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SPATIAL BIOMARKER TO ASSESS THE CONDITIONS OF THE REPRODUCTION OF NATIVE FISH IN SURFACE WATERS OF UKRAINE

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Problems of the propagation of native fish in Ukraine's surface waters started appearing simultaneously with the inclusion of rivers and lakes in water management complexes (regulation, irrigation, sewage disposal, hydraulic engineering, hydropower), as well as with changes in the structure of the surface of land catchment area of dry valley hydrobiocenoses (plowing of river and lake basins, forest cutting, non-compliance with the status of coastal water protection zones and protective belts, drainage reclamation). Many researchers have pointed out problems of the reproduction of native fishes [1, 3, 4]. However, no changes occurred in management policy. As a result, in Ukraine, which has significant water resources, the issue of effective natural reproduction of native fishes has become urgent; fish productivity of the river-lake network has decreased several-fold, the need for the restoration and rehabilitation of transformed water bodies has arisen [1, 2, 3, 4, 5].

Objects and methods of the study. The objects of the study were right tributaries of Prypiat (Styr, Horyn, Sluch, Ikva, Stokhid, Vyzhivka rivers, small Khrinnytske and Mlynivske reservoirs, large reservoirs of the Dnipro river system of dams, lake system in the Shatskyi National Nature Reserve, estuarine system of the Dnipro, Dniester and Danube rivers).

Study results and discussion. Disruption of the natural propagation of fish in aquatic ecosystems was determined based on the state of the catchment surface state, aquatic environment quality, biological diversity and fish productivity of water bodies, which are related by a functional relationship:

$$I_{diversity} = f\left(\Delta K_{эк}, \frac{\sum I_n}{n}, \Delta n, N, St, \tau\right) \quad (1)$$

were: $\Delta K_{ек}$ – transformation of the catchment surface; $\sum In/n$ – average characteristics of the accounted indices of the hydrobiocenoses and aquatic environment state $\sum In/n = \frac{Ia + Ib + Ic + Iэ}{n}$; Δn – change in the abundance or species composition of fish due to the introduction, restoration (disappearance) of sensitive species; N – the number of border (intermediate) ecotones; St – presence of stressful situations; τ – floodplain flooding period.

With this approach, we can study correlations, determine the limiting factors influencing the diversity and productivity of water bodies in order to control the situation. The presence of environment-forming factors makes it possible to compare the level of disturbances in moderately transformed and very congested basins, flowing and non-flowing water bodies with natural (non-transformed) ecosystems or basins.

Indeed, the classification of the state of surface waters and the indexation of the state of aquatic environment can be carried out on the basis of the anthropogenic factor of influence − with respect to the maximum permissible concentration, sensitivity to the oxygen regime, food supply. However, a comparison of the results of field studies only in relation to undisturbed water bodies, without taking into account the ichthyo-ecological state of the water basin, entails the possibility of a methodological error.

The parameters of the river's ecosystem vary depending on the level and period of stay of water on the floodplain, where: river water is settled and cleaned to quality class I; live food (zooplankton) develops in it and the temperature rises to 10−12°C, which are necessary for spawning and embryogenesis of most native fishes; at the same time, the number of border zones — ecotones, which are migration routes for fish under unfavorable environmental conditions — disruption of the oxygen regime, lack of food supply and deterioration of water quality, increases. Such boundary ecotones tend to become tributaries of the rivers I and II class, sources, and topographic lows − phantom lakes-spawning grounds.

Based on the above, we proposed a spatial biomarker to assess the reproduction conditions of the native fish in waters, by finding the physiologically necessary characteristics of the black box − the state of the aquatic environment [fig. 1].

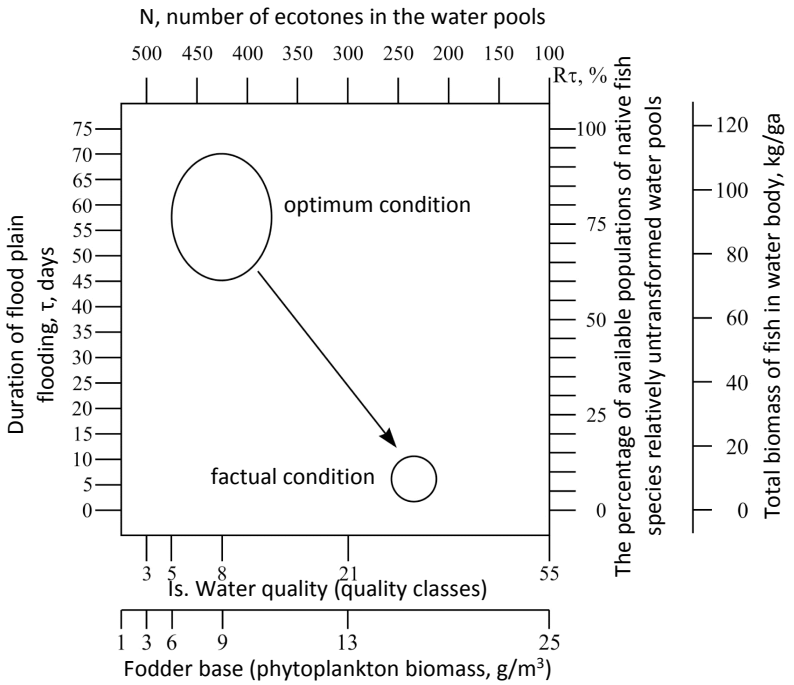

Fig. 1. **Spatial biomarker to asses the reproduction conditions of ichthyofauna in river basins**

The least costly and most realistic trend of fish stocks replenishment in Ukrainian water bodies is the restoration and rehabilitation of the natural process of native fish reproduction in the river-lake network in regions.

Among the priority measures, following should be done:

– identification of spawning and wintering grounds in river basins, their certification and protection;

– restoration and rehabilitation of wintering grounds in river mouths - tributaries (I & II class);

– cutting and removing phytomass of higher aquatic vegetation from natural spawning grounds, which, when decomposed in shallow waters, creates hydrogen sulfide zones − cause of fish egg and juvenile fish death;

– adherence to the protection of the coastal protective strips, the prohibition of fishing during spawning and spawning run periods;

– creation of the Verhniy Dnipro Reserve with the core in the Kyiv reservoir for biodiversity conservation on the basis of the reserve network (National Nature Reserve Shatskyi and Prypiat-Stokhid), biosphere reserves (Poliskyi, Rivnenskyi), including the adjoining territories of Poland and Belarus, whose water resources create a single hydroecological corridor.

The spatial biomarker of the conditions for reproduction of native fishes, the components of which is: the duration of floodplain flooding, the number of ecotones, the quality of the aquatic environment, the feed reserve (zooplankton), the state of populations and the number of fish products, is proposed. Behind such an approach, we can see the correcting links, determine the customer's responsibility to increase the productivity and efficiency of the situation.

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A VALUE CHAIN APPROACH AS A KEY ELEMENT IN PROFITABILITY IMPROVEMENT OF FISHERIES ENTERPRISES

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Profitability improvement is a key factor determining the further development of the fisheries and aquaculture industries. These resources are needed to improve the material and technical base and to establish new technologies [1] that will lead to