The Age Structure of the Coenopopulations of Rare Endemic Plant *Ikonnikovia Kaufmanniana* from Kazakhstan

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Abstract Results of studies of the age structure and density *Ikonnikovia kaufmanniana* coenopopulations are presented in this article. *Ikonnikovia kaufmanniana* (Regel) Lincz. (family *Limoniaceae* Ser.) is a rare, disappearing, endemic species with dwindling area and grows only in Kazakhstan and western China (in district Kuldja). Areal of the species is sharply reduced because of the rapid development of new territories and intensified grazing. Endemics such as *Ikonnikovia kaufmanniana* are the most vulnerable part of the regional floras. The loss of these species may lead to decreased stability of the ecosystem, whose integral part they are. Information about the current state of coenopopulations *Ikonnikovia kaufmanniana* is needed to clarify the prospects for their existence and development of strategy of its conservation. Age structure is one of the main characteristics of the plant coenopopulations. Three populations, nine coenopopulations of *Ikonnikovia kaufmanniana* were explored by us in 2013. We laid the accounting sites of 1 m^2 (by 10 accounting sites in each of coenopopulations) along transects every 10-20 meters depending on the terrain relief. We have counted all individuals of a certain age status at each area and have identified of *Ikonnikovia kaufmanniana* environmental density. Analysis age structure of coenopopulations *Ikonnikovia kaufmanniana* showed that all coenopopulations are normal, most of them are incomplete with members, and only two are completed with members. There are absent juvenile or subsenile or senile individuals in incomplete with members coenopopulations. Ecological density was very different and amounted from 5.5 to 29.2 individuals per m^2.

Keywords Population, Coenopopulation, Endemic, Age Structure, *Ikonnikovia Kaufmanniana*

1. Introduction

The Republic of Kazakhstan, is a contiguous transcontinental country in Central Asia. Kazakhstan is the ninth largest country in the world; its territory of 2,727,300 square kilometers. It has borders with Russia, China, Kyrgyzstan, Uzbekistan, and Turkmenistan. 44% of the territory of Kazakhstan is desert, 14% - semi-desert, 26% - steppe and 5.5% - forests. Flora of Kazakhstan has about 5700 species of plants [Flora of Kazakhstan (1956-1966)]. 306 species of plants are included in the first edition of the Red Data Book of Kazakhstan and protected by the Governmentм [Red Data Book the Kazakh SSR (1981)]. New information is being prepared for the second edition of the Red Data Book of Kazakhstan, which will include 404 species of plants in danger.

Endemic and rare plants are an integral component of the local flora and vegetation, and the disappearance of these species can lead to loss of biodiversity.

Some researchers have noted that the threat of the gene pool of rare endemic and endangered species at the present stage is in the anthropogenic transformation of the environment and habitat fragmentation and it's leading to a decrease in population and their isolation [Schnabel, Krutovskii (2004)]. Especially it applies to plants growing in extreme conditions of desert lowlands [Ivashchenko (2008)]. Lack of natural moisture, poor soil conditions, topography, salinity and overgrazing, all of it puts pressure on plants. One of these plants is Ikonnikovia kaufmanniana.

Ikonnikovia kaufmanniana is included in 1997 IUCN red list of threatened plants [IUCN Red List of Threatened Plants (1998)], also it is included in the list of rare and endangered species of animals and plants of the Republic of Kazakhstan [Resolution of the Government of the Republic of Kazakhstan (2006)].

In this regard, it is needed research of the current state populations of Ikonnikovia kaufmanniana. Demographic structure is one of the most significant characteristics of the population, which determines its ability to self-maintenance and sustainable development [Selyutina (2013)]. Goal of the work is identify and study Ikonnikovia kaufmanniana coenopopulations with taking into account such parameters as indicators of density and age structure.

2. Materials and Methods

Ikonnikovia kaufmanniana (Regel) Lincz. (Family Limoniaceae Ser.) is a rare, disappearing, endemic species with dwindling area (Fig. 1). Shrublets, herblike, 14-35(50) cm tall. Root thick, branches usually numerous, thick, covered with remnants of leaves. Numerous tough, leathery leaves are in dense rosettes at the ends of branches; violet-red flowers in very dense, large spikelets. Fl. June-August, fro. July-September. Lower slopes and base of mountains. Xinjiang (Ili River basin) and Kazakhstan. This species grows In Kazakhstan, in the eastern spurs of the Trans-Ili Alatau Mountains (Turgen gorge, mountains Syugaty, Boguty, Turaigyr) and by the foot of the ridge Uzynkara (Ketmentau) in Kazakhstan. Trans-Ili Alatau Mountains and Uzynkara Mountains are part of the Northern Tien Shan, Syugaty, Boguty and Turaigyr are north-eastern extension of Trans-Ili Alatau. Syugaty Mountains, and Boguty Turaigyr are deserted mountains, there is no forest and soils are poorly developed the due to lack of moisture in them. A ridge Uzynkara surrounded on all sides by the desert landscape, by this terms it is a transition between the Northern and Southern Tien Shan. In the east Ikonnikovia kaufmanniana by single individuals and small groups permeates in district Kuldja (China). Areal of the species is sharply reduced because of the rapid development of new territories and intensified grazing [Red Data Book the Kazakh SSR (1981), Baitenov (1986)].

These researches were conducted in Almaty region in the mountains Turaigyr and Syugaty. We investigated three Ikonnikovia kaufmanniana populations, in each of which has been allocated to three coenopopulations. Population 1 (coenopopulations 1,2,3) was located on the pass Alasy in the mountains Turaigyr, coordinates N 43020.124', E 078056.337', altitude - 1394 m, population 2 (coenopopulation 4,5,6) - on the pass Kokpek in the mountains Syugaty, coordinates N 43027.229', E 078038.984', altitude - 1163 m, population 3 (coenopopulation 7,8,9) - in the mountains Syugaty before the pass Kokpek, coordinates: N 43031.472', E 078035.207', altitude - 1033 m (Fig. 2). To study the coenopopulations age structure longitudinal transects were laid in each of them. We have laid the 10 accounting sites by 1 square meter in each coenopopulation along transects every 10-20 meters depending on the terrain relief. We have counted all individuals of a certain age status at each site.

Figure 1. Ikonnikovia kaufmanniana (Regel) Lincz.

Methodological principles and approaches developed by T.A. Rabotnov [Rabotnov (1950)], A.A. Uranov [Uranov (1975)] and his School [Coenopopulations of plants (1976, 1988)] were used by us to study the age structure of populations. We have took into account all age states as juvenile (j), immature (im), virgin (v), a young reproductive (g_1), mature reproductive (g_2), old reproductive (g_3), subsenile (ss) and senile (s). As a unit of account we used individual. Environmental density we considered as the number of individuals per 1 m^2 of habitable space.

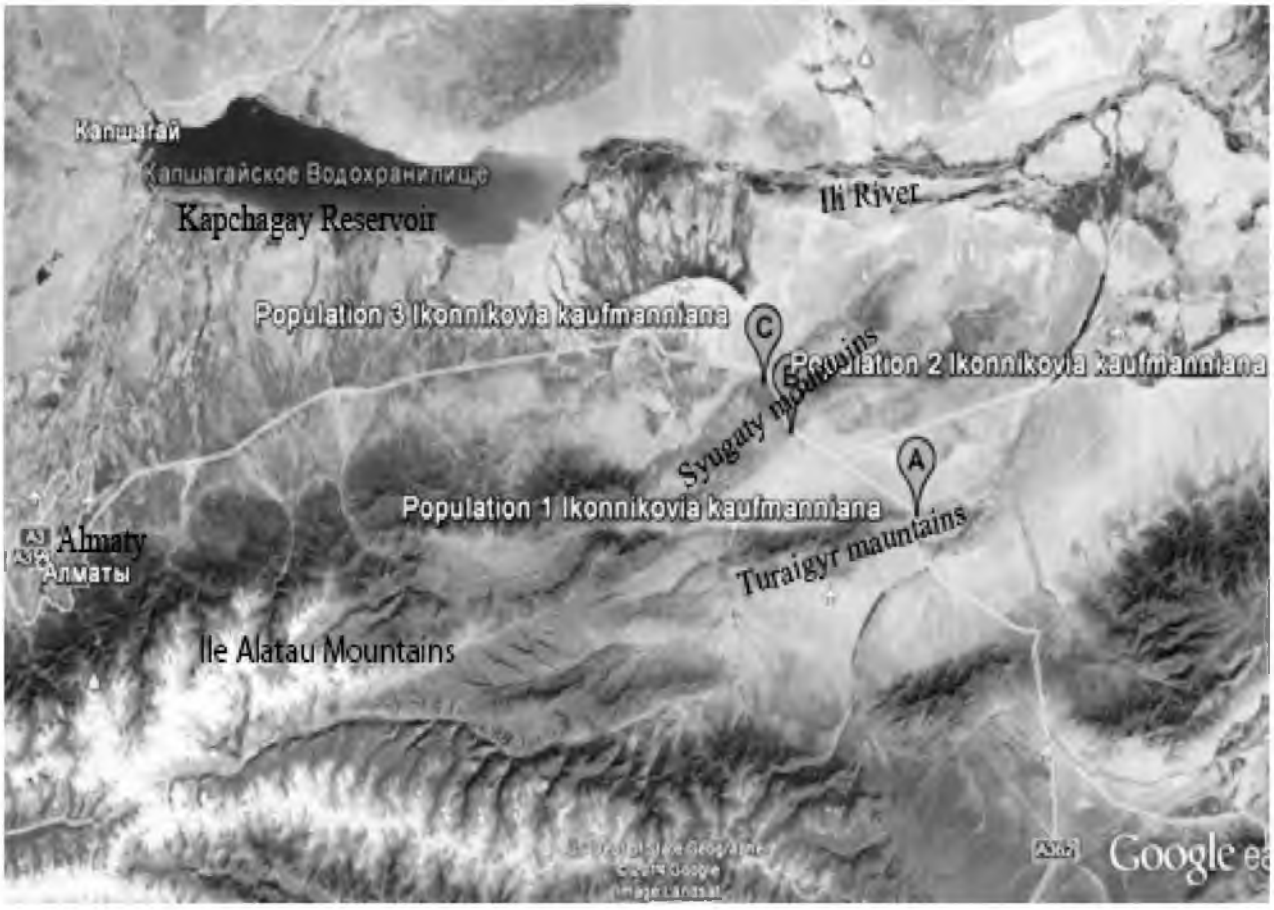

Figure 2. Map of the studied *Ikonnikovia kaufmanniana* populations

Table 1. Age states *Ikonnikovia kaufmanniana* in coenopopulations

No Population	No coenopopulation	Coenopopulation age structure, %								Density of individuals per 1 m^2
		j	im	v	g_1	g_2	g_3	ss	s	
1	1	0	6,2	10,9	35,9	18,7	17,3	4,7	6,3	6,4
	2	0	17,9	24,8	18,8	7,7	23,1	3,4	4,3	11,7
	3	0	17,5	39,5	28,1	6,6	5,2	0	3,1	22,8
2	4	0,6	8,5	30,1	45,2	4,6	6,5	0,6	3,9	15,3
	5	0,3	7,5	50	38	3,1	0,7	0,3	0	29,2
	6	0	11,2	34,7	32,7	7,1	12,2	0	2	9,8
3	7	0	1,7	23,7	42,4	16,9	13,6	0	1,7	5,9
	8	2,6	3,5	43,5	37,4	5,2	4,3	2,6	0,9	11,5
	9	0	5,5	14,5	49,1	5,4	20	0	5,5	5,5

3. Results and Discussion

Population 1. Coenopopulations 1,2 and 3 belong to a normal incomplete with members. There are not juvenile individuals, and also subsenile individuals are absent in 3d coenopopulation (Table 1).

Age spectrum of coenopopulation 1 and 3 are left-sided, have one maximum: in coenopopulations 1 - young reproductive individuals (35.9%), in coenopopulations 3- virginal individuals (39.5%). The age spectrum of the coenopopulation 2 has two maximum - virginal (24.8%) and old reproductive individuals (23,1%) (Fig. 3). The highest density of individuals *Ikonnikovia kaufmanniana* been featured in coenopopulation 3 (Fig.6).

Population 2. Coenopopulations 4,5 and 6 are normal, the coenopopulation 4 of them is complete with members and coenopopulation 5 and 6 are incomplete with members. Senile individuals are absent in coenopopulation 5, while juvenile and subcenile individuals - in coenopopulation 6. The age spectrums of the coenopopulations 4,5,6 are left-sided and have one maximum: in the coenopopulation 4 - young reproductive individuals (45.2%), in coenopopulations 5 and 6 - virginal individuals (50.0% and 34.7%). The highest density of individuals *Ikonnikovia kaufmanniana* been featured in coenopopulation 5 (Fig.6).

Population 3. Cenopopulations 7,8 and 9 are normal, coenopopulation 8 is complete with members, while coenopopulations 7 and 9 are incomplete with members. Juvenile and subsenile individuals are absent in them (Table 1). The age spectrum of the coenopopulation7,8,9 are left-sided with single maximum: coenopopulations 7 and 9 - young reproductive individuals (42.4% and 49.1%), the coenopopulation 8 - virginal individuals (43.5%) (Fig. 5). The highest density of individuals *Ikonnikovia kaufmanniana* been featured in coenopopulation 8 (Fig.6).

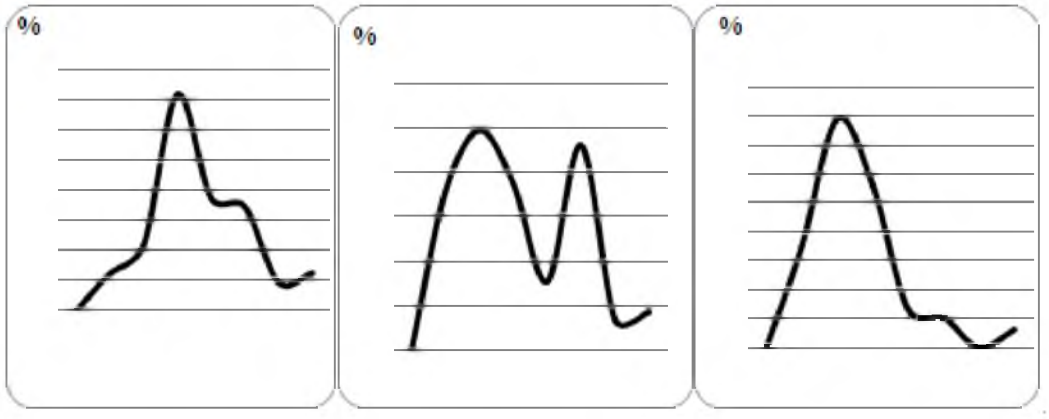

Figure 3. Ikonnikovia kaufmanniana age spectrums in population 1

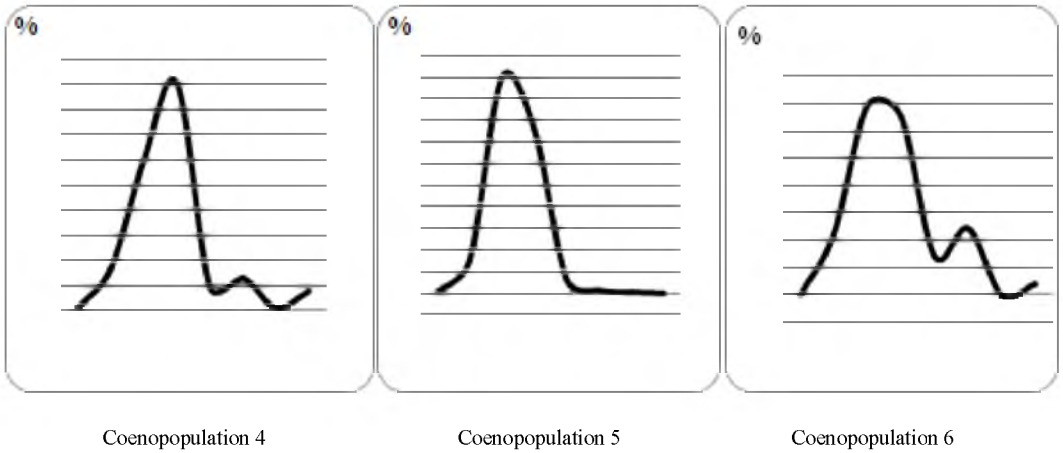

Figure 4. Ikonnikovia kaufmanniana age spectrums in population 2

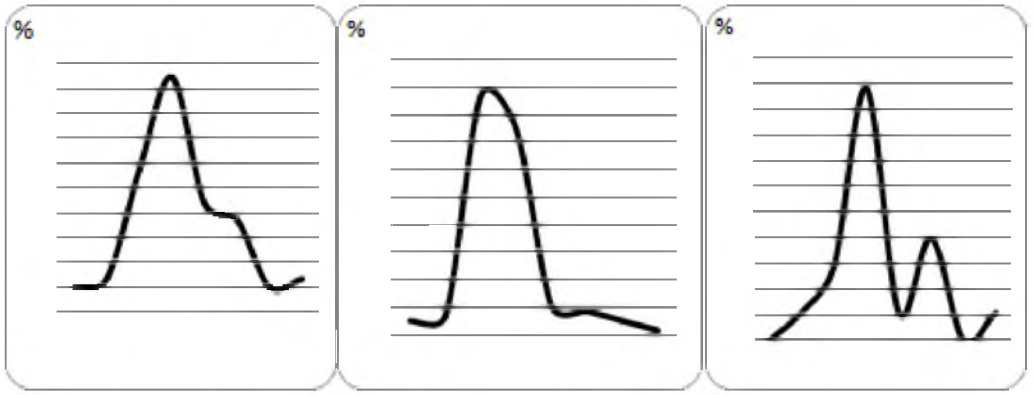

Figure 5. Ikonnikovia kaufmanniana age spectrums in population 3

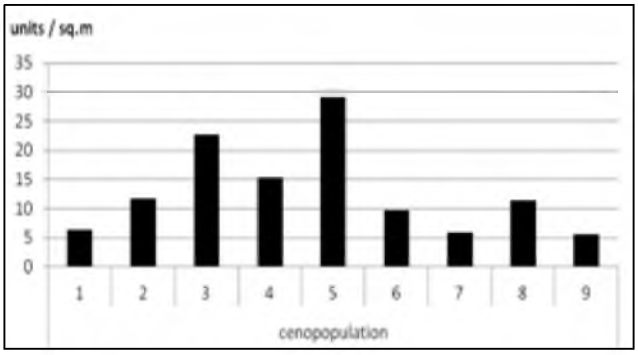

Figure 6. Density Ikonnikovia kaufmanniana in investigated coenopopulations

4. Conclusions

Therefore analysis age structure of coenopopulations *Ikonnikovia kaufmanniana* in three populations showed that all nine coenopopulations are normal, seven of them are incomplete with members, and two are complete with members. The lack juvenile, subsenile and senile individuals in most of the coenopopulations can be explained by that these individuals are usually the first those exposed to adverse conditions. Highest density was noted in coenopopulation 5, lowest density – in coenopopulation 9. The age spectrums of studied coenopopulations are left-sided with peaks on virginal or young reproductive individuals. These data suggest a relatively stable position *Ikonnikovia kaufmanniana* in the studied coepopulations.

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