SYSTEMATIC AND BIOMORPHOLOGICAL ANALYSIS OF AQUATIC PLANTS OF THE CHECHEN REPUBLIC

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Abstract

Compiling a list of aquatic plants of the Chechen Republic is very important from an ecological point of view. The main goal of this study was to provide a detailed list of aquatic plants growing on the territory of the republic. Aquatic plants play an important role in water systems. This work presents a systematic and biomorphological analysis, as well as the occurrence of aquatic plants of the Chechen Republic. This study is an inventory and analysis of the aquatic flora of the republic. These studies were conducted based on the processing of herbarium materials and the authors' own observations. Aquatic vegetation forms the basis of aquatic ecosystems, providing habitats, food, and oxygen for a wide range of aquatic organisms, from invertebrates and fish to larger predators. Moreover, aquatic plants contribute to water purification by filtering pollutants and stabilizing sediments, thus playing a key role in maintaining water quality. The primary objective of this study was to compile a comprehensive list of aquatic plants growing in the various water bodies across the Chechen Republic and to analyze their occurrence, distribution, and ecological roles. This work involved both a systematic and biomorphological analysis of the region's aquatic flora, along with an assessment of how these plants are distributed across different habitats.

Keywords: Chechen Republic, water, aquatic plants, species, genus, family, biomorph, hemicryptophytes, cryptophytes, therophytes, occurrence

I. Introduction

Chechen Republic is located V moderate climate belt, what provides big diversity And wealth flora. In the northern part of the Chechen Republic, the semi-desert turns into steppe, the territories close to the central part change from forest-steppe to forest. Between the belt of forests and snowy peaks there are subalpine and alpine meadows. Thus, the territory of our republic is very diverse in climatic terms, due to which plant forms have great geographic plasticity [5].

Water, the most important resource for sustaining life on our planet, is of critical importance to both humans and the ecosystem as a whole. A number of factors, including population growth, rapid industrialization, urbanization, and unsustainable use of natural resources, have significantly affected water quality in recent decades.

Aquatic plants play an important role in aquatic systems. A comprehensive understanding of their spatial distribution can help in developing biodiversity conservation plans.

II. Methods

Aquatic plants are perennial (less often annual) plants, the necessary condition of life of which is full or partial stay in fresh (mostly), salt or brackish water. Aquatic plants are mostly represented by herbs.

The purpose and objectives of the study. The purpose of the work is to conduct a systematic, biomorphological, and also an analysis of the occurrence of aquatic plants in the Chechen Republic.

III. Results

In the study of the flora, the material obtained during the field research and observations of the authors, as well as information obtained during the study of the herbarium collections of "Botany, Zoology and Bioecology" was used. Chechen State University named after A.A. Kadyrov.

This study presents aquatic plants of the Chechen Republic that have economic significance. As a result of the study, a total of 78 plant species were registered, united into 28 different families. It was established that the dominant families are Cyperaceae, Poacea, and Buckwheat [7] .

The complete list is presented in Table 1. Their numerical ratio is shown in Fig.1.

Table 1: *Systematic analysis of aquatic plants of the Chechen Republic*

No.	Family	Genus	View
1.	*Equisetaceae* Rich. ex DC. – Horsetail	*Equisrtum*	*Equisrtum arvense* L. – Field Horsetail
			Equisrtum fluviatile L. (*E. heleocharis* Ehrh.) – Marsh horsetail
2.	*Marsileaceae* Mirb. – Marsileaceae	*Marsilea*	*Marsilea quadrifolia* L. – Marsilea quadrifolia
3.	*Salviniaceae* Lest. – Salviniaceae	*Salvinia*	*Salvinia natans* (L.) All.– Floating salvinia
4.	*Iridaceae* Juss. –Iridaceae (Iridaceae)	*Iris*	*Iris pseudacorus* L. – Iris (Iris) yellow
5.	*Droseraceae* Salisb. – Sundews	*Drosera*	*Drosera rotundifolia L.* – Round-leaved sundew
6.	*Trapaceae* Dumort. – Chilimaceae (Cornworts)	*Trapa*	*Trapa hyrcana* Woronow – Chilim Hyrcana
7.	*Ranunculaceae* Juss. – Buttercups	*Ranunculus*	*Ranunculus sceleratus* L. – Poisonous Buttercup
			Ranunculus repens L. – Creeping Buttercup
		Aquilegia	*Aquilegia caucasian* Bieb . (*A. olympica* Boiss .) – Caucasian columbine
8.	*Butamaceae* Rich. – Susakovyh	*Butomus*	*Butomus umbellatus* L. – Umbrella susak
9.	*Brassicaceae* Burnett *(Cruciferae)* – Cabbage (Cruciferae)	*Rorippa*	*Rorippa barbareifolia* (DC.) Kitag. *(R. islandica* (Oed.) Schinz et Thell; *R. palustris* (Leyss.) Bess. *)* – Icelandic watercress
			Rorippa austriaca (Crantz) Bess. – Austrian watercress

10.	*Rosaceae* Juss. – Pink	*Potentilla*	*Potentilla supina* L. – Low cinquefoil
			Potentilla reptans L. – Creeping cinquefoil
11.	*Lythraceae* J.St.- Hil. – Lythraceae	*Lythrum*	*Lythrum salicaria* L. – Willow-leaved loosestrife
12.	*Hypericaceae* Juss. - St. John's wort	*Hypericum*	*Hypericum quadrangulum* L. (*N. tetrapterum* Fries; *N. acutum* Moench. now. illegit.) - 3 willow four-winged
13.	*Onagraceae* Juss. – Willowherb (Nickweed)	*Epilobium*	*Epilobium palustre* L. – Fireweed
14.	*Apiaceae* Lindl. – DonkeyCelery (Umbelliferae)	*Berula*	*Berula erecta* (Huds.) Cov. *(Sium erectum Huds.)* – Berula straight
15.	*Polygonaceae* Juss. – Buckwheat	*Rumex*	*Rumex patientia* L. – Spinach sorrel
		Polygonum	*Polygonum amphibium* L – Amphibian knotweed
			Polygonum hydropipe L - Water pepper, water pepper
			Polygonum lapathifolium L. – Buckwheat (Polygonum) sorrel-leaved
			Polygonum persicaria L – Buckwheat
16.	*Primulaceae* Vent. – Primroses	*Samolus*	*Samolus valerandi* L. – Northerner Valeranda
		Lysimachia	*Lysimachia vulgaris* L. – Common loosestrife
17.	*Apocynaceae* Juss . – Apocynaceae	*Trachomitum*	*Trachomitum sarmatiense* Woodson – Sarmatian kendyr
18.	*Laimiaceae* Until. – Lamiaceae (Labiatae)	*Scutellaria*	*Scutellaria galericulata* L. – Skullcap
		Lycopus	*Lycopus europaeus* L. – European watercress
		Menta	*Mentha caucasica* Yand. – Caucasian mint (long-leaved)
			Mentha aquatica L. – Water mint
19.	*Scrophulariaceae* Juss. – Norichnikovye	*Veronica*	*Veronica anagallis-aquatica* L. – Spring Veronica
			Veronica beccabunga L . – Veronica potochnaya
20.	*Asteraceae* Dumort . (*Comnositae*) – Asteraceae (Compositae)	*Eupatorium*	*Eupatorium cannabinum* L. – Eupatorium hemp-like
		Bidens	*Bidens tripartite* L. – Three-part succession
		Sonchus	*Sonchus palustris* L. – Marsh sow thistle
21.	Typhaceae Juss . – Cattails	*Typha*	*Typha latifolia* L. (*T. shulttleworthii* C. Koch et Sond .) – Broadleaf cattail
			Typha angustifolia L. – P ogoz angustifolia
22.	*Sparganiaceae* Rudolnhi – Sparganiaceae	*Sparganium*	*Sparganium erectum L.* (*S. polyedrum* (Ackers, et Graebn.) Juz .; *S. ramosum* Huds .) – Straight burdock
23.	*Potamogetonaceae* Dumort.	*Potamogeton*	*Potamogeton filiformis* Pers. – Filiform

	– Pondweeds		Potamogeton
			Potamogeton crispus L. – Curly garden plant
			Potamogeton natans L. – Floating Potamogeton
24.	*Alismataceae* Vent. – Chasmataceae	*Alisma*	*Alisma plantago aquatica* L.– Chastuha plantain
25.	*Poaceae* Barnhart – Poaceae (Grasses)	*Polypogon*	*Polypogon monspeliensis* (L.) Desf . – Monspelien's polybeard
		Phragmites	*Phragmites australis* (Cav.) Trin. ex Steud. (*Ph. communis* Trin.) – Reed southern
		Calamagrostis	*Calamagrostis pseudophragmites* (Hall fil.) Koel.– False reed grass
		Catabrosa	*Catabrosa aquatic* (L .) Beauv . – Water lily
		Poa	*Poa palustris* L – Marsh bluegrass
		Glycera	*Glycera fluitans* (L .) R . Br . – Mannik floating
			Glycera notata Chevall. (*G. Plicata* (Fries) Fries , *G. acutiuscula* H.Scholz) – Mannik folded
26.	*Cyperaceae* Juss. – Sedges	*Cyperus*	*Cyperus longus* L. – Long sedge
			Cyperus Glaber L. – Smooth cyperus
			Cyperus glomeratus L. – Syt crowded
		Juncellus	*Juncellus serotinus* (Rottb.) Clarke (*Cyperus serotinus* Rottb.) – Sitnichek late
		Scirpus	*Scirpus sylvaticus* L. – Common reed
		Schoenoptectus	*Schoenoplectus lacustris* (L.) Palla (*Scyrpus lacustris* L.)
			Schoenoptectus tabernaemontanii (CC Gmel .) Palla (S. tabernemontanii CCGmel.)
			Schoenoptectus triqueter (L.) Palla (S. triqueter L.) – Three-sided Schenoptectus
		Bolboschoenus	*Bolboschoenus maritimus* (L.) Palla (*B. compactus* (Hoffm.) Drob.) – Sea bulrush
		Eleocharis	*Eleocharis acicularis* (L.) Roem.etSchult. – Needle moth
			Eleocharis quinqueflora (FX Hartm.) O.Schwarz (*E. pauciflora* (Lightf) Link) – Five-flowered marsh grass
			Eleocharis uniglumis (Link) Schult. (*E. multiseta Zinserl.*) – Marsh grass single-scaled
			Eleocharis palustris (L.) Roem.et Schult. (*E. eupalustris* Linld.fil., *E. crassa* Fisch. et CA Mey. ex Zinserl.; *E. intersita* Zinserl.) – Swamp swamp
		Carex	*Carex remote* L.– Sedge spread

			Carex pseudocyperus L.– Sedge false
			Carex dilute Bieb .– Light sedge
			Carex hirta L.– Short-haired sedge
			Carex hordeistichos Vill .– Barley sedge
			Carex acutiformis Ehrh .– Sedge false-acute
			Carex riparia Curt.– Coastal sedge
		Cladium	*Cladium mariscus* (L.) Pohl – Common sword grass
27.	*Lemnaceae* SFCrav – Duckweed	*Lemna*	*Lemna minor* L. – Duckweed
			Lemna trisulca L . – P ternate clover
28.	*Juncaceae* Juss. – Sitnikovye	*Juncus*	*Juncus articulatus* L.– Sitnik articulate
			Juncus bufonius L.– Sitnik froglike
			Juncus Gerardii Loisel.– Sitnik Gerard
			Juncus effusus L. – Divergent rush
			Juncus inflexus L. – Inflexible rush
Total:		47	78

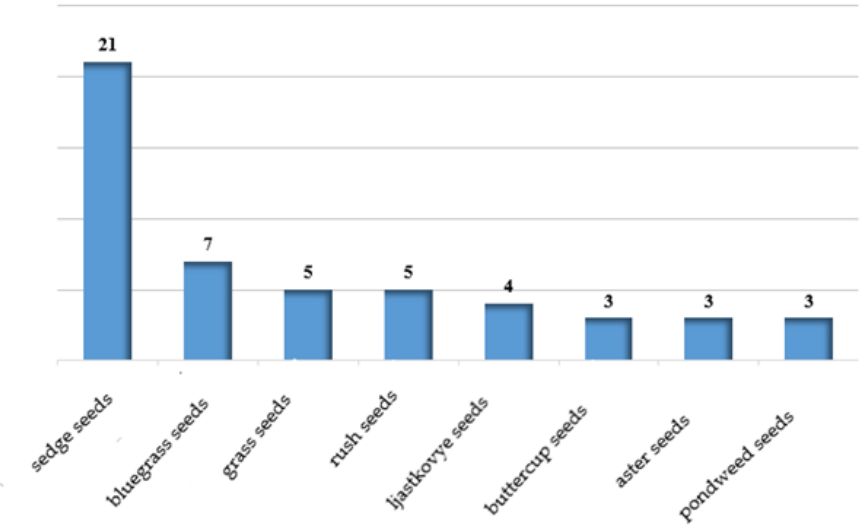

Figure 1: *The numerical ratio of aquatic plants in the Chechen Republic*

According to the classification of K. Raunkier, among 78 species there are 3 biomorphs – hemicryptophytes, cryptophytes and therophytes.

Hemicryptophytes 34 species: *Aquilegia caucasica* – Caucasian columbine , *Potentilla reptans* – Creeping cinquefoil, *Lythrum salicaria* – Willow-leaved loosestrife, *Epilobium palustre* – fireweed, *Rumex patientia* – Spinach sorrel, *Samolus valerandi* – Northern sorrel Valeranda, *Lysimachia vulgaris* – Loosestrife common, *Juncus inflexus* – Sickweed, *Schoenoptectus triquette* – Schenoplektus triangularis, *Scirpus sylvaticus* – Forest reed, *Cyperus longus* – Long-leaved sedge, *Catabrosa aquatic* - Water Adjutant, *Veronica beccabunga* - Veronica Potochnaya and others.

Cryptophytes 30 species: *Equisrtum arvense* – Horsetail, *Equisrtum fluviatile* – X Marsh wax, *Marsilea quadrifolia* – Marsilea quadrifolia, *Iris pseudacorus* – Yellow Iris, *Ranunculus repens* – Creeping Buttercup , *Butomus umbellatus* – Umbrella rush, *Rorippa austriaca* – Austrian watercress, *Berula erecta* – Berula erecta, *Polygonum amphibium* – Amphibian knotweed, *Veronica anagallus - aquatica* – Spring Speedwell, *Typha latifolia* – Broadleaf cattail, *T. angustifolia* – Narrow-leaved cattail , *Sparganium erectum* – Straight bur-reed, *Alisma plantago - aquatica* – Plantago alimentosa, *Potamogeton biliformis* – thread-leaved pondweed, *P. natans – floating pondweed* , etc.

Therophytes 14 species: *Salvinia natans* – Salvinia natans, *Trapa hyrcana* – Hyrcana Chilim, *Ranunculus sceleratus* - Poison buttercup, *Potentilla supine* – Cinquefoil low, *Polygonum amphibia* – Buckwheat (Polygonum) amphibian , *P. lapathifolium* – G. (buckwheat) sorrel-leaved, *P. persicaria* – G. (buckwheat) bird-leaved, *Bidens tripartite* – Three-part Bidens, *Polipogon monspeliensis* – Hemp-beard, *Cyperus Glaber* - Naked sedge, *Lemna minor* – Duckweed, *Cyperus glomeratus* – *Lemna trisulca* – P. trifoliate and *Juncus bufonius* – frog rush [7] .

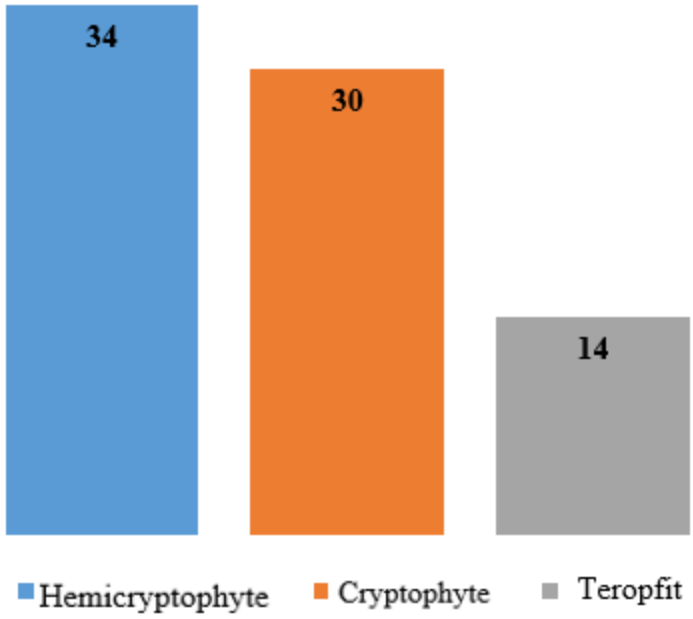

Figure 2: *Biomorphological analysis of aquatic species of the Chechen Republic*

In the process of human anthropogenic impact on nature, species that are small in number or are found scattered, rare, or very rare are at risk.

The largest number of species (32) are **scattered** , which is 41.02%: *Carex hordeistichos* Vill . – Barley-growing sedge, *Eleocharis palustris* (L.) Roem . et Schult – Marsh moth, *Schoenoptectus triqueter* (L.) Palla . – Chenoplectus triquetrum, *Scirpus sylvaticus* L. – Forest reed, *Juncellus serotinus* (Rottb .) Clarke – *Glycera notes* Chevall . (*G. Plicata* (Fries) Fries , *G. acutiuscula* H. Scholz) – Mannik plicata, *Potamogeton natans* L. – Floating pondweed, *Sparganium erectum* L. (*S. polyedrum* (Ackers , et Graebn .) Juz.; *S. ramosum* Huds .) – Straight burdock, *Sonchus palustris* L. – Marsh sow thistle, *Eupatorium cannobinum* L. – Hemp agrimony, etc.

Typically 28 species (35.89%) are found: *Ranunculus repens* L. – Creeping buttercup, *Potentilla reptans* L. – Creeping cinquefoil, *Typha angustifolia* L. – Narrow-leaved cattail, *Catabrosa aquatica* (L.) Beaur . – Water lily, *Schoenoptectus lacustris* (L.) Palla . – Lake Schenoplektus, *Bolboschoenus maritimus* (L.) Palla – Sea club-rush, *Carex riparia* Curt . – Coastal sedge, *Juncus gerardii* Loisel . – Sitnik Gerard et al.

Rarely found 17 species (21.79%): *Lemna trisulca* L. – *Carex* trifoliate*pseudocyperus* L. – False sedge, *Eleocharis uniglumis* (Link) Schult – Cyperus *glomeratus* L. – Crowded cyperus, *Polipogon monspeliensis* (L.) Desf . – *Polygonum amphibia* L. – Knotweed (buckwheat) amphibious, *Potamogeton biliformis* Pers . – Thread-leaved pondweed, etc.

Very rare 1 species is found, which makes up 1.28%: *Cladium mariscus* (L.) R. Br . – Common sword grass [7] .

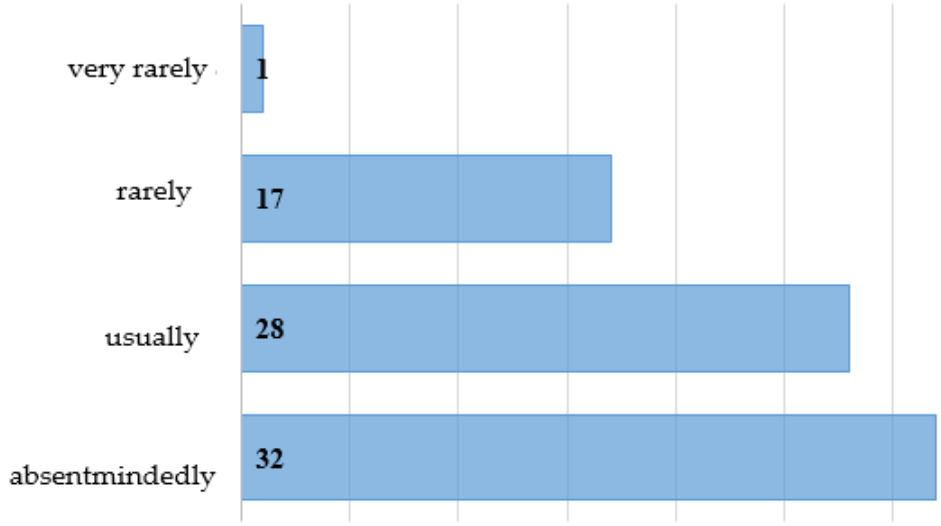

Figure 3: *Analysis of the occurrence of aquatic plant species in the Chechen Republic*

IV. Discussion

The systematic and biomorphological analysis is a scientific study focused on the flora of aquatic and riparian ecosystems in this region. The primary goal of this analysis is to examine the species diversity, taxonomic classification, biomorphological features, and ecological adaptations of aquatic plants in the specific environmental conditions of the Chechen Republic. This analysis can be broken down into several key components.

First, the **systematic analysis** involves the classification and identification of plant species present in the water bodies, such as rivers, lakes, ponds, and wetlands, as well as in adjacent shoreline areas. This process includes determining the species composition of aquatic plants, grouping them into families, genera, and species based on traditional morphological and molecular data, and analyzing their geographical distribution. It also involves comparing the local flora with that of other regions to understand regional uniqueness and shared characteristics. For example, a taxonomic breakdown may include species like Potamogeton natans (floating-leaved pondweed) from the family Potamogetonaceae, part of the class Monocotyledonae.

Second, the biomorphological analysis focuses on the morphological characteristics and life forms of aquatic plants, as well as their adaptations to the aquatic environment. This includes studying the anatomical and morphological features of the plants, such as leaf shapes, stem structures, root systems, and reproductive organs. Moreover, plants are classified according to their life forms and survival strategies in aquatic habitats, such as hydrophytes (fully submerged plants) and hygrophytes (plants growing in wet soils). These adaptations include specialized structures like aerenchyma (air-filled spaces in tissues for gas exchange), hydrophilic leaf structures optimized for water absorption, and reproductive strategies such as floating seeds or vegetative propagation. Examples include fully submerged species like *Elodea* and amphibious plants like reeds and rushes that thrive in wetland areas.

In addition to biomorphological characteristics, this analysis also examines ecological factors influencing plant growth and distribution, such as hydrological conditions (water levels, flow rates) and the impact of anthropogenic activities like agriculture, pollution, and water regulation.

Understanding these factors helps in assessing the overall health of aquatic ecosystems and the adaptability of plant species to changing environmental conditions.

The significance of this research lies in its contribution to the conservation of biodiversity. By identifying rare or endemic species and evaluating the threats to their survival, such studies play a crucial role in the development of conservation strategies. Additionally, the findings from this analysis support better management and restoration of aquatic ecosystems, particularly in the face of climate change and human impact. This type of systematic and biomorphological analysis is essential for understanding the structure, function, and preservation of aquatic plant communities in the Chechen Republic's water bodies.

Among the aquatic plants of the study area, the most numerous in terms of species content are the family *Cyperaceae* Juss . – Sedge (21 view). Family *Poaceae* Barnhart – Poaceae (7 species), *Polygonaceae* Juss . – Buckwheat and *Juncaceae* Juss . – Rush (5 species), 4 species belong to the *Laimiaceae family* Until . – Lamiaceae, the families Ranunculaceae, Asteraceae and Podestaceae have 3 species each, 7 families have 2 species, 13 families contain only 1 species each.

According to the classification of K. Raunkier, among 78 species there are 3 biomorphs. There are 34 species of hemicryptophytes, 30 species of cryptophytes, and 14 species of therophytes.

According to the occurrence analysis, 32 species are scattered, 28 are commonly found, 17 are rare, and 1 species is very rare.

The results of this study show that aquatic plants of the republic contribute to the richness of plant diversity, indicating the need for conservation and protection of the study area.

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