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Research Article

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Zh. Adamzhanova*, S. Mukhtubayeva, N. Duisenova, A. Lukmanov

Mangyshlak Experimental Botanical Garden, Aktau, Kazakhstan
**Corresponding author: imangarden@mail.ru*

Identification of important plant areas in the Mountainous Eastern Karatau (Mangystau)

The identification of Important Plant Areas (IPAs), which are of particular significance for the conservation of biological diversity, is one of the international programs implemented under the Convention on Biological Diversity. The aim of this study was to identify IPAs in the Eastern Karatau Mountains. Field research was conducted using the traditional route reconnaissance method, covering the most diverse biotopes (landscape and ecological conditions) and their characteristic phytocoenoses. The vegetation cover of the identified areas was studied using standard geobotanical methods, including the description of plant communities, as well as the assessment of species diversity and vegetation condition. The flora of the Mangystau Region is characterized by a relatively low level of species diversity, and the vegetation cover is typical of desert regions. Based on criteria A–C, eight IPAs were identified: Kurkeruek, Kirezhyk Zheke, Eskildi Aday, Shili, Kaskyr Sai, Kaskyr Sai 2, Bakshy, and Agashty. The locations of ten species with IUCN conservation statuses 2(U), 3(R), and 4(I) were recorded: *Armeniaca vulgaris*, *Tulipa sogdiana*, *Capparis herbacea*, *Crambe edentula*, *Ephedra aurantiaca*, *Onosma staminea*, *Rhamnus sintenisii*, *Rubus caesius*, *Verbascum blattaria*, and *Crataegus ambigua*. For each Important Plant Area, a passport was compiled, threats to vegetation were identified, and recommendations for biodiversity conservation were developed.

Keywords: flora, Eastern Karatau Mountains, rare, endangered species, endemics, Red Book of Kazakhstan, important plant areas

Introduction

Import Plant Areas (IPAs) are an internationally recognized expert approach developed in the UK by Plantlife [1]. It aims to identify and conserve the richest areas in terms of plant life, possibly within existing protected areas. The designation of IPAs is necessary in order to combine efforts to conserve important wild plant populations in these areas and is an important complement to the Key Biodiversity Areas designated in a broader context [2].

The identification and designation of IPAs is based on three criteria, which take into account floristic richness, the number of rare and endemic species in need of protection, species listed in the Red Data Books, or species whose current status is of great importance for the evolution and preservation of life-supporting biosphere systems, as well as the presence of rare and threatened plant communities (habitats) [3–5].

The Mangystau region is an important industrial region with a significant range of environmental problems, as well as poorly studied areas in terms of assessing their condition and the presence of protected plant species. This problem is particularly acute in light of global climate change and the increasing anthropogenic pressure on natural areas [6–8]. The Mountainous Eastern Karatau region in Mangyshlak is one such poorly studied area.

The choice of the research area was determined by its relatively good floristic study, the availability of a large array of herbarium collections over a period of more than 50 years, the significant species diversity of the natural flora, and the presence of a number of endangered, rare, and endemic species in the area, the preservation of which is of not only national but also important international significance.

The aim of this study is to identify important plant areas for the Eastern Karatau Mountains.

Experimental

Surveys were conducted using route reconnaissance methods, covering different seasons of the 2024 growing season. The coordinates of plant species locations were determined using a GPS navigator. The geo referencing of historical herbarium sample collection points was carried out using Google Earth.

The following criteria were used to identify key botanical areas:

Criterion *A.* The site contains important populations of one or more plant species that are of high value on a global or European scale. There are four categories under criterion A.

A(i) — plant species recognized as being threatened with global extinction. This includes plants from the International Union for Conservation of Nature (IUCN) Red List.

A(ii) — plant species recognized as being threatened with extinction in Europe.

A(iii) — endangered endemic species not included in A(i) or A(ii). According to the guidelines for identifying KBTs, this category includes areas with national endemic species whose range does not extend beyond the borders of Kazakhstan and which are listed in the national Red Book.

A(iv) — endangered sub-endemic species with a narrow range, not included in A(i) or A(ii) and distributed in neighboring countries.

A(v) — species that are rare, endangered, and in need of protection within Kazakhstan and the Mangystau region.

Criterion *B* — the site is distinguished by its floristic richness or richness in plant species of special significance.

Criterion *C* — represents a unique or rare type of ecosystem, the presence of threatened habitats.

The main criterion is designated as A, as it includes Red Book species, the protection of which is specified by the legislation of the Republic of Kazakhstan.

The list of IPA trigger species and their distribution was compiled using data from field expeditions and herbarium collections stored in the herbarium of the Mangyshlak Botanical Garden (MANG), the Institute of Botany and Phytointroduction (AA), the Herbarium of the Botanical Institute of the Russian Academy of Sciences in St. Petersburg (LE), and the Herbarium of Moscow State University (MW). The collected herbarium material was identified using fundamental summaries: Flora of Kazakhstan [9], Illustrated Plant Guide of Kazakhstan [10], and the Plant Guide of the Mangystau Region [11]. The nomenclature of each taxon was carried out in accordance with POWO source [12]. The conservation status of each species was determined in accordance with the Red Book of Kazakhstan [13] and the regional Mangystau Red Book [14].

Results and Discussion

The Eastern Karatau Range is the highest massif of the Mangyshlak Mountains [15]. Its elevation ranges from 380 to 480 m above sea level. The highest point is Mount Beschoku, rising 555 m above sea level. The ridge stretches for 45 km and is about 10 km wide. Its summit is a peneplanated, hilly surface with ridges of dense rock, stretching parallel to each other and rising 5–10 m above the plain. Individual cone-shaped peaks rise 50–100 m above the peneplain (the Dzhipakhchi, Beschoku, and other mountains). Eastern Karatau has very steep slopes, almost vertical in places. The slopes are deeply cut by deep ravines. The northern and southern macroslopes of the ridge are very steep, rocky and gravelly, with outcrops of bedrock, cut by numerous canyon-like gorges, deep ravines, and gullies. The lithological composition of the rocks that make up Eastern Karatau is very diverse. It is represented by various sandstones, siltstones, and shales, with one or another type of rock predominating.

There are 9 rare species in Eastern Karatau, whose numbers are declining, of which 3 species are included in the Red Book of Kazakhstan [13], and 6 are included in the Red Book of the Mangystau Region [14] (Tab.).

T a b l e

Vascular plant species of Eastern Karatau included in the Red Data Books

Species	No. IPAs	Status (according to IUCN Red List)	Population status	Note
Armeniaca vulgaris Lam.	8	3 (R)	Rare species with declining numbers	Listed in the Red Book of Kazakhstan
Capparis herbaceae Sp.	8	2 (U)	Rare species	Listed in the Red Book of Mangystau Region

Continuation of Table

Species	No. IPAs	Status (according to IUCN Red List)	Population status	Note
Crambe edentula Fisch.	7, 8	2 (U)	Rare species	Listed in the Red Book of Mangystau Region and Kazakhstan
Ephedra aurantiaca Takht. et Pachom.	1	4 (I)	Uncertain species	Listed in the Red Book of Mangystau Region
Onosma staminea Ledeb.	8	2 (U)	Rare species	Listed in the Red Book of Mangystau Region
Rhamnus sintenisii Rech.	1–8	4 (I)	Uncertain species	Listed in the Red Book of Mangystau Region
Rubus caesius L.	6–8	4 (I)	Undetermined species	Listed in the Red Book of Mangystau Region
Verbascum blattaria L.	8	2 (U)	Rare species	Listed in the Red Book of Mangystau Region
Tulipa sogdiana Bunge	8	5 (co)	Rare species	Listed in the Red Book of of the Republic of Kazakhstan and Mangystau Region

Survey of the territory showed an extreme degree of vegetation transformation, which allowed us to identify 8 IPAs: 1). Kurkeruek; 2). Kirezhyk zheke; 3). Eskildi adai; 4). Shili Gorge; 5). Kaskyr sai; 6). Kaskyr sai 2; 7). Bakshy; 8). Agashty (Fig. 1).

Figure 1. Locations of important plant areas in the Eastern Karatau Mountains

The important plant area Kurkeruek (N 44°04'200"; E 052°36'365", altitude — 156–361 m above sea level) is located in the foothills of the Mountainous Eastern Karatau Range. The relief is low-mountainous, with very steep slopes, almost vertical in places. The slopes are deeply cut by ravines. The water regime is automorphic, characterized by seasonal atmospheric moisture in the area, dry gorges, and no water. They consist of gray-brown soil cover.

The floral diversity offered by IPA Kurkeruek consists of 49 species of vascular plants. The vegetation cover includes species listed in the Red Book of Mangystau Region, *Rhamnus sintenesii* and *Ephedra aurantiaca*, whose presence meets criterion *A(iii).*

The territory is partially used for grazing. The main part of the vegetation cover of the territory is assessed as background with patches of slight disturbance. The low density of settlements contributes to the

preservation of beautiful flowering ornamental and medicinal species. Types of anthropogenic impacts are grazing and roads. The degree of anthropogenic impact ranges from low to moderate. Part of the site (dry slopes with rock outcrops) requires a complete ban on grazing.

Important plant area Kirezhyk Zheke Gorge (N 44°04'200"; E 052°36'365", altitude — 304–320 m above sea level). The proposed Kirezhyk Zheke IPA is located in the foothills of the Eastern Karatau Mountains, on a salt marsh depression in the foothill plain. The water regime is automorphic, characterized by atmospheric moisture, semi-hydromorphic, characterized by the influence of closely occurring groundwater, and hydromorphic, caused by the influence of surface water from springs. The soil profile is characterized by a poor humus horizon and a slightly lumpy structure.

According to criterion *A(iv)*, two Red Book species have been identified: *Rhamnus sintenesii* and *Verbascum blattaria*, which are listed in the regional Red Book [14]. According to criterion *B*, the site is characterized by a fairly complete range of flora typical of sub-mountain medium deserts. Thirty-seven species of vascular plants have been identified here. According to criterion *C*, grazing livestock poses a threat to the preservation of the vegetation of the proposed IPA.

The important plant area Eskildi Adai (N 44°00'332"; E 052°42'590", elevation 135–164 m above sea level). The IPA is located on the foothill plain of the southwestern slope of the Mountainous Eastern Karatau ridge. The relief is rocky and heavily dissected. The water regime is automorphic, characterized by atmospheric moisture. The gently undulating foothill plain is characterized by the spread of gray-brown desert soils.

The proposed IPA Eskildi is botanically interesting as an example of a foothill plain with complex vegetation cover. The floristic diversity of the proposed site is demonstrated by a list of 47 species of vascular plants. There is also a species listed in the catalog of rare and endangered plant species of Mangystau — *Rhamnus sintenesii*, which meets criterion A*(iii)*. Criterion *B* — the high floristic diversity of IPA is demonstrated by 42 plant species. Criterion *C* — threats to the habitat of plants in the proposed Eskildi IPA include grazing, plant collection, and steppe fires.

Overall, the condition of the vegetation cover is satisfactory. The remoteness from populated areas ensures the preservation of the flora. It is recommended that this area be given the status of a specially protected area as a botanical reserve.

The important plants area Shili Gorge (N 44°28'40"; E 052°38'450", altitude — 212 m above sea level). The site is located in the Kus Konbas area of Eastern Karatau. There is a mineral water spring within the site. The site is characterized by specific conditions that allow for a unique combination of communities from different ecological and geographical groups (desert and mountain-desert) in the local area. The value of the site also lies in the presence of the Red Book species *Rhamnus sintenesii*, which meets criterion *A(iii).* Criterion C — The originality of the site lies in its fairly diverse species composition. The proposed IPA may be subject to anthropogenic influences associated with mineral extraction and intensive grazing of domestic livestock.

The important plant area Kasqyr Sai (N 44°02'325"; E 052°37'291", elevation — 258 m above sea level). The area is occupied by rocky lowlands with short, rugged foothill valleys of dry ravines covered with stones and scree. The soils of plant communities are rocky. The vegetation consists mainly of petrophytic communities, reflecting various stages of overgrowth of rocky mountain rocks in the process of their weathering.

The botanical value of the site lies in its significant species diversity — 53 species — and the presence of the rare species *Rhamnus sintenesii* and *Verbascum blattaria*, which are listed in the catalog of rare and endangered plant species of Mangystau [14]. Criterion A *(iii)* — rare species: *Rhamnus sintenesii* and *Verbascum blattaria.* Criterion B — Great diversity of habitats and floristic richness. Criterion C — Groups of petrophytes on rocks and scree slopes are rare in the desert zone as a whole.

Overall, the condition of existing plant communities, rare species, and their habitats can be assessed as stable, with livestock grazing posing a threat.

The important plant area Kaskyr sai 2 (N 44°02'378"; E 052°36'101", elevation — 229 m above sea level). The site has a fragmented relief, with large rocky cliffs on all sides, stretching for about 1.2 km with a width of 30–60 m. The entrance to the gorge is not wide, 25–30 m, and narrows even more towards the bottom to 15–20 m. The communities proposed for designation occupy the rocky and stony slopes, the lower part and the bottom of the gorge. The substrate is stony, gray-brown and clayey at the foot.

The site represents typical mountain desert vegetation characteristic of the middle and lower parts of the gorges of the Eastern Karatau Mountains. The vegetation cover is slightly disturbed, and the floristic

diversity of the communities is fairly well represented. Criterion *A (iii)* — the presence of rare species listed in the Red Book of Kazakhstan: *Rubus caesius, Rhamnus sintenesii*, included in the catalog of rare and endangered plant species of Mangistau. Criterion B — high overall species diversity of plants (43 taxa) characteristic of mountainous desert areas represented in this key area. The condition of the vegetation cover in the area described is good but unstable.

The important plant area Bakshy (N 44°03'229"; E 051°30'064", elevation — 290 m above sea level) is located at the entrance to the gorge. It features a private garden, an artificial apricot plantation, and a reservoir. The gorge has a dissected relief, with large rocky slopes on all sides, stretching for about 3 km with a width of 40–80 m. The entrance to the gorge is wide, but after 25 m it narrows to 20 m. The communities proposed for designation occupy the slopes, lower part, and bottom of the gorge. The substrate is large and rocky, with gray-brown soil.

Criterion A (iii) — presence of Red Book species — *Crambe edentula*, *Rhamnus sintenisii* (Fig. 2), *Armeniaca vulgaris, Artemisia gurganica, Rubus caesius, Teucrium polium*. Criterion *B* is high floristic diversity of IPA, including 58 species of higher plants. Criterion C — the habitat is occupied by slightly disturbed communities of low-mountain vegetation.

A B

Figure 2. Teucrium polium (A) and Rhamnus sintenesii (B)

The status of rare species is stable. They are threatened by recreational pressure, mudslides, and livestock grazing. The degree of transformation is estimated at 20–25 %. The area needs restrictions on livestock grazing.

The important plant area Agashty (N 44°03'318"; E 051°30'416", altitude — 288 m above sea level). The site is rocky and stony, with steep, rocky slopes on all sides, stretching for about 1.2 km and 20–40 m wide. The entrance to the gorge is not wide, 25–30 m, and narrows even more towards the bottom to 15–20 m. The communities proposed for designation occupy the rocky and stony slopes, the lower part and the bottom of the gorge. The substrate is stony, gray-brown and clayey at the foot.

The site represents typical mountain desert vegetation characteristic of the middle and lower parts of the gorges of the Eastern Karatau Mountains. The vegetation cover is slightly disturbed, and the floristic diversity of the communities is fairly well represented, including 80 species of vascular plants. Criterion *A (iii)* is represented by species listed in the Red Book of Kazakhstan and the catalog of rare and endangered plant species of the Mangystau region: *Armeniaca vulgaris, Verbascum blattaria, Salix alba, Rubus caesius, Rhamnus sintenesii, Crambe edentula, Tulipa sogdiana*, and *Onosma staminea* (Fig. 3). Criterion B is the overall high species diversity of plants, characteristic of mountain desert areas, represented in this IPA. The area is subject to anthropogenic impact and livestock grazing.

A B

Figure 3. Rubus caesius (A) and Tulipa sogdiana (B)

Conclusion

Thus, as a result of studies of the flora of the Mountainous Eastern Karatau of the Mangystau region, eight IPAs were identified that meet the international criteria for IPA: Kurkeruek; Kirezhyk zheke; Eskildi adai; Shili Gorge; Kaskyr Say; Kaskyr Say 2; Bakshy and Agashty. The communities were described and the species composition of the communities in these areas was determined.

The locations of 10 species with IUCN status 2(U), 3(R), 4(I) have been identified: *Armeniaca vulgaris, Capparis herbaceae, Crambe edentula, Ephedra aurantiaca, Tulipa sogdiana, Onosma staminea, Rhamnus sintenisii, Rubus caesius, Verbascum blattaria*. A passport has been created for each key botanical territory, factors threatening the condition of vegetation have been identified, and proposals for biodiversity conservation have been made.

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Conflict of Interest

Authors declare no conflict of interest.

Author contribution

The manuscript was written through contributions from all authors. All authors have given approval to the final version of the manuscript. **Adamzhanova Zhanna** — mapping of IPA, investigation, visualization, manuscript writing; **Mukhtubaeva Saule** — investigation, methodology; **Duisenova Nurzaugan** — identification of criteria according to IPA; **Lukmanov Akimzhan** — compilation of a list of vascular plant species.

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Ж. Адамжанова, С. Мухтубаева, Н. Дуйсенова, А. Лукманов

Таулы Шығыс Қаратаудың (Маңғыстау) негізгі ботаникалық аумақтарын бөлу

Биологиялық алуантүрлілікті сақтау үшін ерекше маңызы бар аумақтарды (сирек өсімдіктер кездесетін негізгі ботаникалық аумақтарды қоса алғанда) анықтау — биологиялық алуантүрлілік жөніндегі конвенция шеңберінде жүзеге асырылатын халықаралық бағдарламалардың бірі. Зерттеудің мақсаты — Шығыс Қаратау таулы өңірінің негізгі ботаникалық аумақтарын айқындау. Зерттеу экспедициялары маршруттық рекогносцирлеу әдісімен жүргізіліп, алуан түрлі биотоптар (ландшафтық-экологиялық жағдайлар) мен оларға тән фитоценоздарды қамтыды. Негізгі ботаникалық аумақтардың өсімдік жамылғысын зерттеу дәстүрлі геоботаникалық әдістермен жүргізілді, оған өсімдік қауымдастықтарын сипаттау, түр алуандығымен өсімдіктердің жағдайына баға беру кірді. Маңғыстау облысының флорасы түрлік алуандықтың төмендігімен ерекшеленеді, ал оның өсімдік жамылғысы шөлді аймақтарға тән. А-С критерийлерін қолдана отырып, Құркеруек, Кірежік Жеке, Ескілді Адай, Шілі, Қасқырсай, Қасқырсай 2, Бақшы және Ағашты сияқты 8 негізгі ботаникалық аумақ анықталды. МСОП бойынша мәртебесі бар 10 түрдің мекендері тіркелді, олар: *Armeniaca vulgaris, Tulipa sogdiana, Capparis herbaceae, Crambe edentula, Ephedra aurantiaca, Onosma staminea, Rhamnus sintenisii, Rubus caesius, Verbascum blattaria, Crataegus ambigua*. Әрбір негізгі ботаникалық аумаққа паспорт жасалды, өсімдік жамылғысына қауіп төндіретін факторлар айқындалды және биоалуантүрлілікті сақтау бойынша ұсыныстар берілді.

Кілт сөздер: флора, Шығыс Қаратау таулы өңірі, сирек, жойылып бара жатқан түрлер, эндемиктер, Қазақстанның Қызыл кітабы, негізгі ботаникалық аумақтар

Ж. Адамжанова, С.К. Мухтубаева, Н. Дуйсенова, А. Лукманов

Выделение ключевых ботанических территорий Горного Восточного Каратау (Мангистау)

Выявление территорий, имеющих особое значение для сохранения биологического разнообразия (включая ключевые ботанические территории с редкими растениями), является одной из международных программ, реализуемых в рамках Конвенции о биологическом разнообразии. Целью настоящего исследования являлось выделение ключевых ботанических территорий Горного Восточного Каратау. Экспедиционные исследования объектов производились традиционным методом маршрутной рекогносцировки с охватом наиболее разнообразных биотопов (ландшафтно-экологических условий) и свойственных им фитоценозов. Изучение растительного покрова ключевых ботанических территорий осуществлялось традиционным методом геоботанических исследований, включающим описание рас-

тительных сообществ, а также оценку видового разнообразия и состояния растительности. Флора Мангистауской области отличается невысоким уровнем видового разнообразия, растительный покров этого региона типичен для пустынных регионов. При использовании критериев А-С было выделено 8 ключевых ботанических территорий: Куркеруек, Кірежік Жеке, Ескілді Адай, Шилі, Каскырсай, Каскырсай 2, Бакшы и Ағашты. Выявлены местонахождения 10 видов, имеющих статус по МСОП 2(U), 3(R), 4(I): *Armeniaca vulgaris, Tullipa sogdiana, Capparis herbaceae, Crambe edentula, Ephedra aurantiaca, Onosma staminea, Rhamnus sintenisii, Rubus caesius, Verbascum blattaria, Crataegus ambigua*. Для каждой ключевой ботанической территории составлен паспорт, определены факторы, угрожающие состоянию растительности, и сформулированы предложения по сохранению биоразнообразия.

Ключевые слова: флора, горный Восточный Каратау, редкие, исчезающие виды, эндемики, Красная книга Казахстана, ключевые ботанические территории

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Information about the authors

Adamzhanova Zhanna — Candidate of Biological Sciences, Mangyshlak Experimental Botanical Garden, Aktau, Kazakhstan; e-mail: adamzhanovazanna@gmail.com, https://orcid.org/000-00002-6719-327X

Mukhtubaeva Saule Kakimzhanovna — Candidate of Biological Sciences, Associated Professor, Leading Researcher, Mangyshlak Experimental Botanical Garden, Aktau, Kazakhstan; e-mail: mukhtubaeva@mail.ru; https://orcid.org/0000-0001-5921-3113

Duisenova Nurzhaugan — Candidate of Biological Sciences, Head of Laboratory of Mangyshlak Experimental Botanical Garden, Aktau, Kazakhstan; e-mail: nurzhaugan_84@mail.ru; https://orcid.org/0009-0004-3459-4246

Lukmanov Akimzhan — Master of Environmental Technology, Researcher, Mangyshlak Experimental Botanical Garden, Aktau, Kazakhstan; e-mail: lukmanov_a@mail.ru; https://orcid.org/0009-0006-6061-5156