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Taxonomic analysis of the Dongyztai flora

Abstract: This article provides a taxonomic analysis of the Dongyztai flora. It is represented by 314 species from 170 genera and 40 families. The materials were obtained based on field studies, the literature data were taken into account. The analysis of the family-species spectrum testifies that 5 leading families make up 60.9 % (186 species). The leading families in the area are *Amaranthaceae*, *Asteraceae*, *Brassicaceae*, *Poaceae*, *Fabaceae*. The key position is taken by *Amaranthaceae* family, represented by 67 species which is 21.6 % of the flora species. The second position is taken by *Asteraceae*, which includes 40 species (12.8 %). The predominance of these families in the flora of the region characterizes it as continental one. The analysis of the structure of the leading families showed that the spectrum of flora refers to the Turanian, Mediterranean and boreal types.

Keywords: Dongyztai flora, vascular plants, the taxonomic analysis.

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Introduction. Dongyztai chink is insufficiently explored territory, it is located in a remote part of the Aktobe region at the junction of Atyrau, Mangystau regions.

Dongyztai chink lies in the southwestern part of the Aktobe region between 46° 08' n.l. - 46° 68' n.l. and 56° 13' E - 57° 60' E. It is the Northern part of the Ustyurt plateau covering an area of not less than 900 km². The territory is located on the rocky and hollow-wavy surface of the accumulative-denudation plain within the Ustyurt plateau in the natural zone of desert with a sharply continental arid climate [1].

Characterization of flora is an important indicator of the heterogeneity degree of the territory of flora, of the diversity of physical and geographical conditions

In the East the chink is limited with high spurs of Chagray Cape, in the South – with higher spurs of the Ustyurt plateau and in the East – with a very low ridge of Karamay spurs of Ustyurt, in the West – with the Zheltau mountains and in the North-West – with Zmystan island hill.

The climate of the region is of the type of desert of boreal type. The general features of the climate of the region are sharp temperature contrasts, cold severe winter and hot summer, rapid transition from winter to summer and short spring period, unsteadiness and scarcity of precipitation, great dryness of air, intensity of evaporation processes, instability of climatic parameters in time and a large amount of solar heat. The duration of sunshine is 2300-2700 hours per year. According to long-term observations of the weather station in Ayakkum, the coldest month in the region is January with average monthly air temperature of -10.1 °C, the absolute minimum temperature is -36.9 °C, and the hottest month is July with average monthly air temperature +26.6 °C, the absolute maximum is +40.7 °C.

Precipitation is the main factor of groundwater supply. Annual precipitation changes for the areas within 195-262 mm. Little rainfall and high air temperature cause a large humidity deficit. The total amount of evaporation per year from the free water surface reaches 1200-1500 mm, exceeding 5-6 times the amount of annual precipitation. Summer precipitation is almost completely spent on evaporation [2].

Low-humic sierozemic and chestnut soils predominate in the region, commonly saline and in some places – strongly saline [3].

Dongyztau chink is located in the natural zone of desert. The vegetation of the area is dominated by communities with a predominance of belozemelnaya polyn or zhusan (*Artemisia teirae-albae*) and itsigek (*Anabasis aphylla*) on elevated plains (Viktorov, 1971). The slopes are covered with species of mortuk (*Eremopyrum orientale*, *E. triticeum*).

To fill the existing gap in the knowledge about the nature of Kazakhstan we carried out a floristic survey of the Donyztau chink. Below are the main indicators characterizing the flora of the region under study. After all, the characteristic of flora is an important parameter, indicating the degree of heterogeneity of the territory of flora, the diversity of physical and geographical conditions. Systematic analysis is a logical completion of the flora inventory and is intended, first of all, to reveal the level of abundance of flora species, its taxonomic diversity, as well as the ratio of species between the systematic categories of higher ranks, i.e. the systematic structure of this flora [4].

Materials and methods. Field studies provided the materials for the work. The studies were based on the enroute method, the sites were visited 2-3 times during the season. All flowering and vegetating plants were taken into account, floristic lists of the surveyed areas were compiled, on the basis of which a General list of species of vascular plants was compiled. Herbarium samples stored in the herbarium Fund of the Institute of botany and Phytointroduction of RK MES, Mangyshlak experimental Botanical garden, Botanical Institute named after V. L. Komarov RAS, as well as the literary data in "The Results of a complex expedition to the South-Eastern part of Zhylyoi district of Atyrau region of the Republic of Kazakhstan" (Astana, 2017), "Flora of Kazakhstan" (1956-1966), "Guide to plants of Central Asia" (1968-1993), "The sketches on the flora of Aktobe floristic district" (Aipeisova, 2012), «To the study of species composition of wild counterparts of cultivated plants grown of Mangistau region» (Imanbayeva A.A., Ishmuratova M.Yu., Duisenova M.I., Tuyakova A.T., 2015) were analyzed[5,6,7,8,9].

The Plant List (2013) Version 1.1 database was used to unify the material. The volume of the flowering plant family was taken according to the APG IV system (Angiosperm Phylogeny Group) (2016).

The definition of plants, clarification of their systematic position in taxonomically complex groups was given according to the following literary sources: "Guide to higher vascular plants" (Aktau, 2006), "Guide to cereals of Kazakhstan" (1948), "Cereals of the USSR" (Tsvelev, 1976), as well as using monographic treatments for individual groups of plants[10,11,12].

Results and discussion. The conducted research allowed to establish that 314 species of higher plants belonging to 170 genera and 41 families were found on the area under study.

Gnetopsida class is represented by two species (0.63 % of the total number of flora species). The vast majority of species refer to angiosperms. *Magnoliophyta* group numbers 303 species (99.3 %). 38 species out of them (12.1 percent) refer to the *Liliopsida* class, and 274 species (87.2 %) refer to *Magnoliopsida* class. The ratio of monocotyledonous and dicotyledonous species is 1:7.2. The share of gymnosperms is insignificant (table 1).

Table 1 - Key taxonomic indicators of the Dongyztau flora

Taxonomic indicators	Flora of Dongyztau
Total number of species	314
Total number of genera	170
total number of families	40
The average number of species in a genera	1.8
The average number of species in a familie	7.6
The average number of genera in a familie	4.1
Number of single species	11
Number of single families	11
The maximum number of species in one genera	13
The maximum number of species in one familie	67
The maximum number of genera in one familie	25
The share of species in the top 10 families%	78.3
The share of Monocots among angiosperms, %	12.1

The share of Eudicots among angiosperms, %	87.2
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The share of the top ten according to the number of types of families is made up by 239 types, accounting for 78.3% of the total diversity of the Donguztau flora (table 2).

Table 2 - The taxonomic composition of the Dongyzttau flora

Nº	Family	Number of genera, un.	Relative index of genera, %	Number of species, un.	Relative index of species, %
1	<i>Amaranthaceae</i>	25	14.70	67	21.33
2	<i>Asteraceae</i>	20	11.76	40	12.73
3	<i>Brassicaceae</i>	20	11.76	31	9.87
4	<i>Poaceae</i>	16	9.41	27	8.59
5	<i>Fabaceae</i>	8	4.70	26	8.28
6	<i>Boraginaceae</i>	10	5.88	16	5.09
7	<i>Caryophyllaceae</i>	7	4.11	14	4.45
8	<i>Apiaceae</i>	8	4.70	11	3.50
9	<i>Polygonaceae</i>	5	2.94	8	2.54
10	<i>Ranunculaceae</i>	5	2.94	6	1.91

The dominant family with more than 20 species is the family of *Amaranthaceae* - 67 species, the second position is with *Asteraceae* - 40 species, in third position is *Brassicaceae* - 31 species, slightly inferior to *Brassicaceae* family *Poaceae* -27 species, in fifth position is the family *Fabaceae* - 26 species. In total the first five families include 88 genera (51.7% of the total number of genera) and 190 species (61% of the total number of species).

It is obvious that the species of vascular plants from different families are not equally represented in the Dongyzttau flora (figure 1).

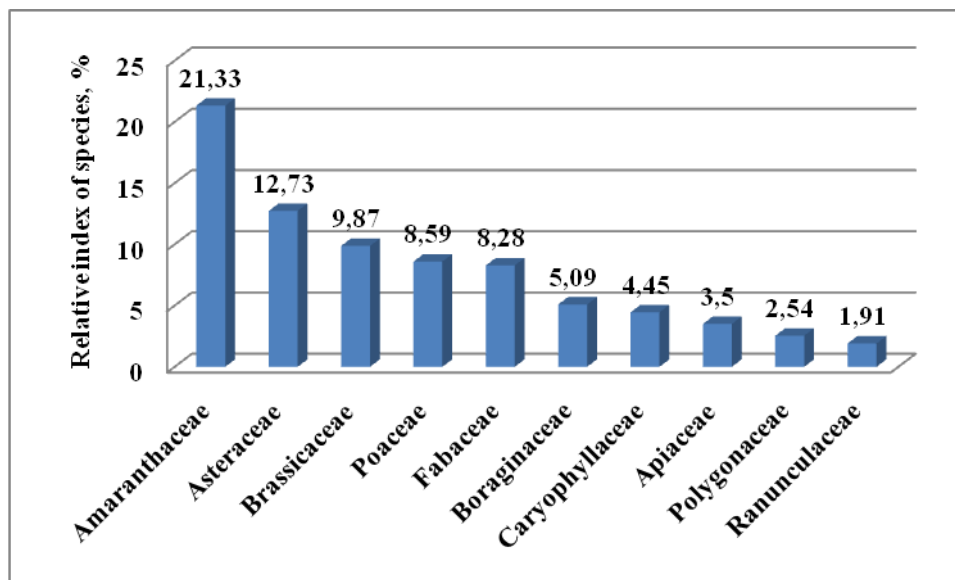


Figure 1. Representation of the leading families in the Dongyzttau flora

Many-genera families, presented in the Dongyzttau flora with more than ten genera are the following: *Amaranthaceae* - 25 genera, *Asteraceae* - 20 genera, *Brassicaceae* - 20 genera, *Poaceae* -16 genera. In total they include 80 genera (47% of the total number of genera) and 164 species (52.2% of the total number). All the named genera are multiple. The following families have the greatest species diversity (more than 6 species): *Amaranthaceae* - 67 (21%), *Asteraceae*-40(12.73%), *Brassicaceae*-31 (9.8%), *Poaceae*-27 (8.59%), *Fabaceae*-26 (8.28%), *Caryophyllaceae*-14 (4.59%), *Boraginaceae*-16 (5.09%), *Apiaceae*-11 (3.50%), *Polygonaceae*-8 (2.54%), *Ranunculaceae*-6 (1.96%), other 69 species (20.8%) refer to 30 families which contain from one to five species. *Polygonaceae* family contains 5 species. Families with 3-4 species number 10. They contain 34 species, i.e. 11.1% of the total

number. 4 species are distinguished in the families *Papaveraceae*, *Nitrariaceae*, *Plumbaginaceae*, *Tamaricaceae*. Families *Liliaceae*, *Amaryllidaceae* (*Alliaceae*), *Asparagaceae*, *Rubiaceae*, *Convolvulaceae*, *Lamiaceae* contain 3 species each. 18 families contain only 1-2 species each: *Zygophyllaceae*, *Rosaceae*, *Geraniaceae*, *Rutaceae*, *Capparaceae*, *Apocynaceae*, *Caprifoliaceae*(*Dipsacaceae*), *Ixioliriaceae*, *Cyperaceae*, *Berberidaceae*, *Crassulaceae*, *Elaeagnaceae*, *Euphorbiaceae*, *Malvaceae*, *Frankeiaceae*, *Solanaceae*, *Phrymaceae*, *Linderniaceae*.

This species spectrum of the Dongyzttau flora is a clear indicator of the heterogeneity degree of the flora territory, testifies to the diversity of its geographical conditions.

This family structure is the result of the location of the study area near the border of the Boreal and ancient Mediterranean sub-kingdoms of the Holarctic Kingdom (Kamelin, 2012). The leading position of *Amaranthaceae*, *Boraginaceae*, *Polygonaceae* families are typical for Turanian flora, the high number of species of the *Asteraceae*, *Fabaceae* and *Rosaceae* families testifies to the influence of Mediterranean flora proper, the *Caryophyllaceae*, *Ranunculaceae*, *Brassicaceae*, *Cyperaceae* families are indicative of the boreal features of flora [13].

According to the table of multi-species genera the following families include a little, more than 10 species: *Astragalus* – 13 species, *Artemisia* – 12 species, *Salsola* – 10 species, two genera - *Anabasis*, *Suaeda* contain 7 species each, two genera - *Stipa*, *Climacoptera* 6 species each, *Atriplex*, *Lappula* - 5 species each. Such a structure of the largest genera is specific to the Turan floristic province(table 3).

Table 3 - Leading genera of the Dongyzttau flora

№	Genus	Absolute index, un.	Relative index, %
1	<i>Astragalus</i>	13	4.26
2	<i>Artemisia</i>	12	3.93
3	<i>Salsola</i>	10	3.27
4	<i>Anabasis</i>	7	2.29
5	<i>Suaeda</i>	7	2.29
6	<i>Stipa</i>	6	1.19
7	<i>Climacoptera</i>	6	1.19
8	<i>Atriplex</i>	5	1.63
9	<i>Lappula</i>	5	1.63

The data show that the major part of the flora structure is occupied by one-two-species genera - 26 genera (65% of the total). They include 53 species, which is 17.3% of the total number of species. Thus, the enrichment of the studied flora with genera is in process which indicates the predominance of allochthonous trends (Tolmachev, 1960) in the formation of flora .

L. I. Malyshev [14,15] proposed an indicator that allows to estimate the ratio of autochthonous and allochthonous trends in the process of florogenesis It is the relative difference between the actual (S) and the estimated (S1) number of species:

$$A = (S - S1)/S$$

The calculated number of species is determined by the empirical quadratic equation:

$$S1 = 314.4 + 0.0045383 * G^2,$$

where G is the number of genera in a given flora, hence

$$S1 = 314.4 + 0,0045383 * 1682 = 442.4$$

$$A = 305 - 442.4/305 = -0.45$$

The negative value of the autonomy index of this flora shows the allochthonous nature of the flora. Since the ratio of species to genera also depends on the size of the flora, this can be partly explained by the relatively small size of the studied region (Malyshev, 1987). The factor of floristic study insufficiency of the territory is not excluded, as in recent years the surveyed region has seen

long droughts with low rainfall in the spring. This may lead to the transfer of the part of plant species to an idle state and the impossibility of detection in the studied period of time. Therefore to understand more completely the Dongyztau flora long-term observations are required.

Conclusion

To the present time the Dongyztau territory has 314 species registered belonging to 170 genera and 40 families. The leading families include *Amaranthaceae* – 67, *Asteraceae*-40, *Brassicaceae*-31, *Poaceae*-27, *Fabaceae*-26. The studied flora combines the features of the flora of Turanian, Mediterranean and Boreal types. The high relative proportion of genera compared to the number of species in the studied flora shows that it is predominantly of allochthonous nature.

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Доңызтау флорасының таксономиялық талдауы

Аңдатпа: Мақалада Доңызтау флорасына таксономиялық талдау жасалған. Флора 40 тұқымдасқа жататын 170 туыс пен 314 түрден құралған. Материалдар далалық экспедициялар нәтижелері мен әдеби мәліметтерге сүйене отырып алынған. Талдау нәтижелері басты 5 тұқымдас барлық өсімдік жамылғысының 60,9%(186 түр) құрайтынын көрсетті. Зерттеу аймағындағы негізгі тұқымдастарға *Amaranthaceae*, *Asteraceae*, *Brassicaceae*, *Poaceae*, *Fabaceae* жатады. *Amaranthaceae* тұқымдасы жалпы флораның 67 түрін(21,6 %) құрап, басымдылық танытты. Екінші орында *Asteraceae* 40 түр (12,8%). Мұндай көрсеткіш аймақты континентальдығын айқындайды. Басым тұқымдастар құрылымының талдау нәтижелері флора спектрі Тұран, Жерортатеңіздік және бореалды типке жататындығын көрсетті.

Түйін сөздер: Доңызтау флорасы, түтікті өсімдіктер, таксономиялық талдау.

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Таксономический анализ флоры Донгызтау

Аннотация: В данной статье приводится таксономический анализ флоры Донгызтау. Она представлена 314 видами из 170 родов и 40 семейств. Материалы получены в результате полевых исследований, учтены литературные данные. Анализ семейственно-видового спектра показывает, что 5 ведущих семейств составляет 60,9 % (186 вида). Лидирующими семействами в данном районе являются *Amaranthaceae*, *Asteraceae*, *Brassicaceae*, *Poaceae*, *Fabaceae*. Ведущее место занимает семейство *Amaranthaceae*, представленное 67 видами, что составляет 21,6 % от видов флоры. Второе место занимает *Asteraceae*, включающее 40 видов (12,8 %). Преобладание этих семейств во флоре района характеризует её как континентальную. Анализ структуры ведущих семейств показал, что спектр флоры относится к туранскому, средиземноморскому и бореальному типам.

Ключевые слова: флора Донгызтау, сосудистые растения, таксономический анализ.

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