

VEGETATION OF THE BIRJUČIJ ISLAND SPIT IN THE AZOV SEA. SAND STEPPE VEGETATION

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Abstract: The syntaxa of the near-natural sand steppes (class *Festucetea vaginatae*) and their substitutes due to trampling (*Chenopodietae*) were studied in 1991 during the Ukrainian-Czech expedition to the Birjučij Island Spit (Azov Sea, Ukraine). Within the alliance *Festucion beckeri* VICHEREK 1972 (class *Festucetea vaginatae* SOÓ 1968 emend. VICHEREK 1972, order *Festucetalia vaginatae* SOÓ 1957) three associations and five communities without rank are described, covering the vegetation variability along gradients of sand stabilization/soil development and salinization/moisture. Further, two associations of the class *Chenopodietae*, due to deer influence, are described. Four associations (*Centaureo odessanae-Stipetum capillatae*, *Poo bulbosae-Caricetum colchicae*, *Secali-Cynodontetum dactyli* and *Heliotropio dolosi-Brometum japonici*) are described as new.

INTRODUCTION

The present study sums up the first results of phytosociological and synecological investigations carried out in the year 1991 during the expedition of Ukrainian and Czech geobotanists to the Birjučij Island Spit in the Azov Sea, Ukraine. The aim of this expedition was to elaborate a survey of vegetation variability on the Birjučij Island Spit, to map the territory and judge the influence of deer on its vegetation. Though the research was limited to a relatively small spit in the north of the Azov Sea, the results obtained concerning the syntaxonomy, synecology and syndynamics of the sand steppe vegetation are relevant to a wide region adjacent to the northern part of the Azov Sea.

INVESTIGATED AREA

Since 1986, the Birjučij Island Spit has become the centre of interest for Ukrainian geobotanists. Their first investigations were devoted to phytomass productivity and the possible use of spectrazonal photos for geobotanical studies (in prep.).

The Azov-Sivaš Hunting Ground was established over a greater part of the spit area in 1927 to acclimatize introduced deer, above all, stags. Since 1990, 2500 stags (*Cervus engelmani*, *C. dama* and other stag species), 600 mouflons (*Ovis* sp. div.), and 20 donkeys (*Equus hemionus*) were acclimatized there (cf. BOLDYENKOV 1987). Their influence is not the same in different places of the given territory. Most intensively endangered are sand dunes with many plants of high nutritive value (*Fabaceae*).

In April 1993, the Azov-Sivaš Hunting Ground was registered as the Azov-Sivaš National Natural Park, the fourth National Park of the Ukraine. On its territory, a protected zone with a strongly regulated regime was introduced.

Geomorphology, Geology

The territory under study consists of a narrow, 40 km long and 3-5 km broad area extending from SW to NE into the NW part of the Azov Sea. Though it is usually denoted as "Island Birjučij", in fact it is a peninsula occasionally separated from the mainland at its lowest part by high floods. It occupies the proximate part of the Black Sea depression filled in with a thick layer of Palaeozoic, Mesozoic and Cenozoic sediments. The basic geological bedrock of the recent landscape is formed by Upper Pliocene sand-loamy deposits lying on Pontic limestones. In the region near the Sivaš these Pliocene deposits are covered by layers of loess and loess loams as well as marine and lacustrine loamy, clayey and sand-shelly sediments; their thickness amounts to 25-50 m.

The Azov-Sivaš Steppe Region belongs to the lowest regions of the southern steppe subzone. Along the Sivaš and on the shores of the Azov Sea the elevation is only 5-10 m a.s.l., on the islands even less. The higher SE shore of the peninsula washed by the Azov Sea rises as a sandy wall to a height of 1.5-5 m. The low NW part of the territory adjacent to the Utljuk liman (Fig. 1) is divided into a great number of tiny bays. Here flat areas consisting of the sand-shelly substrate and colonized by steppe vegetation alternate regularly with solonchak depressions running in the direction of the orientation of the whole territory.

Climate

The climate is of the continental type (cf. BUČINSKIJ 1960, 1963). The vegetation period takes 230-250 days. The first slight autumn frosts come in the third decade of October, the last spring frosts at the beginning of the second decade of April, the frostless period being 120-200 days. The mean depth of the snow cover is 5-10 cm, it lies for 30-40 days. The average annual temperature is 9-10 °C, the average June temperature 20-24 °C (maximum 38-40 °C). The average January temperature does not fall below -3 °C. However, very hard frosts (up to -34 °C) are also to be observed here. The yearly precipitation is very low (300-350 mm); the average annual sum of evaporation is very high (900-1000 mm). Summer and spring-summer breezes blowing from the sea to the land by day, at night in the opposite direction, are typical. During the warm season NW winds prevail.

Soils and vegetation

The soils of the investigated area belong to various types (see VERNANDER et al. 1951, DZENS-LITOVSKAJA 1951). There have been recorded:

1. Sands: On non-stabilized sands, only single psammophilous plants are to be found; stabilized sands are covered by sand dune vegetation of the class *Honckenyo-Elymetea*, rarely *Festucetea vaginatae*.

2. Primitive sand-shelly chestnut-coloured sand-steppe and salt-meadow soils with varying content of humus, sand or sea shells and with varying salinity: Within this group especially moderately humus-rich salt-steppe soils occur very frequently. At the depth of ca. 50-80 cm, a layer of shell fragments cemented with sand ("rakušečnik") has been built up, on which the precipitation water accumulates ("verchovodka").

3. The very rare chestnut-coloured meadow soils with an admixture of shell material and varying percentage of sand and/or loam material and with differing salinization intensity: These soils occur at sites with fresh groundwater lying at the above mentioned depth of about 0.5 to 0.8 m ("verchovodka"). They are covered by meadow vegetation (*Cynodon dactylon*, *Elytrigia elongata*, *Calamagrostis epigeios*) with a slight admixture of steppe elements and halophytes.

4. Swampy meadow carbonate soils of analogous properties: Slightly solonchak-like soils of different texture fill in the landscape depressions with swampy (*Phragmites australis*) and halophilous vegetation (*Juncus gerardii*). The groundwater contains 30-50 g/l of salt. In restricted areas there are also non-salty swampy meadow soils dominated by *Phragmites australis*.

5. The solonchaks are represented by two groups, viz. by the swampy solonchaks and the sors, so called "sory". The swampy solonchaks are clay-loam-sandy. Salinization by Cl-ions is typical for the initial stage of solonchak development. The forming of sors characterized by the dominance of *Salicornia europaea* is conditioned by the shift of salts from the

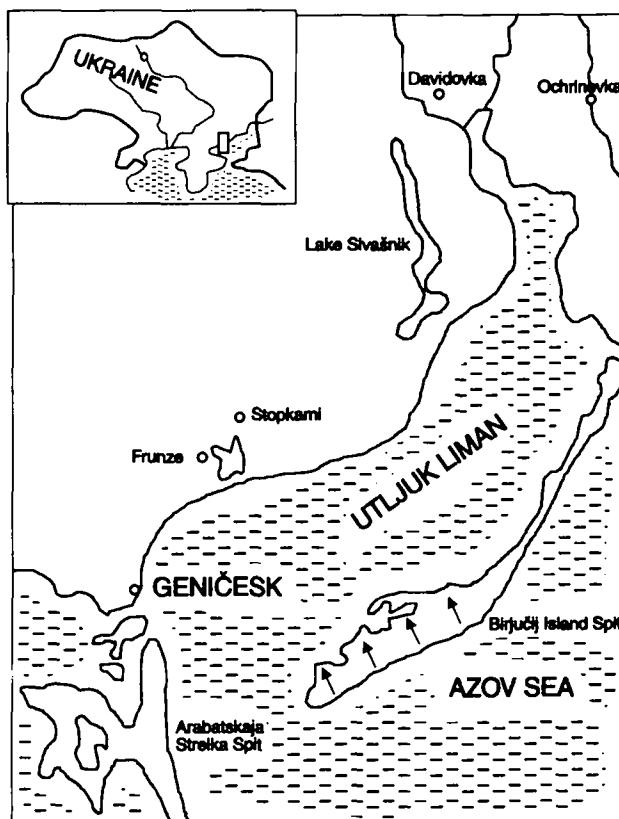


Fig. 1. Schematic map of the area. Arrows indicate the transects along which the vegetation was studied. → - Profiles 1-4 (numbered from SW to NE). The box shows the location of the main map within Ukraine.

groundwater table towards the soil surface. The groundwater table lying at the depth of 1.0-1.6 m favourably influences the growth of both herbs and woody plants.

Phytogeography

Since the very beginning of this century, the flora and vegetation of the Azov coast (incl. the investigated area) has been the centre of interest for many botanists (cf. DZENS-LITOVSKAJA 1951, 1954, KRASNOV 1902, POPOVIČ 1938, POSTRYGAN' 1939, etc.). The territory under study belongs to the zone of steppes (Pontic steppe province, cf. ŠELJAG-SOSONKO et al. 1982). In their composition rootstock grasses and *Artemisia* species prevail. The intrazonal vegetation of the Birjučij Island Spit is represented first of all by psammophilous steppes and "meadow" swampy vegetation types. Furthermore, salt (steppe) meadows, solonchak vegetation and pioneer psammophilous vegetation ("gruppirovki") are to be found here. The flora of the Birjučij Island Spit comprises less than 500 species (cf. DZENS-LITOVSKAJA l.c., KOTOV 1928, KOTOV & PRJANIŠNIKOV 1937, POSTRYGAN' 1939, etc.).

In the investigated area, the psammophilous species of sand steppe and dune vegetation prevail (ca. one half of the total number of species). Elements of halophilous meadows comprise 18%, the remaining species belong to the solonchak and solonetz vegetation, reeds, as well as synanthropic vegetation. In the biomorphological spectrum of the Birjučij Island Spit vegetation, the prevalence of polycarpous herb species (70%) is typical. The amount of monocarpous annuals (20%) is also rather high.

The presence of deer contributes to the occurrence and distribution of synanthropic plant species and communities. Many non-indigenous tree species have been planted in the area since 1914.

From the phytogeographical point of view, more than 18% of the total number of species are Pontic-Caspian endemics, more than 17% are species with European distribution, while only over 12% are Eurasian species. The remaining species correspond to North-American, circumpolar and pluriregional ones. There are many interesting species of the sand steppe vegetation, such as Pontic-Caspian endemics *Centaurea borysthenica*, *Corispermum ucrainicum*, *Limonium platyphyllum*, Pontic endemics *Centaurea odessana*, *C. paczoskii*, *Senecio borysthenicus*, *Tragopogon borystenicus*, *T. ucrainicus*, *Apera maritima*, South-Pontic endemics *Centaurea majorovii*, *Helichrysum corymbiforme*, *Limonium meyeri*, *Agropyron dasyanthum*, *A. lavrenkoanum*, *Syrenia cana*, *Cerastium syvaschicum*, *C. ucrainicum*, *Dianthus campestris*, *Medicago kotovii*, West-Pontic endemics *Asperula setulosa* and *Dianthus guttatus* etc., from the rare species also *Allium guttatum*, *Koeleria cristata*, *Onosma borysthenica*, *Asparagus levinae*, *Syrenia siliculosa*, etc.

The flora of the investigated area is rich in economically important species, as well as forage (*Medicago*, *Melilotus* species), ornamental (*Centaurea adpressa*, *Echinops sphaerocephalus*, *Limonium* species) and medical plants (*Ephedra distachya*, *Helichrysum*, *Achillea* sp. div.). Of protected plants *Stipa capillata* and *Stipa borysthenica* are included in the first version of the Ukrainian Red Data Book (ČOPYK 1980). Five species are proposed for protection in the second, newly prepared version (*Astrodaucus littoralis*, *Astragalus littoralis*, *Crambe pontica*, *Medicago kotovii*, *Thalictrum foetidum*).

METHODS

During the Ukrainian-Czech expedition in 1991, the vegetation was studied along 4 ecological profiles (see Fig. 1). In the investigated territory, the profiles were chosen in the most typical and representative places, primarily according to the geomorphological structure which is the most important factor determining the distribution of vegetation on the spit. The transects were based by the overmarine spit base where the processes of spit formation are most intensive. The choice of relevés on the transects depended on the relief, aiming to record all relief elements.

About 150 relevés according to the BRAUN-BLANQUET approach (BRAUN-BLANQUET 1964) were recorded. Plant taxa were determined by the first author together with other Ukrainian botanists (V.V. Protopopova and others), mostly according to PROKUDIN (1987). The dominance of the species expressed originally for more detailed studies in percentages, was transformed into the Braun-Blanquet scale. The relevés of sand steppe and salt meadow vegetation were recorded on an area of 50-100 m², those of the halophilous vegetation on ca. 10-30 m². The association is understood as a basic phytosociological unit unifying phytocoenoses, conforming mutually from the viewpoint of floristic composition, organization, ecology, syndynamics and syngenetics and occupying a certain geographical area. The word "community" is used to denote a concrete stand (phytocoenosis). In the name of a vegetation unit, this term is used for a unit of undetermined rank, i.e. lacking the above parameters. The names of syntaxa correspond with the Code of Phytosociological nomenclature.

The sand-steppe communities distinguished in the investigated territory were compared with analogous sand-steppe communities of the Ukrainian Black Sea coast and Dnieper sand region, and of the Pontic region of Romania, Bulgaria and of Greece. Among the most important sources are the papers by DESJATOVA-ŠOSTENKO (1928), DESJATOVA-ŠOSTENKO & LEVYNA (1935), KORŽENEVSKIJ (1987), KORŽENEVSKIJ & KLJUKIN (1986, 1990), MIRKIN et al. (1988, 1989), MORARIU (1957, 1959), OBERDORFER (1952, 1954), PORECKIJ (1929), PAČOSKI (1927), SOLOMEČ et al. (1988), ŠALYT (1939) and VICHEREK (1972).

The soil analyses were performed by A.V. Miroljubov. The authors thank him for his kind help.

GENERAL CHARACTERISTICS OF SAND STEPPE VEGETATION

The psammophytic steppes are herb-rich vegetation with prevailing *Festuca beckeri*, *Stipa borysthenica*, *S. capillata*, *Carex colchica* or *Scirpoides holoschoenus*. The coverage of these sand steppes is lower than in herb-grass steppes on the heavy soils of the Continent. In a moister summer, spring ephemerals, summer-autumnal annuals and biennials begin to develop rapidly. A ground layer is formed by lichens of the genus *Cladonia* (*C. convoluta*, *C. rangiformis*, *C. alcicornis*) and *Parmelia kamtschadalensis*, rarely also by *Calophaea lactea* and *Cornicularia steppae* and by moss *Tortula ruralis*. In the floristic composition, psammophytes of the class *Festucetea vaginatae* prevail. Besides the seminatural vegetation, steppes markedly influenced by pasturing are also to be found here. In the heavily grazed steppes, elements of pasturing degression are typical: on the one hand the frequent occurrence of herbs avoided by animals (*Helichrysum corymbiforme*, *Euphorbia seguieriana*), on the other hand the abundant occurrence of annual grasses (*Secale sylvestre*, *Bromus squarrosus*, *Anisantha tectorum*, *Bromus japonicus*, etc.).

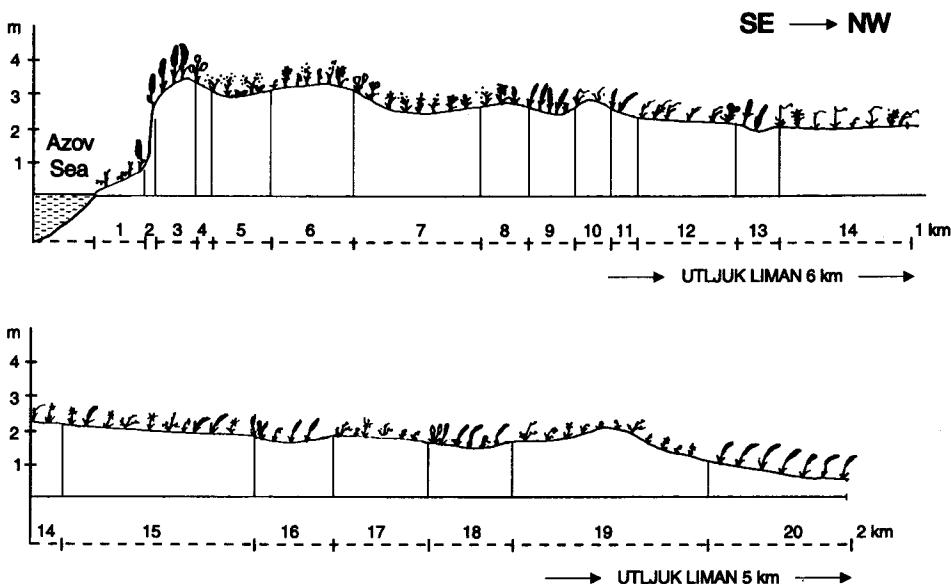


Fig. 2. Distribution of the vegetation along the transects (simplified). 1 *Cakiletea maritimae*, 2 *Tournefortietum sibiricae*, *Salsola soda*-*Leymus sabulosus* comm., 3 *Elymo-Astrodaucetum littoralis*, degrad. phase with *Helichrysum corymbiforme*, 4 *Medicago kotovii*-*Crambe pontica* comm., *Helichrysum corymbiforme*-*Festuca beckeri* stage, 5 *Carex colchica* stage, *Scirpoidea holoschoenus* comm., *Medicago kotovii* stage, *Ephedra distachya*-*Silene subconica* comm., 6 *Carex colchica* stage, *Festuca beckeri* stage, *Helichrysum corymbiforme*-*Festuca beckeri* stage, *Poo-Caricetum colchicae*, 7 *Carex colchica* stage, *Secali-Cynodontetum dactyli*, 8 *Poo-Caricetum colchicae*, *Scirpoidea holoschoenus* comm., 9 *Artemisio-Elytrigietum elongatae*, *Cynodon dactylon*-*Elytrigia elongata* comm., 10 *Secali-Stipetum borysthenicae*, *Festuca beckeri* stage, *Secali-Cynodontetum dactyli*, 11 *Artemisio-Elytrigietum elongatae*, *Calamagrostis epigeios* comm. and other types of salt meadows, 12 *Secali-Stipetum borysthenicae*, *Helichrysum corymbiforme* stands, *Secali-Cynodontetum dactyli*, 13 *Cynodon dactylon*-*Elytrigia elongata* comm., 14 *Secali-Stipetum borysthenicae*, *Heliotropio dolosi*-*Brometum japonici*, 15, 17 *Heliotropio dolosi*-*Brometum japonici*, *Cynodon dactylon*-*Elytrigia elongata* comm., 16, 18 *Calamagrostis epigeios* comm., *Carex extensa* comm. and other types of salt meadows, 19 *Heliotropio dolosi*-*Brometum japonici*, 20 *Artemisio-Elytrigietum elongatae*.

In contrast to the salt meadows, which occur on rich substrate, the sand steppes typically have a poor substrate. In the vicinity of the sea, sand steppes develop on the sites facing the sea under the long-term influence of sea water on the soil development. On the sites turned away from the sea, salt meadows are more frequent. In the centre of the Birjučij Island Spit the influence of relief on the location of sand steppes and salt meadows is less distinct and the influence of xerophytization begins to prevail (see Fig. 2). The "verchovodka" linked with depressions (see above) disappears, the habitat is substantially drier; unlike the salt meadows, however, the sand steppes are not temporarily flooded with stagnant water.

Psammophytic steppes occur in the southern part of the Birjučij Island Spit. They form a narrow zone along the shore wall on sand elevations of 1.5-5 m.

Synopsis of studied communities

Class *Festucetea vaginatae* Soó 1968 emend. VICHEREK 1972 (Natural sand-steppe vegetation and substitute psammophilous grasslands with continental distribution)

Order *Festucetalia vaginatae* Soó 1957 (Natural sand-steppe vegetation and substitute psammophilous steppes of the SE-European distribution, occurring on calcareous or non-calcareous sand-dune soils of different acidity)

Alliance *Festucion beckeri* VICHEREK 1972 (Natural sand-steppe vegetation on mostly non-calcareous soils of the Pontic region)

1. *Festuca beckeri* stage
2. *Helichrysum corymbiforme*-*Festuca beckeri* stage
3. *Secali-Stipetum borysthenicae* KORŽENEVSKIJ ex DUBYNA, NEUHÄUSLOVÁ et ŠELJAG-SOSONKO 1995
4. *Centaureo odessanae-Stipetum capillatae* ass. nov.
5. *Carex colchica* stage
6. *Poo bulbosae-Caricetum colchicae* ass. nov.
7. *Ephedra distachya-Silene subconica* community
8. *Scirpoidea holoschoenus* community

Class *Chenopodietae* BR.-BL. in BRAUN-BLANQUET, ROUSSINE et NÈGRE 1952 emend. LOHMEYER, J. TÜXEN et R. TÜXEN ex MATUSZKIEWICZ 1962 (Holarctic nitrophilous communities on hoed soils or disturbed ruderal sites; cf. MORAVEC et al. 1983)

Order *Sisymbrietalia* J. TÜXEN ex MATUSZKIEWICZ 1962 emend. GÖRS 1966 (Nitrophilous communities on disturbed soils of ruderal sites)

Alliance *Bromo-Hordeion murini* HEJNÝ 1978 (Secondary communities of low therophyte grasses on anthropogenic soils of different origin)

9. *Secali-Cynodontetum dactyli* ass. nov.

Order *Polygono-Chenopodieta* J. TÜXEN ex MATUSZKIEWICZ 1962

Alliance *Eragrostion* (R. TÜXEN 1950) OBERDORFER 1954 (Secondary communities of non-stabilized, heavily disturbed sand soils)

10. *Heliotropio dolosi-Brometum japonici* ass. nov.

CHARACTERISTICS OF THE VEGETATION UNITS

Festuca beckeri stage

Most typical, little disturbed, open stands dominated by *Festuca beckeri* occur on elevations and slopes. About 15 species participate in the stands, among them the Pontic endemics *Stipa borysthenica* and *Agropyron lavrenkoanum*. As an example of this stage, the relevé Nr. 1a is presented.

Locality: Southern part of the Birjučij Island Spit, analyzed area 100 m², orient. E, inclination 3°, 5 m a.s.l. Herb layer - 35%, ground layer - 5%.

Herb layer (H): *Festuca beckeri* 2, *Euphorbia seguierana* 2, *Carex colchica* 1-2, *Helichrysum corymbiforme* 1-2, *Secale sylvestre* 1, *Agropyron lavrenkoanum* +, *Ephedra distachya* +, *Alyssum hirsutum* +, *Teucrium polium* +, *Anisantha tectorum* r, *Centaurea odessana* r, *Plantago scabra* r, *Poa bulbosa* r, (*Scirpoidea holoschoenus* r), (*Thymus dimorphus* r).

Ground layer (G): *Tortula ruralis* 1, *Parmelia kamtschadalis* 1.

This stage is formed by open stands with coverage of 20-35%. It contributes to sand stabilization; the period of sand stabilization takes 5-7 years here under gradual lowering of elevations caused by sand blowing away (Fig. 2, sector 6). This initial stage is present during this period.

***Helichrysum corymbiforme-Festuca beckeri* stage**

This community is formed by medium-closed stands (coverage 50-60%). *Helichrysum corymbiforme*, an indicator of light soils of open stands, appears together with *Medicago kotovii*, *Melilotus albus*, *Secale sylvestre* in the not markedly distinguished higher herb layer (about 30 cm). In the lower herb layer (height of about 10-20 cm) *Festuca beckeri*, *Anisantha tectorum*, *Teucrium polium* are abundant.

This stage is linked to sites intensively trampled by deer or sites exposed to wind erosion or to slight burying by sand. It always occurs behind the coastal mound, in the bordering SW part of the territory (Fig. 2, sector 6).

***Secali-Stipetum borysthenicae* KORŽENEVSKIJ ex DUBYNA, NEUHÄUSLOVÁ et ŠELJAG-SOSONKO hoc loco (Table 1)**

Nomenclatural type: Relevé 3 in Tab. 1 (holotype) (Appendix)

Diagnostic species combination: H - *Achillea euxina*, *Agropyron dasyanthum*, *Agropyron lavrenkoanum*, *Allium guttatum*, *Alyssum hirsutum*, *Arabidopsis toxophylla*, *Arenaria serpyllifolia*, *Artemisia santonica*, *Astragalus varius*, *Bassia sedoides*, *Bromus squarrosus*, *Carex colchica*, *Centaurea odessana*, *Cuscuta monogyna*, *Cynodon dactylon*, *Dianthus pseudoarmeria*, *Ephedra distachya*, *Festuca beckeri*, *Medicago kotovii*, *Scirpoides holoschoenus*, *Secale sylvestre*, *Seseli tortuosum*, *Stipa borysthenica*, *Teucrium polium*, *Thlaspi perfoliatum*, *Thymus dimorphus*, G - *Parmelia kamtschadalis*, *Tortula ruralis*.

This association was described by KORŽENEVSKIJ (in KORŽENEVSKIJ et al. 1990). However, according to the Code of phytosociological nomenclature (BARKMAN et al. 1976), his paper cannot be taken for a valid publication and the name has to be validated here.

The stands of this association consist mostly of 25 - 35 species, of which the above mentioned of the diagnostic species combination are most frequent. The locally characteristic species of this community is *Stipa borysthenica*. The species differentiating this association from the closely related *Centaureo odessanae-Stipetum capillatae* are to be seen in Tab. 4. The occurrence of the halophilous species *Artemisia santonica*, *Bassia sedoides*, *Arabidopsis toxophylla* and *Cuscuta monogyna* indicate sea spray. The coverage of stands usually amounts to 45-80%. This lower coverage is a consequence of intensive grazing. The herb layer is characterized by an irregularly mosaic structure. It is divided into two distinct sub-layers, the higher one with the dominant *Stipa borysthenica*, height up to 50 cm, with admixed species *Euphorbia seguierana*, *Secale sylvestre*, rarely *Carduus uncinatus*, and the lower sub-layer (up to 15 cm) with predominance of low grass species (*Poa bulbosa*, *Bromus squarrosus*, *Cynodon dactylon*). A higher participation of *Cynodon dactylon* and/or *Bromus squarrosus* indicates the degradation of stands under the influence of intensive grazing. It results in the recession of sand steppe elements and in the more frequent occurrence of species belonging to synanthropic vegetation. Deer especially seek out species of the family *Fabaceae*

(*Astragalus*, *Trigonella*, *Medicago*) and *Agropyron lavrenkoanum*. The ground layer is sometimes absent, locally it covers more than one quarter of the area. It is poor in species, with *Parmelia kamchadalensis*, *Tortula ruralis* and sporadically also species of the genus *Cladonia*.

The contact communities are usually *Festuca beckeri* or *Helichrysum corymbiforme*-*Festuca beckeri* stages or other types of sand steppes as well as salt steppes. The community occurs on moderate slopes facing S and SE (not SW). The primitive sandy soils remain dry almost all the year round. They are very poor in humus, and their reaction is slightly alkaline to almost neutral. The community is very rare (it covers 1% of the investigated area) and it is confined to the border zones in the SE part behind the coastal mound line. Its distribution area is limited to the North by the territory along the northern coast of the Azov Sea. It occurs also along the lower reaches of the Don, but it does not occur in the Crimea.

By consolidating the sands the community plays an important role in forming landscape. It prepares the substrate for the coming of more exacting species (*Fabaceae*). It represents an ecotope for many invertebrates, above all for insects, and is a typical nesting place of the lark (*Alauda arvensis*). It contributes to the aesthetic value of the landscape and is significant for the preservation of rare plant species (Pontic endemics *Stipa borysthenica*, *Agropyron lavrenkoanum*, *Tragopogon borystenicus*, *T. ucrainicum*, *Centaurea odessana*, etc.).

An analogous community with frequent occurrence of *Stipa borysthenica* was described by VICHEREK (1972) from the Tendra Island (South Ukraine) as *Centaureo odessanae*-*Festucetum beckeri*. It is not possible to identify the *Secali-Stipetum borysthenicae* with the syntaxon of VICHEREK (l.c.), characterized by the higher participation of *Agropyrum junceum*, *Alyssum tenderense*, *Cerastium semidecandrum*, *Centaurea adpressa*, *Koeleria glauca*, *Linaria genistifolia*, *Onosma arenaria*, *Polygonum arenarium*, *Scabiosa ucranica*, *Silene exaltata*, etc., missing in the community of the Birjučij Island Spit. On the contrary, the following frequent species of *Secali-Stipetum borysthenicae* were not recorded in the association of VICHEREK (l.c.): *Achillea euxina*, *Agropyron dasyanthum* et *lavrenkoanum*, *Allium paczoskianum*, *Alyssum hirsutum*, *Arabidopsis toxophylla*, *Arenaria serpyllifolia*, *Astragalus varius*, *Bassia sedoides*, *Bromus squarrosus*, *Cuscuta monogyna*, *Cynanchum acutum*, *Cynodon dactylon*, *Dianthus pseudoarmeria*, *Scirpoides holoschoenus*, *Syrenia cana*, *Teucrium polium*, *Thlaspi perfoliatum*, *Thymus dimorphus*. Both syntaxa are vicariant associations.

Centaureo odessanae-Stipetum capillatae ass. nov. hoc loco (Table 1)

Nomenclatural type: Relevé 9 in Tab. 1 (holotypus)

Diagnostic species combination: H - *Alyssum hirsutum*, *Arenaria serpyllifolia*, *Asperula setulosa*, *Centaurea odessana*, *Cynanchum acutum*, *Cynodon dactylon*, *Dianthus pseudoarmeria*, *Ephedra distachya*, *Euphorbia seguieriana*, *Festuca valesiaca*, *Medicago kotovii*, *Scirpoides holoschoenus*, *Stipa capillata*, *Teucrium polium*.

This association forms open to medium-closed stands with coverage of 25-70%. The herb layer is divided into two distinct sub-layers. The higher sub-layer, achieving a height of about 0.5 m, is formed by the dominant *Stipa capillata*, accompanied by *Euphorbia seguieriana*, *Stipa borysthenica*, *Leymus sabulosus*, *Eryngium campestre*, *Echinops sphaerocephalus*, *Melilotus albus*, *Medicago kotovii*, *Calamagrostis epigeios*, etc. The lower herb sub-layer,

about 15-20 cm in height, consists primarily of low grasses (*Cynodon dactylon*, *Anisantha tectorum*, *Festuca valesiaca*, *F. beckeri*, *Eragrostis minor*) and herbs (*Alyssum hirsutum*, *Arenaria serpyllifolia*, *Asperula setulosa*, etc.).

Though the species diversity of the association is rather high (60 - 70 species in Tab. 1), it does not reach the diversity of feather-grass meadows on the Continent. The number of species in individual relevés is relatively low and only rarely exceeds 30. A higher participation of *Cynodon dactylon* and the occurrence of species typical for disturbed and trampled soils accompanied by a conspicuous decrease in the species diversity of stands is the consequence of long-term grazing. The species of the family *Fabaceae* are very damaged by browsing as well as *Ephedra distachya* represented in the whole territory by low, heavily damaged individuals. The ground layer develops only rarely.

The association is bound to the highest, flat, non-flooded sites in the contact line with salt (steppe) meadows. It occurs on dry, loam-sandy grey steppe soils. In this association *Stipa capillata*, a species demanding a high content of nutrients in the soil, experiences conditions at a limit of its occurrence as a dominant. The community occurs in the central and southwestern part of the Birjučij Island Spit. In this territory it is very rare, its occurrence does not exceed 0.1% of the whole area.

Analogous stands were found on sandy substrates from the Danube to the Don. An analogous community dominated by *Stipa capillata* was studied by PUSCARU-SOROCEANU et al. (1963) as ass. of *Stipa capillata*, variant of the steppe of Dobrogea. In spite of the floristic similarity of the associations mentioned above they represent two separate units with regard to many regional endemics in both of them.

***Carex colchica* stage**

Carex colchica, a species of sandy steppes, in the territory under study forms stands both on non-consolidated and on consolidated sands. On non-consolidated sandy elevations it forms open stands consisting of only a few species resistant to wind erosion and to burying by sand. The following relevé is given as an example of the *Carex colchica* stage.

Rel. Nr. 26. Birjučij Island Spit, profile 1, flat elevation at the western sea side, analyzed area 100 m². Herb layer - 45%, ground layer - 20%.

H - *Apera maritima* +, *Astragalus varius* +, *Bassia hirsuta* +, *Carex colchica* 2-3, *Euphorbia seguierana* 2, *Festuca beckeri* 1, *Helichrysum corymbiforme* +, *Otites salina* r, *Poa bulbosa* r, *Secale sylvestre* 2, *Teucrium polium* 1,

G - *Parmelia kamtschadalensis* 2, *Tortula ruralis* 2.

This succession stage with *Carex colchica* as a dominant will probably develop to the ass. *Poo bulbosae-Caricetum colchicae*.

***Poo bulbosae-Caricetum colchicae* ass. nov. hoc loco (Table 2)**

Nomenclatural type: Relevé 17 in Tab. 2 (holotypus) (Appendix)

Diagnostic species combination: H - *Bassia hirsuta*, *Carex colchica*, *Centaurea diffusa*, *Cynanchum acutum*, *Cynodon dactylon*, *Ephedra distachya*, *Festuca beckeri*, *Medicago kotschyi*, *Poa bulbosa*, *Secale sylvestre*, *Teucrium polium*, *Thymus dimorphus*, G - *Parmelia kamtschadalensis*, *Tortula ruralis*.

These are the stands with *Carex colchica* on consolidated sandy soils. They occur on flat moderate depressions among the dunes. *Carex colchica* forms medium-closed stands with about 60-80% coverage. The herb layer is divided into two sub-layers. The higher herb sub-layer is about 30-40 cm high (*Euphorbia seguierana*, *Chondrilla juncea*, *Eryngium campestre*, *Cynanchum acutum*), the lower one predominantly consists of annual grasses. The ground layer is almost always developed, consisting of *Tortula ruralis* and *Parmelia kamtschadalensis*; its coverage varies between 10 and 20%. On intensively grazed sites, *Tortula ruralis* spreads very rapidly, locally covering up to one third of the whole area of stands. The number of species per relevé, as a rule, does not exceed 20.

Poo-Caricetum colchicae occurs on the slopes of silted dunes as well as on the flat depressions among them in the neighbourhood of the seashore wall. It is distributed on the most developed soils closely related to the group of chestnut-coloured soils. The soils are dry, but moister than those of *Stipa borysthenica* or *Stipa capillata* communities, with more distinct alkaline reaction and with a higher humus content.

Many species of this association (*Coronilla varia*, *Medicago kotovii*, *Ephedra distachya*, young plants of *Carex colchica* and *Scirpoides holoschoenus*) are grazed by deer. The localities of this association are a typical biotope harbouring many invertebrates.

This association is in contact with almost all vegetation units of sandy soils in the territory under study. In the investigated territory it occupies only rather small areas in the southwestern part (3-5% of all area). It also occurs on the coasts of both the Azov Sea and the Black Sea. An analogous community was recorded in Romania by MORARIU (1959) as *Ephedro distachyae-Caricetum ligericae*. According to IVAN et al. (1993), *Carex ligerica* is identical with the Ukrainian *Carex colchica*. Both communities are quite similar in their physiognomy, but differ substantially in floristic composition. The frequent occurrence of *Alyssum borzeanum*, *Lamium amplexicaule*, *Poa pratensis* s.l., *Scabiosa ucranica*, *Thlaspi perfoliatum* is typical for the Romanian community, as well as the presence of *Crepis rhoeadifolia*, *Linaria dalmatica*, *Salvia aethiopsis*, *Stachys sideritoides*, *Verbascum banaticum*, missing in the Azov-coast association. In contrast, the frequent species of the Azov community, such as *Bassia hirsuta*, *Centaurea diffusa*, *Cynanchum acutum*, *Festuca beckeri*, *Secale sylvestre*, *Teucrium polium* etc. are missing in the association of MORARIU (l.c.).

Further, two other closely related associations *Caricetum colchicae* SIMON 1960 and *Scabioso ucranicae-Caricetum ligericae* KRAUSCH 1965 were described in Romania. SIMON (1960) published one species-poor relevé from the Danube Delta, with the dominant *Carex colchica*, under the name "Caricetum colchicae ass. nova". It is a community of xerophytes of seashore dunes. The author considers *Secale sylvestre* to be the character species of the community; further, *Dianthus bessarabicus* and *Scabiosa ucranica* (not present in the Azov community) are present. In contradiction to the Code of phytosociological nomenclature, KRAUSCH (1965) included the association of SIMON (l.c.) into his ass. *Scabioso ucranicae-Caricetum ligericae*. This syntaxon, differentiated from the ass. *Poo-Caricetum colchicae* by the presence of *Asperula cynanchica*, *Convolvulus persicus*, *Dianthus bessarabicus*, *Festuca vaginata*, *Kochia arenaria*, *Koeleria glauca*, *Salsola kali*, *Scabiosa ucranica*, *Verbascum banaticum*, etc., is a vicariant association of the same alliance.

***Ephedra distachya-Silene subconica* community (Table 2)**

Diagnostic species combination: H - *Alyssum hirsutum*, *Bromus japonicus*, *Centaurea diffusa*, *Consolida regalis*, *Ephedra distachya*, *Medicago kотовii*, *Silene subconica*, *Verbascum pinnatifidum*, G - *Parmelia kamtschadalensis*, *Tortula ruralis*.

This open community (average cover of about 30-35%) is poor in species and occurs fragmentarily in the investigated area, mostly in sites heavily damaged by grazing deer. The very open herb layer does not reach over 30 cm in height; the cover of individual species is very low. The ground layer is well developed, covering mostly 20-30% of the relevé area. Here and there, annual grasses occur with a high dominance (*Bromus japonicus*, *B. squarrosum*, *Anisantha tectorum*). In comparison with the association *Poo-Caricetum colchicae*, in the *Ephedra distachya-Silene subconica* community the species *Carex colchica*, *Festuca beckeri*, *Secale sylvestre*, *Thymus dimorphus*, *Cynanchum acutum*, etc. recede a little or absolutely into the background and, on the contrary, the species *Silene subconica*, *Verbascum pinnatifidum*, *Alyssum hirsutum*, as well as *Consolida regalis* and *Bromus japonicus* appear regularly. This community occurs above all in flat sites among the dunes.

An analogous community with well developed tufts of *Ephedra distachya*, was recorded from the North-Aegean dunes in Greece. OBERDORFER (1952) determined this community as the ass. *Ephedra distachya-Silene subconica* from the alliance *Ammophilion* and characterized it, besides the two species mentioned above, by the occurrence of *Silene dichotoma*, *Verbascum pinnatifidum* (occurring in the stands of the territory under study, too), *Thymus* sp. and by a number of other species not found in our stands (*Centaurea cuneifolia*, *Corynephorus articulatus*, *Phleum arenarium*, *Jasione heldreichii*, *Galilea mucronata*, *Agropyron junceum*, *Anthemis tomentosa*, *Vulpia fasciculata*, etc.). The author emphasizes the large share of chamaephytes and therophytes in his association, which is very rich in species and with higher participation of character species. These two communities are separate syntaxa with their own diagnostic species combinations.

***Scirpoides holoschoenus* community (Table 2)**

Diagnostic species combination: H - *Agropyron lavrenkoanum*, *Alyssum hirsutum*, *Centaurea diffusa*, *Cerastium syvaschicum*, *Lactuca tatarica*, *Scirpoides holoschoenus*, *Thymus dimorphus*, G - *Parmelia kamtschadalensis*.

The species composition of this community is related to the sand steppe communities. It forms two-layered stands with the dominant species *Scirpoides holoschoenus* in the herb layer and *Parmelia kamtschadalensis* in the ground layer. It is rich in species (more than 50 species in the relevés recorded here), its stands are medium-closed with a mosaic-like pattern of species. Besides the name-giving species and others of the diagnostic species combination, further elements of sand steppes and dunes appear here with a lower coverage. The occurrence of xerohalophytes (*Artemisia santonica*, *Limonium meyeri*, *L. caspium*, *Plantago salsa*) is usually very rare, though these species with a wide cenotic amplitude are typical for the spits. They occur here in all non-halophytic communities with at least a minimum moisture content. The contact communities are stands of the *Poo-Caricetum colchicae* or the *Secali-Stipetum borysthениcae*, in lower sites salt (steppe) meadows.

The community occurs on shallow depressions among the elevations and moderate slopes. The dry, sandy soils with admixture of shell material are slightly alkaline. These stands occupy

a small part (1% of the total area) of the territory.

The stand described from the Danube Delta as *Lythro-Holoschoenetum romani* (SIMON 1960) also contains some hygrophytic species of reeds. A stand with *Scirpoides holoschoenus* as dominant species was also reported under the name *Holoschoenetum vulgaris* by BOJKO as early as (1934); however, it is not documented by a relevé, only by the dominance of two diagnostic species, viz. *Scirpoides holoschoenus* and *Equisetum ramosissimum*.

The stands of *Scirpoides holoschoenus* contribute to the consolidation of sands. They are relatively resistant to grazing because adult plants of the dominant *Scirpoides holoschoenus* are not browsed; their nutrition value is low.

Secali-Cynodontetum dactyli ass. nov. hoc loco (Table 3)

Nomenclatural type: Relevé 47 in Tab. 3 (holotypus) (Appendix)

Diagnostic species combination: H - *Anisantha tectorum*, *Alyssum hirsutum*, *Centaurea diffusa*, *Consolida regalis*, *Cynanchum acutum*, *Cynodon dactylon*, *Elytrigia elongata*, *Euphorbia seguierana*, *Secale sylvestre*, *Senecio vernalis*, *Teucrium polium*, G - *Parmelia kamtschadalis*.

The association is characterized by the dominance of *Cynodon dactylon*, accompanied by *Anisantha tectorum* and/or *Teucrium polium* or *Alyssum hirsutum* with a high constancy, often as a subdominant. Stands in the sand steppe area have a coverage not exceeding 50-65%. In higher sites, the dominant *Cynodon dactylon* forms open stands particularly on slopes exposed to spraying with sea water.

Stands with *Cynodon dactylon* can also, however, represent a degradation stage of salt (steppe) meadows due to grazing. In such a case, the physiognomy of densely closed stands with a usual coverage of 80-90% is determined by the species combinations of *Cynodon dactylon-Elytrigia elongata*, *Cynodon dactylon-Euphorbia seguierana-Elytrigia elongata*, or *Cynodon dactylon-Elytrigia elongata-Puccinellia distans-Limonium meyeri*.

The association occurs on moister, non-flooded flat areas of sand steppes at contact with salt (steppe) meadows as well as dry slope areas heavily disturbed by deer. It occurs on sand-loamy grey soils with an alkaline reaction and low humus content. This association occupies about 1% of the total territory. Its occurrence in the south of the Ukraine has been recorded between the rivers Dniester and Don. A further spreading of this community at the expense of near-natural sand-steppe stands in the studied territory is to be expected in view of the high stocks of game.

The community described from the Pannonian Lowlands as *Brometum tectorum* BOJKO 1934 is a separate unit lacking numerous Pontic species typical for the Azov association. Further, POP (1970) studied in Dobrogea the *Bromo-Cynodontetum ponticum*, with *Centaurea rhenana*, *Silene pontica*, *Carduus nutans*, *Euphorbia stepposa*, *Scolymus hispanicus*, *Alyssum minutum*, etc. It is an East-Romanian vicariant within the same alliance.

Heliotropio dolosi-Brometum japonici ass. nov. hoc loco (Table 3)

Nomenclatural type: Relevé 53 in Tab. 3 (holotypus)

Diagnostic species combination: H - *Alyssum hirsutum*, *Bassia hirsuta*, *Bromus japonicus*, *B. squarrosus*, *Carex colchica*, *Centaurea diffusa*, *Cynanchum acutum*, *Cynodon dactylon*, *Eragrostis minor*, *Euphorbia seguierana*, *Festuca beckeri*, *Heliotropium dolosum*, *Lepidium*

Table 4. Synoptic table (abbreviated)

Vegetation units	I	II	III	IV	V	VI	VII
Ch, D - Ass., comm.							
<i>Stipa borysthenica</i> KLOKOV ex PROKUDIN	100	25	29	20	20	60	60
<i>Seseli tortuosum</i> L.	75	38	0	0	10	0	27
<i>Astragalus varius</i> S.G. GMEL.	75	0	14	0	0	20	27
<i>Allium guttatum</i> STEVEN	38	0	0	0	0	30	27
<i>Vincetoxicum maeoticum</i> (KLEOPOW) BARBAR.	38	0	0	0	0	0	0
<i>Stipa capillata</i> L.	13	100	0	0	0	0	13
<i>Festuca valesiaca</i> GAUDIN	0	75	14	0	0	0	7
<i>Poa bulbosa</i> L.	13	13	86	40	50	0	20
<i>Silene subconica</i> FRIV.	13	38	0	100	0	40	33
<i>Consolida regalis</i> GRAY	0	0	57	100	0	80	13
<i>Bromus japonicus</i> THUNB.	0	0	0	100	0	20	80
<i>Asparagus levinae</i> KLOKOV	13	25	0	60	0	40	27
<i>Verbascum pinnatifidum</i> VAHL	0	0	0	100	0	0	13
<i>Coronilla varia</i> L.	25	13	0	60	0	0	0
<i>Scirpoidea holoschoenus</i> (L.) SOJÁK (lok.)	75	63	57	0	100	0	60
<i>Lactuca tatarica</i> (L.) C.A. MEY.	0	0	0	0	70	0	13
<i>Tragopogon borystenicus</i> ARTEMZUK	25	0	14	0	50	20	27
<i>Anisantha tectorum</i> (L.) NEVSKI	13	25	0	0	10	90	47
<i>Descurainia sophia</i> (L.) WEBB ex PRANTL	25	38	0	0	10	40	7
<i>Marrubium peregrinum</i> L.	13	25	14	0	0	30	93
<i>Heliotropium dolosum</i> DE NOT.	13	13	0	0	0	0	100
<i>Picris hieracioides</i> L.	38	13	0	0	20	20	73
<i>Lithospermum arvense</i> L.	13	13	0	0	0	30	67
<i>Eragrostis minor</i> HOST	0	38	0	0	0	0	80
<i>Lepidium campestre</i> (L.) R.BR.	0	0	0	0	0	10	80
<i>Tribulus terrestris</i> L.	13	0	0	0	0	0	40
<i>Diplotaxis muralis</i> (L.) DC.	0	0	0	0	10	0	40
Ch, D - <i>Festucetea vaginatae</i> and lower syntaxa							
<i>Agropyron dasyanthum</i> LEDEB.	75	38	57	0	10	10	7
<i>Asperula setulosa</i> BOISS.	50	63	0	0	20	10	33
<i>Centaurea odessana</i> PRODÁN	88	75	14	0	0	20	7
<i>Allium paczoskianum</i> TUZSON	50	50	0	0	0	30	13
<i>Euphorbia seguierana</i> NECK.	25	100	29	0	60	100	100
<i>Secale sylvestre</i> HOST	88	38	100	0	10	80	80
<i>Carex colchica</i> J. GAY	63	50	100	60	80	60	80
<i>Festuca beckeri</i> (HACK.) TRAUTV.	75	25	100	0	60	40	73
<i>Thymus dimorphus</i> KLOKOV et SHOST.	63	25	71	0	70	0	33
<i>Syrenia cana</i> (PILLER et MITTERP.) NEILR.	50	25	0	0	0	20	53
<i>Erysimum diffusum</i> EHRRH.	38	38	0	0	10	40	27
<i>Chondrilla juncea</i> L.	13	0	43	60	40	40	0
<i>Gypsophila paniculata</i> L.	0	25	0	0	0	20	0
Ch, D - <i>Honckenyo-Elymetea</i> and lower syntaxa							
<i>Cynanchum acutum</i> L.	50	63	71	0	60	90	67
<i>Galium humifusum</i> M. BIEB.	13	13	0	0	10	50	33
<i>Gypsophila perfoliata</i> L.	13	25	0	0	20	40	0
<i>Helichrysum corymbiforme</i> OPPERMAN ex KATINA	0	38	14	0	10	0	0

Vegetation units	I	II	III	IV	V	VI	VII
<i>Crambe pontica</i> STEVEN ex RUPR.	0	0	0	0	0	0	27
<i>Leymus sabulosus</i> (M. BIEB.) TZVELEV	13	25	0	0	0	0	0
Ch, D - <i>Asteretea tripolium</i> and lower syntaxa							
<i>Bassia sedoides</i> (PALL.) ASCH.	75	0	0	0	0	0	27
<i>Artemisia santonica</i> L.	75	0	0	0	0	60	40
<i>Bassia hirsuta</i> (L.) ASCH.	0	0	86	0	0	50	73
<i>Elytrigia elongata</i> (HOST) P. BEAUV.	13	13	0	0	10	70	0
<i>Aeluropus littoralis</i> (GOUAN) PARL.	0	0	0	0	0	0	60
<i>Medicago kotovii</i> WISSJUL.	88	88	71	100	10	10	47
<i>Limonium meyeri</i> (BOISS.) KUNTZE	13	13	0	0	20	10	13
<i>Apera maritima</i> KLOKOV	13	13	0	20	0	20	13
<i>Puccinellia distans</i> (JACQ.) PARL.	0	0	0	0	10	20	7
Ch - <i>Chenopodietea</i> and lower syntaxa							
<i>Bromus squarrosus</i> L.	88	0	57	0	10	10	67
<i>Teucrium polium</i> L.	100	75	100	0	20	100	93
<i>Cynodon dactylon</i> (L.) PERS.	88	63	86	0	20	100	87
<i>Senecio vernalis</i> WALDST. et KIT.	38	0	0	0	0	70	73
<i>Sisymbrium altissimum</i> L.	38	25	0	0	0	40	67
Other accompanying species							
<i>Achillea euxina</i> KLOKOV	63	38	0	0	0	0	20
<i>Cuscuta monogyna</i> VAHL	63	0	0	0	0	20	13
<i>Arabidopsis toxophylla</i> (M. BIEB.) N. BUSCH	63	0	0	0	0	0	20
<i>Thlaspi perfoliatum</i> L.	63	0	0	0	0	0	53
<i>Arenaria serpyllifolia</i> L.	88	63	43	0	0	20	13
<i>Agropyron lavrenkoanum</i> PROKUDIN	100	13	0	0	70	30	60
<i>Cerastium syvasicum</i> KLEOPOW	0	13	0	0	80	20	53
<i>Alyssum hirsutum</i> M. BIEB.	100	88	14	100	80	90	80
<i>Centaurea diffusa</i> LAM.	0	0	71	100	70	70	67
<i>Dianthus pseudoarmeria</i> M. BIEB.	75	100	0	60	10	20	27
<i>Ephedra distachya</i> L.	63	63	71	100	0	0	27
<i>Artemisia taurica</i> WILLD.	0	0	0	0	20	50	33
<i>Eryngium campestre</i> L.	38	25	14	0	10	20	0
<i>Linum austriacum</i> L.	25	13	0	0	50	0	7
<i>Trigonella monspeliaca</i> L.	38	38	0	0	10	0	13
<i>Plantago dubia</i> L.	13	0	0	0	0	0	53
<i>Consolida paniculata</i> (HOST) SCHUR	25	13	0	0	10	0	27
<i>Melilotus albus</i> MEDIK.	0	13	0	0	20	0	33
<i>Calamagrostis epigeios</i> (L.) ROTH	13	25	0	0	20	20	0
<i>Silene supina</i> M. BIEB.	13	0	0	0	10	20	20
<i>Allium pervestitum</i> KLOKOV	0	0	0	0	0	10	40
<i>Tragus racemosa</i> (L.) ALL.	25	0	0	0	0	20	13
<i>Artemisia pontica</i> L.	13	0	0	0	0	10	20
<i>Plantago lanceolata</i> L.	0	0	0	0	10	30	7
<i>Plantago maritima</i> L.	25	25	0	0	0	0	0
<i>Otites media</i> (LITV.) KLEOPOW	38	0	0	0	0	0	7
<i>Anthemis ruthenica</i> M. BIEB.	13	0	0	0	0	0	20
<i>Thesium arvense</i> HORV.	0	13	0	0	0	0	20

Vegetation units	I	II	III	IV	V	VI	VII
<i>Sideritis cornosa</i> (ROCHEL ex BENTH.) STANK.	25	13	0	0	0	0	0
<i>Carduus uncinatus</i> L.	13	0	0	0	0	0	13
<i>Cirsium alatum</i> (S.G. GMEL) BOBROV	25	13	0	0	0	0	0
<i>Phragmites australis</i> (CAV.) TRIN. ex STEUD.	38	0	0	0	0	0	0
<i>Plantago salsa</i> PALL.	0	0	0	0	20	0	7
<i>Cuscuta approximata</i> BAB.	25	0	0	0	0	0	0
<i>Astragalus cicer</i> L.	25	0	0	0	0	0	0
<i>Sinapis alba</i> L.	0	0	29	0	0	0	0
<i>Inula hirta</i> L.	0	0	0	0	20	0	0
E0							
<i>Parmelia kamtschadalis</i> (MONT.) MONT.	75	38	86	100	90	70	87
<i>Tortula ruralis</i> (HEDW.) GAERTN. et al.	63	38	86	100	0	50	100
I - <i>Secali-Stipetum borysthenicae</i> ;							
II - <i>Centaureo odessanae-Stipetum capillatae</i> ;							
III - <i>Poo-Caricetum colchicae</i> ;							
IV - <i>Ephedra distachya-Silene subconica</i> comm.;							
V - <i>Scirpoidea holoschoenus</i> comm.;							
VI - <i>Secali-Cynodontetum dactyli</i> ;							
VII - <i>Heliotropio dolosi-Brometum japonici</i> .							

campestre, *Lithospermum arvense*, *Marrubium peregrinum*, *Picris hieracioides*, *Secale sylvestre*, *Senecio vernalis*, *Sisymbrium altissimum*, *Teucrium polium*, G - *Parmelia kamtschadalis*, *Tortula ruralis*.

This community of a height of about 30 cm (only individual plants of *Crambe pontica* or *Euphorbia seguierana* are higher) is characterized by a very loose herb layer (coverage 30-40%) and by strong development of the moss *Tortula ruralis* and lichens of the genera *Parmelia* and *Cladonia*. These species locally form a coverage of up to 80%.

There are numerous species of synanthropic and salt-meadow vegetation here. This community reached a high spatial extent under the trampling by deer and is still increasing. It is sought by deer, especially in the spring time during high tides, when the lower parts of the territory are flooded. In the flat, dry, warm sites deer find good conditions for rest. If the deer interference is prevented, the sites of this community, earlier covered by the driest variant of salt (steppe) meadows, could expect an invasion of steppe grass species (*Stipa borysthenica*, *S. capillata*, *Festuca valesiaca*) and transition to the sand steppes.

The association occurs on a flat relief without marked elevations. The soils are strongly compacted, humus poor, grey loam-sandy steppe soils with an admixture of shell material. They are dry, but markedly moister than soils in the stands of sand steppes with feather-grass or fescue dominant. The soil reaction is slightly alkaline.

This association covers 1% of the total area. Fragments also occur in the highest sites of the central part of the territory, which are heavily disturbed by grazing. It is also distributed elsewhere along the northern coast of the Azov Sea.

CONCLUSIONS

In the territory mentioned above, the class *Festucetea vaginatae* comprises near-natural sand steppes; their substitutes due to trampling are included in the class *Chenopodietea*. The floristic differences between the communities studied are summarized in Tab. 4.

The *Festucetea vaginatae* communities form a succession series following the soil development in the area. They include several initial stages (*Festuca beckeri* initial stage, *Helichrysum corymbiforme*-*Festuca beckeri* stage, *Carex colchica* initial stage) leading to different communities later. Further, there are closed communities ranging from those with high salt soil content due to salt spray (*Secali-Stipetum borysthenicae* of primitive soils) to rich communities, namely *Centaureo odessanae*-*Stipetum capillatae* (the highest flat sites in the contact line with salt meadows), and *Poo-Caricetum colchicae* (slopes on humus-richer, alkaline soils closely related to the group of chestnut soils). Two species poor communities occur in shallow depressions (*Ephedra distachya*-*Silene subconica* open community, *Scirpoides holoschoenus* community).

Two associations of the class *Chenopodietea* are strongly influenced by deer damage; namely, the *Secali-Cynodontetum dactyli* ass. nov. (Tab. 3), occurring on non-flooded flat areas of sand steppes at contact with salt (steppe) meadows or dry slopes, may be expected to spread further because of the high stocks of game in the territory. This will lead to the decrease of the near-natural sand steppes. The preservation of near-natural sand-steppes would require a reduction of the number of acclimatized deer. Otherwise, sand-steppe communities rich in species will be replaced by synantropic vegetation.

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Appendix

Localities of relevés

Table 1

Rel. 1. Birjučij Island Spit, profile 1, eastern slope of an elevation, rel. 25 by Dubyna & Neuhäuslová, 12.VIII.1991; 2. The same locality, profile 1, rel. 35 by Husák, 12.VIII.1991; 3.-6. The same locality, profile 1, eastern slopes of an elevation, rel. 57-60 by Dubyna, 26.VIII.1991; 7. The same locality, profile 1, upper level part of an elevation, rel. 61 by Dubyna, 26.VIII.1991; 8. The same locality, profile 2, rel. 10 by Dubyna & Neuhäuslová, 11.VIII.1991; 9.-11. Birjučij Island Spit, profile 1, upper convex part of an elevation, rel. 54-56 by Dubyna, 25.VIII.1991; 12.-15. The same locality, profile 1, rel. 27, 29, 30, 32 by Husák, 12.VIII.1991; 16. The same locality, eastern part of profile 1, rel. 24 by Dubyna & Neuhäuslová, 12.VIII.1991.

Table 2

Rel. 17.-20. SW part of the Birjučij Island Spit, slopes of maritime elevations, profiles 1 and 2, rel. 1-3 and 5 by Dubyna, 1990-1991; 21. The same locality, profile 1, maritime elevation, rel. 12 by Dubyna & Neuhäuslová, 10.VIII.1991; 22. The same locality, profile 2, rel. 4 by Dubyna 1991; 23. The same locality, profile 1, near the western coast, rel. 26 by Dubyna & Neuhäuslová, 12.VIII.1991; 24.-28. Birjučij Island Spit, level, non-inundated part of the profiles 3 and 4, rel. 1-5 by Dubyna, 1991; 29. SO part of the Birjučij Island Spit, maritime elevation, profile 4, rel. 7 by Dubyna, 11.VI.1991; 30. Birjučij Island Spit, depression among elevations, profile 2, rel. 14 by Dubyna & Neuhäuslová, 11.VIII.1991; 31.-37. SO part of the Birjučij Island Spit, moderate slopes of maritime elevations, profiles 1-4, rel. 1-6 and 8 by Dubyna, 9.-11.VI.1990; 38. The same locality, depression among the elevations, profile 2, rel. 15 by Dubyna & Neuhäuslová, 11.VIII.1991.

Table 3

Rel. 39.-43. Central part of the Birjučij Island Spit, level, non-inundated sites, profiles 1-4, rel. 1-5 by Dubyna, 1990-1991; 44.-48. The same locality, profiles 1 and 2, rel. 2, 10, 11, 21, 29 by Dubyna & Neuhäuslová, 10.-12.VIII.1991; 49. Birjučij Island Spit, the highest part of profile 2, rel. 30 by Dubyna & Neuhäuslová, 12.VIII.1991; 50.-52. The same locality, rel. 31 (eastern slope), 42 and 49 (central part of an elevation) by Dubyna, 23.-25.VIII.1991; 53. The same locality, western slope of a maritime elevation, rel. 22 by Dubyna & Neuhäuslová, 11.VIII.1991; 54.-56. The same locality, central part of an elevation, rel. 38-40 by Dubyna, 24.VIII.1991; 57. The same locality, maritime elevation, profile 4, rel. 50 by Neuhäuslová, 13.VIII.1991; 58.-63. The same locality, eastern slope and central part of the elevations, profiles 2 and 3 (Fedotova kosa Spit), rel. 32, 36, 44, 37, 41 and 43 by Dubyna, 23.-25.VIII.1991.

Table I

Association	Secali-Stipetum borysthenicae								
Relevé Nr.	1	2	3	4	5	6	7	8	%
Orientation	-	-	E	E	E	E	-	-	
Inclination	-	-	2	2	2	2	-	-	
Area analyzed (m ²)	100	100	100	100	100	100	100	100	
Total cover (%)	95	45	45	45	50	50	55	80	
Number of species	33	23	41	42	37	32	29	26	
Ch, D-Ass.									
<i>Stipa borysthenica</i> KLOKOV ex PROKUDIN	4	3	2	2	2	2	2	1	100
<i>Seseli tortuosum</i> L.	r	-	+	r	r	+	+	-	75
<i>Artemisia santonica</i> L.	-	-	+	+	+	+	+	1	75
<i>Astragalus varius</i> S.G. GMEL.	-	-	+	+	+	+	+	r	75
<i>Bassia sedoides</i> (PALL.) ASCH.	-	-	r	r	+	+	r	r	75
<i>Allium guttatum</i> STEVEN	-	-	-	r	r	-	-	r	38
<i>Vincetoxicum moeoticum</i> (KLEOPOW) BARBAR.	-	-	-	+	+	-	-	-	38
<i>Stipa capillata</i> L.	-	-	-	-	-	-	-	-	13
<i>Festuca valesiaca</i> GAUDIN	-	-	-	-	-	-	-	-	0
Ch, D - <i>Festucetea vaginatae</i> and lower syntaxa									
<i>Centaura odessana</i> PRODÁN	-	-	+	1	1	+	+	+	88
<i>Scirpoidea holoschoenus</i> (L.) SOJÁK (lok.)	+	-	-	+	+	+	r	r	75
<i>Secale sylvestre</i> HOST	-	-	+	+	+	r	r	3	88
<i>Euphorbia seguieriana</i> NECK	2	-	-	-	-	-	-	2	25
<i>Asperula senulosa</i> BOISS.	+	-	-	+	+	-	-	-	50
<i>Agropyron dasyanthum</i> LEDEB.	-	-	-	+	+	+	1	2	75
<i>Carex colchica</i> J. GAY	-	-	-	1	1	2	2	2	63
<i>Festuca beckeri</i> (HACK.) TRAUTV.	-	-	-	+	+	+	+	2	75
<i>Allium pacsztianum</i> TÜZSON	-	-	-	-	+	+	r	r	50
<i>Thymus dimorphus</i> KLOKOV et SHOST.	-	-	-	+	+	+	+	+	63
<i>Erysimum diffusum</i> BURH.	-	-	+	r	r	-	-	-	38
<i>Syrenia cana</i> (PILLER et MITTERP.) NEIR.	-	-	-	+	+	+	-	r	50
<i>Silene subovaria</i> FRIV.	-	-	+	-	-	-	-	-	13
<i>Tragopogon borystericus</i> ARTEMczUK	-	-	-	-	-	+	+	-	25
<i>Gypsophila paniculata</i> L.	-	-	-	-	-	-	-	-	0
<i>Chondrilla juncea</i> L.	-	-	-	-	-	-	-	+	13
Ch, D - <i>Honckenyo-Elymetea</i> and lower syntaxa									
<i>Cynanchum acutum</i> L.	1	-	-	-	+	+	+	-	50
<i>Gypsophila perfoliata</i> L.	1	-	-	-	-	-	-	-	13
<i>Asparagus levinae</i> KLOKOV	r	-	-	-	-	-	-	-	13
<i>Leymus sabulosus</i> (M. BIEB.) TZVELEV	-	r	-	-	-	-	-	-	13
<i>Helichrysum corymbiforme</i> OPPERMANN ex KATINA	-	-	-	-	-	-	-	-	0
<i>Galium humifusum</i> M. BIEB.	+	-	-	-	-	-	-	-	13
Ch, D - <i>Asteretea tripolium</i> and lower syntaxa									
<i>Medicago kotovii</i> WISSJUL.	r	+	+	+	1	1	+	-	88
<i>Limonium mayeri</i> (BOISS.) KUNTZE	+	-	-	-	-	-	-	-	13
<i>Elytrigia elongata</i> (HOST) P. BEAUV.	+	-	-	-	-	-	-	-	13
<i>Apera maritima</i> KLOKOV	-	+	-	-	-	-	-	-	13
Ch - <i>Chenopodieta</i> and lower syntaxa									
<i>Teucrium polium</i> L.	2	+	1	1	1	1	1	+	100
<i>Cynodon dactylon</i> (L.) PERS.	-	+	1	+	+	1	1	3	88
<i>Bromus squarrosus</i> L.	1	-	r	r	+	+	+	r	88
<i>Sisymbrium altissimum</i> L.	+	-	+	+	-	-	-	-	38
<i>Descurainia sophia</i> (L.) WEBB ex PRANTL	-	-	+	+	-	-	-	-	25
<i>Anisantha tectorum</i> (L.) NEVSKI	-	-	-	+	-	-	-	-	13
<i>Marrubium peregrinum</i> L.	-	-	r	-	-	-	-	-	13
<i>Senecio vernalis</i> WALDST. et KIT.	-	-	-	+	-	+	-	+	38
<i>Eragrostis minor</i> HOST	-	-	-	-	-	-	-	-	0
<i>Heliotropium dolosum</i> DE NOT.	-	+	-	-	-	-	-	-	13

Centaureo odessanae-Stipetum capillatae

9	10	11	12	13	14	15	16	%
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
100	100	100	100	100	100	150	100	
35	25	30	90	65	60	50	75	
31	27	27	25	15	10	17	28	
.	.	.	.	.	+	.	2	25
+	+	+	.	.	.	.	.	38
.	.	.	.	.	.	.	.	0
.	.	.	.	.	.	.	.	0
.	.	.	.	.	.	.	.	0
.	.	.	.	.	.	.	.	0
2	2	2	4	3	3	3	3	100
+	+	+	.	+	+	+	.	75
+	+	+	+	+	.	.	r	75
+	+	+	+	.	.	.	+	63
+	r	r	.	.	.	.	.	38
1	1	1	+	+	1	+	+	100
+	.	.	+	+	+	.	+	63
+	+	+	.	.	.	.	.	38
+	+	+	.	.	.	+	.	50
.	.	.	.	+	+	+	.	25
+	+	r	.	.	.	.	r	50
1	+	.	.	.	.	.	.	25
r	.	.	.	+	.	+	.	38
+	r	.	.	.	.	.	.	25
+	.	.	+	.	.	+	.	38
.	.	.	.	+	.	.	.	0
.	.	+	.	+	.	.	.	25
.	.	.	.	.	.	.	.	0
+	+	+	+	.	.	.	+	63
.	.	.	+	.	.	.	r	25
.	.	.	+	.	.	.	r	25
.	.	r	+	.	.	.	.	25
.	.	.	.	+	+	+	.	38
.	.	.	.	.	.	.	+	13
+	1	1	+	+	.	+	r	88
.	.	.	.	.	.	.	1	13
.	.	.	.	.	.	.	r	13
.	.	.	.	.	.	.	+	13
1	1	1	.	1	1	+	.	75
1	1	1	2	.	.	.	2	63
.	.	.	.	.	.	.	.	0
.	.	.	+	.	.	.	+	25
+	r	r	.	.	.	.	.	38
+	+	.	.	.	.	.	.	25
.	.	.	2	.	.	+	.	25
.	.	.	.	.	.	.	.	0
+	+	+	.	.	.	.	.	38
.	.	.	.	+	.	.	.	13

Relevé Nr.	1	2	3	4	5	6	7	8	%
Other accompanying species									
<i>Alyssum hirsutum</i> M. BIEB.	1	+	+	+	+	+	+	2	100
<i>Dianthus pseudoarmeria</i> M. BIEB.	+	+	r	r	r	.	.	+	75
<i>Arenaria serpyllifolia</i> L.	.	+	+	+	+	r	r	r	88
<i>Ephedra distachya</i> L.	.	+	r	r	r	+	.	.	63
<i>Agropyron lavrenkoanum</i> PROKUDIN	1	+	+	+	+	1	2	+	100
<i>Achillea euxina</i> KLOKOV	.	.	+	r	r	+	r	.	63
<i>Trigonella monspeliaca</i> L.	.	.	r	r	r	.	.	.	38
<i>Eryngium campestre</i> L.	2	+	.	.	.	.	.	+	38
<i>Arabidopsis toxophylla</i> (M. BIEB.) N. BUSCH	.	.	+	+	+	+	+	.	63
<i>Cuscuta monogyna</i> VAHL	.	.	+	+	+	+	+	.	63
<i>Thlaspi perfoliatum</i> L.	.	.	+	+	+	+	+	.	63
<i>Picris hieracioides</i> L.	+	+	.	.	.	.	.	+	38
<i>Plantago maritima</i> L.	+	+	.	.	.	.	.	.	25
<i>Sideritis comosa</i> (ROCHEL ex BENTH.) STANK.	+	+	.	.	.	.	.	.	25
<i>Linum austriacum</i> L.	+	+	.	.	.	.	.	.	25
<i>Coronilla varia</i> L.	r	.	.	+	.	.	.	.	25
<i>Consolida paniculata</i> (HOST) SCHUR	+	.	.	.	.	.	.	r	25
<i>Calamagrostis epigeios</i> (L.) ROTH	+	.	.	.	.	.	.	.	13
<i>Cirsium alatum</i> (S.G. GMEL.) BOBROV	.	+	.	.	.	.	.	r	25
<i>Otites media</i> (LITV.) KLEOPOW	.	.	+	+	.	.	.	r	38
<i>Phragmites australis</i> (CAV.) TRIN. ex STEUD.	.	.	+	.	r	+	.	.	38
<i>Poa bulbosa</i> L.	1	.	.	.	.	.	.	.	13
<i>Lithospermum arvense</i> L.	+	.	.	.	.	.	.	.	13
<i>Cuscuta approximata</i> BAB.	.	.	+	+	.	.	.	.	25
<i>Echinops sphaerocephalus</i> L.	.	.	+	.	.	.	.	.	13
<i>Astragalus cicer</i> L.	.	.	.	+	+	.	.	.	25
<i>Tragus racemosus</i> (L.) ALL.	.	.	.	+	+	.	.	.	25
<i>Artemisia pontica</i> L.	1	.	.	.	.	+	+	.	13
<i>Carduus uncinatus</i> L.	+	.	.	.	.	.	.	.	13
<i>Potentilla astracanica</i> JACQ.	+	.	.	.	.	.	.	.	13
<i>Silene supina</i> M. BIEB.	+	.	.	.	.	.	.	.	13
<i>Tribulus terrestris</i> L.	.	+	.	.	.	.	.	.	13
<i>Anthemis ruthenica</i> M. BIEB.	.	.	+	.	.	.	.	.	13
<i>Carex divisa</i> Huds.	.	.	.	+	.	.	.	.	13
<i>Plantago dubia</i> L.	.	.	.	.	+	.	.	.	13
<i>Thesium arvense</i> HORV.	.	.	.	.	+	.	.	.	0
<i>Melilotus albus</i> MEDIK.	.	.	.	.	.	.	.	.	0
<i>Cirsium vulgare</i> (SAV) TEN.	.	.	.	.	.	.	.	.	0
<i>Elytrigia repens</i> (L.) NEVSKI	.	.	.	.	.	.	.	.	0
<i>Trifolium fragiferum</i> L.	.	.	.	.	.	.	.	.	0
<i>Lepidium pusillum</i> BOISS. et BALANSA	.	.	.	.	.	.	.	.	0
<i>Cerastium syvaschicum</i> KLEOPOV	.	.	.	.	.	.	.	.	0
Eq									
<i>Parmelia kamtschadalii</i> (MONT.) MONT.	.	.	1	1	2	1	2	2	75
<i>Tortula ruralis</i> (HEDW.) GAERTN. et al.	.	.	1	1	1	1	2	.	63

9	10	11	12	13	14	15	16	%
r	r	+	1	+	.	+	1	88
+	+	+	+	+	+	+	1	100
+	+	+	2	.	.	+	.	63
r	+	r	.	.	1	.	+	63
.	.	.	1	.	.	.	.	13
+	+	+	.	.	.	.	.	38
+	r	r	.	.	.	.	.	38
.	.	.	1	.	.	.	2	25
.	.	.	.	.	.	.	.	0
.	.	.	.	.	.	.	.	0
.	.	.	.	.	.	.	.	0
.	.	.	.	.	.	+	.	13
.	.	.	.	.	1	+	.	25
.	.	.	.	.	.	+	.	13
.	.	.	.	.	.	.	+	13
.	.	.	.	.	.	r	.	13
.	.	.	+	.	.	.	.	13
.	.	.	+	.	.	.	1	25
.	.	.	+	.	.	.	.	13
.	.	.	.	.	.	.	.	0
.	.	.	.	.	.	.	.	0
.	.	.	.	.	.	.	1	13
.	.	.	.	.	.	r	.	13
.	.	.	.	.	.	.	.	0
.	.	.	r	.	.	.	.	13
.	.	.	.	.	.	.	.	0
.	.	.	.	.	.	.	.	0
.	.	.	.	.	.	.	.	0
.	.	.	.	.	.	.	.	0
.	.	.	.	.	.	.	.	0
+	.	.	.	.	.	.	.	13
.	.	2	.	.	.	.	.	13
.	.	.	+	.	.	.	.	13
.	.	.	+	.	.	.	.	13
.	.	.	.	+	.	.	.	13
.	.	.	.	.	+	.	.	13
.	.	.	.	.	.	.	1	13
+	+	+	.	.	.	.	.	38
+	+	2	.	.	.	.	.	38

Table 2

Ephedra dist.-Silene subcon. - comm.

24	25	26	27	28	%	29	30	31	32	33	34	35	36	37	38	%
-	-	-	-	-	S	0	S	W	S	SW	SW	SW	W	-	-	
-	-	-	-	-	2	2	2	2	3	3	3	3	2	2	-	
100	100	100	100	100	30	100	30	30	30	30	30	30	30	30	100	
30	35	35	35	35	70	95	80	60	70	35	55	60	50	50	55	
17	16	14	11	11	10	25	18	17	10	10	12	10	12	12	33	

Scirpoides holoschoenus - comm.

+	+	.	.	.	40	+	.	+	+	+	+	.	.	.	.	50
1	1	1	1	1	100	.	.	.	.	.	.	.	.	.	.	0
r	r	1	1	1	100	.	.	.	.	.	.	.	.	.	.	0
+	r	r	r	r	100	.	.	.	.	.	.	.	.	.	.	0
+	r	r	.	.	60	.	.	.	.	.	.	.	.	.	.	0
r	r	.	.	.	60	.	.	.	.	.	.	.	.	.	.	0
.	.	.	.	.	0	4	4	3	3	3	3	3	3	3	100	
.	.	.	.	.	0	.	.	+	r	r	.	r	.	.	50	

1	1	.	+	.	60	+	.	1	1	+	+	+	+	+	.	80
.	.	.	.	.	0	+	.	1	+	.	+	+	+	+	.	60
.	.	.	.	.	0	+	.	+	+	+	+	+	+	+	.	70
+	+	.	.	+	60	.	.	+	.	+	+	+	+	.	.	40
.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	r	10
.	.	r	.	.	0	.	r	1	1	1	.	.	.	.	+	60
.	.	r	.	.	20	.	.	+	+	.	.	.	.	.	.	20
.	.	r	.	.	0	.	.	.	.	.	.	.	.	r	.	10
.	.	r	.	.	0	.	.	.	.	.	.	.	.	r	.	10
.	.	r	.	.	0	.	.	.	.	.	.	.	.	r	.	20
.	.	r	.	.	0	.	.	.	.	.	.	.	.	r	.	0
.	.	r	.	.	0	.	.	.	.	.	.	.	.	.	.	0
.	.	r	.	.	0	.	.	r	.	.	.	.	.	.	.	10
.	.	r	.	.	0	.	.	r	.	.	.	.	.	.	.	10
.	.	r	.	.	0	.	.	r	.	.	.	.	.	.	+	10

.	.	.	.	.	0	.	1	2	2	1	.	.	.	+	r	60
.	.	.	.	.	0	r	.	+	+	.	+	+	+	r	.	70
.	.	.	.	.	0	.	2	.	.	.	.	.	.	l	.	20
.	.	.	.	.	0	.	1	.	.	.	.	.	.	.	.	10

+	+	+	+	+	+	100	.	.	.	.	.	.	.	.	r	10
.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	0	
.	.	.	.	.	0	.	1	.	.	.	.	.	.	2	.	20
+	.	.	.	.	20	.	.	.	.	.	.	.	.	.	.	0
.	.	.	.	.	0	.	1	.	.	.	.	.	.	.	.	10
.	.	.	.	.	0	.	+	.	.	.	.	.	.	.	.	10
.	.	.	.	.	0	.	+	.	.	.	.	.	.	.	.	10
.	.	.	.	.	0	.	+	.	.	.	.	.	.	.	.	10

r	r	r	r	r	r	100	.	.	.	.	.	.	.	.	.	0
.	.	.	.	.	0	.	r	.	.	.	.	.	.	r	.	20
.	.	.	.	.	0	.	+	.	.	.	.	.	.	+	.	20
.	.	.	.	.	0	.	.	.	.	.	.	.	.	+	.	10
.	.	.	.	.	0	.	.	.	.	.	.	.	.	+	.	0
.	.	.	.	.	0	.	.	.	.	.	.	.	.	+	.	10
.	.	.	.	.	0	.	.	.	.	.	.	.	.	+	.	10

Relevé Nr.	17	18	19	20	21	22	23	%
Other accompanying species								
<i>Centaurea diffusa</i> LAM.	+	+	+	+	.	+	.	71
<i>Alyssum hirsutum</i> M. BIEB.	.	.	.	.	+	.	.	14
<i>Ephedra distachya</i> L.	1	1	1	2	.	1	.	71
<i>Cerastium syvaschicum</i> KLEOPOW	.	.	.	.	.	.	.	0
<i>Agropyron lavrenkoanum</i> PROKUDIN	.	.	.	.	.	.	.	0
<i>Dianthus pseudoarmeria</i> M. BIEB.	.	.	.	.	.	.	.	0
<i>Linum austriacum</i> L.	.	.	.	.	.	.	.	0
<i>Arenaria serpyllifolia</i> L.	.	.	+	.	r	+	.	43
<i>Sinapis alba</i> L.	+	.	.	.	r	.	.	29
<i>Eryngium campestre</i> L.	.	.	.	.	r	.	.	14
<i>Artemisia taurica</i> WILLD.	.	.	.	.	.	.	.	0
<i>Plantago salsa</i> PALL.	.	.	.	.	.	.	.	0
<i>Calamagrostis epigeios</i> (L.) ROTH	.	.	.	.	.	.	.	0
<i>Inula hirta</i> L.	.	.	.	.	.	.	.	0
<i>Melilotus albus</i> MEDIK.	.	.	.	.	.	.	.	0
<i>Picris hieracioides</i> L.	.	.	.	.	.	.	.	0
<i>Plantago scabra</i> MOENCH	+	.	.	.	.	.	.	14
<i>Festuca valesiaca</i> GAUDIN	.	.	+	.	.	.	.	14
<i>Salsola soda</i> L.	.	.	.	.	.	.	.	0
<i>Trigonella monspeliaca</i> L.	.	.	.	.	.	.	.	0
<i>Diplotaxis muralis</i> (L.) DC.	.	.	.	.	.	.	.	0
<i>Elytrigia repens</i> (L.) NEVSKI	.	.	.	.	.	.	.	0
<i>Centaurea adpressa</i> LEDEB.	.	.	.	.	.	.	.	0
<i>Plantago lanceolata</i> L.	.	.	.	.	.	.	.	0
<i>Silene supina</i> M. BIEB.	.	.	.	.	.	.	.	0
<i>Consolida paniculata</i> (HOST) SCHUR	.	.	.	.	.	.	.	0
E ₀								
<i>Parmelia kamtschadalii</i> (MONT.) MONT.	1	2	1	1	.	1	2	86
<i>Tortula ruralis</i> (HEDW.) GAERTN. et al.	1	2	2	2	.	2	2	86

Table 3

	Secali-Cynodontetum dactyli										%
Relevé Nr.	39	40	41	42	43	44	45	46	47	48	
Orientation	NE	NE	NE	NE	NE	S	-	E	-	-	
Inclination	2	2	2	2	2	5	-	1	-	-	
Area analyzed (m ²)	80	80	80	100	100	100	100	100	100	50	
Total cover (%)	99	100	92	84	75	65	70	85	85	85	
Number of species	25	23	20	19	19	26	30	28	25	22	
Ch. D-Ass.											
<i>Cynodon dactylon</i> (L.) PERS.	4	4	4	4	4	3	3	4	4	3	100
<i>Anisantha tectorum</i> (L.) NEVSKI	3	2	2	2	2	r	+	+	r	-	90
<i>Consolida regalis</i> GRAY	r	r	r	.	.	r	r	r	r	r	80
<i>Elytrigia elongata</i> (HOST) P. BEAUV.	+	+	+	+	+	.	.	r	-	2	70
<i>Descurainia sophia</i> (L.) WEBB ex PRANTL	-	.	.	.	.	+	+	+	r	-	40
<i>Marrubium peregrinum</i> L.	.	.	.	.	.	-	-	-	r	-	30
<i>Heliotropium dolosum</i> DE NOT.	.	.	.	.	.	-	-	-	-	-	0
<i>Bromus japonicus</i> THUNB.	.	.	.	.	r	.	.	2	.	-	20
<i>Lithospermum arvense</i> L.	.	.	r	.	.	r	.	r	.	-	30
<i>Picris hieracioides</i> L.	.	.	.	.	.	-	-	+	-	1	20
<i>Lepidium campestre</i> (L.) R.BR.	.	.	.	.	.	-	-	-	-	+	10
<i>Eragrostis minor</i> HOST	.	.	.	.	.	-	-	-	-	-	0
<i>Bromus squarrosus</i> L.	.	.	.	.	.	-	-	+	-	-	10
<i>Tribulus terrestris</i> L.	.	.	.	.	.	-	-	-	-	-	0
<i>Diplotaxis muralis</i> (L.) DC.	.	.	.	.	.	-	-	-	-	-	0
<i>Portulaca oleracea</i> L.	.	.	.	.	.	-	-	-	-	-	0
Ch. D - Chenopodietae and lower syntaxa											
<i>Teucrium polium</i> L.	+	r	r	+	+	2	+	2	2	1	100
<i>Senecio vernalis</i> WALDST. et KIT.	+	+	.	+	+	.	+	s	+	-	70
<i>Sisymbrium altissimum</i> L.	.	.	.	.	.	r	.	r	+	r	40
Ch. D - Festucetea vaginatae and lower syntaxa											
<i>Euphorbia seguierana</i> NECK.	1	+	l	+	+	1	2	1	1	+	100
<i>Secale sylvestre</i> HOST	+	+	r	r	r	.	3	+	1	-	80
<i>Carex colchica</i> J. GAY	+	+	l	+	+	-	-	2	-	-	60
<i>Stipa borysthenica</i> KLOKOV ex PROKUDIN	r	+	+	.	.	-	+	+	-	2	60
<i>Festuca beckeri</i> (HACK.) TRAUTV.	+	.	.	.	.	-	1	1	-	2	40
<i>Syrenia cana</i> (PILLER et MITTERP.) NEILR.	+	.	.	.	.	-	r	.	-	-	20
<i>Silene subconica</i> FRIV.	.	.	.	.	.	+	r	r	1	-	40
<i>Scirpoidea holoschoenus</i> (L.) SOJÁK (lok.)	.	.	.	.	.	-	-	-	-	-	0
<i>Erysimum diffusum</i> BRRH.	.	.	.	.	.	+	r	+	+	-	40
<i>Allium guttatum</i> STEVEN	.	.	.	.	.	+	r	-	r	-	30
<i>Astragalus varius</i> S.G. GMEL.	.	.	.	.	.	+	-	r	-	-	20
<i>Asperula senulosa</i> BOISS.	.	.	.	.	.	+	-	-	-	-	10
<i>Tragopogon borysthenicus</i> ARTEMZUK	.	.	.	.	.	-	+	r	-	-	20
<i>Allium paczoskianum</i> TUSZON	.	.	.	.	.	r	r	-	+	-	30
<i>Thymus dimorphus</i> KLOKOV et SHOST.	.	.	.	.	.	-	-	-	-	-	0
<i>Artemisia arenaria</i> DC.	.	.	.	.	.	-	-	-	-	-	0
<i>Chondrilla juncea</i> L.	+	.	.	+	+	.	+	-	-	-	40
<i>Seseli tortuosum</i> L.	.	.	.	.	.	-	-	-	-	-	0
<i>Centaurea odessana</i> PRODÁN	.	.	.	.	.	+	+	-	-	-	20
<i>Gypsophila paniculata</i> L.	.	.	.	.	.	-	+	r	-	-	20
<i>Agropyron dasyanthum</i> LEDEB.	.	.	.	.	.	-	1	-	-	-	10
Ch. D - Honckenyo-Elymetea and lower syntaxa											
<i>Cynanchum acutum</i> L.	1	1	1	1	1	1	-	2	1	2	90
<i>Galium humifusum</i> M. BIEB.	r	r	+	+	+	.	-	-	-	-	50
<i>Asparagus levinae</i> KLOKOV	r	+	+	.	.	-	-	-	-	-	40
<i>Gypsophila perfoliata</i> L.	r	+	.	+	.	+	-	-	-	-	40
<i>Crambe pontica</i> STEVEN ex RUPR.	.	.	.	.	.	-	-	-	-	-	0
<i>Lactuca tatarica</i> (L.) C.A. MEY.	.	.	.	.	.	-	-	-	-	-	0

<i>Heliotropio dolosi-Brometum japonici</i>																
49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	%	
-	E	-	-	W	-	-	-	-	E	SE	-	-	-	-	-	
-	2	-	-	3	-	-	-	-	2	2	-	-	-	-	-	
100	100	100	100	100	100	100	100	100	100	100	100	90	100	100	100	
85	70	50	25	80	55	55	55	90	60	60	45	80	45	50		
29	29	45	22	37	39	33	27	22	33	33	34	41	43	43		
+	1	+	.	.	1	1	1	2	1	1	+	2	+	+	87	
+	+	+	.	.	r	r	+	.	.	.	.	.	.	.	47
.	.	.	.	.	.	.	r	r	.	.	.	.	.	.	13
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7
+	+	+	r	.	+	+	1	2	+	1	+	1	+	r	93	
2	+	2	+	2	+	r	+	+	+	+	2	+	2	2	100	
1	r	.	r	.	r	2	3	3	3	2	.	1	2	3	80	
.	.	r	r	.	+	r	.	.	+	+	r	+	r	r	67	
.	+	r	r	.	+	+	+	+	+	+	+	+	r	.	73	
.	+	.	+	+	+	r	+	+	+	+	+	+	+	+	80	
2	+	1	2	1	.	.	.	1	+	r	+	r	2	1	80	
3	2	1	1	3	.	.	.	1	2	.	1	.	+	+	67	
r	.	.	.	.	.	.	.	1	.	r	.	r	.	+	40
.	+	+	.	.	.	.	.	.	r	.	.	+	+	+	40
r	.	.	.	r	.	.	.	.	.	.	.	.	.	.	13
2	1	r	.	r	r	+	+	2	2	+	r	+	r	r	93	
.	+	.	r	r	r	r	r	+	+	+	+	+	+	+	73	
.	r	r	.	+	+	+	+	r	.	r	+	r	r	r	67	
1	1	+	r	+	1	1	1	2	1	2	+	2	1	+	100	
+	+	.	.	.	+	+	+	1	+	r	+	+	r	r	80	
.	+	1	+	.	+	r	+	.	1	+	1	+	+	1	80	
.	+	.	.	.	+	r	r	.	r	+	r	+	+	+	60	
.	1	+	.	.	+	r	+	.	2	+	+	+	+	+	73	
+	.	.	.	.	+	r	r	.	r	+	.	+	r	.	53
r	.	+	.	.	1	+	r	r	.	.	.	.	.	.	33
.	+	.	.	.	+	r	+	.	1	+	+	+	+	+	60	
+	.	+	.	1	.	+	.	.	.	.	.	.	.	.	27
.	r	.	.	.	.	.	.	.	.	r	.	r	.	+	27
.	+	.	.	.	.	.	.	.	.	.	+	.	+	r	27
.	+	.	.	.	.	.	.	r	.	r	.	+	+	+	33
+	.	+	+	+	+	.	.	.	.	.	.	.	.	.	27
.	+	.	.	+	r	.	.	.	.	.	.	.	.	.	13
.	+	.	.	+	+	.	.	.	.	.	+	+	+	+	33
.	+	.	.	+	r	.	.	.	+	.	+	+	+	.	33	
.	+	.	.	+	+	r	.	.	+	.	+	+	+	.	0	
.	+	.	.	.	.	.	.	.	+	.	+	+	+	.	27
r	.	.	.	.	r	.	.	.	.	.	.	.	.	.	7
.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	0
.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	7
.	+	+	.	.	+	+	.	1	+	.	+	r	+	r	67	
.	+	+	.	.	+	r	.	.	.	.	+	+	+	.	33
.	+	.	.	.	+	+	.	.	1	.	.	.	+	+	27	
.	+	.	.	.	r	.	.	.	.	+	.	+	+	.	0
.	+	.	.	.	r	.	.	.	.	+	.	+	+	.	27
.	+	.	.	.	r	.	.	.	.	+	.	+	+	.	13

Relevé Nr.	39	40	41	42	43	44	45	46	47	48	%
<i>Ch, D - Asteretea tripolium</i> and lower syntaxa											
<i>Bassia hirsuta</i> (L.) ASCH.	+	+	+	+	+	50
<i>Artemisia santonica</i> L.	1	1	1	1	+	.	.	.	1	.	60
<i>Aeluropus littoralis</i> (GOUAN) PARL.	+	0
<i>Medicago kotovii</i> WISSJUL.	+	10
<i>Apera maritima</i> KLOKOV	r	.	.	r	.	20
<i>Bassia sedoides</i> (PALL.) ASCH.	0
<i>Puccinellia distans</i> (JACQ.) PARL.	+	1	20
<i>Limonium meyeri</i> (BOISS.) KUNTZE	+	10
<i>Halimione verrucifera</i> (M. BIEB.) AELLEN	0
<i>Frankenia hirsuta</i> L.	0
<i>Odontites salina</i> (KOTOV) KOTOV	0
Other accompanying species											
<i>Alyssum hirsutum</i> M. BIEB.	r	r	r	r	r	2	2	2	.	2	90
<i>Centaurea diffusa</i> LAM.	+	+	+	+	1	+	.	.	+	.	70
<i>Agropyron laevanchoanum</i> PROKUDIN	r	.	.	.	.	.	+	.	.	+	30
<i>Artemisia taurica</i> WILLD.	+	+	+	+	1	.	.	.	.	.	50
<i>Cerastium syvaschicum</i> KLEOPOW	2	1	20
<i>Thlaspi perfoliatum</i> L.	0
<i>Plantago dubia</i> L.	0
<i>Allium perezitum</i> KLOKOV	.	r	.	.	.	.	.	.	.	.	10
<i>Dianthus pseudoarmeria</i> M. BIEB.	+	+	20
<i>Silene supina</i> M. BIEB.	+	r	.	.	20
<i>Melilotus albus</i> MEDIK.	0
<i>Arenaria serpyllifolia</i> L.	.	r	.	.	.	r	.	.	.	.	20
<i>Plantago lanceolata</i> L.	r	+	r	.	.	30
<i>Artemisia pontica</i> L.	1	.	.	.	.	10
<i>Cuscuta monogyna</i> VAHL	+	+	.	.	20
<i>Tragis racemosa</i> (L.) ALL.	+	r	.	.	.	20
<i>Ephedra distachya</i> L.	0
<i>Consolida paniculata</i> (HOST) SCHUR	0
<i>Orobanche sarmatica</i> KOTOV	+	.	.	10
<i>Camelina rumelica</i> VALEN.	+	.	10
<i>Thesium arvense</i> HORV.	0
<i>Poa bulbosa</i> L.	0
<i>Achillea euxina</i> KLOKOV	0
<i>Anthemis ruthenica</i> M. BIEB.	0
<i>Arabidopsis toxicophylla</i> (M. BIEB.) N. BUSCH	0
<i>Calamagrostis epigeios</i> (L.) ROTH	+	.	.	.	+	20
<i>Eryngium campestre</i> L.	+	r	.	.	20
<i>Asparagus littoralis</i> STEVEN	+	.	10
<i>Thesium linophyllum</i> L.	r	.	10
<i>Trigonella monspeliaca</i> L.	0
<i>Carduus uncinatus</i> L.	0
<i>Verbascum pinnatifidum</i> VAHL	0
<i>Stipa capillata</i> L.	r	.	.	.	.	0
<i>Salsola soda</i> L.	r	.	.	.	.	10
<i>Cirsium canum</i> (L.) ALL.	r	.	.	.	10
<i>Potentilla astracanica</i> JACQ.	0
<i>Carex divisa</i> Huds.	0
<i>Linum austriacum</i> L.	0
<i>Otites media</i> (LITV.) KLEOPOW	0
<i>Festuca valesiaca</i> GAUDIN	0
<i>Plantago salsa</i> PALL.	0
<i>Plantago scabra</i> MOENCH	0
<i>Polygonum pulchellum</i> LOISEL.	0
<i>Asparagus tenuifolius</i> LAM.	0
Eo											
<i>Parmelia kamtschadalis</i> (MONT.) MONT.	1	1	1	1	+	.	1	1	.	.	70
<i>Tortula ruralis</i> (HEDW.) GAERTN. et al.	1	1	+	+	+	.	.	.	.	.	50

49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	%	
.	.	+	r	.	1	+	+	+	.	+	1	1	+	+	73	
+	.	1	.	.	.	.	.	.	+	.	+	+	+	+	40
.	r	r	r	.	+	+	r	+	+	60		
.	.	+	.	.	+	.	.	.	+	+	.	+	+	47		
.	.	+	+	.	.	+	.	13		
.	.	+	r	.	+	r	27		
.	+	7		
+	+	13		
1	7		
.	+	7		
.	r	.	.	.	.	7		
2	1	+	r	1	+	1	+	1	.	.	r	+	.	r	80	
+	+	.	+	+	r	+	.	.	+	.	+	+	.	.	67	
+	.	+	.	.	+	+	+	.	.	+	+	+	+	+	60	
.	+	+	.	.	+	.	.	+	.	33		
.	+	.	.	.	r	+	r	1	+	r	.	r	.	.	53	
.	r	r	.	.	+	r	+	r	1	r	r	.	r	.	53	
.	r	.	.	.	+	+	+	.	+	+	+	+	.	.	53	
.	1	+	+	+	+	40		
+	1	.	.	.	2	+	.	.	.	.	27	
.	.	+	r	.	+	.	.	.	.	.	.	.	.	.	20
.	.	.	+	.	1	.	.	.	.	+	+	r	.	.	33
.	+	r	.	.	.	.	.	13	
.	+	7	
2	+	.	.	1	.	.	.	.	+	.	20	
.	.	+	.	+	13	
.	.	r	.	.	.	.	.	.	.	.	r	r	r	.	27
.	+	+	.	+	.	.	.	27	
+	r	.	.	.	r	.	.	.	.	.	13	
r	.	+	.	+	20	
+	r	.	.	.	.	+	.	.	.	.	20	
.	1	.	.	.	r	.	.	.	r	.	.	.	.	.	20
.	.	+	.	r	.	.	.	.	1	.	.	.	.	.	20
.	+	.	.	.	+	r	.	.	.	.	0	
.	0	
.	+	.	7	
.	7	
+	+	13	
+	r	.	.	.	.	.	.	.	.	.	13	
.	r	.	.	.	+	.	.	.	.	.	13	
.	r	.	.	.	r	.	.	.	.	.	0	
.	0	
.	+	7	
.	.	+	7	
.	.	.	+	7	
.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	7
.	.	.	.	+	7	
.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	7
.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	7
.	+	7	
.	r	.	.	.	.	.	.	.	.	.	7	
.	r	.	.	.	.	.	.	.	.	.	7	
.	+	.	7	
+	1	1	1	1	.	+	1	1	1	2	+	1	+	1	2	87
+	+	1	1	+	3	1	1	1	2	2	1	2	1	1	1	100