

**KAPITEL 5 / CHAPTER 5<sup>5</sup>****ADAPTIVE SOLUTIONS IN AQUACULTURE UNDER THE INFLUENCE  
OF TRANSFORMATION OF ABIOTIC AND BIOTIC FACTORS****DOI: 10.30890/2709-2313.2023-16-03-006****Introduction**

Modern content increasingly refers to the transformation of climate parameters as a "climate crisis", justifying it with sufficiently weighty arguments at the global level. The issue of improving the adaptive capacity and resistance of organisms with different functional activity is relevant. In the context of sustainability, the balancing of individual elements of an open ecosystem, scientific complex research with the aim of substantiating certain cases of solving a number of topical issues remains the leading one. Important are the level of correspondence of physiological and biochemical processes in the organism of hydrobionts and adaptation possibilities under certain conditions of exposure, taking into account technological capabilities and biological and economic features of hydrobionts.

Complex adaptive mechanisms of hydrobionts identify the level of plasticity of an individual species, separating homeostasis constants into hard and soft ones. Under certain conditions of existence, in any case, to achieve efficiency, it is important to harmonize the successive links of all processes that ensure the stability of the ecosystem. During adaptation, vital processes are restarted at various levels of the organization. Monitoring measures are one of the necessary aspects in the control of qualitative and quantitative parameters of growing objects in aquaculture. Today, in the European space, the approbation of intelligent aqua farms with the appropriate set of software, management of the intelligent system is already being carried out.

Qualitative indicators of the water environment are among the determining factors in assessing the efficiency of the industry. For example, hydrochemistry control is carried out by a touch panel equipped with sensors of the same spectrum of activity. The organism of hydrobionts is a living, functionally active system that constantly interacts with each of the indicators. Control of rigid constants of homeostatic equilibrium determines the state of transformation of the general functional status of the fish organism. Among such parameters are the buffer capacity of blood, osmotic

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and oncotic pressure of blood and tissue fluid, hematopoiesis, and others. While the soft or plastic constants of homeostatic equilibrium can vary significantly, and the range of their fluctuations will not be significantly reflected on the physiological state of the body, only the correction of the entire system will take place under this parameter. These parameters include blood pressure, heart rate, and others. Therefore, the programming of such an intelligent aquafarm involves the distribution of remote control and direct contact with hydrobionts during sampling of biological material. All outlined processes are important and require comprehensive research.

Considering the complex model of modern cases of aquaculture, it is possible to determine fundamental generally accepted and well-known concepts, hypotheses, methods, from another perspective, there are also those that require in-depth complex scientific and practical research, additional analyzes with validation of results. From the beginning of the adaptation of hydrobionts to specific growing conditions and throughout all stages (phases), their organism demonstrates physiological and genetic plasticity not only to factors of various nature that affect the adaptive and compensatory mechanisms of the fish organism during acclimatization, but also to physiological and biochemical processes, biological complex complexes that together form a system of neuro-humoral regulation of support for the vital activity of hydrobionts.

Only under the conditions of taking into account the whole complex of factors influencing the organism of hydrobionts, it is possible to ensure the rational use of the actual and natural fodder resource, transforming it into a fodder base, relying on specific niches of formed trophic relations in the reservoir with subsequent stages of acclimatization. If we consider the pool cultivation of hydrobionts of the recirculation system, an important issue that requires in-depth research is the aspect of adaptive capabilities of the physiological state of the organism of hydrobionts and its compliance with technological parameters in the context of modernity and innovation.

### **Discussion of topical issues**

Scientific and practical publications on this topic reflect the relevance of the issue under consideration and the urgent need to solve the problems faced by scientists and practitioners of the fishery industry. Publications are available today that contain information on the global impact of climate transformations on the general and fragmented nature of the flora and fauna of most hydroecosystems [5, 7, 8].

Emphasis is placed on the inevitable pressure of the increasing intensity of solar radiation, the increase in the sum of temperatures, which, in turn, directly or indirectly affects the shortening of the wintering period and the ethological features of



hydrobionts at various levels of ecological and biological organization. The authors of numerous studies note that against the background of the outlined changes, there is a dynamic redistribution in the ecosystem of the number and biomass of forage hydrobionts, which is reflected both on the forage resource and on the forage base of water areas of different origin and purpose. Each niche of the living world has transformations, adaptations to the conditions of abiotic and biotic communities [9].

The scientific works of the authors are focused on complex justifications regarding the course and influence of the outlined factors on the transformational processes in the ecosystem, water areas under the angle of rational fishery exploitation, the ecological state at the global level of structured processes. Guided by objective realities, the authors note the urgent need for the development of innovative methods in aquaculture in order to optimize the technological process in qualitatively new conditions (since the changes affected the physico-chemical and hydrobiological components, aspects of fish farming, industrial fishing, production of aquaculture products, eco-direction, stocking programs, bioremediation measures, etc.) [5, 6, 8, 11].

Hydroecosystems of water areas are saturated with living organisms of plant and animal origin with different numbers and corresponding biomass, forming individual trophic chains. Studies of the current state of the fodder base of water areas are reflected in numerous scientific works. The scientific works contain information about the discussion of acclimatization works, scientific events, and the formation of ichthyofauna [1, 2, 8, 15].

In today's conditions, there is a considerable number of programs, measures with the vector of transformation of climatic parameters and adaptation to objectively new realities. For example, Mayors Adapt (an initiative of the Agreement of Mayors on Adaptation to Climate Change) was created by the European Commission with the aim of involving cities in certain actions aimed at adapting to climate change and mitigating the consequences of climate change. In parallel with the reduction of greenhouse gas emissions in order to mitigate the consequences of climate change, cities also need to strengthen their own resilience to the inevitable negative impact of climate change. Undoubtedly, natural extreme phenomena have destructive power, in particular, strong floods, heat waves, storms.

In a complex of environmental factors not caused by the activity of living organisms, the general state of the ecosystem is formed in accordance with their ecological and biological features. A negative impact has already been noted, and the tendency to increase the average temperature parameter requires correction and



optimization of almost all technological aspects in fish farming. Features of spawning, migration, wintering of hydrobionts, general existence in the aquatic ecosystem - all these indicators are directly correlated with the physiological and biochemical parameters of hydrobionts [4, 10, 11, 12, 13, 14, 15].

In this context, the state of solving such global issues is at the stage of formation, the issue remains open and requires global comprehensive scientific and practical research.

### **Setting objectives**

To carry out complex scientific and research work, to analyze the leading parameters, to study the trend of the development of technological solutions in aquaculture in view of European innovations. To analyze the effectiveness of the implementation of certain technological aspects in production. Expand and supplement modern hypotheses, ideas about the transformation of climatic parameters, correlations of abiotic and biotic indicators. To carry out an analysis, taking into account modern global climate transformations, adaptation mechanisms of hydrobionts in modern realities.

### **The main results**

The results of a general nature demonstrate the significant influence of abiotic and biotic factors on the effective parameters of the industry. Regarding technological aspects, we note that the functional state of the organism of hydrobionts determines the leading indicators of ontogenesis and productivity. Against the background of the optimization of technological aspects at all levels of production, adaptation processes in their bodies are being restructured.

With the introduction of innovative elements, there is simultaneously an improvement or, on the contrary, a decrease in resistance to the influence of factors. A whole chain of transformations due to biotic influence is also recorded in water areas. Undoubtedly, the factors affecting hydrobionts are of a different nature, however, among the numerous, determining ones can be noted, among them: temperature, concentration of hydrogen ions in water, salt composition, oxygen concentration and trophic links (chains) in the water area. However, in any case, adaptation by neuro-humoral regulation may or may not be observed in the body of fish.

At the same time, the central nervous system must send an impulse to a specific center, an organ of hydrobionts, and the glands of internal and external secretion must respond by releasing (secreting) a specific hormone. Such a mechanism is basic for any living hydrobiont organism. The abiotic component of reservoirs involves deep



adaptation of the organism of hydrobionts at the level of vital needs of their organism: metabolic processes, respiratory processes, in particular, gas exchange, digestion, reproduction, etc.

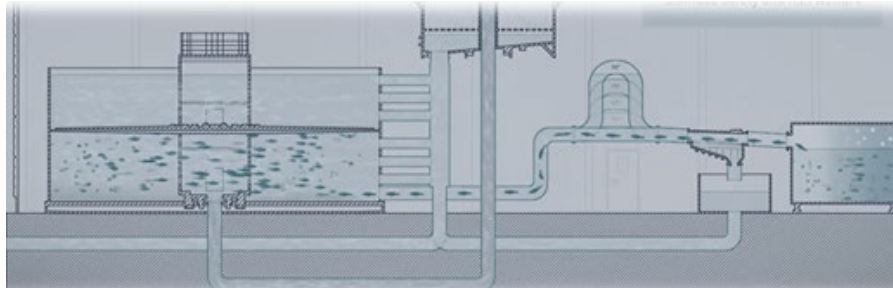
Therefore, hydrobionts are able to adapt in a new environment with new conditions if metabolic processes and neurohumoral regulation are maintained at a level corresponding to viability. Abiotic factors, in turn, are able to adjust the intensity of these processes. As is known, biotic constituent parts are represented by groups of floral and faunal complexes, which are characterized by certain conditions showing the peculiarities of the level of adaptation to changes in qualitative and quantitative criteria that determine the state of the ecosystem. Along with such a feature, the water ecosystem has a certain ability for self-purification, but there are maximum allowable concentrations, limits that are determined by the "biological limits of endurance" of hydrobionts, the potential of their organism with the corresponding tolerance and ecological valence of a specific species.

Such a certain specificity of flora and fauna is of exceptional importance for the formation of the composition of hydrobiocenoses of transformed water areas. Along with the above, returning to the hydrological regime, in close connection with the ichthyofauna, namely the reactions of individual fish species to certain environmental factors, it is necessary to take into account the ecological distribution of fish in relation to spawning migrations, spawning ethology, etc.

Considering the organism of hydrobionts that exists in a certain water environment, and the factors that correct, shape the general functional state of their organism, the formation of populations, it is possible to note the forage factor, the relationship of competitors in the trophic chain. At the same time, the influence of biotic factors on the organism of hydrobionts can collectively play a decisive role in the formation of adaptation mechanisms, especially in the early stages of ontogenesis.

Against the background of the general analysis of ecological, biological, physiological aspects in the body of hydrobionts, it is worth paying attention to technological cases of optimizing the cycle of cultivation, growing, transportation, etc. The following figure presents a model solution with the implementation of "bien-être", "animal welfare". Under the conditions of the performance of a certain operation, a technological measure, optimal conditions for hydrobionts are formed (Fig.1).

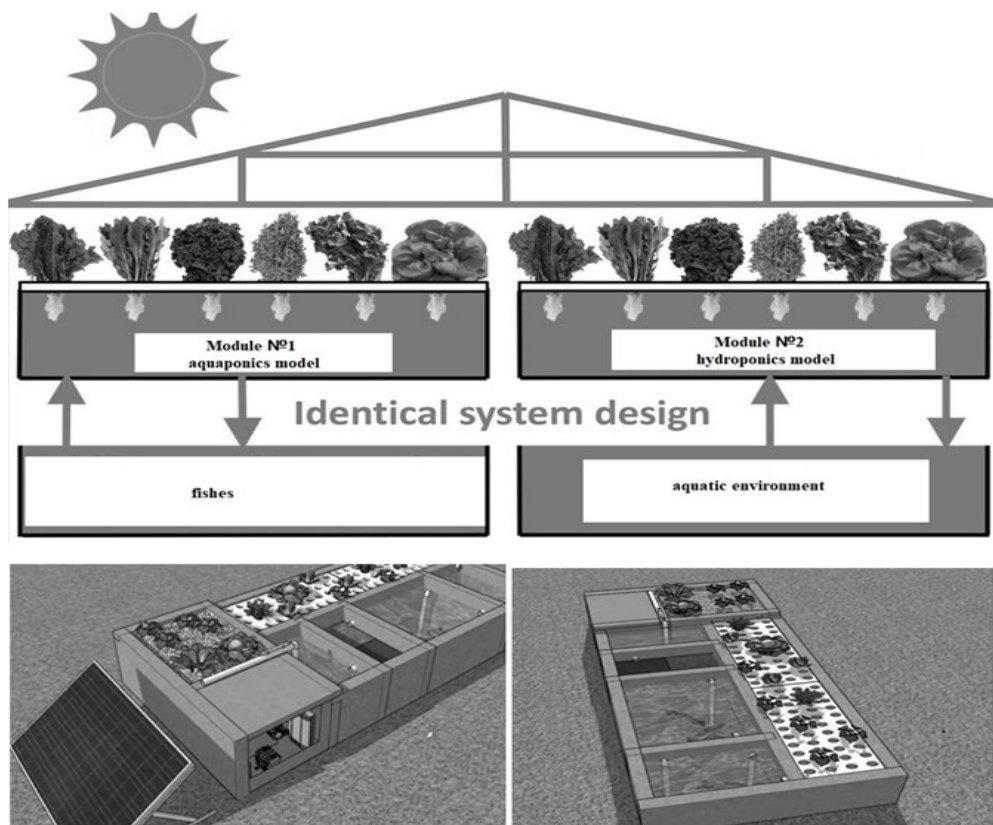




**Figure 1 - A model solution for using an advanced device**

The arrival of hydrobionts occurs in one direction during the implementation of production measures, accordingly, the risk of injury, stressful situations (as a result of the synthesis of hormones, their excessive concentration) is reduced, all this affects the qualitative and quantitative parameters of the muscle part of fish.

The results of the study of the European integration of aspects of energy saving into technological maps of aquaculture demonstrated the positive introduction of alternative energy sources to the general production cycle (Fig. 2).



**Figure 2 - Model solution of integrated elements of alternative energy sources, agriculture, cultivation of hydrobionts**

Combined systems are quite relevant in the conditions of modern transformations of technological solutions. Scientific and experimental studies demonstrate the absence



of a negative impact of agricultural crops and aromatic plants on hydrochemical parameters. Biological filtration objects perform the functions of "moderators" of complex biochemical processes. As a result, a certain pattern of symbiotic relationships occurs. The production receives high-quality products of a diverse nature with the possibility of saving at the expense of alternative energy sources.

In today's conditions, under anthropogenic influence, changing climatic conditions, the transformation of water ecosystems is certainly taking place. It is appropriate to emphasize that all vital connections with the environment are formed in cultivated individuals to a certain extent. Under the conditions of combining theoretical and practical foundations, physiological aspects, it is possible to more deeply understand and investigate the individual characteristics of the organism of hydrobionts during the period of adaptation to certain new environmental conditions.

## **Conclusions**

In today's conditions, when there are rapid changes on a global scale: anthropogenic influence is increasing, biocenoses are being reshaped, climatic conditions, species structures are being transformed, the research of the physiological and biochemical capabilities and potential of objects of introduction in the specific conditions of their existence is relevant. The study of physiological and biochemical processes of adaptation against the background of acclimatization is of great importance for understanding the processes of self-regulation of the organism of hydrobionts, its interaction with the environment under the influence of biotic and abiotic factors.