ISSN 2959-1864 (Online)
ISSN 2958-0536 (Print)
Volume 5, Number 1
March 2026

Acta Botanica Caucasica

TABLE OF CONTENTS

ARTICLE 5

Structure, Species Composition and Diversity of Bothriochloa ischaemum (L.) Keng Communities in Steppe Ecosystems of the South-Eastern Part of Azerbaijan

Kamala K. Asadova[1]* | ORCID: 0009-0003-9976-9644
Nigar Mursal[1] | ORCID: 0000-0003-0721-0222
Rena Abdiyeva[1] | ORCID: 0000-0002-1006-0475
Aygun Mammadova[1] | ORCID: 0009-0000-0909-7660
Sadiq Aleskerov[2] | ORCID: 0009-0005-6088-085X

[1] Institute of Botany, Ministry of Science and Education, Republic of Azerbaijan, Baku, Azerbaijan
[2] Baku State University, Baku, Azerbaijan
* Correspondence: asadova_kam@mail.ru

DOI	Received	Revised	Accepted	Pages
https://doi.org/10.30546/abc.2026.1142	January 5, 2026	February 10, 2026	March 1, 2026	44–51

ABSTRACT

Steppe ecosystems of the South Caucasus are among the most ecologically sensitive and economically significant vegetation types in the region, yet their phytocoenotic diversity remains insufficiently documented. This study investigates the structure, floristic composition, and current ecological status of *Bothriochloa ischaemum* (L.) Keng communities in the arid steppe zone of south-eastern Azerbaijan, encompassing the Gobustan, Salyan, Shirvan, and Saatli districts. Geobotanical surveys were conducted using the Braun-Blanquet relevé method, with species abundance estimated according to the standard cover-abundance scale. A total of 11 families, 25 genera, and 28 vascular plant species were recorded within the study communities. The families Poaceae (7 species, 25%), Fabaceae (4 species, 14%), and Asteraceae (4 species, 14%) are dominant in terms of species richness and ecological significance, while the remaining eight families are each represented by a single species. Seven principal plant associations were identified, ranging from bunchgrass–forb to wormwood–graminoid types, depending on soil salinity and edaphic conditions. The edificator *B. ischaemum* demonstrates high ecological plasticity, colonising diverse substrates including non-saline and slightly saline soils, rocky outcrops, and degraded shrublands. Productivity assessments of wormwood–yellow bluestem pastures revealed a seasonal gross dry matter yield of 16.4 c/ha, with an edible fraction of 8.0 c/ha, corresponding to a carrying capacity of approximately 2 sheep per hectare. The observed decline in species diversity in recent years, combined with increasing anthropogenic pressure and aridification, underscores the need for targeted conservation and sustainable rangeland management strategies across the south-eastern steppe belt of Azerbaijan.

Keywords: *steppe phytocoenoses; plant associations; Bothriochloa ischaemum; yellow bluestem; edificator; pasture productivity; south-eastern Azerbaijan*

1. INTRODUCTION

Steppe vegetation is one of the dominant types on Earth. Steppes are a vital link in the planet's overall bioecosystem chain, serving as a key source of forage pastures (Dengler et al., 2014). In Azerbaijan, particularly in the south-eastern part of the country, steppe vegetation is the primary forage source and is primarily represented by dry steppes. Today, these steppes are experiencing significant anthropogenic impacts.

Steppe landscapes in the southeastern part of the republic dominate the area around the village of Gobustan, as well as the Shirvan, Salyan, Saatli, and Sabirabad districts, occupying primarily flat and foothill areas. Dry steppes, combined with patches of deserts and semi-deserts, form a complex horizontal mosaic, often observed even in the coastal zone of the Caspian

Sea.

The steppe vegetation type mainly consists of drought-resistant species (Asadova, 2008). In terms of climate, the region is characterized by a moderately warm, dry continental climate. The average temperature of the warmest month is +23 to +25°C, and of the coldest month, −2°C. In summer, the absolute maximum temperature reaches +38 to +44°C. Annual precipitation is extremely low, amounting to approximately 250–350 mm per year (Museibov, 1998). Winds are mostly weak and gusty. In winter and autumn, southern and southwestern winds predominate, while in spring and summer, eastern and northeastern ones prevail. The soils of the dry steppe zone are diverse, ranging from light chestnut soils, relatively rich in humus, to grey-brown, slightly saline, and saline soils.

2. MATERIALS AND METHODS

The study of yellow bluestem was conducted primarily in the Gobustan, Salyan, Shirvan, and Saatli districts (Fig. 1). Perennial grasses are the dominant species in the steppe communities of these areas. In our study area, they are represented by beard grass (*Bothriochloa ischaemum* (L.) Keng), fescue (*Festuca rupicola* Heuff), wheatgrass (*Agropyron cristatum* (L.) Gaertn.), and feather grass (*Stipa caspia* C.Koch). Forb perennials and legumes (*Trifolium canescens* Willd., *Filago arvensis* L., *Calendula persica* C.A.Mey., and others) are also common (Atamov, 2002; Gurbanov, 2024).

The studies were conducted using methods generally accepted in geobotany (Pedrotti, 2013). The standard geobotanical description included compiling a species list, determining abundance and projective cover, layering, degree of palatability, and other indicators (Ponyatovskaya, 1960). Species abundance was scored using the Braun-Blanquet cover-abundance scale (Braun-Blanquet, 1932; Theurillat et al., 2021). Yield was determined according to the *Handbook of Hayfields and Pastures* (1956).

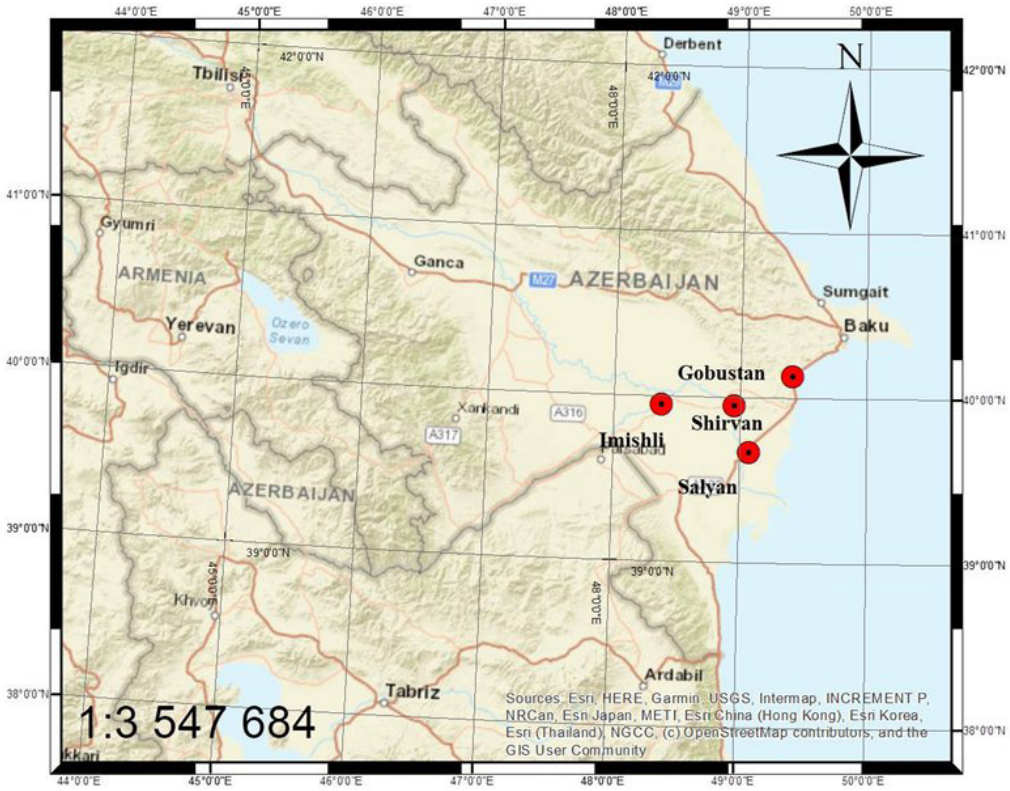

Figure. 1. Map of the investigation routes in the south-eastern part of Azerbaijan, showing sampling localities in the Gobustan, Shirvan, Salyan, and Saatli districts (red dots).

3. RESULTS AND DISCUSSION

Bothriochloa communities predominate

primarily in flat areas and on gentle slopes. Here, the prevalence of this edificator is clearly evident, with a distinct dominant composition represented primarily by grasses. The species composition of yellow bluestem communities in these areas is characterized by low diversity, owing to the influence of a hot desert and semi-desert climate. The constant composition comprises up to 30 species. Depending on climatic conditions, the range of species composition fluctuates between 20 and 56 species in different years. However, in recent years it has shown a clear trend of decline. The main vegetation consists of *Medicago coerulea* Less. ex Ledeb., *Bromus commutatus* Schrad., and other species.

Table 1. Species composition of yellow bluestem communities in the south-eastern part of Azerbaijan.

№	Family	Genus	Species	Life forms (Serebryakov, 1952)	Abundance (Braun-Blanquet, 1932)
1.	Poaceae Barnhart	*Agropyron L.*	*Agropyron cristatum (L.) Gaertn.*	Perennial	3
		Bromus L.	*Bromus commutatus Schrad.*	Annual	1–2
		Bothriochloa L.	*Bothriochloa ischaemum (L.) Keng*	Perennial	3–4
		Stipa L.	*Stipa caspia C.Koch*	Perennial	2–3
		Setaria L.	*Setaria viridis (L.) Beauv.*	Annual	1–2
		Festuca L.	*Festuca rupicola Heuff*	Perennial	2
		Phleum L.	*Phleum paniculatum Huds.*	Perennial	1–2
2.	Fabaceae Lindl.	*Medicago L.*	*Medicago minima (L.) Bartalini*	Annual	1–2
			Medicago rigidula (L.) All.	Annual	1–2
			Medicago coerulea Less. ex Ledeb.	Perennial	2–3
		Onobrychis Hill.	*Onobrychis vaginalis C.A.Mey.*	Perennial	1–2
		Trifolium L.	*Trifolium canescens Willd.*	Perennial	2–3
3.	Asteraceae Dumort.	*Tragopogon L.*	*Tragopogon graminifolius DC.*	Perennial	1–2
		Carduus L.	*Carduus arabicus Jacq.*	Annual	2
		Inula L.	*Inula hirta L.*	Perennial	1
		Artemisia L.	*Artemisia fragrans Willd.*	Perennial	2–3
4.	Brassicaceae Burnett	*Alyssum L.*	*Alyssum hirsutum Bieb.*	Annual	1–2
5.	Chenopodiaceae Vent.	*Salsola L.*	*Salsola dendroides Pall.*	Subshrub	1–2

№	Family	Genus	Species	Life forms (Serebryakov, 1952)	Abundance (Braun-Blanquet, 1932)
6.	Lamiaceae Lindl.	*Salvia L.*	*Salvia viridis L.*	Subshrub	1–2
		Phlomis L.	*Phlomis pungens Willd.*	Perennial	1–2
		Stachys L.	*Stachys pubescens Ten.*	Perennial	1
7.	Apiaceae Lindl.	*Daucus L.*	*Daucus carota L.*	Biennial	2
8.	Caryophyllaceae Juss.	*Arenaria L.*	*Arenaria serpyllifolia L.*	Annual	2
		Melandrium Roehl.	*Melandrium latifolium Poir.*	Annual	2
9.	Scrophulariaceae Juss.	*Euphrasia L.*	*Euphrasia caucasica Juz.*	Annual	2
10.	Papaveraceae Juss.	*Papaver L.*	*Papaver commutatum Fisch. et C.A.Mey.*	Annual	1–2
11.	Euphorbiaceae Juss.	*Euphorbia L.*	*Euphorbia falcata L.*	Annual	2

According to the consolidated species list, yellow bluestem communities comprise 11 families, 25 genera, and 28 species (Fig. 2, Table 1).

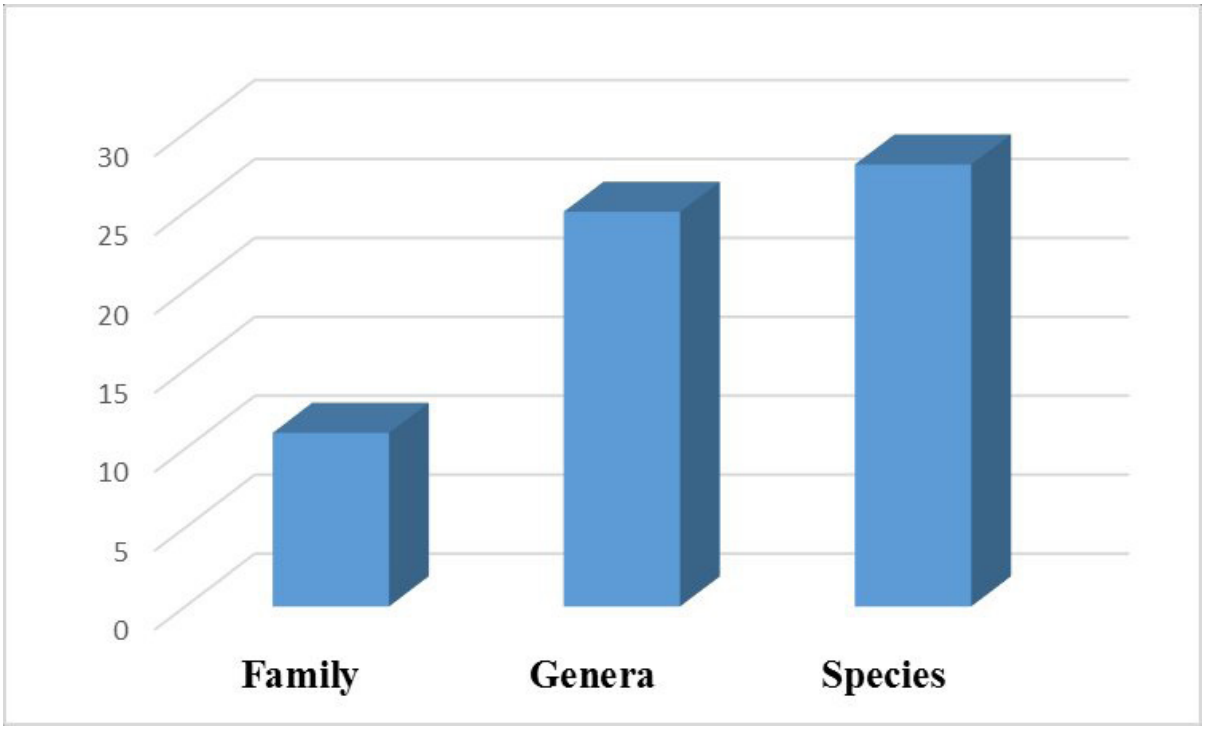

Figure. 2. Taxonomic structure of ***Bothriochloa ischaemum*** (L.) Keng communities in the south-eastern part of Azerbaijan (number of families, genera, and species).

In terms of species composition and abundance, the families Poaceae, Fabaceae, and Asteraceae play the primary role in determining the ecological value of these communities. The remaining families are each represented by a single species (Fig. 3).

Steppe communities are mixed in nature, including elements of semi-desert ecosystems, in particular species of the genera *Artemisia* and *Salsola* (Fig. 4). The value-forming species in such communities are *Bothriochloa ischaemum*, *Agropyron cristatum*, and *Stipa caspia*.

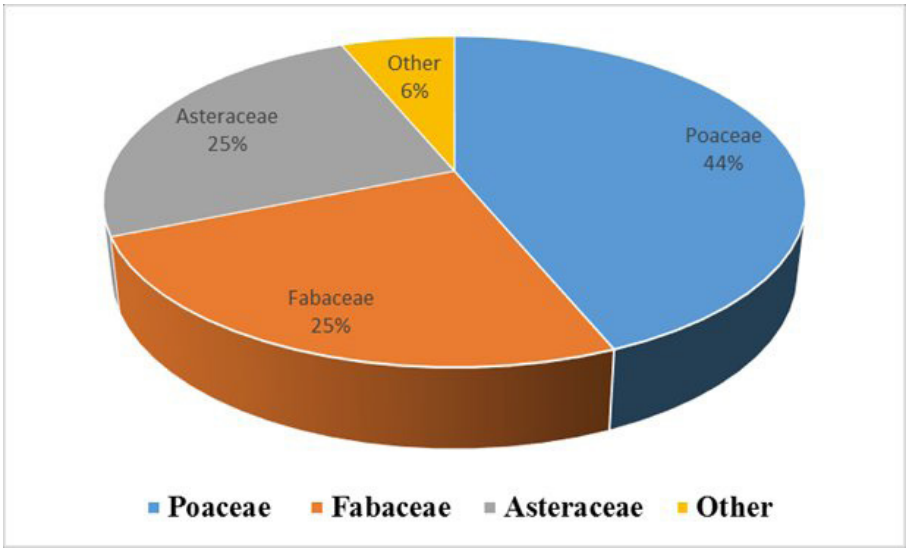

Figure. 3. Proportional contribution of dominant families to the total species composition of ***Bothriochloa ischaemum*** (L.) Keng communities. Poaceae – 44%; Fabaceae – 25%; Asteraceae – 25%; Other – 6%.

The xerophilous perennial edificator grass *Bothriochloa ischaemum* is a turf-forming plant in dry steppes. It forms turfs of various shapes that spread across the soil surface, with a tendency to merge. When turfs merge, they increase the projective soil cover by 20–30%. Where turfs remain separated from one another, other grasses and forbs occupy the intervening spaces.

It is worth noting that yellow bluestem is ecologically flexible. Analysis of numerous phytocoenological relevés reveals that it is found in a variety of plant communities: it penetrates shrub thickets that have replaced cleared forest areas, and also occurs on gravelly and rocky substrates (Zhang et al., 2017; Li et al., 2019). The habitats of *Bothriochloa ischaemum* frequently contain valuable forage-rich grass–forb and forb–legume communities, such as *Bothriochloa ischaemum* + *Trifolium arvense*, *Medicago coerulea* + *Tragopogon graminifolius*, etc.

The dry-steppe variant of *Bothriochloeta* is represented by bunchgrass and bunchgrass–wormwood associations. Depending on edaphic conditions (degree of salinity, moisture regime, and soil type), one or another variant becomes dominant (Lazu et al., 2021). On slightly saline or non-saline soils, *Bothriochloa ischaemum*, fescue (*Festuca rupicola*), wheatgrass (*Agropyron cristatum*), and feather grass (*Stipa caspia*) typically predominate. In areas with higher salinity, wormwood–graminoid associations prevail.

In total, seven associations were identified for dry steppes:

1) Bothriochloa ischaemum + Herbosa;

2) Festuca rupicola + Herbosa;

3) Agropyron cristatum + Herbosa;

4) Cynodon dactylon + Herbosa;

5) Stipa caspia + Bothriochloa ischaemum;

6) Agropyron cristatum + Artemisia lerchiana;

7) Bothriochloa ischaemum + Artemisia lerchiana.

Wormwood–beard grasslands (*Artemisia lerchiana* + *Bothriochloa ischaemum*) are located at elevations of 500–700 m above sea level and play an important role in the region's forage resources. Fragments of these grasslands were mostly recorded at elevated sites. This type of grassland forms a transitional link between wormwood desert, semi-desert, and dry yellow bluestem grassland. Some permanent dominant species include *Festuca rupicola*, *Stipa caspia*, *Poa bulbosa*, and *Catabrosella humilis*. Compared to wormwood–ephemeral grasslands, *Poa bulbosa* is less abundant here, owing to altered habitat conditions. This type of grassland predominates on slightly saline soils, resulting in a greater diversity of ephemeral vegetation.

The forage value of wormwood–yellow bluestem pastures is based not only on ephemerals but also on perennial bunchgrasses (*Agropyron cristatum*, *Stipa caspia*, *Bothriochloa*

ischaemum). These species significantly increase the stability of the grass stand under long-term grazing (Wang et al., 2024; Wu et al., 2024). The percentage of each dry yield fraction, presented in Table 2, shows that in spring, alongside the edificator (17.2%), the legume and forb fractions produce high yields (53.7% combined). A comparison of spring and autumn yield data reveals that during autumn, the percentages of legumes, grasses, and forbs decrease sharply to negligible levels. Yellow bluestem, however, continues to persist in the pastures. Forage plants account for approximately 58.7% of the total composition of these pastures, of which grasses and legumes occupy a significant share. Among the forbs, Asteraceae plays a notable role in forage value. In spring, community productivity is based primarily on ephemerals and, to some extent, on the growing green mass of yellow bluestem (Table 2).

Table 2. Productivity of wormwood–yellow bluestem pastures on slopes.

Feed fractions	Spring					Autumn				
	Dry yield 1 m² total (g)	Dry yield 1 m² food (g)	Dry yield 1 ha total (c)	Dry yield 1 ha food (c)	%	Dry yield 1 m² total (g)	Dry yield 1 m² food (g)	Dry yield 1 ha total (c)	Dry yield 1 ha food (c)	%
Wormwood	19.9	7.3	1.99	0.73	13.9	88.2	43.9	8.82	4.39	47.7
Yellow bluestem	24.7	16.1	2.47	1.61	17.2	90.6	14.1	9.06	1.41	48.5
Cereals	21.8	19.7	2.18	1.97	15.2	3.2	2.9	0.32	0.29	1.6
Legumes	37.6	32.9	3.76	3.29	26.3	–	–	–	–	–
Mixed herbs	39.4	21.0	3.94	2.10	27.4	4.4	2.1	0.44	0.21	2.2
Total	**143.4**	**97.0**	**14.34**	**9.7**	**100**	**186.4**	**63.0**	**18.64**	**6.3**	**100**

In the combined spring–autumn period, the gross yield is 16.4 c/ha of dry matter, including 8 c/ha of edible matter, which corresponds to a carrying capacity of 2 sheep per hectare.

a *b* *c*

Figure. 4. Steppe landscapes of south-eastern Azerbaijan. (a) *Bothriochloa ischaemum* community with sparse vegetation on sandy-loam soil, Salyan district; (b) mixed bunchgrass–wormwood steppe with *Artemisia* spp. and shrub elements, Shirvan district; (c) degraded dry steppe with *Bothriochloa ischaemum* and *Salsola* spp. under grazing pressure, Gobustan district.

4. CONCLUSION

Steppe vegetation is extensively developed in the foothill zone of the northwestern Shirvan Plain. Based on geobotanical surveys, two principal steppe formations were distinguished: bunchgrass steppes dominated by yellow

bluestem (*Bothriochloa ischaemum*), and subshrub–bunchgrass dry steppes in which bearded grass (*Bothriochloa* spp.) and wormwood (*Artemisia* spp.) play a significant role.

The steppe belt is mainly confined to the southeastern part of the study area. Toward the north, the importance of steppe communities decreases sharply, giving way to wormwood and wormwood–saltwort (*Artemisia–Salsola*) formations. Steppe grasslands are characterized by well-developed bunchgrass communities, with dominant taxa including feather grass (*Stipa* spp.), fescue (*Festuca* spp.), and beard grass.

The floristic spectrum of the investigated yellow bluestem communities includes 11 families, 25 genera, and 28 species. The leading families in terms of species richness and ecological significance are Poaceae, Fabaceae, and Asteraceae.

REFERENCES

Asadova K.K. (2008). Steppe Vegetation of Winter Pastures of Jeyranchol. Transactions of the Institute of Botany of ANAS, Baku, Vol. XXVIII, pp. 45–52.

Atamov V.V. (2002). Steppe Vegetation of Azerbaijan. Elm, Baku. 264 p.

Braun-Blanquet J. (1932). Plant Sociology: The Study of Plant Communities (Transl. G.D. Fuller & H.S. Conrad). McGraw-Hill, New York. 539 p.

Cheng J., Hu T.M., Cheng J.M. (2010). Responses of distribution of Bothriochloa ischaemum community to hydrothermal gradient in Loess Plateau. Acta Agrestia Sinica, 18(2), 167–171. https://doi.org/10.11733/j.issn.1007-0435.2010.02.005

Chytrý M., Tichý L., Holt J., Botta-Dukát Z. (2002). Determination of diagnostic species with statistical fidelity measures. Journal of Vegetation Science, 13(1), 79–90. https://doi.org/10.1111/j.1654-1103.2002.tb02025.x

Dengler J., Janišová M., Török P., Wellstein C. (2014). Biodiversity of Palaearctic grasslands: a synthesis. Agriculture, Ecosystems & Environment, 182, 1–14. https://doi.org/10.1016/j.agee.2013.12.015

Gurbanov E.M. (2024). Vegetation Cover of Azerbaijan. Elm, Baku. 536 p.

Házi J., Purger D., Penksza K., Bartha S. (2024). Changes in species composition, diversity, and biomass of secondary dry grasslands following long-term mowing. Grasses, 3, 130–142. https://doi.org/10.3390/grasses3030011

Lavrenko E.M., Korchagina A.A. (eds.) (1960–1974). Field Geobotany. Vols. I–III. USSR Academy of Sciences, Moscow–Leningrad.

Lazu S., Titica G., Miron A., Teleuță A., Talmaci L., Guțu A.I., Dziuba T. (2021). Syntaxonomy of steppe semi-savannoid with Chrysopogon gryllus (L.) Trin. and Bothriochloa ischaemum (L.) Keng from the Eurasian Area. Romanian Journal of Grassland and Forage Crops, 23, 13–42.

Li C.Y., Dong J., Zhang X.B., Zhong H., Jia H.L., Fang Z.H., Dong K.H. (2019). Gene expression profiling of Bothriochloa ischaemum leaves and roots under drought stress. Gene, 691, 77–86. https://doi.org/10.1016/j.gene.2019.01.006

Museibov M.M. (1998). Physical Geography of Azerbaijan. Maarif, Baku. 256 p.

Nowak A., Świerszcz S., Nowak S., Nobis A., Nobis M. (2024). Conspectus of the vegetation types of Tajikistan and adjacent areas with special focus on phytosociological classes. Acta Societatis Botanicorum Poloniae, 93(1), 191675. https://doi.org/10.5586/asbp.191675

Pedrotti F. (2013). Plant and Vegetation Mapping (Geobotany Studies). Springer, Berlin. 275 p. https://doi.org/10.1007/978-3-642-30235-0

Ponyatovskaya V.M. (1960). Brief Program and Methodological Note on Stationary Study of the Structure of a Grass or Shrub Community in Its Seasons. USSR Academy of Sciences, Moscow–Leningrad. 190 p.

Serebryakov I.G. (1952). Morphology of Vegetative Organs of Higher Plants. Sovetskaya Nauka, Moscow. 376 p.

Theurillat J.-P., Willner W., Fernández-González F., et al. (2021). International Code of Phytosociological Nomenclature, 4th edition. Applied Vegetation Science, 24(1), e12491. https://doi.org/10.1111/avsc.12491

Wang F., Shi L., Zhang R., Xu W., Bo Y. (2024). Effects of nitrogen addition and Bothriochloa ischaemum and Lespedeza davurica mixture on plant chlorophyll fluorescence and community production in semi-arid

grassland. Frontiers in Plant Science, 15, 1400309. https://doi.org/10.3389/fpls.2024.1400309

Wu Y., Li H., Cui J., Han Y., Li H., Miao B., et al. (2024). Precipitation variation: a key factor regulating plant diversity in semi-arid livestock grazing lands. Frontiers in Plant Science, 15, 1294895. https://doi.org/10.3389/fpls.2024.1294895

Zhang Q., Jia X., Shan L., Duan B., Wang G. (2017). Growth, morphological, and physiological responses to drought stress in Bothriochloa ischaemum. Frontiers in Plant Science, 8, 230. https://doi.org/10.3389/fpls.2017.00230

ISSN 2958-0536

www.botanic.az