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Formation Of Broodstock Of Siberian Sturgeons Reared In Uzbekistan

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Summary: *This article is devoted to the study of the formation of the breeding stock of Siberian sturgeon, which was brought to the Research Institute of Fisheries (Uzbekistan) from the Konokovo Fish Farming Plant (Russian Federation) in 2009. The results of the experiments presented in this article are part of A.R. Kurbanov's dissertation research on the topic "Biological foundations and technological principles of breeding valuable fish species in Uzbekistan".*
Keywords: *Body width, broodstock of Siberian sturgeons, Circumference of body, Condition factor, Head length, Maximum body height, Minimum body length, Morphometric Indicators, Total body length, Weight.*

INTRODUCTION

As a result of long-term scientific research and experiments conducted by specialists from the Scientific Research Institute of Fisheries (Uzbekistan), recommendations have been developed for adaptation and acclimatization of Siberian sturgeons to the climatic conditions of the Republic of Uzbekistan. The fish were imported as fry from Konokovo Factory of the Russian Federation in 2009.

At the beginning of this dissertation study, a broodstock had formed consisting of more than 300 individuals aged over 12 years with an average weight of about 9–12 kg each. Additionally, there was a repair-brood stock comprising more than 160 individuals weighing between 6.0 and 9.5 kg.

RESEARCH METHODS

he maturation status of sturgeon was monitored using the AcuVista VT880b ultrasound device. Individuals of established sex were marked on their ventral fins. Before selecting breeders for egg production, the degree of nuclear polarization in the eggs was analyzed using the following formula by E. Hofmann: [4, с. 443–454.]

$$K_n = \frac{l}{L}, \qquad (1)$$

where: (K_n) — polarization coefficient, (l) — distance from the animal pole to the upper edge of the nucleus, (L) — maximum distance from the animal pole to the vegetative pole.

Thus, the sturgeon breeders were artificially produced and reared in recirculating aquaculture systems (RAS). Adult individuals were transferred to tanks with flowing water at the temperature of the natural water body and were kept until they reached the stages of juveniles, marketable fish, and breeders.

Morphometric parameters of sturgeon were determined as follows (Figure 2.3.1): [7, p. 92]

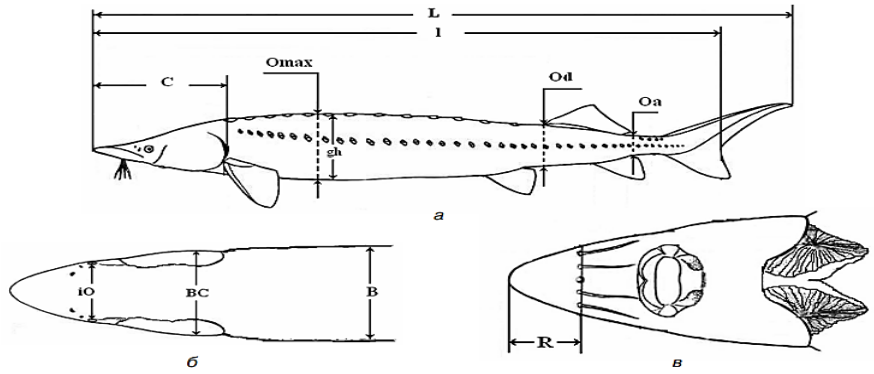

Figure 1 - Morphometric Parameters of Sturgeon Fish

(L) — total body length, sm; (l) — standard body length; (C) — head length; (BC) — maximum head width; (R) — distance from the tip of the snout to the left branch of the jaw; (gh) — maximum body height; (B)

— body width; (O_{max}) — maximum body perimeter; (O_d) — chest circumference in front of the pectoral fins; (O_a) — body circumference near the anal opening; (iO) — frontal width between the eyes.
The obtained data underwent biometric analysis using the Microsoft Excel software package. Arithmetic mean values ((X)), standard error of the mean ((S_X)), and coefficient of variation ((CV%)) were calculated. The fatness coefficient ((K_c)) according to Fulton's method was used for a comprehensive assessment of fish condition. The calculation formula is as follows: [2, с. 115–122.]

$Kc=m\times100l^3$ or $Kc=lm^3\times100$ (2)

where: (m) — live weight of the fish, kg; (l) — body length, sm.

RESEARCH RESULTS

During this doctoral research, analysis of growth trends and morphometric characteristics of sturgeons reared under artificial conditions at the laboratory-experimental complex of the Scientific Research Institute of Fisheries was carried out. Morphometric analysis of the broodstock of Siberian sturgeons formed at the institute is presented in Table 1.

Table 1

Morphometric Indicators of Brood Stock of Siberian Sturgeon

Indicator	Weight Range (kg)		
	10,3-14,5 кг *n*=35		
	X±Sx	Cv,%	Limit
Weight, kg	12,7±0,12	12,3	10,3-15,2
Total body length, sm	129,5±0,75	7,6	119,3-140,6
Minimum body length, sm	109,2±0,61	7,5	108-111
Head length, sm	21,5±0,15	5,4	19-23
Maximum body height, sm	17,1±0,11	8,3	16-19
Body width, sm	16,2±0,13	5,1	14-19
Circumference of body, sm	59,1±0,12	10,2	56-62
Condition factor, %	0,9±0,05	8,9	0,4-1,0

According to data in Table 1, it can be seen that the brood stock established at the Scientific Research Institute of Fisheries has an average weight of approximately 12.7 kg, which is an important indicator of productivity and maturity among individual fish. This value shows relatively stable distribution with low standard deviation (±0.12), indicating minor variability in weights within the group.

Body lengths range from 119.3 to 140.6 sm, with an average value close to 129.5 sm, demonstrating uniform development across individuals within the population. The mean head length of around 21.5 sm exhibits minimal variation (ranging from 19 to 23 sm), typical for healthy adult specimens. Maximum body height fluctuates between 16 and 19 sm, averaging 17.1 sm. Similarly, body width averages 16.2 sm, showing small variations (from 14 to 19 sm). Circumference measurements are consistent, averaging nearly 59.1 sm, providing insight into overall physique and health condition. Minor fluctuations (between 56 and 62 sm) confirm homogeneity within the herd. Coefficient values indicate levels of heterogeneity in key traits: Weight (12.3%) indicates moderate dispersion. Total body length (7.6%), minimum body length (7.5%), maximum body height (8.3%) reflects low variability, suggesting high homogenization. Body width (5.1%) remains stable. Circumference (10.2%) demonstrates slightly higher variance but still acceptable consistency.

Overall, the morphometric analysis reveals excellent stability in critical anatomical features of the studied brood stock of Siberian sturgeon. These results demonstrate good physical condition and suitability for further breeding programs and research efforts.

Key morphometric indicators evaluated the dynamics of individual growth, focusing on the correlation between body size dimensions and behavior patterns observed in the artificial pond environment. The collected data clearly illustrate rapid increases in both mass and linear dimensions of the sturgeons, highlighting their strong adaptive capabilities in Uzbekistan's climate.

Below Figure 1 presents a diagram illustrating the morphometric parameters of the brood stock of Siberian sturgeons.

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Bayesian Correlation Table:

	Pearson	Kendall	BF_{+0}
Mass of sturgeons, kg	r = Length of sturgeons, sm	tau B = 0.887	1.729×10^{11}
Mass of sturgeons, kg vs. Length of sturgeons, sm	0.946		

This table provides statistical correlations between two main variables—body mass and total body length—with corresponding Bayesian factors supporting these relationships.

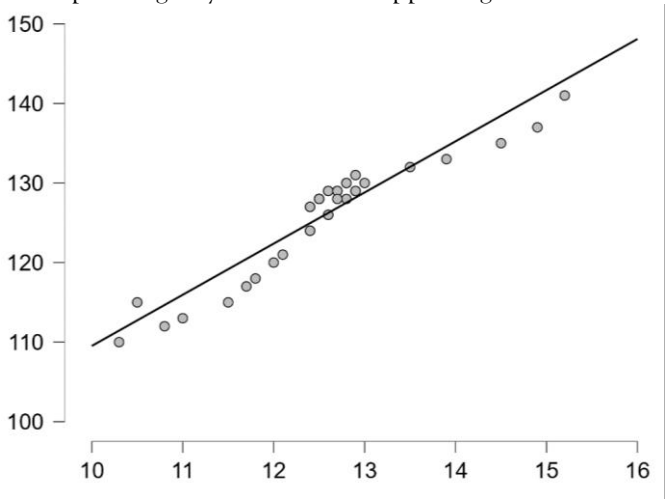

Figure 2. - Morphometric Parameters of Brood Stock of Siberian Sturgeon

Analysis of Correlation Results:

- Pearson Correlation Coefficient (r): The coefficient value is r=0.787. Correlation coefficients vary from −1 to +1, where |r| < 0.3 represents weak association, |r| ≈ 0.3–0.7 indicates moderate relationship, while |r| > 0.7 suggests strong positive or negative connection. Since our calculated coefficient equals 0.787, we conclude that the dependency is strong and positive. It means that increase in female body length leads to significant increase in her body mass.
- Statistical Significance (p-value): The reported p-value is equal to 3.10×10^{-6}, much smaller than the conventional threshold α=0.05. Therefore, the probability of observing such effect purely by chance is extremely low. Low p-values validate the robustness of detected interconnection between variables L and l.

Figure 2 illustrates the dependence between total body length and standard body length for females in the group of sturgeon fish.

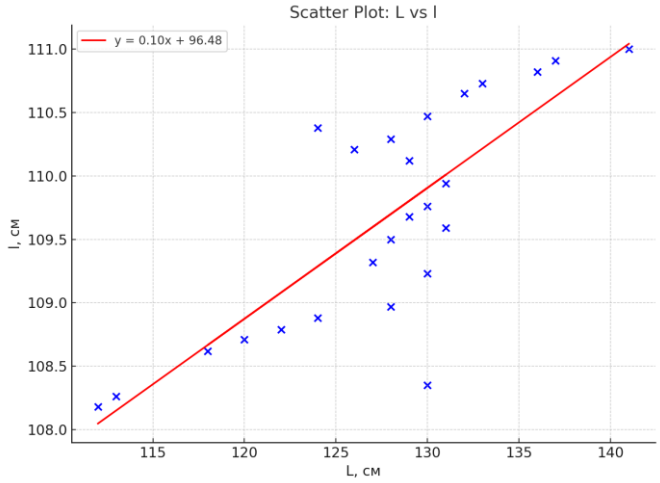

Figure 3. - Dependence Between Total Body Length and

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Standard Body Length Among Female Sturgeon Fishes

Based on the data provided in Table 1, the calculated correlation coefficient was found to be r=0.828, which indicates very high positive correlation between the analyzed parameters. As body mass *(W)* increases, fat tissue accumulation becomes significantly pronounced. The obtained p-value of 1.79×10^{-7} is exceptionally low, underscoring the high level of statistical reliability associated with this finding.

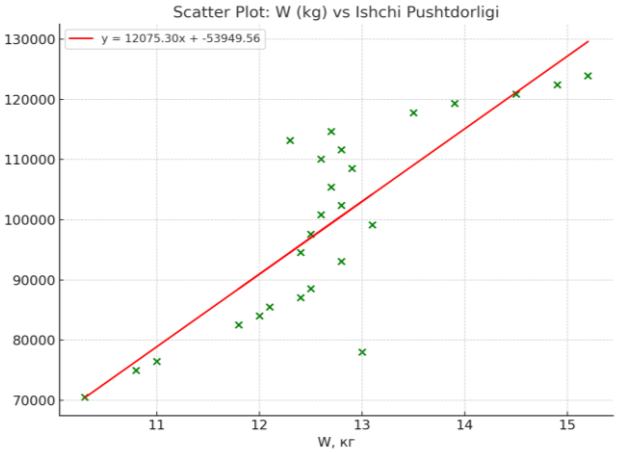

Figure 4. - Depicts the relationship between body weight and fecundity among female sturgeon fishes

The Pearson correlation coefficient is approximately equal to *0.947*. This value being close to one indicates a strong positive influence of body weight on the fecundity of female sturgeon fish. More specifically, as body weight increases, the number of eggs produced rises substantially. Figure 4 displays the interdependence between three variables: body weight *(W)*, body length *(L)*, and reproductive capacity *(P)*.

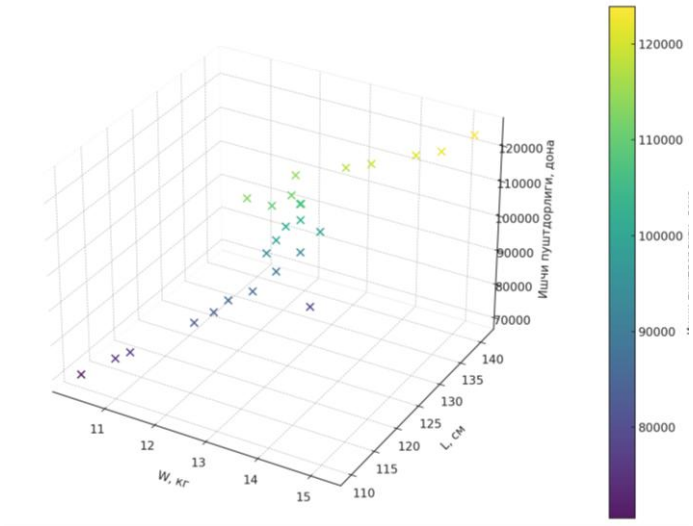

Figure 5. - Interdependence between three variables: weight (*W*), length (*L*) and reproductive performance index (*P*) of female broodstock of Siberian sturgeon

The three-dimensional scatter plot in Figure 4 clearly illustrates the interdependence among these three variables: weight (*W*), length (*L*), and reproductive performance index (*P*). There is a strong and statistically significant positive correlation between *W*, *L* and *P*. This finding suggests that these parameters can be effectively utilized for selection, monitoring, and prediction purposes within agricultural or biotechnological domains.

Table 2 Morphometric characteristics of repair stock of Siberian sturgeons raised at Fish Breeding Research Institute

Indicator	Body Mass Range (kg)
	6,1-9,8 кг, n=90

	X±Sx	Cv,%
Weight (kg)	8,4±0,11	13,5
Total body length (sm)	120,4±0,77	8,1
Shortened body length (without tail), sm	109,4±0,61	8,8
Head length (sm)	21,9±0,17	6,7
Maximum body height (sm)	14,1±0,12	7,9
Body width (sm)	12,3±0,14	6,3
Maximum perimeter (sm)	41,2±0,18	11,1
Condition factor (%)	0,78±0,09	9,7

Analysis of the results in Table 2: The average body weight is 8.4±0.11 kg with a coefficient of variation (CV) of 13.5%, indicating a high uniformity in the weight of the fish. The total body length is 120.4±0.77 sm, with a CV of 8.1%, suggesting moderate variability in size. The standard body length without the caudal fin is 109.4±0.61 sm, with a CV of 8.8%. The head length is 21.9±0.17 sm, with a CV of 6.7%, indicating negligible dispersion. The maximum body height is 14.1±0.12 sm, with a CV of 7.9%, reflecting good uniformity. The body width is 12.3±0.14 sm, with a CV of 6.3%. The perimeter of the cross-section is 41.2±0.18 sm, with a CV of 11.1%, showing diversity in body shape. The condition index is 0.78±0.09%, with variation of 9.7%, indicating an acceptable level of nutrition and health.

The data confirms the high quality and balance of the Siberian sturgeon population at the Scientific Research Institute of Fisheries (Uzbekistan). Moderate variations in morphological traits suggest the effectiveness of management and feeding methods. Figure 5 illustrates the relationship between body length and weight, which aids in understanding the biological characteristics of sturgeons and optimizing their rearing process.

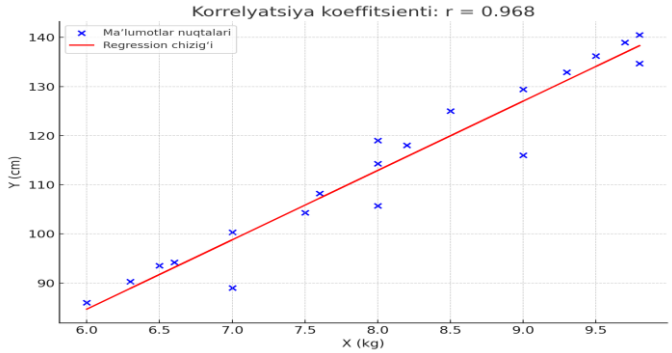

Figure 6 - Overall relationship between total body length and body mass of the repair herd of Siberian sturgeon

Correlation coefficient (r): 0.968 This result indicates a strong positive correlation. In other words: As the value of X increases, the value of Y also increases. This means that an increase in mass is accompanied by an almost proportional increase in length. On the graph, this relationship is represented by a regression line that closely passes through all points—this indicates a strong interaction.

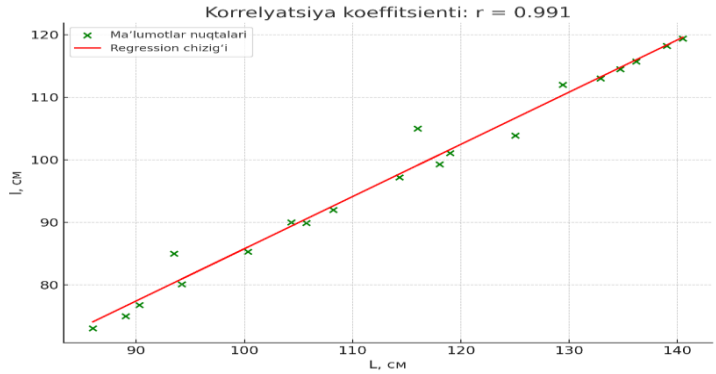

Figure 7 - Overall relationship between standard body length and total body length of the repair herd of Siberian sturgeon

The Pearson correlation coefficient is r=0.991, which indicates an extremely strong positive correlation between total and standard body length of the sturgeons. An increase in one variable leads to a corresponding increase in the other, as confirmed by the graph showing a close grouping of points around the regression line.

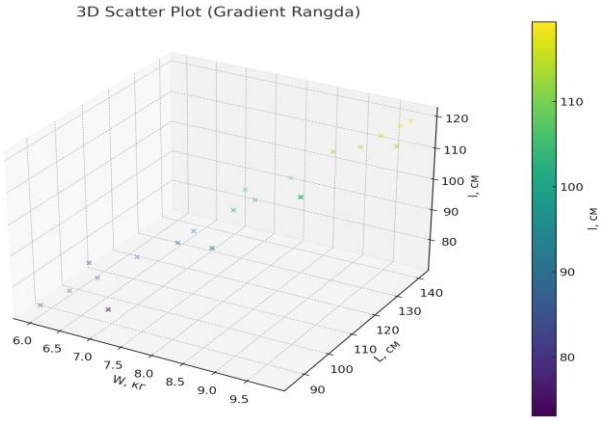

Figure 8 - Direct relationship between standard length (l) and the mass and external length of the repair stock of Siberian sturgeons.

The graph shows an increase in color gradation from top to bottom, reflecting a direct correlation between the standard body length and mass of sturgeons. A strict linear pattern of point distribution is observed, confirming a strong three-way positive correlation among mass, body length, and external dimensions. The results indicate a significant positive linear relationship between these parameters, which is important for monitoring the population status and rational use of sturgeon fish resources.

Thus, the analysis confirms that the formation and maintenance of a healthy and sustainable broodstock in the scientific research base of the Research Institute of Aquaculture has been successfully accomplished.

The results obtained are consistent with the literature data of authors: Shebanin V.M., Podushka S.B. (2000) [8, p. 8-23]; Samuel H. Logan (1986) [6, p. 16]; Chebanov M.S., Galich E.V., Chmyr Y.N. (2004) [1, p. 227]. The research confirmed that the methods of sturgeon breeding at the Research Institute of Aquaculture in Uzbekistan meet global standards. The prospects for further work are associated with a deeper study of the adaptive capabilities of sturgeons and the development of new methods for their cultivation in artificial water bodies. The following table 3 demonstrates the similarity of growth rates and adaptation of sturgeons worldwide, emphasizing the universality of the technologies employed.

Table 3 Comparative Characteristics of Morphometric Indicators from Different Researchers

Author / Study	Average Body Mass (kg)	Total Body Length (sm)	Head Length (sm)	Body Height (sm)	Body Width (sm)	Body Circumference (sm)
Shebanin V.M., Podushka S.B.	11,8	126,4	20,8	16,5	15,8	57,6
Samuel H. Logan	12,5	130,1	21,3	17,2	16,1	58,5
Chebanov M.S. et al.	12,3	128,7	21,1	16,9	16,0	58,2
Kurbanov A.R.	12,7	129,5	21,5	17,1	16,2	59,1

Data analysis of Table 3 demonstrates a comparative analysis of the average morphometric indicators of the Siberian sturgeon broodstock presented by various researchers. Below, we will analyze each characteristic separately and draw conclusions about the differences and common features.

1. Average Body Weight (kg): The average body weight in our experiment is higher than that reported by foreign researchers, indicating better growing conditions and nutrition. The average values from the other authors vary within narrow limits, showcasing similarities in husbandry conditions and comparable results.
2. Total Body Length (sm): The shortest fish were recorded by Shebanin V.M., Podushka S.B. [8], while the remaining measurements are close to each other, which may indicate similar growth rates among the individuals.

3. Head Length (sm): The shortest head length was observed in sturgeons studied by Shebanin V.M., Podushka S.B. [8], while the longest was obtained in this dissertation research. The other measurements differ insignificantly.
4. Body Height (sm): Body height shows no significant differences among all authors, except for Shebanin V.M., Podushka S.B. [8], whose fish were the shortest.
5. Body Width (sm): The widest fish were obtained in this dissertation research. The other measurements differ insignificantly, with the narrowest being from Shebanin V.M., Podushka S.B. [8] The other authors show intermediate results.
6. Body Girth (sm): The smallest body girth was recorded for Shebanin V.M., Podushka S.B. [8], while the largest was obtained in this dissertation research. The measurements from the other authors are close to each other.

CONCLUSIONS

Conclusions from the comparison with literature data:

- The main indicators coincide with the results of other authors, with minimal differences that correspond to the biological diversity of populations.
- The greatest similarity is observed in body mass and length.
- Some measurements (head length, body height) slightly exceed standard values, possibly due to individual characteristics of the specimens.
- The average body circumference is higher than normal, which is characteristic of mature individuals.
- The results obtained indicate a significant statistically confirmed positive linear relationship between the length and body mass of female sturgeon. These findings are useful for ecological monitoring, assessing the status of populations, and managing the resources of sturgeon species.
- Thus, the conducted analysis confirms that the formation and maintenance of a healthy and sustainable breeding stock at the research base of the Research Institute of Fishery has been successfully accomplished.

The obtained results are similar to published works, demonstrating good consistency and effectiveness of the applied methodology. The breeding stock of Siberian sturgeon in Uzbekistan exhibits high adaptive capabilities and meets international quality standards. Prospects include optimizing feeding and creating specialized diets to increase the productivity of the industry. This experience will allow for the establishment of a sustainable system for the commercial breeding of sturgeon in the country, reducing dependence on imported products and enhancing the competitiveness of national agriculture.

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