

Artemisia Communities in Arid Zones of Uzbekistan (Central Asia)

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Abstract—Central Asia, and particularly the former Soviet Middle Asian countries, with more than 180 taxa (45 endemics), is one of the centers of origin and speciation of the genus *Artemisia* L. (Asteraceae, Anthemideae). Several species of this genus, mainly belonging to subgenus *Seriphidium* (Besser) Rouy, are shrubs that dominate the landscape and form large communities in arid (desertic, semidesertic, steppic, and other) zones of this region. Arid lands constitute approximately 90 percent of the territory of Uzbekistan, and there are approximately 40 *Artemisia* species. In this paper we present a characterization of some of these species (including six Central Asian endemics) and communities, with ecological, chorological (with a distribution map), biogeographical, cytogenetic, and chemical data. We also include some references to plant use and management in these areas.

Introduction

The region of our investigation belongs to the Turanian (or Aralo-Caspian) and Turkestanian Provinces of the Irano-Turanian region in the Tethyan (Ancient Mediterranean) floristic subkingdom (Takhtajan 1986). The Middle Asiatic Desert includes the Irano-Turanian Desert region that occupies the southern portion of the Aralo-Caspian Desert and the southern part of Kazakhstan, including Dsungaria. The Central Asiatic Desert comprises a part of Dsungaria, the Gobi Desert, the western part of Ordos on the great bend of the Hwan-Ho, Ala-Schan, Bei-Schan, and the Tarim basin (Kaschgaria), together with the Takla-Makan Desert and the more elevated Tsaidan basin (Walter 1979).

One hundred and eighty *Artemisia* species are present in Middle Asia, 45 of which are endemic to this zone (Poljakov 1961b). From these taxa, 36 grow in Uzbekistan, some of them in desert or semidesert zones, and others in mountain zones. The existence of 19 Middle Asian endemic species of the genus (Vvedenskii 1962) is remarkable in Uzbekistan.

Investigations of the *Artemisia* species and their distribution were carried out using basic ecogeographical and

mapping methods. In addition to the location of *Artemisia* species and communities in Uzbekistan (fig. 1), we present some data on general distribution, ecology, chemical composition, chromosome numbers, and uses of the main taxa of the genus (table 1).

The species belonging to the subgenus *Seriphidium*, which includes most of the Central Asian taxa of *Artemisia* that are relevant in the landscape, have some elements of xeric structure: tomentose leaves, biological repose in summer, and the possibility to expel essential oils in hot weather for plant protection from excessive heating due to very high temperatures. Species of this subgenus have three vegetation phases: (1) mesothermic (in spring) for growing and development, (2) xerothermic (in summer) for biological repose, and (3) microthermic (in autumn and winter) for seed production and death of the inflorescences. The structure of *A. ferganensis*, *A. porrecta*, and *A. serotina* is simpler, because they have only a very small woody perennial stem (Mailun 1976). Most of the species in this subgenus are predominant in vegetation and good forage plants for livestock. Dry mass content of the forage plants of desert shrubland with predominating *Artemisia* species varies from 1.3 to 2.6 centner per hectare. Forage plant dry mass protein content varies from 0.15 to 0.09 centner per hectare. Some species are used for other purposes, such as *A. juncea* (medicine and perfumery) and *A. serotina* (soap-boiling) (Larin 1937; Goryaev and others 1962).

Essential oil content of *Artemisia* species predominating in vegetation in different zones of Uzbekistan varies from 0.32 to 3.1 percent, the highest concentrators being *A. dracunculus* (up to 3.1 percent), *A. ferganensis* (up to 2.1 percent), and *A. porrecta* (up to 1.5 percent) (Goryaev and others 1962). Camphor is present in the essential oils of *A. leucodes* (93 percent), *A. ferganensis* (85 percent), and *A. porrecta* (37 percent); cinneol in *A. serotina* (78 percent), *A. porrecta* (47 percent), and *A. leucodes* (35 percent); and thujone in *A. baldshuanica* (60 percent) (Goryaev and others 1962). Flavonoids are present in *A. leucodes*, *A. dracunculus*, and *A. serotina*; sesquiterpene lactones in *A. tenuisecta*, *A. santolina*, *A. serotina*, *A. juncea*, and *A. leucodes*; coumarins in *A. porrecta*, *A. diffusa*, and *A. dracunculus*; acetylenes in *A. turanica* and *A. dracunculus* (Marco and Barberá 1990). Essential oil concentration in weed species varies from 0.34 percent (*A. tournefortiana* and *A. annua*) to 1 percent (*A. vulgaris*, *A. scoparia*, and *A. absinthium*—up to 2 percent) (Goryaev and others 1962). Most of these weed species also contain acetylenes, coumarins, flavonoids and sesquiterpene lactones (Marco and Barberá 1990).

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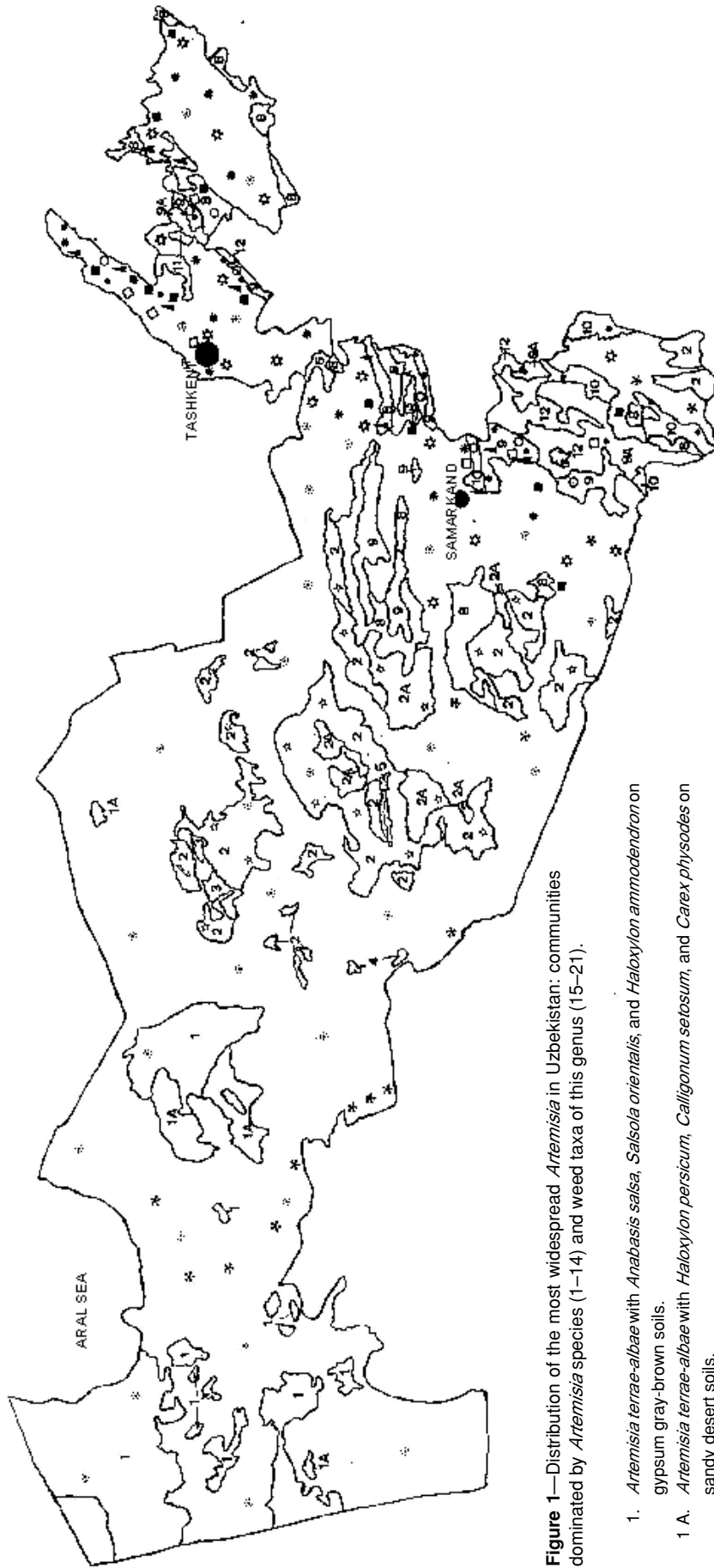


Figure 1—Distribution of the most widespread *Artemisia* in Uzbekistan: communities dominated by *Artemisia* species (1–14) and weed taxa of this genus (15–21).

1. *Artemisia terrae-albae* with *Anabasis salsa*, *Salsola orientalis*, and *Haloxylon ammodendron* on gypsum gray-brown soils.
- 1 A. *Artemisia terrae-albae* with *Haloxylon persicum*, *Calligonum setosum*, and *Carex physodes* on sandy desert soils.
2. *Artemisia diffusa* with *Calligonum leucocladum*, *Astragalus villosissimus*, and *Carex physodes* on sandy desert and sandy gray-brown soils.
- 2A. *Artemisia diffusa* with *Salsola orientalis*, *Carex pachystylis*, *Salsola arbuscula*, and *Ferula ibetida* on gray-brown soils.
3. *Artemisia turanica* with *A. diffusa*, *Carex pachystylis*, *Poa bulbosa*, *Salsola arbuscula*, and *S. orientalis* on gray-brown soils.
4. *Artemisia santolina* with *Carex physodes* and *Mausolea eriocarpa* on sandy desert soils.
5. *Artemisia juncea* with *A. diffusa*, *Ceratoides latens*, *Convolvulus fruticosus*, *Astragalus scleroxylon*, *Zygophyllum atriplicoides*, and *Salsola arbusculiformis* on gray-brown soils of the low mountain slopes.
6. *Artemisia ferganensis* with *A. diffusa*, *Habocharis hispida*, and *Climacoptera longistylosa*, on saltiest light serozem soils.
7. *Artemisia leucodes* with *A. diffusa*, *Convolvulus hamadae*, and *Astragalus villosissimus*.
8. *Artemisia sogdiana* with *Carex pachystylis*, *Poa bulbosa*, *Bromus danthoniae*, *Ceratocarpus utriculosus*, and *Vulpia myuros* on typical serozem soils.
9. *Artemisia tenuisecta* with *Elytrigia trichophora*, *Plangos pabularia*, *Inula grandis*, and *Amygdalus spinosissima* on typical and dark serozem soils.
- 9A. *Artemisia tenuisecta* with *Juniperus seravschanica*, *J. semiglobosa*, and *Elytrigia trichophora* on typical brown soils.

10. *Artemisia baldshuanica* with *Carex pachystylis*, *Amygdalus bucharica*, *Orostegia bucharica*, and *Pistacia vera* on dark serozem soils.
11. *Artemisia lehmanniana* with *Festuca sulcata* on light-brown soils.
12. *Artemisia dracunculoides* with *Cousinia allolepis*, *C. macilentia*, *Acanthophyllum alataivicum*, *Festuca sulcata*, and *Plangos pabularia* on light-brown soils.
13. *Artemisia porrecta* with *Carex pachystylis*, *Salsola sclerantha*, *Phlomis thapsoides*, and *Eremostachys ericalyx* on serozem soils, sometimes slightly salty.
14. *Artemisia persica* with *Cerasus verrucosa*, *Dactylus glomerata*, *Poa nemoralis*, *Agropyron trichophorum*, and *Organum tyrtanthum* on chernozem soils.
15. *Artemisia sieversiana*.
16. *Artemisia scoparia*.
17. *Artemisia tournefortiana*.
18. *Artemisia annua*.
19. *Artemisia absinthium*.
20. *Artemisia vulgaris*.
21. *Artemisia serotina*.

Table 1—Systematic, chorological, ecological, chemical, and karyological data on Uzbek *Artemisia* species, and main uses of these taxa (information drawn from references and our personal knowledge).

Subgenus	Species (and life form)	Distribution area	Ecology	Chemical composition	Utilization	Chromosome number (2n)
<i>Artemisia</i>	<i>A. vulgaris</i> L. (perennial)	Central Asia, Siberia China, Afghanistan, Japan, India, Caucasus, North America, Mediterranean region, Mongolia, West Europe, European part of the former Soviet Union	Weed species, from plain up to the middle zone of mountains, river beaches, gardens, and meadows	Essential oil containing cineol, thujone, paraffin, and borneol. Acetylenes, coumarins, flavonoids, and sesquiterpene lactones. Root contains inulin, tannic substances, and resin. Leaves contain vitamins A and C.	Food for livestock, rabbit, beaver, gopher, marmot. Used for medical purposes by local people. Leaves and stems are used as a condiment for meat dishes.	16
	<i>A. persica</i> Boiss. (perennial)	Central Asia (Tian-Shan, Pamir-Alai), Iran, Tibet, Afghanistan	Road metal slopes from foot up to middle zones of the mountains	Essential oil containing pinene, camphorene, camphor, borneol, and bornilacetate. Leaves and stems contain alkaloids, acetylenes, and coumarins.	Mountain specimens of this species can be used to obtain camphor.	18
	<i>A. tournefortiana</i> Reichenb. (annual or biennial)	Central Asia, Caucasus, Tibet, Afghanistan, Iran	River valleys from plain up to the middle zone of mountains, forests near rivers, and weed species in gardens	Essential oil containing aldehydes, phenols, alkaloids, acetylenes, and sesquiterpene lactones.		18
	<i>A. annua</i> L. (annual)	Central Asia, Siberia, Europe, Iran, China, Afghanistan, Japan, North India, North Africa, North America, Far East, Caucasus	Weed, ruderal in gardens, fields, villages, and towns	Essential oil containing pinene, camphene, cineol, artemisiactene, and artemisiactane. Alkaloids, acetylenes, coumarins, flavonoids, and sesquiterpene lactones.	Perfumery. Condiment. Root extract used for wool and leather dyeing in lemon-yellow color.	18
<i>Absinthium</i>	<i>A. absinthium</i> L. (perennial)	Central Asia, Siberia, Western Europe, Iran, Afghanistan, North India, North America, Caucasus, Mediterranean, European part of former Soviet Union	From plain up to the middle zone of mountains, river beaches, forests near rivers	Essential oil containing absinthol, thuyone, felandrene, pinene, cadinene, terpenes, and absinthin. Acetylenes, coumarins, flavonoids, and sesquiterpene lactones. Leaves contain vitamin C and carotene.	Food for rabbits. Essential oil is used for pharmaceutical and vodka industries. Leaves are used as spice. Plant is used for medical purposes from ancient time.	18
	<i>A. sieversiana</i> Willd. (annual or biennial)	Central Asia, Siberia, China, Japan, Mongolia, east of the European part of former Soviet Union	Road metal slopes from foot up to middle zones of mountains, river and canal beaches, weed species in gardens and fields	Essential oil. Alkaloids in leaves, stems, and flowers. Acetylenes, coumarins, flavonoids, and sesquiterpene lactones.	This plant can be used for silaging.	18
<i>Dracunculus</i>	<i>A. scoparia</i> Waldst. et Kit. (annual or biennial)	Central Asia, Siberia, Western Europe, China, Afghanistan, Japan, North India, Caucasus, European part of former Soviet Union	Weed species widely spread on plains, foothills, and gardens	Essential oil containing α - and β -pinene, and myrcene. Acetylenes, coumarins, flavonoids.	Food for camel, horse, sheep, and rabbit.	16

(con.)

Table 1—Con.

Subgenus	Species (and life form)	Distribution area	Ecology	Chemical composition	Utilization	Chromosome number (2n)
	<i>A. dracunculus</i> L. (perennial)	Central Asia, Siberia, south of the European part of former Soviet Union, Minor Asia, Afghanistan, North America, Mongolia	Subalpine and alpine meadows from 2,800 to 3,700 m on fulvous type soils	Essential oil containing sabinene and myrcene.	Perfumery, used by local people. Food plant.	18, 36, 72, 90
<i>Scriphiidium</i>	<i>A. tenuisecta</i> Nevski (perennial)	Central Asia	Communities widespread on the slopes of the lower and middle zones of Tian-Shan and Pamir-Alai Mountains	Essential oil. Alkaloids, organic acids, and ethers. Sesquiterpene lactones.	Food for livestock.	18
Section <i>Scriphiidium</i>	<i>A. ferganensis</i> Krasch. ex Poljak. (perennial)	Central Asia	Communities on loam, loam-road metal and sandy loam salty soils of river valleys, from foothills up to middle mountain zones	Essential oil containing camphor, α -thujone, carvone, cineol. Sesquiterpene alcohols. Green shoots and leaves contain alkaloids.	Food for livestock.	36
	<i>A. porrecta</i> Krasch. ex Poljak. (perennial)	Central Asia	On loam, road metal and stony slopes from foothills up to middle mountain zones	Essential oil containing camphor, cineol, aldehydes, phenols, and azulene sesquiterpenes. Coumarins.	Food for livestock.	18
	<i>A. serotina</i> Bunge (perennial)	Central Asia	On the loam and loam-road metal, sometimes slightly salty soils of plains, foothills, and lower zones of the mountains	Essential oil containing cineol, camphor, acids, and carotene. Stem and leaves contain alkaloids and flavonoids.	Food for livestock. Used for soap-boiling.	18
	<i>A. turanica</i> Krasch. (perennial)	Central Asia, Iran, Afghanistan	Sandy, loam, gray-brown and gray-brown road metal soils of the desert plains and foothills	Essential oil. Tannin. Resin. Acetylenes.	Food for livestock.	18
	<i>A. diffusa</i> Krasch. ex Poljak. (perennial)	Central Asia	Sandy and gray-brown desert soils, serozem of the foothills	Essential oil. Coumarins.	Food for livestock. Used to make hay stocks by local people.	36
	<i>A. sogdiana</i> Bunge (perennial)	Central Asia, Afghanistan	Loam-road metal soils (sometimes slightly salty) and stony slopes from foothills up to middle mountain zones	Essential oil.		36
	<i>A. baldshuanica</i> Krasch. et Zapr. (perennial)	Central Asia (South Pamir-Alai)	Loam-road metal and stony slopes of the North Exposition from foothills up to middle mountain zones	Essential oil containing α - and β -thujone, thujone alcohol, isothujvalerianate, and aldehydes.		36
	<i>A. lehmanniana</i> Bunge (perennial)	Central Asia	Subalpine and alpine meadows from 2,800 to 3,700 m on fulvous type soils	Essential oils. Phenols, cetones, sesquiterpenes.		Unknown (con.)

Table 1—Con.

Subgenus	Species (and life form)	Distribution area	Ecology	Chemical composition	Utilization	Chromosome number (2n)
	<i>A. santolina</i> Schrenk. (perennial)	Central Asia, Iran, China	Sandy, sometimes slightly salty, desert soils	Sesquiterpene lactones.	Food for livestock.	18
	<i>A. terrae-albae</i> Krasch. (perennial)	Central Asia, Mongolia, Western China	Gypsum gray-brown soil of plateau and sandy desert soils, northern part of the desert zone	Essential oil containing cuminaldehyde, cineol, borneol, camphor, and artemisiacetone.	Food for livestock.	Unknown
Section <i>Junceum</i>	<i>A. juncea</i> Kar. et Kir. (perennial)	Central Asia, China	Alluvial road metal-sandy-loam soils of the plain, loam-road metal and stony slopes from foothills up to lower mountain zones	Essential oil. Tannic substances. Resin. Sesquiterpene lactones.		18
	<i>A. leucodes</i> Schrenk. (annual or biennial)	Central Asia	Sandy desert soils of the plains, loam and road metal-loam soils of the foothills and lower mountains	Essential oil containing camphor, cineol, cis-pinocampheol, borneol ether, isovalerianic acid, azulene sesquiterpenes, and azulenes. Santonin. Flavonoids and sesquiterpene lactones.	Used for medicinal purposes and perfumery.	18

Artemisia Communities in Uzbekistan

The Uzbek Desert zone is included in the Turanian Province. The mean annual temperature is 14 °C, and the mean annual precipitation is 130 mm per year. The annual duration of the sun radiance is about 3,000 hours. Climax communities of the Turanian Desert type are dominated by *A. diffusa* Krasch., *A. turanica* Krasch., and *A. terrae-albae* Krasch. Figure 1 shows the distribution of the most widespread *Artemisia* species in Uzbekistan, not only those that are dominating in different communities, but the weed taxa of the genus as well.

Artemisia diffusa (fig. 2A) is a South Turanian species endemic of Middle Asia. It is a very ramified shrub, about 20 to 50 cm tall, with dense white indumentum. This plant is more widespread and predominant in different soil types of the desert zone in Uzbekistan. About 50 *A. diffusa* associations have been described in Uzbekistan, which contain 140 vascular plant species: 34 shrubs, 28 perennial herbs, and 77 annual species (Granitov 1964; Melnikova 1973; Momotov 1973; Zakirov 1973).

Artemisia turanica (fig. 2A) is distributed in Middle Asia, Iran, and Afghanistan (Vvedenskii 1962). It is a shrub about 20 to 40 cm tall, with violet-brown (or black) stems. It is often codominant in the *A. diffusa* communities and sometimes predominante in salty loam gray-brown soils of the pre-mountain plains. Desert *Artemisia* (*A. diffusa*, *A. turanica*) are very polymorphic, and in their communities there are often plants that have been considered by several authors as hybrids between both species, even though they are closer to *A. turanica* in habit (Poljakov 1958, 1961a; Momotov 1973). Anatomical characteristics of those species are variable in the different types of the soils of Kyzylkum Desert. In the drier conditions of loam soils, leaves are flatter, with denser nervation; water-carrier facing cells are larger and thick-walled mesophylle; sprouts are more lignified. *Artemisia turanica* is more adapted to strict conditions and has a higher stomata density than *A. diffusa* (Alimuchamedova 1983; Padunina and Momotov 1983). Twenty *A. turanica* associations were described in Uzbekistan. Floral composition varies from 25 to 57 (5 shrubs, 16 perennial herbs, and 36 annual) species (Granitov 1964; Melnikova 1973; Momotov 1973; Zakirov 1973). Xeric pelitic shrubland of *A. diffusa* and *A. turanica* communities with *Salsola orientalis*, *S. arbuscula*, *Carex pahystylis*, and *Poa bulbosa* predominate on loam and clay gray-brown soils of the mountain plains. Xeric psammophytic communities of *A. diffusa* with *Calligonum leucocladium*, *Astragalus villosissimus*, *Carex physodes*, *Convolvulus hamadae*, *Salsola arbuscula*, and *Ferula foetida* predominate on sandy gray-brown soils and sandy desert soils. Xeric petrophytic shrubland of *A. diffusa* and *A. turanica* with *Salsola arbusculiformis*, *Convolvulus fruticosus*, *Stipa aktauensi*, *Astragalus scleroxylon*, and *Atrophaxis spinosa* is spread on the calcareous slopes of low desert mountains. Salty shrubland of these species with *Climacoptera lanata*, *Gamanthus gamocarpus*, and *Girgensohnia oppositiflora* is distributed on saline gray-brown soils and solonchaks.

Artemisia terrae-albae (fig. 2B), a North Turanian species, is one of the most important plants in the plant cover of

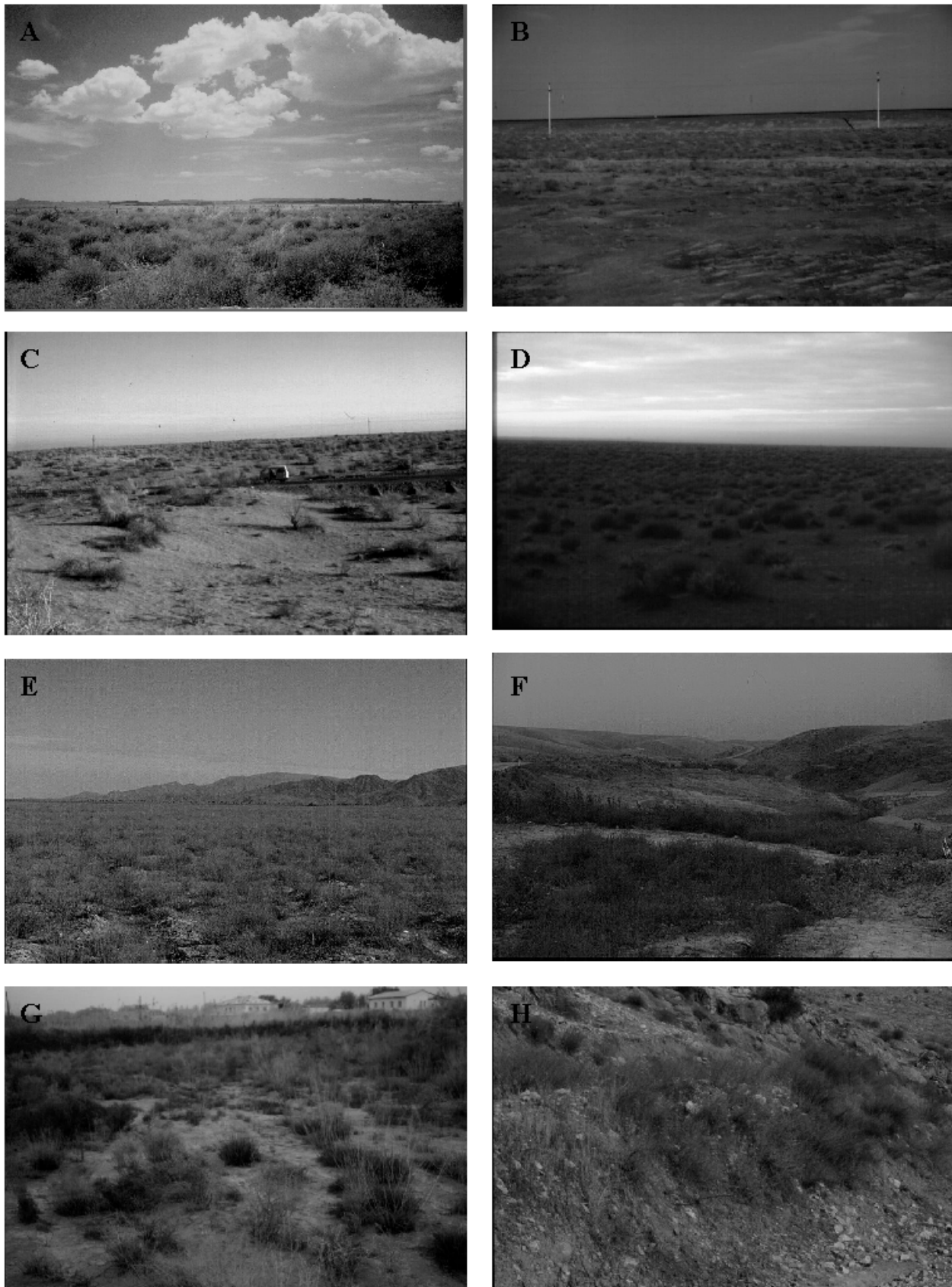


Figure 2—Communities dominated by different *Artemisia* species in Uzbekistan. (A) *A. diffusa* and *A. turanica*. (B) *A. terrae-albae*. (C) *A. santolina*. (D) *Mausolea eriocarpa* (*Artemisia eriocarpa*). (E) *A. sogdiana*. (F) *A. serotina*. (G) *A. ferganensis*. (H) *A. baldshuanica*.

Kazakhstan and the Central Asian Desert zone (Musaev 1968; Safronova 1998), including the Uzbekistan Northern Desert part. It is a shrub about 25 cm tall. The leaves have an epidermis of small cells with a thick cuticle layer and are densely tomentose (Zakrzewski and Korovin 1935). Epidermic cells contain tannic substances. The distribution area of this species includes Middle Asia and Mongolia (Vvedenskii 1962). *Artemisia terrae-albae* communities (with *Anabasis salsa*, *Salsola orientalis*, and *Haloxylon ammodendron*) are widespread on gypsum gray-brown soils of the Usturt Plateau, and occur in a small territory (with *Haloxylon persicum*, *Calligonum setosum*, and *Carex physodes*) in the desert sandy soils, and sandy gray-brown soils in the North Desert zone. There are 10 *A. terrae-albae* associations in Uzbekistan. Their floral composition varies from seven species on gypsum soils to 48 species (22 percent shrubs, 27 percent perennial herbs, and 51 percent annuals) on sandy gray-brown soils (Momotov 1973).

Artemisia santolina (fig. 2C) is a desert white tomentose shrub about 40 to 60 cm tall. This species spreads in Middle Asia, Iran, and China, but very seldom predominates in the vegetation cover of Uzbekistan. Small spots of *A. santolina* communities with *Mausolea eriocarpa* (*Artemisia eriocarpa*) (fig. 2D) and *Carex physodes* occur in sandy desert soils of the southwest part of the desert zone near the Amu-Daria River. Their floral composition is about 12 species.

Shrublands with *A. sogdiana*, *A. serotina*, *A. ferganensis*, *A. porrecta*, *A. baldshuanica*, and *A. tenuisecta* communities predominate in the semidesert and low mountain zones of Uzbekistan (Mailun 1976). Soils are represented by serozems with gypsum or detritus in some places. Average annual temperature is 12 to 15 °C. Average annual precipitation is 250 to 400 mm. The width of the mountain semidesert belt is 30 to 50 km and makes up two-thirds (more than 64,000 km²) of the mountain territories of the Republic.

Artemisia sogdiana (fig. 2E) is a shrub about 40 cm tall, with 10 to 15 cm that is woody perennial part. Leaves are slightly tomentose. The epidermis is thicker than that of other *Artemisia* species. *Artemisia sogdiana* stomata size and distribution are similar to those of *A. turanica*. Epidermal cell walls have a winding structure. These are mesomorphic indications (Alimuchamedova 1983). Distribution area of *A. sogdiana* expands in Middle Asia and Afghanistan (Vvedenskii 1962). Communities are widespread from premountain plains up to low mountain zones (500 to 800 m). There are 28 *A. sogdiana* associations in Uzbekistan. Their floristic composition is approximately 150 species (Mailun 1976). Most typical species in *A. sogdiana* communities are *Carex pachystylis*, *Poa bulbosa*, *Bromus danthoniae*, *Ceratocarpus utriculosus*, *Vulpia myuros*, *Cousinia resinosa*, *Phlomis thapsoides*, *Eremostachys eriocalyx*, and *Psoralea drupacea*.

Artemisia serotina (fig. 2F), endemic to Middle Asia, has a short perennial part and numerous herbaceous stems about 40 to 80 cm tall, very tomentose in the beginning of the vegetation period and almost glabrous to the end. This plant grows on different types of soils from plains to lower parts of mountain zones (Vvedenskii 1962) and is very often codominant in *A. sogdiana* and *A. serotina* communities, with *Phlomis thapsoides*, *Cousinia resinosa*, *Haplophyllum perforatum*, *Solenanthus turkestanicus*, *Poa bulbosa*, *Carex pachystylis*, *Garhadiolus angulosus*, *Lens orientalis*, and

Medicago rigidula. These communities are secondary and occupy very small places in Uzbekistan.

Artemisia ferganensis (fig. 2G) is an endemic shrub to Central Asia, with its perennial part about 10 cm and only a few tomentose offshoots about 60 to 100 cm tall. This plant grows in different type of soils and sometimes on very salty places like a halophyte. According to anatomical and morphological indications, *A. ferganensis* has less xeromorphic structure (bigger leaves, stomata, and main rib; dense leaf nervation) than *A. turanica*, *A. diffusa*, and *A. sogdiana* (Alimuchamedova 1983). Communities dominated by *Artemisia ferganensis*, with *Camphorosma monspeliaca*, *Salsola orientalis*, *Kalidium caspicum*, *Climacoptera intricata*, *C. longistylis*, *Suaeda arcuata*, and *Halocharis hispida*, occupy small salty places near Aidar Lake and in the Fergana Valley. Sometimes *A. ferganensis* predominates on loam soils of the low mountains with *Taeniatherum crinitum*, *Aegilops truncialis*, *Bromus danthoniae*, *Poa bulbosa*, *Hordeum bulbosum*, *Phleum paniculatum*, *Alyssum marginatum*, *Srigosella trichocarpa*, *Psoralea drupacea*, and *Eremurus sogdianus*. *Artemisia ferganensis* has been planted in the Aral Sea region for arid land regeneration and pasture-improving purposes.

Artemisia porrecta is an endemic shrub to Middle Asia, with erect herbaceous stems about 75 cm tall. Its morphological structure is very close to that of *A. ferganensis*, but they differ by inflorescence form. There are three associations of *A. porrecta*, with *Carex pachystylis*, *Phlomis thapsoides*, *Eremostachys eriocalyx*, *Salsola sclerantha*, *Girgensohia oppositiflora*, *Hordeum leporinum*, and *Aegilops squarrosa* on salty soils along the rivers from lower to middle mountain zones in Uzbekistan (Mailun 1976).

Artemisia baldshuanica (fig. 2H) is an endemic species to Middle Asia, with a very limited distribution area in the South Pamir-Alai Mountain system. This shrub has erect stems about 60 to 100 cm tall with a woody part 20 to 40 cm (Vvedenskii 1962). *Artemisia baldshuanica* communities are spread on northern slopes, sometimes with crushed stones, from foothills up to the middle part of the mountains. There are three associations with this species in Uzbekistan, with *Dactylis glomerata*, *Agropyron trichophorum*, *Calamagrostis epigeios*, *Origanum tyttanthum*, *Phlomis bucharica*, *Ziziphora brevicalyx*, *Muretia fragrantissima*, *Agropyron trichophorum*, *Carex pachystylis*, *Poa bulbosa*, *Gentiana olivieri*, *Gagea stipitata*, and *Ixiolirion tataricum*. *Artemisia baldshuanica* is codominant in *Amygdalus bucharica*, *Pistacia vera*, *Otostegia bucharica*, and *Juniperus seravchanica* communities on stony slopes (Mailun 1976).

Artemisia tenuisecta is an endemic shrub to Middle Asia (West Tian-Shan and Pamir-Alai), about 35 to 75 cm tall, with woody and rather thick stems, and very tomentose in the beginning of the vegetation period (Vvedenskii 1962). This species needs highly humid and warm weather. There are 16 associations with this species in Uzbekistan. Their floristic composition comprises about 136 species (Mailun 1976). *Artemisia tenuisecta* is codominant with *Elytrigia trichophora*, *Amygdalus spinosissima*, *Atrophaxis pyrifolia*, *Rosa maracandica*, *Caragana alaica*, *Spiraea hypnicifolia*, *Hammada leptoclada*, *Prangos pabularia*, *Inula grandis*, *Poa bulbosa*, and *Carex pachystylis* on typical serozems of foothills and lower mountains (600 to 1,500 m above sea

level), and with *Juniperus seravschanica* and *J. semiglobosa* on typical brown soils. *Artemisia tenuisecta* communities with *Agropyron trichophorum*, *A. intermedium*, *A. setuliferum*, *Festuca valesiaca*, *Althaea nudiflora*, *Elytrigia trichophora*, *Prangos pabularia*, *Inula grandis*, and *Amygdalus spinosissima* occupy areas of mountain steppes at heights up to 2,000 to 2,600 m above sea level. Dark sierozems are the main soils, although pale-gray and brown mountain-steppe soils occur in under parts. Average annual temperature is 11 to 14 °C.

Artemisia lehmanniana, *A. dracunculus*, and *A. persica* form shrublands on the slopes and tops of the mountains higher than 2,000 m (Akjigitova and Mailun 1984). *Artemisia lehmanniana* is an endemic shrub to Middle Asia, about 15 to 45 cm tall, with short, perennial, woody, very ramified stems. *Artemisia dracunculus* has erect herbaceous stems about 40 to 80 cm tall and very characteristic—very rare in the genus—entire leaves. It occurs in Middle Asia, Siberia, the southern part of the former Soviet Union, Minor Asia, Afghanistan, North America, and Mongolia. *Artemisia persica* is a gray-green shrub with stout woody stems. Its distribution area comprises Middle Asia, Iran, Afghanistan, and Tibet. Those three species are codominant in *Juniperus seravschanica* and *J. semiglobosa* communities, accompanied by *Lonicera altmannii*, *Rosa hissarica*, *R. maracandica*, *Malus sieversii*, *Acer semenovii*, *Adonis turkestanica*, *Arenaria griffithii*, *Phlomis olgae*, and *Acantholimon erythraeum*. *Artemisia lehmanniana* and *A. persica* predominate in higher steppe mountain zones, and subalpine and alpine meadows located between 2,800 and 3,700 m and characterized by a significant rate of humidity (precipitation rate up to 800 mm) and a temperately cold climate with average annual temperature of 8 °C. Soils belong to the mountain-meadow-steppe fulvous type and, less often, to the chernozem-like subalpine type. Associations of *A. lehmanniana* and *A. persica* with *Festuca valesiaca*, *Cerasus verrucosa*, *Dactylis glomerata*, *Poa nemoralis*, *Cousinia verticillaris*, *Koeleria gracilis*, *Bromus inermis*, and *Arenaria griffithii* are typical in the steppe zone, and those with *Prangos pabularia*, *Ligularia thomsonii*, *Polygonum coriarium*, *Ferula tenuisecta*, *Cicer maracanthum*, and *Phlomis severtzovii* are found in subalpine and alpine meadows.

Karyology and Distribution

Sixteen *Artemisia* species form shrubland communities in the desert and mountain zones of Uzbekistan. Most widespread communities are dominated by species belonging to the subgenus *Seriphidium*: *A. diffusa* in the desert zone; *A. sogdiana* on premountain plains and the low mountain zone; *A. tenuisecta* and *A. baldshuanica* from foothills up to the middle part of the mountains; and *A. lehmanniana* in the higher mountain zone. These species are endemic to Middle Asia. From a karyological viewpoint, it is worth noting that widespread species in the desert and semidesert zones (*A. diffusa*, *A. sogdiana*) are polyploid ($2n = 36$), whereas more chorologically restricted species—adapted to xerophilous conditions in the desert (*A. turanica*, *A. santolina*, *A. leucodes*) or to more humid conditions in the mountains (*A. tenuisecta*, *A. juncea*, *A. serotina*, *A. porrecta*)—are diploid ($2n = 18$).

This fact, noted by Vallès and others (2001), agrees with the rather general assumption that polyploids usually cover larger territories than related diploids (Ehrendorfer 1980), even though many exceptions to this rule can be found (Bretagnolle and others 1998).

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