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ACCELERATED STEPPE DEMUTATION (ECOLOGICAL RESTORATION) AS AN EFFECTIVE METHOD FOR RESTORATION OF THE CRIMEAN STEPPE LANDSCAPES

PRZYŚPIESZONA DEMUTACJA STEPÓW (PRZYWRÓCENIE EKOLOGICZNE) JAKO SKUTECZNA METODA RENOWACJI KRYMSKICH KRAJOBRAZÓW STEPOWYCH

***Key words*: Steppe, landscape, accelerated demutation (ecological restoration), Kerch peninsula

Słowa kluczowe: step, krajobraz, przyśpieszona demutacja (przywrócenie ekologiczne), Półwysep Kerczeński

Abstract

Accelerated steppe demutation (ecological restoration) is an effective method for restoration of the Crimean steppe landscapes. Critical state of steppe type of vegetation is analyzed, the slow rate of natural demutation is assessed, the urgency of measures for accelerated restoration of steppe habitats is argued for. Data on flora of steppe areas of the Kerch peninsula steppe used as the bank for seed material are provided, as well as the data of the vegetation at the areas chosen for accelerated restoration. The experiment on accelerated demutation has been conducted following the method by D.S. Dzybov with the author's modifications.

Streszczenie

Artykuł omawia stan krytyczny roślinności naturalnej krymskich stepów, wskazuje na wolny przebieg naturalnej demutacji i uzasadnia konieczność prowadzenia prac przyśpieszających odradzanie się stepowych fitocenozów. Scharakteryzowano florę obszarów stepowych Półwyspu Kerczeńskiego służących za obszary źródłowe materiału nasiennego oraz stan roślinności w obrębie obszarów, wytypowanych do demutacji roślinności stepowej. Eksperymentalne prace demutacyjne wykonano wg zmodyfikowanej przez autorów metody D.S. Dzybowa.

INTRODUCTION

By the middle of the 20^{th} century, it has been evident that the man virtually exterminated steppe habitats in the course of the economic activities: 90% of steppe areas have been transformed to agrosystems (Mordkovich et al., 1997). Remaining 10% are the steppe reserved areas of incidentally preserved steppe fragments and degraded steppe communities of Eurasia. Deep destructive changes are regrettably usual for the most of contemporary steppes of Ukraine and Crimea (Didukh et al., 1998; Dzens-Litovskaya, 1970; Vakhrusheva and Dragan, 2002). Little effectiveness of steppe conservation within the reserved areas and little representation of steppe areas within natural reserves were suggested also (Isaeva-Petrova et al., 1983). The choice of regime of conservation and management is disputable because the highest level of conservation led to the reserve-induced succession, so the steppe lost its original structure (Vedenkov, 1979; Tkachenko, 1984, 2004; Vakhrusheva and Krainyuk, 2005). The accent changed from the conservation to the restoration of original habitats (or at least of their analogues). The rate of natural demutation as long as 50-70 years (Kondratyuk and Chuprina, 1992) does not match present social requirements. So the restorative approach in ecology has been developed since the early 20^{th} century. The first experiments in demutation were conducted by John Curtis (1913-1961) (from Mirkin, 2010). The method of accelerated restoration of steppes was enthusiastically developed in Ukarine and Russia, the countries lost much of their natural steppe vegetation (Vedenkov, 1997; Kondratyuk and Chuprina, 1992; Dudar, 1976; Dzybov, 1995; 2010; Dzybov and Denshchikova, 2003). While planning demutation measures, it is necessary to consider that communities never migrate in whole. Only a certain species can form a diaspora. Cenoses can form at a certain habitat only, in course of adaptive strategies of the taxa. This approach is considered in the method of accelerated steppe demutation developed by D.S. Dzybov in 1995 to 2010.

Since natural vegetation has been preserved at only 2% of original area in the lowland Crimea (Gurzuf, 1997), restoration of steppe habitats is critically important for this region. The most suitable area for it is the Kerch peninsula. The most of non-agricultural lands need optimization and restoration. However, the percentage of natural vegetation at the Kerch Peninsula is larger than in other Crimean lowlands, about 9% at present (Novosad, 1992), so these steppe areas can be a necessary source for seeds of typical steppe plants for steppe restoration.

OBJECT AND METHODS OF STUDY

Two types of areas were chosen as the objects of study: 1 – preserved areas of steppe vegetation belonging to forb bunchgrass steppes chosen as the source of seed material for the "portrait model" of the steppe being restored; 2 – degraded areas representing the last stage of pasture regression to be restored. The standard geobotanical study was conducted at the chosen areas: full floristic composition was identified, rhythms of phonological development were studied and quantitative ratios of species in in projective cover were calculated (Shennikov, 1964; Rabotnov, 1992).

Collection of the seed material was conducted following the method by D.Dzybov (2001) recommended for the forming of "portarait model" of the steppe. However, the method was modified for this study. To catch all the species diversity, four mowings were conducted, from early June to late September. Areas chosen as the sources of seed material were used in the following way: the first and the third mowing were conducted at one area, and the second and the fourth mowing at another area, given that the vegetation at all areas is the same syntaxon. This approach allowed to take seeds of 12 to 15 species each time; inflorescences of the next generation are inevitably damaged during this process, so the next mowing was conducted at another area and after that returned to the area 1. As a result, seeds of almost all species were mowed in the natural ratios.

RESULTS AND DISCUSSION

The area at the flat top of the ridge with south carbonate chernozem soil was chosen as the etalon for the restoring "portrait model" of steppe. At such areas, typical feather grass communities usually develop where the clearly distinct dominants are *Stipa lessingiana var.* Braunerii and *S. ucrainica* P.Smirn. Usual co-dominants are *Festuca rupicola* Heuff., *F. valesiaca* Gaudin , *Galium ruthenicum* Willd., *Coronilla varia* L. In late July, the presence of *Stipa capillata* L. is being expressed in small quantities. Its aspect is low because its cover is less than 10%. Typical steppe true grasses are represented by *Festuca rupicola, Poa bulbosa* L., *Koeleria cristata* (L.) Pers, *Melica taurica* C.Koch. Also genuine steppes of the Kerch peninsula are characterized by presence of mesoxerophilous and xeromesophilous grasses (in addition to euxerophilous ones): *Dactylis glomerata* L , *Bromopsis riparia* Rehm. Holub, *B. inermis* Leys. Holub. So the fluctuating variation of steppe communities is enabled: in years with high precipitation, these species together with *Galium ruthenicum* Willd. and *Coronilla varia* L. rise in abundance and form mesoxerophyte steppes at the place of euxerophyte ones. Such an event took place in 2011. That is why during this study, instead of most feather grass and sheep fescue phytocenoses, forb mesoxerophyte variants of genuine steppes formed: these were the associations of Stipeto-Galietum coronilliosum, Stipeto-Coronillietum festucosum, Stipetum galiosum, Stipeto – Salvinietum stiposum. Total foliage projective cover at maximum was 100%, with the 10% overlap. The distinct dominants were *Galium ruthenicum, Coronilla varia, Stipa lessingiana* and *S. ucrainica;* their total cover was up to 50%. 30% were covered by *Galium ruthenicum* and *Coronilla varia*. Secondary but ever-present members were *Salvia nutans* L., *S.nemorosa* L., *S. austriaca* Jacq., *Teucrium polium* L., *Phlomis taurica* Hartwiss et Bunge, *Dianthus pallens* Sibt. et Smith, *D. capitatus* Balb.ex DC., *Senecio grandidentatus* Ledeb., *Medicago romanica* Prod., *Astragalus asper* Jacq., *Stachys atherocalix* C. Koch. , *Filipendula vulgaris* Moench, *Inula oculus christi* L., *I. ensifolia* L. Single specimens recorded were *Artemisia taurica* Willd., *Marrubium peregrinum* L., *Salvia aethiopis* L, *etc.* From

April to May, *Iris pumila* L., *Muscarimia muscari* L. Losinsk. ,*Verbascum phoeniceum* L., *Tulipa gesneriana* L. were present, and in early June the clearly distinct sinusia of geoephemeroids was composed by *Bellevalia sarmatica* (Georgi.) Woronow and *Ornithogalum ponticum* (Zahar.); their percentage at some areas is up to 6-10% of the projective cover. Among the annual plants with short-term vegetation there are *Medicago minima* (L.)Bartalini, *M.agrestis* Ten, *Trifolium arvense* L., *Lathyrus aphaca* L., *Galium tenuissimum* Bieb., *Briza elatior* Sibt. et Smith, *Valerianella turgida* (Stev.) Batcke, *Holosteum umbellatum* L .From mid-May to early June they developed total cover of about 30%. To obtain the seed ratio close to their percentages in the herbage of the etalon steppe, the first mowing was conducted at the Area 1 in early June, the seeds of main ephemerae and ephemeroids were taken (as seeds not fanned out). Then the day temperatures rose high, and the seed ripening accelerated, so the second mowing was conducted at the Area 2 in late June. It composition included seeds of lately ripened *Bellevalia sarmatica* and *Ornithogallum ponticum* but mainly corresponded to the percentages of true grasses. The third mowing brought dicotyledons forming the forb sinusia of the etalon steppe: *Galium ruthenicum, Coronilla varia, Salvia nutans, S.nemorosa, Salvia aethiopis, Teucrium polium, Phlomis taurica, Verbascum phlomiodes* L., *Euphorbia seguierana* Neck., *Marrubium peregrinum, Stachys atherocalix*, *Astragalus asper* Jacq., *Medicago romanica* Prod.; Poaceae were represented by *Stipa capillata.*This mowing was conducted on August 20, at the Area 1 again. The fourth mowing is necessary for including the plants with late-ripening seeds. These species were not abundant; however they are ever-present components of genuine steppes of the Kerch peninsula: *Limonium gmelinii (*Willd.) O. Kuntze , *L. mejeri(*Boiss.) O. Kuntze, *Goniolimon tataricum* (L.)Boiss., *Artemisia taurica, Crinitaria linosyris* (L.) Less., *Verbascum phlomoides, Marrubium peregrinum, Salvia aethiopis*, etc.

Total weight of the sample was 2,437 kg. After mowing the mix was dried and placed to the dry well-ventilated shedder in open bags. The seeding was conducted as 10 kg of the mix per ha. Before the seeding, to reduce dispersion, the seeds were mixed with wet sand because the weather was windy during the seeding season that could lead to significant loss of seeds and their uneven dropping. The area chosen for demutation matched the principle of ecological relevance in soil quality and the ectomorphs of plant species. The favourable factor is the adjoining area of virgin steppe, the source of natural inspermation. The area is 10 ha; it is situated in Djailav site and is an abandoned field, which demutation was interruputed by the using the area as a pasture. At present, the ruderal association of *Elytrigio-Centauriosum diffusae* is developed there. In addition to two dominants, the following species grow at the area: *Bromus squarrosus* L., *B.mollis* L., *Cynodon dactylon* (L.)Pers., *Hordeum leporinum* Link., *Lolium perenne* L., *Lappula patula (*Lehm.)Menyharth., *Carduus nutans* L., *Carthamus lanatus* L., *Consolida orientalis* (J. Gay*)* Schroding, *C. paniculata* (Host.)Schur., *Achilea nobilis* L., *Trifolium arvense,Centaurea solstitialis* L., *Carduus hamulosus* Ehrh., *Medicago minima, Holosteum umbellatum, Papaver rhoeas* L., *Tulipa gesneriana* , *Muscarimia muscari*. The presence of two latter species is the evidence for a positive direction of natural restoring succession, so it is suggested that the seeding of typical steppe plants would lead to successful restoration of structure of the steppe phytocenosis of optimization of steppe biotopes of the Kerch peninsula in whole. By the end of the first vegetation period 42 plant species were recorded at the area; 80% of them were typical steppe plants and 20% were ruderal steppe species.

The process of anthropogenic press is global; it hinders the conservation of the areas suitable for establishment of reserved areas, environmental networks and corridors. So at present the protection unique, etalon and rare components of flora, vegetation and habitats requires the transition to active intrusion into demutation processes: abandoned lands should be included into active succession process. To perform these measures, it is necessary to find natural floristic and cenotic complexes in preserved fragments of natural steppe habitats of Crimea: they can be used as models for creating new communities. These areas are rich in floristic and cenotic elements, the bearers of historically formed floristic and cenotic genetic pool, which is the base for habitat diversity.

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