

# Trends In The Development Of Medical And Environmental Services For Landscape Biodiversity

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## ABSTRACT

*A significant part of the ecosystem (biome) and natural landscape diversity of the Earth's temperate belt is represented in the Russian Federation. It is preserved due to the relatively low disturbance of the country's territory (up to 65% of the country's area, mainly in the Arctic, Siberia and the Far East, maintain a natural mode of functioning). The share of arable land in biomes reaches 40-50% in the forest-steppe and steppe, and in general, agricultural lands occupy in the biomes of the Russian Federation from 0% (tundra) to 85% (steppes).*

*The landscape diversity of the Russian Federation itself includes about 20 types of landscapes (arctic, subarctic, boreal (taiga), subboreal humid, semiarid and arid, subtropical, mountainous - alpine, glacial, etc. Swamp, floodplain, aquatic, shallow marine, etc.) and more than 350 types of landscapes. Among them, taiga (boreal) landscapes are leading in terms of area - 52%. Cold arctic and subarctic (plain and mountainous) occupy 21%. Mountain landscapes occupy 30–33%. The most developed, optimal for the development of agriculture, the territory of the forest-steppe and broad-leaved forests occupy 8%. The Convention on Biological Diversity (CBD) links the concept of "biodiversity" and "sustainable development".*

*It follows from the preamble of the Convention that biodiversity must be conserved not only for its own sake, but also for the use and enhancement of human well-being.*

*This has given rise to the concept of ecosystem goods and services that biodiversity provides and that can be critical to the needs for foodstuffs, health and healthy environmental needs.*

*In the National Strategy for the Conservation of Biodiversity of the Russian Federation, the main groups of life-supporting functions of biological diversity have been identified: production functions, environment-forming functions, informational and spiritual-aesthetic functions.*

**Keywords:** *biodiversity, investment, innovation, environmental management, medical ecology, forest ecosystem, green economy, monitoring, recreation.*

## **1. INTRODUCTION**

The Russian Federation occupies 1/8 of the planet's land mass - most of extratropical Eurasia, its area is 17,075.4 thousand km<sup>2</sup>. Despite the high landscape diversity, biodiversity is relatively low compared to more southerly regions. The territory of the country includes landscapes of 8 natural zones, where hundreds of thousands of different representatives of flora and fauna meet, making up from 1 to 20% of the world diversity of individual taxa, more than 12,500 species of vascular plants are represented, about 2,200 - bryophytes, about 3,000 - lichens, at least 11 thousand species of mushrooms, 320 - mammals, 732 - birds, 80 - reptiles, 29 - amphibians and almost 343 species of freshwater fish, 9 - cyclostomes and about 1,500 species of marine fish. The fauna of invertebrates exceeds 150 thousand species, the regions of the Far East, southern Siberia and the North Caucasus are distinguished by the highest level of diversity of flora and fauna, and a relatively high level of local biodiversity on the plain is characteristic of zonal ecosystems of the forest-steppe of the European part of the Russian Federation [1,2,7].

Part of the species (subspecies, populations) of various taxonomic groups is included in the Red Book of the Russian Federation, which is an official document containing a collection of information about rare and endangered objects of the animal and plant world, as well as the necessary measures for their protection and restoration, where 413 species (subspecies) of animals, 652 species (subspecies) of plants and 24 species of fungi [1, 10].

## **2. METHODOLOGY**

The landscape diversity of Russia itself includes about 20 types of landscapes (arctic, subarctic, boreal (taiga), subboreal humid, semiarid and arid, subtropical northern, mountain - alpine, glacial and other boggy, floodplain, aquatic, shallow sea, etc.) and more than 350 types of landscapes. Among them, taiga (boreal) landscapes are leading in terms of area - 52%. Cold arctic and subarctic (plain and mountainous) occupy 21%. Mountain landscapes occupy 30–33%. The most developed landscapes of the forest-steppe and deciduous forests, optimal for the development of agriculture and living, occupy 8%. CBD links the concept of "biodiversity" and "sustainable development". It follows from the preamble to the Convention that biodiversity needs to be conserved not only for its own sake, but also for the use and enhancement of human well-being. This has given rise to the notion of health and environmental goods and services that biodiversity provides and that can be critical to meeting the needs for food, health and a healthy environment [2,3].

## **3. RESULTS**

Sea coasts and shallow waters are of an intrazonal nature and are located in almost all natural zones of Russia - from polar deserts and arctic tundras to broad-leaved forests of the Far East, semi-deserts of the Caspian Sea and xerophilous open forests of the Mediterranean type of the Black Sea coast.

They are represented by a wide range of coastline types, which are important for the formation of the biodiversity of coastal ecosystems. Regions with the highest level of species richness of flora and fauna are confined to them: in the Far East, local flora and fauna of mammals reach 1200 and 75 species per 100 km<sup>2</sup>, respectively, on the Black Sea coast - 1100 and 70 species per 100 km<sup>2</sup>.

A significant part of the ecosystem (biome) and natural landscape diversity of the Earth's temperate belt is represented in Russia.

Data on the biodiversity of the seas themselves are no less significant (tab. 1).

Table 1. Species richness of the main groups of organisms in coastal marine ecosystems in Russia

Sea	Species of benthic invertebrates	Species of fish and cyclostomes	Algae species
Black	791	166	236
Azov	186	79	33
Caspian	400	78	116
Japanese	2000	603	379
Okhotsk	2100	276	299
Beringovo	1500	297	138
Baltic	20 (marine)	50	50
Barents	1800	182	194
White	1000	82	200
Karskoe	1300	82	134
Laptev	500	81	16
East Siberian	600	55	21
Chukotka	800	102	70

It is preserved due to the relatively low disturbance of the country's territory (up to 65% of the country's area, mainly in the Arctic, Siberia and the Far East, maintain a natural mode of functioning). Significant areas within the boundaries of forest and steppe biomes are occupied by meadows and steppes (table. 2).

Table 2. Biomes of Russia: distribution of forests and agricultural land by biomes of Russia

Biome	Biome area million ha	Biome area share %	Share of forests in biome area %	Area share agricultural land %	Including	
					Arable land %	Hayfields and pastures %
Polar deserts and tundra	197,8	11,6	-	0,03	-	-
Forest-tundra, woodlands and northern taiga	233,6	13,7	37,7	0,05	-	-
Middle taiga	222,6	13,0	76,4	5,0	4,3	1,1

Southern taiga and	245,4	14,3	57,6	217,3 1	10,4	6,9
coniferous - broadleaf	127,3	7,5	27,5	57,2	40,6	16,6
and broadleaf forests	79,9	4,7	4,0	73,3	47,3	26,0
Forest-steppe	22,2	1,3	–	85,5	51,8	33,7
The steppes are real and arid	14,7	0,9	-	75,9	13,5	62,4
The steppe is dry and deserted	565,7	33,0	62,7	7,6	1,5	6,1

The share of arable land in biomes reaches 40-50% in the forest-steppe and steppe, and in general, agricultural land (not counting the pastures of domesticated reindeer) occupies in the biomes of the Russian Federation from 0% (tundra) to 85% (steppes. [2,10].

In the National Strategy for the Conservation of Biodiversity of the Russian Federation, the main groups of life-supporting functions of biological diversity were identified:

- production functions;
- environmental functions;
- information;
- spiritual and aesthetic functions;

The classification of medical and environmental services for the Russian Federation is based on these groups of life-supporting functions. In addition to them, a group of recreational services is highlighted, since they are complex in nature and depend on all major groups.

Classification of ecosystem services in Russia:

1. Production services (production of biomass by natural systems, which is removed by human from nature and used for various needs):

1.1. Wood production.

1.2. Production of non-wood products from forests and other terrestrial ecosystems (mushrooms, berries, nuts, bark, bast, medicinal, cosmetic, ornamental plants, etc.).

1.3. Production of livestock feed on natural pastures and hayfields.

1.4. Production of products of marine ecosystems, primarily fish.

1.5. Production of products of freshwater ecosystems, primarily fish.

1.6. Production of hunting products.

2. Environment-forming services (formation and maintenance of environmental conditions favorable for human life and economic development):

2.1. Climate regulation services:

- regulation of greenhouse gas flows;
- storage of carbon stocks in ecosystems.

2.2. Hydrosphere regulation services:

- regulation of the amount of precipitation and the total volume of water flow;
- stabilization of water flow, reduction of flood intensity and damage from them;
- water quality assurance by terrestrial ecosystems.

2.3. Services for the formation and protection of soils:

- formation of soil bioproductivity;

— protection of soil from water erosion; prevention of soil drift into water bodies, landslides and mudflows;

— protection of soil from wind erosion, prevention of dust storms;

— regulation of cryogenic processes.

2.4. Pollution capture and treatment services:

— capture and processing of pollution by terrestrial ecosystems;

— biological water purification in natural reservoirs;

2.5. Services for the regulation of biological processes important for the economy and environmental safety (control of the number of pests in agriculture and forestry, pollinators, etc.).

3. Information services (information useful to a person and intangible benefits):

3.1. Genetic resources of natural species and populations;

3.2. Information about the structure and functioning of natural systems that can be used by humans;

3.3. Aesthetic and cognitive value of natural systems.

3.4. Ethical, spiritual, religious significance of natural systems.

4. Recreational services (formation of natural conditions for human recreation based on combining service components from the first 3 groups):

4.1. Formation of natural conditions for daily rest near the house.

4.2. Formation of natural conditions for Sunday rest and dacha recreation.

4.3. Formation of natural conditions for educational tourism in nature.

4.4. Formation of natural conditions for active tourism in nature, amateur and sport fishing, hunting.

4.5. Formation of natural conditions for health-improving recreation at resorts.

The timber production service is the most economically important for Russia among production services. The share of the forestry sector in GDP today is about 1%, but has great potential for growth. The service is important at the regional and national levels of government. The potential volume of services provided by ecosystems can be estimated by indicators of timber stock by regions, taking into account the volume of allowable removal - by allowable cut. The actual use of the service is expressed in the volume of timber harvesting, both commercial timber and firewood. For an accurate assessment of the actual use of the service, an adjustment for the volume of illegal logging is required. The need for a service can be assessed in the long term - through indicators of the development of the forest sector, currently - through the indicator of the number of employed workers in the forest sector, assuming that everyone should have sufficient income. The population's demand for firewood is determined by the duration of the heating season and the number of houses with stove heating [3,5,10].

Non-wood resources of forests and other terrestrial ecosystems are very diverse in their composition and nature of use. They include harvesting the bark of trees and shrubs, brushwood, twig fodder, fir, pine and spruce paws and other forest materials, as well as food forest resources, medicinal, melliferous, technical and other economic groups of plants, berries, edible species of mushrooms, forest pastures and grasslands. The value to society of non-wood forest resources is significant. The harvest of wild berries, nuts and mushrooms in

Russia is measured in millions of tons, while in certain categories of forests the cost of these resources exceeds the cost of timber. For city dwellers, the possibility of picking mushrooms and berries is not only of commercial value, but also of recreational value. However, most of these resources are located outside the commercial reach.

The state statistics of harvesting and consumption of non-wood forest resources is currently not kept in full. Estimates of the volume of the main types of non-wood products of natural ecosystems are made on the basis of many years of research and a combination of data from different sources. Indirect indicators of the volume of consumption of services at present can be the population in the region and the transport accessibility of the territory.

The service of production of products of natural pastures and hayfields is important for regions where grazing cattle breeding is widespread, primarily the regions of the North and Siberia, as well as the steppe and semi-desert regions of the Caspian Sea region and southern part of Western Siberia, as well as throughout the country - for the rural population, which keeps private livestock. This ecosystem service is important, first of all, at the local and regional management levels. In addition to the direct economic value as a source of feed for livestock, this service is important for maintaining the traditional types of farming of the indigenous peoples of Russia, first of all, the reindeer herding population of the North. Despite the importance of this service for agriculture and the well-being of the population, the state registration of the dynamics of the areas of natural and semi-natural grasslands in Russia is not separately kept. Some information about the areas, state and trends of changes in these ecosystems can be obtained from the information of the State Land Register on "forage lands" and data on pastures and meadows from the State Forest Register.

The potential volume of the service can be estimated by the indicator of ecosystem productivity within the main types of pastures in Russia. However, it must also be borne in mind that, in addition to extensive pastures, small hayfields and pastures are important, which are used for private livestock. The actual use of this service is determined by the livestock population in the regions where natural pastures and hayfields are used.

The production of products of marine and freshwater ecosystems, as productive ecosystem services of marine and freshwater ecosystems, are of national and regional importance. Despite the fact that the fishing industry accounts for less than 1% of the country's GDP, the economy of some regions, primarily the Far East, is largely determined by the fishing industry. The potential volume of these services is defined as the raw material base of fishing, the actual use corresponds to the volume of catch of biological resources. The degree of development of the raw material base in recent years has been on average about 60%, for an accurate assessment of the volume of use of aquatic biological resources, it is necessary to know the volume of fishing, the need for a service can be estimated on the basis of the prospects for the development of fisheries, and at present - by the number of people employed in the industry. The value of the productive services of freshwater ecosystems is significantly less than that of marine. So, in 2019, the total catch in all fresh water bodies amounted to 0.178 million tons, while the catch in the exclusive economic zone, the territorial sea and inland sea waters amounted to 3.36 million tons. However, for freshwater ecosystems, the recreational component of these services is large, providing good conditions for recreational and sport fishing. In addition, freshwater fishing is important for preserving

the traditional way of life of the indigenous peoples of the North, Siberia and the Far East of Russia. Regulation of greenhouse gas flows between the Earth's surface and the atmosphere. The volume of services provided by ecosystems is estimated in terms of carbon sink / release (tab. 3).

Table 3. Contribution of different ecosystems to carbon dioxide deposition.  
 - positive values correspond to carbon sink from the atmosphere  
 - negative - to its source

Ecosystem type Mt C per year	Area, millionhectares	Carbon balance, Mt C per year
The woods	820,9	691,9
Swamps	144,6	153,4
Abandoned arable land	29,9	46,1
Meadows	24,0	28,5
Arable land and pastures	145,8	25,0
Deposits	19,0	14,2
Other land, including waters	101,1	-11,8
Grass and shrub ecosystems	315,	-15,0
Gary	23,7	-20,8
Forest openings	85,1	-40,3
Total ecosystem of Russia	1709,8	761,2

The production of hunting products, as an ecosystem service for the production of hunting products, is primarily of regional and local importance. The recreational component of this service is great. In addition, it is important for preserving the traditional way of life of the indigenous small-numbered peoples of the North, Siberia and the Far East of Russia. The potential volume of the service is assessed by the stock of game animals. The actual consumption of services is estimated by the indicators of their production. The need for a service can be assessed on the basis of the prospects for the development of the hunting economy, and at present - by the number of hunters in the region.

Forests are the most powerful carbon sinks, which is associated not only with their predominance in area, but also with their current state (a large proportion of secondary forests of different stages of restoration), followed by swamps. Abandoned arable lands absorb carbon most actively per unit area. Allocate carbon - forest openings and burnt places. Grass and shrub ecosystems (mainly zonal and mountain tundra), which are in second place in terms of area, are also a weak source of carbon for the atmosphere today, which is associated with the negative impact of warming. The territory of Russia as a whole is a net carbon sink. The carbon sink is more intense in the ecosystems of the European part, which is associated with the presence of significant areas of young forests and overgrown agricultural lands. In the Asian part, the share of ecosystems that are a source of carbon dioxide for the atmosphere is noticeable, which is associated with the influence of extensive wildfires [4,8].

The storage of carbon stocks accumulated by natural ecosystems, as the volume of services provided by ecosystems, is estimated from carbon stocks in soils, including marsh and

permafrost, and in biomass. The most important are long-term carbon storage in soils, peat, and permafrost. The carbon stock in the living and dead plant mass of forests is 49.4 GtC, in forest soils 116.5 GtC. The carbon stock in peat bogs in Russia is 33.6–67.2 GtC. The total reserve for the steppe biome of Russia can be estimated at 35 GtC. The total carbon stock in the soils of the tundra of Russia is estimated at 28.6 GtC. The largest reserves of carbon in soil are concentrated in Western Siberia, as well as in the zones of permafrost and steppe soils[5,6].

The volume of consumption of global services is equal to the volume of their implementation by ecosystems. The entire population of the Earth benefits from climate regulation by ecosystems. In other words, all the work on climate regulation done by ecosystems is consumed by the inhabitants of the Earth in the form of benefits from preventing negative climate change. However, the formation of international (interregional) markets for ecosystem services raises the question of assessing the national (regional) volume of consumption of global services. It can be estimated through the population or the size of the economy, which directly depends on the climate, primarily agriculture[7].

Services for the regulation of the hydrosphere of ecosystem services is one of the most important for the well-being of the population and the development of the economy, primarily agriculture. It includes services for regulating the amount of precipitation and the total volume of water flow, stabilizing water flow, reducing the intensity of floods and damage from them, and ensuring the quality of water entering water bodies. The scope of these services is regional, or rather, basin-wide. At the same time, it is necessary to take into account the direction of the flow: ecosystems in the upper reaches of the river provide services to the regions that are in the lower reaches. The most important water management services are in regions with intensive agriculture and high population density [1, 8].

The ability of ecosystems to perform this group of services is determined by their area in the region (basin). Forests play the most important role in the performance of these functions; therefore, at the first stage of the development of the system for assessing ecosystem services in Russia, forest cover by regions can be used as the main indicator. The need for these services is determined by the volume of water consumption, or rather, by the degree of use of water resources in the region[3,11].

Services for the formation and protection of soils include services for the formation of soil bioproductivity, protection of soil from wind and water erosion, prevention of dust storms and landslides, regulation of cryogenic processes. The scope of the services of this group is regional and local. The ability of ecosystems to provide these services is determined by the degree of their disturbance in the region, where natural ecosystems occupy a large area, the potential volume of services is large, where natural ecosystems are few or not, the service is practically not provided [3,11].

The demand of people and the economy for this group of services is greatest in agricultural regions, where natural ecosystems have been preserved in minimal quantities. The ecosystem service for the formation of soil bioproductivity is most important in regions with developed agriculture, where it determines the productivity of agricultural land. Ecosystem service of soil protection from wind and water erosion is most important in erosion-hazardous regions, which are also regions of intensive agriculture. An ecosystem service for the regulation of

cryogenic processes is important in the permafrost zone. The influence of natural ecosystems (primarily vegetation) on the formation and destruction of permafrost is of a local nature. Destruction of vegetation cover leads to destabilization of permafrost and threats to buildings and infrastructure.

These regions cover almost the entire territory of the country. Therefore, in general for Russia, ecosystem services of this group are extremely important, since they are key factors that determine the efficiency of agriculture and threats to infrastructure, residential and industrial structures in the permafrost zone and in mountainous regions. The capture and processing of pollution by terrestrial ecosystems, as an ecosystem function of air purification by vegetation, has a local-regional character. It "works" directly in settlements and industrial zones, providing people with clean air. Also, this service is important to prevent pollution of agricultural fields and catchment areas.

An indicator of the volume of services provided by ecosystems is the amount of pollution captured by the vegetation. The most efficient pollution is captured by forest plantations, therefore, first of all, the forest cover of the region is important. To clarify these indicators, data on the presence of vegetation directly in settlements are useful. Air purification services are most important in regions with high levels of pollution [5,11].

Biological treatment of water in natural reservoirs provides the population and economy with clean water. The scope of the service is regional and local. The potential volume of services that ecosystems can provide is determined by the area of aquatic ecosystems. The effectiveness of this service depends on the state of aquatic plant and animal communities. Transformations of aquatic vegetation, plankton, communities of aquatic invertebrates and fish lead to changes in their water purification functions. Currently, the most important factors that affect this service are water pollution, hydraulic engineering, invasions of alien species. Rivers and lakes of Russia located in economically developed regions are significantly polluted. Hydroconstruction has transformed most of the large rivers into stagnant chains with variable water levels. The ecosystems of these rivers are significantly disturbed. Accordingly, their ability to perform water treatment services has changed. The introduction of alien species also changes the structure and functioning of aquatic ecosystems, this service is most important in regions with intensive use of water resources, as a service for the regulation of biological processes that are important for the economy and environmental safety.

An ecosystem service for the control of the number of forest pests is important, first of all, in the regions where forests are most susceptible to diseases and pests. These regions are also at the same time the most sparsely wooded and the most developed by humans, which further increases the value of this service in them.

An ecosystem service for the control of agricultural pests is important in agricultural regions. A pollinator control service is important in regions where entomophilous crops are grown. An indicator of the need for this service can be the area of fruit and berry plantations, an indicator of additional economic benefits - the volume of honey production.

Genetic resources of natural species and populations, as indicators of the potential volume of ecosystem services for the storage of natural genetic resources, is species abundance. This assessment can be supplemented by an indicator of the uniqueness of species diversity - the

proportion of monotypic taxa in regional faunas and flora. The use of natural genetic resources for the production of pharmaceuticals, cosmetics and other types of biotechnological products has grown rapidly in recent years. The turnover of products obtained using natural genetic resources is comparable to or exceeds the volume of trade in biological resources. However, there is no information on the commercial use of genetic resources obtained in Russian ecosystems, therefore, it is currently impossible to assess the degree of use of this service (collection of medicinal plants, mushrooms, etc. is attributed to the service for the production of non-wood products of terrestrial ecosystems).

The potential volume of information services for the storage of genetic resources is in the opposite interdependence with the degree of anthropogenic transformation of regions. The ecosystems of those regions where the species diversity is greatest are disturbed to the maximum extent by humans. This underlines the key importance of preserving the remaining natural ecosystems in developed regions as repositories of potentially useful information for humans.

#### **4. DISCUSSIONS**

Information about the structure and functioning of natural systems that can be used by humans, as an indicator of the potential volume of ecosystem services for storing information about the structure and functioning of natural systems that can be used by humans, are species abundance and diversity of ecosystems. The latter can be assessed through the diversity of vegetation and landscapes.

The aesthetic, cognitive, ethical, spiritual and religious significance of natural systems as an ecosystem service associated with the aesthetic and cognitive significance of natural systems are significant, first of all, as components of recreational services. Ecosystem services related to the ethical, spiritual and religious significance of natural ecosystems are the most difficult to assess. At the local level, an indirect indicator of their importance can be natural monuments of cult significance (sacred trees, stones, springs, etc.). At the national level - unique natural objects that are important for national culture (for example, Lake Baikal). At the global level, a formal assessment of this service can be made on the basis of natural UNESCO World Heritage Sites in Russia. An indirect indicator of the relevance of the religious significance of natural ecosystems can be the assessment of the significance of national traditions in the cultural environment of the regions.

Recreational services are complex, as different combinations of all three major groups of ecosystem services are important for different types of recreation for people. In the group of production services, the most important are non-wood forest resources (mushrooms, berries, etc.), hunting and fish resources (amateur and sport hunting and fishing), wood raw materials for construction and for heating recreational dwellings.

Environment-forming services provide a healthy environment for recreation of the population, specific natural conditions of resort significance. Information services are important for educational recreation, observation of nature, the formation of attractive landscapes and landscapes, in the formation of natural conditions for daily recreation near the house, for Sunday rest and dacha recreation [5,6,7].

The potential volume of ecosystem services for the formation of natural conditions for daily rest near the house, Sunday rest and summer cottage recreation (including recreational fishing

and hiking for mushrooms and berries) is determined by the level of climate comfort and the degree of disturbance of natural ecosystems. The latter indicator has the opposite meaning - the less natural ecosystems are preserved in the region, the less recreational services can be provided. The quality of these services also decreases in regions with high levels of environmental pollution. This group of ecosystem services is most in demand in areas with a high population density, that is, exactly where their potential volume is limited due to anthropogenic transformation of the natural environment.

## 5. CONCLUSION

Medical, ecological and ecosystem services for the formation of natural conditions for educational and active tourism in nature (including amateur and sports hunting and fishing) are determined, as for the previous group of services, by the degree of disturbance of natural ecosystems, species and landscape diversity, since there is a large what matters is the beauty of the landscapes, the variety of life forms that tourists can observe. For some outdoor activities such as mountain hiking or river rafting, mountainous landscapes are important. For recreation, including recreational and sport fishing or hunting, the productive services of aquatic ecosystems and hunting grounds are important. The possibilities of using this group of services are determined by the transport accessibility of the territory, as well as for a number of forms of recreation - by the availability of recreational infrastructure [4,7,8].

The potential volume of ecosystem services for the formation of natural conditions for health recreation at resorts depends on the comfort of the climate, the absence of pollution, the presence of natural health factors (mineral water, mud, etc.), the availability of swimming pools, the presence of mountain slopes for skiing, etc. The possibility of using these services is determined by the presence of a developed recreational infrastructure, first of all, high-quality hotels and catering facilities (transport accessibility is ensured if these conditions is ensured).

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