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Management System of Fish Populations Artificial Reproduction Based on Neuroendocrinological Research

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Short Communication

Nonapeptidergic neurosecretory cells (NP-NSC) in hypothalamo-hypophysial neurosecretory system (HHNS) are of the most degree plasticity among all NSC of different ergicity, which is provided by their capability for functional reversion [1]. It is shown that they are organized by the principle of the triad of the balanced system, which consists of two alternative states: accumulation and release of neurosecretory products and the self-regulating center controlling the dynamics of their interrelations. It is supposed that the functional possibilities of the key chains of biological integrational systems are realized at different levels of organization by this common structural–functional principle as the basis of the high degree of plasticity [1]. The degree of NP-NSC plasticity turns out to be sufficient for participation in the integration of fish reproduction.

By means of ecological-histophysiological and experimental full-system studies using morphometric methods of light-, electron microscopy and immunocytochemistry the participation of HHNS in fish reproduction was firstly established. At the beginning of spawning migrations of sturgeon and salmon there is activation of synthesis of neurohormonal products (nonapeptide neurohormones, particularly) in neurosecretory cells of the preoptic nucleus and transport them to neurohypophysis, where, however, their mass accumulation occurs. This violation of the long-adapted type of osmoralulation (at sea-areas during foraging) is the main physiological stimulus to habitat change (from sea to river). At the same time, there is the extrusion of nonapeptide neurohormones from dendrites of neurosecretory cells and its neurosecretory axonal terminals into cerebrospinal fluid (liquor) of the III brain's ventricle, which causes their neurotropic effect in the behavioral centers of the central nervous system in the form of a dominant physiological state – "migration impulse" [2].

At the beginning of spawning, a strong activation of HHNS is established, followed by a decrease in its functional activity by the end of spawning, which reflects its participation in the body's protective and adaptive responses to natural physiological stress. Thus, the main functional role of the HHNS in fish breeding is to initiate energy-intensive processes of migratory and spawning behavior and to finish spawning by suppressing the hyperactivity of the target glands, which ensures the body's transition to energy-saving plastic metabolism. The analysis of this key role of the HHNS in the integration of fish reproduction, by self-regulation principle, has led to the development of a constructive working scheme on the basis of which effective managing principles have been formulated and new methods of management of breeding, producer survival and youngs growth rates have been developed in order to improve the effectiveness of fish-farm populations reproduction [3]. These methods, combining the effects of complex environmental and hormonal natural factors, are presented in the form of 9 inventions and application for invention. They form a system for managing the fish reproduction biotechnology, which is proposed for use in fish farming and natural conservation fields.

Specifically, in order to increase the degree (%) of fish producers usage in sturgeon farming by stimulating their puberty, a preparate of the isolated anterior pituitary lobe has been developed and introduced into industry [4]. For this purpose, a preparate of the isolated posterior pituitary lobe to stimulate the maturation of male fish in doses, providing waste-free technology of both preparates has been also developed [5]. The increase the degree of fish-breeding use of producers by an average of 15% and save up to 40% of the source biological pituitary material have been shown by industrial tests of the effectiveness of these drugs at sturgeon farms at the Lower Volga and Don rivers [6].

In order to delay sexual maturation of producers a method of their long-term industrial reserving in the critical salinity environment of 4-8‰, optimal also for maintenance fish brood stocks have been developed [7]. In this habitat the highest survival rate and delayed producers puberty was firstly established and not only in seawater, but also in solutions of industrial table salt of the same concentration.

On this basis, a biotechnology of breeding management was originally developed for farm reproduction of commercial fish populations with different spawning seasons [8]. The ecological and physiological principle of this management is to perform reserving producers in universal for different fish species "critical" salinity medium at the species-specific pre-spawning thresholds of "signal" factors (temperature and photoperiod) and in subsequent stimulation of their maturation and growing youngs by smooth transferring them into a complex of optimal adequate environmental conditions.

The new full-system method of artificial reproduction of valuable fish species populations is developed on the basis of additional use of species-specifical phylogenetic adaptations systems of sea foraging, which provide the greatest productivity of populations by the maximum manifestation and usage of adaptive species potentials of breeding, survival, and growth [9]. This method allows to overcome the main shortcomings of the biotechnics of artificial reproduction of salmonid fish: low survival in nature (up to 0.4%) of one-year-old factory youth (the final weight of up to 26g) and factory removal of producers from spawning grounds at the expense of natural reproduction. The method is carried out by mass harvesting of producers at fishing areas in sea, cages content of brood stocks in brackish sea water (4-8‰) and getting offspring here. Then, after the river farm incubation of fish eggs and the cultivation of larvae and youngs to signs of readiness for migration, grow youngs in marine gardens weighing more than 40g, which will ensure their necessary survival in nature, at least 2%. Years of production tests of the method for the first time were established 3 most important fish-breeding and biological effects of growing commercial fish in the environment of critical salinity: 1) the highest survival, 2) long-term preservation of high reproductive quality of producers 3) accelerating the development and growth of youngs.

However, the exclusion of river fishing from spawning grounds affects the interests of fish farms and therefore it is proposed firstly to use new our invention in the field of recreational aquaculture to implement the compensation mechanism of feedback in this improved natural-protection system [10]. To further develop new methods in aquaculture, especially year-round fish farming in continental closed water supply systems, the development of a universal method of growing fish in an artificially modified biostimulation medium has begun [11]. Its essence is to reserving producers, obtain offspring and then grow youngs in a table salt solution by concentration approximated to isotonic medium, which accelerating the youngs growth rate [12].

Large-scale closed water supply systems for fish farms based on off-season underground conditioning of the fish breeding habitat have been developed in order to industrialize all the proposed biotechnology, develop year-round aquaculture and protect products from pollutions [13,14]. These systems operate on a new biotechnology principle of reproduction management and on the natural-industrial principles of engineering ecology.

In the field of biodiversity conservation of our Europe Northwest region's natural resources, the important problem is to save local population of the Ladoga lake sturgeon as a unique form of Atlantic species. This requires the creation of a sturgeon farm in the Ladoga Lake basin, optimal for the preservation of its natural stock. The presented system of biotechnology management of fish populations reproduction is also proposed for the creation of a sturgeon base specialized for the Northwest region [3].

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