

## Analysis Of Dagestan Flora And Peculiarities Of Taxonomic Structure In Its Floristic Districts

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**Comparative analysis of species composition of floristic regions of Dagestan is given in the article. It is noted that families' location succession in spectra shows the influence of one or another floristic center on flora formation in separate regions. It is shown that regions, situated in the same natural zone, are alike. According to the character of leading families location in spectra its own peculiarities for each region are determined.**

**Keywords:** *Flora, Dagestan, floristic regions, comparative analysis, similarity of flora*

### INTRODUCTION

Biological diversity is the subject - matter of any area study that allows to solve a number of fundamental and practical problems. The natural flora study is given a leading role in these problems, and it is aimed at addressing issues related to taxonomy, florogenesis, resource studies, as well as the protection of species and their habitats.

Dagestan is a very interesting floristically region in the Caucasus and is considered to be one of the centers of xerophytic flora development and resettlement in the region (Kuznetsov, 1910; Grossgeim 1925, 1936; Bush, 1935). Dagestan flora uniqueness has attracted many researchers' attention. Its study has more than three hundred years history. Despite this, there is still no generalizing works on the flora and its analysis. In this regard, we have carried out the work to revise and compile a general list of Dagestan flora. Analysis of recent work on the floristic findings (Guseinov, 2012, 2013; Muhumaeva, Hizrieva, Adzhieva, 2014; Kasumova, 2015) and some of our additions to the flora (Murtazaliev 2011; Murtazaliev, Teymurov, Yarovenko, 2012), having been revealed after the "Dagestan flora conspectus" (Murtazaliev, 2009), allowed us to clarify the species composition, according to which, currently there are 3380 species the flora.

### MATERIALS AND METHODS

Field studies were carried out within the period of 1995–2015 during the different seasons while the growing period and within this time there were carried out about 360 expeditions in various regions of Dagestan and the Caucasus as a whole. Direc-

tions and route selection were carried out taking into account the certain areas knowledge.

Besides own research, the importance in clarifying the plant species spread features there had the analysis of herbarium specimens. Thus, in the course of the work there has been viewed a significant number of herbarium sheets, stored in different herbaria (BAK, DAG, ERE, LE, LENUD, MHA, MOSP, MW, SPI, TBI, TGM, WILR, RW).

The species, having been identified, have different allocations, and it is primarily due to the diversity of climatic and physiographic conditions, that is undoubtedly reflected in the diversity of plant communities represented in Dagestan. The certain effect on vegetation there is provided by high-altitude zone, that have its own characteristics in Dagestan. On the basis of physical, geographical and geobotanical zoning of the Dagestan territory we singled 13 floristic districts, that rather sharply do differ from each other in a number of features (Murtazaliev, 2004).

### RESULTS AND DISCUSSION

Table 1 provides data on the taxonomic structure of Dagestan flora. The greatest number of species belongs to the *Magnoliophyta* branch – 3319, which is over 98%. The second highest number of species belongs to the *Polypodiophyta* branch with 40 species (1.18%). The rest of the branches are represented by a small number of species.

The species share of the *Magnoliopsida* class in a total amount is 76.92%, and that of *Liliopsida* class – 21.27%. The ratio of them to each other is 3.6:1.

**Table 1.** Taxonomic structure of Dagestan flora.

Phyllum	Families	Genies	Species	% of total
<i>Lycopodiophyta</i>	2	2	4	0,118
<i>Equisetophyta</i>	1	1	7	0,207
<i>Polypodiophyta</i>	10	22	40	1,183
<i>Pinophyta</i>	3	3	8	0,236
<i>Gnetophyta</i>	1	1	2	0,059
<i>Magnoliophyta</i>	142	799	3319	98,19
<i>Cl. Liliopsida</i>	32	181	719	21,27
<i>Cl. Magnoliopsida</i>	110	618	2600	76,92
<b>TOTAL</b>	<b>159</b>	<b>828</b>	<b>3380</b>	<b>100</b>

As a part of the *Magnoliophyta* department there are a number of families which species number is more than 50. The total number of such families is 15. To the pointed families there belong 2392 species, which constitute more than 70% (tab. 2).

**Table 2.** The large family of Dagestan flora.

Families	Species	% of total
<i>Asteraceae</i>	456	13,491
<i>Poaceae</i>	336	9,940
<i>Fabaceae</i>	234	6,923
<i>Brassicaceae</i>	182	5,384
<i>Rosaceae</i>	169	5,000
<i>Caryophyllaceae</i>	154	4,556
<i>Apiaceae</i>	143	4,230
<i>Lamiaceae</i>	129	3,816
<i>Cyperaceae</i>	121	3,579
<i>Scrophullariaceae</i>	109	3,224
<i>Chenopodiaceae</i>	92	2,721
<i>Ranunculaceae</i>	86	2,544
<i>Boraginaceae</i>	75	2,218
<i>Polygonaceae</i>	56	1,656
<i>Rubiaceae</i>	50	1,479
<b>Total: 15 families – 2392 species – 70,76%</b>		

The first group is composed of the families, which typically are in a such sequence in many regions of the temperate zone. This family with 456 species is the *Asteraceae* (13.49% of the total number of species), followed by the *Poaceae* with 336 taxons (9.94%), then it is followed by the *Fabaceae* family – 234 (6.92%). The second group consists of the family, which species diversity is found in the Mediterranean. These are the *Brassicaceae* (5,38%), the *Caryophyllaceae* (4,55%), the *Apiaceae* (4,23%), the *Lamiaceae* (3,81%) and the *Scrophullariaceae* (3,22%). In the same group at the fifth position there is the *Rosaceae* family with 169 species that are typical of more northern latitudes. Quite a significant number of species there contains the *Cyperaceae* family which is typical of the boreal zone as well. The remaining 5 families contain from 50 to 100 species and reflect the traces of both boreal and Mediterranean-Turan floras.

At comparative analysis of the various floras it is important to consider both quantitative and

qualitative indicators (Malyshev, 1975; Tolmachev, 1986; Yurtsev, Kamelin, 1991; Kamelin 2014). One such indicator is the taxonomic structure of the flora, the nature of the distribution of species in various floral sites, thanks to which assesses are given to the originality and identity of an area flora.

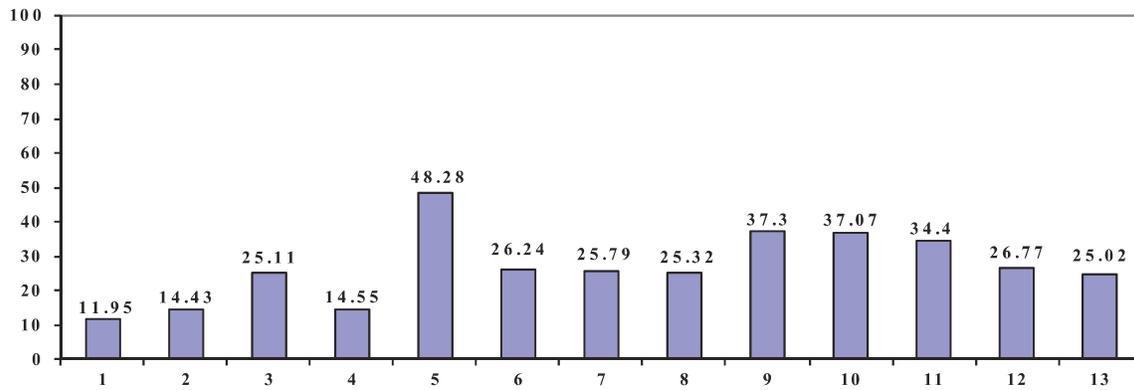
Table 3 presents data on the taxonomic structure of each of the selected 13 floristic districts.

**Table 3.** The taxonomic structure of the floristic districts.

Floristic districts	Families	Genus	Species
<b>Primorskiy</b>	73	238	404
<b>Tersko-Kumskiy</b>	69	250	488
<b>Tersko-Sulakskiy</b>	104	387	849
<b>Samurskiy</b>	93	309	492
<b>Predgorniy</b>	120	594	1632
<b>Kazbekovskiy</b>	110	426	887
<b>Buynakskiy</b>	104	413	872
<b>Kaitago-Tabasaranskiy</b>	101	378	856
<b>Centralno-Dagestanskiy</b>	114	438	1261
<b>Akhtynsko-Kurinskiy</b>	100	445	1253
<b>Diklosmta-Dulydagskiy</b>	106	401	1163
<b>Bezhtinsko-Didoyskiy</b>	95	357	905
<b>Transsamurskiy</b>	82	316	846
<b>Dagestan in total</b>	<b>159</b>	<b>855</b>	<b>3380</b>

As it is shown in table 3 the floristic districts, located in the plains of Dagestan (Primor., Ter.-Kum., Ter.-Sul. and Sam.) are characterized by the lowest number of species, within 400–500, except Ter.-Sul. district for which there identified 849 taxa. The lower band of the foothills, highlighted by us in a separate floristic area (Predg.), is a transition zone between the plains and the mountainous part, in this connection, here you can find species characteristic for both parts. It explains the richness of its flora, numbering 1632 species. Some of the local sites researches of this district also confirmed its floristic richness (Abachev, 1995; Adzhieva, 1998; Teymurov, Asimov, 2005; Yarovenko, 2005; Magomedova, 2011). In the upper band of the foothills there are three floristic district (Kazb., Buyn. and Kait.-Tab.) Which contain almost the same number of species, ranging of about 850–900 species.

Midmontinous Dagestan – is the arid zone, the distribution area of upland xerophytic communities. This part of Dagestan can be subdivided into two sub-area – limestone and sand-shale, which we have divided into separate floristic region – Centr.-Dag. and Akht.-Kur. respectively. For both regions there is registered almost the same number of species that are in each account for about 37% of the total Dagestan flora (fig. 1).



**Fig. 1.** The proportion of the species composition of the floristic districts of Dagestan (1 – Primor., 2 – Ter.-Kum., 3 – Ter.-Sul., 4 – Sam., 5 – Predg., 6 – Kazb., 7 – Buyn., 8 – Kait.-Tab., 9 – Centr.-Dag., 10 – Akht.-Kur., 11 – Dikl.-Dult., 12. – Bezht.-Did., 13 – Transsam).

Central Dagestan District is the most original and interesting, not only floristically, where there is a number of ancient endemic forms, including that are at the genus level, so due to which the whole Mountainous Dagestan is singled out into a separate floristic provinces (Kuznetsov, 1909; Kamelin, 2004), but also on the composition of plant polydominant communities of an upland-xerophilous vegetation, where there many endemics act as dominant and subdominant.

This area is relatively isolated geographically, and for a long time there is formed endemism major center. More than half of the flora endemic of the Eastern Caucasus is related to this center (Murtazaliev 2012), many of which aren't outside the given district (*Allium daghestanicum* Grossh., *A. mirzojevii* Tscholok., *Astragalus daghestanicus* Grossh., *A. fissuralis* Alexeenko, *Centaurea avarica* Tzvel., *Delphinium crispulum* Rupr., *D. darginicum* Dimitrova, *Muehlenbergella oweriniana* (Rupr.) Feer, *Psephellus andinus* Galushko et Alieva, *Tanacetum akinfiewii* (Alexeenko) Tzvel. and others). Unlike limestone, there is less endemics in the shale part of middle zone of Dagestan (Akht.-Kur.) – only 6 (*Asplenium daghestanicum* Christ, *Allium samurense* Tscholok., *Delphinium ruprechtii* Nevski, *Stipa sosnowskyi* Seredin, etc.). However, unlike the Centr.-Dag. district Akht.-Kur. is characterized by the presence of a significant number of Armenian-Iranian and North Iranian elements.

In the mountainous part of Dagestan we have singled out three floristic districts. The largest one is Dikl.-Dult., for which there is found 1163, accounting for 34.4% of the Dagestan flora (fig. 1). The other two districts, located in the south-west (Bezht.-Did.) and southeastern (Transsam.) parts of Dagestan have fewer species. The all parameters reduction is observed from west to east.

More significant differences between floristic districts of Dagestan are observed in the analysis of the leading families of the flora. For a comparative analysis we have taken our leading families of the Dagestan flora with 50 or more species. Such families there in the studied flora – 15 (tab. 2.). It turned out that in the floristic districts, located in the plain – Primor, Ter.-Kum, Ter.-Sul., Sam. in the first place is the family of *Poaceae*, having replaced the *Asteraceae* to second place. The predominance in the number of the *Poaceae* family species over the *Asteraceae* one for the Terek-Sulak Lowland it was noted there in my work and of Gadjieva (2006) as well. Another feature of these districts is the third place loss by the *Fabaceae* family in the spectrum of the leading families in the number of species. There in Primor., Ter.-Kum. and Ter.-Sul. districts the third place is of the *Chenopodiaceae* family, which means the effect of the Turan province on that part Dagestan flora. It should be noted that across the northern part of the Dagestan lowland (within the Terek-Kuma Lowland) there is a border between the Pontic and Turan provinces (Kamelin, 2004). At the 4th place in these areas there is the family of the *Brassicaceae*, displacing the *Fabaceae* to the fifth line, and in Primor. it also concedes the *Cyperaceae* family. In Samur floristic district, where almost the entire area is occupied by the tertiary liana forests with the Hirkan elements (Novikova, Polyanskaya, 1994; Yarovenko, Murtazaliev, Ilina, 2004) on the third place there is the *Cyperaceae* family. It is interesting to note that here, in contrast to all other floristic districts of Dagestan one of the leading family is the *Orchidaceae*, ranking fifth in the number of species, losing the 4th one to the *Lamiaceae* family.

In other districts (all are located in the mountainous part of Dagestan) there is observed a classical arrangement of the first three families: the

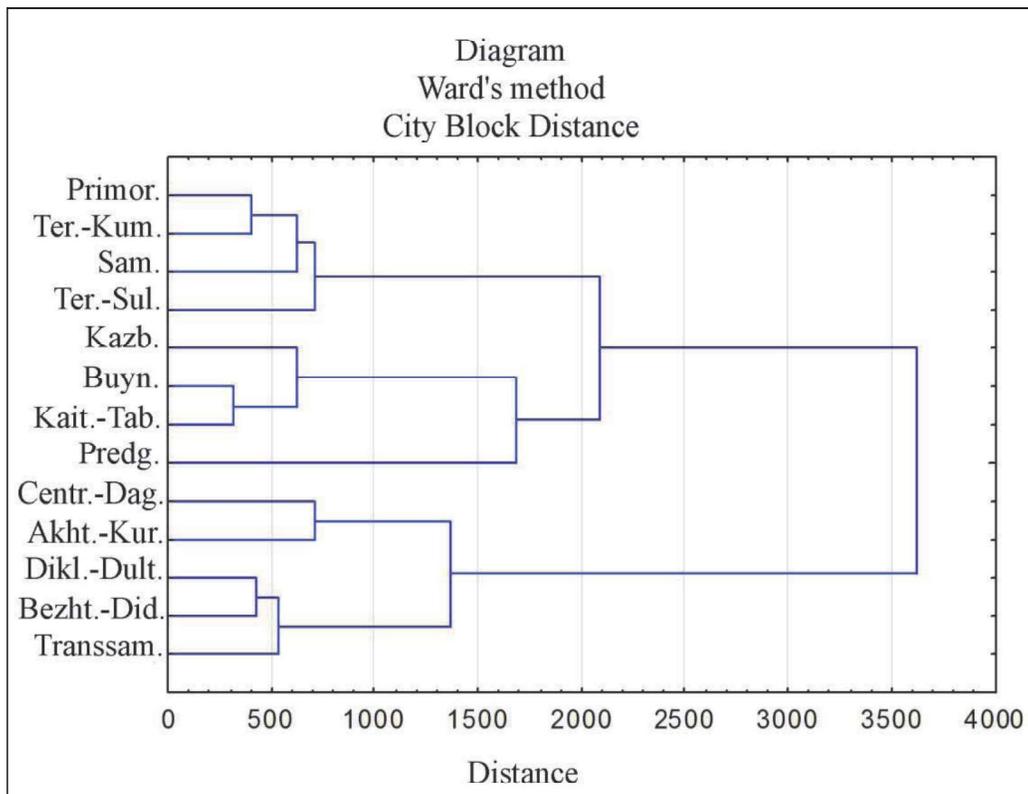


Fig. 2. Klastergramma floristic similarity districts on the basis of species composition.

*Asteraceae*, *Poaceae*, *Fabaceae*. The only exception is the two districts (Dikl.-Dult. Bezht.-Did.) where the third place goes to the *Rosaceae* family. If there in Dikl.-Dult. the *Fabaceae* family occupies the 4th place, in the Bezht.-Did. it only takes the 6th place, where it is, moreover, gives in the *Scrophulariaceae* and *Caryophyllaceae* families. Such state of *Rosaceae* family in these areas can be explained by the presence of humidity and climate deciduous forests and mesophilic meadows in these regions, where there the given family species are represented at more extent, rather than *Fabaceae* species, prevailing mainly in the arid areas. In all floristic mountainous part districts of the republic there the positions from the 5th to 10 in different sequences are occupied by the families of *Brassicaceae*, *Apiaceae*, *Caryophyllaceae*, *Lamiaceae*, *Scrophulariaceae*, indicating a significant influence on the formation of the ancient Mediterranean flora of Mountainous Dagestan.

In general, the families location sequence in the districts has its own characteristics, depending on various factors. For example, in the floristic mountainous districts of Dagestan there the 15 leading families include such ones as the *Campanulaceae* and *Gentianaceae*, where, as it is known, more often there are the representatives of these families.

If we compare the flora of the districts on the role of leading families with the other regions of the Caucasus, it is possible to find similarities, although there are some differences in the sequence of the location of the compared families. Thus, significant similarities of floristic districts of Kazb., Buyn., and Kait.-Tab. by the given feature there are found with the flora of the Chechen Republic (Taysumov, Omarhadzhieva, 2012).

But the more clear similarities there between the floristic districts appears in the processing of the full species composition using cluster analysis. Thus, according to the chart obtained by the method of Ward (distance city-block (Manhattan)), it is clear that the districts are subdivided into two main groups (fig. 2). In the one there have been united the districts of lowland and foothill Dagestan, and in the second district there are middle and high areas of the republic.

The first group of districts are divided into two clades, where there Lowland districts of Dagestan (Primor., Ter.-Kum., Ter.-Sul., Sam.) are merged into one, and the second one unites the Foothill (Predg., Kazb., Buyn., Kait.-Tab.). There in the Lowland Dagestan, the most similar to each other turned out to be the Primorsky and Terek-Kuma Districts, for which similarity coefficient (Jaccard on) is equal to 0.374. There in the second clade of

this group the districts, located in the upper zone of the foothills have merged into one group, and the similarity between Buynakskii and Kaitag-Tabasaranskiy districts is the highest (0.685) compared to all other districts. In this clade the Foothill District there stands apart from all the others that says about its isolation. Its similarity coefficient with neighboring districts is an average one or below average: with Ter.-Sul. – 0.343; a Kazb. – 0.380; with Buyn. – 0.308; with Kait.-Tab. – 0.289; with Sam. – 0.239.

In the second group of districts there also two clades are distinguished. The first one combines the Mid-mountainous Dagestan, Centr.-Dag. and Akht.-Kur., for which the rate of similarity is equal to 0.560. In the second clade there the High-district of Dagestan - Dikl.-Dult, Bezht.-Did., and Transsam. are grouped. Here is, a higher rate of similarity found between Dikl.-Dult. and Bezht.-Did. districts, which equals to 0.657.

## RESULTS

Thus, the having been made researches allowed to clarify the species composition of the flora, which numbers 3380 species belonging to 159 families. More than 70% of the floras belong to 15 large families. Analysis of the species distribution in different areas confirmed the overall consistency of the 13 floristic districts allocation there in Dagestan. The comparative analysis of leading families and the full species composition of floristic districts have shown the distinctive characteristics and different degree of similarity between them. The greatest number of species as it turned out is there in the foothills floristic region, which is noted for almost half of the entire flora of Dagestan.

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### **Dağıstan Florasının Təhlili Və Onun Floristik Rayonlarının Taksonomik Strukturunun Xüsusiyyətləri**

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Aparılan tədqiqatlar Dağıstanın floristik bölgələrinin növ tərkibinin müqayisəli təhlilinə həsr olunmuşdur. Məqalədə qeyd edilir ki, spektrlərdə fəsilələrin yerləşmə ardıcılığı ayrı-ayrı rayonlarda bu və ya digər floristik mərkəzin floranın formalaşmasına təsirini göstərir. Müəyyənləşdirilmişdir ki, eyni təbii ərazidə yerləşən bölgələr oxşardır. Floristik spektrlərdə aparıcı fəsilələrin yerləşmə xarakterinə görə hər bölgənin səciyyəvi xüsusiyyətləri təyin edilmişdir.

*Açar sözlər: Dağıstan, flora, floristik rayonlar, müqayisəli təhlil*

### **Анализ Флоры И Особенности Таксономической Структуры Флористических Районов Дагестана**

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Работа посвящена анализу флоры Дагестана. В статье приведен сравнительный анализ видового состава флористических районов Дагестана. Последовательность расположения семейств в спектрах указывает на влияние того или иного флористического центра на формирование флоры отдельных районов. Показано, что районы, расположенные в одной и той же природной зоне сходны между собой. Для каждого из них выявлены особенности расположения ведущих семейств в флористических спектрах.

*Ключевые слова: Дагестан, флора, флористические районы, сравнительный анализ*