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The *Anemone biflora* complex (Ranunculaceae) in Central and South-West Asia: its differentiation and affinities

SVETLANA ZIMAN[1], FRIEDRICH EHRENDORFER[2], CARL S. KEENER[3], BRYAN E. DUTTON[4], VALENTINA TRIFONOVA[5], OLGA TSARENKO[1], ELENA MOLDOVANOVA[1], N. TERENTJEVA[1]

[1]Institute of Botany, Ukrainian National Academy of Sciences, 252601 Kiev-4, Tereshchenkivska str.2, Ukraine; [2]Institute of Botany of the Vienna University, 1030, Rennweg 14, Vienna, Austria; [3]Pennsylvania State University, 208 Mueller Laboratory, 16802, University Park, Pennsylvania, U.S.A; [4]Brooklyn Botanic Garden, 1000 Washington Av., Brooklyn, N.Y. 11225-1099, U.S.A.; [5]V. I. Komarov Botanical Institute, Russian Academy of Sciences, 197198, St.-Petersburg, Popov str.2, Russia.

S. ZIMAN, F. EHRENDORFER, C. S. KEENER, B. E. DUTTON, V. TRIFONOVA, O. TSARENKO, E. MOLDOVANOVA & N. TERENTJEVA (1998): The *Anemone biflora* complex (Ranunculaceae) in Central and South-West Asia: its differentiation and affinities. – Thaiszia – J. Bot. 8: 57-85. – ISSN 1210-0420.

ABSTRACT: A study dealing with a discussion of the taxonomy and evolutionary trends within the *Anemone biflora* complex (Ranunculaceae, *Anemone* Sect. *Anemone*) distributed throughout Central and South-West Asia (mainly at the territory of the former Soviet Union - Tadjikistan, Uzbekistan, etc.). *Anemone biflora* and 10 segregate species were reevaluated, and on the basis of the critical morphological and anatomical analyses one subsection, three series and six species could be distinguished. Meanwhile, two species are regarded as varieties of *A. biflora* and three species names are recognized as synonyms only. A key to the representatives of this subsection is presented.

KEYWORDS: *Anemone* Sect. *Anemone* Subsect. *Biflorae*, *Anemone biflora* complex, geography, morphology, taxonomy, evolution

Introduction

The genus *Anemone* L. is one of the most interesting within the family *Ranunculaceae* JUSS. because of its considerable diversity, geographic circumscription, division into intergeneric taxa, as well as the status of many species have been debatable for many years.

The aim of this paper is to examine the *A. biflora* complex precisely and to establish the relationships among taxa within it.

Material and methods

Our treatment is based mainly on herbarium material involving about 2500 specimens contained in 7 collections (Tab. 1). From these specimens, both flower and fruit samples (about 90) were studied. Standard anatomical techniques were employed, including light and scanning microscopy. Pollen grains were studied by means of the light and scanning microscopy. We also examined about 400 adult plants collected in 18 natural populations of 8 taxa, mainly in 1992-1995 (list and characteristics of these populations are given in the Tab. 2). From 20 to 25 flowering or fruiting plants were randomly chosen from each examined population. Peculiarities of ontogeny were studied within 14 populations of 5 species and variations of the anatomical structures of leaf petioles were analyzed within 10 populations of these species.

Historical survey

DE CANDOLLE (1818, 1824) recognized subgeneric groups within the Genus *Anemone*, and separated *A. coronaria* L., also several allied species as Sect. *Anemonanthea* DC. In his description of *A. biflora* DC., this author characterized it by a yellow or reddish 5-segmented perianth, also many-sected basal and involucral leaves with narrow ultimate lobules, and DE CANDOLLE noted it was distributed "in Oriente" (not in Europe, like *A. coronaria*). This author recognized within *A. biflora* two varieties, var. *bifoliata* DC. and var. *trifoliata* DC.

Therefore, for a some time *A. biflora* was regarded as the single tuberous species distributed out of limits of the Mediterrannean, mainly in Central Asia. Later the accumulation of the large herbarium collections was the basis for the description of several new taxa, closely related to *A. coronaria* and *A. biflora*.

KARELIN and KIRILOV (1842) described A. *gortschakowii* KAR. et KIR. as the species allied to *A. biflora* var. *trifoliata* because of having of palmately-tripartite radical leaves with sessile primary segments.

Later, REGEL (1884) re-examined the allied tuberous species, *A. coronaria* and *A. biflora*, and as a result he described *A. eranthioides* REGEL (resembled *Eranthis longistipitata* REGEL by its habit) and *A. tschernjaewii* REGEL (on the basis of M. G. TSCHERNJAEW collection). In addition, REGEL (1884) described several other varieties of *A. coronaria*: var. *parviflora* REGEL (=*A. gortschakowii*), var. *bucharica* REGEL, var. *bucharica lutea* REGEL, var. *pluriflora* REGEL, and var. *intermedia* REGEL.

Table 1.List of the examined herbarium materials of *Anemone biflora* complex

Species	Country	Region	Herbaria	No. of specimens
1a. *A. biflora* var. *biflora*	Iran C. Asia Afghanistan		KW, LE, WU, GH, NY	100
1b. *A. biflora* var. *petiolulosa*	Tadjikistan Turkmenistan Uzbekistan Kazakhstan Kirgisztan Iran	N. and W. Pamir Alai W. Tien Shan Kopetdag Kugitang	LE, TASH, KW, AA, TAD, WU, NY	800
1c. *A. biflora* var. *eranthioides*	Tadjikistan	W. and C. Pamir	LE, TAD, KW	120
2. *A. bucharica*	Tadjikistan Uzbekistan Afghanistan	S. Pamir Alai	LE, TASH, KW, TAD, AA, WU, NY	360
3. *A. baissunensis*	Tadjikistan Uzbekistan	C. and S. Pamir Alai	LE, KW, AA, TASH, TAD, WU, NY	280
4. *A. gortschakowii*	Tadjikistan Turkmenistan Uzbekistan Kazakhstan Kirgisztan	E. Pamir Alai W. Tien Shan Dzungar Alatau Betpakdala Kashgaria	LE, KW, AA, TASH, TAD	450
5. *A. serawschanica*	Tadjikistan Uzbekistan	W. Pamir Alai	LE, TASH, AA, LE	110
6. *A. tschernajewii*	Tadjikistan Uzbekistan Turkmenistan Afghanistan Pakistan	Pamir Alai W. Tien Shan Kopetdag Kugitang	LE, TASH, TAD, WU, KW	340

KOMAROV (1896) described *A. serawschanica* KOM. as a species allied to *A. tschernjaewii.*

Twenty years later, FINET and GAGNEPAIN (1904) recognized *A. coronaria* var. *bucharica* as an independent species, *A. bucharica* (REGEL) FINET et GAGNEP., but they believed that *A. eranthioides* had to be included to *A. coronaria* as a variety, and *A. gortschakowii* was merely a synonym of *A. coronaria.*

Several additions and descriptions within the *A. biflora* complex were realized by JUZEPCHUK (1937), who studied *Anemone* within the flora of the former Soviet Union. He recognized two subsections of Sect. *Oriba* (ADANS.) SPACH (=Sect. *Anemonanthea* DC., =Subgen. *Eriocephalus* HOOK. f. et THOMSON): Subsect. *Coronarioides* P. POPOV and Subsect. *Biflora* P. POPOV (both were described previously by POPOV 1913). Within Subsect. *Biflora* JUZEPCHUK described two cycles, *Eubiflorae* JUZ. and *Tschernjaewianae* JUZ. JUZEPCHUK also described three new species allied to *A. biflora*: *A. petiolulosa* JUZ., *A. almaatensis* JUZ., and *A. oligotoma* JUZ. JUZEPCHUK paid attention to a yellow-flowered variety of *A. bucharica* which deserved a specific status of *A. baissunensis.*

Table 2. The populations of Anemone species included in this study (localities follow the name of species, under species are given a code of population, elevation in m, communities, collector and date)

1b. *Anemone biflora* var. *petiolulosa* Uzbekistan, Tien Shan, Chatkalski Ridge, Khodjikent (PE 1, PE 2); Kazakhstan, Tien Shan, Karzhantau Ridge, Kaplanbek, Majskoe (PE 3 - PE 6)

PE 1 (1000 m), *Rosa divina* + *Festuca sulcata*, ZIMAN 4.04.1993
PE 2 (1100 m), *Festuca pseudovina* + *Anemone petiolulosa*, ZIMAN 16.04.1993
PE 3 (800 m), *Eremurus regelii* + *Carex pachystylis*, ZIMAN 5.04.1993
PE 4 (900 m), *Carex pachystylis* + *Festuca pseudovina*, ZIMAN 5.04.1993
PE 5 (900 m), *Hordeum bulbosum*, ZIMAN 15.04.1995
PE 6 (950m), *Festuca sulcata*, ZIMAN 15.04.1995

1c. *Anemone biflora* var. *eranthioides* Tadjikistan, Pamir Alai, Hissar Ridge, Anzob Pass

ER (3200 m), *Oxytropis immersa* + *Potentilla flabellata*, ZIMAN 27.06.1979

2. *Anemone bucharica* Tadjikistan, Pamir Alai, Fakhrabad Pass; Vakhsh, Dagana

BU 1 (1100 m), *Elytrigia trichophora* + *Hordeum bulbosum*, ZIMAN 13.04.1992
BU 2 (900 m), *Pistacia vera* + *Carex pachystylis*, SHARIPOVA 6.04.1970

3. *Anemone baissunensis* Tadjikistan, Pamir Alai, Hissar Ridge, Kondara Ravine, Fakhrabad Pass.

BA 1 (1200 m), *Amygdalus bucharica* + *Juno vicaria*, ZIMAN 10.04.1992
BA 2 (1000 m), *Acer turkestanicum* + *Carex pachystylis*, ZIMAN 20.04.1995
BA 3 (1100 m), *Elytrigia trichophora* + *Hordeum bulbosum*, ZIMAN 13.04.1992

4. *Anemone gortschakowii* Kazakhstan, Tien Shan, Zaili Alatau, Kurganka Mt., Myrnyi, Betpakdala;

AL (800 m), *Carex pachystylis* + *Anemone gortschakowii*, ZIMAN 10.04.1993
GO (600 m), *Festuca sulcata*, ORAZOVA 22.04.1976

5. *Anemone serawschanica* Tadjikistan, Pamir Alai, Hissar Ridge, Sangardarak; Seravshan Ridge, Osman Tala

SER 1 (1220 m), *Juniperus serawschanica*, PJATAEVA 5.06.1948
SER 2 (1600 m), community unknown, KOCHKAREVA 14.06.1972

6. *Anemone tschernjaewii* Tadjikistan, Pamir Alai, Hissar Ridge, Kondara Ravine; Fakhrabad Pass

TSCH 1 (1200 m), *Amygdalus bucharica* + *Juno vicaria*, ZIMAN 10.04.1992
TSCH 2 (1000 m), *Acer turkestanicum* + *Carex pachystylis*, ZIMAN 20.04.1995
TSCH 3 (1100 m), *Elytrigia trichophora* + *Hordeum bulbosum*, ZIMAN 13.04.1992

Later SHARIPOVA (1967) worked out a Latin diagnosis for *A. baissunensis* and credited this species to JUZEPCHUK. Furthermore, OVCHINNIKOV and SHARIPOVA (1975) described *A. verae* Ovcz. et SCHARIP., a species close to *A. baissunensis* and *A. petiolulosa*.

Besides JUZEPCHUK (1937), data on these taxa are contained in papers on the flora of Uzbekistan (BUTKOV 1953), Kazakhstan (GAMAJUNOVA 1961), Tadjikistan (OVCHINNIKOV & SHARIPOVA 1975), Turkmenistan (NIKITIN & GELDIKHANOV 1988), Iran, Afghanistan (BOISSIER 1867, RECHINGER & RIEDL 1992 etc.), as well in papers of SHARIPOVA (1966, 1967, 1971), KOVALEVSKAYA (1972) and others.

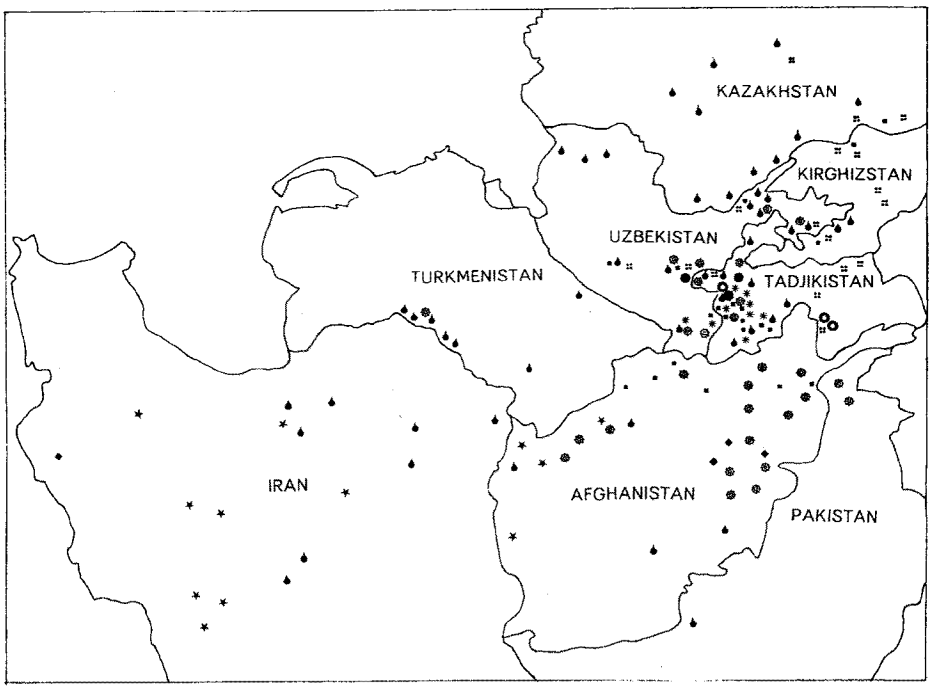

Fig. 1. Geographical distribution of *Anemone biflora* complex in the Asia. ✳ *Anemone baissunensis;* ★ *A. biflora* var. *biflora;* ♦ *A. biflora* var. *petiolulosa;* O *A. biflora* var. *eranthioides;* ◆ *A. flexuosissima;* ❖ *A. gortschakowii;* ■ *A. bucharica;* ● *A. serawschanica;* ❁ *A. tschernjaewii.*

Anemone flexuosissima Rech. was described (RECHINGER & RIEDL 1992)as an endemic of C and E Afghanistan very close to *A. petiolulosa.*

All the above mentioned tuberous species of the *A. biflora* complex are distributed mainly in the territory of the Central Asiatic States which until recently were included in the Soviet Union, also in the close territories of North Iran, Afghanistan, Pakistan and China.

Systematic analysis

All plants within Section *Anemone* (=*Anemonanthea* DC. p.p., *Eriocephalus* HOOK. f. et THOMSON p.p.) are perennial herbs with perfect actinomorphic flowers consisting of petaloid sepals which are densely pubescent abaxially (outside) and glabrous adaxially (inside), and numerous free stamens and carpels with filiform styles. The carpels matures into lanate achenes compacted in heads. Aerial

shoots are simple or branched scapes with one or few pedicellate flowers in cymes, subtended by an involucre of sessile or subsessile leaves. The long-petiolate radical leaves are 1- or 2-ternate and form a rosette. Underground shoots are tuberous thickened rhizomes. Basic chromosome number is x=8.

Subsection *Biflorae*

BOISSIER (1867) noted the morphological differences between *A. coronaria* and *A. biflora*, but he left both of them within the Section *Eriocephalus*. P. POPOV (1913) described Subsect. *Coronarioides* P. POPOV and *Biflora* P. POPOV on the base of the various shape of radical leaf ultimate lobules: long-acute in *A. coronaria* and allied taxa, short-obtuse in *A. biflora*. This author believed also that the taxa of the above subsections differ with their geographic area: the former ones occur in the Mediterranean including South Europe, Asia Minor and North Africa, meanwhile, the latters are distributed throughout Central Asia.

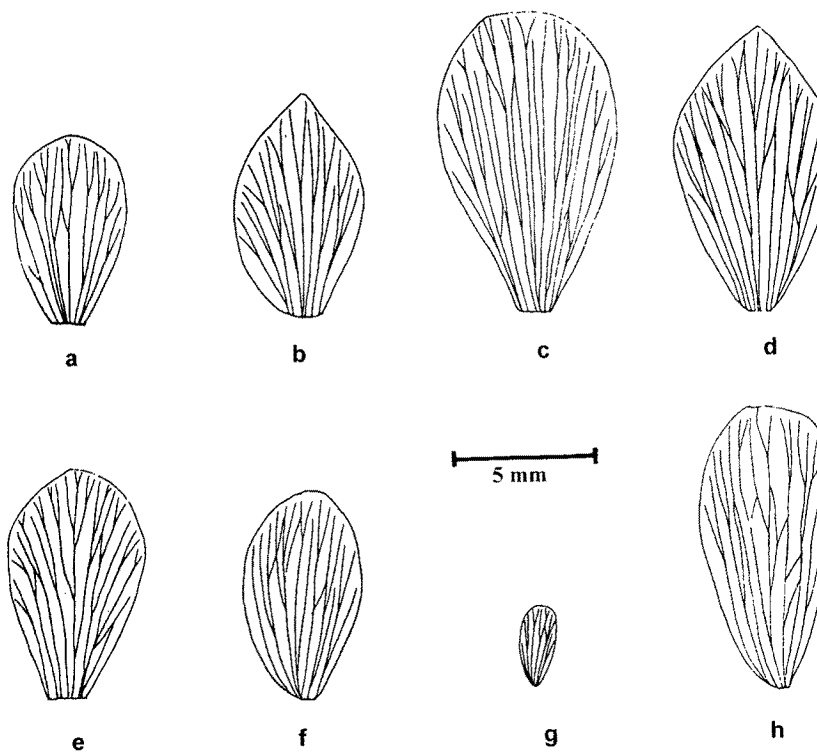

Fig. 2. Sepals of the *A. biflora* complex: a. *A. biflora* var. *biflora;* b. *A. biflora* var. *petiolulosa;* c. *A. bucharica;* d. *A. baissunensis;* e. *A. gortschakowii*; f. *A. biflora* var. *eranthioides*; g. *A. serawschanica*; h. *A. tschernjaewii.*

Conspectus

ANEMONE L., Sp. Pl., 1753.

Gen. *Oriba* ADANS., Fam. Pl. 2: 459, 1763; Sect. *Anemonanthea* DC., Syst. 1: 212, 1818, p. p.; Sect. *Oriba* (ADANS.) SPACH, Hist. Nat. 7: 250, 1839; Sect. *Eriocephalus* HOOK. f. & THOMSON, Fl. Ind. 1: 20, 1855; Sect. *Anemone* TAMURA, Acta Phytotax. Geobot. 42: 180, 1991.

LECTOTYPE: *A. coronaria* L.

Subsect. *Biflora* P. POPOV, Tr. Tiflis. Bot. Gard. 12: 169, 1913.

TYPE: *A. biflora* DC.

1. *Anemone biflora* DC. *A. biflora* var. *biflora*, *A. biflora* var. *petiolulosa* comb. nova, *A. biflora* var. *eranthioides* comb. nova
2. *A. bucharica* (REGEL) FINET et GAGNEP.
3. *A. baissunensis* JUZ.
4. *A. gortschakowii* KAR. et KIR.
5. *A. serawschanica* KOM.
6. *A. tschernjaewii* REGEL

Key to the representatives of the *Anemone biflora* complex

Radical leaves monomorphic, with obtuse ultimate lobules, glabrous; involucral leaves 3, resemble radical ones. Stems 1-2-flowered (lateral flowers have two small bracts). Sepals 5, persistent. Achene bodies ovoid or elongate-elliptic, lanate, with spindle-like beaks. Achene heads hemispherical.

1a. Tuberous rhizomes spherical, radical leaves solitary, rarely 2,with sessile primary segments, and few ultimate lobules; involucral leaves sessile 2
1b. Tuberous rhizomes irregular; radical leaves more than 2, in a rosette, various, but many-sected, involucral leaves with petiole-like bases 3
2a. Sepals white or bluish, pilose outside, 8-22 mm long; achene bodies 3.0-3.5 mm, with hairs 5.0-6.0 mm, beaks 1.7-2.5 mm long..... ***6. A. tschernjaewii***
2b. Sepals yellowish-green, glabrous, 5-8 mm long; achene bodies 2.0-2.2 mm, with hairs 1.7-2.3 mm, beaks 0.5-0.7 mm long..... ***5. A.serawschanica***
3a. Radical leaves mainly with sessile primary segments; sepals 5-15 mm long, achene bodies 2.7-3.0 mm, with hairs 3.0-4.0 mm, beaks 2.0-2.5 mm long..... ..... ***4. A. gortschakowii***
3b. Radical leaves petiolulate (sometimes petiolules very short, but distinct); sepals 10-28 mm long; achene bodies 2.5-4.5 mm, with hairs 2.5-5.5 mm, beaks 1.7-2.5 mm long 4
4a. Number of veins at sepal bases 5-13; number of sepal vein anastomoses 7-30 5
4b. Number of veins at sepal bases 5-9; number of sepal vein anastomoses 1-3 6
5a. Sepals red inside and outside; achene bodies 2.5-3.0 mm, with hairs 2.5-3.5 mm, beaks 1.8-2.5 mm long, pubescent basally ..... ***2. A. bucharica***

5b. Sepals yellow inside, yellow or reddish outside; achene bodies 3.5-4.5 mm, with hairs 4.5-5.5 mm, beaks 2.0-3.0 mm long, glabrous..... ***3. A. baissunensis***

6a. Petiolules of primary segments of radical leaves predominately 5-10 mm long; achene bodies 2.7-2.8 mm, with hairs 2.5-3.5 mm, beaks 2.2-2.8 mm .... ***1. A. biflora* var. *petiolulosa***

6b. Petiolules of primary segments of radical leaves predominately 1-3 mm long; achene bodies 3-4 mm, with hairs 2-5 mm, beaks 2-3 mm..... 7

7a. Achene bodies 3.0-3.3 mm long, with hairs 2.0-2.2 mm, beaks 2.0-2.2 mm long ..... ***1. A. biflora* var. *biflora***

7b. Achene bodies 3.0-4.0 mm long, with hairs 4.0-5.0 mm, beaks 2.5-3.0 mm long ..... ***1. A. biflora* var. *eranthioides***

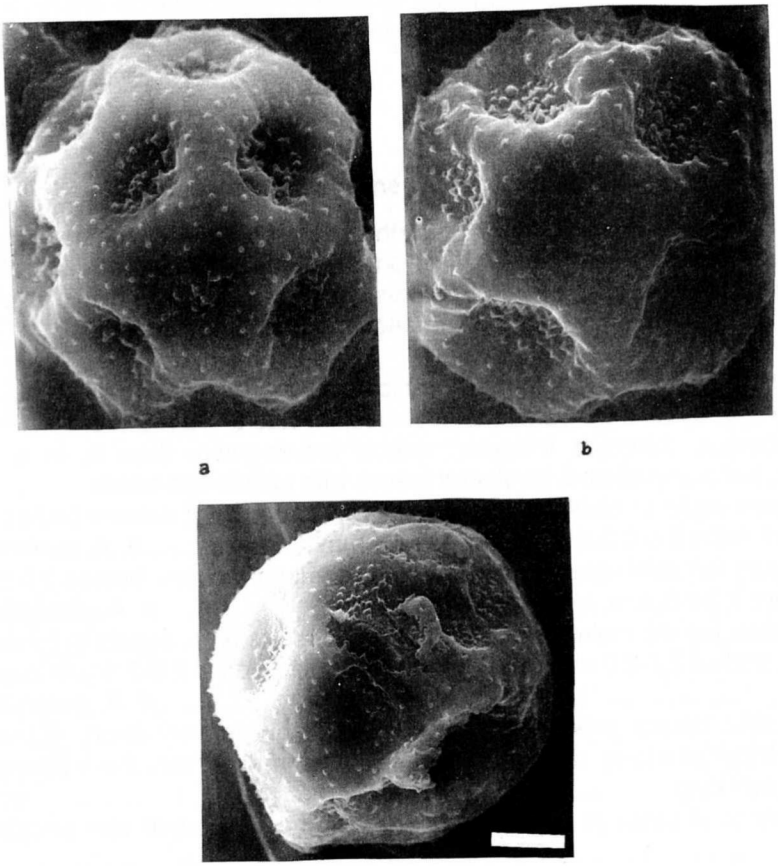

Fig. 3. Pollen grains of the *A. biflora* complex: a. *A. bucharica*, b. *A. baissunensis*, c. *A. tschernjaewii*. (Bar = 10 µm).

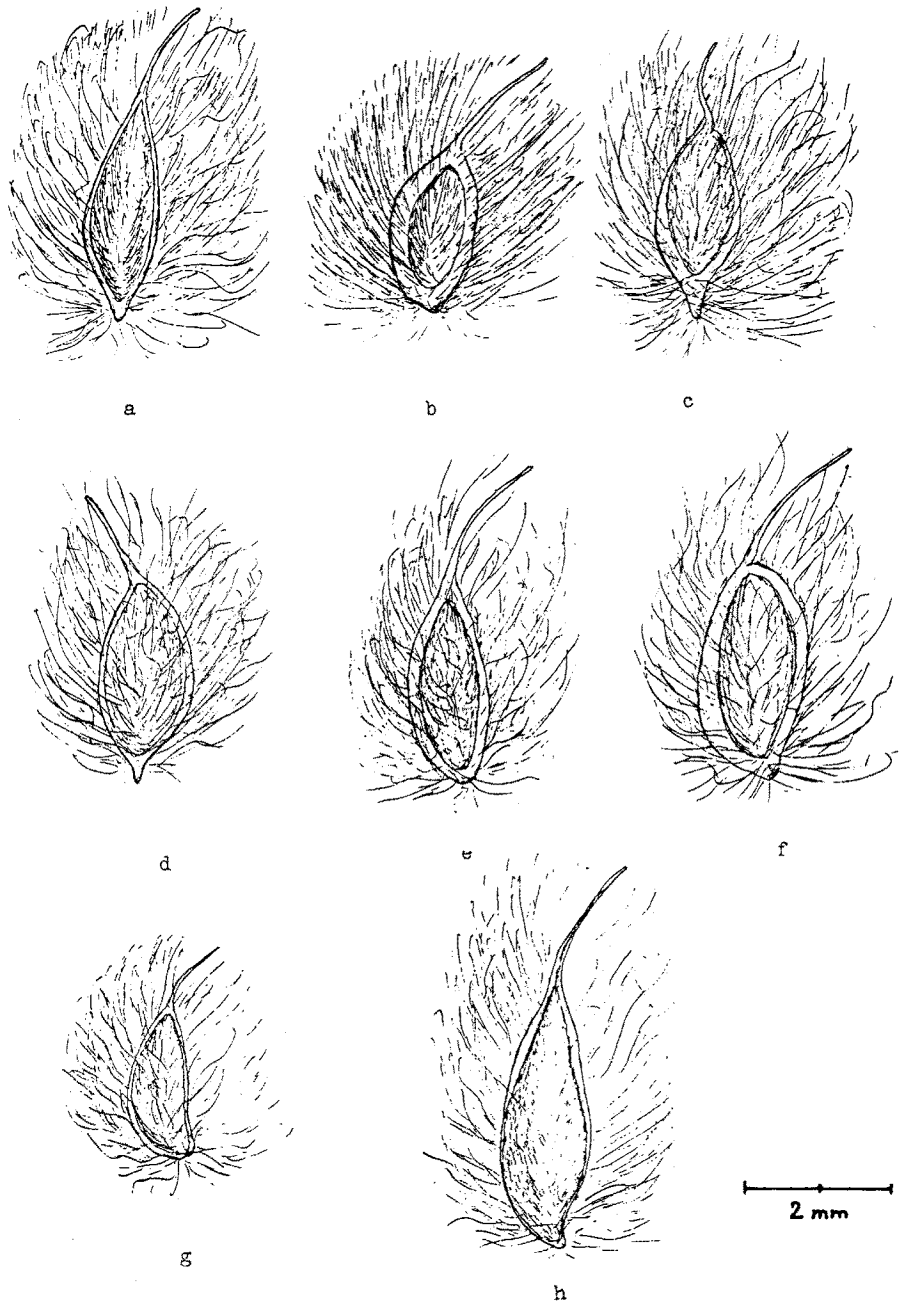

Fig. 4. Achenes of the *A. biflora* complex: a. *A. biflora* var. *biflora;* b. *A. biflora* var. *petiolulosa*; c. *A. bucharica*; d. *A. baissunensis;* e. *A. gortschakowii*; f. *A. biflora* var. *eranthioides;* g. *A. serawschanica;* h. *A. tschernjaewii.*

1. *Anemone biflora* DC. Syst.1: 201, 1818.

Synonyms: *Anemone formosa* CLARC Neuc. Enteec. 3: 157, 1822; *A. coronaria* var. *biflora* (DC.) FINET & GAGNEP. Bull. Soc. Bot. France 51: 75, 1906; *A. subvillosa* PAU Trab. Mus. Nac. Ci. Nat. Madrid, Bot. 10: 12, 1918; *A. petiolulosa* JUZ. in KOMAROV Fl. URSS 7: 259, 1937; *A. eranthioides* REGEL Acta Hort. Petropol. 8: 691, 1884.

Described from "Oriente". Typus: Paris.

Rhizomes tuberous, irregular (asymmetrical), rarely branched,1.0-2.5 x 1.0-2.5 cm. Roots various, but thickened ones predominate. Radical leaves 3-5 (in adult plants), glabrous; petioles 2-5 cm long; blades twice-ternate, 1.5-5.0 x 1.5-5.0 cm, with 15-35 (up to 80) obovate to almost linear ultimate lobules; petiolules 1-10 mm long; involucral leaves having petiole-like flat bases; blades 1-3 cm, with10-30 ultimate lobules, glabrous. Stems 1-3, 2-5 (-20) cm long, glabrous; pedicels 2-5 (-10) cm, appressed-pilose. Sepals 5(6), ovate or elliptic, yellow or reddish, 8-15 x 4-9 mm, the number of veins at the base of sepals (NSV) 5-9, and the number of sepal vein anastomoses (NSVA) is 1-3. Pistils with yellow styles. Achene bodies measure 2.7-4.0 x 1.0-1.2 mm, they are lanate (densely covered with hairs 2-5 mm long), and have achene beaks 2-3 mm long, basally covered with hairs.

Variation and distribution

After examination of many herbarium specimens including about 150 plants collected by one of the authors (ZIMAN 1992-1995) in seven natural populations in Kazakhstan, Uzbekistan and Tadjikistan, we observed the essential similarity of key morphological characters of all above specimens of *A. biflora* s. l., also a considerable variability in their morphometric values, including length of petiolules of primary segments of radical leaves (1-10 mm, up to 30 mm), length of petioles of radical leaves (mainly 2-5 cm, up to 10 cm), length of stems (2-5cm, up to 20 cm), also number of ultimate lobules of radical (15-80) and involucral (1-30) leaves. Within the characters of reproductive organs, the most variable were length of sepals (8-15 mm), their shape (with obtuse or acute tips), also sepal colour on the abaxial side (reddish, greenish, sometimes pink, lilac or light violet). We also have to stress that phenomenon of the alteration of many characters during a typical growing season was one of the main reason for describing of several narrow circumscribed taxa related to *A. biflora* s. str.

According to BOISSIER (1867), *A. biflora* occurred in Iran, Afghanistan and Turkestan in a wide sense (including Turkmenistan, Uzbekistan and other modern States in Central Asia within the territory of the former Soviet Union). However, JUZEPCHUK (1937) regarded *A. biflora* as an aggregate species which was replaced by several narrow species (races) in the territory of the Soviet Union. By RECHINGER and RIEDL (1992), *A. biflora* dominated in Iran, especially in its western districts, and it was distributed partly also in Western Afghanistan. They believed that *A. biflora* and *A. petiolulosa* were the close taxa which sometimes grew together.

In the above manuscript RECHINGER described *A. flexuosissima*, but so briefly, that by this description everybody can see that this taxon is really very close to *A. petiolulosa* by the characters of flowers (small, with glabrous sepals), leaves and stems, an no more. Unfortunately, this author has no data on achenes of the new taxon, and without the detaled study of its specimens it is impossible to come to the final conclusion about its status.

1a. *Anemone biflora* var. *biflora*

Plants are characterized with all above characters of *A. biflora* s. l., but also with short petiolules of primary segments of radical leaves (1-3 mm), achene bodies 3.0-3.3 mm long, hairs on them 2.0-2.2 mm and beaks 2.0-2.2 mm long.

Examined selected samples of flowers:

Afghanistan, Herat, Shindand, KOIE 1962 - WU;

Iran, Fars, Firusabad, IRANSHAHR 5.03.1975 - WU; Lagharak, Agjah, KUKHAZD-NARUN 1976 - WU; Tehran, Lashgarak, TERMEH et MATIN 30.04.1976 – WU.

Examined selected samples of achenes:

Iran, Kermanshah, Kazand, SHARIF 16.04.1951 - WU; Tehran, Lashgarak, TERMEH et MATIN 30.04.1976 - WU; Fars, Firusabad, IRANSHAHR 5.03.1975 - WU; Semnan, RIEDL 1976 - WU; Lagharak, Agjah, KUKHAZD-NARUN 1976 - WU;

Afghanistan, Herat, Shindand, KOIE 1962 - WU.

Anemone biflora var. *biflora* dominates in W. Iran, but it also occurs in N, E and S Iran, and Afghanistan, on open slopes at 1000-3300m above sea level (fig.1).

1b. *Anemone biflora* var. *petiolulosa* (JUZ.) ZIMAN, comb. nova.

Basionym: *Anemone petiolulosa* JUZ. in KOMAROV Fl. URSS 7: 259,1937.
Synonym: *A. coronaria* var. *pluriflora* REGEL Acta Hort. Petropol.7: 689,1884.
Described from W Tien Shan, Ak-tash in montibus Karshan-Tau, distr.Tashkent.
Typus: LE.

Plants are characterized with long petitiolules of primary segments of radical leaves (5-10 mm), achene bodies 2.7-2.8 mm long, hairs on them 2.5-3.5 mm and beaks 2.2-2.8 mm long.

Examined selected samples of flowers:

Uzbekistan, Pamir Alai, Seravshan Ridge, Amankutan, MIKHELSON 20.04.1913 - TASH; Samarkand Distr., Nuratinski Ridge, ZAPROMETOVA 5.04.1954 - TASH; Nuratanski Ridge, Urta Sai, Zargar, MOMOTOV 11.05.1957 - TASH; Fergana Distr., Arsif, RAKHIMOV 16.03.1968 - TASH; Chatkalski Ridge, Khodzhikent, ZIMAN 4.04.1993 - KW;

Kazakhstan, Karzhantau Ridge, Aktash GOLOSKOKOV 3.06.1940 - LE; Karzhantau Ridge, Kaplanbek, JUSEPCHUK 8.04.1954 - LE; Sary Agach, PRATOV 22.04.1960 -TASH; Karzhantau Ridge, Kaplanbek, ZIMAN 5.04. 1993 - KW; Majskoe, Ziman 15.04.1995 - KW.

Examined selected samples of achenes:

Kazakhstan, Tien Shan, Talass Alatau, Taldybulak, BORISENKO 15.04.1947 - AA; Sary-Agach Ridge, PRATOV 14.04.1960 - TASH; Karzhantau Ridge, Birisek, SAMOJLOVA

8.05.1989 - AA; Karzhantau Ridge, Kaplanbek, ZIMAN 5.04.1993 - KW; Majskoe, ZIMAN 15.4.1995 – KW.

Uzbekistan, Tien Shan, Chatkalski Ridge, Khodzhikent, ZIMAN 4.04.1993 - KW; ZIMAN 16.04.1995 - KW; Turkmenistan, Kopetdagh, Nokhur, GUBANOV 17.05.1962 - LE.

On our study of the age structure of five populations *A. biflora* var. *petiolulosa* (fig. 5), the germination is epigeal, and the seedlings have a short (2-3 mm long) hypocotyle, entire, rounded-elongate (2.5-3.5 x 2.0 mm) cotyledonary leaf blades with petioles united in a tube 8-10 mm long, and thin primary roots.

Juvenile plants are characterized by a single initial leaf having petioles 1.8-3.0 cm long, 3-lobed or 3-partite rounded-cordate blades 0.3-0.5 x 0.3-0.4 cm, with undivided lobes or parts, tuberous-thickened ovoid hypocotyles 4-5 x 2-3 mm, and thin adventitious roots.

Immature plants have 1-2 leaves with petioles 1.6-3.5 cm long and 3-sected blades 0.6-1.3 x 0.4-1.0 cm having shortly petiolulate primary segments with 3-8 divisions and obtuse terminal lobes. Tuberous rhizomes are still ovoid, 0.6-0.8 x 0.3-0.4 cm.

Hairs are absent on seedlings, juvenile and immature plants.

Non-flowering but mature vegetative plants are characterized by 2-3 radical leaves, and shape and size of them resemble those in reproductive plants, but tuberous rhizomes become irregular and disintegrate basally.

Senile plants are characterized by an absence of flowering stems, simpler shape and smaller size of radical leaves which sometimes strongly resemble juvenile leaves. Several aerial shoots sometimes develop because of a partial particulation of rhizomes, but vegetative propagation is rare.

We note the following peculiarities of the anatomical structure of leaf petioles: horseshoe outline in cross section, with vascular bundles arranged in arc (dorsiventral type), 7 vascular bundles (within them 3 large), fragmented collenchyma, and a few-layered sclerenchyma.

A. biflora var. *petiolulosa* occurs in the wide geographic area included all Central Asiatic States of the former Soviet Union, also about 20 localities in Iran and Afghanistan (fig. 1).

Plants grow in both lowland and high-mountain localities (700-2000 m), in belts of semideserts, semisavannas, sybljak and steppes, in the communities in which trees and shrubs (*Juniperus turkestanica* KOM., *J. serawschanica* KOM., *Acer turkestanicum* PAX, *Pistacia vera* L., *Amygdalus bucharica* KORSH., *Rosa divina* SUMN., etc.) and perennial herbs (*Elytrigia trichophora* (LINK.) NEVSKI, *Carex pachystylis* L., *Prangos pabularia* LINDL., *Eremurus regelii* VVED., *Ligularia thomsonii* (CLARKE) POJARK., *Poa relaxa* OVCZ., etc.) predominate.

1c. *Anemone biflora* var. *eranthioides* (REGEL) ZIMAN, comb. nova.

Basionym: *Anemone eranthioides* REGEL Acta Hort. Petropol. 8: 691, 1884.
Described from Bukhara, khanate of Baldzhuan (Ak-su River,Lyangar foothills) and Darvaz (Wandsch River and Fort). Typus and paratypus: LE.

Fig. 5. The main age groups of *A. biflora:* s - seedlings; j - juvenile plants; im - immature plants; v - virginile plants; r - reproductive plants; se - senile plants. (Bar = 2 cm).

Plants are characterized with short petiolules of primary segments of radical leaves (1-3 mm), almost sessile involucral leaves, achene bodies 3.0-4.0 mm long, hairs on them 4.0-5.0 mm and beaks 2.5-3.0 mm long.

Examined selected samples of flowers:

Tadjikistan, Pamir Alai, Hissar Ridge, Anzob Pass, ZIMAN 26.06.1979 -KW; Maikhura, FEDORONCHUK 21.06.1991 - KW; Siakhub, FEDORONCHUK 22.06.1991 - KW.

Examined selected samples of achenes:

Tadjikistan, Pamir Alai, Hissar Ridge, REGEL 03.1884 - LE; Anzob Pass, ZIMAN 25.06.1979 - KW.

2. *Anemone bucharica* REGEL ex FINET et GAGNEP. Bull. Soc. Bot. France 51: 75, 1906.

Synonym: *Anemone coronaria* var. *bucharica* REGEL Acta Hort. Petropol. 8: 689, 1884.

Described from "Pjandzh prope Kuljab". Typus and paratypus: LE.

Rhizomes tuberous irregular, rarely branching. Within roots thin ones predominate. Radical leaves 2-4(-6) glabrous, petioles 5-8 cm long; blades 2-ternate, 1.5-4.0 x 1.5-4.5 cm, with 30-80 ultimate lobules; primary segments distinctly petiolulate (middle one frequently longer than lateral ones); involucral

leaves with petiole-like narrow bases, blades 1-5 cm, with 15-35 terminal lobes. Sepals obovate, purple or red inside and outside, 1.5-2.8 x 1.7-1.8cm, with NSV 5-13 and NSVA 7-30. Achene bodies 2.5-3.0 x 1.4-1.8 mm, lanate (hairs 1.7-2.5 mm), beaks 1.7-2.5 mm long, pubescent basally.

According to the characteristics of the main age groups, *A. bucharica* (our data within a population at the Fakhrabad Pass, 1992) is close to *A. petiolulosa*: epigeal germination, short hypocotyle, cotyledonary petioles united in a tube, entire rounded-elongate blades, ovoid tuberous rhizomes formed from the hypocotyl, solitary leaves of juvenile plants with 3-partite blades, and long petioles, 1-2 leaves of immature plants with 3-sected shortly petiolulate blades, senile plants having several non-flowering shoots and partial particulation.

With respect to the anatomical structure of the leaf petioles, *A. bucharica* is also close to *A. petiolulosa*: horseshoe outline of across section, dorsiventral arrangement of vascular bundles, total number of bundles 7 (large bundles 3), fragmented collenchyma and parenchyma and a 2-3-layered sclerenchyma.

Variation and distribution

As a whole, *A. bucharica* is similar to *A. petiolulosa*, especially with respect to the characters of vegetative organs and achenes, peculiarities of main age groups and anatomical structure of leaf petioles, but *A. bucharica* differs in its larger red or reddish sepals and larger NSV and NSVA.

Like *A. petiolulosa*, it is a rather variable taxon within which SHARIPOVA (1971) described several forms: f. *floribunda* (plants with dark red sepals, many stems and flowers), f. *cuneata* (plants with reddish-brown wide sepals), f. *praecox* (plants with small dark red flowers and low stems), f. *latisecta* (plants with reddish-violet sepals and wide terminal leaf lobes), and f. *multisecta* (plants with large flowers and many-sected radical leaves). According to our data, within this taxon the most variable characters include lenght of stem, leaf petioles and petiolules, pedicels and sepals, number of stems, radical leaves and flowers.

The area of *A. bucharica* is limited to Pamir Alai (Central and South -Western Tadjikistan, Hissar, Darwaz, Aruktau, Rangontau, Khozretisho and other Ridges, and Surkho Ridge in South-Eastern Uzbekistan), and this species occurs also in North Afghanistan.

Plants of *A. bucharica* grow mainly in semisavanna and sibljak belts (700-2000 m), in the communities in which *Juniperus turkestanica*, *J. serawschanica*, *Pistacia vera*, *Amygdalus bucharica*, *Acer turkestanicum*, *Rosa divina* predominate, also in the herbaceous communities of *Carex pachystylis*, *Hordeum bulbosum* L., *Poa bulbosa* L., *Artemisia* sp. and others.

Examined selected samples of flowers:

Tadjikistan, Pamir Alai, Rangontau, Baglysai, ROZHEWITS 30.04.1906 - AA; Kurgan Tjube, GOMOLITSKI 13.05.1937 - AA; Rangontau, FEDORONCHUK 20.06.1991 - KW; Fakhrabad Pass, ZIMAN 13.04.1992 - KW.

Examined selected samples of achenes:

Tadjikistan, Pamir Alai, Rangontau, GOMOLITSKI 3.05.1937 - TAD; Chaltau, Sangtudy, MITJAKINA 4.04.1955 - LE; Aruktau, Gandzhino, ALEKSEENKO 5.03.1958 - TAD;

Rangontau, Tashmechetj, BATRITDINOVA 3.04.1959, - TAD; Baba-Tag, CHUKAVINA 27.03.1967 - TAD; Vakhsh,Dagana, SHARIPOVA 6.04.1970 - TAD; Sultanabad, Chormazak Pass, SHARIPOVA 18.04.1970 - TAD; Khozretisho, Chargy, KARIMOV 15.04.1971 -TAD; Fakhrabad Pass, ZIMAN 13.04.1992 - KW;

Uzbekistan, Pamir Alai, Surkho Ridge, Babatag, VVEDENSKI 19.04.1928- TASH.

3. *Anemone baissunensis* JUZ. ex SHARIPOVA in KOMAROV Fl. URSS 7: 259, 1937.

Synonyms: *Anemone coronaria* var. *intermedia* REGEL Acta Hort. Petropol. 8: 689, 1884; *A. coronaria* var. *bucharica lutea* KNEUCKER Allgem. Bot. Zeitschr. 10: 169, 1905; *A. verae* OVCZ. et SHARIPOVA Fl. Tadjikistan 4: 532, 1975.

Described from "Regulum Bucharicum, bejetum Baissunense, Baissun-Tau", leg. 3.04.1913 A. I. MICHELSON. Isotypus: LE. Descr. ross. in adnot. Addenda 4: 532; Lat. descr. SHARIPOVA Izv. Acad. Sci. Tadzh. SSR Otd. Biol. Sci. 4: 29, 1967.

Rhizomes tuberous irregular, branched, 1.0-2.5 x 1.5-4.5 cm. Radical leaves 2-6; petioles 3-8 cm; blades twice-ternate, 1.5-4 x 1.5-3.5 cm, with 30-80 (up to 100) ultimate lobules; primary segments distinctly petiolulate (petiolules almost always unequal). Stems 1-3, 5-15 cm long, glabrous, pedicels 2-9 cm, sparsely puberulent. Involucral leaves with petiole-like narrow bases; blades 3-parted, ultimate lobules 15-35, sparsely puberulent along margins. Sepals 5-6, obovate or oblong, yellow inside and reddish outside, 12-28 x 8-20 mm, with NSV 5-11 and NSVA 7-15, densely pubescent. Achene bodies elliptic, 3.5-5 x 1.2-1.5 mm, lanate (hairs 4-5.5 mm), beaks 2-3 mm long, glabrous.

In examining the peculiarities of the main age groups, *A. baissunensis* (our data on 3 populations, 1992 and 1995) is close to *A. petiolulosa* and *A. bucharica*: epigeal germination, hypocotyle 3-5 mm long, petioles of cotyledonary leaves in a tube 10-15 mm long, rounded-elongate shape of their blades, 1-leaved juvenile and immature plants with 3-partite or 3-sected blades and long petioles, ovoid tubers formed from hypocotyle. This taxon differs from both above species by its complete particulation within the senile plants, with the result that senile plants frequently form small dense clumps.

With respect to the anatomical structure of leaf petioles, *A. baissunensis* also is close to both *A. petiolulosa* and *A. bucharica*: horseshoe outline (cross section), dorsiventral arrangement of vascular bundles, total number of bundles 7 (3 large bundles), fragmented collenchyma and a 4-5-layered sclerenchyma.

Moreover, certain morphometric characters of the radical and involucral leaves, and sepals and achenes suggest that this species is closely related to *A. bucharica*. However, the achene bodies and glabrous beaks of *A. baissunensis* are longer. Furthermore, the dense pubescence of the achene bodies consist of the hairs longest within the *A. biflora* complex (4.5-5.5 mm long).

Variation and distribution

The most variable within this taxon are length of stems, pedicels and leaf petioles, also number of radical leaves and their ultimate lobules, an soon as a size of sepals.

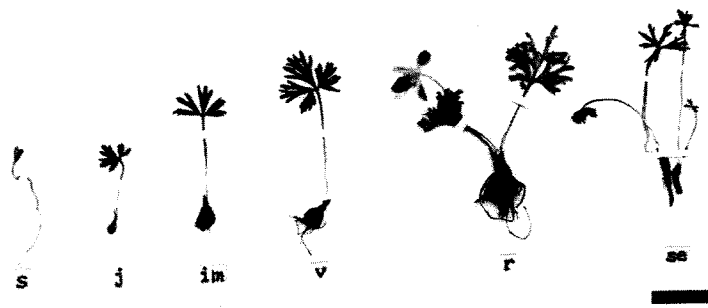

Fig. 6. The main age groups of *A. gortschakowii*: s – seedlings; j - juvenile plants; im - immature plants; v - virginile plants; r - reproductive plants; se - senile plants. (Bar = 2 cm)

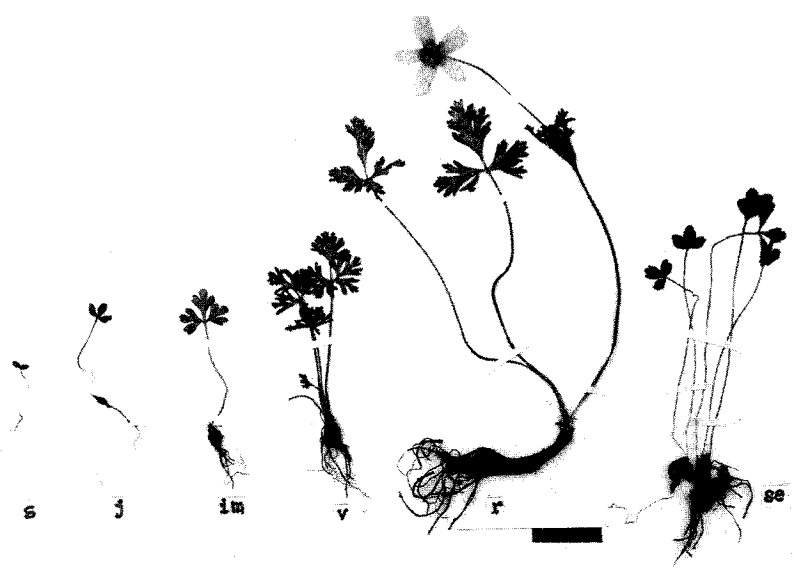

Fig. 7. The main age groups of *A. baissunensis* s – seedlings; j - juvenile plants; im - immature plants; v - virginile plants; r - reproductive plants; se - senile plants. (Bar = 2cm)

OVCHINNIKOV and SHARIPOVA (1975) described *A. verae* from the flora of Central and Southern Tadjikistan. It appeared separated from *A. petiolulosa* on the basis of its long-acute tips of sepals and subsessile lateral segments of the radical leaves, and from *A. baissunensis* on the basis of the wider terminal leaf lobes and narrower sepals.

However, after a comparative study of about 80 plants of "*A. verae*" collected by us (ZIMAN 1992, 1995 within several natural populations at the locus classicus (Hissar Ridge, Kondara Ravine, 60km north of Dushanbe, Tadjikistan) and of about 50 plants of *A. baissunensis* collected in 1992 within a natural population at the Rangontau Ridge (Fakhrabad Pass, 40 km south of Dushanbe, Tadjikistan), we have not found any distinguishing morphological differences between these plants, including peculiarities of anatomical structure of leaf petioles and ontogeny (main age groups).Therefore, we regard that plants from these populations belong to the same species (*A. baissunensis* or *A. biflora* s. l.).

Anemone baissunensis occurs in the South-Eastern Pamir Alai in the territories of Tadjikistan (Hissar, Darwaz, Aruktau, Rangontau, Baldzhuan Ridges, etc.) and partly Uzbekistan (Surkho Ridge only). Plants grow in semisavanna and sibljak belts (600-2000 m), sometimes together with *A. bucharica* and almost always they grow within the communities of *Pistacia vera*, *Amygdalus bucharica*, *Juniperus turkestanica*, *Acer turkestanicum*, *Rosa divina*, *Elytrigia trichophora*, *Carex pachystylis*, *Hordeum bulbosum*, *Artemisia* sp. (like in communities with the participation of *A. bucharica*).

Examined selected samples of flowers:

Tadjikistan, Pamir Alai, Hissar Ridge, Luchob, GRIGORJEV 12.04.1956 - TAD; Kondara Ravine, FEDORONCHUK 23.06.1991 - KW; Kondara Ravine ZIMAN 10.04.1992 - KW; ZIMAN 20.04. 1995 - KW; Fakhrabad Pass, ZIMAN 13.04.1992 - KW.

Examined selected samples of achenes:

Tadjikistan, Pamir Alai, Luchob, GRIGORJEV 12.04.1956 - TAD; Aruktau, Burma, CHUKAVINA 27.04.1959 - TAD; Rangontau, Tashmechetj, BATRITDIINOVA 30.03.1971 - TAD; Khodzha-Kozjan, SHARIPOVA 24.03.1978 -TAD; Hissar Ridge, Kondara Ravine, ZIMAN 10.04. 1992 - KW; Fakhrabad Pass, ZIMAN 13.04.1992 - KW; Kondara Ravine, ZIMAN 10.04.1995 - KW;

Uzbekistan, Pamir Alai, Surkho Ridge, Chenturi, VVEDENSKI 20.04.1928 - TASH; Baissun, LEPESHKIN 10.05.1936 - KW.

4. *Anemone gortschakowii* KAR. et KIR. Bull. Soc. Nat. Moscou 15: 131, 1842.

Synonyms: *Anemone almaatensis* JUZ. in KOMAROV, Fl. URSS 7: 565, 1937; *A. oligotoma* JUZ. in KOMAROV Fl. URSS 7: 565, 1937.

Described from Air River, Dzhungaria. Typus: LE.

Rhizomes tuberous, irregular, branched, 0.8-1.8 x 1.0-2.5 cm. Radical leaves 2-3 (-5); petioles 2-5 cm; blades once-trisected, primary segments shortly petiolulate or sessile, ultimate lobules puberulent. Involucral leaves 3, with short petiole-like bases; blades 3-parted, with 7-15 ultimate lobules. Sepals oblong-elliptic, yellow inside and greenish-reddish outside, 5-15 x 4-8 mm, with NSV 5-9

and NSVA 1-2, densely appressed-pilose. Achene bodies elliptic, 2.7-3.0 x 1.2-1.4 mm, lanate (hairs 3-4 mm), beaks 2.0-2.5 mm long, basally pubescent.

Variation and distribution

According to the morphological characteristics of the main age groups, *A. gortschakowii* (our data on a population, 1993) is very close to *A. petiolulosa* and other foregoing species including morphometric characters of seedlings, juvenile, immature and senile plants.

This taxon is close to *A. biflora* s. str. and differs by radical leaves with mainly sessile primary segments and smaller flowers. But the shape of radical leaves is variable, and plants with shortly petiolulate (1-3, up to 5 mm) radical leaves frequently occur.

Anemone oligotoma JUZ. was described from the Alai Ridge of Pamir Alai (Isfairam Valley below the Tengiz-bai Pass) by JUZEPCHUK (1937) and author regarded it as taxon very close to *A. gortschakowii*, differed on the basis of its less strongly dissected leaves and fewer, also shorter ultimate leaf lobules. However, after a critical comparison of the type material, OVCHINNIKOV and SHARIPOVA (1975) did not find any differences between these taxa, a conclusion we have also reached on the basis of a comparative study of available herbarium material. Accordingly, we do not recognize *A. oligotoma* as a species.

Anemone almaatensis was also described (from the vicinity of Alma Ata) by JUZEPCHUK (1937) who regarded this taxon closely related to *A. gortschakowii* too. According to the description of this author, *A. almaatensis* differed from *A. gortschakowii* on the basis of more slender habit, very short petiolules of primary segments of radical leaves and fewer number of ultimate leaf lobules. After a comparative study of ca. 100 herbarium specimens (including material collected by ZIMAN in 1993 from the "locus classicus" at the Talgar, 40 km of Alma Ata, Kazakhstan), we did not find any differences between these taxa. Therefore, we do not recognize *A. almaatensis*.

Area of *A. gortschakowii* includes mainly Pamir Alai and Eastern Tien Shan at the territories of Kazakhstan, Tadjikistan, Uzbekistan, Kirgizstan and it is disjunctive.

Plants grow at the belts of lowland and high-mountais steppe (2000- 3500 m).

Examined selected samples of flowers:

Kazakhstan, Tien Shan, Talass Alatau, Alma Ata TITOV 20.04.1921 - AA; Talgar GRANITOVA 25.04.1930 - AA; Vernyi GELD 30.04.1934 - AA; Karabulak, DMITRIEVA 28.04.1935 - AA; Chuili Ridge, Krasnogorski GOLOSKOKOV 31.05.1942 - AA; Dzhambul Distr., Chokpar, PAVLOV 9.05.1951- AA; Sjugaty Ravine, GOLOSKOKOV 10. 04.1955 - AA; Uzun Kargali, GOLOSKOKOV 13.05.1963 - AA; Myrnyi, Betpakdala ORAZOVA 22.04.1976 – AA; Talgar, Kurganka Mt., ZIMAN 10.04. 1993 - KW.

Examined selected samples of achenes:

Tadjikistan, Pamir Alai, Petr I Ridge, Ljangarisho, STRYZHOVA 1952 - TAD;

Kazakhstan, Tien Shan, Zaili Alatau, Alma Ata, Kazenni Sad, TITOV 20.04.1921 - AA; Talgar, GRANITOVA 25.04.1930 - AA; Vernyi Distr., Kaskelen, GELD 30.04.1934 - AA; Chuili Ridge, Krasnogorski, GOLOSKOKOV 31.05.1942 - AA; Dzhambul Distr., Chokpar,

PAVLOV 9.5.1951- AA; Myrnyi, Betpakdala, ORAZOVA 22.04.1976 - AA; Karaganda Highway, NELINA 19.05.1980 - AA;

Uzbekistan, Samarkand Distr., Urgut, POPOV 19.04.1940 - TASH; Bukhara Distr., Irmir, Bukan-Tau, NOVIKOVA 29.3.1952 - TASH; Alai Ridge, Kichik Kuvur-Bulak, SAKHOBIDDINOV 27.6.1949 - TASH; Padshaat, GALKINA 21.5.1957 - TASH;

Kirgizstan, Karavan Distr., Dzhida -Sai, NABIEV 4.05.1952 - TASH.

5. *Anemone serawschanica* KOM. Acta Petersb. Soc. Nat. Bot. 26: 49, 1896.

Decribed from Zeravshan Valley, Artuch, Tadjikistan. Typus: LE.

Rhizomes tuberous, spherical, unbranched, ca. 0.5 x 0.8 cm, with thin adventitious roots. Radical leaves solitary; petioles 2.5-4.5 cm; blades once-3-sect, segments sessile, with 8-15 ultimate lobules. Stems 3-8 (-10) cm, glabrous, pedicels 1-3 cm, sparsely glabrous. Involucral leaves sessile; 3; blades with 12-25 lobes or lobules, puberulent at upper part only. Sepals elongate-elliptic, green or yellowish, 7-8 (-10) x 3-5 mm, with NSV 3-7 and NSVA 0-2, glabrous. Achene bodies 2.0-2.2 x 1.0 mm, ovoid, pubescent (hairs 1.7-2.3 mm), beaks 0.5-0.7 mm long, glabrous.

Distribution:

Anemone serawschanica is a narrow endemic of the Pamir Alai, occuring in the Serawschan Ridge close to Urgut, Sangardarak, etc.

Examined selected samples of flowers:

Tadjikistan, Pamir Alai, Hissar Ridge, Sangardarak, PJATAEVA 5.06.1948 - TASH; Seravshan Ridge, Osman Tala, KOCHKAREVA 14.6.1972 -TAD.

Examined selected samples of achenes:

Tadjikistan, Pamir Alai, Surkho Ridge, Obi-Zarang, CHAVRENIDI 20.5. 1948 -TASH; Hissar Ridge, Sangardarak, PJATAEVA 5.6.1948 -TASH; Seravshan Ridge, Osman Tala, KOCHKAREVA 14.06.1972 – TAD.

6. *Anemone tschernjaewii* REGEL. Acta Hort. Petropol. 8: 690, 1884.

Described from Ura-Tjube, Tadjikistan. Syntypus: LE.

Rhizomes tuberous, nearly spherical, 0.5 x 1.0 cm long and wide. Radical leaves solitary; petioles 4-12 cm; blades 3-parted, 1.5-2.5 x 2.0-4.5 cm, rounded bases and with 8-15 ultimate lobules. Stems 5-15 (-25) cm, glabrous, pedicels 3-10 (-15) cm, sparsely puberulent. Involucral leaves 3; sessile; blades basally connate, with 5-15ultimate lobules. Sepals elongate-ovoid to lanceolate, white or pink and light-violet, 17-22 x 8-12 mm, with NSV 5-11 and NSVA 5-15, puberulent. Achene bodies ovoid, 3.0-3.5 x 1.2-1.4, lanate (hairs 5-6mm), beaks 1.7-2.5 mm long, basally pubescent.

With respect to its ontogeny *A. tschernjaewii* differs from other taxa of the *A. biflora* complex in its seedlings (cotyledonary petioles connate only at a base) and shape of leaf blades of the juvenile plants (tripartite with entire segments). In

addition, plants of all main age groups have 1-2 scale-like leaves 2-3 mm long, and adult plants have 2-3 scales 4-6 mm long.

There are some differences also in the peculiarities of an anatomical structure of leaf petioles: total number of vascular bundles is 5 (not 7 like in other species), but a cross section is horseshoe-shaped, 1-layered interrupted collenchyma and 4-5-layered sclerenchyma.

Variation and distribution

The most variable characters of *A. tschernjaewii* are length of stem, petioles of radical leaves, pedicels and number of ultimate lobules of radical and involucral leaves. The distinguishing characters include solitary radical tripartite leaves which develope after flowering, basal stem scales, basally connate involucral leaves (larger than radical ones), white or pink or slightly violet (not yellow) sepals, subspherical small tuberous non-branching rhizomes, nearly free cotyedonary petioles, and 5 vascular petiolar bundles.

The geographical area of *A. tschernjaewii* includes mainly Tien Shan, Pamir Altai and Kopetdag at the territories of Tadjikistan, Uzbekistan and Turkmenistan, also partly Afghanistan, and it is characterized by large disjunctions.

Plants of *A. tschernjaewii* grow in belts of semisavanna and sibljak (700-2200 m), in the communities of *Acer turkestanicum*, *Juniperus turkestanica*, *J. serawschanica*, *Amygdalus bucharica*, *Rosa divina*, also *Ferula foetidissima* REGEL & SCHMALH., *Hordeum bulbosum*, *Eremurus olgae* REGEL, *Calophaca* FISCH. sp., *Carex pachystylis* and others.

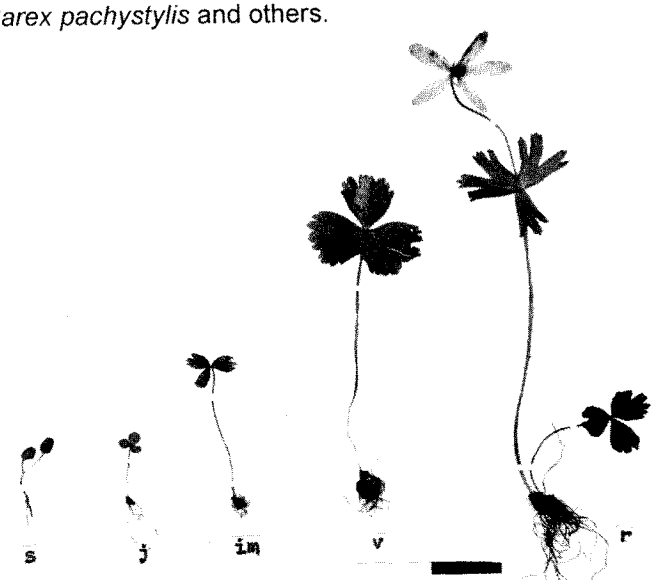

Fig. 8. The main age groups of *A. tschernjaewii*: s – seedlings; j - juvenile plants; im - immature plants; v - virginile plants; r - reproductive plants. (Bar = 2 cm)

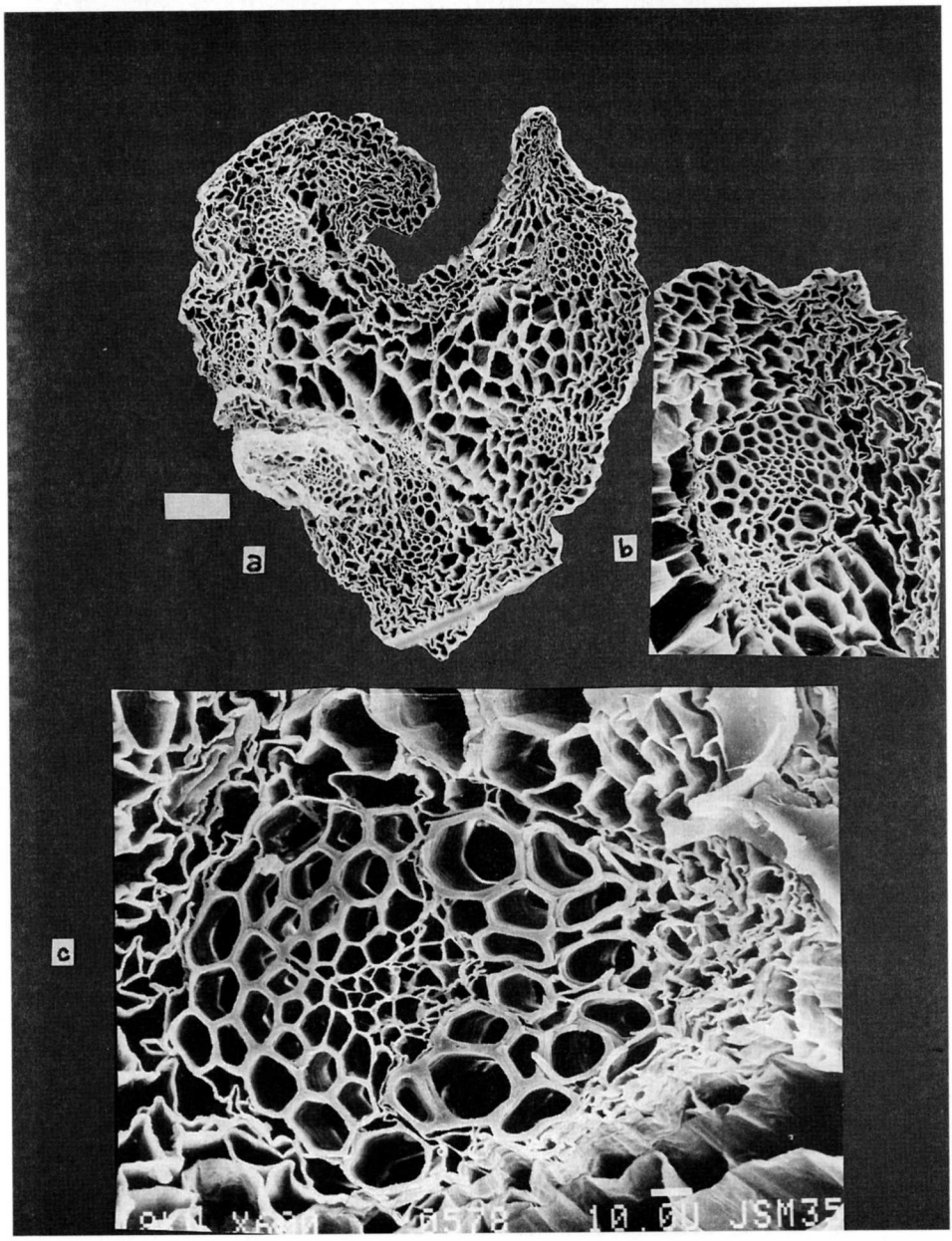

Fig. 9. Peculiarities of anatomical structure of petioles of *A. bucharica* a. complete cross-section; b. part of it; c. part of it. (Bar = 100 μm)

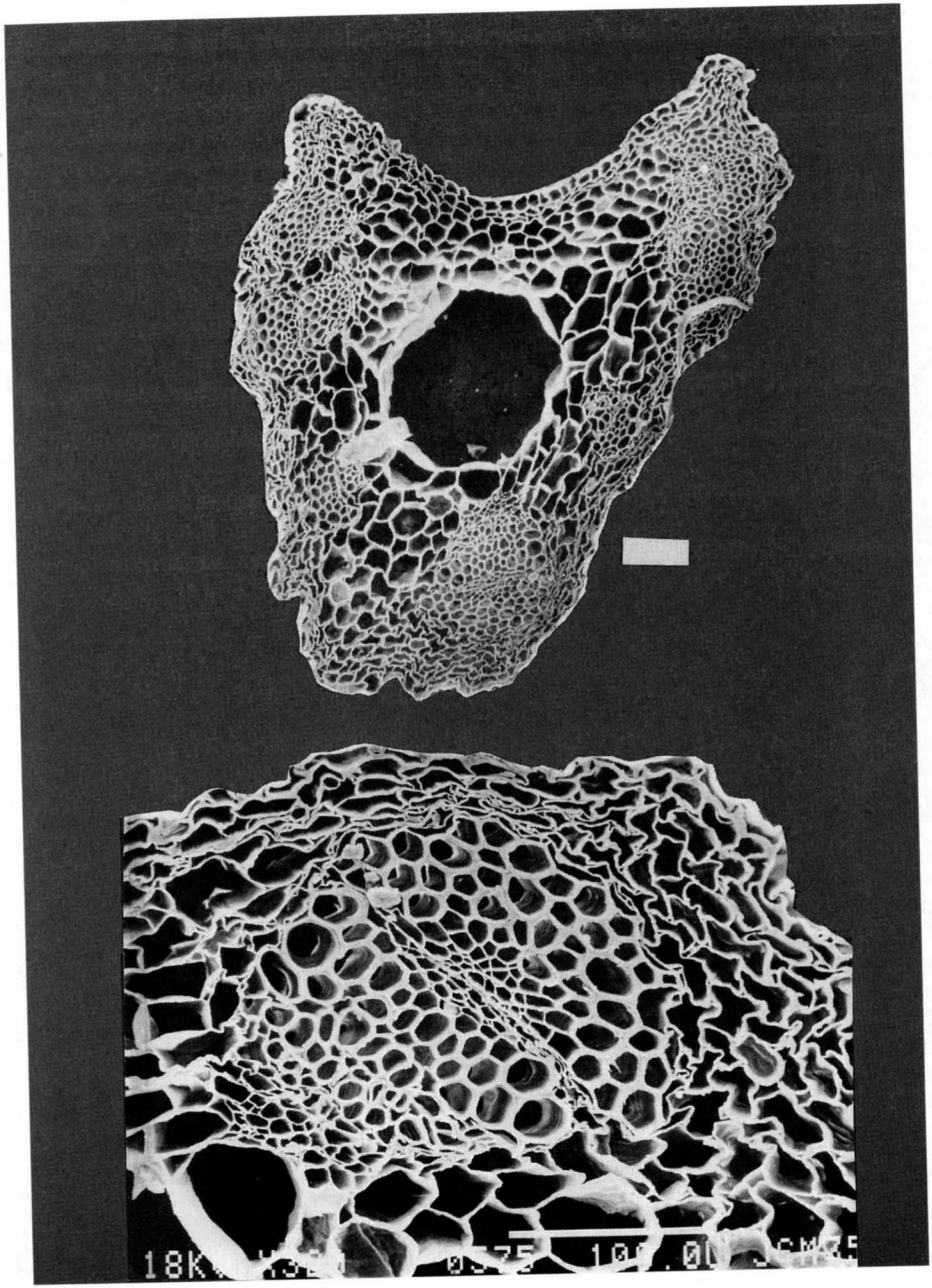

Fig. 10. Peculiarities of anatomical structure of petioles of *A. baissunensis* a. complete cross-section; b. part of it. (Bar = 100 μm)

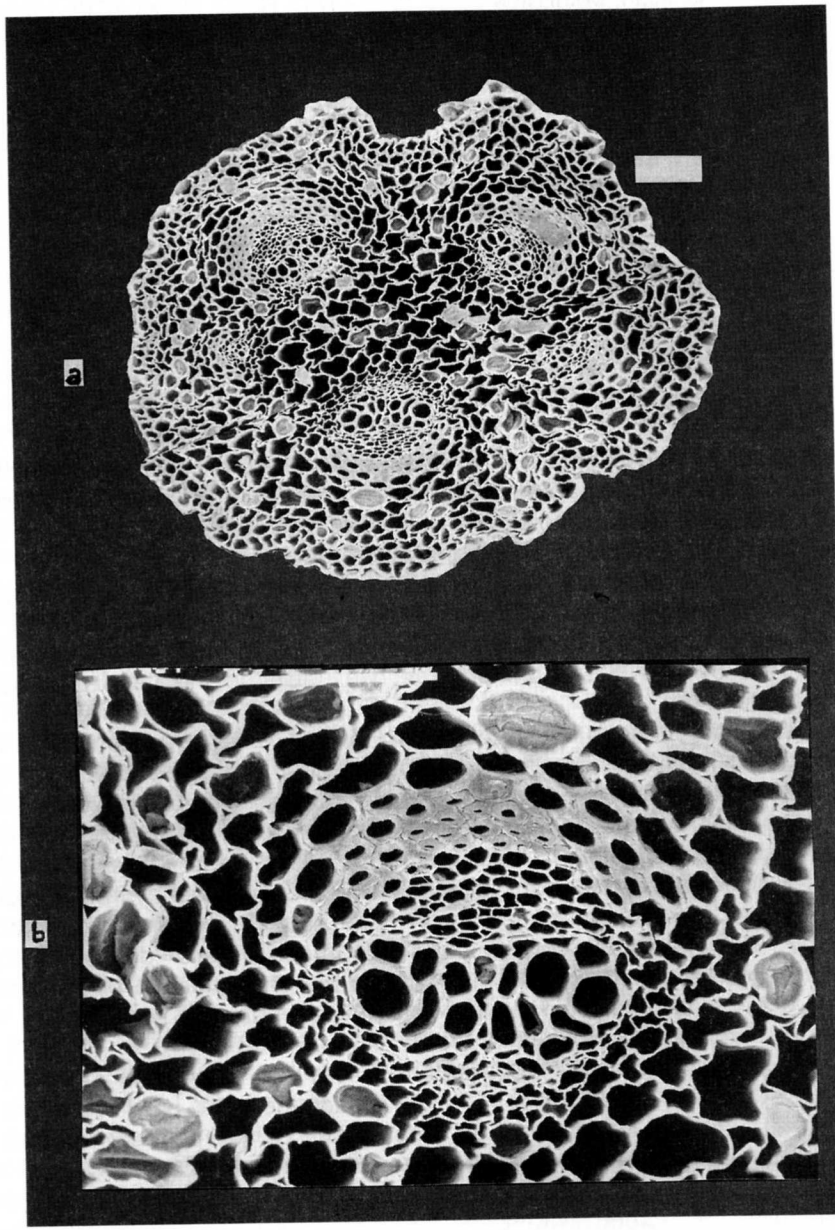

Fig. 11. Peculiarities of anatomical structure of petioles of *A. tschernjaewii* a. complete cross-section; b. part of it. (Bar = 100 μm)

Examined selected samples of flowers:

Tadjikistan, Baldjuan, MIKHELSON 23.03.1913 - TAD; Ramit, VASAK 12.04.1956 - TAD; Rangontau, Tashmechety, BATRITDINOVA 4.04.1970 - TAD; Seravshan Ridge, Allajaran, Urgut, ZUKERVANIK 13.05.1979 – AA; Hissar Ridge, Kondara Ravine, ZIMAN 10.04.1992 - KW; ZIMAN 20.4.1995 - KW; Fakhrabad Pass, ZIMAN 13.04.1992 - KW;

Uzbekistan, Pamir Alai, Tien Shan, Fergana Distr., Ankhor, Arpa, BABENKO 13.04.1916 - TASH; Denau Distr., Chobair, WEDENSKI 25.04.1957- TASH; Angren, BUTKOV 28.05.1954 - TASH; Samarkand Distr., Aman-Kutan, WEDENSKI 25.04.1957 - TASH;

Afghanistan, Mazar Sharif, FREITAG 1958 - WU.

Examined selected samples of achenes:

Tadjikistan, Pamir Alai, Hissar Ridge, Kondara Ravine, ZIMAN 4.04.1992 - KW; Kondara Ravine, ZIMAN 20.04.1995 - KW; Fakhrabad Pass, ZIMAN 13.04.1992 - KW;

Uzbekistan, Tien Shan, Angren, BUTKOV 28.05.1954 - TASH; Pamir Alai, Samarkand Distr., Aman Kutan, WEDENSKI 25.04.1957 - TASH;

Afghanistan, Kabul, ANDERS 10.04.1970 - WU.

Discussion

As a result of our examination of about 80 characters, we distinguished only 27 characters which appeared constant. However, 13 of them are in common to all taxa of the *A. biflora* complex and only 16 (including several ratios) are useful for our taxonomic and phylogenetic analysis.

We include the results of the comparison of the above essential characters of the *A. biflora* complex into Tab. 3; afterwards we selected within them 12 ones and worked out their evolutionary significance (Tab. 4), next we worked out the matrix (Tab. 5) The cluster dendrogram was built on the base of distances among the taxa (fig. 12).

The essential characters in common to the *A. biflora* complex include monomorphic radical glabrous leaves (many other species of Sect. *Anemone* have dimorphic leaves) with obtuse ultimate lobules, 3 involucral leaves much resembling the radical ones, 2 small involucral bracts subtending the lateral flowers, few-flowered stems, persistent 5(-6)-leaved perianth, lanate ovoid or elongate-elliptic achenes with spindle-like beaks, a one-layered endocarp, amphistomatic leaves, and petioles with horseshoe outline of a cross section, small number of vascular bundles (5-7) arranged in arc (dorsivental type). Achene heads hemispherical. All these plants are characterized by pantoporate pollen grains and have similar karyotypes (three acrocentrics, two submetacentrics and three metacentrics - MADAHAR 1967).

As one can see from fig. 12, *Anemone biflora* var. *biflora* and *A. biflora* var. *petiolulosa* are very close (differ in length of achene hairs only), therefore, we regard them as two varieties of *A. biflora* but not independent species like JUZEPCHUK (1937) and other considered.

Anemone biflora var. *eranthioides* is similar to them with respect to its morphological characters.

Anemone gortschakowii is much similar to *A. biflora* (very close distance at the fig. 12), but it differs from the latter by its smaller sepals and by the radical leaves which have predominately sessile primary segments. Maybe, this taxon is a

variety of *A. biflora* too, but our certain data is not sufficient to decide its status finally.

However, *A. bucharica* and *A. baissunensis* stand apart within the *A. biflora* complex, and the former is unique with its red flowers and large sepals, as well as larger number of sepal veins and sepal vein anastomoses. *A. baissunensis* being close to *A. bucharica*, have in common the majority of morphometric characters, including certain peculiarities of ontogeny and anatomical structure of the leaf petioles, and large number of sepals vein anastomoses. *A. baissunensis* differs from *A. bucharica* by its yellow flowers, lower number of sepal veins, longer achene bodies and glabrous achene beaks.

Anemone serawschanica and *A. tschernjaewii* are close and they stand apart within the *A. biflora* complex. *A. serawschanica* is characterized with glabrous smaller sepals, reduced NSV and NSVA and very short achene beaks on smaller achene bodies with shorter hairs, solitary once-tripartite radical leaves, their blades less dissected than those of the sessile involucral leaves. *Anemone tschernjaewii* is close to *A. serawschanica* in terms of the characters of radical and involucral leaves, but the involucral leaves of *A. tschernjaewii* are larger than the radical ones and connate basally. *A. tschernjaewii* differs from *A. serawschanica* and other species of the *A. biflora* complex by developing of its radical leaves after flowering,presence of scale-like radical leaves, colour of sepals (white or pink, etc., but not yellow), cotyledonary leaves with nearly free petioles, leaf petioles with 5 vascular bundles, and a large number of NSV and NSVA.

As a result of our discussion of the population analysis, we regard the *A. biflora* complex as corresponding to Subsect. *Biflorae* P. POPOV and includes three series: Ser. *Biflorae* (*A. biflora* and *A. gortschakowii*), Ser. *Bucharicae* SHARIP. (*A. bucharica* and *A. baissunensis*), and Ser. *Tschernjaewieae* JUZ. (*A. tschernjaewii*, *A. serawschanica*). We reject previously recognized species *A. petiolulosa, A. eranthioides*, *A. almaatensis*, *A. oligotoma* and *A. verae*. We recognize *A. petiolulosa* and *A. eranthioides* as varieties of *A. biflora*, *A. oligotoma* and *A. almaatensis* as synonyms of *A. gortschakowii*, and *A. verae* as a synonym of *A. baissunensis*.

In our opinion, the evolutionary trends within the *A. biflora* complex included a decrease of the number of radical leaves and their terminal lobes, a decrease of sepal and achene size, reduction of NSV and NSVA, and pubescent perianth and achenes, a transformation of irregular branching tuberous rhizomes into spherical tubers, and a reduction of vegetative propagation.

In comparison of the number of primitive and derivative characters within all examined species, three groups of species correspond to three evolutionary levels: a) species with 11-13 primitive characters (*A. biflora* and *A. gortschakowii*, b) species having 9-10 primitive characters (*A. bucharica*, *A. baissunensis*), c) species having 6 primitive characters (*A. serawschanica*, *A. tschernjaewii*). These data confirm our opinion about existance of three series within the Subsect. *Biflorae*.

Table 3. Comparison of the taxa of the *Anemone biflora* complex by the essential morphological characters.

Population: Character	BA	BI1	BI2	BI3	BU	GO	SER	TSC
SEPALS:								
SHAPE								
elongate-ovate	+							
obovate		+	+	+	+	+	+	+
SIZE								
longer than 1cm	+	+	+	+	+			+
shorter than 1 cm						+	+	
COLOR (INSIDE)								
white or red					+			+
yellow	+	+	+	+			+	
pubescent	+	+	+	+	+	+	+	
glabrous								+
NSVA								
>5	+				+			+
<5		+	+	+		+		
<2							+	
STAMENS								
yellow	+	+	+	+		+	+	
violet					+			+
STYLODIA								
light		+	+	+		+	+	
dark	+				+			+
>2 mm	+	+	+	+	+	+		+
<1 mm							+	
HAIRS ON ACHENES								
>4,5mm	+			+	+			+
>2,5mm		+	+			+		
<2,2mm							+	
BASAL LEAVES								
2 or more	+	+	+	+	+	+		
solitary							+	+
twice to three times-sected	+	+	+	+	+	+		
3-parted							+	+
PRIMARY SEGMENTS								
petiolulate	+	+	+	+	+	+		
sessile							+	+
PETIOLULES								
>4 mm	+				+			
<4 mm		+	+	+		+		
LPBL/LBBL								
>3							+	+
<3	+	+	+	+	+	+		
LBBL/WBBL								
>1	+	+	+	+	+			
<1						+	+	+
NTBL >NTIL	+	+	+	+	+	+		
NTBL <NTIL							+	+

Abbreviations: Codes of the populations like in tab. 2; LPBL – length of petioles of basal leaves [cm]; LBBL – length of blades of basal leaves [cm]; WBBL – width of blades of basal leaves [cm]; NTBL – number of teeth of basal leaves; NTIL – number of teeth of involucral leaves.

Table 4. The characters important for taxonomy and phylogeny of the *Anemone biflora* complex (O=primitive, 1=derivative)

1. LSe/WSe: 0=less than 2,5, 1=more than 2,5.
2. Sepals: 0=pubescent, 1=glabrous.
3. Number of sepal vein anastomoses: 0=>3, 1=<3.
4. Ovaries: 0=pubescent, 1=glabrous.
5. Achene beaks: 0=pubescent at a base, 1=glabrous.
6. Achene beaks size: 0=longer than 2 mm, 1=shorter than 1 mm.
7. Achene hairs: 0=longer than 2,5 mm, 1=shorter than 2,2 mm.
8. Basal leaf number: 0=2 or more, 1=solitary.
9. Basal leaf dissection: 0=2-3-sected, 1=43-partite.
10. Basal leaf segments: 0=petiolulate, 1=sessile.
11. Involucral leaves: 0=with petiole-like base, 1=sessile.
12. 0=number of teeth of basal leaves> number of teeth of involucral leaves,1=NTBL<NTIL.

Table 5. Matrix indicated the characters used in the phylogenetic analysis of the *Anemone biflora*-complex

	1	2	3	4	5	6	7	8	9	10	11	12
ABA	0	0	0	1	1	0	0	0	0	0	0	0
ABI1	0	0	1	1	0	0	0	0	0	0	0	0
ABI2	0	0	1	1	0	0	0	0	0	0	0	0
ABI3	0	0	1	1	0	0	0	0	0	0	0	0
ABU	0	0	0	1	0	0	1	0	0	0	0	0
AGO	0	0	1	1	0	0	0	0	0	0	0	0
ASE	0	1	1	0	0	1	1	1	1	1	1	1
ATS	1	0	0	1	0	0	0	1	1	1	1	1

Abbreviations: Characters as in Tab 4., ABA=*A. baissunensis*, ABI1=*A. biflora* var. *biflora*, ABI2=*A. biflora* var. *petiolulosa*, ABI3=*A. biflora* var. *eranthioides*, ABU=*A. bucharica*, AGO=*A. gortschakowii*, ASE=*A. serawschanica* ATS=*A. tschernajewii*.

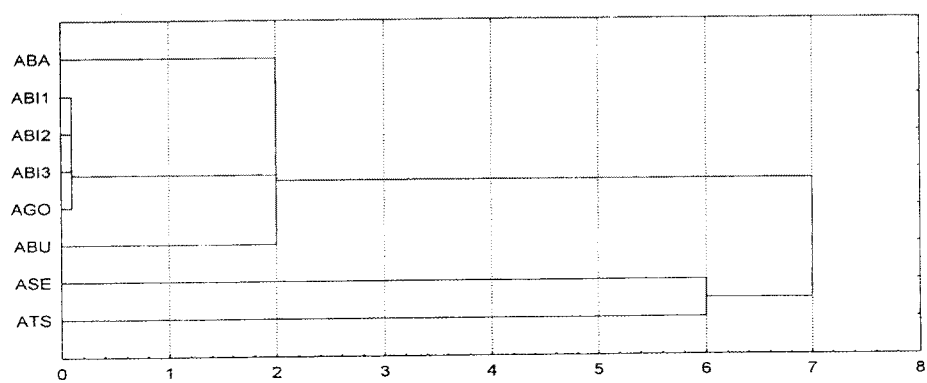

Fig. 12. Dendrogram (single linkage) for 5 populations of 5 species of the *A. biflora* complex by 6 characters of vegetative organs. Abbreviations: ABA=*A. baissunensis*, ABI1=*A. biflora* var. *biflora*, ABI2=*A. biflora* var. *petiolulosa*, ABI3=*A. biflora* var. *eranthioides*, ABU=*A. bucharica*, AGO=*A. gortschakowii*, ASE=*A. serawschanica*; ATS=*A. tschernajewii*.

Summary

On the basis of the critical morphological and anatomical analyses we recognized within the *Anemone biflora* complex within Sect. *Anemone* of the genus *Anemone* (Ranunculaceae) six segregate species. The above complex corresponds Subsect. *Biflorae* and its species are grouped into three series: Ser. *Biflorae* (*A. biflora* included var. *biflora*, var. *petiolulosa* and var. *eranthioides*, *A. gortschakowii*), Ser. *Bucharicae* (*A. bucharica*, *A. baissunensis*) and Ser. *Tschernjaewianae* (*A. tschernjaewii*, *A. serawschanica*).

We suggested the possible evolutionary trends within the *A. biflora* complex, and we elaborated a key to the representatives of this comlex.

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