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Contributions to the bryophyte flora of Kyrgyzstan

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Abstract: Based on a recent expedition, we report 36 moss species and one liverwort species from Kyrgyzstan. *Orthotrichum affine* Brid. is a new record for the country, and several species are reported as new to various provinces. Many of the species are common in large areas of the Northern Hemisphere, which demonstrates how the bryophyte flora of Kyrgyzstan is still poorly known.

Keywords: bryofloristics, Central Asia, distribution.

Introduction

Kyrgyzstan is a small, mountainous country in Central Asia. Its area is 199 950 km², of which 94% is more than 1000 m above sea level. The climate is continental with warm summers and cold winters. Annual rainfall varies in different parts of the country: foothills in the north and the Fergana Valley are dry in the summer, but in the mountains summer rains are common (MERZLYAKOVA 2002). More than half of the country is agricultural land, of which only 7 % is arable land and the rest is permanent pastures. At present forests cover only ca. 5 % of the country. In addition to Lake Issyk-Kul there are many small lakes and numerous brooks and rivers, but wetlands are scanty. The flora of Kyrgyzstan is rich due to the diverse mountains and the position of the country at the meeting point of different floristic elements (MERZLYAKOVA 2002). Ca. 10 % of vascular plants are endemic to the country (LAZKOV & UMRALINA 2015).

The bryophyte flora of Kyrgyzstan is poorly known. Apart from the checklist by BAIBULATOVA & RAHMATULINA (2015), which contains 169 moss species, the data on the bryophyte flora of Kyrgyzstan are scattered in several publications, many of them in Russian (cf. GREENE & HARRINGTON 1989). The "Check-list of mosses of East Europe and North Asia" by IGNATOV et al. (2006) compiles the floristic data. In that list we counted a total of 333 moss species recorded for Kyrgyzstan. It is relatively great number compared with neighbouring Kazakhstan, which is a much larger country; according to HRADÍLEK et al. (2011) only 390 moss species and 38 liverwort species are known from Kazakhstan. The bryophyte flora in the Chinese parts of the Tian-Shan Mountains has been studied by, e.g., ZHAO (1993) and MEMTIMIN & ZHAO (1996). ZHAO (1993) listed 225 moss species from the region and MEMTIMIN & ZHAO (1996) stated that they added eight moss species to the flora, although in fact six of them were already listed by ZHAO (1993).

In a classic expedition led by the Finnish bryologist V. F. Brotherus in 1896 to Turkestan, a large region east of the Caspian Sea in Central Asia, only 220 moss species were collected (BROTHERUS 1896, 1902, JÄRVINEN & KOPONEN 1975, KOPONEN & PIIPPO 2002). The first set of the specimens is in H and duplicates were distributed to several major herbaria as exsiccates under the name *Musci Turkestanici*, probably between 1899 and 1903 (SAYRE 1971). Part of the expedition took place in north-eastern Kyrgyzstan, especially around Lake Issyk-Kul. The list of taxa collected by Brotherus from Kyrgyzstan but missing from the checklist by BAIBULATOVA & RAHMATULINA (2015) is given in the Appendix 1.

Expedition 2009

In July-August 2009 botanists of the Finnish Museum of Natural History of the University of Helsinki (Leo Junikka, Marja Koistinen, Sampsa Lommi, Alexander Sennikov, Pertti Uotila and Henry Väre) conducted a ten-day expedition in Kyrgyzstan mainly to collect herbarium specimens of vascular plants. Smaller collections were made of mosses and liverworts (Lommi & Uotila), algae (Koistinen), lichens (Lommi) and other fungi (Uotila). Seeds and living plants were collected for the Helsinki Botanic Gardens (Junikka). Dr Georgy Lazkov participated in the expedition, representing the Institute of Biology and Soil Science of the Kyrgyz Academy of Sciences. He was responsible for the technical arrangements of the expedition.

The expedition visited Western Tian-Shan, (Kyrgyz, Suusamy, Chatkal, Pskem, Chandalash and Fergana Ranges, Babash-Ata and At-Oinok Mts.). Specimens were collected from 52 localities in Chüy, Talas and Jalal-Abad Regions. A diary of the expedition has been published separately (UOTILA 2010), as well as some important findings of vascular plants (SENNIKOV et al. 2011). The specimens collected are kept in H.

Collecting localities of mosses

The present list of localities, provided with the original numbering of all localities (see UOTILA 2010), includes, in ascending order, only the 19 localities

where bryophytes were collected. The locality numbers are printed on the labels of the herbarium specimens collected and indicated in the list of species given below. The biogeographical provinces given as abbreviations after the locality number are outlined and explained in Fig. 1 and they follow LAZKOV & SULTANOVA (2011).

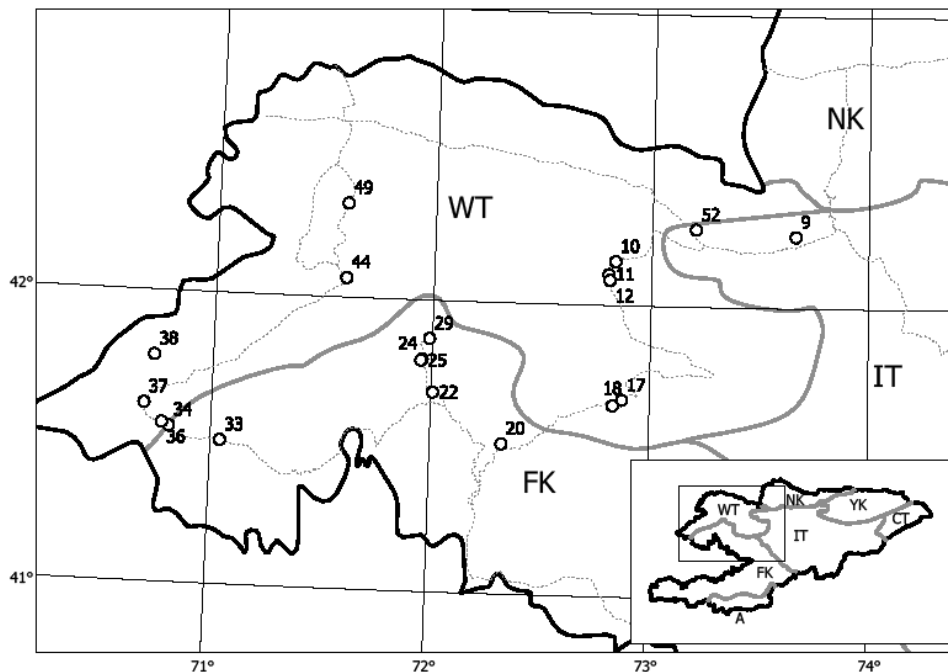


Fig. 1. The localities where bryophytes were collected by P. Uotila and S. Lommi in 2009 (for all collecting localities, see UOTILA 2010). The Biogeographical Provinces of Kyrgyzstan are marked on the insert map. Abbreviations (in brackets Cyrillic ones used by ВАЙБУЛАТОВА & РАХМАТУЛИНА 2015) are as follows: A = Alai Valley [А, Алайская долина], СТ = Central Tian-Shan [ЦТ, Центральный Тянь-Шань], FK = Fergana part of Kyrgyzstan [ПФ, Приферганские районы Кыргызстана], IT = Inner Tian-Shan [ИТ, Внутренний Тянь-Шань], YK = Issyk-Kul (Ysyk-Köl) Depression [ПИ, Иссyk-Кульская котловина], NK = Northern Kyrgyzstan [СК, Северный Кыргызстан], WT = Western Tian-Shan [ЗТ = Западный Тянь-Шань].

9. IT. Chüy Region, Panfilov District. Lowermost part of the southern slope of Kyrgyz Ala-Тоо, slopes along Kichi-Korumdu [Кичи-Корумду] River. 42.245°N 73.661°E. 2600 m. Pasture grassland on hill slope, near the top. 25 August 2009.

10. WT. Talas Region, Talas District. S slope of Talas Ala-Тоо, NE shore of It-Agar [Ит-Агар] River, near the bridge of the main road along the valley of Chychkan [Чычкан] River. 42.151°N 72.831°E. 1800 m. River valley, *Abies* – *Betula* forest at foot of rocks; rocky slopes. 26 July 2009.

- 11.** WT. Talas Region, Talas District. N slope of Suusamyр-Тоо, along Chychkan [Чычкан] River, E side of the river. 42.105°N 72.803°E. 1650 m. Fairly sparse deciduous forest and scrub along river side. 26-27 July 2009.
- 12.** WT. Talas Region, Talas District. N slope of Suusamyр-Тоо, along Chychkan [Чычкан] River, W side of the river and main road. 42.086°N 72.807°E. 1600 m. Margin of spring; stream. 27 July 2009.
- 17.** WT. Jalal-Abad Region, Toktogul District. Northernmost end of Fergana Ala-Тоо, along Kara-Suu [Кара-Суу] River and the lower slopes on the north side of the river. 41.676°N 72.874°E. 1100 m. Scrub and grassy passing place along abandoned road on river bank. 28 July 2009.
- 18.** WT. Jalal-Abad Region, Toktogul District. Northernmost end of Fergana Ala-Тоо, roadside along Kara-Suu [Кара-Суу] River. 41.655°N 72.832°E. 1050-1060 m. Steep N-facing slope with rock, boulders and gravel, and with some shrubs and small deciduous trees. 28 July 2009.
- 20.** FK. Jalal-Abad Region, Aksy District. Suuk [Суук] Mts. (part of At-Oinok [Ат-Ойнок] Range), valley of the Kürp-Say [Күрп-Сай] River 3.5 km N from the Naryn River. 41.515°N 72.328°E. 850 m. River valley with semi-open deciduous woodland and grassland; stream ravine with shrubby vegetation; grazed treeless rocky and gravelly slopes. 28 July 2009.
- 22.** FK. Jalal-Abad Region, Aksy District. Chatkal Range, southwest side of Kara-Suu [Кара-Суу] River, between the river and the main road. 41.685°N 72.007°E. 1000 m. Pebbly shores of fast-running river and small side channels. 30 July 2009.
- 24.** FK. Jalal-Abad Region, Aksy District. Chatkal Range, Arkyt [Аркыт] Village, lower slopes on the western side of Padsha-Ата [Падша-Ата] River. 41.798°N 71.954-71.955°E. 1250 m. *Malus* forest; dry pebbly river bed. 31 July 2010.
- 25.** FK. Jalal-Abad Region, Aksy District. Chatkal Range, Arkyt [Аркыт] Village, center, near Padsha-Ата [Падша-Ата] River. 41.795-41.797°N 71.951-71.954 °. 1250-1450 m. *Juglans regia* forest. 31 July 2009.
- 29.** FK. Jalal-Abad Region, Aksy District. Chatkal Range, Sary-Chelek Nature Reserve, small lake ENE of the N end of Lake Kyla-Köl [Кыла-Көл] and ridge W of it. 41.8681°N 71.9852°E. 1950 m. Lake with clear water; grassy east-facing slopes and top of a ridge. 2 August 2009.
- 33.** FK. Jalal-Abad Region, Ala-Buka District. Chatkal Range (S slope), shore of Kasan-Say [Касан-Сай] River, and west side of an unnamed north-side tributary, 600 m from the main river. 41.497°N 71.043°E. 1700- 1870 m. Almost treeless valley bottom near river; cattle gathering place along small road, very nitrate-rich; river shore. 3-4 August 2009.
- 34.** FK. Jalal-Abad Region, Chatkal District. Chatkal Range, Chapchyma [Чапчыма] Pass. 41.5352°N 70.8059°E. 2840-2860 m. Strongly eroded east-facing mountain slope with very sparse alpine vegetation. 5 August 2009.

36. WT. Jalal-Abad Region, Chatkal District. Chatkal Range, the valley W of Chapchyma [Чапчыма] Pass (ca. 8 km from the pass along the road), at foot of the southern slope. 41.5476°N 70.7752°E. 2275 m. Edge of small pond by roadside. 5 August 2009.
37. WT. Jalal-Abad Region, Chatkal District. Chatkal Range (N slope), Besh-Aral [Беш-Арал] Nature Reserve, confluence of Ters [Терс] and Kichi-Kyzyl-Jar [Кичи-Кызыл-Жар] Rivers. 41.603-41.612°N 70.688-70.691°E. 1580-1750 m. Grassland on gravelly river bank. 5-7 August 2009.
38. WT. Jalal-Abad Region, Chatkal District. Pskem Range (S slope), Kara-Korum [Кара-Корум] River, Kyzyl-Jar [Кызыл-Жар] locality ca. 14 km N of Kurulush village. 41.775-41.780°N 70.713–70.70.730°E. 1830-2080 m. Bottom of river valley, heavily grazed fairly sparse deciduous forest (*Betula*, *Populus*); grassy hill slopes; wooded stream ravines. 7-8 August 2009.
44. WT. Jalal-Abad Region, Chatkal District. Junction of Chandalash, Chatkal and Talas Ranges, confluence of Chatkal [Чаткал] and Kara-Kasmak [Кара-Касмак] Rivers, at the bridge over the Kara-Kasmak River. 42.063-42.067°N 71.591-71.594°E. 2250 m. Gravel banks, gravel fields and meadows in and near series of river rapids. 9-11 August 2009.
49. WT. Talas Region, Kara-Buura District. Talas Ala-Too (N slope), along Kara-Buura [Кара-Буура] River. 42.320-42.321°N 71.588-71.591°E. 1750-1820 m. Rocky mountain slopes; heavily grazed stream ravine. 12 August 2009.
52. IT. Chüy Region, Panfilov District. Talas Ala-Too, Ötmök [Өтмөк] Pass, S slope a short distance southeast from the pass. 42.266°N 73.199°E. 3150 m. Heavily grazed alpine meadow and stream side on gentle SW-facing slope. 13 August 2009.

List of species

All specimens were determined by J. Enroth in 2010–2012, if not otherwise indicated. The coordinates are given as WGS84_LatD and WGS84_LonD. Previous records from various provinces are based on the checklist by BAIBULATOVA & RAHMATULINA (2015), which however lacks numerous taxa listed in IGNATOV et al. (2006). *Musci Turkestanici* also lists 21 species missing from the checklist (see Appendix 1).

Abietinella abietina (Hedw.) M. Fleisch.

24. FK. *P. Uotila* 47607 (H3220529). – Reported from PI, SK, ZT and A; new to FK.

Brachythecium rivulare Schimp.

38. WT. Ca. 1950 m, on stones in the stream, *P. Uotila* 47950 (H3220509), 47951 (H3220508). – Reported from YK and NK; new to WT.

Bryum pseudotriquetrum (Hedw.) P. Gaertn., B. Mey. & Schreb.

44. WT. Pond-like channel in river complex, *P. Uotila* 48004 (H3220521). – Not listed in BAIBULATOVA & RAHMATULINA (2015) but cited for Kyrgyzstan in IGNATOV et al. (2006).

Cratoneuron filicinum (Hedw.) Spruce

10. WT. River valley forest at foot of rocks, *P. Uotila* 47405c (H3220471), 47405e (H3220469). – **33.** FK. West side of an unnamed north-side tributary, 100 m from the main river. 41.4931°N, 71.0435°E, alt. ca. 1700 m. Small spring-fed stream running from the hill slope. 4 August 2009, *P. Uotila* 47766 (H3220473), 47767 (H3220472), 47768 (H3220474), 47769 (H3220477), 47770 (H3220476). – **37.** WT. 41.611°N, 70.691°E, alt. ca. 1580 m. Gravel field along small stream, with sparse *Betula*, *Populus* and *Salix* woodland. 7 August 2009, *P. Uotila* 47898 (H3220501). – **38.** WT. 41.775°N, 70.724°E, alt. ca. 1950 m. Small fairly sparse, grazed birch woodland along small stream on fairly steep NNE-facing slope; on stones in the stream, 8 August 2009, *P. Uotila* 47953 (H3220507), 47954 (H3220502). – **38.** WT. 41.78009°N, 70.71941°E, alt. 2000 m. On stone in a stream. 8 August 2009, *S. Lommi* 3360, p.p. – **44.** WT. 42.065°N, 71.593°E, alt. ca. 2250 m. Pond-like channel in river complex. 9 August 2009, *P. Uotila* 48003 (H3220522). 42.063°N, 71.594°E, alt. ca. 2250 m. Low gravel banks in fast-flowing river confluence; in water. 10 Aug 2009, *P. Uotila* 48060 (H3220520). – **49.** WT. 42.320°N, 71.591°E, alt. ca. 1760 m. Stream below waterfall, *P. Uotila* 48130 (H3220517). – Reported from YK and NK; new to WT and FK.

Didymodon tophaceus (Brid.) Lisa

9. IT. On stone on sunny, dry, east-facing grassland slope, sparse, *S. Lommi* 3131. – **20.** FK. Small stream in a ravine, rock in rapids. 29 July 2009, *P. Uotila* 47544 (H3220492). – Reported from NK; new to IT and FK.

Distichium inclinatum (Hedw.) Bruch & Schimp.

29. FK. Grassy steep slope NE-facing slope, rock face in shade, *P. Uotila* 47677b3 (H3220478). – Reported from A; new to FK.

Drepanocladus aduncus (Hedw.) Warnst.

22. FK. Open grazed river shore meadows, in small side channels of large river, wet soil, *P. Uotila* 47570b (H3220463). – **44.** WT. 42.065°N, 71.593, alt. ca. 2250 m. Pond-like channel in river complex, 9 August 2009, *P. Uotila* 48001 (H3220512). – Not listed in BAIBULATOVA & RAHMATULINA (2015) but cited for Kyrgyzstan in IGNATOV et al. (2006).

Drepanocladus polycarpus (Bland. ex Voit.) Warnst.

44. WT. 42.065°N, 71.593°E, alt. ca. 2250 m. Pond-like channel in river complex. 9 August 2009, *P. Uotila* 48000 (H3220511). – New to WT. Treated as a taxonomic synonym of *D. aduncus* by IGNATOV et al. (2006), but recognized as a distinct species by ŽARNOWIEC (2001), who reported it from NE Kyrgyzstan based on two *Brotherus* specimens (Issyk-Kul, Kungey Alatau) and one from “Tuzgaj”.

Fontinalis antipyretica Hedw.

22. FK. Open grazed river shore meadows, in small side channels of large river, *P. Uotila* 47570a (H3220491). – Reported from NK; new to FK.

Grimmia poecilostoma Cardot & Sebille

10. WT. 42.1487°N, 72.83292°E, alt. 1830 m. On 50 cm boulder. 26 July 2009, S. Lommi 3154. – This specimen was identified as *G. crassifolia* Broth. by Henk Greven in 2013, which was treated as a distinct species by him (GREVEN 2003). However, that name was synonymized with *G. poecilostoma* by MUÑOZ (1999) and we follow that treatment. The name is placed under synonymy of *G. tergestina* Tomm. ex Bruch & Schimp. in Tropicos (<http://www.tropicos.org/Name/35147437?tab=synonyms>), but IGNATOV et al. (2006) recognized *G. poecilostoma* as a distinct species.

Grimmia ovalis (Hedw.) Lindb., det. H. C. Greven 2013

37. WT. 41.61198°N, 70.69107°E, alt. 1600 m. On rock outcrop, exposed to the west. 6 August 2009, S. Lommi 3331 p.p. – Reported from NK; new to WT.

Grimmia reflexidens Müll. Hal.

9. IT. 42.2525°N, 73.6622°E, alt. 2500 m. On stone on sunny, dry, east-facing grassland slope, sparse. 25 July 2009, S. Lommi 3129. – 34. FK. 41.53598°N, 70.81087°E, alt. 2900 m. On rock. 5 August 2009, S. Lommi 3317. – Not listed in BAIBULATOVA & RAHMATULINA (2015) but cited for Kyrgyzstan in IGNATOV et al. (2006).

Grimmia tergestina Tomm. ex Bruch & Schimp.

18. WT. 41.65645°N, 72.82991°E, alt. 1050 m. On rock outcrop in partial shade in open mesic forest on N-facing slope. 28 July 2009, S. Lommi 3177. – Reported from NK; new to WT.

Homalothecium philippeanum (Spruce) Schimp.

24. FK. 41.798°N, 71.955°E, alt. ca. 1250 m. Dry, pebbly river bed in open, grazed *Malus* woodland, *P. Uotila* 47608 (H3220494). *Juglans regia* forest. 41.79679°N, 71.95471°E, alt. 1300 m. On trunk of *Juglans regia* on mesic NE-facing slope; partial shade, S. Lommi 3232. – 29. FK. Grassy, steep NE-facing slope, rock face in shade, *P. Uotila* 47680 (H322048). – Reported from NK; new to FK.

Hygroamblystegium tenax (Hedw.) Jenn. **var. *spinifolium*** (Schimp.) Jenn., det. M. S. Ignatov, 2010

37. WT. 41.611°N, 70.691°E, alt. ca. 1580 m. Gravel field along small stream, with sparse *Betula*, *Populus* and *Salix* woodland. 7. August, 2009, *P. Uotila* 47897 (H3220528). – The species (without any varietal taxon name) was reported from NK; it is new to ZT.

Hymenostylium recurvirostre (Hedw.) Dix.

49. WT. Waterfall in a stream from mountains, perpendicular rock face behind the falling water and continuously washed by spray, alt. ca. 1760 m, 42.320°N, 71.591°E, *P. Uotila* 48134 (H3220514), 48135 (H3220518). – Reported from IT, A and FK; new to WT.

Hypnum cupressiforme Hedw.

10. WT. NW-slope. 42.1487°N, 72.83292°E, alt. 1830 m. On base of trunk of *Betula* in partial shade in dense mesic forest, S. Lommi 3138. – 17. WT. On rock outcrop in partial shade in open mesic forest on N-facing slope, *P. Uotila* & S. Lommi 3189. – Reported from NK; new to WT.

Hypnum revolutum (Mitt.) Lindb.

29. FK. 41.8664°N, 71.98248°E, alt. 1900 m. On old *Crataegus*. 2 August 2009, S. Lommi 3281. – Reported from YK and NK; new to FK.

Marchantia polymorpha L.

37. WT. 41.611°N, 70.691°E, alt. ca. 1580 m. Gravel field along small stream, with sparse *Betula*, *Populus* and *Salix* woodland. 7 August 2009, P. Uotila 47896 (H3220526). – 38. WT. 41.776°N, 70.730°E, alt. ca. 1830 m. Bottom of river valley, heavily grazed fairly sparse deciduous forest (*Betula*, *Populus*), small water channel. 7 August 2009, P. Uotila 47926 (H3220466). – 38. WT. 41.78009°N, 70.71941°E, alt. 2000 m. On stone in a stream. 8 August 2009, S. Lommi 3360 p.p. – Earlier reported only from NK.

Mnium marginatum (Dix. ex With.) P.Beauv. (*Polla marginata*)

29. FK. Grassy, steep slope facing northeast, rock face in shade, P. Uotila 47678 (H3220479), 47677b1 (H3220478). – Reported from NK; new to FK.

Orthotrichum affine Brid.

38. WT. 41.775°N, 70.724°E, alt. ca. 1950 m. Small, fairly sparse grazed birch woodland along small stream on fairly steep NNE-facing slope; bark of old *Betula* near the base of the trunk. 8 August 2009, P. Uotila 47936 (H3220506). – New to Kyrgyzstan. This is a widely distributed species, the nearest other records being from Kazakhstan, Turkmenistan and Tadjikistan (IGNATOV et al. 2006).

Orthotrichum cupulatum Hoffm. ex Brid.

37. WT. 41.61198°N, 70.69107°E, alt. 1600 m. On rock outcrop, exposed to the west. 6 August 2009, S. Lommi 3329, 3330, 3331 p.p. – Reported from NK and A; new to WT.

Orthotrichum obtusifolium Brid.

11. WT. On *Populus*. 42.10652°N, 72.80109°E, alt. 1650 m. 26 July 2009, S. Lommi 3163. – 24. FK. 41.79402°N, 71.96089°E, alt. 1250 m. On *Juglans regia*. 30 July 2009, S. Lommi 3225. – 29. FK. 41.8664°N, 71.98248°E, alt. 1900 m. On old *Crataegus*. 2 August 2009, S. Lommi 3275. – Not listed in BAIBULATOVA & RAHMATULINA (2015) but cited for Kyrgyzstan in IGNATOV et al. (2006).

Orthotrichum pumilum Sw.

38. WT. 41.77737°N, 70.72881°E, alt. 1850 m. On *Populus talassica* by river. 8 August 2009, S. Lommi 3372. – Reported from NK and YK (ELLIS et al. 2015a, under *O. dagestanicum*); new to WT.

Orthotrichum speciosum Nees

10. WT. NW-slope. 42.1487°N, 72.83292°E, alt. 1830 m. In partial shade in forest by stream; on *Abies* tree, trunk diameter 20 cm, S. Lommi 3148. – Reported from YK, FK (ELLIS et al. 2014, under *O. revolutum*), WT (ELLIS et al. 2015b, under *O. scanicum*) and NK;.

Palustriella commutata (Hedw.) Ochyra (*Cratoneuron commutatum*)

9. IT. Fairly steep, small stream ravine, wet stream bank, alt. ca. 2600 m, 42.245°N, 73.661°E, P. Uotila 47374 (H 3220496), 47375 (H 3220497). – 20. FK.

Wet riverside, alt. ca. 850 m, 41.515°N, 72.328°E, *P. Uotila* 47515 (H3220495). – **37.** WT. Gravel field along small stream, with sparse *Betula*, *Populus* and *Salix* woodland. Alt. ca. 1580 m, 41.611°N, 70.691°E, 7 August 2009, *P. Uotila* 47899 (H3220500). – **38.** WT. Small fairly sparse, grazed birch woodland along small stream on fairly steep slope facing NNE. Alt. ca. 1950 m, 41.775°N, 70.724°E, 7 August 2009, *P. Uotila* 47927 (H3220510). – **44.** WT. Pond-like channel in river complex. Alt. ca. 2250 m, 42.065°N, 71.593°E, 9 August 2009, *P. Uotila* 48002 (H3220523). – **49.** WT. Waterfall in a stream from mountains; perpendicular rock face at side of the falling water and continuously washed by water. Alt. ca. 1760 m, 42.320°N, 71.591°E, *P. Uotila* 48133 (H3220516). – Reported from YK and NK; new to IT and WT.

Philonotis calcarea (Bruch & Schimp.) Schimp.

9. IT. 42.245°N, 73.661°E, alt. ca. 2600 m. Fairly steep, small stream ravine, wet stream bank. *P. Uotila* 47376 (H3220498). – **38.** WT. 41.775°N, 70.724°E, alt. ca. 1950 m. Small fairly sparse, grazed birch woodland along small stream on fairly steep NNE-facing slope; on stones in the stream. 8 August 2009, *P. Uotila* 47952 (H3220503). – Not listed in BAIBULATOVA & RAHMATULINA (2015) but cited for Kyrgyzstan in IGNATOV et al. (2006).

Philonotis fontana (Hedw.) Brid., det. T. Koponen, 2010

44. WT. Gravel banks south of the confluence. 42.063°N, 71.594°E, alt. ca. 2250 m. Low gravel banks in fast flowing river confluence; in water. 10 August 2009, *P. Uotila* 48059 (H3220525). – Not listed in BAIBULATOVA & RAHMATULINA (2015) but cited for Kyrgyzstan in IGNATOV et al. (2006).

Polytrichum juniperinum Hedw.

52. IT. Heavily grazed mountain meadow on gentle SW-facing slope. *P. Uotila* 48187 (H3220524). – Reported from NK, YK, and WT; new to IT.

Pseudoleskeella tectorum (Funck ex Brid.) Kindb. ex Broth.

9. IT. 42.245°N, 73.661°E, alt. ca. 2600 m. Fairly steep, small stream ravine, wet stream shore. *P. Uotila* 47360 (H3220504). – **10.** WT. 42.151°N, 72.831°E, alt. ca. 1800 m. River-valley forest at foot of rocks. *P. Uotila* 47405f (H3220468). – **11.** WT. 42.10652°N, 72.80109°E, alt. 1650 m. On marble boulder in riverside open forest in valley; in partial shade. 27 July 2009, *S. Lommi* 3182. – **20.** FK. West side of the Naryn River. 41.517°N, 72.324°E, alt. ca. 800 m. Small wooded stream ravine, on trunks of *Juglans regia*, near the ground. 29 July 2009, *P. Uotila* 47542 (H3220475), 47545 (H3220487). – **25.** FK. *Juglans regia* forest; stem of *Crataegus turkestanica*. *P. Uotila* 47591 (H3220499). – Reported from NK and FK; new to IT and WT.

Schistidium helveticum (Schkuhr) Deguchi, det. E. A. Ignatova, 2010

29. FK. Grassy, steep NE-facing slope, rock face in shade. *P. Uotila* 47677b4 (H3220478), 47679b (H3220484). – Not listed in BAIBULATOVA & RAHMATULINA (2015) but cited for Kyrgyzstan in IGNATOV et al. (2006).

Stereodon vaucheri (Lesq.) Lindb. ex Broth.), det. M. S. Ignatov, 2010 (*Hypnum vaucheri*)

10. WT. River valley forest at foot of rocks. *P. Uotila* 47405b (H3220467). – **29.** FK. Ridge W of a small lake. 41.8677°N, 71.9863°E, alt. ca. 1960 m. Grassy, steep NE-facing slope, rock face in shade. *P. Uotila* 47679a (H3220484). – **33.** FK. 41.5060°N, 71.0398°E, alt. ca. 1870 m. Steep rocky slope with much bare soil and several shrubs, perpendicular N-facing rock face. 4 August 2009, *P. Uotila* 47744 (H3220485), 47745 (H3220482). – **49.** WT. 42.320°N, 71.591°E, alt. ca. 1760 m. Stream from mountains, steep ravine towards east; on stone. *P. Uotila* 48131 (H3220515). – Reported from YK and NK; new to FK and WT.

Syntrichia ruraliformis (Besch.) Cardot

10. WT. River valley forest at foot of rocks. *P. Uotila* 47405d (H3220470). – **29.** FK. Grassy, steep NE-facing slope, rock face in shade, *P. Uotila* 47677a (H3220488). – Not listed in BAIBULATOVA & RAHMATULINA (2015) but cited for Kyrgyzstan in IGNATOV et al. (2006) as *S. ruralis* var. *ruraliformis*.

Syntrichia ruralis (Hedw.) F. Weber & D. Mohr (*Tortula ruralis*)

9. IT. 42.2525°N, 73.6622°E, alt. 2500 m. On stone on sunny, dry, east-facing grassland slope. Sparse. *S. Lommi* 3130. – **20.** FK. West side of the Naryn River. 41.517°N, 72.324°E, alt. ca. 800 m. Small wooded stream ravine, on trunks of *Juglans regia*, near the ground. 29 July 2009, *P. Uotila* 47546 (H3220486). – **33.** FK. East side of an unnamed north-side tributary, 1600 m from the main river. 41.5060°N, 71.0398°E, alt. ca. 1870 m. Steep rocky slope with much bare soil and several shrubs, perpendicular N-facing rock face. 4 August 2009, *P. Uotila* 47746 (H3220481), 47749 (H3220483). – **37.** WT. 41.61198°N, 70.69107°E, alt. 1600 m. On rock outcrop, exposed to the west. 6 August 2009, *S. Lommi* 3331 p.p. – Reported from YK, NK, IT, WT, A and FK.

Tortella alpicola Dixon, det E. A. Ignatova, 2010

29. FK. Grassy, steep NE-facing slope, rock face in shade, *P. Uotila* 47677b2 (H3220478). – Not listed in BAIBULATOVA & RAHMATULINA (2015) but reported by OTNYUKOVA et al. (2004) from YK ("Turkestan, Issikkul [Lake], VIII. 1877, A. Regel, N 3243a, LE"). New to FK.

Tortula mucronifolia Schwaegr. (*Syntrichia mucronifolia*)

20. FK. Small wooded stream ravine, on trunks of *Juglans regia*, near the ground, 29 July 2009, *P. Uotila* 47543 (H3220493). – Reported from YK, NK, IT, WT and FK.

Warnstorfia exannulata (Schimp.) Loeske (*Drepanocladus exannulatus*)

36. WT. 41.5476°N, 70.7752°E, alt. ca. 2275 m. Small pond by roadside, full of *Chara*. 5 August 2009, *P. Uotila* 47826a (H3220527), 47826b (H3220530). – Reported from YK and NK; new to WT.

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Appendix 1. Species collected by V. F. Brotherus in Kyrgyzstan in 1896 and distributed in *Musci Turkestanici* (JÄRVINEN & KOPONEN 1975) but missing from the checklist by BAIBULATOVA & RAHMATULINA (2015). The names used in *Musci Turkestanici* are given in parentheses if different from the currently used and accepted names (checked from Tropicos Oct. 19th 2015: <http://www.tropicos.org/Home.aspx>). Abbreviations of the provinces from which the species were collected are given in Roman and Cyrillic letters (cf. legend of Fig. 1).

- Aloina rigida* (Hedw.) Limpr. (YK, ПИ)
- Amblyodon dealbatus* (Hedw.) P. Beauv. (YK, ПИ)
- Brachythecium glareosum* (Bruch ex Spruce) Schimp. (*Hypnum glareosum* var. *rugulosum*) (YK, ПИ)
- Brachythecium plumosum* (Hedw.) Schimp. (*Hypnum pseudoplumosum* var. *obtusiusculum*) (NK, CK)
- Brachythecium turgidum* (Hartm.) Kindb. (*Hypnum turgidum*) (YK, ПИ)
- Bryum timmiostomoides* H. Philib. (YK, ПИ)
- Bryum turbinatum* (Hedw.) Turner (NK, CK)
- Cirriphyllum cirrosum* (Schwägr.) Grout (*Hypnum cirrosum* var. *funckii*) (NK & YK, CK & ПИ)
- Ctenidium procerrimum* (Molendo) Lindb. (YK, ПИ)
- Grimmia anodon* Bruch & Schimp. (YK, ПИ)
- Grimmia crinita* Brid. (NK, CK)
- Hennediella heimii* (Hedw.) R.H. Zander (*Pottia heimii*) (YK & NK, ПИ & CK)
- Hygrohypnella duriuscula* (De Not.) Ignatov & Ignatova (*Amblystegium dilatatum*) (YK, ПИ)
- Indusiella thianschanica* Broth. & Müll. Hal. (YK, ПИ)
- Myurella julacea* (Schwägr.) Schimp. (YK, ПИ)
- Philonotis calcarea* (Bruch & Schimp.) Schimp. (NK, CK)
- Plagiobryum zieri* (Hedw.) Lindb. (YK, ПИ)
- Pseudocalliergon turgescens* (T. Jensen) Loeske (*Amblystegium turgescens*) (YK, ПИ)
- Pseudocampylium radicale* (P. Beauv.) Vanderp. & Hedenäs (*Amblystegium hygrophilum*) (NK, CK)
- Tayloria hornschurchii* (Grev. & Arn.) Broth. (*Dissodon hornschurchii*) (YK, ПИ)
- Tortula atrovirens* (Sm.) Lindb. (NK, CK)

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