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PLANT FORMATIONS FORMED BY *CYPERACEAE* SPECIES OCCURRING IN THE LOWLAND AREAS OF KARABAKH

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Abstract

Present taxonomic status of the taxa belonging to the sedge family (*Cyperaceae* Juss.), widespread in the southern part of the Lesser Caucasus within the borders of Azerbaijan, was studied. It was determined that 12 genera and 31 species of the family were widespread in the boggy vegetation in the studied area. Using geobotanical and floristic methods, 4 formation classes, 4 formations, and 8 associations have been recognized in the boggy vegetation of the lowland area of Karabakh. It has been established that the satellites of the species are sedges (*Carex* sp.), characteristic of lowland areas. Expeditions were carried out along certain routes to the lowland areas of Karabakh. Based on the CPS data of the species encountered here, GIS maps of the ranges of the species belonging to the family, as well as the expedition routes, were developed (Arc GIS Pro 3.3). As a result, 12 genera and 31 species belonging to the *Cyperaceae* Juss. family were identified in the boggy vegetation of the lowland regions of Karabakh.

Key words: Cyperaceae; Vegetation; Phytocoenosis; Formation; GIS

Introduction

Karabakh is situated between the Lesser Caucasus Mountains and the Kura and Araz rivers. There is not only great diversity in the climatic conditions but also the area is known for its extremely complex and geomorphological structure. The diversity in climatic and complexity in geological and geomorphological condition is well represented in the diversity and richness of the vegetation.

The lowland areas of Karabakh include Tartar, Barda, Agjabadi, and Agdam districts. The climate is temperate-warm and dry subtropical. Boggy vegetation is found in meadow-boggy and boggy soils (Mammadova *et al.*, 2017; Ibadulllayeva and Huseynova, 2021). This type of vegetation is introzonal (Mammadova & Gurbanov, 2016a).

The species composition and structure of phytocoenoses differ from each other (Ibadullayeva, 2011, Gurbanov, 2018). Floristic studies have shown that the life forms of species belonging to the sedge family in the study area are perennial and annual herbs. The genus *Carex* is represented by maximum number species in the study area.

The widespread boggy vegetation in Azerbaijan has been studied from time to time by different workers (Gurbanov, 2024; Ibadullayeva *et al.*, 2023) However, the taxonomic data including the correct identification of the species has not been fully done. The objective of the research was the study of the current status of the genera and species of the sedge family in the boggy vegetation found in the wild flora of the lowland areas of Karabakh in 2022-2024. Therefore, in order to fill this gap, the (recent study) of geobotanical research was undertaken to develop an appropriate classification based on phytoecological principles (Flora of Karabakh 2024).

Material and Methods

Six geobotanical regions are noted in the floristic division of Karabakh. The lowland areas are included in the southern Karabakh geobotanical region according to this division (Ibadullayeva *et al.*, 2023). Expeditions were conducted along 3 routes in the study area at the beginning of summer and in the fall of this year (Fig. 1). Layers of the relevant regions of Azerbaijan were obtained from the NextGIS database (https://data.nextgis.com/en/catalog/subdivisions/ ?country=AZ), and GIS maps were developed using ArcGIS Pro 3.3 software. ArcGIS Pro is a licensed functional, desktop geoinformation system (Andy Mitchell., 2020., https://arcreview.esri-cis.ru/2021/08/24/new-books-for-arcgis-pro/).

During geobotanical and floristic studies, the life forms (Raunkier, 1934; Serebryakov, 1964), the correct naming of species, was done with the help of Flora of Azerbaijan, 1950-1961 and International Code of Algae-Fungi and Plants (2012), 1974; https://www.ipni.org/) and ecological groups (Shennikov, 1964), geographical types (Grossheim, 1939-1961; Portenier, 2000) were taken into account. At the same time, various geobotanical field research methods were carried out while recording phytocoenoses found in meadow-boggy and boggy soils in the study area (Ramensky, 1971; Gurbanov, 2018; Lavrenko & Korchakina, 1959-1976.).

In the classification of boggy vegetation found in the study area, type, formation class, formation group and associations are adopted as geobotanical classification units (Classification scheme). Based on GPS data obtained during expeditions to the study area, as well as literature (Flora of Azerbaijan, 1950-1961), the distributional ranges of the dominant species were determined and a GIS map of the area was developed (Fig. 2).

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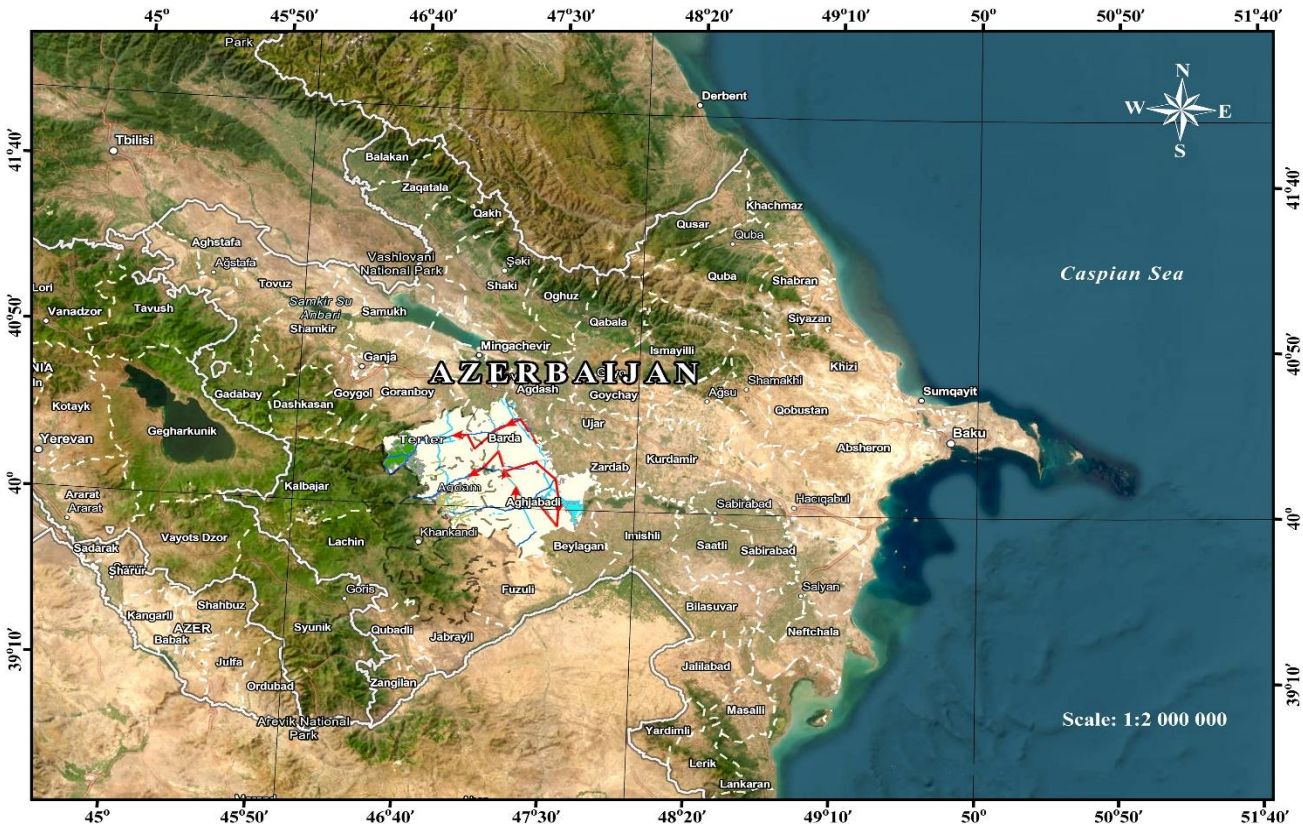
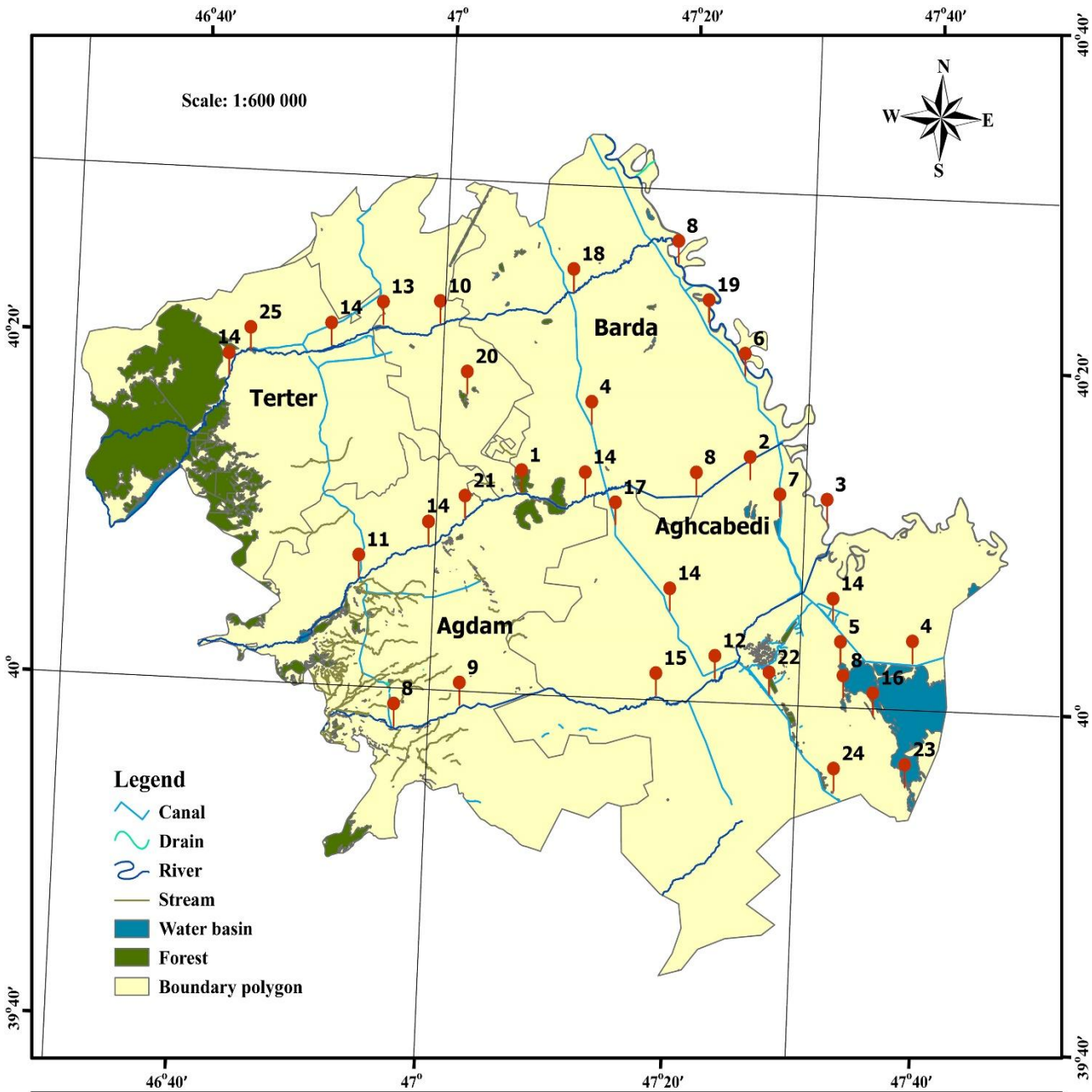


Fig. 1. Studied areas (Tartar, Agjabadi, Barda and Agdam regions).

Table. 1. Flora conspectus and bioecological characteristics of species of the sedge family (*Cyperaceae* Juss.) found in the lowland regions of Karabakh.

	Name of species	Floristic element	Botanical geographical region
1.	*Cyperus fuscus* L.	Mediterranean	Lesser Caucasus South
2.	*C.longus* Boeckeler.	Mediterranean	L.C. South
3.	*C.rotundus* L.	Mediterranean	L.C. South
4.	*Cyperus pygmaeus* Rottb. = *Dichostylis pygmaea* (Rottb.) Nees	Sub cosmopolitan	L.C. South
5.	*Juncellus serotinus* (Rottb.) C.B. Clarke	Mediterranean	L.C. South
6.	*Pycerus globosus* Rchb.	Sub cosmopolitan	L.C. South
7.	*Mariscus cyri* Grossh.	Unknown	L.C. South
8.	*Torulinium ferax* (Rich.) Ham.	Sub cosmopolitan	L.C. South
9.	*Schoenoplectus lacustris* (L.) Palla	Boreal	L.C. South
10.	*Sch.mucronatus* (L.) Palla	Mediterranean	L.C. South
11.	*Sch.litoralis* (Schrad.) Palla	Mediterranean	L.C. South
12.	*Bolboschoenus maritimus* (L.) Palla	Boreal	L.C. South
13.	*B.macrostachyus* (Willd.) Grossh.	Mediterranean	L.C. South
14.	*B.compactus* (Hoffm.) Drobow	Boreal	L.C. South
15.	*Heleocharis intersita* Zins = *Eleocharys polustris* subsp. *palustris*.	Boreal	L.C. South
16.	*H.eupalustris* Lindb. = *Eleocharis palustris* (L.) Roem.&Schult	Boreal	L.C. South
17.	*H.euuniglumis* Zinserl.	Boreal	L.C. South
18.	*Fimbristylis dichotoma* (L.)	Tropico-subtropical	L.C. South
19.	*Cladium mariscus* Benth.	Mediterranean	L.C. South
20.	*Carex divisa* Oeder	Boreal	L.C. South
21.	*C. remota* L.	Boreal	L.C. South
22.	*C. compacta* Lam.	Boreal	L.C. South
23.	*C. divulsa* Gaudin	Boreal	L.C. South
24.	*C. tomentosa* L.	Boreal	L.C. South
25.	*C. michelii* Host	Mediterranean	L.C. South
26.	*C.diluta* M.Bieb.	Mediterranean	L.C. South
27.	*C. acutiformis* Brot.	Boreal	L.C. South
28.	*C. cuspidata* Wahlenb	Mediterranean	L.C. South
29.	*C. riparia* (R.Br.) Poir.	Boreal	L.C. South
30.	*C. melanostachya* M.Bieb.ex Willd.	Eurosiberian/Eurasian	L.C. South
31.	*C. pseudocyperus* L.	Cosmopolitan	L.C. South



Cyperaceae Juss

***Cyperus* L.**
1. *C. fuscus* L.
2. *C. longus* Boeckeler.
3. *C. rotundus* L.

***Dichostylis* P.Beauv. ex T.Lestib.**
4. *D. pygmaeae* (Rottb.) Nees

***Juncellus* C.B.Clarke**
5. *J. serotinus* (Rottb.) C.B.Clarke

***Pycreus* P.Beauv.**
6. *P. flvescens* (L.) P.Beauv. ex Rchb.
7. *P. globosus* Rchb.

***Maricus* Scop.**
8. *M. cyri* Grossh.

***Torulinium* Desv.**
9. *T. ferax* (Rich.) Ham.

***Schoenoplectus* (Rchb.) Palla**
10. *S. setaceus* (L.) Palla
11. *S. lacustris* (L.) Palla
12. *S. mucronatus* (L.) Palla
13. *S. litoralis* (Schrad.) Palla

***Bolboschoenus* (Asch.) Palla**
14. *B. maritimus* (L.) Palla
15. *B. macrostachyus* (Willd.) Grossh.
16. *B. compactus* (Hoffm.) Drobow

***Heleocharis* T.Lestib.**
17. *H. euuniglumis* Zinserl.

***Fimbristylis* Vahl**
18. *F. dichotoma* (L.) Vahl

***Cladium* P.Browne**
19. *C. mariscus* Benth.

***Carex* L.**
20. *C. divisa* Oeder
21. *C. compacta* Lam.
22. *C. tomentosa* L.
23. *C. diluta* M.Bieb.
24. *C. riparia* (R.Br.) Poir.
25. *C. melanostachya* M.Bieb. ex Willd.

Fig. 2. Ranges of dominant species belonging to the *Cyperaceae* Juss. family, distributed in the lowland areas of Karabakh.

Classification scheme 1. Classification scheme of formations formed by species of the family Cyperaceae Juss. in boggy vegetation of the lowland areas of Karabakh

Type	BOGGY			
Formation class	Shrub-grass-sedge	Sedge-grass	Grassy bogs	Grass-sedge
Formation	Tamarix-reed-sedge *Tamarix-Phragmites-Carex* (*Tamarixeta-Phragmitetum-Carexsosum*)	Sedge-reed *Carex-Phragmites* (*Carexetum-Phragmitosum*)	Sedge-rush-bulrush *Carex-Juncus-Typha* (*Carexeta-Juncusetum-Typhosum*)	Reed-sedge *Phragmites-Carex* (*Phragmitetum-Carexosum*)
Association	French tamarix-common reed-bright sedge *Tamarix ramosissima-Phragmites australis -Carex diluta* (*Tamarixeta ramosissima-Phragmitetum australis-Carexosum diluta*)	Remote sedge-common reed *Carex remota-Phragmites australis* (*Carexetum remota-Phragmitosum australis*)	Coastal sedge-somerset rush-broadleaved cattail *Carex riparia-Juncus subulatus-Typha latifolia* (*Carexetum riparia-Juncetum subulatus-Typhosum latifolia*)	Common reed-great plains sedge *Phragmites australis-Carex melanostachya* (*Phragmitetum australis-Carexosum melanostachya*)
	Common (south) reed-compact sedge *Phragmites australis-Carex compacta* (*Phragmitetum australis-Carexosum compacta*)		Coastal sedge-narrowleaf cattail *Carex riparia-Typha angustifolia* (*Carexetum riparia-Typhosum angustifolia*)	
	Hohenacker tamarix-common reed-Sivrili cilliyi *Tamarix hohenackeri-Phragmites australis-Carex cuspidata* (*Tamarixeta hohenackeri-Phragmitetum australis-Carexosum cuspidata*)		Somerset rush-broadleaved cattail *Juncus subulatus-Typha latifolia* (*Juncetum subulatus-Typhosum latifolia*)	

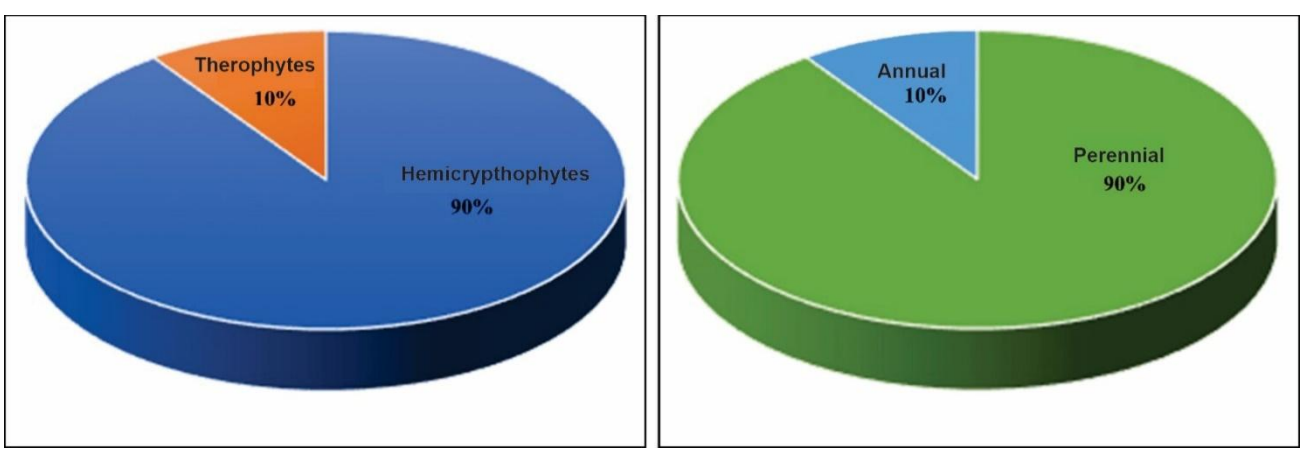


Fig. 3. Percentage of life forms of species of the Cyperaceae Juss. family found in the lowlands of Karabakh.

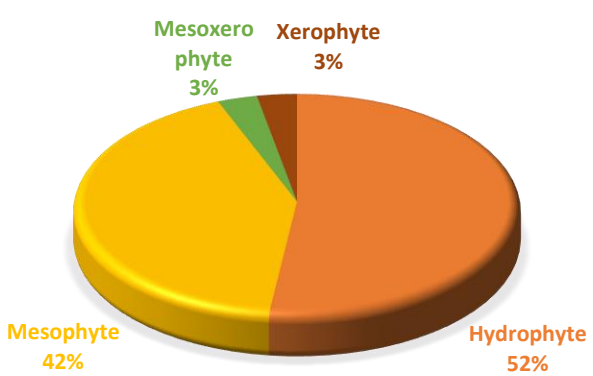


Fig. 4. Percentage of species of the Cyperaceae Juss. family found in the lowland areas of Karabakh by ecological groups.

Experimental part: While studying the current status of genera and species belonging to the sedge family (*Cyperaceae* Juss.) in the study area, a floristic synopsis was developed and it was determined that the species of this family were represented by 12 genera and 31 species. Species were classified according to their life forms. It was found that out of 31 species of the lowland areas of Karabakh, 3 were Therophytes and 28 were Hemicryptophytes (Raunkiaer, 1934). At the same time, 3 of the corresponding species were annuals and 28 were perennials (Serebryakov, 1964) (Fig. 3)

When studying the ecological groups of species, 16 hydrophyte, 13 mesophyte, 1 mesoxerophyte, and 1 xerophyte species were identified (Fig. 4).

Table 1 presents information on the range types of the species in relation to the flora elements and botanical geographical zonning (Table 1).

During research conducted on the banks of the lake within the boundaries of Aggöl National Park, Agjabedi district, one of the lowland regions of Karabakh, when studying the species composition and structure of the tamarix-reed-sedge formation, it was found that the dominant species of the formation was *Carex diluta* Bieb. The vegetation cover of the formation has been recorded in meadow-boggy and boggy soils in the southern part of Aggol National Park.

The studied vegetation belongs to the introzonal vegetation widespread in the meadow-marsh and marsh soil types of dry-subtropical steppes (Mammadova & Gurbanov, 2016b). Phytocenoses characteristic of wetland vegetation are mainly found within the boundaries of Aggol National Park. The most characteristic phytocenose of this vegetation is the shrub-tachilot-sedge formation class formed on meadow-marsh and marsh soils in the territory of Aggol National Park. The species composition and structure of the sedge-reed-sedge formation group and the multi-branched sedge-Australian reed-bright sedge (Tamarixeta ramosissima–Phragmisetum australis- Crexosum diluta) association belonging to this formation class are given below (Table 2).

It is also clear from the geobotanical description that bright sedge (*Carex diluta*) is a dominant species of phytocoenosis with 4-5 points abundance. The subdominant is common reed (*Phragmites australis*) with 3-4 points abundance followed by French tamarisk (*Tamarix ramosissima*) with 2-3 point abundance and Hohonacker tamarix (*T. hohenackeri*) with 2 points abundance.

In the 1st layer of the phytocenosis, French tamarisk (*T. ramosissima*), Hohonacker tamarix (*T. hohenackeri*), common reed (*P. australis*), broadleaved cattail (*Typha latifolia*) were present in the 2nd layer were *Bolboschoenus macrostachys*, late rush (*Juncellus serotinus*), brown galingale (*Cyperus fuscus*) and hydrophytic species; in the III layer were *Dichostylis pygmala*, forked fimbry (*Fimbristylis dichotoma*) and other species. The total coverage of the vegetation was 60-100% of the lake's water surface.

Geobotanical study of some species along with their botanical characteristics and economic importance was conducted, including sea clubroot (*Bolboschoenus maritimus* (L.) Palla), Greater pond sege (*Carex riparia* (R.Br.) Poir.) and Sweet cyperus *(Cyperus longus* Boeckeler.).

Bulboschoenus maritimus is a perennial plant, the creeping rhizome has spherical, tuberous thickenings at the ends. Flowering occurs between May and October. It is found in boggy areas and moist meadows almost throughout Azerbaijan, from the plains to the middle mountain belt. It is a medium quality fodder plant. It is mainly grazed by cattle and horses. Straw obtained from early-mown plants is good for feed. The yield of collected straw varies between 20-50 centners per hectare, and the yield of silage mass varies between 70-150 centners. Its nutritional value is significantly lower than that of grasses. Tubers of sea clubroot are rich in starch and can be eaten fried or boiled. Starch flour can be prepared from the tubers and used in the preparation of flour products. The plant can also be used for weaving purposes.

C. riparia (Great Pond Sedge) is a perennial plant that blooms in May-June. It is distributed in the Kur-Araz lowland, in the center of the Lesser Caucasus, from the plain to the middle mountain belt, along the edges of swamps, rivers, and lakes. The leaves of the coastal sedge are used for weaving baskets. Due to the good quality of its fibers, the leaves of the coastal sedge are used in rope weaving and the production of hard materials.

C. longus (Sweet Cyperus) is a perennial, rhizomatous plant. Flowering occurs between June and September. It is mainly found in boggy areas, ditches, and moist meadows. Its roots are used as a spice because they have an aromatic bitterness.

It should be noted that the vegetation cover of these hydrophytes in the area is a refuge for waterfowl and other wild animals. From this perspective, it is purposeful to conduct biomonitoring of these areas regularly.

Table 2. Geobotanical description of the species composition and structure of the tamarix-rush-sedge (Tamarix-Phragmites-Carex) formation.

No.	Name of biomorphic species	Ecological groups	Abundance (with point)	Average height (in cm)	Phenological - phases
1	2	3	4	5	6
		Bushes			
1.	*Tamarix ramosissima* Ledeb.	mesoxerophyte	2-3	I (250)	flow.
2.	*T. hohenackeri* Bunge	mesoxerophyte	2	I (180)	flow.
		Perennial herbs			
3.	*Phragmites australis* (Cav.) Trin.ex Steud.	hydrophyte	3-4	I (150)	veg.
4.	*Carex diluta* Bieb.	hydrophyte	4-5	II (80)	flow.
5.	*C. difusa* Huds.	hydrophyte	1-2	II (50)	flow.
6.	*Cyperus longus* Boeckeler.	hydrophyte	1-2	II (35)	flow.
7.	*Typha latifolia* L.	hydrophyte	1	I (120)	veg.
8.	Juncellus serotinus (Rottb.) Clarke	hydrophyte	1	II (70)	veg.
9.	*Bolboschomus macrostachys* (Willd.) Egor.	hydrophyte	1	II (60)	veg.
10.	*Cladium mariscus* Benth.	mesophyte	1	II (45)	veg.
		Biennial herbs			
11.	*Torilinuem ferax* (Rich.) Ham.	mesophyte	1-2	II (55)	veg.
		Annual herbs			
12.	*Cyperus fuscus* L.	hydrophyte	1-2	II (60)	flow.
13.	*Dichostylis pygmala* (Rottb.) Nees.	mesophyte	1-2	III (30)	veg.
14.	*Fimbristylis dichotoma* (L.) Vahl.	hydrophyte	1-2	II (25)	veg.

The total project coverage is 60-100%

Result

Of the 31 species found in the studied area, 28 were hemicryptophytes, 3 were therophytes, while 28 were perennials and 3 were annuals. The floristic elements were the Ancient Mediterranean and Mediterranean Irano-Turanian elements, as well as the Ancient Mediterranean and Boreal range types were also predominate. Based on botanical geographical zoning as the studied area covers the southern regions of the Lesser Caucasus within the borders of Azerbaijan.

During the study, the current state and structure of the *Tamarix-Phragmites-Carex* formation, included the species belonging to the Cyperaceae Juss. family were found in the natural vegetation of the area. The characteristic: species in the boggy vegetation of the study area were concentrated in 4 formation classes, 4 formation groups, and 8 associations. The species composition of the formation consisted of 14 species. Of these, 2 species (14.3%) were shrubs, 8 species (57.2%) were perennial herbs, 1 (7.1%) species were biennial, and 3 species (21.4%) were annual herbs. According to ecological analysis by group, 10 species (71.4%) were hydrophytes, 2 species (14.3%) were mesophytes, and 2 species (14.3%) were mesoxerophytes.

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