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Syntaxonomy of tugai forests of the Syrdarya River

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Keywords: Middle Asia, phytosociology, *Populetea euphratica*, Syrdarya, tugai forests.

Summary. A floristic classification of the vegetation of tugai forests in the Syrdarya river basin on the territory of the Republic of Uzbekistan is presented. Poplar (*Populus pruinosa*) forests are assigned to the class ***Populetea euphraticae*** and the order ***Populetalia euphraticae***. A formalized analysis of the Syrdarya and Amudarya tugai communities allowed to identify species that differentiate them. The poplar forests in the Syrdarya valley are characterized by higher species diversity. At the same time, they are less affected by degradation processes associated with soil salinization, which are typical for the lower reaches of the Amudarya River. Based on comparative analysis, a new alliance ***Galio spirii–Populion pruinosae*** all. nov. is described, which includes two associations with distributions covering various sections of the Syrdarya valley. The association ***Poo bulbosae–Populetum pruinosae*** ass. nov. represents tugai forests in the lower section of the Syrdarya valley and includes the richest communities. Two variants, ***Imperata cylindrica*** and ***Leymus multicaulis***, are identified within the association. The association ***Lycio dasystemi–Populetum pruinosae*** ass. nov. unites tugai forests of the Fergana intermountain basin characterized by a well-developed shrub layer, often dominated by *Lycium dasystemum*. Two variants, ***typica*** and ***Clematis orientalis***, are distinguished within the association. A prodromus of the vegetation of Central Asian tugai forests has been compiled including one class, one order, three alliances, seven associations, and six variants. The poplar forests of the region require conservation within newly established protected areas.

Синтаксономия тугайных лесов Сырдарьи

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Ключевые слова: Амударья, Средняя Азия, тугайные леса, флористическая классификация растительности, *Populetea euphratica*.

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Аннотация. Представлена флористическая классификация растительности тугайных тополевых (*Populus pruinosa*) лесов бассейна Сырдарьи на территории Республики Узбекистан. Они отнесены к классу ***Populetea euphraticae*** и порядку ***Populetalia euphraticae***. Формализованный анализ сырдарьинских и амударьинских тугайных лесов позволил выделить группы дифференцирующих их видов. Тополевые сообщества в долине Сырдарьи отличаются более высоким видовым разнообразием. При этом они менее подвержены процессам деградации, связанным с засолением почв, что характерно для нижнего течения Амударьи. На основании сравнительного анализа описан новый союз ***Galio spirii–Populion pruinosae*** all. nov., включающий 2 ассоциации, ареал которых охватывает различные отрезки долины реки. Ассоциация ***Poo bulbosae–Populetum pruinosae*** ass. nov. представляет тугайные леса нижнего отрезка долины Сырдарьи. Она представляет наиболее богатые типы тугайных лесных сообществ. В составе ассоциации выделены два варианта – ***Imperata cylindrica*** и ***Leymus multicaulis***. Ассоциация ***Lycio dasystemi–Populetum pruinosae*** ass. nov. представляет тугайные леса Ферганской долины, которые характеризуются развитием богатого кустарникового яруса, чаще всего с доминированием *Lycium dasystemum*. В составе ассоциации выделены два варианта – ***typica*** и ***Clematis orientalis***. Составлен продромус растительности тугайных лесов Средней Азии, включающий один класс, порядок, три союза, 7 ассоциаций и 6 вариантов. Тополевые леса региона нуждаются в сохранении в составе новых особо охраняемых территорий.

Introduction

The forest vegetation in the river valleys of the arid lowland regions of Central Asia is represented by tugai communities dominated by poplars from the subgenus *Turanga* (Bunge) Dode – *Populus pruinosa* and *Populus euphratica*. Forests are a key element of the complex valley ecosystems of large rivers, which also include shrub and herbaceous phytocoenoses, often of secondary origin. Tugai vegetation has important economic and environmental significance and has long attracted the attention of researchers (Zaktreger, 1927; Drobov, 1947; Vernik, Mailun, 1956; Petrov, 1961; Arifkhanova, 1967; Freitag, 1971; etc.).

In recent decades, changes in the natural environment in Uzbekistan (Orsenigo et al., 2022; Fenu et al., 2022, 2024), associated with climate aridization and increasing anthropogenic pressure, have led to the degradation of ecosystems. Tugai forests are among the most vulnerable components of valley vegetation. A vivid example is the Amudarya basin, where they are being replaced by communities dominated by salt-tolerant shrubs and grasses (Treshkin, Kuzmina, 1993; Korolyuk et al., 2024). Identifying the floristic and phytocoenotic diversity of ecosystems, including tugai forests, is an urgent task for establishing an effective system for the conservation of Uzbekistan's biodiversity.

To date, a detailed classification system of tugai vegetation has been developed based on the traditional dominant classification approach (Vernik et al., 1964; Mailun, 1973; Bakhiev, 1985; etc.). The study of valley poplar forests in Central Asia from the perspective of floristic classification has a relatively short history and is mainly related to the Amudarya basin. The research began in 1994 in the river's lower reaches (Bakhiev et al., 1994). In 1995, poplar forests were assigned to the alliance ***Populion aurianae*** Golub et Kuzmina in Bakhiev et Golub 1995, which included the single association ***Populetum aurianae*** Golub et Kuzmina in Bakhiev et Golub 1995 (Bakhiev, Golub, 1995). However, these syntaxa names are not valid since they lack differential (diagnostic) species, a requirement for syntaxa validity since 1980 (Theurillat et al., 2021). In the same year, N. V. Sinelnikova described the association ***Eriantho ravennae–Populetum euphraticae*** Sinelnikova 1995 in the Amudarya Nature Reserve in Turkmenistan (Sinelnikova, 1995). In 2001, the alliance ***Populion euphraticae*** Golub in Barmin 2001 was described (Barmin, 2001). In the "Tigrovaya Balka" Nature Reserve the alliance ***Elaeagno angustifoliae–Populion pruinosae*** A. Nowak et al. 2017 includes the single association ***Populetum pruinosae*** A. Nowak et al. 2017 (Nowak et al., 2017). We have described three associations representing the tugai forests of the lower Amudarya, which belong to the alliance ***Populion euphraticae*** Golub in Barmin 2001 (Korolyuk et al., 2025).

The aim of the study is to identify and present the diversity of tugai forests in the Syrdarya river valley from the perspective of floristic vegetation classification.

Natural conditions of the region

The Syrdarya River, with a total length of 2272 km, is the longest river in Central Asia and a critical water source for the region. It originates from the confluence of the Naryn and Karadarya rivers in the Fergana intermountain basin and

flows through Kyrgyzstan, Uzbekistan, Tajikistan, and Kazakhstan before draining into the remnants of the Aral Sea. The river's basin covers an area of approximately 462000 km², with the main water-generating zone accounting for about 219000 km², supporting agriculture, hydropower and ecosystems. The Syrdarya basin has a hot and arid climate in the downstream plains but a cool and humid climate in the mountains (Bocchiola et al., 2017). Around 80 % of the basin's water resources are generated between March and September, primarily as a result of snow and glacier melt in the mountainous regions (Cardenal et al., 2011). Annual precipitation across the basin is about 350 mm, though it varies significantly – from 500 to 1000 mm in the Tien Shan mountains to only 100–200 mm in the lower plains (Harris et al., 2014). Based on data from 20 hydrological stations, an analysis of annual and seasonal spatio-temporal variations in river discharge, precipitation and temperature across the Syrdarya basin shows that river flows in the upper basin have significantly increased between 1930 and 2006 years. This increase was mainly driven by rising temperatures – approximately 0.3 °C per decade – which accelerated glacier melting. In contrast, river discharge in the middle and lower reaches declined due to irrigation. Between 1992 and 2015, the expansion of built-up areas (128.83 km² / year) and agricultural lands (66.68 km² / year) in the middle basin led to a substantial increase in water consumption (Zou et al., 2019).

Materials and methods

To assess the diversity of communities and to develop a classification of tugai vegetation, we analyzed 82 relevés from the studied region (Fig. 1). Data processing was carried out using the IBIS 7.2 software (Zverev, 2007) and Statsoft Statistica v.8.0. As a result of a hierarchical agglomerative cluster analysis using Ward's linkage method, based on a secondary matrix calculated in IBIS, a dendrogram was constructed that reflects the similarity of relevés. The Czekanowski-Dice-Sørensen coefficient, traditionally used in geobotanical studies, was applied. To reduce the excessive influence of dominant species, we converted the percentage cover of species into a 9-point geometric scale. Based on the cluster analysis results, unranked phytocoenoses were identified. For their interpretation, we used approaches of floristic vegetation classification (Braun-Blanquet, 1964; Mirkin, Naumova, 2012). The homogeneity of species composition and tree layer dominants served as criteria for distinguishing associations. To identify species differentiating tugai forests in the Syrdarya and Amudarya valleys, the fidelity index (Tichý, 2002) was used, with a threshold value of 0.3.

The relevés were conducted on 400 m² plots. In the tables characterizing the communities, species cover values are given according to the following scale: + (< 1 %), 1 (1–4 %), 2 (5–9 %), 3 (10–24 %), 4 (25–49 %), 5 (50–74 %), 6 (75–100 %). The nomenclature of species followed "Plants of the World Online" (POWO. URL: https://powo.science.kew.org). The syntaxonomic nomenclature is presented in accordance with the rules of the "International Code of Phytosociological Nomenclature" (Theurillat et al., 2021).

Result and discussion

Cluster analysis revealed general patterns of differentiation in tugai vegetation (Fig. 2). At the first clustering level poplar forests (Cluster A) were separated from herbaceous and shrub communities (Cluster B). At the second level the tugai forests were divided into two phytocoenoses representing different segments of the Syrdarya valley. Communities of the first one (Cluster 1) are widespread in the Fergana intermountain basin in the Syrdarya valley over a stretch of at least 80 km – from the border with Tajikistan near the Pungan settlement to the Shakhand Village (Fig. 1). We have also surveyed the valley further upstreams, but natural poplar forests there had been completely destroyed due to agriculture. The second phytocoenosis (Cluster 2) represents communities found further downstreams from the Bekabad City (Fig. 1). These are best preserved within protected hunting areas where they form large patches of forest vegetation. Additionally, they occur in small fragments surrounded by arable lands.

A formal comparison was carried out between the two phytocoenoses and the associations representing the tugai poplar forests of the Amudarya valley. Cluster analysis demonstrated the distinctiveness of community types in the Syrdarya valley, which separated from their Amudarya counterparts (Fig. 3). A comparison of tugai forests from two valleys made it possible to identify groups of differentiating species (Table 1) that distinguish two basins. This allowed us to describe a new alliance representing the poplar forests of the Syrdarya valley. The two phytocoenoses were interpreted as associations, each containing two recognized variants (Table 2).

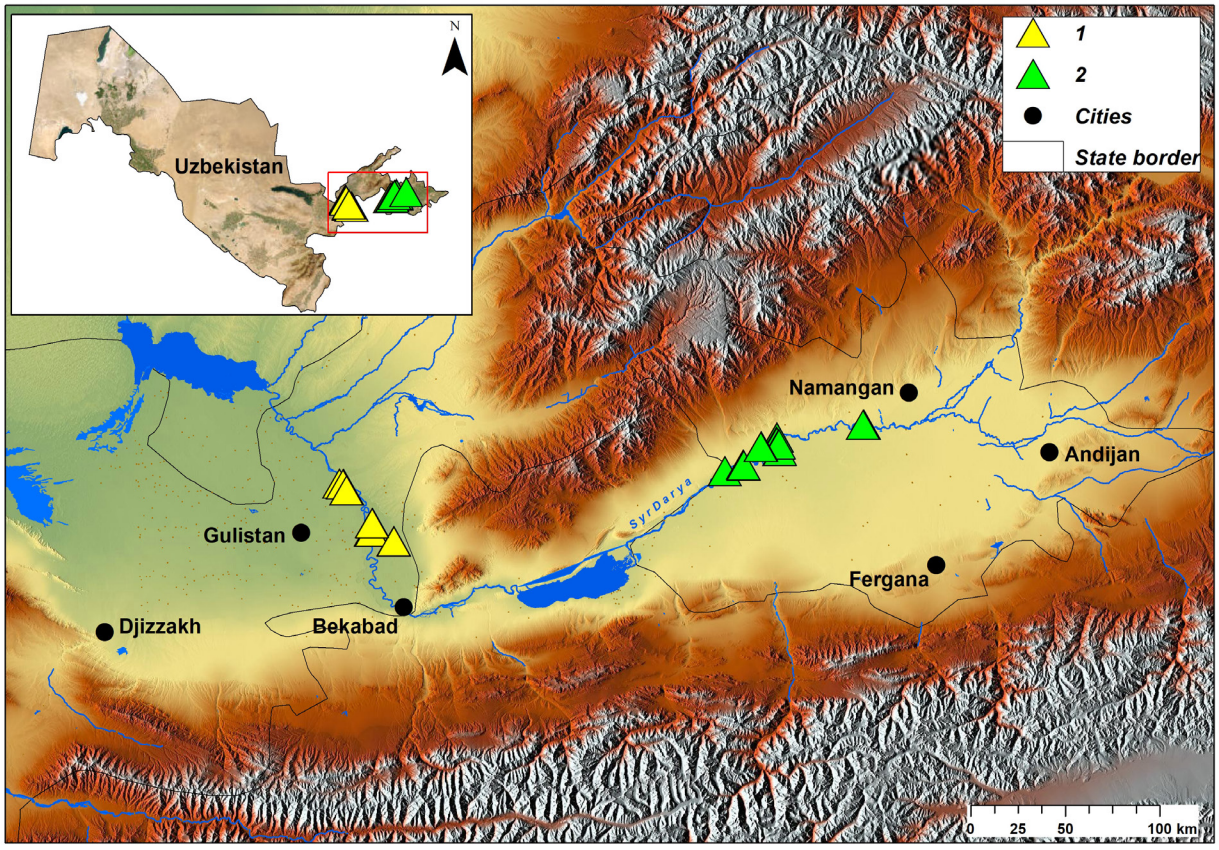

Fig. 1. Localities of associations: 1 – ***Poo bulbosae–Populetum pruinosae*** ass. nov., 2 – ***Lycio dasystemi–Populetum pruinosae*** ass. nov.

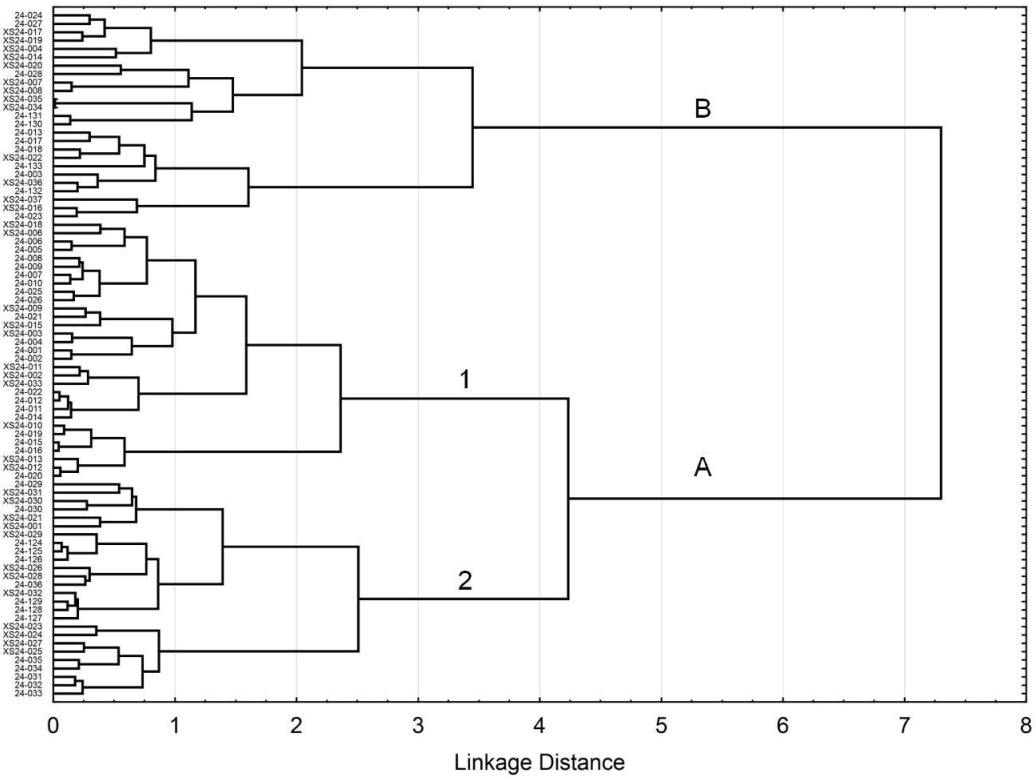

Fig. 2. Cluster analysis of relevés set.

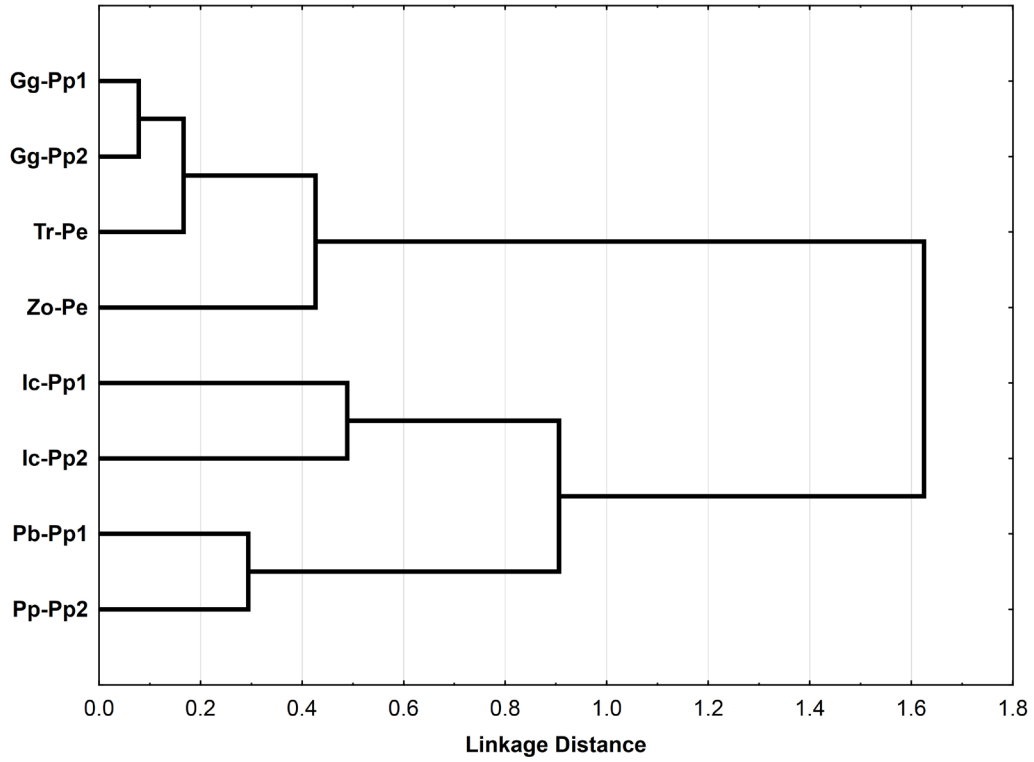

Fig. 3. Cluster analysis of syntaxa representing tugai forests of Syrdarya and Amudarya valleys. Gg-Pp – ass. ***Glycyrrhizo glabrae–Populetum pruinosae*** (Gg-Pp1 – var. ***typica***, Gg-Pp2 – var. ***Populus euphratica***), Tr-Pe – ass. ***Tamarici ramosissimae–Populetum euphraticae***, Ld-Pp – ass. ***Lycio dasystemi–Populetum pruinosae*** (Ld-Pp1 – var. ***typica***, Ld-Pp2 – var. ***Clematis orientalis***), Pp-Pp – ***Poo bulbosae–Populetum pruinosae*** (Pp-Pp1 – var. ***Imperata cylindrica***, Pp-Pp1 – var. ***Leymus multicaulis***), Zo-Pe – ass. ***Zygophyllo oxiani–Populetum euphraticae***.

Table 1. Species that differentiate tugai forests of the Syrdarya and Amudarya valleys (species fidelity is given)

River	Syrdarya	Amudarya
Number of relevés	54	160
Species that differentiate the Syrdarya tugai forests		
Asparagus persicus	88	.
Lycium dasystemum	71	.
Galium spurium	63	.
Hordeum murinum	58	.
Atriplex micrantha	51	.
Poa bulbosa	51	.
Bromus scoparius	49	.
Elymus repens	47	.
Torilis arvensis	46	.
Zygophyllum fabago	44	.
Imperata cylindrica	42	.
Geranium pusillum	42	.
Silene conica	42	.
Crupina vulgaris	42	.
Galium tenuissimum	40	.

Ending Table 1

River	Syrdarya	Amudarya
Number of relevés	54	160
Species that differentiate the Syrdarya tugai forests		
Lactuca tatarica	40	.
Artemisia subsalsa	40	.
Descurainia sophia	39	.
Cynodon dactylon	38	.
Crepis pulchra	38	.
Lactuca serriola	37	.
Taraxacum comitans	37	.
Rosa beggeriana	36	.
Phleum paniculatum	36	.
Aegilops tauschii	36	.
Medicago minima	36	.
Dodartia orientalis	36	.
Populus pruinosa	35	.
Aegilops triuncialis	34	.
Arenaria serpyllifolia	34	.
Vicia sativa subsp. *nigra*	34	.
Festuca ambigua	34	.
Berberis heteropoda	32	.
Euphorbia lamprocarpa	32	.
Filago arvensis	32	.
Carduus pycnocephalus	32	.
Carex pachystylis	32	.
Tripidium ravennae	30	.
Species that differentiate the Amudarya tugai forests		
Populus euphratica	.	77
Tamarix ramosissima	.	43
Elaeagnus angustifolia	.	31

Table 2. Synoptic table of the alliance ***Galio spirii–Populion pruinosae*** all. nov. (species with more than I constancy class in at least one syntaxa are given)

Number of relevés	15	10	9	10
Syntaxa	1	2	3	4
Diagnostic species of the ass. ***Lycio dasystemi–Populetum pruinosae*** and its variants				
Suaeda altissima	V	IV	I	.
Atriplex micrantha	III	IV	I	.
Phragmites australis	IV	II	II	.
Zygophyllum fabago	IV	.	.	.
Clematis orientalis	I	V	I	.
Taraxacum comitans	II	IV	.	.

Continued Table 2

Number of relevés	15	10	9	10
Syntaxa	1	2	3	4
Diagnostic species of the ass. ***Lycio dasystemi–Populetum pruinosae*** and its variants				
Lactuca tatarica	.	IV	II	I
Berberis sphaerocarpa	.	IV	.	.
Diagnostic species of the ass. ***Poo bulbosae–Populetum pruinosae*** and its variants				
Poa bulbosa	.	.	V	III
Geranium pusillum	.	.	III	IV
Elymus repens	I	.	III	IV
Crupina vulgaris	.	.	III	IV
Torilis arvensis	I	I	III	III
Galium tenuissimum	.	I	IV	II
Artemisia subsalsa	.	.	IV	II
Lactuca serriola	I	.	III	III
Crepis pulchra	.	.	III	II
Phleum paniculatum	.	.	II	III
Vicia sativa subsp. *nigra*	.	.	II	III
Imperata cylindrica	I	.	V	I
Pleconax conica	.	.	V	I
Medicago minima	.	.	V	I
Arenaria serpyllifolia	.	.	IV	I
Carex pachystylis	.	.	IV	.
Festuca ambigua	.	.	IV	I
Diarthron vesiculosum	.	.	III	I
Aegilops tauschii	.	.	.	IV
Aegilops triuncialis	.	.	.	IV
Zygophyllum oxianum	I	I	.	III
Leymus multicaulis	I	I	.	III
Stizolophus balsamita	.	.	.	III
Camelina microcarpa	.	.	.	III
Carduus pycnocephalus subsp. *arabicus*	.	.	.	III
Ventenata dubia	.	.	.	III
Secale sylvestre	.	.	.	III
Carthamus lanatus subsp. *turkestanicus*	.	.	.	III
Diagnostic species of alliance ***Galio spirii–Populion pruinosae***				
Lycium dasystemum	V	V	.	II
Asparagus persicus	V	V	V	II
Bromus scoparius	I	II	II	IV
Galium spurium	II	IV	III	IV
Hordeum murinum	I	V	II	III
Descurainia sophia	III	I	I	II

Continued Table 2

Number of relevés	15	10	9	10
Syntaxa	1	2	3	4
Diagnostic species of the class ***Populetea euphraticae***, the order ***Populetalia euphraticae***, the alliance ***Populion euphraticae***				
Populus pruinosa	V	V	V	V
Cynanchum thesioides	IV	IV	II	II
Aeluropus littoralis	IV	III	III	II
Tamarix ramosissima	III	I	V	II
Tripidium ravennae	I	II	III	II
Glycyrrhiza glabra	II	.	IV	I
Tamarix hispida	III	II	I	.
Halostachys caspica	II	.	.	.
Caragana halodendron	I	I	II	I
Elaeagnus angustifolia	I	II	I	.
Apocynum venetum subsp. *lancifolium*	.	II	I	.
Other species				
Cynodon dactylon	I	II	II	I
Filago arvensis	.	.	III	I
Rhaponticum repens	.	I	I	III
Calamagrostis canadensis	I	III	.	I
Taeniatherum caput-medusae	.	.	II	II
Rosa beggeriana	I	II	I	.
Lepidium latifolium	.	III	.	.
Dodartia orientalis	.	.	III	I
Limonium otolepis	I	.	I	II
Convolvulus arvensis	.	I	II	I
Sophora alopecuroides	I	II	.	.
Equisetum ramosissimum	I	II	I	.
Bromus japonicus	.	.	III	.
Erigeron canadensis	.	.	II	I
Erodium cicutarium	.	.	II	I
Cerastium sp.	.	.	I	II
Carduus pycnocephalus	.	I	.	II
Scandix stellata	.	.	.	II
Litwinowia tenuissima	.	.	.	II
Bromus hordeaceus subsp. *hordeaceus*	.	.	.	II
Lepidium draba	.	.	.	II
Spinacia oleracea	.	.	.	II
Calystegia sp.	I	II	.	.
Parentucellia flaviflora	.	.	II	.
Asparagus breslerianus	.	.	II	.
Cynoglossum creticum	.	.	II	I
Alyssum turkestanicum	.	.	II	I

Ending Table 2

Number of relevés	15	10	9	10
Syntaxa	1	2	3	4
Sonchus oleraceus	.	I	II	.
Morus alba	.	II	.	.
Elwendia chaerophylloides	.	.	.	II
Plantago major	.	II	.	.
Capparis spinosa var. *herbacea*	.	.	.	II
Gleditsia triacanthos	.	.	.	II
Onopordum acanthium	.	.	II	.
Eremopyrum triticeum	I	.	.	.
Centaurium pulchellum	.	.	II	.

Syntaxa: 1 – ***Lycio dasystemi–Populetum pruinosae*** var. ***typica***, 2 – ***Lycio dasystemi–Populetum pruinosae*** var. ***Clematis orientalis***, 3 – ***Poo bulbosae–Populetum pruinosae*** var. ***Imperata cylindrica***, 4 – ***Poo bulbosae–Populetum pruinosae*** var. ***Leymus multicaulis***.

Description of syntaxa

Class ***Populetea euphratica*** Zohary ex Korolyuk, Shomurodov et Khabibullaev 2025.

Diagnostic species: *Populus euphratica* (dom.), *P. pruinosa* (dom.), *Aeluropus littoralis, Cynanchum acutum, Elaeagnus angustifolia, Tripidium ravennae, Glycyrrhiza glabra, Caragana halodendron, Phragmites australis, Tamarix ramosissima, T. florida, Apocynum venetum.*

The class represents valley poplar forests of arid regions of Eurasia and North Africa. Communities are widely distributed in the river valleys of Central Asia. The class is represented by a single order.

In publications prior to 2025, various authors classified tugai forests as the class ***Nerio-Tamaricetea*** Br.-Bl. et Bolós 1957. This class is currently interpreted as comprising circum-Mediterranean and Macaronesian intrazonal shrubland types but not forest communities (Mucina et al., 2016). An eastern ecological analogue of this class was described by H. Akhani and L. Mucina (2015). The class ***Tamaricetea arceuthoidis*** Akhani et Mucina 2015 represents riparian and adjacent shrub vegetation of the Irano-Turanian region, Central Asia and the Lower Volga valley. The dominant species in these communities are various species of the genus *Tamarix,* which indicate high groundwater levels in arid climates and moderately saline soils.

The tugai communities representing a forest vegetation should be attributed to the class ***Populetea euphratica*** Zohary 1962 ex Korolyuk, Shomurodov et Khabibullaev 2025, which includes valley forests of arid regions within the Saharo-Gobian desert area (Zohary, 1962; Sinelnikova, 1995; Kürschner, 2004; Korolyuk et al., 2025). This class was initially described from Israel and Jordan (Zohary, 1962). Its known easternmost range limit is in the Alashan Gobi (Kürschner, 2004). The main diagnostic feature of the class is the dominance of poplars from the subgenus *Turanga* (Bunge) Dode, which is represented by two species in the studied area – *Populus euphratica* (syn. *P. ariana*, *P. diversifolia*) and *Populus pruinosa* (Skvortsov, 2010). The dominance of tree species is the key criterion for distinguishing poplar forests from shrub communities with similar species composition, the latter should be assigned to the class ***Tamaricetea arceuthoidis***.

Order ***Populetalia euphraticae*** Zohary ex Korolyuk, Shomurodov et Khabibullaev 2025.

At present, the only order within the class.

Alliance ***Galio spirii–Populion pruinosae*** Korolyuk, Shomurodov et Khabibullaev all. nov.

Nomenclatural type (holotypus) – ***Poo bulbosae–Populetum pruinosae*** Korolyuk, Shomurodov et Khabibullaev ass. nov.

Diagnostic species (D. s.): *Asparagus persicus*, *Bromus scoparius*, *Descurainia sophia*, *Galium spurium*, *Hordeum murinum*, *Lycium dasystemum*.

Association ***Poo bulbosae–Populetum pruinosae*** Korolyuk, Shomurodov et Khabibullaev ass. nov. (Supplement, Table 1, see the journal's website).

Nomenclatural type (holotypus) – relevé field number 24-124: Tashkent Region, 6.5 km southwest of the Novo-Alekseevka settlement (Buka District); coordinates – 40°38′49.9″N, 68°59′45.6″E; 15 VI 2024;

author – A. Yu. Korolyuk. Species list: *Populus pruinosa* (4), *Populus pruinosa* (juv.) (1), *Tamarix ramosissima* (+), *Alyssum turkestanicum* (+), *Arenaria serpyllifolia* (+), *Artemisia subsalsa* (+), *Asparagus persicus* (+), *Carex pachystylis* (1), *Crepis pulchra* (+), *Crupina vulgaris* (+), *Dodartia orientalis* (+), *Elymus repens* (1), *Festuca ambigua* (1), *Galium spurium* (+), *Galium tenuissimum* (+), *Geranium pusillum* (+), *Glycyrrhiza glabra* (+), *Imperata cylindrica* (3), *Lactuca serriola* (+), *Medicago minima* (1), *Parentucellia flaviflora* (+), *Poa bulbosa* (2), *Silene conica* (+), *Torilis arvensis* (+), *Tripidium ravennae* (2).

D. s.: *Artemisia subsalsa, Crepis pulchra, Crupina vulgaris, Elymus repens, Galium tenuissimum, Geranium pusillum, Lactuca serriola, Phleum paniculatum, Poa bulbosa, Torilis arvensis, Vicia sativa* subsp. *nigra*.

The association represents the forests of the lower section of the Syrdarya valley (Fig. 4). The canopy closure varies widely depending on the degree of anthropogenic transformation. This association includes the most species-rich types of tugai communities with an average species richness of 29 species per relevé. The shrub layer is usually poorly developed, though in some plots *Lycium dasystemum* reaches high cover. The herbaceous layer is diverse, with total cover reaching 40–50 %. It is dominated by perennial grasses, which may co-dominate in various proportions: *Imperata cylindrica*, *Elymus repens*, *Leymus multicaulis*, *Poa bulbosa*, and *Tripidium ravennae*. A characteristic feature of these communities is the high abundance of ephemeral plants: *Secale sylvestre*, *Hordeum murinum*, *Aegilops triuncialis*, *Aegilops cylindrica*, *Carduus pycnocephalus* subsp. *arabicus*, among others. Two variants are distinguished within the association – ***Imperata cylindrica*** and ***Leymus multicaulis*** *(*Supplement, Table 1, see the journal's website).

Association ***Lycio dasystemi–Populetum pruinosae*** Korolyuk, Shomurodov et Khabibullaev ass. nov. (Supplement, Table 2, Fig. 5).

Nomenclatural type (holotypus) – field number 24-012: Namangan Region, 1.6 km northwest of the Chiganak settlement; coordinates – 40°47′20.4″N, 71°03′16″E; 15 V 2024; author – A. Yu. Korolyuk. Species list: *Populus pruinosa* (4), *Populus pruinosa* (juv.) (+), *Lycium dasystemum* (4), *Tamarix ramosissima* (2), *Aeluropus littoralis* (+), *Asparagus persicus* (+), *Atriplex micrantha* (+), *Bromus scoparius* (+), *Eremopyrum triticeum* (+), *Galium spurium* (+), *Phragmites australis* (+), *Suaeda altissima* (+), *Zygophyllum fabago* (1).

Fig. 4. Association ***Poo bulbosae–Populetum pruinosae***, Tashkent Region, 6.5 km southwest of the Novo-Alekseevka (Photo by B. S. Khabibullaev).

Fig. 5. Association ***Lycio dasystemi–Populetum pruinosae***. Namangan Region, to the south of the Shaxand City (Photo by A. Yu. Korolyuk).

D. s.: *Atriplex micrantha*, *Lycium dasystemum*, *Suaeda altissima*.

Association represents the tugai forests of the Fergana intermountain basin. The canopy of trees, reaching 8–14 meters in height, has an average closure of about 40 %, depending on logging intensity. In the most closed-canopy communities, found in minorly disturbed areas of the river valley, this value reached 60–65 %. A distinctive feature of these communities is a well-developed shrub layer with an average cover of about 20 %. The most frequent dominant is *Lycium dasystemum*, less often *Tamarix hispida*. As dominants and co-dominants, the following species were recorded: *Berberis heteropoda*, *Elaeagnus angustifolia*, *Caragana halodendron*, *Halostachys caspica*, *Rosa beggeriana*, and *Tamarix ramosissima*. In the sparse ground cover, which usually does not exceed 20 %, there are no constant dominants. Among perennial species with cover exceeding 5 % were noted *Zygophyllum fabago*, *Asparagus persicus*, *Glycyrrhiza glabra*, and *Sophora alopecuroides*. In some areas the annual *Atriplex micrantha* and *Suaeda altissima* are abundant. The average species richness of these communities is 17 species per relevé. Two variants are distinguished within this association – ***typica*** and ***Clematis orientalis*** *(*Supplement, Table 2, see the journal's website).

Based on new data, a prodromus of the tugai forests of Central Asia has been compiled.

Class ***Populetea euphratica*** Zohary ex Korolyuk, Shomurodov et Khabibullaev 2025

Order ***Populetalia euphratica*** Zohary ex Korolyuk, Shomurodov et Khabibullaev 2025

Alliance ***Populion euphraticae*** Golub in Barmin 2001

Ass. ***Eriantho ravennae–Populetum euphraticae*** Sinelnikova 1995

Ass. ***Glycyrrhizo glabrae–Populetum pruinosae*** Korolyuk, Shomurodov et Khabibullaev 2025

Var. ***typica***

Var. ***Populus euphratica***

Ass. ***Tamarici ramosissimae–Populetum euphraticae*** Korolyuk, Shomurodov et Khabibullaev 2025

Ass. ***Zygophyllo oxiani–Populetum euphraticae*** Korolyuk, Shomurodov et Khabibullaev 2025

Alliance ***Elaeagno angustifoliae–Populion pruinosae*** A. Nowak et al. 2017

Ass. ***Populetum pruinosae*** A. Nowak et al. 2017

Alliance ***Galio spurii–Populion pruinosae*** Korolyuk, Shomurodov et Khabibullaev all. nov.

Ass. ***Poo bulbosae–Populetum pruinosae*** Korolyuk, Shomurodov et Khabibullaev ass. nov.

Var. ***Imperata cylindrica***

Var. ***Leymus multicaulis***

Ass. ***Lycio dasystemi–Populetum pruinosae*** Korolyuk, Shomurodov et Khabibullaev ass. nov.

Var. ***typica***

Var. ***Clematis orientalis***

Conclusion

Tugai forests dominated by *Populus euphratica* and *Populus pruinosa*, belonging to the section *Turanga*, are a key element of riparian vegetation along the major rivers of Central Asia. To date, they have been largely destroyed as a result of centuries-long human activity. In the Syrdarya valley they survived only locally, often as small patches under strong anthropogenic pressure. Analysis of our data, along with the limited published sources, allowed us to describe the new alliance ***Galio spurii–Populion pruinosae***, which includes two associations and four variants. In comparison with the poplar forests of the Amudarya valley, which in Uzbekistan belong to the ***Populion euphraticae*** alliance, the Syrdarya communities are significantly richer in species. At the same time, they are more heavily disturbed and fragmented. This underscores the urgent need to develop effective measures for the conservation of tugai ecosystems in the Syrdarya basin.

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