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Weed species in plant communities as indicators of degradation of vegetation cover and fertile soil layer in desert regions

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Abstract. *Osmonali B, Tokbergenova A, Taukebayev O, Zulpykharov K, Salmurzauly R, Smanov Z, Ussen S. 2024. Weed species in plant communities as indicators of degradation of vegetation cover and fertile soil layer in desert regions. Biodiversitas 25: 4930-4938.* The geographical position of Kazakhstan on the continent of Eurasia determines its special role in solving problems of conservation of biodiversity of natural biological and land resources. One of the numerous factors of anthropogenic desertification is overgrazing. Under long-term unsystematic grazing, fodder lands of sandy massifs are more exposed to various types of soil deflation and vegetation changes. In desert regions, weeds can be an important indicator of degradation of vegetation cover and fertile soil layer. Some weed species may indicate soil moisture deficiency, salt degradation or lack of fertile substances. The purpose of our work is to identify soil changes, depending on the dominance of weed species and the degree of disturbance. On the example of the following weed species: *Peganum harmala, Pseudosophora alopecuroides, Alhagi pseudalhagi, Suaeda linifolia, Karelinia caspia. Suaeda linifolia* and *K. caspia* are indicator plants of salinisation by toxic salts. The study of weed species in desert regions can help to determine the level of degradation of soil and vegetation cover and to develop measures for their restoration and improvement. The study of weed species in plant communities of desert regions can help to determine the degree of degradation of vegetation cover and fertile soil layer, as well as to develop measures for their restoration and protection. *Peganum harmala* and *A. pseudalhagi* are indicators of overgrazing and degradation of vegetation cover. *Pseudosophora alopecuroides*, also known as indicator shrub, is a plant species that is often used as an indicator of land cover degradation. This species typically grows on soils with low nutrient content and can tolerate dry and unfavourable conditions. Thus, observing the presence of *P. alopecuroides* in a particular area can be a useful indicator to determine the level of vegetation degradation and the need for measures to restore and protect soil and vegetation.

Keywords: Aboriginal plants, arid areas, pasqual plants, phytocenoses, segetal flora, soil

Abbreviations: S-C: Species-Community, TPC: Total Projective Cover

INTRODUCTION

The geographical position of Kazakhstan on the continent of Eurasia determines its special role in solving the problems of conservation of biodiversity, conservation of natural biological and land resources. The lack of a targeted environmental policy in nature management, extensive resource-intensive economic activity in the second half of the XX century led to the degradation of natural ecosystems on a large territory and the development of global negative processes, one of which is desertification (Duan et al. 2022; Amirov et al. 2023; Smanov et al. 2023; Rakhmanov et al. 2024).

Due to global climate warming, it is extremely necessary to study the transformations of natural ecosystems and their components in the territory transitional to the desert zone proper in order to develop preventive measures to prevent desertification processes (Beketova and Starikova 2016; Baranova et al. 2018; Mysnik et al. 2018; Luneva 2020, 2021). In Kazakhstan, this is especially true for the subzones of dry and deserted steppes. Inclusions of desert elements in the structure of natural steppe biogeocenoses, plant and animal communities, their relative number and place in biogeocenotic links, indicate trends of natural changes towards natural desertification (Vesselova 2013, 2017). Drought, especially prolonged drought, increases the areas of 'deserted' inclusions, changing the structure of ecosystems. With sustained climate warming, the character of such changes increases (Yu 2020). Desert elements first penetrate and expand their representation in indigenous (native) communities, and then suppress or displace fewer stable elements (Ma et al. 2019; Luneva 2021; Vesselova et al. 2022; Laiskhanov et al. 2023).

One of the numerous factors of anthropogenic desertification is overgrazing. With long-term unsystematic grazing, fodder lands of sandy massifs are more exposed to various types of soil deflation and vegetation changes. Intensive grazing only during 3-4 years leads to changes in the structure, productivity of vegetation cover and irreversible replacement of dominants of vegetation cover (*Artemisia arenaria* DC., *A. scoparia* Waldst. & Kit., *A. leucodes* Schrenk, *Ceratocarpus utriculosus* Bluket ex Krylov, *Leymus racemosus* (Lam.) Tzvelev) by other weed species. Complete absence of grazing also deteriorates the quality of pasture, reducing the reserves of fodder mass (Luneva 2021).

The coincidence of unfavourable impacts: natural and anthropogenic (their summation) causing acceleration of rates and expansion of areas of development of desertification processes is characteristic and causes special concern for Kazakhstan. Currently, desertification processes occur in all administrative regions of Kazakhstan, and there is a tendency to their acceleration (Luneva 2021; Kusmangazinov et al. 2023; Sumbembayev et al. 2023; Orazov et al. 2024).

The consequences of desertification are reduction of pastures' fodder capacity, complete or partial loss of their resource role, deterioration of fodder nutrition, clogging with non-edible or unproductive, and often poisonous species, reduction of floristic and phytocenotic diversity, as well as of stable (indigenous) types of pastures, change of perennial dominants to annual ones, formation of wastelands unsuitable for grazing, etc. Due to overgrazing, overuse of pastures, the vegetation cover changes for the worse. Weed species that are poorly or not eaten appear (Sengl et al. 2016, 2017; Erdős et al. 2017; Kigomo et al. 2018; Zinnen et al. 2021). Studying weed species in desert regions can help determine the level of soil and vegetation degradation and develop measures for their restoration and improvement (Walz and Stein 2014; Nuri et al. 2016; Sengl et al. 2016, 2017; Yorkina et al. 2020).

The study of weed species in plant communities of desert regions can help to determine the degree of degradation of vegetation cover and fertile soil layer, as well as to develop measures for their restoration and protection (Pueyo et al. 2006; Lech-hab et al. 2015). It should be noted that the basis for this study were the works of Vesselova P.V. and the species that were selected for the study are related to the works of this author (Vesselova 2017, et al. 2022; Kubentayev et al. 2021, et al. 2024). The purpose of our work is to identify soil changes, depending on the dominance of weed species and the degree of disturbance.

MATERIALS AND METHODS

The objects of the study are plant communities (communities) located in disturbed and slightly disturbed areas with participation and dominance of weedy species of desert flora (Republic of Kazakhstan). With the help of QGIS programme, a map of points of the studied samples was made (Figure 1). Data on the study points are presented in Table 1.

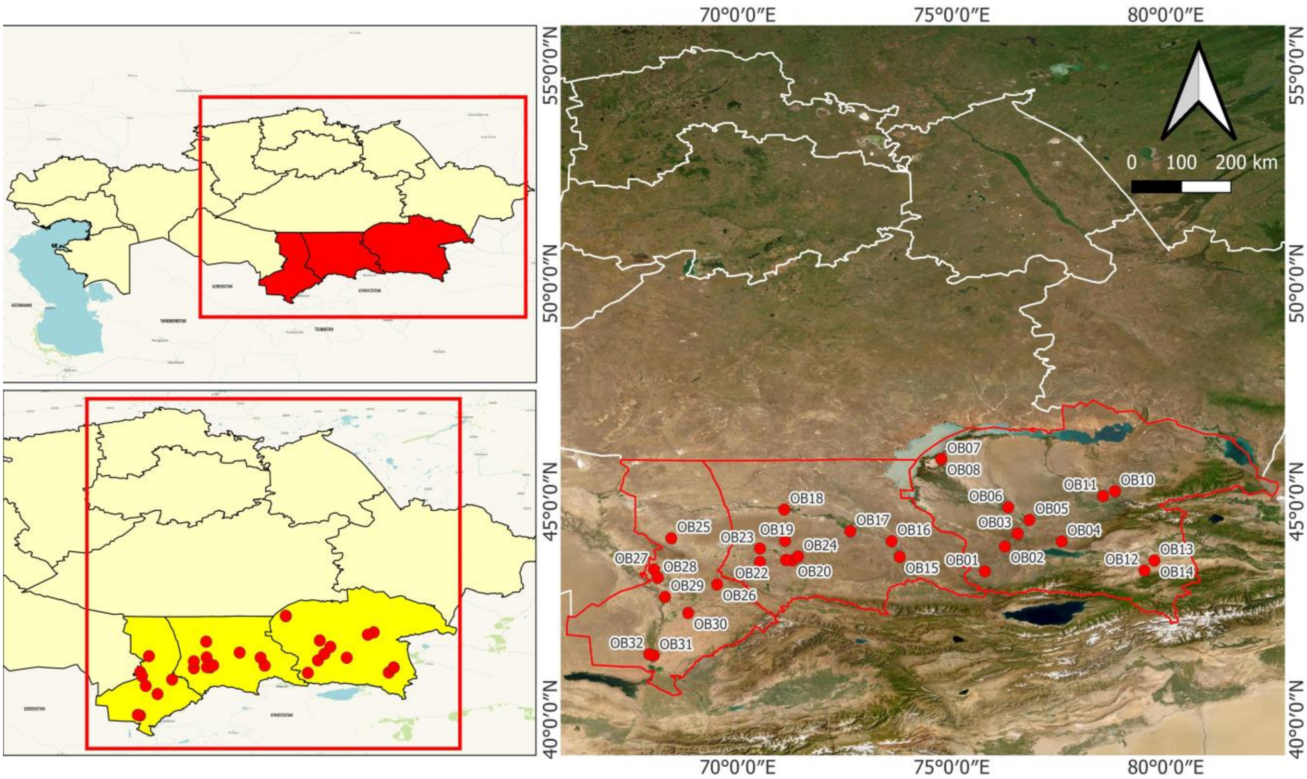

Figure 1. Map of soil sampling points and described plant communities in Southern and South-Eastern Kazakhstan (2022-2023)

Table 1. Points of described communities and soil sampling in Southern and South-Eastern Kazakhstan

Selection No.	Communities	TPC, %	Degree of disturbance of vegetation cover	Dominant and predominant species in vegetation composition	Coordinates
OB01	*Atripletum*	80	Weak	*Atriplex verrucifera, Halostachys belangeriana, Climacoptera obtusifolia, Petrosimonia sibirica*	43.398832 N 75.773175 E
OB02	*Peganetum*	40	Severe	*Peganum harmala, Erysimum* sp., *Alyssum desertorum, Festuca valesiaca, Agropyron fragile, Ceratocarpus utriculosus, Poa bulbosa*	43.967477 N 76.240037 E
OB03	Ceratocarpusetum	30	Medium	*Ceratocarpus utriculosus, Poa bulbosa, Bassia prostrata, Alyssum desertorum, Lappula squarrosa, Artemisia terrae-albae, Haplophyllum perforatum, Calligonum leucocladum*	44.262402 N 76.538307 E
OB04	Ceratocarpusetum	60	Medium	*Ceratocarpus utriculosus, Haplophyllum perforatum, Poa bulbosa, Alyssum desertorum, Festuca valesiaca, Agropyron fragile*	44.084082 N 77.566385 E
OB05	*Petrosimonetum*	30	Medium	*Petrosimonia sibirica, Suaeda linifolia, Karelinia caspia, Pseudosophora alopecuroides, Limonium otolepis*	44.577755 N 76.811277 E
OB06	*Artemisietum*	40	Medium	*Artemisia terrae-albae, Lactuca tatarica, Petrosimonia sibirica, Tamarix laxa, Nitraria schoberi*	44.866157 N 76.320763 E
OB07	*Climacoptosum-Haloxylonetum*	40	Weak	*Climacoptera obtusifolia, Climacoptera longistylosa, Anabasis aphylla, Pyankovia brachiata, Haloxylon aphyllum*	45.969507 N 74.756193 E
OB08	*Phragmitetum*	65	Weak	*Karelinia caspia, Phragmites australis, Limonium otolepis, Oxybasis glauca, Krascheninnikovia ceratoides*	45.981277 N 74.755608 E
OB09	*Phragmitetum*	35	Weak	*Artemisia terrae-albae, Krascheninnikovia ceratoides, Tamarix laxa, Halimocnemis sclerosperma*	45.981167 N 74.756167 E
OB10	*Artemisietum*	60	Weak	*Artemisia terrae-albae, Ceratocarpus utriculosus, Pseudosophora alopecuroides, Festuca valesiaca, Agropyron fragile, Poa bulbosa*	45.235123 N 78.811758 E
OB11	*Artemisietum*	70	Weak	*Artemisia terrae-albae, Ceratocarpus utriculosus, Hordeum geniculatum, Festuca valesiaca, Agropyron fragile, Poa bulbosa*	45.128078 N 78.536203 E
OB12	*Artemisietum*	20	Severe	*Artemisia terrae-albae, Ceratocarpus utriculosus, Hordeum geniculatum, Festuca valesiaca, Agropyron fragile, Poa bulbosa*	43.415668 N 79.503313 E
OB13	*Aeluropetum*	70	Medium	*Aeluropus littoralis, Neotrinia splendens, Limonium otolepis, Petrosimonia sibirica, Plantago lanceolate, Glycyrrhiza glabra, Pseudosophora alopecuroides, Elaeagnus oxycarpa, Tamarix laxa, Suaeda linifolia, Inula britannica*	43.644142 N 79.732547 E
OB14	*Aeluropetum*	60	Medium	*Neotrinia splendens, Aeluropus littoralis, Suaeda linifolia, Limonium otolepis, Petrosimonia sibirica, Kalidium foliatum, Halocnemum strobilaceum, Phragmites australis, Convolvulus arvensis, Potentilla soongorica, Epilobium hirsutum*	43.644242 N 79.732747 E
OB15	*Alhagietum*	20	Severe	*Elaeagnus oxycarpa, Tamarix laxa, Aeluropus littoralis, Phragmites australis, Alhagi pseudalhagi, Carex physodes*	43.730000 N 73.783333 E
OB16	*Alhagiosum-Petrosimonietum*	30	Medium	*Krascheninnikovia ceratoides, Petrosimonia sibirica, Alhagi pseudalhagi, Salsola orientalis, Pseudosophora alopecuroides*	44.089444 N 73.595833 E
OB17	*Phragmitetum*	60	Weak	*Populus diversifolia, Elaeagnus oxycarpa, Tamarix laxa, Halimodendron halodendron, Phragmites australis, Artemisia* sp., *Setaria viridis*	44.318056 N 72.630000 E
OB18	*Halocnemetum*	25	Weak	*Halocnemum strobilaceum, Climacoptera longistylosa, Climacoptera obtusifolia, Salsola orientalis, Suaeda linifolia, Ephedra* sp., *Tamarix laxa, Phragmites australis*	44.814167 N 71.087222 E
OB19	*Krascheninnikovietum*	15	Weak	*Krascheninnikovia ceratoides, Salsola arbuscula, Ceratocarpus utriculosus, Echinops ruthenicus, Setaria viridis, Poa bulbosa*	44.10000 N 71.106667 E
OB20	*Elaeagnetum*	70	Medium	*Elaeagnus oxycarpa, Alhagi pseudalhagi, Karelinia caspia, Artemisia pauciflora, Pseudosophora alopecuroides*	43.646944 N 71.271944 E
OB21	*Alhagetum*	40	Medium	*Elaeagnus oxycarpa, Aeluropus littoralis, Tamarix laxa, Alhagi pseudalhagi, Limonium gmelini, Setaria viridis, Poa bulbosa, Bromopsis inermis*	43.657778 N 71.126389 E
OB22	*Poaetum*	50	Medium	*Krascheninnikovia ceratoides, Poa bulbosa, Bromopsis inermis, Meniocus linifolius, Alyssum desertorum, Eremopyrum triticeum*	43.609167 N 70.519722 E
OB23	*Elaeagnetum*	40	Medium	*Elaeagnus oxycarpa, Halimodendron halodendron, Poa bulbosa, Aeluropus littoralis, Bromopsis inermis, Meniocus*	43.922222 N 70.519722 E

OB24	Divergent grass	30	Medium	*linifolius, Alyssum desertorum, Eremopyrum triticeum, Phragmites australis, Pseudosophora alopecuroides, Poa bulbosa, Aeluropus littoralis, Bromopsis inermis, Eremopyrum triticeum, Echinops* sp., *Artemisia pauciflora, Ceratocarpus utriculosus, Alhagi pseudalhagi*	43.739167 N 71.410556 E
OB25	*Peganetum*	3-5	Severe	*Peganum harmala, Artemisia* sp., *Carex physodes, Cousinia* sp., *Ceratocarpus utriculosus*	44.156667 N 68.448611 E
OB26	*Pseudosophoretum*	50	Severe	*Setaria viridis, Pseudosophora alopecuroides, Centaurea arenaria, Aeluropus littoralis, Bromopsis inermis, Artemisia pauciflora*	43.098889 N 69.517778 E
OB27	*Pseudosophorosum-Artemisietum*	20	Severe	*Pseudosophora alopecuroides, Artemisia pauciflora, Aeluropus littoralis, Carex physodes*	43.440556 N 68.044167 E
OB28	*Atripletum*	45	Weak	*Atriplex verrucifera, Alhagi pseudalhagi, Aeluropus littoralis, Tamarix laxa*	43.249444 N 68.132500 E
OB29	*Alhagetum*	15	Severe	*Climacoptera obtusifolia, Aeluropus littoralis, Alhagi pseudalhagi, Tamarix laxa*	42.811111 N 68.300278 E
OB30	*Alhagetum*	40	Severe	*Alhagi pseudalhagi, Tamarix laxa, Zygophyllum fabago, Phragmites australis, Peganum harmala, Artemisia pauciflora, Aeluropus littoralis, Poa bulbosa*	42.441389 N 68.843056 E
OB31	*Alhagosum-Petrosimonietum*	60	Medium	*Climacoptera obtusifolia, Alhagi pseudalhagi, Petrosimonia sibirica, Aeluropus littoralis, Suaeda linifolia, Limonium otolepis, Karelinia caspia*	41.466944 N 68.038333 E
OB32	*Ammodendretum*	10	Weak	*Ammodendron bifolium, Calligonum aphyllum, Alhagi pseudalhagi, Carex physodes*	41.495278 N 67.933889 E

Classical botanical (route-reconnaissance; ecological-systematic; ecological-geographical) methods were used in the research process. For identification of the collected material, we used fundamental summaries: ‘Flora of Kazakhstan’ (1956-1966), ‘Illustrated Identifier of Plants of Kazakhstan’ (1968, 1970), ‘Conspectus Florae Asiae Mediae’ (1968-2015). The names of plant species were given in accordance with the POWO database. Vegetation was studied using field geobotanical research methods (Vesselova 2017, et al. 2022; Osmonali and Urazalina 2024).

Description of communities and collection of material for soil analyses was carried out during expedition studies in 2023. As instructional and methodological documents were used: Instruction on conducting large-scale soil surveys of lands of the Republic of Kazakhstan; Systematic list and main diagnostic indicators of soils of the plain territory of the Republic of Kazakhstan (Vesselova 2017, et al. 2022; Duan et al. 2022; Osmonali et al. 2023; Osmonali and Urazalina 2024).

A general route survey of the study territory was carried out to identify the distribution patterns of soils and soil-forming rocks and their relationship with vegetation. The route survey of the territory included clarification of landscape, geomorphological, hydrogeological conditions determining the impact on soils (Ma et al. 2019; Duan et al. 2022; Mukhamediev et al. 2023).

Reconnaissance survey allowed to visually establish the initial condition of soils, the nature of their use, potentially possible degradation factors, to outline the locations of soil transects. The transects were laid out in the field period taking into account the character of relief (meso and microrelief) and vegetation, type and degree of degradation (disturbance). Special attention was paid to the most common types of degradation in the study area: secondary salinisation, erosion, pasture digression, overconsolidation of soils (Laiskhanov et al. 2023; Osmonali et al. 2024).

The morphological properties of the soil profile were described in the section, soil samples were taken for chemical analyses. Field genetic name of soil was determined based on morphological description. Soil sampling was performed in accordance with the requirements of GOST 17.4.3.01-2017, Nature Protection. Soils. General requirements for sampling GOST 17.4.4.02-2017 Soils (Duan et al. 2022; Orazov et al. 2022; Kulymbet et al. 2023; Laiskhanov et al. 2023).

As a result of expedition works, 32 communities with different degrees of disturbance were described, and soil samples were taken at the same points. The number of soil samples taken was 88. Samples were taken according to the number of horizons to a depth of 50 cm. The following data were revealed from the collected samples: humus, sum of salts, pH, sum of salts (C, SO4, Ca, Mg, Na, K) (Figure 2).

Chemical analyses were carried out in the Laboratory of Chemical Analyses of "Kazakh Research Institute of Soil Science and Agrochemistry named after U.U. Uspanov" LLP in Almaty. Kazakh Research Institute of Soil Science and Agrochemistry LLP in Almaty City, which have licences to carry out these types of analyses (Zhuchkova 1977; Zhuchkova and Rakovskaya 1997). For interpretation and visual convenience, all obtained results of chemical analyses were processed using OriginPro 2024 software (OriginLab, Northampton, Massachusetts, USA).

RESULTS AND DISCUSSION

The result showed that the highest amount was obtained at the following points: OB14, OB15, OB26, OB28, OB29 (3.56-4.63%). And the lowest percentage of humus amount in soil was found in the following points: OB02, OB03, OB04, OB5, OB07, OB8, OB9, OB16, OB17, OB19, OB21, OB22, OB23, OB30 (0.18-1.26%). Based on the results of pH analysis, the following points revealed more average and are considered the lowest pH: OB01, OB02, OB11, OB15, OB20, OB23, OB25, OB26, OB27, OB28, OB29, OB31 (8.33-8.85 pH). It should be noted that a figure of pH = 7.0 is neutral. Figures less than 7.0 (6.0 to 0) indicate an acidic solution. If the pH is above 7.0 (7.1 to 14.0), it means that the solution is alkaline. This means that all of our selected points are alkaline, as the pH of all points is above 8.0. Chemical analysis for salt quantities for the following points revealed the highest percentages: OB05, OB06, OB13, OB18, OB23, OB24, OB28, OB31, OB32 (1,1-10,4%). The rest of the points had a low score of 0.028-0.218% (Figure 2).

According to the obtained soil survey data, preferences of 5 weedy species to different environmental conditions in natural habitat, with different degrees of projective cover and vegetation disturbance were analysed. Considering the data on the first species *Suaeda linifolia* Pall., it can be seen that the total projective coverage of the selections ranges from 30% to 70%, here it is interesting that in low percentages of humus as 0.89% and 1.96% projective TPC is 25-30%. And when TPC is 60% and more the amount of humus is more than 2%, which is enough in desert conditions. But regarding the pH or salt amount data, it is very difficult to interpret the data, pH is from 8.66 to 9.77 and salt amount in percentage is from 0.101% to 5.779% in soil (Figure 3). Regarding the weed species *Karelinia caspia* (Pall.) Less., it is very difficult to judge from the soil analysis data as clear presence in disturbed areas was recorded in only 3 locations. According to TPC from 30-65%, pH from 8.66 to 9.36, sum of salts between 0.116-5.249%. A well analysed species from soil data, and frequently found in desert regions *Pseudosophora alopecuroides* (L.) Sweet. TPC from 20-70%, percentage of humus in soil 0.85-3.56%, pH from 8.37 to 9.33, salt sum is relatively low compared to other species, as this species prefers non-saline areas, salt sum from 0.077% to 3.5%. *Alhagi pseudalhagi* (M.Bieb.) Desv. ex Wangerin is another species often found in desert areas of Kazakhstan. TPC from 10-70%, humus 0,85%-4,63%, pH 8,45-9,36, concerning the sum of salts in most cases the percentage is not big but still there are populations where the big number of salts is fixed, the sum of salts from 0,42% to 5,249%. Next, we will consider *Peganum harmala* L., it is not frequently met species, but its presence says that this territory is strongly disturbed. TPC 5-40%, humus 0.74-2.68%, pH 8.71-9.08, total salts 0.074%-1.994% (Figure 3).

Disturbance is considered on three scales - weakly, moderately, and severely disturbed plant communities. Weakly disturbed plant communities are characterised by insignificant changes in the structure and composition of the plant community, which do not seriously affect its functioning. Moderately disturbed plant communities have more pronounced changes that may lead to a decrease in biodiversity and ecosystem stability. Severely disturbed plant communities are characterised by serious changes in the structure and composition of the plant community, which may lead to the extinction of some plant species and disturbance of the ecological balance. Determining the degree of disturbance of plant communities allows us to assess the state of the ecosystem and develop measures for its restoration (Figure 4).

When plant communities are disturbed, the composition and structure of the vegetation cover is altered, which can lead to a decrease in biodiversity and ecosystem resilience. Total projective cover describes the proportion of area occupied by plants in a particular area. When plant communities are disturbed, total projective cover may decrease due to anthropogenic impacts such as deforestation, soil, and water pollution, changing climatic conditions and other factors. The study of total projective cover helps scientists and ecologists to assess the state of vegetation cover and its changes under the influence of various factors. Thus, the concept of total projective cover is related to the disturbance of plant communities and allows monitoring and assessment of the state of ecosystems.

Discussion

It has been established that spatial expression of desertification processes of fodder lands is different in various desert subzones. In northern deserts (predominantly semi-shrubby, wormwood deserts), there is focal (local) overgrazing around wintering grounds, barns, wells, and focal-linear overgrazing along the routes of cattle drives. In the middle and southern regions, in addition to overgrazing, pastures are subject to significant anthropogenic impact (especially in the west of the republic). Furthermore, the process is aggravated by unsystematic road network, as well as river regulation, cutting of saxaul, etc. Sandy desert pastures are particularly affected by irregular use, for example: sandy honeysuckle-hemlock lands are transformed into annual-grass-hemlock lands, which is accompanied by a reduction in the seasons of their use, productivity, and fodder nutrition, as well as deflation and formation of barchans (Lech-hab et al. 2015). At moderate degradation the vegetation cover is represented by long-term derived, more or less stable communities. Severe degradation of vegetation cover is the spread of short-term derived, unstable communities, in the composition of which weed, and non-edible species are found in great abundance.

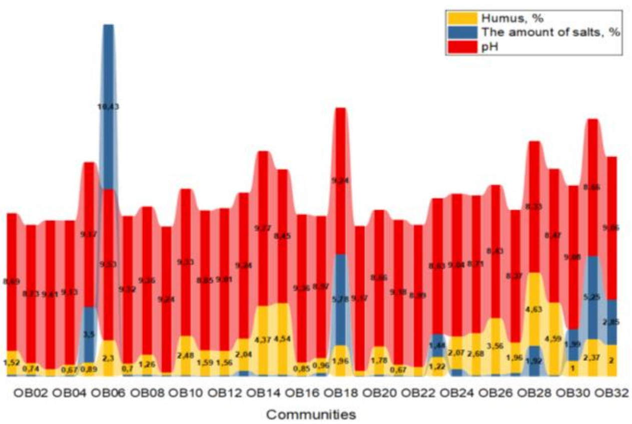

Figure 2. Results of chemical analyses of soil samples

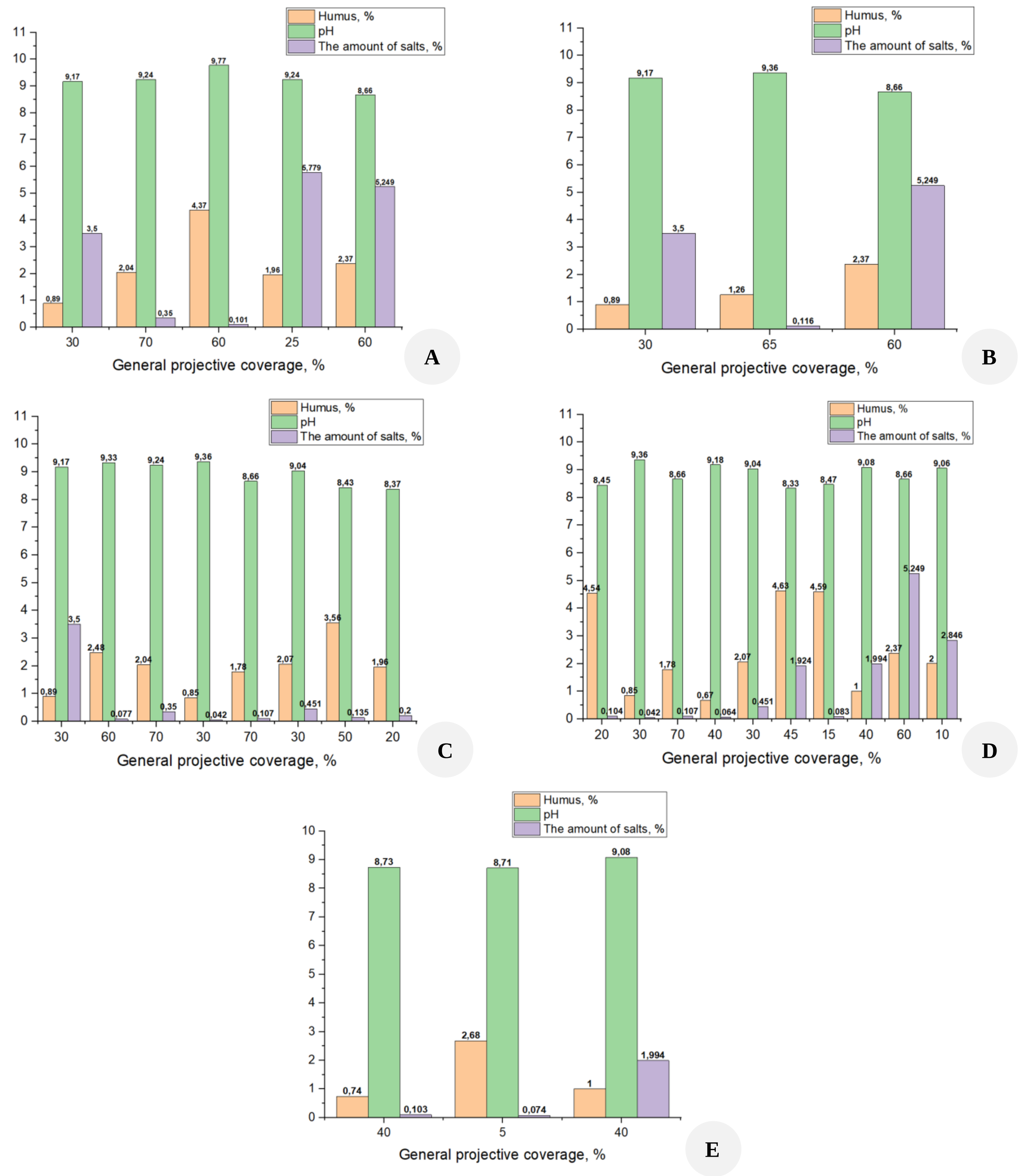

Figure 3. Results of chemical analyses in relation to the species under study. A. *Suaeda linifolia*; B. *Karelinia caspia*; C. *Pseudosophora alopecuroides*; D. *Alhagi pseudalhagi*; E. *Peganum harmala*

At very strong degradation irreversible changes are observed, indigenous communities are completely replaced by annual, weedy species. Thus, the factors of anthropogenic impact cause different degrees of transformation of vegetation cover and their desertification. In psammophytic vegetation, the manifestation of severe and very severe desertification is low, although sandy pastures are intensively used (Pueyo et al. 2006; Vesselova 2017; Kigomo et al. 2018). The main activities for pasture and hayland management at the national level should be the following: (i) Creation of a law on pastures and hayfields; (ii) Establishment of a unified information base including desertification monitoring, analyses, decision-making.

Suaeda linifolia is commonly found in coastal areas and salt marshes. This plant species is able to withstand high soil salinity and harsh environmental conditions. *Suaeda* *linifolia* plays an important role in strengthening the soil and protecting coastlines from erosion (Vesselova 2017, et al. 2022). It also serves as a food source for some animals and birds. *Suaeda linifolia*, also known as weed, is a weedy species of plant in the amaranth family. It typically grows in salt marshes, sandy soils, and other unharvested areas. This species can compete with cultivated plants for nutrients and moisture, so it is often considered a weed. It is reported to have good tolerance to sulphate-sodium salinity (SO4 3.052%-3.851%, Na 0.99%-1.739%) (Figures 3 and 4). In case these species are dominant in one or another environment where salinisation of natural origin is clearly visible, this community is indigenous to the study area.

Karelinia caspia, also known as a weedy species, is a plant that typically grows in saline areas such as salt marshes, salt marshes and salt marshes. This plant has the ability to tolerate high salinity of soil and water, which makes it adapted to live in such conditions. It has the ability to survive in extreme conditions such as high soil and air salinity, water shortage and high temperatures (Vesselova 2017, et al. 2022). *Karelinia caspia* has a strong root system that helps it extract water from deep layers of soil, and special mechanisms that allow it to cope with excess salt in its tissues. This species plays an important role in strengthening the soil and preventing erosion in desert and saline areas. *Karelinia caspia* usually has small leaves and discreet flowers, but its ability to survive in extreme conditions makes it a valuable species for reclaiming saline soils and water bodies. Its roots help hold soil and prevent erosion, making it useful for soil conservation. This weedy species can be both beneficial and detrimental, depending on the context of its growth. In some cases, it can help restore saline ecosystems, while in others it can compete with beneficial plants and impede their growth. It has been reported to have good tolerance to sulphate-sodium type salinity (SO_4 1.442%-3.052% and Na 0.721%-0.99%). It does not require a lot of humus in the soil for sprouting and the pH is quite high. We recorded that this species is found in slightly and moderately disturbed areas (Table 1; Figures 3 and 4).

Pseudosophora alopecuroides, also known as weedgrass, is a plant species that is often found in natural plant communities. This species typically grows in pastures, meadows, roadsides, and other open areas. It can spread rapidly and compete with other plants for resources, making it a weedy species in many ecosystems (Vesselova 2017, et al. 2022). Although *P. alopecuroides* may be useful to some animals as food, its excessive presence can cause problems for other plants and the ecosystem as a whole. Therefore, it is important to control its distribution and remove it when necessary to maintain balance in natural communities. According to our data, the studied species prefers non-saline habitat, but it can tolerate low salinity, but in this case, it is a companion species in the community (Table 1; Figures 3 and 4). The dominance of this species was recorded at two points OB26-OB27, where relative pH is less than 9 (8.37-8.43) and the sum of salts is not high (0.135%-0.2%). The dominance of this species indicates that overgrazing and deterioration of forage base is observed in this area (Table 1; Figures 3 and 4).

Alhagi pseudalhagi is a plant that is often found in desert regions. It is a weed that can spread rapidly and compete with other plants for water and nutrients. This type of plant can be a problem for agriculture and ecosystems because it can oppress plants that are important to animals and other species. In some cases, weedy *A. pseudalhagi* can be toxic to animals, making it even more harmful (Vesselova 2017, et al. 2022). This species is an invasive plant that can spread rapidly and displace native plant species. It can adapt to extreme dry desert conditions and can grow in salt soils. The weed *A. pseudalhagi* creates dense thickets that can inhibit the growth of other plants and degrade soil quality. Chemical and biological control methods are often used to control this weed species. According to the obtained data it has good tolerance to sulphate-sodium type of salinity (SO_4 1,419%-3,052% Na 0,689%-0,99%), but in most cases it dominates where the least saline soil. It dominates in the following communities: OB16, OB21, OB29, OB30, OB31. It occurs in slightly, moderately, and severely disturbed areas and can also occur in association with *P. alopecuroides, P. harmala* and *K. caspia* (Table 1; Figures 3 and 4).

Peganum harmala, also known as harmala, is a weedy plant species that inhabits desert and semi-desert regions such as the Middle East, North Africa and Central Asia. It is a plant from the nightshade family that usually grows on infertile soils, sand dunes and rocky slopes. *Peganum harmala* has many medicinal properties and is used in traditional medicine to treat various diseases (Vesselova 2017, et al. 2022). However, its seeds also contain alkaloids that can be toxic if consumed in large quantities. This plant species can spread rapidly and compete with native flora species, making it a weed and undesirable to the local ecosystem. In some regions, measures are being taken to control the spread of *P. harmala* to prevent its negative impact on the environment. According to our results, this species prefers non-saline habitat, but in some cases, it may be present in sulphate, calcium, and sodium salinization of soil (SO_4 1.15%, Ca 0.228%, Na 0.265%), the sum of salts when the species dominates is 0.074%-0.103%. In terms of pH, the medium prefers no more than 9 (8.71-8.73). Dominant in communities OB02 and OB25, which have an SRB of 5% and 40%. Dominance or sub-dominance of this species means severe disturbance of vegetation and soil cover. (Table 1; Figures 3 and 4).

For forage lands, widely represented in all natural zones and administrative districts of the republic, condition monitoring should be carried out periodically on a cartographic basis, cover the diversity of pastures and hayfields of the main sub-zones and districts of ecological zoning, and include passportisation of lands, including analysis of land transformation will allow to make adjustments to the required norms of use or the need for protection, restoration, determination of a different regime of use. Access to information at the local level is generally difficult. It is necessary to create real mechanisms for transferring information. Within the framework of the National Strategy and Action Plans to Combat

Desertification in the Republic of Kazakhstan, project proposals on issues of zoning and monitoring of degraded lands have been given. The projects propose creation of a unified inventory and information base as a basis for subsequent management using GIS-technology.

In conclusion, *S. linifolia* and *K. caspia* are indicator plants of salinisation by toxic salts. They are able to survive in high salinity soil and water conditions due to their specific adaptation to the saline environment. In addition, these plants can accumulate salts in their tissues, which helps them to protect themselves from the toxic effects of salts. Thus, the presence of *S. linifolia* and *K. caspia* in a particular region may indicate a high degree of soil and water salinization by toxic salts. Therefore, these plants can be used as indicators to assess the level of salinisation in natural ecosystems and to understand its impact on plant life. *Peganum harmala* and *A. pseudalhagi* are indicators of overgrazing and vegetation degradation. *Peganum harmala*, also known as hornwort seed, usually grows on partitions and fallow land. This plant is an indicator of overgrazing as it is able to survive under low nutrition and grazing pressure. *Alhagi pseudalhagi*, known as honey alhagi, is also an indicator of vegetation degradation. This plant is well adapted to dry and brackish soils and its presence may indicate insufficient vegetation and deteriorating soil conditions. Thus, observing the presence of *P. harmala* and *A. pseudalhagi* can help determine the level of overgrazing and vegetation degradation in the area. *Pseudosophora alopecuroides*, also known as indicator shrub, is a plant species that is often used as an indicator of land cover degradation. This species typically grows in low nutrient soils and can tolerate dry and unfavourable conditions. When *P. alopecuroides* begins to appear in large numbers in a particular area, it may indicate soil and vegetation degradation. This plant species has the ability to compete with other plants for resources and adapt to harsh conditions, making it a successful colonizer in degraded areas. Thus, observation of the presence of *P. alopecuroides* in a particular area can be a useful indicator to determine the level of degradation of vegetation cover and the need for measures to restore and protect soil and vegetation.

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