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SPECIES DIVERSITY OF WETLAND AND COASTAL AQUATIC FLORA OF THE KETPEN RIDGE

An analysis of the wetland and coastal aquatic flora of the Ketpen ridge is provided in order to study the composition and distribution of plant species adapted to certain conditions of the area. As a result of the study, it was revealed that the flora of the Ketpen ridge is represented by a variety of species adapted to wet and swampy conditions. The most common types of wetland flora of the Ketpen ridge are various types of sedges, reeds, cattails and reeds. Rare aquatic plant species such as white-water lily, species from the Gentianaceae family and others were also discovered. An ecological analysis of the distribution of wetland species showed that most of these are species of reservoirs, swamps and streams, where there is a sufficient amount of moisture, but there are species found on land, in drier conditions. The study and analysis of wetland flora and coastal aquatic flora of the Ketpen ridge made it possible to identify 211 species of vascular plants belonging to 101 genera and 39 families. Low species richness of families characterizes this flora, and it is 5.4. Among the 11 largest families with the largest number of species, including 151 species and 83 genera, of which 6 genera are large and polymorphic, such as *Carex* (15 species), *Ranunculus* (11 species), *Juncus* (7 species), *Rumex* (7 species), *Epilobium* (6 species) and *Potamogeton* (6 species). These genera make up 39.3% of the total number of species of wetland and coastal aquatic flora.

Key words: flora, Ketpen ridge, diversity, wetland and coastal-aquatic floristic complex.

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Кетпен жотасының сулы-батпақты және жағалаудағы флорасының түрлік әртүрлілігі

Ауданның белгілі бір жағдайларына бейімделген өсімдік түрлерінің құрамы мен таралуын зерттеу мақсатында Кетпен жотасының сулы-батпақты және жағалаулық су флорасына талдау жасалған. Зерттеу нәтижесінде Кетпен жотасының флорасы ылғалды және батпақты жағдайларға бейімделген алуан түрлерден тұратыны анықталды. Кетпен жотасының сулы-батпақты жер флорасының ең көп тараған түрлеріне әр алуан қырық, қамыс, құйрық, қамыс жатады. Сондай-ақ ақ су лалагүлі, Gentianaceae тұқымдасының түрлері және басқалары сияқты сирек кездесетін су өсімдіктері де табылды. Сулы-батпақты алқаптардың түрлерінің таралуын экологиялық талдау олардың көпшілігі су қоймаларының, батпақты және ағынды сулардың түрлері екенін көрсетті, онда ылғалдың жеткілікті мөлшері бар, бірақ құрлықта, құрғақ жағдайда кездесетін түрлері бар. Кетпен жотасының сулы-батпақты флорасы мен жағалаудағы су флорасын зерттеу және талдау 101 тұқымдас пен 39 тұқымдасқа жататын тамырлы өсімдіктердің 211 түрін анықтауға мүмкіндік берді. Бұл флораны сипаттайтын тұқымдастардың төмен түр байлығы, ол 5,4. Ең көп түрі бар 11 ірі тұқымдастардың ішінде, оның ішінде 151 түр және 83 тұқымдас, оның ішінде 6 тұқымдасы ірі және полиморфты, мысалы, Carex (15 түр), *Ranunculus* (11 түр), *Juncus* (7 түр), *Rumex* (7 түр), *Epilobium* (6 түр) және *Potamogeton* (6 түр). Бұл тектер сулы-батпақты және жағалаудағы су флорасы түрлерінің жалпы санының 39,3%-ы.

Түйін сөздер: флора, Кетпен жотасы, әртүрлілік, сулы-батпақты және жағалаудағы су флористикалық кешені.

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Видовое разнообразие водно-болотной и прибрежно-водной флоры хребта Кетпен

Приводится анализ водно-болотной и прибрежно-водной флоры хребта Кетпен с целью изучения состава и распределения растительных видов, приспособленных к определенным условиям данной местности. В результате исследования было выявлено, что флора хребта Кетпен представлена разнообразными видами, адаптированными к влажным и болотистым условиям. Наиболее распространенными видами водно-болотной флоры хребта Кетпен являются различные виды осок, тростника, рогоза и камыша. Также были обнаружены редкие водные виды растений, такие как белая кувшинка, виды из семейства *Gentianaceae* и другие. Экологический анализ распределения водно-болотных видов показал, что в большинстве это виды водоемов, болот и ручьев, где имеется достаточное количество влаги, но есть виды, встречающиеся на суше, в более сухих условиях. Исследование и анализ водно-болотной флоры и прибрежно-водной флоры хребта Кетпен позволил выявить 211 видов сосудистых растений, принадлежащих к 101 роду и 39 семействам. Низкая видовая насыщенность семейств характеризует эту флору, и она составляет 5,4. Среди 11 крупнейших семейств с наибольшим числом видов, включающих 151 вид и 83 родов, из которых 6 родов являются крупными и полиморфными, такими как *Carex* (15 видов), *Ranunculus* (11 видов), *Juncus* (7 видов), *Rumex* (7 видов), *Epilobium* (6 видов) и *Potamogeton* (6 видов). Эти роды составляют 39,3% от общего числа видов водно-болотной и прибрежно-водной флоры.

Ключевые слова: флора, хребет Кетпен, разнообразие, водно-болотный и прибрежно-водный флористический комплекс.

Introduction

The Ketpen ridge belongs to the Northern Tien Shan, which is located in the southern part of Kazakhstan and extends along the border with China. According to geographic zoning within Kazakhstan, the ridge under study belongs to the Central Asian country, Tien Shan region, North Tien Shan province, Chilik-Ketpen district [1]. The length of the Ketpen ridge in Kazakhstan is more than 150 km, and its width is about 40-50 km. The highest point of the Ketpen ridge reaches 3680 meters in the eastern part on the border with China. In the west, the height of this ridge gradually decreases to 3400 meters. The Ketpen ridge has no glaciers and no peaks that reach the snow line. It borders with the Dzungarian Alatau in the north, separated by the Ili depression, with the Kungey Alatau in the west and smoothly passes into the Temerlik ridge in the east, which merges with the Boro-Khoro mountain system [2].

In the last decade, scientific interest in the study of aquatic vegetation has noticeably increased [3,4,5,6,7,8,9,10,11,12,13,14].

Materials and methods

The main methods for studying the species of wetland and coastal aquatic flora of the Ketpen Range include: classical methods of botanical and floristic research: include the study of the morphological and anatomical characteristics of plants, as well as their taxonomy and floristics. Traditional methods of geobotanical research: include the study of plant communities of wetland and coastal aquatic flora and their interaction with the environment. To do this, a detailed geobotanical description of the communities present at points recorded using GPS is carried out. Route-reconnaissance method: in the field, the method of walking along routes is used to locate and collect plants. This allows you to cover a large area and study the diversity of species. Collection and processing of herbarium material: collected specimens of wetland and coastal aquatic plant flora are placed in herbarium folders with a description of the place of collection, date and collector. After field work, the material is dried and viewed under binocular loupes. The collection and processing of herbarium material is carried out according to the generally accepted method of A.K. Skvortsov [15]. Species identification and taxonomy: carried out in the laboratory after field work. For this purpose, multi-volume reports and reference books are used, such as “Flora of the USSR” [16], “Flora of Kazakhstan” [17], “Plants of Central Asia” [18], “Identifier of plants of Central Asia” [19], “Illustrated directory of plants of Kazakhstan “[20] and others. The

species and generic names of wetland and coastal aquatic plants of the studied ridge are given according to S.K. Cherepanov and S.A. Abdulina [21,22]. To analyze life forms, the classifications of K. Raunkier and I.G. were used. Serebryakov [23].

Results and discussion

Taxonomic analysis

Taxonomic analysis of wetland and coastal flora showed the presence of 211 plant species that belong to 101 genera and 39 families. Of the total number of species, 124 belong to dicotyledonous plants, and 83 species belong to monocotyledonous plants. The ratio of wetland and coastal aquatic flora species is 39:101:211. There are on average 2.0 species per genus. The species richness of families of wetland and coastal aquatic flora is low and amounts to 5.4. There are no endemic species in the study area, which indicates the absence of autochthonous trends in the development of the flora. The absence of polymorphic genera and the negative value of the autonomy index (-0.707) indicate the predominance of allochthonous species in the development of the flora of the wetland and coastal aquatic floristic complex. These data allow us to draw conclusions about the composition and characteristics of vegetation in the studied complex. The wetland and coastal-aquatic floristic complex of the studied Ketpen ridge according to A.L. Takhtadzhyan [24] consists of 10 subclasses, of which 3 subclasses (Alismidae, Arecidae, Commeliniidae) belong to Liliopsida and 7 subclasses to Magnoliopsida (Magnoliidae, Ranunculidae, Caryophyllidae, Rosidae, Lamiidae, Dilleniidae, Asteridae). From the class Magnoliopsida, the richest in species composition were the subclasses Lamiidae, Rosidae, Dilleniidae, Caryophyllidae, Ranunculidae, Asteridae, and from Liliopsida, these were Alismidae, Commeliniidae and Arecidae (Fig.1).

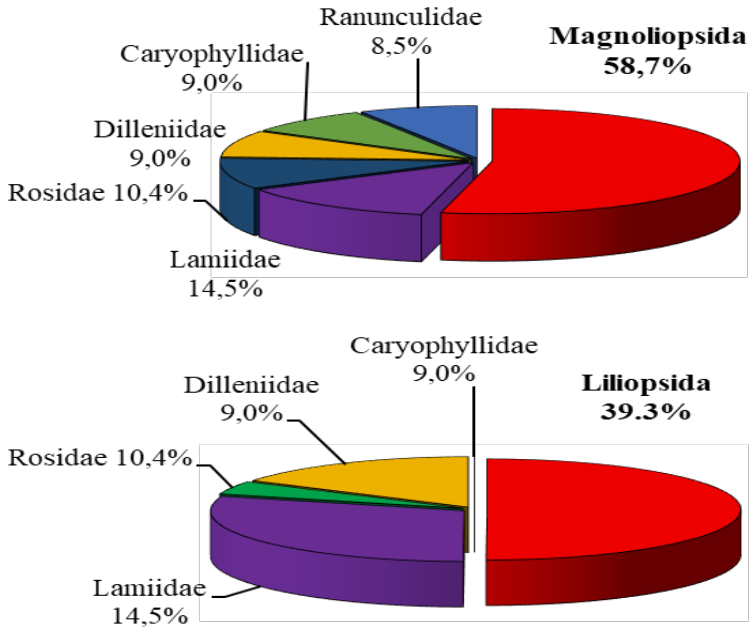

Figure 1 – Wetland and coastal-aquatic floristic complex in the proportions of systematic groups

Of the families of wetland and coastal aquatic flora of the Ketpen ridge listed below in Table 1, the richest and largest families in terms of the number of species were: *Cyperaceae* (30; 14.2%), *Poaceae* (27; 12.2%), *Ranunculaceae* (18; 8.5%), *Asteraceae* (13; 6.1%), *Lamiaceae* (12; 5.6%), *Polygonaceae* (11; 5.2%), *Fabaceae* (9; 4.2%), *Gentianaceae* (9; 5.2%). 4.2%), *Caryophyllaceae* (8; 3.8%), *Juncaceae, Scrophulariaceae* (7 species each, 3.3%).

Table 1 – Leading families of wetland and coastal aquatic vegetation of the Ketpen ridge

Families	Number of genera	Number of species	% of total number of species
1.*Cyperaceae*	9	30	14,2
2.*Poaceae*	12	27	12,7
3.*Ranunculaceae*	7	18	8,53
4.*Asteraceae*	9	13	6,1
5.*Lamiaceae*	9	12	5,68
6.*Polygonaceae*	3	11	5,21
7.*Fabaceae*	5	9	4,26
8-9.*Gentianaceae*	5	9	4,26
8-9.*Caryophyllaceae*	5	8	3,8
10-11.*Juncaceae*	1	7	3,3
10-11.*Scrophulariaceae*	3	7	3,3
Total:	**68**	**151**	**71,5**

As can be seen from the table, in the families *Cyperaceae, Poaceae* and *Ranunculaceae* there are 75 species or 35.5%, and in the twelve leading families there are 151 species (71.5%) (Figure 2). The following families: *Potamogetonaceae, Onagraceae, Primulaceae* (6 species each, 2.8%), *Apiaceae* (5; 2.3%), *Equisetaceae* (4; 4.3%). Four families contain 3 species each (1.42%). Three families contain two species each (*Saxifragaceae, Lemnaceae, Sparganiaceae*). Twelve families: *Nymphaceae, Ceratophyllaceae, Salicaceae, Haloragaceae, Hippuridaceae, Callitrichaceae, Butomaceae, Zannichelliaceae, Najadaceae, Primulaceae, Lythraceae, Apogynaceae* contain one species each (5.6%).

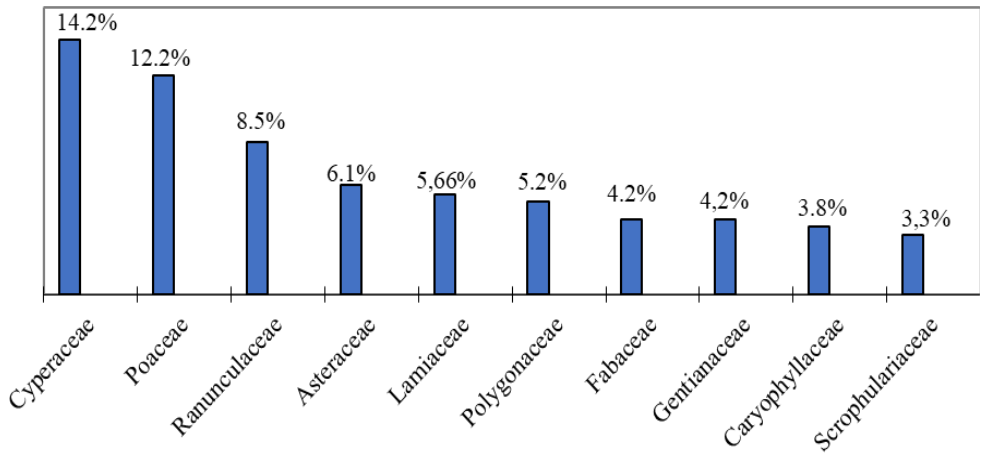

Figure 2 – Proportions of the largest families of wetland and coastal aquatic vegetation of the Ketpen ridge

By the number of genera, the most leading families are: *Poaceae* (12; 5.6%), *Cyperaceae* (9; 4.2%), *Asteraceae* (9; 4.21%), *Lamiaceae* (9; 4.2%), *Ranunculaceae* (7; 3.3%), *Fabaceae, Gentianaceae, Caryophyllaceae* (5 genera each; 2.36%).

Table 2 – Leading genera of wetland and coastal aquatic vegetation of Ketpen

Genera	Number of species	% of total number of species
1. *Carex*	15	7,1
2.*Ranunculus*	11	5,2
3-4. *Juncus*	7	3,3
3-4. *Rumex*	7	3,3
5-6. *Epilobium*	6	2,84
5-6. *Potamogeton*	6	2,84
7-8. *Primula*	5	2,36
7-8. *Piccinella*	5	2,36
7-8. *Veronica*	5	2,36
7-8. *Equisetum*	4	1,9
9-10. *Cirsium*	4	1,9
9-10. *Persicaria*	4	1,9
9-10. *Poa*	4	1,9
Total:	**83**	**39,3**

The richest genera in terms of the number of species were: *Carex* (15; 7.1%), *Ranunculus* (11; 5.2%), *Juncus* (7; 3.3%), *Rumex* (7; 3.3%), *Epilobium* (6; 2.8%), *Potamogeton* (6; 2.8%), *Primula* (5; 2.3%), *Puccinella* (4; 2.3%), *Veronica* (5; 2.3%), *Calamagrostis* (4; 4.3%), *Equisetum, Poa, Cirsium, Persicaria* (4 species each). These thirteen genera contain 83 species (39.3%). 3 species (17.2%) each contain 7 genera, 2 species each contain 20 genera, and finally, 60 genera each contain 1 species (28.4%) (Fig. 3).

In the wetland and coastal water complex, there are 16 species of true species that are characteristic only for this complex. The main true species include: *Butomus umbellatus, Potamogeton pectinatus, P. natans, P. filiformis, Bolboschoenus maritimus, Triglochin maritimum, Scirpus tabernaemontanii, Eleocharis meridionalis, Blusmus compressus* and others.

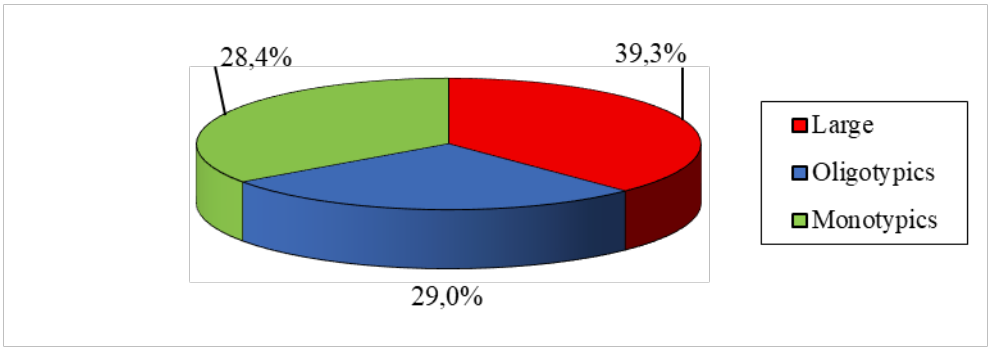

Figure 3 – Proportions of large, oligotypic and monotypic genera wetland and coastal aquatic vegetation of the Ketpen ridge

Biomorphological analysis

Biomorphological analysis of life forms revealed a predominance in the wetland and coastal aquatic flora of flowering herbaceous plants (210; 99.5%), of which most belong to herbaceous polycarpics (172; 81.5%). Herbaceous monocarpics are represented by only 38 species (18%) of the entire composition. This complex contains only one shrub. The wetland and coastal aquatic floristic complex is characterized by the absence of woody, semi-shrubby, tuberous

and onion plants (Figure 4). Of the polycarpics, rhizomatous – 23 species (24.7%), short rhizomatous – 26 species (12.36%), long rhizomatous – 53 species (25.1%), short rhizomatous – 50 species (23.7%), cystic rhizomatous – 5 species (2.3%). Annuals predominate in the families *Gentianaceae* (9), *Polygonaceae* (5), *Asteraceae* (4), *Poaceae* (5), *Fabaceae* (2), *Ranunculaceae* (1), *Caryophyllaceae* (2), *Lamiaceae* (2), *Callitrichaceae* (1), *Najadaceae* (1) and *Juncaceae* (2). Perennials predominate in the families *Cyperaceae* (30), *Ranunculaceae* (16), *Potamogetonaceae* (6), *Primulaceae* (5), *Onagraceae* (6), *Poaceae* (22), *Equisetophýtina* (4), *Typhāceae* (3) *Alismatáceae* (3). The remaining families contain 2 and 1 species. In relation to humidity, mesohygrophytes dominate – 124 species (58.7%) and hygrophytes – 62 species (29.3%), hydrophytes – 25 species (11.8%).

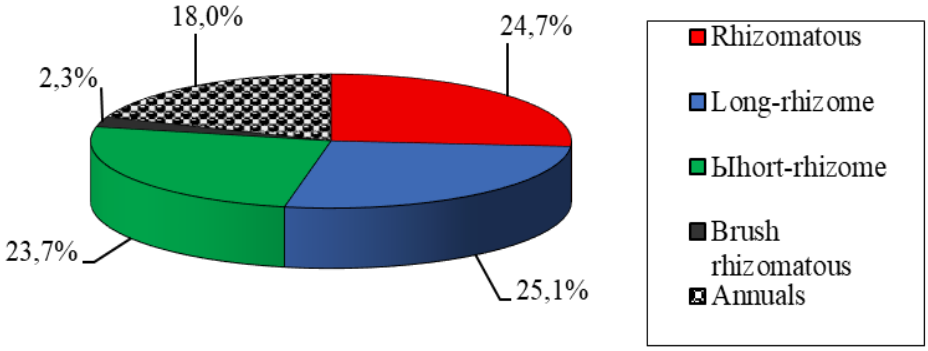

Figure 4 – Proportion of life forms in wetland and coastal aquatic vegetation

Geographic analysis

As part of this flora, 23 geographical elements were identified, united in 5 groups of areas (Fig.5).

The next largest are species that have a significant range within the Palaearctic – the boreal group, numbering 64 species (30.3%), of which with a range throughout the Palaearctic – 35, in its eastern part – 22, in the western part – 7. Group species with wide ranges are represented by 60 species (28.4%), where pluriregional – 12, Holarctic – 48. The ancient Mediterranean group is represented by 18 species (8.5%). And the mountainous Central Asian group is represented by a small number of only 9 species (4.2%).

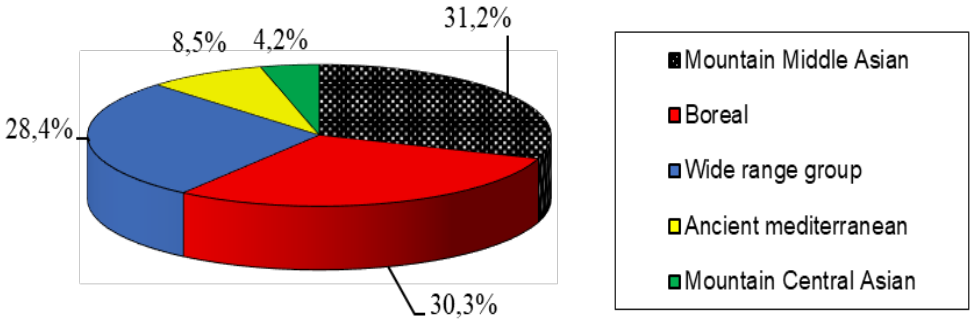

Figure 5 – Distribution of species of wetland and coastal aquatic vegetation of the Ketpen ridge by habitat type

Table 3 – Distribution of species of wetland and coastal aquatic vegetation of the Ketpen ridge by habitat type

Area name	Number of species	% of the total number of species
1. Pluriregional	12	5,6
2. Holarctic	48	22,7
3. Palearctic	30	14,2

Table continuation

Area name	Number of species	% of the total number of species
4. West Palearctic	7	3,31
5. East Palearctic	22	10,4
6. Ancient Mediterranean	2	0,94
7. Eastern Ancient Mediterranean	4	1,9
8.European-Ancient Mediterranean	12	5,6
9.Eurosiberian-Kazakhstan	5	2,36
10. Mountainous Middle Asian	28	13,2
11. Mountain- middle asian-Iranian	3	1,42
12. Mountain middle asian- mountainous middle asian	5	2,3
13. Mountainous middle asian -Himalayan	3	1,42
14. Altai-Himalayan	1	0,47
15. Altai-mountainous middle asian	7	3,31
16. Tarbagatae-mountainous middle asian	3	1,42
17. Siberian-mountain middle asian	5	2,36
18. Tien Shan	4	1,9
19. Tien Shan-Pamir-Alai	11	5,21
20. Altai-Tienshan	2	0,94
21. North Tien Shan	1	0,47
22. Gornosiberian-Tienshan	2	0,94
23. Chinese	2	0,94
Total:	**211**	**100**

The next largest are species with a significant range within the Palearctic – the boreal group, numbering 64 species (30.3%), of which 35 species with a range throughout the Palearctic, 22 in its eastern part, and 7 in the western part. species with wide ranges are represented by 60 species (28.4%), where pluriregional – 12, holarctic – 48. The ancient Mediterranean group is represented by 18 species (8.5%). And the Middle Asian mountain group is represented by a small number of only 9 species (4.2%).

Conclusion

The analysis showed that the wetland and coastal aquatic floristic complex of the Ketpen Ridge is an important element of the biological diversity of this region, providing shelter and food for many species of animals and playing an important role in maintaining ecological balance. Representatives of the wetland and coastal aquatic floristic complex in the study area of the Ketpen ridge are adapted to the constant presence of water in the soil or constant waterlogging and are confined to various habitats: reservoirs, banks and river valleys, where they form aquatic, wetland and meadow (riparian) -water) ecological and geographical groups. The distribution of swamps on the Ketpen ridge is associated with a strong dissection of the mountain topography; small fragments of swamps are present in the high-mountain belt; in the foothill plains they are found along river valleys, in places where groundwater emerges. As noted by N.I. Rubtsov high-mountain swamps are essentially a relict formation. during the Pleistocene glaciation, they were apparently much more widespread in the mountains [25].

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