

**THE BIOSPHERE RESERVE «ASKANIA NOVA» IS A GOOD MODEL
FOR TRACKING OF THE ECOSYSTEM PROCESSES
IN THE PROTECTED STEPPES OF EURASIA**

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The regularities of location of the steppe reserves of Eurasia are considered. The peculiarities of behavior of succession processes in different reserving regimes are discussed. It is indicated that mesophyting processes and phanerization of ecosystems are intensified without pressure of the hoofed animals especially at the small steppe reserve of the East Europe. The most of regularities of succession processes founded during one hundred years practice of the steppe reserving has its reflection in the Biosphere Reserve «Askania Nova».

Key words: the steppe reserves, productivity, specific diversity, mesophyting processes, phanerization, hoofed animals.

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**БИОСФЕРНИЙ ЗАПОВІДНИК «АСКАНІЯ-НОВА» ІМЕНІ Ф.Е. ФАЛЬЦ-ФЕЙНА –
 ВДАЛА МОДЕЛЬ ДЛЯ ВІДСТЕЖЕННЯ ЕКОСИСТЕМНИХ ПРОЦЕСІВ
 В ЗАПОВІДНИХ СТЕПАХ ЄВРАЗІЇ**

Розглядаються закономірності розміщення степових заповідників Євразії, обговорюються особливості протікання сукцесійних процесів в різних режимах заповідності, вказується на посилення процесів мезофітизації і фанеризації екосистем при відсутності пресу копитних тварин, що особливо проявляється в малих степових заповідниках Східної Європи. Більшість закономірностей сукцесійних процесів, виявлених протягом 100-літньої практики степового заповідання, мають своє відображення в Біосферному заповіднику «Асканія-Нова».

Ключові слова: степові заповідники, продуктивність рослинних угруповань, видове різноманіття, мезофітизація, фанеризація, копитні тварини.

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**БИОСФЕРНИЙ ЗАПОВЕДНИК «АСКАНІЯ-НОВА» – УДАЧНА МОДЕЛЬ
 ДЛЯ ОТСЛЕЖИВАНИЯ ЭКОСИСТЕМНЫХ ПРОЦЕССОВ
 В ЗАПОВЕДНЫХ СТЕПЯХ ЕВРАЗИИ**

Рассматриваются закономерности размещения степных заповедников Евразии, обсуждаются особенности протекания сукцессионных процессов в разных режимах заповедности, указывается на усиление процессов мезофитизации и фанеризации экосистем при отсутствии прессы копытных животных, что особенно проявляется в малых степных заповедниках Восточной Европы. Большинство закономерностей сукцессионных процессов, выявленных на протяжении 100-летней практики степного заповедания, имеют свое отражение в Биосферном заповеднике «Асканія-Нова».

Ключевые слова: степные заповедники, продуктивность растительных сообществ, видовое разнообразие, мезофитизация, фанеризация, копытные животные.

The Biosphere Reserve “Askania Nova” is a largest steppe reserve of Europe and oldest on Planet by antiquity of the reserving. The first evaluation of state and productivity of the Askania Nova steppes was assessed by F. Teetzmann in 30th of XIX century (Teetzmann, 1926). On the beginning of XX century the reserve functioned as a private, and since 1919 it became the state scientific natural protected institution. Every generation of scientists made their contribution to cognition of reserving processes therefore the long chronological lines of observations for abiotic and biotic environment factors. The scientists of the reserve did expeditions to many reserves of Eurasia from Daurian steppes

to Hungarian pushts (steppes). It gave rich comparative materials for definition of a role of reserved steppe ecosystems on biodiversity conservation and of contribution of Askania Nova in cognition of reserving processes.

OBJECTIVE OF RESEARCHES

The objective hereof presentation is an analytical review of steppe ecosystems at the reserves of States allocated in the steppe zone; identification general trends of succession processes at the reserves of the steppe zone; description of prospects of biodiversity conservation, estimate of a state of the protected steppe ecosystems and some approaches for management of steppe ecosystems.

RESULTS AND DISCUSSION

The variety of living conditions of species, which are adaptive to arid and subarid conditions, is determined by large length of Eurasian steppes in latitudinal and meridional directions and also formation of set the steppe biocoenosis.

The numerous indexes of presence of reserves and national parks in the steppe zones, in which an area of steppe spaces exceeds 30%, are shown in Table.

Quantity of steppe reservats in States of the steppe zone

Hungary	Rumania	Moldova	Ukraine	Russia	Kazakhstan	Mongolia	China
1	1	2	5	5	4	2	2

It should be noted that transition steppe ecosystems occur in many reserves bordering with natural zones, subzones or conditional by an alpine zonation at the mountain regions. At that time many steppe reserves are located with deviation from one to three degrees between 46°22' - 49°58' of the northern latitude: Hortobagy (Hungary), Yagorlyk (Moldova), Yelanetsky steppe, Askania Nova, The Stone Graves, Khomutovsky steppe (Ukraine), Naurzum Natural Reserve, Korgaldzhinskiy Nature Reserve, Altyn Dala Reserve (Kazakhstan), the Rostovsky reserve, The Black Lands, Daurian reserve (Russia), the Great Gobi reserve (Mongolia). The Biosphere Reserve “Askania Nova” clear fit in with this coordinates scheme (Fig. 1).



Fig. 1. Location of main steppe protected area of Eurasia

We confirm the opinion of many researchers that a man has played the important part in steppification of the big spaces for 3-4 thousand years and especially for two last centuries. Absolutely all steppe reserved sites of Europe carry a mark of human activity and now their spontaneous development in many respects depends on a degree of influence of the anthropogenic environment. Absolutely reserved regime, which is established in the most natural reserves of the post soviet space, allowed finding a common mechanism of rapid spontaneous overgrowing of the herbaceous ecosystems by wood plants.

Analyzing the results of numerous researches, which are conducted in the protected steppes, we see that scientists have received most important and summary results there, where the long-term permanent researches were started, but the reserves had substantial sizes. On Ukraine only the Biosphere Reserve “Askania Nova” meets these requirements at present day. The most of our reserves have a steppe territory from some hundreds hectares till three thousand in spite of great number of the protected steppe plots. Allocation of some reserves scattering about subzones has a cluster feature. There is no way they create a continuum of the steppe ecosystems. In this sense there are Asian reserves more preferable: Naurzum Natural Reserve, Korgalzhinskiy Nature Reserve and newly creating Altyn Dala Reserve in Kazakhstan, the Great Gobi reserve in Mongolia, and also a transboundary Daurian reserve on the frontier with Russia, Mongolia and China. The last ones have areas from some hundreds of thousands till four million hectares.

The first reserved steppe plots were excluded by Friedrich Falz-Fein – owner, sheep breeder and naturalist – in 1898.

The first description of the reserved plots was done by Josheph Pachoskiy in 1902, who continued description of these territories until the middle of XX century. The expansion of a network of the protected areas on the Eurasian continent gave the opportunity to go on the studying of peculiarities of the reserving successions, which are presented in the biosphere reserve “Askania Nova” completely.

The regularities are identified as a result of analysis of the spontaneous ecobiological processes and exogenous factors at the Biosphere Reserve “Askania Nova”. Also they are visible in other steppe reserves of Eurasia, but they are shown in the reserve fully. The replacement of ruderal vegetation by zonal one happens in the first years after reservation. This regularity was noted by J. Pachoskiy (Пачоский, 1908, 1917, 1924). In the first ten years after institution of the reserving regime the regular increase of saturation and projective covering of zonal steppe vegetation happens (Пачоский, 1908, Шалит, 1938). The analysis summarized by Ye.P. Vedenkov (Веденьков, 1995) on example of askanian steppes (Table 2) shows that the protected regime influenced positively on increasing of some zonal associations of the steppe vegetation *prima facie* fescue grass (*Festuca vallesiaca* Gaud.).

Table 2

Succession of vegetation cover of the first protected plot “Stara” in Askania Nova, reserved in 1898 (according to Vedenkov, 1995)

Name of allotments and associations	Years of investigations and areas of formations on the map of the protected steppe in %			
	1927	1952	1968	1980
Feather grass formations	47,4	30,5	26,8	18,1
Fescue grass formations	30,9	50,3	52,5	53,9
Mesophilous Rhizome grasses	6,2	6,8	18,9	22,1
Anthropogenic derivative vegetation	4,4	12,4	1,8	1,3

It simultaneously happen the reduction of areas occupied by the anthropogenic derivative vegetation.

However in further the regular accumulation of the steppe felt (litter), that is kept till present time (Fig. 2), with following stabilization or activation of mesophytization mechanism, which is leading to gradual increase of areas with rootstock grasses and sedges is observed (Table 2). Accumulation of the steppe felt (litter) impedes development of the spring ephemeral species, habitation of steppe mammals’ species: little souslik *Spermophilus pygmaeus*, great jerboa *Allactaga major*, steppe polecat *Mustela eversmannii* belonging to protected species, for their sake the reserving was done. Such picture is seen in the most of steppe reserves. This process is especially observed in north reserves with

meadow steppes in the Central Chernozem Biosphere Reserve (Russia) for example. On the figure 3 we represented diagrams of quantity changes of plants' species subject to regime of the protected steppe according to materials of Sobakinskikh (1995).

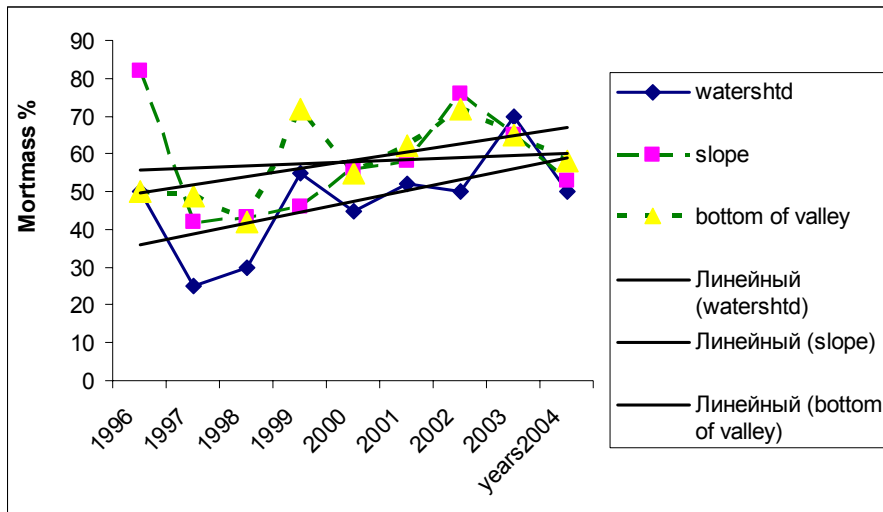


Fig. 2. Dynamics of relative weight of dead plant residues in the ecological line of protected steppe “Askania Nova” (according to Гавриленко В.С., Дрогобич Н.Ю et al., 2006)

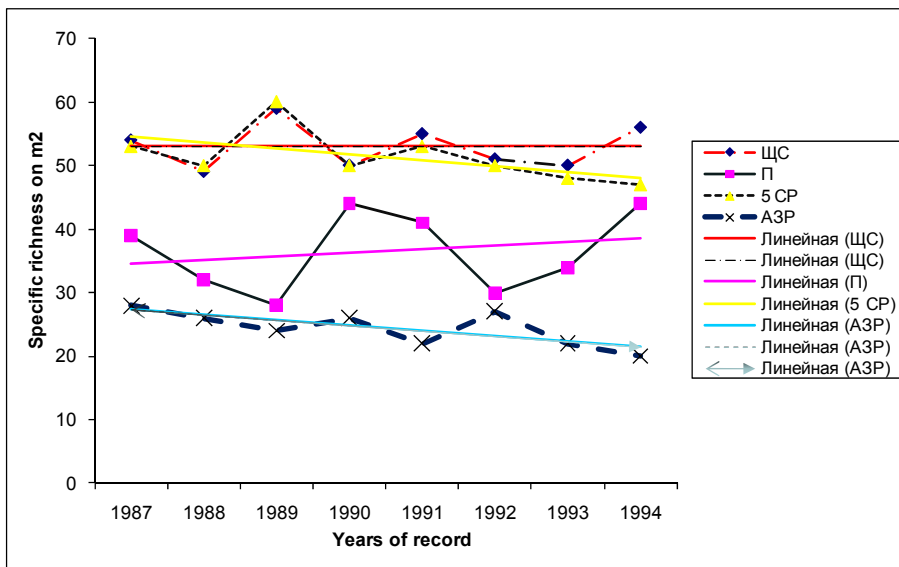


Fig. 3. Influence of natural use regimes on the specific richness of grass stand in the Streletskaaya Steppe of the Central Chernozem Biosphere Reserve (Russia) on the base of data of Sobakinskikh

It should be noted that besides regimes, a small territory of plot influences and will influence on reduction of specific diversity in this reserve.

This process is tracked in the Biosphere reserve “Askania Nova” also, because of territories with different protected regimes are larger here. The process of further environment transformation is going on and vice versa the increasing of total number of flora and fauna species is tracking (Table 3).

Change of flora diversity of the Biosphere Reserve "Askania Nova"

Author of plants' list	Year of listing	Square of area's investigation (ha)	Number of naturally growing plants' species	Index of diversity (species number on 100 ha)
Pachoskiy	1923	32 000	310	0,97
Korotkova	1954	22 000	357	1,62
Vodopyanova	1975	11 000	436	4,00
Vedenkov, Yelonova	1990	11 000	478	4,35
Shapoval	2010	11054	509	4,40

However the increasing of species happens through the adventitious flora and animals of dendrophilous complex which occupy the ecosystems neighboring with the reserve more active, penetrating into the core area. The reasons of this process will be considered lower.

It is known that steppe ecosystems have regular substantial fluctuations of phytocenosis productivity subject to a hydrometric regime. The dynamics indices of elevated living phytomass of grass stand in grazing period before reserving (according to Teetzmann), and also under conditions of the reserving (according to Drogobych, Shapoval) are presented on the fig. 4.

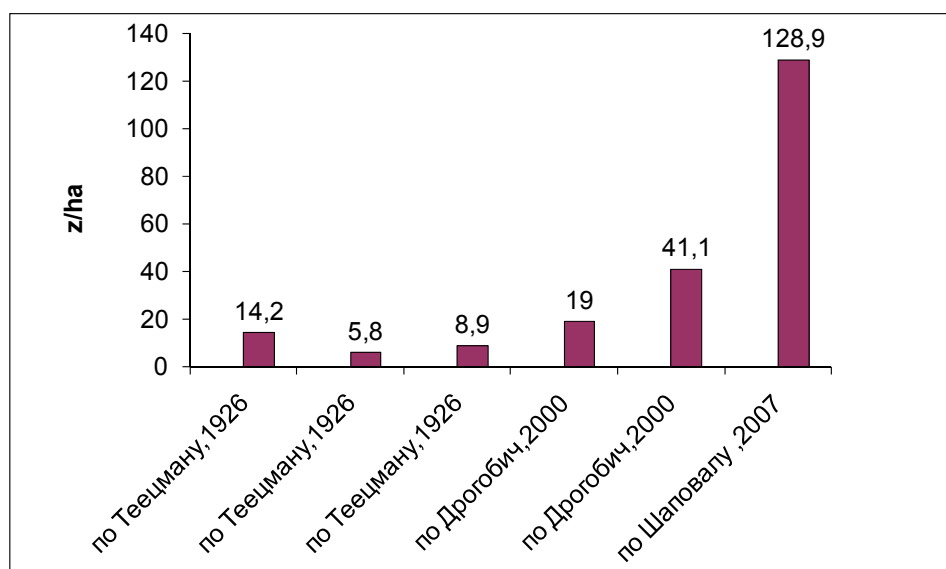


Fig. 4. Productivity amplitude of herbaceous associations in askanian steppe (according to data of different authors)

Total growth of productivity increased through both cases the lowering of grazing load and increasing of total amount of precipitations that is observed last ten years. It is visually confirmed by comparative analysis of temperature regime and precipitation in Askania Nova since 1926 (Fig. 5).

The same regularity occurs in the east regions of the steppe zone and that's why this process affected the population of saiga antelope *Saiga tatarica* in Kalmykia (Абатров, 2007). The growth of average annual amount of precipitations increases not only accumulation of the steppe felt but assists to intervention of wood vegetation into protected territories. Phanerization of the protected steppe ecosystems of the East Europe received an extensive distribution. The influence of this fact is appreciable especially in the small reserves without impact of the big hoofed animals. Thesis of well-known phytocoenologist T.A. Rabotnov remains absolutely right and actual: "a first priority of the steppe reserves

must be permanent destruction of faunistic inferiority” (Работнов, 1982). Thirty years passed and we had to state that process of forestation in a line of reserves went so far that some steppe territories grew over with shrubs and wood vegetation. This fact takes place even in arid region where the Biosphere reserve “Askania Nova” is situated. The active overgrowth of new fallow lands by wood vegetation from forest belts happens in the buffer zone because of absence of the hoofed animals. Such phenomena did not observe here earlier. (Fig. 6. A.B.)

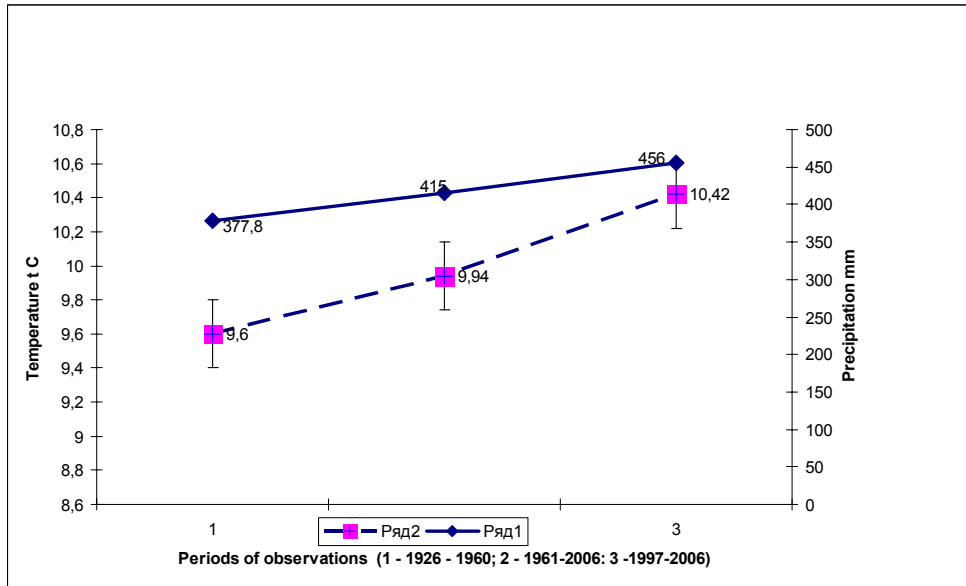


Fig. 5. Growth of temperature and precipitation for different periods of observations (according to data of meteorostation “Askania Nova”)

Thereby the steppe reserves of the East Europe lost the big herbivorous animals- destructors of grass cover; they were unable to resist both the internal tendencies to the overgrowing by shrubs and external intervention of wood vegetation. The direction of sylvatization process and its speed is connected directly with area of an object, a degree of environment transformation of the reserve and an aggressivity of alien species, displaced by human in the artificial forest belts.



Fig. 6. A. The reserve “Mychajlovskaya tselina” became as a shrub phytocenosis for 50 years. B. Overgrowth of the buffer zone by elm in the Biosphere Reserve “Askania Nova” (ten years fallow land)

Development of sylvatization processes is begun after removal of the anthropogenic press. It may be stopped in case of renovation of stress by the roofed animals. The overgrowing by wood vegetation and change of the steppe associations by forest is increasing from the south to north. The development of sylvatization processes on the sites with steppe vegetation is watching for fescue grassland and meadow steppe of the East Europe in the first 5-10 years of the reserving. A tendency of the steppe's overgrowing by wood vegetation because of absence of the hoofed animals influence is clearly visible on the figure 7 presented below. This tendency was observed in the natural reserve "Yelanetsky Steppe" in conditions of 15th years experiment.



Fig. 7. The left – 8 American bison at 70 ha keep a steppe in the natural state. On the right of fence a steppe begins to overgrown by shrubs

The balance of warmth and atmospheric precipitation in the vegetation period and also thickness of litter complex exerts the largest influence on the rates of the overgrowing. The litter intensifies mesophyting processes and forwards to the root proliferous overgrowing by shrub vegetation (i.e. to the first phase of sylvatization at the meadow steppes: Mychajlovskaya tselina (Ukraine), the Central Chernozem Biosphere Reserve (Russia) and others (Ткаченко, Генюв, Лисенко, 2003; Ткаченко, Гавриленко, 2007, Гавриленко, 2007). These processes are observing at the south steppes where Askania Nova is situated. For the period of 100 years the overgrowing by shrub vegetation *Amygdalus nana* and *Caragana scythica*, which were presented by solitary shrubs at the steppe in 1917, occupies nearby 10 ha now due to a large area of the single reserved massif (more than 8 thousand ha of 11054) (Пачоский, 1923). However the wood introduction plants appeared in the steppe as a result of the zoochoric and anemochorous distribution. Diaspores of wood plants have the possibility to grow successfully only in cases of the baring of a soil cover after fires or zoogenic influence on the steppe vegetation, for example the burrowing activity of rodent. The further litter's accumulation gradually favours the distribution of associations of the rhizome cereals though the zonal species of feathers and fescues. The reserve succession doesn't forward the conservation of many ephemorous species, which often make up a rarity component of flora. The complex of coprophagous species became poorer because of the falling of the big roofed animals from nutrition lines. The increasing of habitus of grass plants under conditions of the reserving doesn't favour the conservation of many steppe species of small vertebrate animals. According to observations the steppe species can be in the resting stage for long time and give the population flash after fires.

Integrally the protected steppes of the East Europe need the management on the part of human solved a main problem of determination of tendencies of reserved successions. This is a difficult process. An individual approach and analysis of all previous periods of ecosystems' function is necessary for solution of problems of each protected site.

CONCLUSIONS

The Biosphere Reserve "Askania Nova" is a good model for the tracking of long-term spontaneous processes in the south steppes of Ukraine. It allows discovering the general regularities of changes happened in the protected steppe ecosystems outside its region.

The steppe protected ecosystems of Eurasia undergo consequence changes under the influence of the reserve successions. They have the general processes, which rate and directions depend on original state of ecosystems excluded from economic use, an area of the protected site, geographic location, a degree of transformation the areas surrounding it and peculiarities of the update using of the areas.

The small steppe reserves without renovation of herbivorous animals can promptly turn into derivatives of the forest ecosystems.

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