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## DEMOGRAPHIC ANALYSIS OF THE SPECIES OF GENUS *STIPA* L. IN THE REGIONAL LANDSCAPE PARK "KLEBAN-BYK"

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**Safonov A. I., Bandurko V. V. Demographic analysis of the species of genus *Stipa* L. in the regional landscape park "Kleban-Byk".** – As a result of the inventory on the territory of the RLP "Kleban-Byk" 13 species of *Stipa* L. were determined. Most species of genus *Stipa* growing on the territory of the RLP "Kleban-Byk" had regressive populations or tended to regression and low level of individual renewal. If special measures are not taken, *Stipa* in the RLP's phytocenoses will reduce considerably.

*Key words:* *Stipa*, monitoring, reintroduction, econiches.

### Introduction

Steppe type of vegetation in Ukrainian is regarded as priority protected units as it recovers very slowly when superficial layer of soil is disturbed and it quickly reduces its territories under anthropogenic pressure.

Scientific knowledge of functioning of *Stipa* L. steppes of Donbass (the most ecologically tense and urbanized region of Europe), that are characterized by floristic, biomorphological, ecological and phytocenotic richness, is significant provided there is an overall analysis based on botanic and ecological complex approach. On the steppe territories of Donbass there are 112 rare species of plants. Among them 14 are listed in The Red Book of Ukraine, 6 are on The European Red List, 23 are protected according to resolutions of regional Councils, 24 are rare species of the Donetsk basin. *Stipa* steppes number 395 species prospective for economy. Among them 288 species are decorative, 155 – are fodder crops, 123 species are officinal, 104 – are phyto-land-improvement species, and also eatables, that's why it's very important to preserve phytocenofund of the territory under analysis [4]. The species of genus *Stipa* are edipicators, often being dominants and indicators of steppe ecosystems, systems of disturbed vegetable cover and evaluation of anthropogenic pressure level onto natural systems. They play an integral role in normal functioning of the unique fertile steppes of Donbass, so study and preservation of different species of genus *Stipa* are of great scientific and practical importance.

Monitoring of biosystems of populational level is an important component of complex ecological monitoring. Plants populations have some peculiarities that determine their high diagnostic value as monitoring objects. When studying plants associations the state of functionally significant subsystems can be determined, and the tasks of natural territorial complex optimization are achieved by regulating its vegetable components.

It's very important to use the following groups of plants as objects of populational monitoring: 1) edipicators, that mostly form the environment of a phytocenotic field; 2) officinal, ornamental and industrial plants, as indicators of the state of plant resources; 3) rare species of plants, various species of genus *Stipa* L. being their representatives [4]. In our case the objects belong to the first and the third group.

Populational monitoring can be conducted on local, regional and zone levels [3].

Extent of monitoring realization determines its further spatial organization. For the given work it's expedient to conduct local monitoring. Such monitoring embraces small territories and usually doesn't go out of the limits of one botanical and geographic area. Such observation allows to reveal basic laws of biosystems functioning and to work out protection activities and rules of ecologically grounded nature use [3], which is theoretically based for practical analysis and introduction of activities on the territory of the RLP "Kleban-Byk".

One of the necessary conditions of protection of biodiversity of plants genetic fund is introduction *ex situ* rare and disappearing species of plants for their further reintroduction in disturbed natural ecosystems. Steppe plants became disappearing quite recently, but the areas of their natural growing reduced quickly enough under the impact of anthropogenic factors. That's

why preservation and reproduction of these plants in artificial conditions is gaining immediate significance [6].

Reintroduction of plants nowadays is a contemporary method of preservation *ex situ* that enables to preserve genetic fund of natural flora and to renew natural plants cover.

Thus, *Stipa* plays a priority role in Ukrainian steppes being prospective for overall ecological and botanical analysis and, undoubtedly, needs control and applying activities on renewal of natural populations that are being considerably transformed in conditions of anthropotechnogenesis.

Thus, aim of our scientific project is to find out mechanisms and strategies of survival of rare species on the basis of inventory and demographical analysis of the species of genus *Stipa* L.; to work out and to apply a complex of activities for preservation and renewal of steppe plots of the RLP "Kleban-Byk" and adjacent territories.

### Materials and methods

The research was conducted on the territory of the RLP "Kleban-Byk" (Kostyantynivskyi district of the Donetsk region in Ukraine).

As the species of genus *Stipa* L. are in The Red Book of Ukraine, the research was conducted at the same areas with minimal removal of individuals from the population. For description of the researched areas a card-protocol of the environment description was used [2]. The overall territory of the experimental areas made 103 m<sup>2</sup>.

To evaluate the state of *Stipa* on the territory of steppe areas of the RLP "Kleban-Byk" we conducted the following research:

- determining biometric indices of plants;
- determining projecting cover of plants;
- abundance evaluation by O. Drude's scale;
- determining age structure of populations;
- reintroduction methods.

### Results and discussion

As the result of the research aiming at investigation of the list of species of *Stipa* populations, we identified 13 species of *Stipa* L. in the central area of the RLP: *Stipa capillata* L., *Stipa anomala* P. Smirn (*S. pennata* subsp. *sabulosa* Pacz Tzvel.), *Stipa dasyphylla* Czern., *Stipa pennata* L. (*S. joannis* Celak.), *Stipa grafiana* Stev. (*Stipa pulcherrima* C. Koeh), *Stipa disjuncta* Klok, *Stipa borystenica* Klok., *Stipa ucrainica* P. Smirn., *Stipa lessingiana* Trin et Rupt, *Stipa asperella* Klok., *Stipa tirsia* Stev., *Stipa maeotica* Klok et Ossycznjuk, *Stipa zaleskii* Wilensky. All the enumerated species of genus *Stipa* are in The Red Book of Ukraine, and *S. anomala* and *S. zaleskii* are also on The European Red List. Three species are endemics: *S. pulcherrima* is a endemic, *S. borystenica* is an endemic, *S. ucrainica* is an endemic of the south of the European part [5]. *S. anomala* and *S. zaleskii* are also in The International Red Book (IUNP) [1].

According to the system of vital forms classification suggested by L. G. Ramenskiy, the herbaceous biocenoses we analyzed lack such climatomorphs as fanerophytes. It's only in the spectrum of stepants that nanofanerophytes occur, presented by bushes of 0,5 to 2,0 meters high, mostly of genera *Caragana* and *Spirea*. This system became popular after ideas of r- and K-selection and strategies got quite popular, and in connection with the classification of vital strategies of plants, presented by an English scientist J. Grime.

We ascertained that the species of genus *Stipa* L. are regarded as violents, according to their strategy. Individuals of different ages can differ according to their strategies, so the term "violent" can be used only as related to grown-up individuals. This statement meets our research as regards the fact that juvenile individuals of the species of genus *Stipa* L. are patients. Moreover, the higher their patientness and ability to survive in the conditions of resources limitation, the higher overall violentness of the species. It's worth noticing that for patients realized niches are formed under the influence of violents, as, for example, in our research niches for juvenile individuals of the species

of genus *Stipa* L. were formed under the influence of generative individuals (*S. lessingiana*, *S. dasyphylla*).

The so-called r- strategy is connected with high significance of biotic potential of a population, while K- strategy is directed to survival increase (which is particularly important in the conditions of tough competition). For the analyzed populations of the species of genus *Stipa* L. in the RLP "Kleban-Byk" the both types of strategies are characteristic, depending on the parameters of ecological factors of basic places of growing, for instance, for *Stipa capillata* L.

In cenotic and morphological structure of the analyzed areas megathermophytes and heliophytes prevail. At the narrow local background the most significant structure-forming ecological factors for plants are soil fertility and moistening, so we paid them more attention during initial ecological analysis of the plant cover of the RLP "Kleban-Byk".

We discovered that each type in an association is able to change its positions in the limits of amplitude of ecological factors depending on its ontogenesis and peculiarities of cenotically conditioned functioning.

We determined that species of *Stipa* are able to change cardinal points of factors value in multidimensional space of a niche against the background of its ontogenesis and dynamics of conditions. It's especially true for the conditions of increased anthropogenic pressure: direct – trampling down and indirect – changes of chemical-toxicological balance. The species of *Stipa* survive on the verge of the lowest and the highest thresholds (critical points) of their existence according to all the factors and resources.

The lowest threshold in this case is soil humidity and mineral balance, the highest – temperature factor and light. We consider that it would be very useful to subsequently analyze phytocenotic barriers for separate species of genus *Stipa*.

Parameters of ecological factors (EF) of basic types of places of growing were studied using unified scales of ecological amplitudes of synphytoindication. Average score of gradient of the environment was determined for the overall complex of phytocomponents of a cenosis.

Appropriateness of distribution of climatic factors parameters along one axis was exposed by gradient analysis. We observed a clear ecotopic differentiation of ecospace ("ordination fields") of steppe agglomerative associations, formed on chernozems. To find out character and role of ecofactors changeability related to structure genesis and representation of self-development processes and some functional peculiarities of associations we used ordination of different-age states of stationary areas in the system of coordinates of the mentioned factors. We determined that fluctuation corridors on the ordination field of ecofactors of humidity and thermal conditions turned out to be very close.

Having conducted a two-factor dispersion analysis we stated that according to the number of vegetative stems all the presented species had no considerable difference between juvenile and sinil individuals. *Stipa dasyphylla*, *Stipa maeotica*, *Stipa disjuncta*, *Stipa ucrainica*, *Stipa lessingiana*, *Stipa anomala* don't differ in individuals at the stages j, g3 and SS. Individuals of *Stipa maeotica* that were at the stages g1, g2, g3 didn't differ according to the number of generative stems from g1 of *Stipa disjuncta*, *Stipa ucrainica*, *Stipa Lessingiana*. Besides, plants of *Stipa maeotica*, *Stipa lessingiana*, *Stipa disjuncta*, *Stipa dasyphylla* didn't considerably differ according to the number of generative stems SS.

According to the number of inflorescences individuals of all the species that were at generative stage almost didn't differ. But there's a considerable difference between them and sinil and virginal stages as inflorescences don't appear at the stages of ontogenesis.

Studying *Stipa* populations and factors that have negative effects on them we discovered the following facts. Comparing projecting cover of plants on the areas where *Caragana frutex* (L.) Koch and areas free from it or areas with insignificant number of it, we stated that projecting cover of different species of genus *Stipa* reduced with the growth of projecting cover of *Caragana frutex* (L.) Koch. Historically these plants should not compete, but taking into consideration the weakened state of *Stipa* populations, we can conclude that *Caragana* ousts species of genus *Stipa* from occupied biotopes, which leads to disturbances on the phytocenotic level.

With 52% of projecting cover being covered by *Caragana*, *Stipa* falls out of phytocenosis. It was found that the most sensitive to *Caragana's* influence were the following species: *S. grafiana*, *S. lessingiana*, *S. ucrainica*. Thus, in 2007 projecting cover of *Caragana* on the areas with these species was as high as 50%, while projecting cover of *Stipa* made up less than 1%. In 2008 projecting cover of *Caragana* on these areas increased up to 55%, and *S. grafiana*, *S. lessingiana*, *S. ucrainica* fell out of phytocenosis, in accordance with our prognostication. Level of abundance of the majority of the species of genus *Stipa*, according to O. Drude's scale, was determined by the score cop1. Usually the role of such plants in forming an areas' appearance is not really significant, but the species of genus *Stipa* can influence the look of vegetation considerably, especially during fruiting.

Researching age spectra of the species of genus *Stipa* we determined that populations of all the species of *Stipa* are incomplete according to their age structure and are characterized by domination of generative individuals. It is also determined that age spectra of all the populations with moderate pasture maximum of individuals are generative (over 53%) that proves accumulation of individuals in these populations, which is related to high life duration of individuals in this period of ontogenesis. Populations with moderate pasture also lack individuals of young part of spectrum.

Fluctuation of age spectrum changes in model populations are presented in diagram (fig. 1).

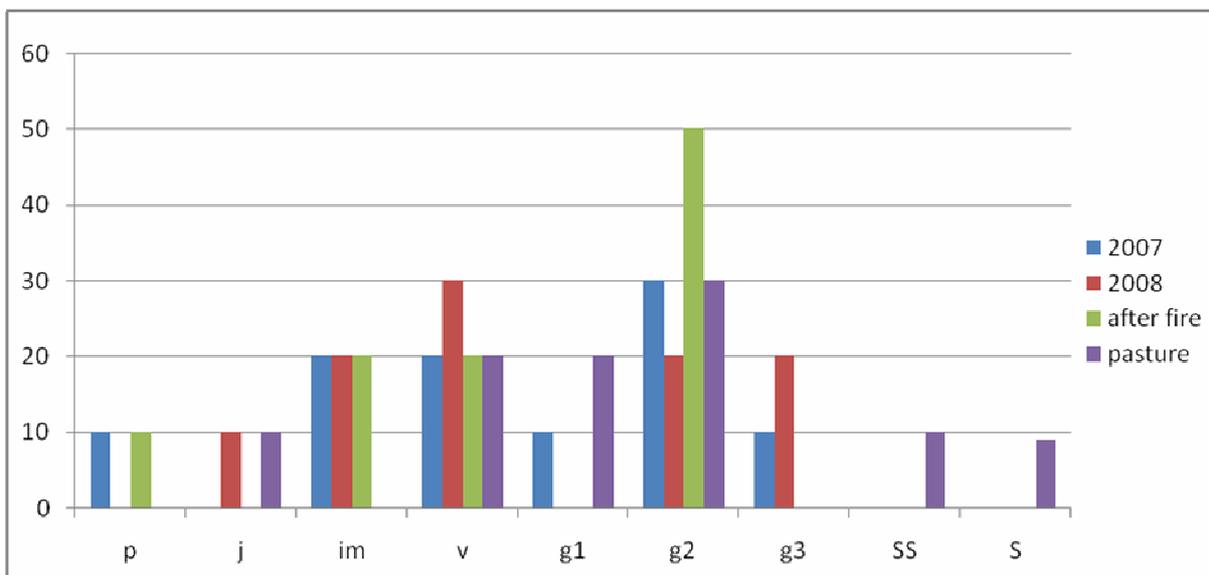


Fig. 1. Fluctuation of age spectrum changes in populations of *Stipa capillata* L.

We have stated that in the conditions of anthropogenic pressure considerable territories contain groups that are at different stages of degradation, where the experimental species of *Stipa* are being excluded by those of little value or disappear. In the cases when anthropogenic impact causes disappearance of these species from vegetable groups, there is a necessity of their reintroduction.

One of the conditions of choosing the place for the research work was availability of territories with thin vegetable cover at the moment of plants transplantation, which would ensure a further possibility of their seed reproduction.

Experimental data prove that the researched species of plants are violents according to their strategy, and they play a considerable role in cenoses, having cenotic status of dominants (mostly) or subdominants. As regards to moisture, most of them are xerophytes, mesoxerophytes (*Stipa dasyphylla*, *Stipa pennata*, *Stipa borystenica*) or euxerophytes (*Stipa lessingiana*, *Stipa zalesskii*), as regards to light – heliophytes. The overwhelming majority of the researched species are presented by not numerous isolated populations that take small areas (compared to potentially possible). Generative reproduction plays an important role in self-support of these species populations. The

majority of the populations are characterized by incompleteness of age spectra. Such populations lack separate age groups, more often pre- and post generative individuals. Incompleteness of separate populations are related mostly to anthropogenic factors. Some natural populations of certain species (*S. borystenica*, *S. ucrainica*, *S. tirsia*, *S. grafiana*, *S. anomala*) need purposeful improvement by way of reintroduction.

By the results of active and passive monitoring of the state of populations we have made up a working scheme-project of activities as for preservation and renewal of steppe areas of the RLP.

### Conclusion

1. As a result of the inventory on the territory of the RLP "Kleban-Byk" 13 species of *Stipa* were determined. This is indicative of high floristic representation of the territory as for this species and it grounds the research and realization of the general aim of the scientific work.

2. In the course of the research it was stated that the age state of the populations is not satisfactory and demands reintroduction measures. In cases when anthropogenic impact leads to disappearance of these species from the complex of vegetable groups, there is need of their reintroduction, its successfulness having been proved for *S. dasyphylla* and *S. capillata*.

3. It was proved that by decreasing the number of *Caragana* and vegetable steppe bedding as well as by balanced recreational tension it's possible to improve the state of populations of *Stipa* and to preserve their number in the RLP "Kleban-Byk".

4. It was stated that *S. borystenica*, *S. ucrainica*, *S. tirsia* are under the most threat of disappearing from steppe ecosystems. *S. grafiana*, *S. anomala* are threatened to a great extent, too. *S. dasyphylla*, *S. capillata* and, probably, *S. maeotica* must become dominant.

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**Сафонов А. И., Бандурко В. В. Демографический анализ видов рода *Stipa L.* на территории регионального ландшафтного парка "Клебан-Бик".** – В результате инвентаризационных работ на территории РЛП "Клебан-Бик" было определено 13 видов ковылей. Большинство видов рода *Stipa L.* имели регрессивные популяции или тенденцию к регрессивности и сниженный уровень возобновления особей; если не принять специальные меры, то видовое разнообразие ковылей в фитоценозах РЛП уменьшится.

*Ключевые слова:* *Stipa*, мониторинг, реинтродукция, экониши.

**Сафонов А. И., Бандурко В. В. Демографічний аналіз видів роду *Stipa L.* на території регіонального ландшафтного парку "Клебан-Бик".** – У результаті інвентаризаційних робіт на території РЛП "Клебан-Бик" було визначено 13 видів ковил. Більшість видів роду *Stipa L.*, що зростають на території РЛП "Клебан-Бик", мали регресивні популяції або тенденцію до регресивності й знижений рівень відновлення особин; якщо не вжити спеціальних заходів, то ковили у фитоценозах РЛП значно зменшаться.

*Ключові слова:* *Stipa*, моніторинг, реінтродукція, екониші.