

**PHYSICO-CHEMICAL LIMITATIVE FACTORS FOR  
GROWTH AND DEVELOPMENT IN STERLET (*ACIPENSER  
RUTHENUS* LINNAEUS, 1758) IN EXTENSIVELY SYSTEM**

**FACTORII FIZICO-CHIMICI LIMITATIVI PENTRU  
CREȘTEREA ȘI DEZVOLTAREA LA CEGĂ (*ACIPENSER  
RUTHENUS*, LINNAEUS, 1758) ÎN SISTEM EXTENSIV**

R. C. DIMA<sup>2</sup>, N. PATRICHE<sup>1</sup>, MARILENA TALPEȘ<sup>1</sup>,  
MAGDALENA TENCIU<sup>1</sup>, DESIMIRA MARIA DICU<sup>1</sup>

<sup>2</sup>*National Agency for Fishery and Aquaculture, npatriche@xnet.ro*

<sup>1</sup>*Institute of Research and Development for Aquatic Ecology, Fishing and Aquaculture  
Galați, România, icdeapa@icdeapa.ro*

*The oldest and most common method of increasing fish is a fish breeding ponds in which the supervision of nutrition and growth of biological material. Sterlet (*Acipenser ruthenus ruthenus* Linnaeus 1785) is the 4th of sturgeon scale and economic importance as a share of production of these fish. Monitoring of physico-chemical parameters of sturgeons ponds has a crucial role to obtain satisfactory yields both in qualitative and quantitative. Chemical characteristics of water were determined in laboratory ecosystems Chemistry of the Institute of Research and Development for Ecology Aquaculture, Fisheries and Aquaculture Galați for the samples have been taken of the total water. Determination of the chemical characteristics was performed by standardized methods. Physic-chemical parameters of water were determined according to norm on the classification of surface water quality in order to establish the ecological status of water (Order no. 161/2006), for Class II of quality*

**Keywords:** aquaculture, pond, sturgeons, sterlet.

### **Introduction**

This paper aims to identify and characterize the physico-chemical parameters of a pond limiting growth exemplars of sterlet as extensively.

Biological process of water is strictly dependent on the chemical, when they are well balanced and provide micro and macro-flora development, micro and macro-fauna and development stocks.

## Materials and Methods

In order to study the physico-chemical factors of water on growth and development of species *Acipenser ruthenus* (Linnaeus, 1758), the experiment was conducted in the pond of farm in the Research and Development Brateş belong the Institute of Research and Development for Aquatic Ecology, Fisheries and Aquaculture Galaţi. Ponds characteristics used in the experiment are: the area of 0.5 ha, the minimum depth of 1.5 m, power plants and water independent, full vacuum, devoid of vegetation.

Depending on the habitual and biological requirements of the ichthyologic material as well as the indicators of natural productivity of experimental ponds, population was made with a 5000 fist summer old exemplars, with an average individual mass of 24.5 g / ex.

The preparation program of experimental ponds for rearing the sterlet lot in the fist summer, make the classic stages, specific to an extensive system rearing, but adapted to his pedological characteristics. This program was staggered on stage and involved the review and adaptation measures with hydro-technical facilities and pedo-ameliorative measures with the two types of works: homogenization and fertilization.

Monitoring of physical-chemical parameters of water in the experimental ponds was conducted during the vegetative period of 136 days. In determining the main parameters that intervene in determining the quality of the chemical were observed working protocols indicated in standardized methods for analysis of surface waters in force, and methods of literature in the field, while using the kits and the ready-prepared reagents, using which, where possible, to reduce working time, obtaining reliable and accurate results.

Interpretation of results obtained was conducted in accordance with the Norm on the classification of surface water quality in order to establish the ecological status of water bodies (Ord. No. MEWM. 161/2006), correlated with data from literature for use with fishing waters.

Determination of physical-chemical parameters of elementary (oxygen, pH, temperature) for the experimental ponds has been made daily with multi-parameters portable HACH HQ 40D.

Chemical tests were performed monthly in the chemistry laboratory of the Institute of Research and Development for Aquatic Ecology, Fisheries and Aquaculture Galaţi.

## Results and Discussion

Water is the living environment for aquatic organisms, the place of all the physiological processes of development and growth. For any species of fish aquaculture subject is very important to know the biology and biological requirements of species growing to be achieve, as far as possible growth conditions as close to the optimum required.

Water quality in ponds for culture is essential, and changes in physical-chemical parameters have a major influence on normal development a cultured fish. Measurements and observations made on the ground had the water transparency, water temperature, pH, dissolved oxygen, organic substance, calcium, magnesium, carbonates, bicarbonates, nitrates, phosphates, nitrites, ammonia, ammonium; all this information is contained in Table no. 1.

Table 1

Characterization of physical-chemical parameters followed during in the experiment

Physical-chemical parameters / monthly average	M.U.	Experimental pond					max. val. adm. Ord. no. 161/2006 grade II quality	Maximum allowed by the literature
		May	June	July	August	September		
The parameters determined of the field (daily)								
Transparency	cm	35	46	54	35	31	-	20
Temperature	°C	18,6	22,7	26,5	23	19,1	-	-
pH	upH	7,78	7,15	7,9	8,4	8,1	6,5-8,5	
Dissolved oxygen	mg/l	8,04	8,34	8,21	7,98	9,58	7	4-14
The parameters determined in the laboratory (monthly)								
Organic substance	mg KMnO <sub>4</sub> /l	37,9	27,8	38,21	47,15	48,54	-	60
Calcium Ca <sup>2+</sup>	mg/l	38	36,5	40,1	45,2	40,9	100	160
Magnesium Mg <sup>2+</sup>	mg/l	25,4	24,5	25,2	27,4	25	50	50
Carbonates CO <sub>3</sub> <sup>-</sup>	mg/l	5,82	6,26	5,49	6,45	5,74	-	20
Bicarbonates HCO <sub>3</sub> <sup>-</sup>	mg/l	183,43	190,15	187,87	178,75	185,6	-	600
Nitrites NO <sub>2</sub> <sup>-</sup>	mg/l	0,006	0,006	0,006	0,006	0,012	-	0,2
Phosphates PO <sub>4</sub> <sup>3-</sup>	mg/l	0,25	0,13	0,11	0,23	0,26	-	3
Nitrates NO <sub>3</sub>	mg/l	2,04	1,4	1,35	1,42	1,2		
Ammonia NH <sub>3</sub>	mg/l	0,001	0,001	0,002	0,003	0,002	-	0,2
Ammonium NH <sub>4</sub> <sup>+</sup>	mg/l	0,1	0,08	0,11	0,09	0,10	0,8	-
Alkalinity	mg/l	3,01	2,25	2,09	3,54	2,53	-	6
Suspension	mg/l	30	48	54	62	41	-	80

**Temperature.** Since the experiment was conducted in ponds, being subjected to direct action of environmental factors, water temperature recorded

daily variations, depending on variations in atmospheric thermal. Temperature is one of the main factors that makes physical and direct correlation with other physical, chemical and mechanical, the normal processes of development and growth a cultured fish.

Optimum temperature for a body which is the metabolic processes and hence the whole activity, growth and development occur with the smallest loss of energy. If the experiment, to minimize diurnal fluctuations in temperature, has achieved a level of adequate water of 1.5 m and has intervened by increasing or decreasing it depending on atmospheric temperatures.

**pH.** The water pH value is a measure water concentration of hydrogen ions. For the fisheries water, according Ord. 161/2006, the pH must be between the of 6,5-8,5 upH values. The variation in water pH is dependent on the quantities of free CO<sub>2</sub> and carbonate and bicarbonate ions. Table 1 showed that in the experimental basin pH has small fluctuations; the recorded values fall within the optimum over the entire experimental period. These values have provided optimal conditions for the development of sterlet exemplars. pH is an important factor, which characterize the chemical properties of ponds' water and the variation of this parameter is mainly related to changes in the ratio of the amount of free CO<sub>2</sub> and bicarbonate and carbonate ions. In part, the fluctuations of pH are also determined by concentration of dissolved oxygen in water and by the main biogenic elements (N and P).

**Organic substance** is the main source of biogenic elements which are obtained through the process of mineralization. The maximum quantity of organic substances allowed for water ranked in the II category, with fisheries use, is 60 mg KMnO<sub>4</sub> / l. In experimental pond, organic substance has recorded relatively small variations (Table 1), maintaining almost the entire period below the maximum allowed. In August and September organic substance were recorded higher values which not exceeding the permissible limit for fisheries water due to the intake of permanent water, which was done in order to complement the losses due transpiration(evaporation) and infiltrations.

**Calcium and magnesium.** Calcium and magnesium ions are essential in the development and growth process of fish. For an efficient uptake of these ions into the fish body, the ratio of Ca<sup>2+</sup>/Mg<sup>2+</sup>, must be 5:1. Although, there were given the necessary quantities of limestone amendments (fertilisers) to supplement the water deficit, the Ca<sup>2+</sup>/Mg<sup>2+</sup> ratio was permanently below 2:1 in the experimental pond. This is explained by the continued uptake of calcium ions by the fish body and by keeping this deficit in water (Table 1).

**Carbonates and bicarbonates.** Determination of these parameters is important for water quality because they have a major influence in maintaining a constant concentration of hydrogen ions. Normally, the carbonate ions must be determined in the waters with fisheries use. The presence of bicarbonate ions in water determines the pH variation or to maintain the alkaline values of pH, as

required by sturgeon breeding technology. Determined quantities (Table. 1) in the experimental pond were placed in the optimum range for fisheries' water.

**Biogenic substances (nitrate and phosphates).** For water fish, the most important biogenic substances are nitrate and phosphates, with direct involvement in determining the productivity of a natural basin. The amount of these is determined by the quantity of organic substances in the river and the nitrate and phosphorus ratio is essential in the development of natural food, growth and development of fish.

**Phosphorus**, along with calcium oxide (CaO) and carbon dioxide (CO<sub>2</sub>), has an important role as limiting factor for productivity of fish in ponds water. In general, phosphorus is found in small quantities in the ponds water, being stored or absorbed by vegetation. Resulted in quantities up to 1 mg / l, that is considered optimal quantities. Resulted in higher volumes of 2 mg / l, it is considered that the water is harmful and can not be used for aquaculture.

In the Table 1, it can be seen that the first experimental period **nitrogen** were poor and therefore have received mineral fertilizers with nitrogen. Distribution of fertilizers was done directly in water in the form of solution, on entire surface of the ponds in three repeated doses.

During vegetative period nitrates were consumed and converted into natural food, which constituted the trophic basis of crop species, respectively there can be found out in the growing gain.

To maintain a balance between nitrate and phosphates, the report recommended is 4:1 for productive fisheries water, it was necessary the distribution of mineral fertilizers based on phosphorus.

In the last experimental period, when water temperature dropped significantly and micro flora existing in water ponds was reduced quantitatively and qualitatively, the amount of nitrate consumed decreased which is evident by increasing concentration in water analysis.

**Nitrite** ions are dependent on the amount of oxygen from water. When the concentration of dissolved oxygen in water is normal, nitrites are in quantities which do not have any threat to fish material. When dissolved oxygen starts to decline and take place a process of conversion of nitrate into nitrite and their concentration may increase. Increase of nitrite over a certain level can lead to poisoning of the biological material and even mortality.

In the experimental pond, the value of nitrites were constant at 0.0066 mg NO<sub>2</sub>-/ l, in the months May to August and in September had a higher value (0.012 mg NO<sub>2</sub>-/ l). These values did not exceed the maximum allowed, and their effects were not felt on fishes, because there have taken the necessary technological measures immediately (partial replacement of tank' water and oxygenation).

**Ammonia (NH<sub>3</sub>) and ammonium (NH<sub>4</sub><sup>+</sup>).** Besides nitrate, ammonia and ammonium are the main source of nitrogen that entering in the process of development of natural food in ponds water.

Into the bacterial circuit, nitrogen of amino-acids is mineralized until to ammonia. The amount of ammonia in water is dependent on pH and the amount of dissolved oxygen. As long as the pH of water and oxygen values was normal, ammonia is not a threat to the biological material from pond. If water pH values increase to over 9, while the decrease of oxygen, then ammonia can reach concentrations that are dangerous and can occur with ammonia poisoning or even mortality.

In the experiment, ammonia was not a stress factor for fish because both pH and oxygen were determined at nearly optimal, throughout the period analyzed.

**Alkalinity** 10 - 50 mg/l. It is found optimum suspension in the experimental basin is determined volumetric analysis, the method consists in neutralizing a volume of water analyzed with a dilute mineral acid (usually HCl) in the presence of indicator methyl-orange. It is expressed in ml HCl/l. Alkalinity maximum allowed for surface water with fish use is 6 ml HCl / l. The alkalinity (Table 1) are determined in general lower than permissible limit.

**Suspensions**, expressed in mg / l were determined gravimetric - the method lies in the setting up material suspended from water by filtration. The tests show oscillations of the suspension in Section I, between according to Table 1.

### Conclusions

According to Ord. 161/2006, the water quality in the experimental basin monitored falling in class II of the quality, appropriate a good ecological status.

As I could notice the experiment conducted, the physical - chemical factors of water are closely interrelated.

By monitoring the physical-chemical parameters of water were allowed to intervene in time, which resulted in a good survival of starlet exemplars, in the vegetative period.

Thus, knowing the composition of the water and needs of crop species, it is acting efficiently, in the desired direction, creating optimal conditions of living biological material, thereby obtaining the desired products.

### References

1. Patriche N, 2001, Sevruga, biology and artificial reproduction, Publishing House Ceres, Bucharest
2. Patriche Neculai, Pecheanu Constantin, Vasile Mihai, Talpes Marlana, 2002, Rearing Techniques of Sturgeons Rearing the Stellate Sturgeon *Acipenser*

*stellatus* in-Mono-and Polyculture with Chinese and Common Carps in Ponds  
*International Review of Hydrobiology* ,**87**, 561-568

3. Popa Paula, Neculai Patriche, Raluca Mocanu, Costel Sârb, 2001 Quality environment aquatic, Publishing Ceres, Bucharest

4. Popa Paula, Neculai Patriche, 2001, Chemistry of aquatic environment, Publishing Ceres, Bucharest

5. Patriche, N., Talpes, M., Tenciu, M., Paltenea, E., Iorga, V., Cristea, V., Costache, M., Popescu, C., 2006, Technology for recovery of complex aquatic bio-resources through inter-specific poly- culture species of sturgeon endemic and acclimate- Manual presentation, Publishing Presa Națională ISBN 973-99702-6-5, 136

6. Stăncioiu, S., Patriche, N., 2006, General ichthyology, Publishing Pedagogical and Didactic RA, Bucharest

7. Talpeș, Marilena, Patriche, Neculai, 2005, Technology framework to increase the sturgeon in the system extensively in poly-culture with Asian species cyprinids, Publishing Pedagogical and Didactic RA, Bucharest, 2005, ISBN 973-30-1472-9

8. Talpeș, Marilena, Patriche, Neculai, 2005, Technology framework to increase sturgeon in monocultures, Publishing Pedagogical and Didactic RA, Bucharest, 2005, ISBN 973-30-1484-2