
Features of Quasi-Natural Ecosystems and Their Role in the Conservation of Biodiversity

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Abstract: This work aims to justify the potential for biodiversity conservation in moderately exploited lands that are characterized by a low degree of technogenic transformation and occupy an intermediate position between natural and artificial ecosystems due to their ecological features. Ecosystems of such kind can be referred to as quasi-natural. In this study focus is made on the most typical objects in this respect - multipurpose ponds and protective forest belts in Ukraine. Conventional ecological methods were used for accounting for the composition of the communities and assessing their productivity. The general species richness and diversity of groups in communities of quasi-natural ecosystems, as a rule, reach high values, than in their surroundings. In the survey of 30 pond-fish farming areas in the forest-steppe zone of Ukraine, 150 species of vertebrate animals (except fish) were found there, of which more than 90 are listed as protected. Forest shelterbelts of the steppe zone of Ukraine are the habitat of 584 species of beetles, and in forest-steppe protective forest belts there can be found up to 30 protected plant and animal species per hectare of stand. Arable land, pastures and haymaking steppe areas of southern Ukraine support rare bird species, of which 10 are listed in the Red Data Book of Ukraine. Therefore the considered quasi-natural ecosystems undoubtedly play a significant role in the conservation of wildlife and there is a need to provide opportunities for comprehensive implementation and enhancement of their conservation potential.

Keywords: Quasi-Natural Ecosystems, Biodiversity, Species Richness, Econet, Agrolandscape

1. Introduction: The Problem of Biodiversity Conservation in Environmentally Depleted Biotopes

As a result of human activity, the living cover of the planet has undergone significant changes. With a significant reduction in the area of multi-component natural ecosystems, mono-dominant artificial agro-systems and technogenic objects have become widespread. In large areas, especially in densely populated regions, there is a significant simplification of the biotope structure of the landscape and a dangerous decline in the level of biodiversity. With the loss of diversity, the sustainability of the living cover decreases. At the same time, the possibilities for expanding the territories of the absolutely protected regime are very limited.

The situation that has arisen makes us seek new, non-trivial and economically beneficial forms of preserving living

nature. This is also important because there are very few actually intact ecosystems on the planet. One of the real ways to maintain biodiversity in anthropogenically transformed landscapes is the combination of conservation objectives with the tasks of using bioresources.

2. Purpose, Materials and Methods of Research

The present work is aimed at justifying the potential for biodiversity conservation in moderately exploited lands that are characterized by a low degree of technogenic transformation and occupy an intermediate position between natural and artificial ecosystems due to their ecological features. As a result of reclamation works carried out to solve a number of practical problems (for example, water purification, microclimate mitigation, soil and vegetation cover reclamation, etc.), multi-component structured

communities including various subsystems and buffer zones were created in some areas. Moreover, more often it was done on the basis of or based on the pattern of natural ecosystems with the maximum use of relief elements, hydrological features and bioresources of the given terrain. At the same time, in some sectors (forestry, fish farming, etc.), a fundamental technological transition from monoculture to polyculture of the bioobjects used was observed. To such artificially created objects, ecological systems and functional features are close to moderately exploited (and, as a consequence, to some extent modified) ecosystems of natural origin. The considered group of anthropogenic and transformed ecosystems can be called quasi-natural [1]. These are artificial or transformed ecosystems of resource-saving type of operation that meet the following qualitative criteria [2]: 1) Characterized by an ecological regime favorable for the majority of inhabitants, maintained within certain limits in accordance with operating conditions; 2) By the level of biodiversity (taxonomic and ecological richness) are not inferior, and sometimes - superior to similar natural ecosystems and, therefore, are the centers of maintaining biodiversity in anthropogenically transformed landscapes; 3) By the degree of balance of the basic circulation processes correspond to natural ecosystems, since the lack of natural self-regulation is compensated here by the optimal control (or design of the object) aimed at the long-term (in principle, infinite) use of certain resources; 4) They have typologically similar natural analogues and to some extent fulfill their ecological functions. These are, for example, fish farming ponds, recreational lakes, English-style parks, shelterbelts, fruit and berry plantations, honey-bearing glades, erosion and water protection plantings, moderately grazed meadows and other objects comparable to those of natural ones in terms of species richness and diversity.

The work mainly uses materials on the most typical objects in this respect - multipurpose ponds and protective forest belts of Ukraine. The initial data were obtained using generally accepted methods in ecology of accounting for the composition of communities and assessing their productivity.

3. Results and Discussion

3.1. *Quasi-Natural Ecosystems and Their Conservation Potential*

In terms of landscape and biotopic features these are moderately exploited lands that are typologically close to natural habitats and have a higher diversity of population than the surrounding transformed areas. Such lands, although they are not full-fledged natural objects, actually represent islands of biodiversity in ecologically depleted agrolandscapes [3, 4]. Many representatives of flora and fauna concentrate here, whose traditional places of habitation have disappeared due to anthropogenic transformation of the area.

The basis of the population of the considered lands consists of widespread, abundant plant and animal species. However, there are often environmentally significant, aesthetically valuable, rare and protected species. In fact, all species surveyed by the author are listed in the Bern Convention and/or the Red Book of Ukraine. At the same time, in areas of the studied type with a high biotopic variety, it is possible to find new species for the fauna of Ukraine, even among well-studied groups of invertebrates [5].

The general species richness and diversity of groups in communities of quasi-natural ecosystems, as a rule, reach high values. In the survey of 30 pond-fish farming areas in the forest-steppe zone of Ukraine, 150 species of vertebrate animals (except fish) were found there, of which more than 90 are protected. Species richness, assessed here for nearby water plants and invertebrates, in the overwhelming majority of cases exceeded similar indicators of surrounding areas [6]. In one massif of moderately used haymaking meadows, up to 100 species of higher plants can be found [7]. The forest shelterbelts of the steppe zone of Ukraine are the habitat of 584 species of beetles [8], and in forest-steppe protective forest belts there can be found up to 30 protected plant and animal species per 1ha of stand [9]. Used for arable land, grazing and haymaking steppe areas of southern Ukraine support the existence of rare bird species, of which 10 are listed in the Red Book of Ukraine [10].

Therefore, in terms of species richness and diversity of communities (taking into account rare and protected species), quasi-natural ecosystems often reach the level of natural objects and significantly exceed the depleted agrocoenoses in this plan, and by some indicators also natural biocoenoses similar in scale and structure. First of all, this concerns trophic factors, since high intensity of product-destructive processes causes some excess of nutrients and fodder biomass. Increasing the productivity and diversity of some communities is stimulated by the moderate exploitation of their resources. Often, areas where quasi-natural communities are formed are characterized by a significant variety of habitats (such as hydrosystems with a set of diverse types of reservoirs and streams, park plantations on slopes, etc.). In addition, such land is protected to some extent by their users. For example, for forest plantations of the Feofaniya Landscape Park with an area of 130 hectares located within the city of Kiev, there are quite high indicators of floristic and faunistic representativeness, in particular 57 protected species of plants and animals, 11 of which are listed in the Red Book of Ukraine [11]. For comparison, there are 29 Red Data Book species registered in the forest reserve seven times larger in area and located in the vicinity of Lesniki, which is mainly a natural forest area [12]. The total density of waterfowl, as well as the density of their individual populations, was significantly higher in the areas of rural fish farming than in natural lakes [13, 14].

Being peculiar components of the biosphere, functionally quasi-natural ecosystems to some extent compensate for the

reduction of natural living cover and in this regard deserve additional study and special protection. So, park zones to a certain extent fulfill the role of forest tracts, and ponds fed by small rivers perform the functions of floodplain reservoirs.

3.2. *Quasi-Natural Ecosystems as Components of the Econet*

C. The importance of creating forest belts specifically for the conservation of biodiversity was one of the first to be pointed out by C. Elton [15]. He also stressed that such densely populated belt habitats form a kind of connective tissue, connecting individual biotopic elements of the agrolandscape. Although quasi-natural ecosystems are not, as nature reserves, the standards of natural living cover with all its interrelations, but by ensuring the conservation and reproduction of many species, they can feed the surrounding biotopes, including natural ones, with living matter [16]. In terms of their functional characteristics, such objects occupy an intermediate position between multi-sectoral nurseries and natural reproduction areas. Their inclusion in local and regional ecological networks is very important for conserving and enhancing biodiversity.

Currently, Ukraine is already practicing the creation of objects of a nature reserve fund on the basis of quasi-natural ecosystems. For example, 2/3 of the forests of the Mezinsky National Nature Park (Chernihiv Oblast) are represented by artificial plantations coping with erosion, the basis of the Bandurovsky National Ornithological Reserve (Kirovograd Region) are fishponds, etc. [11]. Some of the areas represented by quasi-natural ecosystems are included in the list of especially important territories for conservation of birds [17]. In addition, in order to maintain high biodiversity and stabilize the ecological regime of small-scale island-like conservation areas, whose resources cannot ensure the natural reproduction of many species, it is proposed that they can be renaturalized to a quasi-natural state [18]. It is shown that agricultural lands, depending on the type and mode of their exploitation, can perform the functions of various elements of the econet [19, 20].

An important aspect of the problem is the legislative regulation of the status and regime of use of lands that are important for maintaining local biodiversity. For the time being, these sites do not have sufficient legal environmental protection, but it is desirable to have them under the supervision of local environmental inspectors, and their inclusion in the eco-network is coordinated by a special subdivision of the relevant ministry.

Currently, there are no quasi-natural objects in the list of categories of the natural reserve fund of Ukraine [21]. They also do not correspond to any of the definitions of the basic elements of the econet [22], although they actually fulfill their environmental functions. Apparently, the moderately exploited quasi-natural ecosystems, which are distinguished by their considerable taxonomic wealth and high density of

individuals, are worthy of being distinguished as special components of the econet.

In this plan, at the first stage, it is necessary to conduct an inventory of quasi-natural ecosystems and distinguish their types in terms of significance for maintaining biodiversity. Then, depending on the environmental value of specific sites, they should be assigned the status of protected areas (originally - sanctuaries, landscape parks, etc.). In the future, for such systems, it is expedient to justify and legislatively establish special categories of protected objects with targeted use by analogy with protected hunting grounds. At the final stage - to develop recommendations for optimizing their ecological regime through the use of resource-saving technologies, etc. Thus, the country's environmental fund of protected areas could significantly increase without any significant financial costs [23].

3.3. *Wise Management of Quasi-Natural Ecosystems*

An important role in preserving the biodiversity of quasi-natural objects and maintaining an appropriate ecological regime for them is played by the interest of their users (stakeholders), which must be comprehensively encouraged [24]. Some effect here can be reached by assigning the lands a nature conservation status, provided that the appropriate ecological regime is maintained there (through the use of resource-saving technologies, monitoring places of habitation of rare species, etc.). Now, most users are interested in such cooperation, which will give them additional power to protect the land.

The design and use of quasi-natural ecosystems should not be based on the intensification of their natural productivity, which implies achieving the maximum effect per unit of space (for example, the mass of production per hectare). Maximization of productivity is often accompanied by a simplification of the structure and a decrease in the stability of ecosystems [25]. The main approach here should be optimization, which involves achieving the maximum effect per unit of costs, as well as preventing possible losses in the use of resources. For example, analysis of the specific natural bioproductivity of ponds shows that with increasing intensification of fish farming, the efficiency of using the fodder base by fish increases to a certain limit, and then falls, i.e. the highest specific productivity of both fodder organisms and fish is achieved at some average levels of intensification [26, 27]. As Figure Shows, the ratio of the real and theoretically possible natural fish productivity of the pond (the upper curve), as well as the fish productivity and productivity of food objects (the lower curve) are greatest at medium levels of fish farming intensification. In all cases, the assessment of the effectiveness of the use of quasi-natural ecosystems should be complemented by clarifying their significance for the conservation of biodiversity.

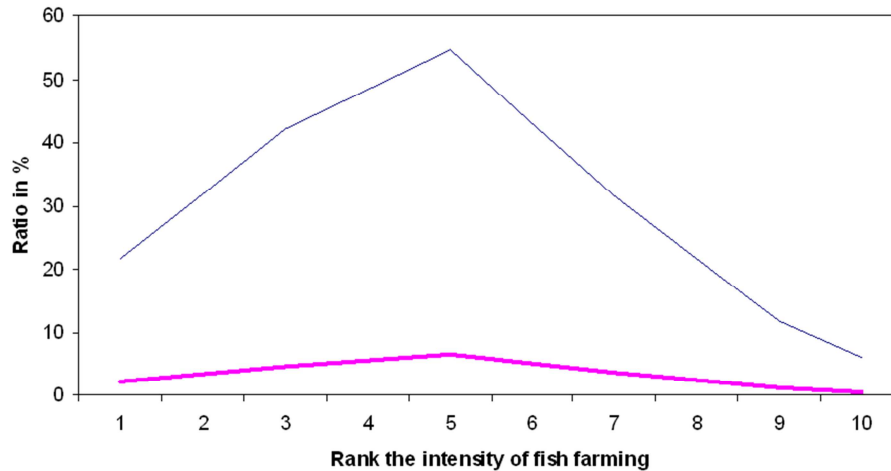


Figure 1. The ratio of natural fish production in the ponds to its potential values (upper curve) and to production of food organisms (lower curve).

The rational management of quasi-natural ecosystems should ensure their stable and uninterrupted functioning when achieving the maximum beneficial effect. It encompasses not only the use of special technologies for the sustainable or regenerative exploitation of resources, but also the maintenance of an ecological regime favorable for most biological components, the implementation of certain protective measures, etc. It also implies the optimization of the design of the structure of such objects and how they will be used. For many of them, the stage of designing the project is the most important one.

Preservation and enhancement of biodiversity as an important strategic resource is recognized as a very important and urgent task in most countries of the world. Therefore, all modern projects for the creation and reconstruction of sites operating on the basis of quasi-natural ecosystems must necessarily envisage the possibility of maintaining the highest possible level of biodiversity there. In this regard, the development of a modern strategy for managing quasi-natural ecosystems is becoming particularly relevant. Its core concept is the maximum, if possible - versatile and comprehensive, use of the resource potential of ecosystems, integrated with the preservation of the richness and diversity of their biocomponents. It is aimed at achieving the maximum overall (cumulative) effect on the basis of a balance of benefits from the implementation of both utilitarian and environmental capabilities of the site. Such management strategy for quasi-natural ecosystems includes:

1. Maximum use of natural production and stabilization (environment-forming) capabilities of ecosystems. The consequence of this approach is the minimization of technological intervention in the processes of biocenotic self-regulation. As a result, the profitability of the site and the stability of the associated ecosystem should increase.
2. Widespread introduction of resource-saving technologies and methods of moderate exploitation of natural resources. In order to maintain the stability of the ecosystem, it is important that the limits of the use (extraction) of useful bioproducts stimulate its creation.

3. Maintaining a close to natural (for a given type of area) ecological regime. Such a regime, as a rule, is favorable for the majority of the inhabitants. This contributes not only to the fulfillment of objective functions, but also to the preservation of living components.
4. Complex use of opportunities, resources and useful products provided by quasi-natural ecosystems (for example, irrigation + fish, wood + recreation, honey + fruit harvest). At the same time, all forms of their use should be integrated with measures to conserve local biodiversity.
5. Continuous improvement of the overall biodiversity by filling the potential ecological niches with their respective species. The low density of the niche structure causes the possibility of introducing new species here, especially those representing a significant ecological and nature protection interest.
6. Artificial stimulation of reproduction of valuable, rare and protected species. Some institutions (breeding stations, nurseries, etc.) have significant opportunities in this regard and can fulfill not only production, but also environmental orders.
7. Optimize the balance of metabolic processes and maintain stable relationships with surrounding ecosystems. In the anthropogenically transformed landscapes, the stabilizing role of quasi-natural ecosystems increases noticeably.
8. Improving the ways and mechanisms for maintaining the relative integrity and continuity of the living cover of lands, which will also increase their value as components of local and regional eco-networks.
9. Development of emergency compensatory measures for unforeseen violations of the ecological regime (and also for cases of ecological disasters).
10. Establishment of a special legal framework for legal protection of quasi-natural ecosystems in accordance with their specifics. At present, they do not belong to any of the existing conservation categories and do not have a special status, although they play a significant

role in the conservation of wildlife.

For the full realization of the environmental potential of quasi-natural ecosystems in terms of bioproduction and shaping the environment, it is necessary to implement a unified strategy for their rational and wise management. Its essence is to achieve the maximum beneficial effect due to the optimal combination of utilitarian (the creation of useful products and conditions favorable for human beings) and the actual nature protection functions of these ecosystems. This approach should receive support from both environmental organizations and users of natural resources. The implementation of an overall strategy for the rational management of quasi-natural ecosystems is one of the mechanisms for transforming the biosphere into the noosphere.

4. Conclusion

the Possibility of Combining the Interests of Nature Management with the Conservation of Biodiversity.

Quasi-natural ecosystems were created mainly for obtaining bioproducts (hatchery, fruit planting) or for improving the ecological situation (protective forest belts). The solution of both tasks requires the maintenance of favorable conditions for the existence of majority of their inhabitants, including those accompanying them. Consequently, the combination of environmental management with conservation of biodiversity in the course of the use of quasi-natural ecosystems is possible on the basis of optimizing the conditions for the existence of living organisms.

The considered quasi-natural (actually anthropogenic) ecosystems, which in a certain sense are the centers of biodiversity, play a significant role in the conservation of wildlife and are of undoubted environmental interest. Previously, when creating the bulk of quasi-natural ecosystems, special tasks aiming to preserve and enhance biodiversity were not put forward. They were solved only in some cases, for example - in forest park complexes. In modern projects related to establishing quasi-natural objects and the regime of their usage, it is necessary to provide opportunities for comprehensive implementation and enhancement of their conservation potential, including the protection of biodiversity. Undoubtedly, such areas along with reserves, reserves, landscape parks, forests, water protection zones should be included in a single network of protected areas.

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