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Distribution patterns, floristic structure and habitat requirements of the alpine river plant community *Stuckenietum amblyphyllae* ass. nova (*Potametea*) in the Pamir Alai Mountains (Tajikistan)

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Abstract

This paper discusses the floristic structure, distribution and habitat requirements of a new aquatic syntaxon, *Stuckenietum amblyphyllae* ass. nova. Patches of the *Stuckenietum amblyphyllae* association occur in the Pamir Alai Mountains in Middle Asia (Tajikistan). The biotope of this community represent high mountain rivers and ponds at the bottom of glacial river valleys situated at elevations between 1900 and 3800 m. Patches of the *Stuckenietum amblyphyllae* association are characterised by a clear predominance of the typical species, i.e. *Stuckenia amblyphylla*, which occupies an aerial extent of between near 40 up to 90% of the surface studied. Patches of the community are poor in species, comprising a maximum of five taxa. Among associated species mainly rush, aquatic, meadow and marsh taxa have been noted. The *Stuckenietum amblyphyllae* community prefers cold, open, alkaline waters with medium flow-rate, ranging in depth from 15 to 75 cm. It is also, but rarely, found in the mountain ponds. Together with the *Stuckenia filiformis* community it designates in the Pamir Alai Mountains the upper limit of aquatic vegetation.

Keywords: *Stuckenia amblyphylla*, syntaxonomy, distribution, aquatic vegetation, new plant association

Introduction

Tajikistan is a country located almost entirely in the central part of the Pamir Alai Mountains – one of the main mountain systems in the Middle Asia, lying on the border of the subtropical and temperate zones. Tajikistan is also one of the regions richest in plant species diversity in the former Soviet Union. According to the ten-volume study of the flora of the former Soviet Socialist Republic of Tajikistan, completed by a multi-author team and supplemented by the works of other researchers, ca 4550 vascular plant species are known from the country [1]. This number is not final as recently some new species have been reported from Tajikistan [2-6] and new records to its flora have been added [7-12]. According to the literature, ca 30% of the entire flora of vascular plants known from Tajikistan are generally accepted endemics of the country (endemics sensu stricto + subendemics) [1,13,14].

Hydrophyte communities of flowing and standing waters represent poorly known type of vegetation both in Tajikistan and in a whole Middle Asia. Information about these phytocoenoses is scanty and related mostly to the species composition in terms of their ecological classification. It pertains mainly to the aquatic flora. Research on vegetation in Tajikistan was previously based on the principles of Russian phytosociological school, according to which the individual syntaxa are not distinguished and thus the studies were generally limited to indicating only the main types of vegetation at the level of syntaxonomic classes (e.g., poimennaya rastitel'nost' – communities of aquatic plants occurring in river valleys). Aquatic and rush vegetation was described in very general terms, supplying information on just a few main species, which dominated the communities [15-17].

Plant communities of flowing waters show considerable differences in species composition due to variable habitat conditions, i.e. physical-chemical properties of water, trophic conditions and flow rate [18-20]. In Central Europe, until now, few types of aquatic phytocoenoses have been recognized and described. For example in Germany nine syntaxa have been classified within the *Ranunculion* alliance: *Ranunculetum fluitantis* (Allorge 1922) W. Koch 1926, *Sparganio-Potamogetonetum interrupti* (Hilbig 1971) Weber 1976, *Ranunculo trichophylli-Sietum submersi* Th. Müller 1962, *Groenlandietum densae* de Bolós 1957, *Callitricho hamulatae-Myriophylletum alternifolii* (Steusloff 1939) Weber-Oldecop 1967, *Veronico beccabungae-Callitrichetum stagnalis* (Oberd. 1957) Th. Müller 1962, *Callitricho-Ranunculetum penicillati* Dethioux et Noirfalise 1985, *Callitrichetum obtusangulae* Seibert 1962 and *Ranunculetum hederacei* (R. Tx. et Diemont 1936) Libbert 1940 [21]. The classification of Schubert et al. is slightly different [22]: *Callitricho hamulatae-Ranunculetum fluitantis*

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Oberd 1957, *Ranunculetum fluitantis*, *Veronico-Beruletum erecti* (Roll 1939) Pass. 1982, *Callitricho-Potamogetonetum berchtoldii* Pass. 1982 and *Sparganio emersi-Potamogetonetum pectinati* Hilb. 1971. In Poland, there are three main types of phytocoenoses: *Ranunculetum fluitantis* – occurring mainly in the lowlands, in clean, eutrophic rivers, *Ranunculo-Callitrichetum hamulatae* Oberd. 1957 em. Müll. 1977 – in cold and fast-flowing, non-calcareous waters in the lowlands and at the foothills and *Ranunculo-Sietum erecto-submersi* (Roll 1939) Müll. 1962 – occurring in clean, well-oxygenated and fast-flowing alkaline waters [23,24]. From Slovakia only two associations have been reported: *Potametum nodosi* Pass. 1964 and *Groenlandietum densae* de Bolós 1957 [25]. In Tajikistan, a native phytosociological system has not been worked out yet; hence, the only system that could be considered for use is that of Korotkov et al. designed for the territory of the former Soviet Union [26]. In this system the order *Callitricho-Batrachietalia* Pass. 1978 is distinguished with three associations from *Batrachion aquatilis* Pass. 1964 alliance: *Batrachietum circinati* Segal 1965, reported from Ukraine and Lithuania, *Batrachietum rionii* Hejný et Husak 1978 – from the delta of the Volga River and *Batrachio trichophylli-Callitrichetum cophocarpae* Soó (1927) 1960 – from Bashkiria. The typical fast-flowing water alliance – *Ranunculion fluitantis* Neuhäusl 1959 has not been yet reported from Middle Asia.

Generally, several authors have emphasized relatively high similarity of the physiognomy and species structure between different communities of fast-flowing waters, which is probably caused by the low diversity of aquatic habitats between different geographic regions. Some of the authors suggest, that the phytosociological method is not appropriate to study the aquatic vegetation of *Ranunculion* alliance [18,27-29]. However, in determining the protected habitats, both in Poland and other EU countries, it was the phytosociological Braun-Blanquet method that was considered as the reference research attitude [29,30].

The importance of communities of the *Ranunculion fluitantis* alliance for the maintenance of vegetation diversity and rather limited knowledge on their character and distribution in Middle Asia, were the major reasons for undertaking new research on aquatic vegetation of Tajikistan. As a result, in this paper a new association of *Stuckenia amblyphylla* (C. A. Mey) Holub, plant species relatively rare in Middle Asia, is described.

Current chorology of this association in Tajikistan is discussed here in terms of its structure, distribution range and phytosociological classification.

Methods

Field studies were carried out between the years 2007 and 2010, in a summer season (from June to July), in the mountain streams and lakes within two main Tajikistan mountainous systems: Alai and Pamir (Fig. 1). The absolute altitude of this area reaches 5500 m above sea level in the Zeravshan mountains and is close to 7500 m in the mountains of western Pamir. The low-lying areas are the outlets of the river valleys – ca. 850 m above sea level. The climate of the mountains of Tajikistan is typically alpine, although, because of a continental location and less rainfall it is supposed to be more acute. During field exploration a search for the presence of *S. amblyphylla* and its community was made in

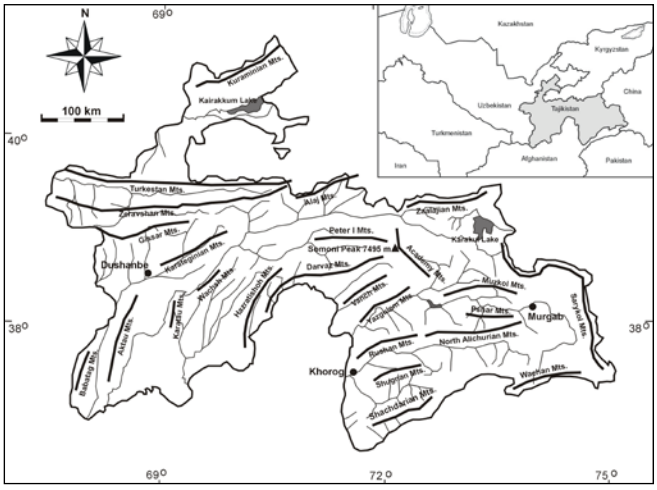

Fig. 1 The study area (Tajikistan) with main rivers, mountain ridges and cities.

more than 30 streams and rivers, and in about 15 mountain lakes in the Chimtarga Massif, Balshaya Ganza, in the valleys Arkh, Allovodi, Sarytag, Kulikalon, Kshtut, Iskander-daria, Mogien-daria, Pasrud-daria, Jagnob, Varzob, Kullon, Vakhsh, Zeravshan (Zeravshan Mts) and Vanch, Pyandzh, Shakhdara and Surchob (Pamir Mts).

Generally, 12 sites and 22 vegetation plots with *Stuckenia amblyphylla* were sampled using the phytosociological Braun-Blanquet approach [31]. The phytosociological relevés were made in streams (16), mountain lakes (3) and small, shallow puddles (3). All collected specimens have been deposited in the herbaria of Opole University (OPUN) and Jagiellonian University (KRA). The plant nomenclature follows Kaplan [32] for *Stuckenia* species and Czerepanov [33] for the rest of the species found.

To determine the habitat conditions, for some patches of vegetation the following parameters were studied: flow velocity class (stagnant; low flow velocity – from just visible to ca. 30 cm × s^{-1}; medium – ca. 35-65 cm × s^{-1}; high – more than 70 cm × s^{-1}), alkalinity (with ELMETRON CP-105 pH meter), conductivity (μS × cm^{-1} also measured with hand-held ELMETRON CC-105), bed material (substrate: rock, gravel, sand or mud), water temperature, width of the river and water depth, shading of the river (relative cover of woody vegetation growing on the banks) and altitude. For all sampled vegetation plots also geographical co-ordinates were given.

Results

Syntaxonomical position of the association

The patches of *Stuckenietum amblyphyllae* association appear mainly in streams with medium flow velocity, with cold and oligotrophic water. It was the main reason of including it into the *Ranunculion fluitantis* alliance.

Cl.: *Potametea* Klika in Klika et Novak 1941
O.: *Potametalia pectinati* W. Koch 1926
All.: *Ranunculion fluitantis* Neuhäusl 1959
Ass. *Stuckenietum amblyphyllae* ass. nova (holotypus – rel. 2, Tab. 1)

Tab. 1 The *Stuckenietum amblyphyllae* ass. nova (rel. 1-17; holotypus – rel. 2), community with *Stuckenia amblyphylla* (rel. 18-22).

Successive number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		
day	2	2	14	17	14	2	18	17	2	2	2	20	21	1	18	4	2	17	21	20	16	19		
month	7	7	6	6	6	7	6	6	7	7	7	6	6	7	6	7	7	6	6	6	6	6		
year	2009	2009	2008	2008	2008	2009	2009	2007	2009	2009	2009	2008	2008	2008	2009	2008	2009	2008	2008	2008	2008	2008		
Altitude (m a.s.l.)	2040	2110	2220	2220	2220	2100	1984	2200	2100	2110	2100	2470	2640	2810	1984	2000	2038	2215	2640	2500	2450	2720		
Cover of c layer (%)	70	85	75	45	95	90	70	65	75	70	60	60	70	95	80	40	80	40	50	50	45	20		
Cover of d layer (%)	-	-	-	-	-	-	35	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Relevé area (m²)	2	3	4	2	6	3	5	4	4	4	5	10	4	10	4	10	4	2	3	3	5	4		
Locality	Wa	Wa	Ik	Ic	Ik	Wa	MA	Ik	Wa	Wa	Wa	P	A	Sh	MA	BP	Wa	Ic	A	P	Kk	A		
Number of species	3	3	3	3	2	3	3	4	2	2	2	3	3	3	4	2	2	3	2	1	1	1		
Ch. Ass. *Stuckenietum amblyphyllae*																							1-17	18-22
Stuckenia amblyphylla	4	5	5	3	5	5	4	4	4	4	3	3	4	5	4	3	5	3	4	4	3	2	V	5
Ch. All. *Ranunculion fluitantis*																								
Veronica beccabunga "*submersa*"	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	-
D. O. *Potametalia pectinati*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	-
Potamogeton berchtoldii	.	.	+	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	-
Others																							-	-
Chara vulgaris	.	1	.	.	.	1	3	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II	-
Algae indet.	1	.	.	.	.	1	.	.	2	2	1	.	.	.	.	.	.	.	.	.	.	.	II	-
Phragmites australis	.	.	+	+	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II	-
Halerpestres sarmentosa	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	.	.	.	.	.	I	-
Triglochin palustre	.	.	.	.	.	.	.	.	.	.	.	2	+	.	.	.	.	.	.	.	.	.	I	-
Hippuris vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	.	.	.	I	-
Equisetum arvense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	.	.	.	-	2
Carex sp.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	I	-
Catabrosa capusii	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	I	-
Polygonum sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	I	-
Veronica anagallis-aquatica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	I	-
Eleocharis argyrolepis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	I	-
Epilobium minutiflorum	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	-
Plantago major		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	-	1

A – lake in Allowodi valley; BP – between Barzud and Pushan in Pyandzh valley (stream); Ic – melioration channel near Iskanderkul Camping; Ik – stream near Iskanderkul lake; Kk – Karakul stream; MA – Matcha village (puddle); P – Pasruddarya stream; Sh – Shivoz valley in Western Pamir (stream); Wa – Wanch (stream).

Floristic structure, ecology and habitat preferences of *Stuckenietum amblyphyllae*

Patches of the *Stuckenietum amblyphyllae* association are characterised by a clear predominance of a single, typical species – *Stuckenia amblyphylla*, which reaches coverage of approximately 40 to 90% of the sampled vegetation plot (on average about 60%). A slightly stronger growth and a greater coverage were noted in streams in comparison to stagnant waters. Patches of this association, similarly to other communities of *Ranunculion fluitantis* alliance, are poor in species and comprise a maximum of five taxa. Only in two patches *Veronica beccabunga* "submersa" had been found, the species which is yet another one regarded as diagnostic for *Ranunculion* alliance. Amongst typically aquatic species from the *Potametea* class the occurrence of *Potamogeton berchtoldii* was noted in three patches. Other taxa representing different vegetation types had a small share and their constancy in the community did not exceed 20%. These were mainly species recruited from the neighbouring rush communities (*Phragmites australis*, *Hippuris vulgaris* or *Epilobium minutiflorum*) and marshes (*Veronica beccabunga*, *Triglochin palustre* or *Catabrosa capusii*). Other species represented wet habitats, often nitrophilous biotopes. These were *Halerpestres sarmentosa* or *Equisetum arvense*, which appear in Tajikistan very frequently in riparian forests or in the wet meadows (Tab. 1).

The patches of the *Stuckenietum amblyphyllae* association appeared as separated from other aquatic plant communities. Exceptionally, the association creates a mosaic with patches of submerged *Chara vulgaris* or, in case of shallow pools ,with low rush communities with *Eleocharis argyrolepis*. Patches with *Chara vulgaris* occurred in the most alkaline and rather shallow waters.

Stands of this new association occur in high-altitude alpine landscapes in cool streams of medium flow velocity. They were mostly found in small streams in U-shaped, flattened valleys eroded by glaciers, at altitudes of about 1900 to almost 3000 m above sea level. The patches of the community appeared mostly in waters that were clean, transparent and oligotrophic, although it has been found that it is capable of withstanding the relatively high siltation.

The *Stuckenietum amblyphyllae* prefers cool, open waters (although it also develops in slightly shadded areas, in the vicinity of bushes and trees) with a depth of about 15 to 75 cm. They are usually streams with a medium flow rate (ca. 0.35-0.65 $m \times s^{-1}$), rather than irrigation channels or shallow puddles and pools (Tab. 2). Patches of the community were also found in the mountain lake bays, where it occurred in the littoral and outlet zone. In most cases, the river bed consisted of organic alluvium, mixed with fine-grained or silty substrates. Only in a few cases, sandy gravel fractions dominated . In all cases, the aquatic environment was alkaline, sometimes exceeding the 8 value of pH. The content of dissolved salts in water, expressed as the value of conductivity, ranged from 190 to 315 $\mu S \times cm^{-1}$ with an average of about 212.

Discussion

The community of *Stuckenietum amblyphyllae* is clearly different from other communities occurring in alpine waters. It occupies mainly habitats with cold, flowing waters on a mineral substrate but with a distinct ingredient of organic sediments (muds or detritus). The association is a typical community occurring in U-shaped glacial valleys. In V-shaped river valleys, with considerable drops and the rapid current, the plant communities could hardly find favourable conditions to develop. This is the case in e.g., the lower sections of rivers Varzob, Takob and others in Hissar Mts. The range of the association is limited to the high mountains, where the bottoms of the glacial valleys are at an elevation higher than 2000 m. That is why this community does not have suitable habitats in the mountains of northern Asia and Europe. In the Alps, for example, communities of the *Ranunculion fluitantis* alliance occur up to near 1500 m in the foothills and highlands [34,35]. Only in the Andes similar alpine plant association is known from elevations greater than 3000 m – *Stuckenietum punensis* Galán De Mera et al. 2003 [36]. Studies carried out in Tajikistan demonstrate that *Stuckenietum amblyphyllae* appeared first of all in mountain streams and brooks at medium-elevations from about 1900 to 2850 m. Its centre of distribution in this country lays in the middle of and also at the highest altitudes of the Zeravshan Mts, where it was found in a few streams and water channels, for example, around Iskanderkul Lake and in the valleys of the rivers Pasrud-daria, Kara-kul and Iskander-daria. In the eastern Zeravshan Mts this association is rare, having been noted only near the village of Matcha. The same holds true for western Pamir Mts, where it was found at few places in the valleys of the rivers Pyandzh, Vanch and Shakhdara. Despite surveying thoroughly many valleys in the Hissar Mts (eg. Takob, Khondara, Sorbo, Sardai-Miena, Varzob rivers and a few smaller ones), as well as in Pamir Mts (valley of the Surchob river and its tributaries), no patches of the *Stuckenietum amblyphyllae* community had been found there (Fig. 2).

The potential range of the distribution of the *Stuckenietum amblyphyllae* association is obviously included within the range of the characteristic species, *Stuckenia amblyphylla*. This

Tab. 2 Habitat characterization of the *Stuckenietum amblyphyllae* ass. nova in Tajikistan.

Relevé number	location	Altitude (m)	River width (m)	Water temperature (°C)	Conductivity ($\mu s \times cm^{-1}$)	pH	Water depth (cm)	Flow velocity	Shading	Bed material
1	N 38 32 51; E 71 44 45	2040	2.0	11.5	230	7.8	25	medium	0	mud-gravel
2	N 38 34 31; E 71 48 22	2110	1.5	10.5	245	8.2	10	medium	0	mud-gravel
3	N 39 05 19; E 68 22 13	2220	2.5	10.8	180	7.7	60	medium	strong	mud
4	N 39 05 11; E 68 22 10	2220	0.3	10.4	250	7.8	35	high	slight	mud
5	N 39 05 19; E 68 22 14	2220	2.5	11.8	260	7.8	75	medium	strong	mud
6	N 38 34 14; E 71 47 53	2100	2.0	11.0	185	8.2	15	medium	0	mud-gravel
7	N 39 25 50; E 69 28 39	1984	puddle	18.5	315	8.3	15	0	0	mud
8	N 39 05 13; E 68 22 12	2200	3.0	11.2	190	7.8	50	medium	slight	mud
9	N 38 34 12; E 71 47 58	2100	2.0	11.0	190	8.1	15	medium	0	mud-gravel
10	N 38 34 31; E 71 48 21	2110	1.5	10.5	245	8.2	10	medium	0	mud-gravel
11	N 38 34 12; E 71 47 59	2100	2.5	11.0	205	8.3	20	medium	0	mud-gravel
12	N 39 15 22; E 68 19 17	2470	3.0	-	210	7.9	10	medium	0	mud
13	N 39 14 55; E 68 15 58	2640	1.0	-	210	7.9	25	low	0	sand-gravel
14	N 37 11 30; E 71 52 00	2810	3.0	-	217	7.7	20	low	0	mud
15	N 39 25 50; E 69 28 40	1984	puddle	18.5	305	8.1	35	0	slight	mud
16	N 37 56 47; E 71 34 13	2000	4.0	12.0	-	-	70	medium	0	mud
17	N 38 32 51; E 71 44 46	2038	2.5	11.5	225	8.0	35	medium	0	mud-gravel
18	N 39 05 11; E 68 22 09	2215	0.3	10.1	215	7.8	30	high	slight	mud
19	N 39 14 55; E 68 15 58	2640	1.0	-	215	7.7	15	low	0	mud-gravel
20	N 39 15 52; E 68 18 33	2500	4.0	-	215	7.7	40	high	0	sand-gravel
21	N 39 02 10; E 68 16 46	2450	0.5	9.0	155	7.9	70	high	slight	mud
22	N 39 14 40; E 68 15 43	2720	lake	12.0	195	7.6	20	0	slight	mud-gravel

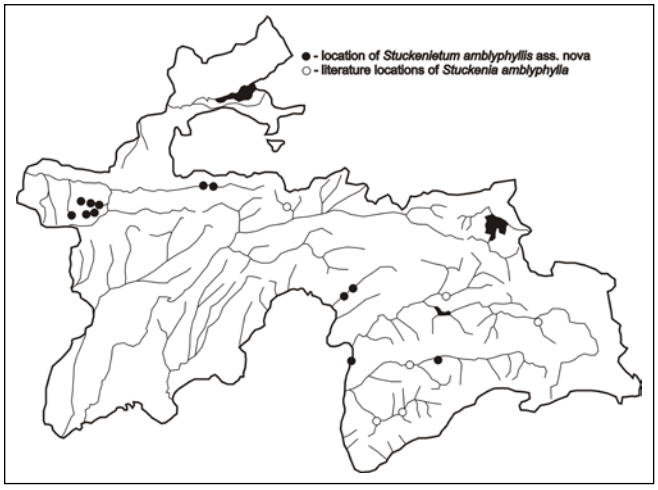

Fig. 2 The distribution of the *Stuckenietum amblyphyllae* ass. nova and *Stuckenia amblyphylla* in Tajikistan.

species occurs in Middle Asia, Pamir Mts, Karakorum Mts and Caucasus Mts at altitudes from about 1800 to 3800 m above sea level [32]. Considering frequent confusion of *S. amblyphylla* and *S. pamirica*, presently known distribution of both taxa will have to be revised. What is certain, however, is that the species covers mountain areas of Middle Asia with some satellite locations in south-western part of the continent. Revision of the material from Dushanbe (TAD) and Tashkent (TASH) herbaria has shown that a significant part of stored specimens identified as *S. pamirica* belonged in fact to *S. amblyphylla* [35]. These species differ, among other traits, in the closure of the leaf sheath and in the blunt or rounded leaf ending in *S. amblyphylla* [32]. Taking all this into consideration, the community of *Stuckenietum amblyphyllae* will probably have more compact range in the middle Asian mountainous systems (Pamir-Alai, Kopet-Dag, Tien Shan) and more scattered in Caucasus and Elburs Mts.

Similarly to the other communities built up of the pondweeds, the *Stuckenietum amblyphyllae* also occurs in stagnant or nearly stagnant waters – a small, shallow pools and periodic puddles, as well as in mountain lakes. Such situation, were the pondweed species occur in *Potamion* as well as in *Ranunculion* communities have been reported also from Poland. It was observed not only for the diagnostic species of stagnant water associations (e.g. *Stuckenia pectinata*, *Potamogeton alpinus*, *P. praelongus*, *P. polygonifolius*) but also for the pondweeds regarded as characteristic for flowing waters like *Potamogeton nodosus* [37-39]. In lakes or puddles water is cold as well, oligotrophic with a relatively fast water exchange and waves buttering caused by frequent strong winds. The *Stuckenietum amblyphyllae* occurs in the outlet zone of the lake, where, periodically, during high water discharge, some small water movements occur. Also the puddles located within large valleys, not far from the main stream of the river, during the flood time, may be included into the river flow. In such places the physiognomy of the community is slightly different, which is

Fig. 3 A stand of the *Stuckenietum amblyphyllae* ass. nova in stream near Iskander-kul lake in north Tajikistan.

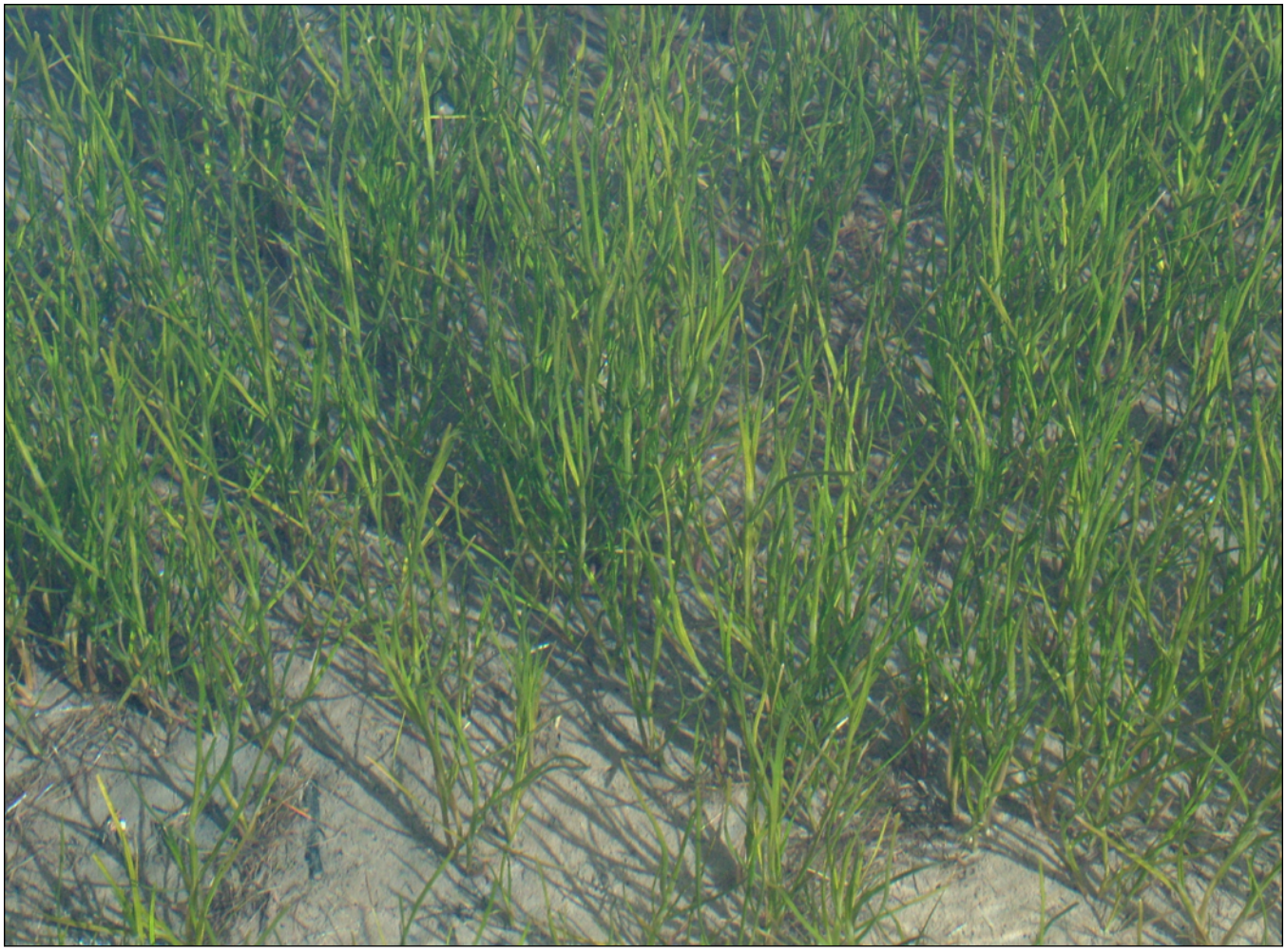

Fig. 4 The *Stuckenietum amblyphyllae* ass. nova in Allowodi lake, in upper section of Pasrud-daria river.

expressed mainly by smaller specimens size, the lower cover rate in sampled vegetation patches and a slightly different morphology of plants (Tab. 1). So, considering the development of the patches of *Stuckenietum amblyphyllae*, the cover rate of the diagnostic species and the size of the individual specimens we are convinced, that the optimum habitat for the association is flowing water. Thus the association should be placed in *Ranunculion* alliance.

In terms of species richness and structure, the community of *Stuckenietum amblyphyllae* is quite uniform. The predominance of the characteristic species is very clear and in the case of wider rivers, or lack of shoreline vegetation from which rush or even pasture species can cross over, we are dealing with species-poor and occasionally monospecies communities of low diversity [40]. A similar situation is observed in case of aquatic association of *Stuckenia punensis* in the Andes, where only two species in patches of that community have been noted [36] as well as in other communities of oligo- or mesotrophic waters in Europe [41-44]. The physiognomy and structure of *Stuckenietum amblyphyllae* patches are typical for vegetation of *Ranunculion fluitantis* alliance (Fig. 3, Fig. 4), i.e. characterised by a domination of characteristic species, with variable cover size, from few up to ca. 90%.

The *Stuckenietum amblyphyllae* association together with *Stuckenia filiformis* patches demarcate in Pamir Alai Mts the upper limit of aquatic vegetation. Above that boundary, harsh habitat conditions, particularly high flowing rate of waters and a very short vegetation season, do not allow the development of vascular plant communities. Only some mats of algae were observed higher up. Therefore, the community is essential in the context of analyzing the vertical ranges of plant communities, including observations of vegetation changes in relation to the climate change [45,46].

Stuckenia amblyphylla and its community, because of the new findings and the dynamics of the general range of the species, can not be currently considered as endangered neither in Tajikistan, nor anywhere else, as it was formerly suggested by Kirschner and Kaplan [47]. Its condition depends mainly on a lack of regulation of mountain streams, which are not affected at present by any engineering works in Tajikistan. But even if there are such plans for the future this activity most likely will take place in the lower sections of the river, where there is no habitat of *S. amblyphylla*. However, we must bear in mind that in Europe the aquatic communities are quickly disappearing and that they respond very rapidly to all environmental changes caused by anthropogenic pressure [42,48-50].

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