SECTION 4. AQUATIC BIORESOURCES AND AQUACULTURE

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INNOVATIVE FRAMEWORK FOR THE RECOVERY OF UKRAINE'S FISHERIES: INTEGRATING CONSERVATION MEASURES AND METEOROLOGICAL FORECASTS

ІННОВАЦІЙНА РАМКА ВІДНОВЛЕННЯ РИБНОГО ГОСПОДАРСТВА УКРАЇНИ: ПОЄДНАННЯ ПРИРОДООХОРОННИХ ЗАХОДІВ І МЕТЕОРОЛОГІЧНИХ ПРОГНОЗІВ

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The integration of protected areas conservation and military meteorology in the recovery of Ukraine’s fisheries represents a novel interdisciplinary approach aimed at ensuring the effectiveness of ecological measures in the

post-war period [1; 2]. The combination of conservation regimes of protected areas with high-precision military meteorological forecasts makes it possible to minimize the risks of unsuccessful stocking, increase the survival of juvenile fish, and enhance the adaptability of aquatic ecosystems to extreme climatic and anthropogenic impacts [3].

The conceptual framework of integration envisages the use of ecological criteria (habitat condition, biodiversity, conservation status of water bodies) together with meteorological indicators (temperature, atmospheric pressure, extreme events) in decision-making regarding the timing, locations, and methods of recovery measures.

Practical mechanisms include the creation of an integrated register of protected-area water bodies linked to meteorological data, the introduction of an early warning system for meteorological risks during fish stocking, the development of adaptive action protocols based on forecasts, as well as financial incentives through grants and targeted state programs [4].

Success depends on interagency coordination among the Ministry of Environmental Protection, the military meteorological service, research centers, and local communities, as well as on the implementation of modern digital tools, in particular GIS platforms combining protected area layers with integrated meteorological forecasts [5].

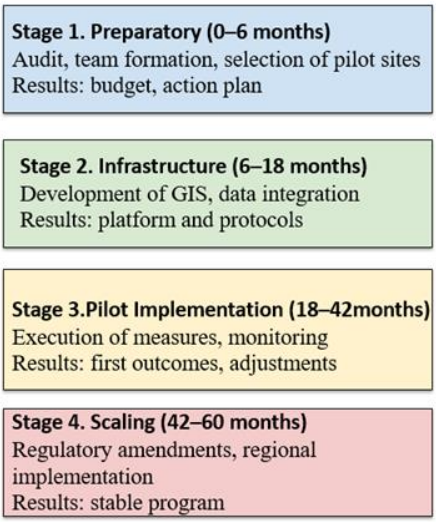
A comparative analysis of international practices shows that Norway, Canada, and Australia have successfully applied integrated ecological–meteorological approaches in fisheries management, combining GIS modeling, satellite monitoring, and sustainable financial models [4; 5]. In Ukraine, the situation is characterized by the fragmentation of the system and limited integration of meteorological data into conservation activities. However, there is potential for introducing such approaches thanks to the existing military meteorological infrastructure and international support [3; 6] (Table 1).

Table 1

International and Ukrainian approaches to integration

Country	Integration of PAs and meteorological data	Technical solutions	Financing
Norway	Partial integration for aquaculture	Advanced GIS and current-flow models	State support and investments
Canada	Comprehensive coastal zone programs	Satellite monitoring, nodal weather stations	Federal programs and grants
Australia	Adaptive meteorological plans in rivers	Local early warning systems	Grants and private co-financing
Ukraine	Fragmentary, no systemic integration	Limited GIS and data	State budget, limited donor involvement

The roadmap for implementation includes four stages: preparatory (data audit, selection of pilot areas), infrastructure development (creation of GIS and protocols), pilot implementation (launch of measures in several representative zones), and scaling with consolidation at the regulatory level (Fig. 1).



The expected results include a 25% increase in the reproduction of target species within three years, a 40% reduction in cases of mass fish mortality, a 60% decrease in unsuccessful stocking due to weather factors, and the integration of new approaches into national programs for the restoration of fish resources.

Fig. 1. Roadmap

The proposed conceptual framework for integrating protected areas conservation and military meteorology into the recovery of Ukraine's fisheries opens a qualitatively new level of interdisciplinary cooperation in the field of environmental management.

Its essence lies in combining ecological priorities – biodiversity conservation, maintenance of protection regimes, and restoration of ecosystem services – with high-precision meteorological forecasts that allow for the rapid adaptation of management decisions. This ensures both spatial and temporal accuracy of restoration measures, which is particularly important in post-conflict Ukraine, where aquatic ecosystems have been subjected to significant anthropogenic and climatic pressures.

International experience demonstrates that the integration of meteorology into environmental and fisheries management is successful when several conditions are combined: the availability of modern technical monitoring solutions, clear regulatory frameworks, and long-term financing models. Ukraine currently possesses only partial prerequisites but, at the same time,

has unique opportunities for transformation thanks to its military meteorological infrastructure, which can be adapted to civilian and environmental tasks. This creates the foundation for building a new fisheries recovery system oriented toward adaptability and resilience.

The expected effect of implementation lies not only in the growth and stability of populations of commercial and protected fish species, but also in strengthening the country's ecosystem security, improving the efficiency of budgetary and donor resource use, and expanding opportunities for local community development through fisheries activities. An important social dimension is the increase of trust in environmental policy, as communities receive transparent data, participate in joint management, and gain access to co-financing mechanisms.

At the same time, the implementation of this approach entails certain risks: restricted access to military data, insufficient staff training, and potential conflicts between protected area regimes and the interests of water resource users. These barriers can be overcome by introducing a multi-level data access system, conducting broad training programs, and implementing mechanisms of compensation and incentives for local communities.

In the long term, the proposed approach may serve as a model for other fields of natural resource management, including forest management, agricultural land use, and climate change adaptation. It outlines a scientifically grounded roadmap that combines international experience with Ukrainian realities and lays the foundation for Ukraine's integration into global biodiversity conservation and sustainable water management programs.

Thus, the integration of environmental conservation and military meteorology is not only an innovative approach to the recovery of fisheries, but also a strategic step toward strengthening Ukraine's ecological and food security and developing a modern system of natural resource management capable of flexibly responding to future challenges.

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REGIONAL SPECIFICITIES OF CHANGES IN FISHERIES DURING THE WAR: A COMPARISON OF SOUTHERN AND WESTERN UKRAINE

РЕГІОНАЛЬНІ ОСОБЛИВОСТІ ЗМІН У РИБНОМУ ГОСПОДАРСТВІ ПІД ЧАС ВІЙНИ: ПОРІВНЯННЯ ПІВДНЯ ТА ЗАХОДУ УКРАЇНИ

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