ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

The characteristics and morphometric features of plant communities in the Toraigyr mountains of Kazakhstan with an occurrence of *Ikonnikovia kaufmanniana (Regel) Lincz.*

Nashtay Mukhitdinov, Zarina Inelova*, Svetlana Nesterova, Ydyrys Alibek, Bekzat Tynybekov, and Kurmanbaeyeva Meruyert.

Department of Biodiversity and Bioresources, Kazakh National University Al-Farabi, Avenue Al-Farabi 71, 050038 Almaty, Kazakhstan.

ABSTRACT

We have studied the *Ikonnikovia kaufmanniana* population of the Toraigyr Mountains of Kazakhstan. *Ikonnikovia kaufmanniana (Regel) Lincz.* is a rare, endangered, endemic species of monotype genus with a shrinking habitat. Three plant communities (phytocoenoses) were singled out within the population. The *Ikonnikovia kaufmanniana* population was found in the low-mountain massif of the Toraigyr Mountains in the region of Alasy Pass in the Enbekshikazakhskiy district of the Almaty region, Kazakhstan. Within this *Ikonnikovia kaufmanniana* population we have collected and identified 88 species of tracheophytes related to 76 genera and 32 families. Analysis of morphometric features showed that in the pre-generative period during transition from juvenile to virginile condition the height of *Ikonnikovia kaufmanniana* plants reached up to 5 cm, the crown diameter up to 8-9 cm, and the number of leaves per plant reached 9-10. In the generative period the majority of receptacles were generated by middle-generative plants. The crowns of such plants were larger in height and wider in diameter, while the number of leaves per each shortened shoot remained almost the same throughout the entire period with leaves numbering 8-10. The post-generative period is characterized by the absence of receptacles and diminished size of plants (height and crown diameter), senile plants are also lacking leaves. Analysis of the number, density and age distribution of the *Ikonnikovia kaufmanniana* population showed that the largest number of species is represented by virginile ones. Our investigation revealed that in the above mentioned locations *Ikonnikovia kaufmanniana* had always occupied a small area and its habitat has been decreasing dramatically every year for *Ikonnikovia kaufmanniana* as a rare and endangered, endemic species of Kazakhstan. For this reason *Ikonnikovia kaufmanniana* needs to become protected.

Keywords: plant communities, *Ikonnikovia kaufmanniana (Regel) Lincz.,* morphometric features.

Corresponding author

ISSN: 0975-8585

INTRODUCTION

The research and preservation of biological diversity is a global task nowadays. This initiative is particularly vital for the Toraigyr Mountains of Kazakhstan.

Many scientists study rare, endemic and endangered species with the aim of preservation of such species. (Wei, et al., 2010; Li and Zhang, 2015; Hmeljevski et al., 2014; Pereira et al., 2014; Cursach and Rita, 2012; Hegazy et al., 2010; Zhao and Sun, 2009; Begenov et al., 2014; Ydyrys et al., 2013; Akhmetova et al., 2015).

The subject of the given study is *Ikonnikovia kaufmanniana (Regel) Lincz*. - a rare, endemic and endangered species. It belongs to a monotype genus *Ikonnikovia* of the *Limoniaceae Lincz* family. The plants comprise bushes 30-40 cm in height with shortened stem densely covered with the remains of old leafstalks. Leaves are 4-12 cm in length, lance-linear to oblong – obovoid in shape, arranged in thick rosettes with numerous leaves. They are large, blueish-grey or green, calcium spotted, crisp leaves with scleroid epidermis and flexuous edges. Receptacles are erect and firm, 2 to 15 in number. Flowers are arranged in thick oblong spica with 4-11 floral, one-sided, sessile, thickened spica. The cup is tubuliflorous and about 8 mm in length, having pilose fibers with 5 trigonal-lanceolate lamina almost without limb. Petals are violet-red, twice the size of the cup. It is found in Zailiyskiy Alatau, Uzynkara Range, and the Toraigyr Mountains in Kazakhstan. It grows on rocky hills and is a xerophyte. It flowers in May-June and bears fruits in June-July (Baitenov, 1986).

This study looks at the characteristics and morphometric features of plant communities which include *Ikonnikovia kaufmanniana (Regel) Lincz.*

MATERIALS AND METHODS

The Toraigyr Mountains can be considered as the South-Eastern terminus of the Zailiyskiy Alatau Range (Northern Tyan-Shan mountain system). Toraigyr is a monolith mountain chain reaching 2471m altitude at its central part, which interlinks with the vast intermountain basin named Iliyskiy bolson. The length of the mountain massif is about 60 km. It is surrounded by piedmont plains, gradually transforming into small intermountain bolsons: from the northern part to the Syugatinskiy basin and from the south-eastern part to the Zhalanashskiy bolson. Both small bolsons are a part of the vast intermountain Iliyskiy basin.

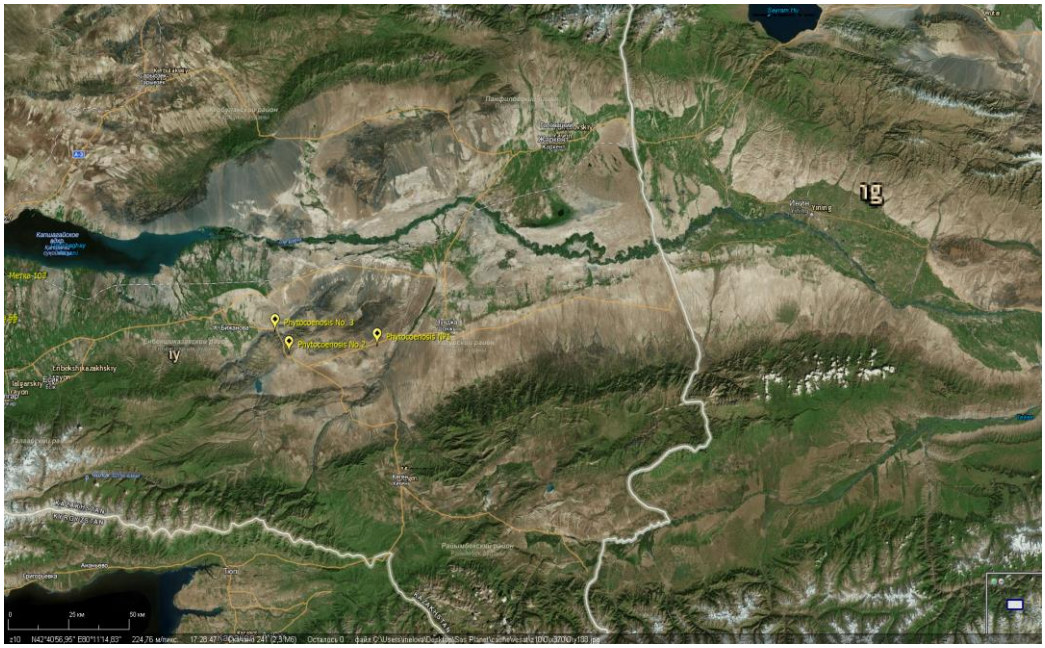
The historical development of the region, the complexity of its geological structures, the variety of land formations plus modern climate conditions, have together determined characteristics of the plant cover, its zonal-belt distribution and the uniqueness of flora. The Toraigyr range is a latitudinally oriented massif, located between Shilik and Sharyn rivers. The territory surrounding Toraigyr Mountains (Picture 1) with adjoining intermountain valleys is in the Kazakhstan fold-mountain region, formed in the Paleozoic period as a result of Calidon faulting, accompanied by intensive volcanism. The climate of the Toraigyr Mountains region and dependent areas is continental (Akiyanova, 2006).

The investigation material concerning the species was collected by the authors of this article between 2010 & 2015.

Isolation of maturation states was performed according to the classification scheme of A.A.Uranov (Bullock, 1994): p - germ and seedlings; j – juvenile species; imm – immaturive; v- virginile or young vegetative; g1 – young generative; g2 – middle or mature generative; g3 – old generative; ss – sub senile s - senile; sc – dying species.

At the first stage of this work we identified ontogenetic features and isolated categories of species by their maturation state.

ISSN: 0975-8585



Picture 1 – Location map of studied population *Ikonnikovia kaufmanniana*

To study age structure, longitudinal transects were laid out at each studied site (Table 1). Discrete areas of 1 m2 (in total 30 areas) were laid out at intervals of 10-20 m depending on the location's relief. At each site, an inventory was made of all specimens of the same species with a breakdown by maturation state.

Density of population was evaluated as the number of species of the same genus per 1 m2.

Phytocoenotic and ecologic features of habitats were evaluated according to main parameters.

Phytocoenosis habitats have been studied. (Field Geobotany, 1959).

Table 1 – Investigation locations, co-ordinates and quantity of discrete areas

Phytocoenosis No.	Investigation location *Ikonnikovia kaufmanniana*	GPS coordinates	Quantity of discrete areas
1	Eastern part of Toraigyr Mountains, Alasy Passage, slopes with exposure to the north-east. Slope ratio 45º	N43020.124/ ,E078 056.337/	10
2	Eastern part of Toraigyr Mountains, Alasy Passage, slopes with exposure to the north. Slope ratio 30-35º	N43020.188/, E078056.345/	10
3	Eastern part of Toraigyr Mountains, Alasy Passage, slopes with exposure to the north-east. Slope ratio 50-55º	N 43020.213/, E 078056.472/,	10

Transects and discount areas were laid out (Field Geobotany, 1964). Genus structure was studied and life forms were determined (Field Geobotany, 1959, 1964). Abundance was taken into consideration (Zlobin et al., 2013); quantity and projective cover were determined on sample areas of 1 m2.

Phytocoenotic population study was carried out using traditional methods (Zlobin et al., 2013; Rabotnov, 1978; Golubev, 1978; Zaugolnova, 1982; Uranov, 1973). Cenopopulation age structure was evaluated according to T.A. Rabotnov (Rabotnov, 1978) and A.A. Uranov (Uranov, 1973).

In the course of the study plants were collected in a herbarium. For identification of herbarium samples we used such sources of information as the multi-volume reports “Flora of Kazakhstan” and “Concordance of Central Asia plants”. For determination of genus and family we also used “Flora of Kazakhstan” by M.S.Baitenov (Flora of Kazakhstan, 1956-1967, “Concordance of Central Asian plants” 1968-1996; Baitenov, 2001).

Placement of species and supraspecific categories in the list of flora and floristic spectrum was carried out in accordance with the classification system of A.L.Tahtadzhan (Tahtadzhan, 1987). Written Latin names and nomenclature changes were verified in accordance with S.K.Cherepanov (Cherepanov, 1995).

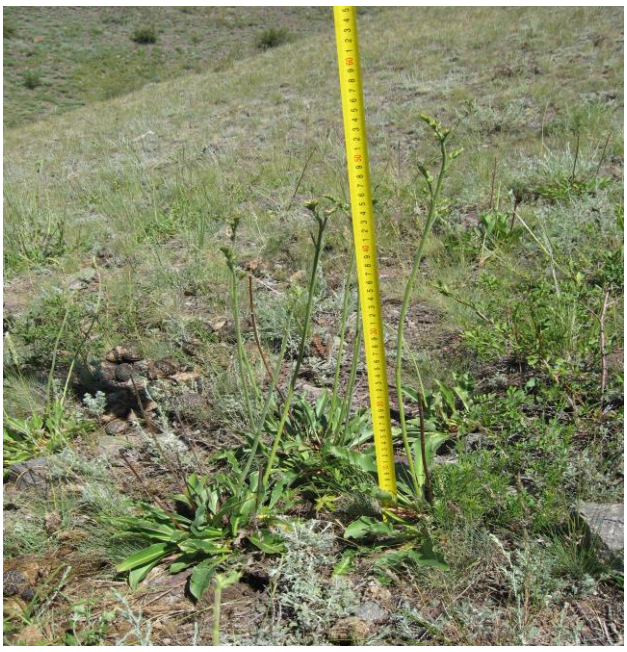
Investigation result and discussion

We found and studied *Ikonnikovia kaufmanniana* populations in the Toraigyr Mountains of Kazakhstan. The list of phytocoenoses types including *Ikonnikovia kaufmanniana* is specified in the Appendix.

Ikonnikovia kaufmanniana population was found on slopes of the Toraigyr low-mountain group in the region of Alasy Passage in the Enbekshikazakhskiy district of the Almaty region.

GPS navigation coordinates: N43°20.124´ and E078°56.337'. Altitude above sea level: 1394 m.

Within the population we isolated three phytocoenoses (cenopopulation). Cenopopulation is a composition of all specimens belonging to the same species within the same plant community (Rabotnov, 1992). Phytocoenosis №1 (Cenopopulation No.1) located on the slope with the angle of 25-30º exposure to the east of a low bald peak. The phytocenosis area was not big with a length of about 100 m and a width of 30 m. Plant cover included Ikonnikov-absinthium-gramineous community (*Artemisia sublessingiana*, *Artemisia heptapotamica, Poa bulbosa, Agropyron pectinatum, Stipa caucasica - Ikonnikovia kaufmanniana).* Projective cover was 65-70%. The soil there is light-brown colour and stony. In plant cover, besides dominants we found *Descurainia sophia* (L.) Webb ex Prantl*, Taraxacum songoricum* Schischk.*, Chenopodium foliosum* Aschers.*, Peganum harmala* etc. Plant cover presented four levels of layering. The first level was covered by *Ikonnikovia kaufmanniana, Erysimum cheiranthoides* L., *Erysimum canescens* Roth to a height of 40-59 cm.; the second level - *Poa bulbosa* L., *Ixiolirion tataricum* (Pall.) Schult. & Schult. Fil., *Scorsonera pubescens* DC to a height of 30-40 cm; the third level - *Artemisia sublessingiana* Krasch. ex Poljak., *Artemisia heptapotamica* Poljak., *Dracocephalum integrifolium Bunge* to a height of 20-30 cm; the forth level - *Carex pachystylis* J.Gay., *Ceratocarpus utriculosus* Bluk., *Thlaspi perfoliatum* L., *Arnebia decumbens* (Vent.) Coss. & Kral. to a height of 7-15 cm. On ground cover we found *Tortula tortuosa* and *Parmelia*.



Picture 2 - Photographs of the species *Ikonnikovia kaufmanniana*

Floristic composition of phytocoenosis No.1 is not rich and consists of 40 species. Within the phytocoenosis we saw many agrestals. On the borders of the community there were many specimen of *Descurainia sophia*. The immediately surrounding area had a green-grey colour because of the presence of *Artemisia sublessingiana* and *Artemisia heptapotamica*.

Phytocoenosis No.2 (cenopopulation No.2) was observed on a north facing slope of a small bald peak not far from the first phytocoenosis. Slope angle was 30-40°. Plant cover included Ikonnikov-absinthium-gramineous community (*Festuca valesiaca, Poa bulbosa, Agropyron cristatum, Artemisia sublessingiana*, *Artemisia heptapotamica, Ikonnikovia kaufmanniana,).* Projective cover made up 75-80% of the area. The soil was a light-brown colour and stony. Plant cover had a three-level texture. The first one was covered by *Erysimum cheiranthoides, Erysimum canescens Ikonnikovia kaufmanniana* to a height of 40-50 cm; the second level- *Poa bulbosa*, *Ixiolirion tataricum, Allium vvedenskyanum* Pavl., *Scorsonera pubescens* to a height of 30-40 cm; the third level - *Artemisia sublessingiana, Artemisia heptapotamica, Kochia prostrata* (L.) Schrad., *Festuca valesiaca* Gaudin to a height of 10-20 cm. Like the first phytocoenosis, here too we encountered ground cover of *Tortula tortuosa* and *Parmelia*. The general background of the plants was a green-grey colour.

In the upper tier of the community at the foot of the rock face there was an abundance of bushes, consisting of *Rosa potentilliflora* Chrshan. & Laseb, *Spiraea hypericifolia* L*., Cotoneaster oliganthus* Pojark., *Cerasus tianschanica* Pojark. of Rosaceae family. In addition, there were *Caragana balchaschensis* (Kom.) Pojark., *Ephedra intermedia* Schrenk et C.A.Mey, and *Lonicera humilis* Kar. & Kir. Between bushes there were *Ferula akitschkensis* B.Fedtsch. ex K.-Pol*., Seseli sessiliflorum* Schrenk. On the low side of the community and in a depression in the ground there were agrestals such as: *Descurainia sophia, Chenopodium foliosum, Rheum tataricum* L. and annual salt grass. Floristic composition of the phytocoenosis was not rich and consisted of 44 species.

Phytocoenosis No. 3 (cenopopulation No.3) was observed on a 50-55º slope of a low bald peak with a north-eastern exposure.

Plant cover included Ikonnikov-absinthium community *(Artemisia sublessingiana, Artemisia heptapotamica, Ikonnikovia kaufmanniana,)* plus grain varieties. The soil was a light-brown colour and very stony. Projective coating did not exceed 55-60%. The condition of most species here was noticeably worse in comparison with the two previous phytocoenoses. The majority of plants were arranged in low-growing clumps of pillow-like formations.

Generally, plant formation was thin, but the state of *Ikonnikovia kaufmanniana* was good. Thus, within the phytocoenosis all age species can be found. Analysis showed that here the quantity of *Ikonnikovia kaufmanniana* specimens of all maturation states per unit of area was much larger in comparison with the two previous phytocoenoses. This is likely to have occurred owing to an almost complete absence of competition with other components of the community, particularly grain varieties.

In sites where plant cover is largely occupied by grain varieties, the condition of *Ikonnikovia kaufmanniana* is marginally worse and the number of specimens per unit of area is much less. It means that *Ikonnikovia kaufmanniana* fares badly in competition for moisture and nutrient materials.

The plant cover of this phytocoenosis also had a three-tier structure. The first tier included *Ikonnikovia kaufmanniana, Salsola arbuscula Pall*. to a height of 40-50 cm; the second tier - *Stipa orientalis Trin., Stipa caucasica Schmalh., Seseli sessiliflorum* to a height of 30-40 cm; the third tier - *Artemisia sublessingiana, Dracocephalum integrifolium, Festuca valesiaca, Agropyron pectinatum (Bieb.) Beauv*. to a height of 10-25 cm.
In surface cover *Tortula tortuosa* was absent and *Parmelia* occurred thinly.

In general, within the *Ikonnikovia kaufmanniana* population in the Toraigyr Mountains, in the Alasy Passage of the Toraigyr low-peaked massif, we gathered and determined 88 species of tracheophytes, relating to 76 genera and 32 families (Appendix).

In classification aspect the flora composition was represented as follows: *Gimnospermatophyta* division was presented by one species *Ephedra intermedia. Angiospermatophyta* class consisted of 87 species, 71 species belonged to *Dicotyledoneae* division, the remaining 16 to *Monocotyledoneae* division. The largest family was *Brassicaceae* with 13 species (14.7%). Second largest was the *Poaceae* family with 8 species (9%), and the third largest was *Chenopodiaceae* family with 7 species (7.9%). Furthermore, in descending order there was *Asteraceae* family with 6 species (6.8%), *Rosaceae* with 5 species (5.6%), *Caryophyllaceae* with 5 species (5.6%). Other families were represented in insufficient number of species, but they also play a key role in formation of plant cover within *Ikonnikovia kaufmanniana* populations and all together made half of the flora (44 species, 50%) of the studied plant communities. Among the indicated life-forms, clear superiority was seen in hemicryptophyte numbers, i.e. perennial herbaceous plants - 56 species (63.6%). The second most significant were therophytes, i.e. annual (biannual) herbaceous plants with short life span – 22 species (25%). Thirdly, nanophanerophytes, i.e. bushes – 7 species (7.9%). Microphanerophytes (bushes) were represented by 3 species.

Upon categorization by ecological type, clear superiority was seen in xerophytes, i.e. plants adapted to the conditions of low water supply. They comprised 37 species (42%) of flora. The second most significant were mesophytes, i.e. the plants adapted to conditions of good water supply, 23 species (26%). The third most significant were mesoxerophytes – plants which grow well regardless of sufficient irrigation – 10 species (11,6%).

Ephemeroids, i.e. perennial herbaceous plants with a short life-cycle were represented by 5 species.

Ephemers, i.e. annual plants with a short life-cycle were represented by 2 species. They were *Papaver pavoninum* Schrenk of *Papaveraceae* family and *Ceratocephalus testiculata* (Grantz) Bess. of *Ranunculaceae* family. The number of endemic species was 4. They were *Allium vvedenskyanum* Pavl., *Lonicera humilis* Kar. & Kir., *Pyrethrum semenovii* (Herd.) C.Winkl. and *Taraxacum songoricum* Schischk. Within this population we discovered 8 groups of useful plants. The most widespread, in terms of both type and quantity per square metre, were forage and weed plants.

Each of these groups had 20 species that made up 45,4% of flora of the studied plant communities. This entirely expected figure reflects the natural development of plant cover of the *Ikonnikovia kaufmanniana* population and of the Toraigyr low-mountain massif in general. The rest of the groups were represented with insufficient species number. However, special note is made about the erosion-preventive group of plants. It is clear that an important role is played by bushes and numerous herbaceous plants with deep root systems. All the plant species within the studied population to some degree bind the soil and in such a manner protect the sides of the mountains and the top-soil from washout. The role of binding soil and preventing top soil washout and wind erosion also belongs to sod grasses and annual plants.

In terms of benefit for economic activity, the plants within this population were divided into 13 groups. Forage plants were the most widely spread among them. They made up more than half of the flora. The second largest proportion was bee plants; 55 species (46,2%), thirdly; weed plants - 20 species (16,8%) and fourthly: medical plants - 16 species (13,4%) of flora. Some species were multipurpose, at the same time being forage, herbal medicine, feed and bee plants.

Ecological-cenotical characteristics of populations are presented in Table 2.

The morphometric characteristics of species in pre-generative, generative and post-generative periods of life of *Ikonnikovia kaufmanniana* from different locations are given in Tables 3-5.

ISSN: 0975-8585

Table 2 –- Eco-Coenotic Characteristics of *Ikonnikovia kaufmanniana* population

Ceno population	Location and soil type, GPS index	Plant community	Dominants	General projective cover
1	Almaty region, Enbekshikazakhskiy district, Eastern part of Toraigyr Mountains, Alasy Passage, north-eastern slope exposure Slope ratio 45º. Soil is light-brown and stony. Coordinates: N 43020.124/ , E 078056.337/, Altitude above sea level - 1394 m	Ikonnikov - absinthium – gramineous	*Artemisia sublessingiana,Artemisiaheptapotamica,Poa bulbosa, Agropyron pectinatum, Stipa caucasica,Ikonnikovia kaufmanniana*	65-70%.
2	Almaty region, Enbekshikazakhskiy district, Eastern part of Toraigyr Mountains, Alasy Passage, North slope exposure. Slope ratio 30-35º. Soil is light-brown and stony. Coordinates: N 43020.188/, E 078056.345/, Altitude above sea level - 1387 m	Ikonnikov - absinthium – gramineous	*Festuca valesiaca, Poa bulbosa, Agropyron cristatum, Artemisia sublessingiana,Artemisia heptapotamica, Ikonnikovia kaufmanniana*	75-80%
3	Almaty region, Enbekshikazakhskiy district, Eastern part of Toraigyr Mountains, Alasy Passage, north-east slope exposure. Slope ratio 50-55º. Soil is light-brown and stony. Coordinates: N 43020.213/, E 078056.472/, Altitude above sea level - 1406 m	Ikonnikov – absinthium	*Artemisia sublessingiana Artemisia heptapotamica, Ikonnikovia kaufmanniana,*	55-60 %

Table 3 – Morphometric characteristics of species in the pre-generative period *Ikonnikovia kaufmanniana*

Height, cm	Crown diameter, cm		Number of leaves, pieces
	North-South	East-West	
J			
0	0	0	0
Im			
1,11±0,10	1,56±0,12	1,55±0,09	4,6±0,2
V			
2,77±0,14	4,36±0,21	4,45±0,21	9,6±0,7

ISSN: 0975-8585

Table 4 – Morphometric characteristics of species in the generative period *Ikonnikovia kaufmanniana*

Height, cm	Crown diameter, cm		Number of flower spikes, pieces	Height of flower spikes, cm	Number of leaves near one flower spike, piece
	North-South	East-West			
g1					
11,58±0,91	10,27 ±0,44	10,64±0,43	2,1±0,1	17,27±0,62	8,9±0,2
g2					
27,80±1,56	20,50 ±1,26	21,28±1,14	5,3±0,5	27,80±0,63	9,3±0,29
g3					
25,02±1,76	16,26 ±0,94	17,73±1,03	3,0±0,3	23,71±0,92	10,1±0,3

Table 5 – Morphometric characteristics of species in the post-generative period *Ikonnikovia kaufmanniana*

Height, cm	Crown diameter, cm		Number of leaves, pieces.
	North-South	East-West	
Ss			
7,43±0,84	11,72±1,58	13,43±1,82	10,0±1,0
S			
4,53±0,52	6,56±1,01	6,72±0,79	0

Morphometric parameters analysis in the pre-generative period for juvenile species of *Ikonnikovia kaufmanniana* showed the following sizes are characteristic: height - not less than 1 cm. crown diameter about 0.5 - 1 cm, and leaves from 2 to 3. On transition to immature condition, the height of specimens in general exceeded 1 cm, crown diameter increased from 1.5 cm up to 2.5 cm, number of leaves increased up to 4-5. In virginile condition, the height of plants steeply increased from 2.5cm up to 5.5 cm and crown size increased from 4 cm up to 9 cm and the number of leaves increased up to 9-10. One to two flower spikes appeared in young generative specimens of *Ikonnikovia kaufmanniana* in the generative period and, in connection with this, the height of plants increased to around 10 - 25 cm, crown diameter also increased to around 10-14 cm and the number of leaves on one short shoot was about 8.

For middle-generative *Ikonnikovia kaufmanniana* species there was an identifiable increase of the number of flower spikes up to 4-6, with height of plants up to 28-36 cm, crown diameter up to 20-27 cm, the number of leaves on one short shoot remained almost the same as young generative plants. The number of flower spikes of old generative species decreased to 2-4, the height of plants from 25-34 cm, crown diameter from 17-26 cm, the number of leaves per one short shoot remained almost the same.

In the post-generative period of life of *Ikonnikovia kaufmanniana* plants, the height of species and crown diameter severely decreased, the number of leaves per one short shoot of subsenile species was 5-10 and in the senile species they were absent.

In the pre-generative period of *Ikonnikovia kaufmanniana* plants during transition from juvenile to virginal states, height increases to 5 cm, crown diameter to 8-9 cm, and the number of leaves on one plant reaches 9-10.

In the generative period the middle-generative plants reach the highest number of flower spikes, have the highest height and the largest crown diameters, but the number of leaves per one short shoot almost does not change during the whole period and makes 8-10.

In the post-generative period the absence of flower spikes and the decrease in size of plants (both height and crown diameter) is characteristic, senile plants are also lacking leaves.

The number of plants of this ontogenetic condition and their percentage participation in cenopopulation are presented in Table 6.

Analysis of the quantity, density and age distribution of the *Ikonnikovia kaufmanniana* population of Toraigyr Mountains (Table 6, Picture 2) showed that in the age spectrum the largest number of species pertains to virginile ones, 30,8%.

Table 6 – Quantity of plants of this ontogenetic condition and its percentage participation in population.

Ontogenetic condition pieces/ %	CenopopulationNo 1	Cenopopulation № 2	CenopopulationNo 3	Total
Juvenile	0	0	0	0
Immature	4 / 6,2	21 / 17,9	40 / 17,5	65 /15,9
Virginile	7 / 10,9	29 / 24,8	90 / 39,6	126 /30,8
Young generative	23 / 35,9	22 / 18,8	64 / 28,2	109 /26,7
Middle-generative	12 / 18,7	9 / 7,7	15 / 6,6	36 /8,8
Old generative	11 / 17,3	27 / 23,1	12 / 5,3	50 /12,2
Sub senile	3 / 4,7	4 / 3,4	0	7 /1,7
Senile	4 / 6,3	5 / 4,3	7 / 3,1	16 / 3,9
Total, pieces	64	117	228	409

Phytocoenosis (cenopopulation) analysis showed that in phytocoenoses №2 and №3, the peak value was for virginile plants and in phytocoenosis №1 – for young generative plants (Table 6, picture 2).

The analysis of quantity, density and age distribution of the *Ikonnikovia kaufmanniana* population showed that in the age spectrum of the population the largest number of species pertains to virginile ones. Cenopopulation analysis showed that in cenopopulation №3 the peak occurs in the virginile plants, and in cenopopulation №1 – in the young generative phase. Table 6 and Picture 2 show that Juvenile plants are absent in cenopopulations №1-3.

Immature, virginile, young generative, middle-generative and old generative plants can be found in all populations, and subsenile plants are absent in cenopopulation №3.

The general condition of the *Ikonnikovia kaufmanniana* population is stable and it faces no immediate threats.

Conclusion

In the *Ikonnikovia kaufmanniana* population of the Toraigyr Mountains we isolated 88 species of vascular plants relating to 76 genera and 32 families. The largest family is *Brassicaceae,* with 13 species (14,7%). Next largest was *Poaceae family,* with 8 species (9%), then *Chenopodiaceae* family, with 7 species (7,9%).

Then, in descending order, there were *Asteraceae* family, with 6 species (6,8%), *Rosaceae,* with 5 species (5,6%), *Caryophyllaceae, also with* 5 species (5,6%).

Out of all the identified clear superiority was seen in hemicryptophytes, i.e. perennial herbaceous plants - 56 species (63,6%). Then followed therophytes, i.e. annual (bi-annual) herbaceous plants with short development cycles - 22 species (25%). Then, nanophanerophytes, i.e. bushes - 7 species (7,9%). Floristic composition of the population is particularly rich and varied.

The analysis of quantity, density and age structure of *Ikonnikovia kaufmanniana* population showed that immature, virginile, young generative, middle-generative, old generative species can be found in all populations, and sub senile vital species are absent in cenopopulation №3.

Our investigation revealed that in the above mentioned locations *Ikonnikovia kaufmanniana* had taken insignificant area and its range has been decreasing from year to year, thus, *Ikonnikovia kaufmanniana* is a rare, declining, endemic species of Kazakhstan. That's why *Ikonnikovia kaufmanniana* needs protection.

New references on Plant Conservation

Reduction and control of grazing to maintain the Ikonnikova kaufmanniana population of the Toraigyr Mountains

ACKNOWLEDGEMENTS

The authors are grateful for financial support to the Ministry of Education and Science of the Republic of Kazakhstan of the Project "Biological Features, Modern Condition and Protection of Cenopopulation of Some Rare Plant Species of Almaty Region", State Registration Number 0112PK00326.

REFERENCES

[1] Akhmetova, A., Mukhitdinov, N., Ydyrys, A.: Anatomical indicators of the leaf structure of *Ferula iliensis*, growing in the eastern part of Zailiyskiy Alatau (Big boguty mountains). Pakistan Journal of Botany, **47(2),** 511-515 (2015).
[2] Akiyanova, F.Zh., Medeu, A.R., Nurmambetov, E.I., Potapova, G.M., Sarsekov, A.S.: Geomorphology. Kazakhstan. Environmental conditions and resources. Almaty. **1**, 205-206 (2006).
[3] Baitenov, M.S.: In the world of rare plants. Alma-Ata, 176 (1986).
[4] Baitenov, M.S.: Flora of Kazakhstan. Almaty, **1-2** (2001).
[5] Begenov, A., Mukhitdinov, N., Ametov, A., Nazarbekova, S., Kuatbayev, A., Tynybekov, B., Abidkulova, K., Ydyrys, A.: Assessment of the current status of populations of kazakh rare plants (*Berberis iliensis* M.Pop). World Applied Sciences Journal: IDOSI Publications., **30 (1),** 105-109 (2014).
[6] Bullock, J.M., Clear, H. B., Silvertown, J.: Tiller dynamics of two grasses - responses to grazing, density and weather. ***Journal of Ecology.*** 82, 331-340, (1994).
[7] Central Asia key to plants, V.V. 1-10 (1968-1996).
[8] Cherepanov, S.K.: Vascular plants of USSR. 509 (1995).
[9] Cursach, J., Rita,J.: Reproductive biology of *Ranunculus weyleri* (*Ranunculaceae*), a narrowly endemic plant from the Balearic Islands with disjunct populations. Flora **207**, 726-735 (2012).
[10] Field Geobotanica: Edition of AS USSR. **1** (1959).
[11] Field Geobotanica: Edition of AS USSR. **3** (1964).
[12] Flora of Kazakhstan: V.V. **1-9** (1956-1967).
[13] Golubev, V.N.: To the methods of numerical study of rare and disappearing plants of Crimean flora. // Bulletin of State Nikitskiy Botanic Garden, Edition **1(32**), 11-15 (1977).
[14] Golubev, V.N., Molchanov, E.F.: Methodological instructive regulations to quantitative and ecological and biological study of rare, disappearing and endemic plants of the Crimea, Yalta: State Nikitskiy Botanic Garden. 41 (1978).
[15] Golubev,V.N.: To ecological and morphological characteristics of life forms of herbaceous plants of Western Siberia forest steppe. Botanic Journal,. **45**, 979-996 (1960).
[16] Hegazy,A. K., Kabiel,H. F., Boulos,L.,. Sharashy,O.S.: Functional traits and life history diversity of the North Africa endemic *Ebenus pinnata* Aiton. Flora **205**, 666-673 (2010).
[17] Hmeljevski, K. V., Freitas, L., Domingues, R.: Conservation assessment of an extremely restricted bromeliad highlights the need for population-based conservation on granitic inselbergs of the Brazilian Atlantic Forest. Flora **209**, 250-259 (2014).
[18] Li,W., Zhang,G.-F.: Population structure and spatial pattern of the endemic and endangered subtropical tree Parrotia subaequalis (Hamamelidaceae). Flora **212**, 10-18 (2015).
[19] Pereira,G., Romero,Ch., Suz,L.M., Atala, C.: Essential mycorrhizal partners of the endemic Chilean orchids Chloraea collicensis and C. gavilu. Flora **209**, 95-99 (2014).
[20] Rabotnov, T.A.: Structure and methods of perennial herbaceous plant cenopopulation study. Ecology, 2, 5-13 (1978).
[21] Rabotnov, T.A.: Phytocenology. 352 (1992).
[22] Tahtadzhyan, A.L.: Magnoliophyta system. 439 (1987).

[23] Uranov, A.A.: Large life cycle and age spectrum of flowering plant cenopopulation. Thesis, report 5th Delegate All-Union Botanic Community conference. 74-76 (1973).

[24] Wei, X.Z., Jiang,.M.X., Huang, H.D., Yang,J.Y., Yu,J.: Relationships between environment and mountain riparian plant communities associated with two rare tertiary-relict tree species, *Euptelea pleiospermum* (*Eupteleaceae*) and *Cercidiphyllum japonicum* (*Cercidiphyllaceae*). Flora, **205**, 841–852 (2010).

[25] Ydyrys, A., Mukhitdinov, N., Ametov, A., Tynybekov, B., Akhmetova, A., Abidkulova, K.: The states of coenopopulations of endemic, relict and rare species of plant *Limonium michelsonii* and their protection. World Applied Sciences Journal*,* **26(7)**, 934-940 (2013).

[26] Zaugolnova, L.B.: Methods of cenopopulation study of rare species of plants in order to evaluation their condition. Protection of plant communities of rare and endangered ecosystems: Materials of All-Union Conference. 74-76 (1982).

[27] Zhao, X., Sun,W.: Abnormalities in sexual development and pollinator limitation in *Michelia coriacea* (*Magnoliaceae*), a critically endangered endemic to Southeast Yunnan, China, Flora **204**, 463-470 (2009).

[28] Zlobin, Yu.A., Sklyar, P.G., Klimenko, A.A.: Rare plant species population. Theoretical basis and methods. Scientific Monograph. Summy: University book, 439 (2013).