commercial herd and selection of females to replenish the repair and breeding stock. As a result of ultrasound diagnostics of Siberian sturgeon individuals, it was noted that the gonads were clearly identified on the images, therefore, their minimum dimensions are greater than the ultrasound wavelength.

As a result of determining the stages of maturity of the gonads of 7+ individuals, males with the second stage accounted for 58%, third – 42%. Females at the first transitional stage were among 84% of the total, females at the second stage – 3%, females at the third stage – 5%, females at the third transitional stage – 3%, females at the resorption stage – 5%. As a result of the diagnosis, a group of Siberian sturgeon females was formed, sent to the breeding stock. The males were deposited in a separate pool for further implementation.



Picture 2 – Frontal section of different echogenicity zones in the area of gonad location of Siberian sturgeon female: 1 – skin and subcutaneous tissue, 2 – muscle tissue, 3 – serous lining of the abdominal cavity. 4 – gonad (on the left stage of maturity IV, on the right – III – IV).

Scanning of individuals aged 6+ was carried out to identify the stages of maturity of females. The percentage ratio was as follows: males at stage II – 88%, males at stage II transitional – 12%, females at stage I transitional – 15%, females at stage II transitional – 39%, females at stage III - 23%, females at stage III transitional – 15%, females with caviar resorption – 8%. Females at the II transitional stage prevailed.

Based on the results of ultrasound diagnostics the sexual structure of the Siberian sturgeon RBS was determined, data on the sexual structure of the studied groups are presented in table 1.

Table 1 – Sex ratio of the studied groups of Siberian sturgeon, 2022 y.

№	Age	Sex	Maturity	Number of individuals
1	2	3	4	5
1	7+	Males	II	22
2		Males	II – III	16
3		Females	I – II	33
4		Females	II	1

1	2	3	4	5
5		Females	III	2
6		Females	III – IV	1
7		Females	Resorption	2
8	6+	Males	II	15
9		Males	II – III	2
10		Females	I – II	2
11		Females	II – III	5
12		Females	III	3
13		Females	III – IV	2
14		Females	Resorption	1

Ultrasound diagnostics of female Bester and ROLO hybrids, as well as female Siberian sturgeon aged 12+, were carried out in order to select individuals with stage IV gonad maturity for further reproducing. The determination of the maturity stage of caviar was carried out according to the same method as the determination of sex in a special stretcher.

According to the research results, 3 ROLO females, 7 bester females and 3 Siberian sturgeon females were at the final stage of caviar maturity.

In addition, females with stage IV were biopsied. The obtained caviar samples were used to determine the polarization coefficients of oocytes (table 2).

Table 2 – Calculations of polarization coefficients of sturgeon oocytes, 2022

Type of sturgeon	The value of variables and the polarization coefficient
ROLO	I=9; L=77; $K_p = 0,12$
	I=16; L=86; $K_p = 0,19$
	I=40; L=120; $K_p = 0,33$
Bester	I=9; L=62; $K_p = 0,15$
	I=23; L=93; $K_p = 0,25$
	I=22; L=140; $K_p = 0,16$
	I=54; L=123; $K_p = 0,44$
	I=40; L=145; $K_p = 0,28$
	I=40; L=145; $K_p = 0,28$
	I=37; L=83; $K_p = 0,45$
Siberian sturgeon	I=30; L=127; $K_p = 0,24$
	I=20; L=96; $K_p = 0,2$
	I=19; L=150; $K_p = 0,13$

Female with a coefficient equal to 0.2 or more were sent to undergo artificial wintering: one ROLO female, three bester female, one Siberian sturgeon female. Two bester females with a polarization coefficient value of 0.4 or more were overripe, they had a process of resorption.

Conclusion. Ultrasound scanning has a number of undoubted advantages over the biopsy method: acceleration of the process, absence of traumatization. The fish recovers quickly after short-term stress, which does not affect its physiological state.

The mass use of this method in the experience of sturgeon enterprises both in Kazakhstan and abroad has a positive effect, but there are a number of significant drawbacks. The gonads of the scanned individuals (females) should be at the full final stage of maturity. This criterion should be followed so that only correctly selected individuals are subjected to biopsies. This is necessary to exclude the fact of unnecessary traumatization of fish, which can lead to negative consequences up to a fatal outcome. Also, the direction to artificial wintering of sturgeon with immature caviar can be fraught with resorption, which negatively affects both the physical condition of sturgeon and the volume of caviar production.

According to the results of the conducted bonitization with the use of ultrasound diagnostics and sex sorting of the Siberian sturgeon repair group, males were culled, and females were sent to the breeding stock. When identifying the stages of females gonads maturity that are part of the road stock of age 6+, no females were observed at the final stage of caviar formation.

During ultrasound diagnostics, in order to determine the stage of caviar maturity in the older age group of the sturgeon fish RBS, a group of females aged 12 + was formed according to the values of the polarization coefficient to undergo artificial wintering in order to obtain caviar.

The results obtained confirm the need to use the ultrasound method at enterprises specializing not only in the lifetime production of sturgeon caviar, but also on farms focused on the production of marketable products, in many ways they help to reduce the cost of maintaining males who give exclusively meat products and increase economic efficiency in the production such a valuable delights as caviar.

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ТҮЙІН

Бекіре тұқымдас балықтарды өсіруде балықтарды зақымдамайтын әдістерді қолдану арқылы балықтардың жынысын және жыныс өнімдерінің жетілу кезеңдерін анықтау өзекті болып табылады. Осындай әдістердің бірі-ультрадыбыстық талдау (УД талдау). Бұл әдіс Батыс Қазақстан облысының "Аквакультура тәжірибелік-өнеркәсіптік өндірісінің оқу-ғылыми кешені" ЖШС-дегі ("АТӨӨФК" ЖШС) тұйық жүйелі сумен қамтамасыз ету қондырғыларында өсірілетін бекіре тұқымдас балықтарға бонитировка жұмыстарын жүргізу кезінде қолданылды. УД-талдауды жүргізу нәтижесінде 6+, 7+ және 12+ жастағы сібір бекіресі (*Acipenser baerii*) жыныс өнімдерінің, сондай – ақ 12+жастағы бестер мен РОЛО бекіре балықтарының будандарының жыныстық құрылымы мен дамуы туралы деректер алынды. УД талдаудың нәтижелері бойынша 6+ жастағы сібір бекіресінің 15% - ы жетілудің III өтпелі кезеңінде екендігі анықталды. УД-сканерлеудің көмегімен 7+ жастағы топтарды бағалау нәтижесінде өндіргіш табынға пайдалану үшін перспективалы аналықтар анықталды. 12+ жастағы уылдырықтары жетілудің соңғы сатысына жеткен аналық табынындағы бекіре тұқымдастары үшін ооциттердің жетілу кезеңдері анықталды. Кейін уылдырық алу мақсатында жасанды қыстатуға жіберілетін балықтар тобы анықталды.

РЕЗЮМЕ

В осетроводстве актуально применение нетравматичных методов определения пола осетровых рыб и стадий зрелости гонад. Одним из таких методов является ультразвуковая диагностика (УЗ-диагностика). Этот метод был применен при проведении бонитировочных работ с осетровыми видами рыб в установке замкнутого водоснабжения (УЗВ) ТОО «Учебно-научный комплекс опытно-промышленного производства аквакультуры» (ТОО «УНКОППА») Западно-Казахстанской области. В результате проведения УЗ-диагностики были получены данные о половой структуре и развитии гонад сибирского осетра (*Acipenser baerii*) возраста 6+, 7+ и 12+, а так же промышленных гибридов осетровых рыб – бестера и РОЛО возраста 12+. По результатам УЗ-диагностики установлено, что на III переходной стадии зрелости находились 15% особей сибирского осетра возраста 6+. В результате оценки группы возраста 7+ с помощью УЗ-сканирования были определены самки, перспективные для использования в маточном поголовье. Для осетровых возраста 12+ из маточного поголовья, находящихся на завершающей стадии созревания икры, были определены стадии зрелости ооцитов. В конце была определена группа рыб, направленных на искусственную зимовку с целью получения икры.