Steppe communities within the coast of the Taman Peninsula

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Abstract. The article presents the results of field research in 2019–2020 of plant communities of the abrasive coast of the Taman Peninsula. The biomorphological structure of populations is dominated by annual species, which indicates a high dynamism associated with exogenous processes. Ecologically, the dominant species are xerophytes and xeromesophytes, as well as species with a wide eco-amplitude. The process of unification of the studied flora is low and amounted to 17%. The generalized floristic list includes 231 plant species from 48 families. In the study area, 7 species of Red Book plants were found, of which 2 species were included in the Red Book of the Russian Federation.

1. Introduction

The climate of the region belongs to the Black Sea subregion of the Atlantic-Continental region and is determined by the impact of circulation processes in the southern zone of temperate latitudes. The Taman Peninsula belongs to the area of insufficient moisture, the moisture coefficient is 0.25–0.30. During the year 200–250 mm of precipitation falls, with a maximum in spring and autumn. Precipitation in the eastern part of the Azov Sea is about 500 mm per year. Air humidity during the year is significant and is 81–86% in the cold period, 72–79% in the warm one. In some rainy years, precipitation falls three to four times more than the average long-term norm, and in dry years, three to four times less than this norm. Precipitation is short-lived, mostly rainstorm. The total number of days with dry winds is 50–75 days in most of the territory, 35–40 days on the coast. Intense and very intense dry winds are absent [1]. According to the existing landscape zoning schemes, the study area belongs to the same type. These are flat-hilly landscapes with mud volcanism with forb-hurb-grass steppes and copses of xerophilous shrubs and trees. However, there is a significant facial diversity within this type of landscape in the boundaries of the study area due to the peculiarities of its location in the coastal zone of the sea, the activity of exogenous and endogenous geological processes.

In most of the territory landslide processes and the associated facies of disturbed landslide and landslide slopes with various types of vegetation on raw soils have been actively developed. Here, the distribution of vegetation and soils is mosaic in nature and completely depends on the current activity of landslides and the duration of their formation. Active landslide areas are indicated by a weak development of soil and vegetation cover. The soil layer on the displaced landslide blocks does not exceed the first centimeters. As a rule, there is a thinned grass cover in such areas. In general, the relief of the study area is a complex combination of landslide bodies of various ages and degrees of activity with a characteristic hilly-depression surface. Amplitudes of heights within the study area are
up to 60–70 m (from sea level to the edges of landslide combs). The erosional dissection of the territory is weak [2].

Erosional forms are represented by shallow gullies, erosional incisions, furrows and washouts. Channel runoff occurs periodically during prolonged rains and snowmelt. The most dominated are erosional forms located between landslide bodies, since they develop for a longer time and are not disturbed with periodic displacement of landslide masses. Landslide bodies on most of the coast are strongly eroded by the sea and in the lower part form abrasion scars several meters high. Abrasion processes are most widespread along the coastline. The main factors contributing to abrasion in this section of the coast are the outcropping of easily eroded rocks (clays, clays with interlayers of sands and marls, mud volcanic breccias), the activity of landslide processes, as well as growing anticlinal structures. As a result, the coast is abrasive almost along its entire length [3]. According to various data, the rate of abrasion in the study area can reach values from 1 m/year to 3-4 m/year, and sometimes even more [4].

The soil cover of the study area is distributed unevenly. In many areas affected by landslide processes, it is severely disturbed and is characterized by a primitive soil with a poorly developed vegetation cover. The zonal type of vegetation is the steppe. Common species in the area are bristle yarrow (Achillea setacea), austrian flax (Linum austriacum), klaus parsnip (Pastinaca clausiti), prickly sage (Phlomis pungens), stipificated sage (Salvia tesquicola), tansy (Tanacetum millefolium), yarrow (Teucrium chamaedrys); barilla (Salsola), southern reed (Phragmites australis), sand wormwood (Artemisia arenaria) and marine artemisia (Artemisia maritima), sweet clover (Melilotus officinalis) and other steppe species grow in saline areas.

2. Materials and methods
The material for the study was the plant species collected in different ecosystems of the Taman Peninsula within the abrasion coast of the Black Sea. The studies were carried out in 2019-2020, and studies from previous years were also used. The study of the vegetation cover was carried out by the route method. The selected routes were visited repeatedly during the study period. This made it possible to identify the species composition, as well as to establish the confinement of species to certain habitats, plant communities in order to figure out or clarify their ecological features, which is most consistent with the research objectives. Descriptions of the vegetation cover of abrasion coasts were carried out according to standard approaches at survey sites up to 100 m². When establishing the systematic affiliation of plants, the following determiners were used: Kosenko I S (1970) [5], Zernov A S (2006) [6].

In accordance with the botanical and geographical zoning, the territory of our research (from Volna village to Cape Tuzla) (figure 1) is located in the Mediterranean region of the Crimean-Novorossiysk province of the Kerch-Taman district of the Taman region [7].

3. Results and its discussion
It was found that the main type of vegetation in the study area is represented by steppe communities (figure 2): wheatgrass-herbs, herbs-feather grass, cereal-herbs, and herbs-wheatgrass. Such communities are zonal vegetation types on the Taman Peninsula. There is the most powerful soil cover with steppe and shrub vegetation in the areas not involved in active landslide processes. About 70 % of the studied area is involved in agriculture. In the unplowed areas adjacent to the abrasion shore, wheatgrass-herb communities dominate. Floristic richness is about 45 species. In such an association, the dominant species is the crested wheatgrass (Agropyron pectinatum (M. Bieb.) P. Beauv.) and the following species are recorded in the herbs: crimean wormwood (Artemisia taurica Willd.), austrian artemisia (Artemisia austriaca Jacq.), eastern cornflower (Centaurea orientalis L.), galatella (Galatella linosyris s(L.) Rchb.f.), green oregano (Origanum vulgare ssp.viride (Boiss.) Hayek), russian bedstraw (Galium rutenicum Willd.) yellow mignonette (Reseda lutea L.), etc. The total projective cover is up to 80 %.
Herbs and wheatgrass communities are in the second place in terms of occurrence. The first tier is dominated by steppe wheatgrass (*Elytrigia×tesquicola* (Prokudin) Klokov). In the second tier, the following species were recorded: purple-stem (*Phleum phleoides* (L.) H. Karst), brome grass *divaricate* (*Bromus squarrosus* L.), ethiopian sage (*Salvia aethiopis* L.), jointed goat grass (*Aegilops cylindrica* Host), crimean wormwood (*Artemisia taurica* Willd.), Bieberstein tulip (*Tulipa biebersteiniana* Schult. et Schult. f.), splendid bellevalia (*Bellevalia speciosa* Woronow ex Grossh), iris *humilis* (*Iris pumila* L.), canadian conyza (*Conyza canadensis* (L.) Cronquist), blueweed (*Echium vulgare* L.), etc. A total of about 30 species, the total projective cover is up to 40 %.

![Figure 1. Planning route of research.](image1)

Also, a significant area of growth is occupied by cereal-herbs communities in the vicinity of Volna village. In the first layer the following species are noted: slender harem (*Bupleurum tenuissimun* L.), soft brome (*Bromus mollis* L.), geniculate barley (*Hordeum geniculatum* All.) yellow everlasting (*Helichrysum arenarium* (L.) Moench), steppe euphorbia (*Euphorbia stepposa* Zoz ex Prokh.), crimean sage (*Phlomis taurica* Hartwiss ex Bunge), austrian artemisia (*Artemisia austriaca* Jacq.), Lerch sagebrush (*Artemisia lerccheana* Weber ex Stechm.), etc. In the second layer, the followings are recorded: white-toment germander (*Teucrium polium* L.), mountain iron woundwort (*Sideritis montana* L.), Marshall thyme (*Thymus marschallianus* Willd.), astrakhan potentilla (*Potentilla astracanica* Jacq.).

![Figure 2. Steppe communities of abrasion coats.](image2)
About 40 species are found in such communities. The height of the first layer is 50 cm, the second is 20 cm. The total projective cover is 60‒70%.

Along the route of the study, abrasion coasts of the herb-feather grass community are found, consisting of the following species of the first layer: crimean sage (*Phlomis taurica* Hartwiss ex Bunge), ethiopian sage (*Salvia aethiopis* L.), steppe sage (*Salvia tesquicola* Klokov & Pobed.) esparto grass (*Stipa capillata* L.), sprawling cornflower (*Centaurea diffusa* Lam.), etc. In the second layer, the followings were noted: iris humilis (*Iris pumila* L.), yellow star of Bethlehem (*Gagea lutea* (L.) Ker Gawl.), austrian wormwood (*Artemisia austriaca* Jacq.), alison hirsute (*Alyssum hirsutum* M. Bieb.) The total projective cover is 80‒100%, about 30 species in total.

The generalized floristic list, compiled from the results of a survey of the abrasion coasts of the Taman Peninsula, confined to the Black Sea coast, includes 231 plant species from 48 families. 11 families have a level of species richness higher above average, the leading families are Asteraceae – 41 species, Poaceae – 38 species, Lamiaceae – 16 species, Fabaceae – 15 species, Rosaceae – 12 species.

On the roadsides of unpaved roads that cut the study area, there are communities with a predominance of weed species: ragweed (*Ambrosia artemisiifolia*), canadian conyza (*Conyza canadensis*), couch grass (*Elytrigia repens*), sow thistle (*Sonchus arvensis*), shepherd's purse (*Capsella bursa-pastoris*), rugose rapistrum (*Rapistrum ugosum*), species that are rarely found in disturbed habitats: lepidium draba (*Cardaria draba*), winterweed (*Stellaria media*) tectorial anisantha (*Anisantha tectorum*), delphinium (*Delphinium consolida*), wild camomile (*Tripleurospermum inodorum*), stinkweed (*Thlaspi arvense*), spread cornflower (*Centaurea pseudosquarrosa* Mikheev ex Gabrieljan et Mikheev) and other species that tolerate trampling well. The process of unification of the studied flora was 17%. Despite the fact that the study area is located near the “Port Taman”, as well as a settlement, the unification process affected the flora being characterized to an insignificant extent. The territory is characterized by high species richness; it is a kind of ecotone zone, which is of great importance for the protection of plants listed in the Red Books of Russia and Krasnodar region.

One of the largest populations of the iris humilis (*Iris pumila* L.) (figure 3) grows in the surveyed area, which belongs to the objects of international agreements and conventions ratified by the Russian Federation [8, 9]. The dynamics of the range and number of the species is stable. The species is found almost throughout the Eastern Azov Sea region and in the north of the Black Sea coast of the Kuban. Its frequency and abundance is high.

![Figure 3](image-url)

**Figure 3.** Full-member population of *Iris pumila* L. in communities of abrasion coasts.
In total, 7 species of Red Book plants from 6 families have been registered: Black Sea mustard (*Cakile euxina* Pobed.), ethiopian sage (*Salvia aethiopis* L.), crimean sage (*Phlomis taurica* Hartwiss ex Bunge), yellow everlasting (*Helichrysum arenarium* (L.) Moench), Bieberstein tulip (*Tulipa biebersteiniana* Schult. et Schult. f.), splendid bellevalia (*Bellevalia speciosa* Woronow ex Grossh.) and iris humilis (*Iris pumila* L.). According to the categories of the Red Book of the Krasnodar region (2017), the largest number of species are listed with the status “Exposed” or 3UV – 5 species, and with the status 2 – “Endangered” or 2 IP – 2 species. The Red Book of the Russian Federation includes two species of splendid bellevalia (*Bellevalia speciosa* Woronow ex Grossh.) and iris humilis (*Iris pumila* L.).

4. Conclusion
With a relatively small area of study, a high value of steppe plant communities was revealed, which contain a unique plant gene and cenofund that require protection measures. The biomorphological structure of populations is dominated by annual species, which indicates a high dynamism associated with exogenous processes. Ecologically, the predominant species are xerophytes and xeromesophytes, as well as species with a wide eco-amplitude. The process of unification of the studied flora is low and amounted to 17%. The generalized floristic list includes 231 plant species from 48 families. The study area is characterized by the presence of protected plant species with fairly large populations.

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References
[1] Agroclimatic resources of the Krasnodar region 1975 56 p
[2] Kosyan R D and Krylenko V V 2018 The main criteria for the complex classification of the Azov-Black Sea coasts of Russia Oceanology 58 3 pp 501–511
[3] Volkova T A, Mishchenko A A, Antiptseva Yu O and Lipilin D A 2017 Coastal geosystems in space and time: based on materials of Krasnodar region 275 p
[4] Peshkov V M 2003 Coastal zone of the sea 350 p
[5] Kosenko I S 1970 Keys to Plants of the Northwestern Caucasus and Ciscaucasia 613 p
[6] Zernov A S 2006 Flora of the Northwest Caucasus 464 p
[7] Atlas Krasnodar region and the Republic of Adygea 1996 48 p
[8] The Red Book of the Russian Federation 2008 (Plants vol 2) (Moscow: Ministry of Natural Resources of the Russian Federation: RAS; RBO; MSU; Chairman: Head of the State Service for Environmental Protection of the MPR of the Russian Federation) 855 p
[9] The Red Book of the Krasnodar Territory. Plants and fungi 2017 ed S A Litvinskaya et al (Krasnodar: Administration of Krasnodar region) 2nd ed 848 p