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PLANTS OF JAHAN NAMA PROTECTED AREA, GOLESTAN PROVINCE, N. IRAN

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Abstract

Jahan Nama Protected Area is located in the eastern parts of Alborz Mountains, between 36º35′ and 36º42′ northern latitudes and 54º08′ and 54º36′ eastern longitudes, with an altitude ranging from 800 to 3100 m. The complicated topography and habitat heterogeneity, in addition to influencing the area by humid Caspian climate at the north and Mediterranean-like climate at the south have caused formation of diverse vegetation types including deciduous montane forests, cold-resistant Juniper woodlands, montane steppes, grasslands and meadows, cliff and riverine vegetation. Based on collection of about 1350 specimens during 1999, 2000 and 2004 to 2007, a total number of 607 vascular plant species were identified from this area belonging to 329 genera and 85 families. The Dicots with 469 species are the richest group of flora of the area followed by Monocots with 119 species, Gymnosperms with 6 species and Pteridophytes with 13 species. The largest families in the area are Poaceae (53 species), Labiatae (50 species) and Brassicaceae (52 species), and the most diverse genera include *Astragalus* (16 species), *Carex* (11 species) and *Veronica* (11 species). The floristic composition of the area is strongly influenced by large number of Euro-Siberian (boreal) elements in the mesic parts and Irano-Turanian elements in the Juniper woodland and montane steppe parts of the area. The area inhabited by several endemic plants of the Hyrcanian and Kopetdagh-Khorassan floristic provinces in addition to local endemics of the eastern and Central Alborz like *Ferula glaucopruinosa* (Rech.f.) Akhani comb. nov. and trees like *Taxus baccata* which is considered as a protected and threatened species in Iran.

Introduction

Iran with about 1.65 million square kilometer surface area is a large country and after Turkey is the richest country of plant diversity in the Middle East. The rich flora and fauna and unique landscapes of this land and its old civilization attracted many biologists and orientalists. This country is situated among three main phytochoria including Euro-Siberian (boreal), Irano-Turanian and Saharo-Sindian (senus White & Léonard, 1991) or Saharo-Arabian (sensu Zohary, 1973; Akhani, 2007) and influenced by the introgression of Somalia-Masaei and Mediterranean species (Zohary, 1973; Takhtajan, 1986; Léonard, 1989).

The knowledge of the floristic composition of an area is a perquisite for any ecological and phytogeographical studies and conservation management activities. In studying any particular piece of vegetation, from an ecological point of view, our first step must be to determine the facts as they exist on the ground: facts regarding the vegetation, on the one hand; facts regarding the habitat, on the other (Nicholes, 1930). If there is any one set of facts which is more susceptible to direct study and exact characterization than any other, it is the floristic composition of the vegetation. Traditionally the designation of protected areas in Iran was largely based on fauna and in

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particular large mammals and birds which are more attracted for hunters. Plant biodiversity and phytogeography are other important factors which should be considered in evaluation of conservational value of an area. Due to relative few numbers of local floristic and ecological studies in Iranian protected areas, our knowledge about flora of Iran and conservation management based on floristic structure and the status and list of threatened species is far from completeness.

According to the first national report of Iran Department of Environment to Convention on Biological Diversity (CBD) about 8.5 million hectares of the surface area of Iran is protected as different kinds of conservational categories (Anonymous, 2000). Golestan Province is located in the easternmost parts of south Caspian forests and known as one of the most biotope rich areas in Iran. Golestan, "the land of flowers" was originated from Golestan forest which is now parts of the "Golestan National Park". So far five areas were designated as protected area in Golestan Province. Jahan Nama Protected Area (JNPA) is the second largest protected area in Golestan Province after Golestan National Park.

Flora and vegetation of JNPA had been scarcely studied hitherto, specially as some occasional plant collections done by botanists who visited the area for a particular plant group or passed in their botanical tours. The oldest botanical visit to the area backs to Bunge who collected several plants from the forests near Ziarat during 1858 (Bunge, 1860). The southern parts of the area, off the protected area in Shahvar Mountain, was botanized by Rechinger during 1948 (Rechinger, 1989). All these plants have been recorded in Flora Iranica (Rechinger 1963-2005). Vegetation studies in this area are limited to few rangeland and meadows ecological studies using satellite imagery (Mottaghi, 2000; Nuhi 2000).

This paper provides a first floristic list of the vascular plants of Jahan Nama Protected Area. This is based on three consecutive collection years from 2004 to 2007 by junior author (S.M.J) and two ealier ones in 1999 and 2000 by the senior author (H.A.) in most parts of the area.

Study area

Location and Topography: Jahan Nama Protected Area (JNPA) with 38,340 hectares surface area is situated between 36º35' and 36º42' northern latitudes and between 54º08' and 54º36' eastern longitudes, on southern highlands of Gorgan, Golestan Province (Figure 1). This area is a mountainous area, with a minimum altitude of 800 m and reaches to a maximum altitude of 3100 m height in some parts. Because of high diversity of wildlife and diverse habitats and landscapes, the area was designated as Protected Area in 1973 (Kiabi & Ghaemi, 2000). Diverse topography, deep inaccessible valleys, typical subalpine and montane ecosystems and vertical cliffs are among the fascinating landscapes and physical structures of the area.

Geology and Climate: Formation of almost all of the high mountains of the area can be attributed geologically to Jurassic era and they are known as Lar formation in Iran. This geologic formation is dominant structure from northern to central parts of area. The oldest geological units in this area can be attributed to late Ordovician era which form

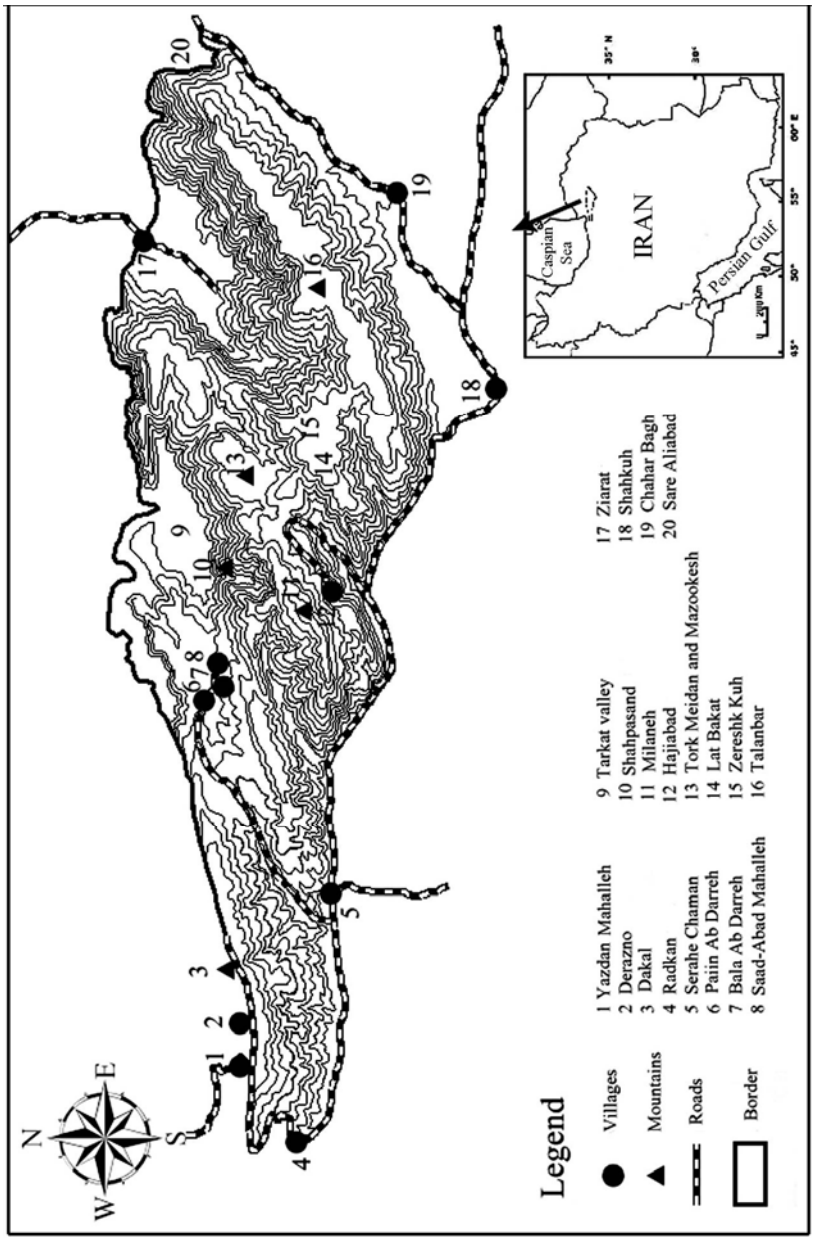

Figure 1: Topographic map of Jahan Nama Protected Area showing position of the area in Iran (inset) and the name of villages and mountains

low altitude mountains throughout the area. Also some Carboniferous outcrops can be seen from southern to central parts which are known as Mobarak formation in Iran (Zamani & Hosseini, 2001). In the Eastern Alborz, most of the Shemshak formation appears to be early Jurassic in age, but it can not be dated due to lack of enough index fossils (Fürsich *et al*, 2005).

The northern slopes of Alborz Mountains face to one of the main resources of humid air for Iran, Caspian Sea air masses, which have caused formation of dense deciduous forests of the northern slopes (Alijani & Harman, 1985). According to available data annual precipitation differs from 600 to 770 mm per year in northern and 300-500 mm in the southern parts of the area. Also average annual temperature differs from about 16-27ºC in the South to 15-18ºC in the North (Khalili, 1973). The Gorgan synoptical station is the only close climatical station to Jahan Nama. Based on average of 38 climatological data the average annual precipitation is 618 mm and the annual temperature is 17.7ºC (Akhani, 1998). Lack of climatology stations in other parts of Jahan Nama leads to unreliable interpretation of climate in detail. This area has a transitional condition; northern parts have humid and relatively warm climate but southern parts have dry and Mediterranean-type climate. This climatic difference has resulted in completely different vegetations at northern and southern parts, which are deciduous closed montane forests in North and Juniper woodlands in South.

Materials and Methods

The checklist presented in this paper is based on various botanical excursions during 1999, 2000 and from 2004 to 2007 (Appendix 1). About 1350 specimens were collected using normal random collecting method. We tried to cover and collect plants of different habitat types in the area (Appendix 2). The exact location and altitude have been determined using GPS in addition notes on the vegetation and habitat. The dried plants have been transferred to laboratory and after providing herbarium labels were identified using available literature (Akhani, 1998; 2005; Rechinger, 1963-2005; Alekseev, 1979; Bhattacharjee, 1982; Wendelbo, 1978; Freitag, 1975, 1985, Aedo *et al.*, 1998) and comparing with identical specimens in herbarium. The chorology of each species was determined using published data (Browicz, 1983-1996; Akhani 1998, 2005). The voucher specimens of all reported plants are available at the herbarium of Botanical Biodiversity Research Laboratory (BBRL), School of Biology, University of Tehran and the private herbarium of H. Akhani housed at the same place. Nomenclature follows mostly after Flora Iranica and Flora of the Golestan National Park (Rechinger 1963-2005; Akhani 1998, 2005).

Results and Discussion

Flora: In this study a total of 607 species of vascular plants has been identified from Jahan Nama Protected Area which belongs to 85 families and 329 genera (Appendix 1). The Dicots with 61 families, 256 genera and 469 species are the most diverse group of vascular plants in this area following Monocots with 15 families, 62 genera and 119 species, Gymnosperms with 3 families, 3 genera, 6 species and Pteridophytes with 6 families, 8 genera and 13 species (Table 1). In published literature we found only 132 species recorded from the area. Therefore 475 species are recorded for the first time from the boundaries of the protected area. Because of taxonomic complexity of some genera like *Orobanche*, *Taraxacum*, *Cousinia*, *Scorzonera*, *Cotoneaster*, *Artemisia* and some species of *Veronica*, *Elymus*, *Festuca* and *Astragalus* not all species of these genera are presented in this checklist. The rich families of vascular plants are Gramineae (53

Table 1: Number of families, genera and species of main groups of plants in JNPA

Plant Group	Family	Genus	Species
Dicots	61	256	469
Monocots	15	62	119
Gymnosperms	3	3	6
Pteridophytes	6	8	13

Table 2: List of rich families of vascular plants in JNPA

Families	Species	Genera
Poaceae	53	30
Brassicaceae	52	30
Labiatae	50	22
Compositae	42	28
Fabaceae	36	14
Caryophyllaceae	27	13
Boraginaceae	27	14
Apiaceae	25	17
Rosaceae	23	12
Scrophulariaceae	19	7
Cyperaceae	15	4
Orchidaceae	14	7
Rubiaceae	14	6

Table 3: List of rich genera of vascular plants in JNPA

Genus	Species	Genus	Species
Astragalus	16	*Alyssum*	6
Carex	11	*Allium*	6
Veronica	11	*Viola*	6
Silene	8	*Orchis*	5
Stachys	8	*Thlaspi*	5
Salvia	8	*Euphorbia*	5
Bromus	6	*Galium*	5
Polygonum	6	*Centaurea*	5

species), Brassicaceae (52 species), Labiatae (50 species), Compositae (42 species), Fabaceae (36 species), Caryophyllaceae (27 species), Boraginaceae (27 species), Rosaceae (23 species) and Apiaceae (25 species) (Table 2). The genus *Astragalus* (16 species) is the richest in this area following *Carex* (11 species), *Veronica* (11 speies), *Silene*, *Salvia* and *Stachys* (each with 8 species) (Table 3). We estimate the presence of ca. 800 species in the area.

Vegetation: Because of diverse habitats and also different governing climatic systems in JNPA several types of vegetation have been formed. The main forms of vegetation types are “deciduous montane forest” which can be classified into two major closed and open types (Frey *et al*., 1999; Dorostkar & Noirfalise 1976), Juniper woodlands, carpet-like

scrubs of *Juniperus communis* and *J. sabina*, shrublands of *Berberis integerrima*, *Paliurus spina-christi* and *Acer monspessulanum* ssp. *turcomanicum*, montane steppes of *Stipa hohenackerana*, *St. holosericea*, *Acanthophyllum glandulosum*, *Onobrychis cornuta* and *Artemisia* sp., montane herbaceous communities of *Arrhenatherum kotschyi* and *Turritis glabra*, *Marrubium astracanicum* and *Stachys byzantina*, rocky cliff vegetation with representative species like *Campanula lourica*, *Parietaria judaica*, *Saxifraga wendelboi*, *Gypsophila aretioides* and riverine-hydrophyte vegetation. Open deciduous montane forests are dominated by open *Quercus macranthera* and the closed types are consisted mainly of *Carpinus betulus*, *Acer velutinum*, *Acer cappadocicum* and *Quercus castaneifolia*. Transitionl mixed formations is a remarkable physiognomy of the vegetation of JNPA. These are mainly deciduous temperate mixed forest and scrub associated with cold-resistant gymnosperms which dominated by *Carpinus orientalis*, *Juniperus communis*, *J. sabina*, *Lonicera* spp. and thorn-cushion formations. A forest type with patches of threatened species *Taxus baccata* occurs in the area which its occurrence in altitude up to 1600 m is in conflict with known ecology of the species in Europe (Thomas & Polwart, 2003).

Phytogeography: Jahan Nama Protected Area is geographically located between two main phytogeographic regions including boreal or Euro-Siberian region (Hyrcanian province) and Irano-Turanian region (Kopetdagh-Khorassan province and Alborz). A considerable number of species (37%) belongs to Irano-Turanian region. The Euro-Siberian species with 18 %, the Mediterranean elements with less than one percent, Irano-Turanian/ Euro-Siberian species (7%), Irano-Turanian/ Mediterranean (9%), Euro-Siberian/ Mediterranean (6.5%), and Irano-Turanian/Mediterranean/Euro-Siberian (9%), pluriregional (9%), cosmopolitan and subcosmopolitan species (1.7 %) compose the phytogeographic spectrum of the area.

As mentioned above the Alborz Mountains act as a barrier wall which traps moist air coming from Caspian Sea in northern slopes and cause formation of dense deciduous montane and lowland forests throughout the northern slopes. The northern parts of the area contain many Euro-Siberian elements belonging to Harcanian province such as *Heracleum gorganicum*, *Ilex spinigera*, *Centaurea hyrcanica*, *Alyssopsis mollis*, *Bupleurum flexile*, *Hesperis hyrcana, Hedera pastuchovii*, *Cynoglossum kandevanense*, *Evonymus velutina*, *Corydalis hyrcana*, *Teucrium hyrcanicum*, *Scilla gorganica*, *Ruscus hyrcanus*, *Crucianella platyphylla*, *Pyrus boissieriana*, *Primula heterochroma*, *Delphinium ursinum*, *Ornithogalum sintenisii*, *Rhynchocorys maxima*, *Ornithogalum bungei*, *Populus caspica*, *Orchis adenocheila*, *Quercus castaneifolia*, *Polygonatum glaberrimum*, *Polygonum hyrcanicum* and *Fritillaria kotschyana*.

Kopetdagh-Khorassan floristic province shows a considerable role in the Irano-Turanian elements of the area. This province extends from Khorassan province of Iran to Kara Kum deserts of Turkmenistan. Representative species of Kopetdagh-Khorassan province in the area include *Acer monspessulanum* subsp. *turcomanicum*, *Sterigmostemum ramosissimum*, *Astragalus macropelmatus*, *Cerasus pseudoprostrata*, *Corydalis chionophila*, *Vincetoxicum pumilum*, *Silene indeprensa*, *Oxytropis suavis*, *Rubia rechingeri*, *Astragalus sumbari*, *Stachys turcomanica*, *Colutea porphyrogramma*, *Nonnea turcomanica*, *Lonicera floribunda* and *Cephalorrhynchus kossinskyi*.

Alborz Mountains have very complex phytogeographic status and considering it as a separate phytogeographic province or district is discrepanious. The occurrence of several

endemic species along Alborz Mountains suggests it as an independent biogegraphic unit (Noroozi *et al.* 2008). Some of the endemic species of Alborz Mountains occur in Jahan Nama Protected Area including *Iranecio elbursensis*, *Minuartia lineata*, *Astragalus megalocystis*, *A. confusus*, *Stachys laxa*, *Sempervivum iranicum*, *Cynoglossum teheranicum*, *Arenaria polycnemifolia*, *Veronica gaubae*, *Saxifraga wendelboi*, *Asperula microphylla*, *Veronica rechingeri* and *Allium derderianum*.

Appendix 1

Checklist of vascular plants of Jahan Nama protected area. Numbers in parenthesis refers to voucher specimen(s). Collectors: A=Akhani, J=Jafari. The author name, volume number, page and year of publication are mentioned for those species which are reported in Flora Iranica (Rechinger 19963-2005) but we have not seen any specimen.

Dicots

Aceraceae: *Acer campestre* L. (J-1957), *Acer cappadocicum* Gled. (J-2442), *Acer monspessulanum* L. subsp. *turcomanicum* (Pojark) Rech. f. (J-2485), *Acer velutinum* Boiss. (J-1877).

Apiaceae: *Anthriscus cerefolium* (L.) Hoffm (Hedge & Lamond in Fl. Iranica 162: 86, 1987), *A. nemorosus* (M. Bieb.) Spreng. (J-1943), *Astrodaucus persicus* (Boiss.) Drude (J-2413), *Bupleurum exaltatum* M. Bieb. (J-2119), *Bupleurum flexile* Bornm. & Gauba (A-13709), *Caucalis platycarpos* L. (J-1962), *Eriocycla ghafooriana* Akhani (A-13702), *Eryngium billardieri* F. Delaroche (J-2348), *E. bungei* Boiss. (J-2190), *E. caucasicum* Trautv. (J-1521), ***Ferula glaucopruinosa* (Rech. f.) Akhani comb. nov.** (Basionym: *Peucedanum glaucopruinosum* Rech. f. in Anz. Österr. Akad. Wiss. Mat. Naturwiss. 89: 243, 1952), (A-13711), *Ferula petiolaris* DC. (Syn.: *Leutea petiolaris* (DC.) M. Pimen.) (J-2356), *Ferula* sp. (J-2358), *Heracleum gorganicum* Rech. f. (J-1918-2), *Laser trilobum* (L.) Borkh. (J-1971), *Lecokia cretica* (Lam.) DC. (Rechinger in Fl. Iranica 162: 190, 1987), *Pimpinella affinis* Ledeb. (J-2292), *Prangos latiloba* Korov. (J-2505), *Sanicula europaea* L. (J-2528), *Scandix aucheri* Boiss. (J-2194), *Scandix pecten-veneris* L. (J-1860), *Scandix stellata* Banks & Soland. (J-2041), *Torilis nodosa* (L.) Gaertn. (J-2281), *Trinia leiogona* (C. A. Mey.) B. Fedtsch. (J-1968), *Turgenia latifolia* (L.) Hoffm. (J-2493).

Apocynaceae s. l. (incl. Asclepiadaceae): *Vinca herbacea* Waldst. & Kit. (A-13940, J-1865), *Vincetoxicum funebre* Boiss. & Kotscy (Rechinger in Fl. Iranica 73: 11, 1974), *Vincetoxicum pumilum* Decne. (J-2200), *Vincetoxicum scandens* Sommier & Levier (A-13699).

Aquifoliaceae: *Ilex spinigera* (Loes.) Loes. (A- 13965, J-1921).

Araliaceae: *Hedera pastuchovii* Woron. ex Grossh. (A-13896, J-2435).

Asteraceae: *Achillea biebersteinii* Afan. (J-2004), *Achillea millefolium* L. subsp. *millefolium* (J-2280), *Acroptilon repens* (L.) DC. subsp. *australe* (Iljin) Rech. f. (J-2342),

Arctium lappa L. (J-2409), *Bellis perennis* L. (J-1830), *Bombycilaena erecta* (L.) Smilj. (Wagenitz in Fl. Iranica 145: 11, 1980), *Calycocorsus tuberosa* (Fisch. & C. A. Mey.) Rauschert (J-1661), *Carduus arabicus* Jacq. ex Murray (J-1977), *C. seminudus* M. Bieb. (J-1976), *C. transcaspicus* Gandog. subsp. *transcaspicus* (J-2027-1), *Centaurea depressa* M. Bieb. (J-2035), *C. hyrcanica* Bornm. (J-1520), *C. iberica* Trev. ex Spreng. (J-2287), *C. virgata* Lam. subsp. *squarrosa* (Willd.) Gugler (J-2347), *C. zuvandica* (Sosn.) Sosn. (A-13945, J-1841), *Cephalorrhynchus kossinskyi* (Krasch.) Kirp. (J-2093), *Cichorium intybus* L. (J-2349), *Cirsium arvense* (L.) Scop. var. *incanum* (S. G. Gmelin) Ledeb. (J-2419), *C. congestum* Fisch. & C. A. Mey. ex DC. (J-2346), *Cousinia decipiens* Boiss. & Buhse (J-2417), *C. smirnowii* Trautv. (J-s.n.), *Crepis sancta* (L.) Bobcock subsp. *nemausensis* (Gouan) Bobcock (J-1838b), *C. willemetioides* Boiss. (J-2029), *Inula thapsoides* (M. Bieb. ex Willd.) Spreng. (J-2376), *Iranecio elbursensis* (Boiss.) B. Nord. (J-2361), *Iranecio othonnae* (M. Bieb.) B. Nord. (J-2399), *Lactuca scarioloides* Boiss. (J-2396), *Petasites hybridus* (L.) P. Gaertn. (A-13905), *Picris strigosa* M. Bieb. subsp. *strigosa* (J-2426), *Scariola orientalis* (Boiss.) Sojak subsp. *orientalis* (J-2329), *Scorzonera* sp. (J-1908), *Senecio glaucus* L. (A-13934), *Senecio vernalis* Waldst. & Kit. (J-1522), *Sonchus asper* (L.) Hill subsp. *glaucescens* (Jordan) Ball (J-1988), *Tanacetum coccineum* (Willd.) Grierson (A-13973), *T. parthenium* (L.) Schultz Bip. (J-2046), *T. polycephalum* Schultz Bip. subsp. *duderanum* (Boiss.) Podl. (J-2015), *Taraxacum* sp. (J-1577), *Tragopogon reticulatus* Boiss. & Huet (J-2180), *Tripleurospermum disciforme* (C. A. Mey.) Schultz Bip. (J-2160), *Tussilago farfara* L. (J-1747), *Urospermum picroides* (L.) F. W. Schmidt (A-13984).

Berberidaceae: *Berberis integerrima* Bunge (J-2453), *Berberis orthobotrys* Bienert ex C. K. Schneider (Browicz & Zielinski in Fl. Iranica 111: 13, 1975), *Bongardia chrysogonum* (L.) Spach (J-1770).

Betulaceae: *Alnus subcordata* C. A. Mey. var. *subcordata* (J-1906), *Carpinus betulus* L. var. *betulus* (J-2398), *Carpinus orientalis* Mill. subsp. *macrocarpa* (Willk.) Browicz (J-2286).

Boraginaceae: *Alkanna bracteosa* Boiss. (J-2188), *Anchusa italica* Retz. var. *italica* (J-20310), *Asperugo procumbens* L. (J-1804), *Cerinthe minor* L. (J-1925), *Cynoglossum creticum* Mill. (J-2523), *C. kandevanense* (Bornm. & Gauba) Akhani (J-1699), *C. officinale* L. (J-1918-1), *C. teheranicum* Riedl (Riedl in Fl. Iranica 48: 144, 1967), *Echium amoenum* Fisch. & C. A. Mey. (J-1922), *E. italicum* L. (J-2374), *Heterocaryum macrocarpum* Zak. (J-2483), *Lappula barbata* (M. Bieb.) Gürke var. *barbata* (J-2023), *L. sinaica* (DC.) Ascherson ex Schweinf. (J-2210), *Lithospermum arvense* L. (J-2221), *L. purpureo-coeruleum* L. (J-1927), *L. sibthorpianum* Griseb. (J-1986), *L. tenuiflorum* L. fil. (J-1649), *Myosotis lithospermifolia* (Willd.) Hornem. (J-1818), *M. olympica* Boiss. subsp. *demawendica* (Bornm. ex Vestergren) H. Riedl (J-1761), *M. silvatica* Ehrh. ex Hoffm. subsp. *rivularis* Vestergren (A-13938), *M. stricta* Link (J-1707), *Nonnea caspica* (Willd.) G. Don subsp. *melanocarpa* (Boiss.) H. Riedl (2070), *N. lutea* (Desr.) Reichenb. ex DC. (J-1588), *N. turcomanica* M. Pop. (J-2003), *Onosma dichroanthum* Boiss. (J-1958), *Rochelia disperma* (L. f.) C. Koch (J-1709), *Solenanthus circinnatus* Ledeb. (J-2043).

Brassicaceae: *Aethionema cordatum* (Desf.) Boiss. (A-13950, J-2135), *Alliaria petiolata* (M. Bieb.) Cavara & Grande (J-1703), *Alyssopsis mollis* (Jacq.) O. E. Schulz (A-13707), *Alyssum dasycarpum* Steph. ex Willd. (J-2463), *A desertorum* Stapf (J-1981), *A. linifolium* Steph. ex Willd. (J-1786), *A. minus* (L.) Roth. var. *micranthum* (C. A. Mey.) Dudley (J-1812), *A. szowitsianum* Fisch. & C. A. Mey. (J-2065), *A. tortusum* Willd. (J-2086), *Olimarabidopsis pumila* (Stephan) Al-Shahbaz & *al.* (J-2197), *Arabis caucasica* Willd. subsp. *caucasica* (A-13910, 13952), *A. sagittata* (Bertol.) DC. (J-1929), *A. nova* Vill. (J-1629), *Barbarea plantaginea* DC. (J-1984), *Brassica elongata* Ehrh. (J-2338), *Camelina rumelica* Velen. subsp. *rumelica* (J-1978), *Capsella bursa-pastoris* (L.) Medicus (J-1982), *Cardamine bulbifera* (L.) Grantz (A-13891, 13903), *C. impatiens* L. var. *pectinata* (Pall.) Trautv. (A-13888, J-1895), *Cardaria draba* (L.) Desv. (J-1947), *Chalcanthus renifolius* (Boiss. & Hohen.) Boiss. (J-2515), *Choriospora iberica* Boiss. (J-1775), *Ch. tenella* (Pall.) DC. (J-1631), *Clypeola microcarpa* Moris (J-2196), *Conringia orientalis* (L.) Andrz. (J-1872), *C. perfoliata* (C. A. Mey.) Busch (J-1803), *C. persica* Boiss. (J-1784), *Crambe kotschyana* Boiss. (J-2092), *C. orientalis* L. (J-2157), *Descurainia sophia* (L.) Webb & Berth. (J-1949), *Draba aucheri* Boiss. (A-13954), *D. huetii* Boiss. (J-1594), *D. nemorosa* L. (J-1870), *Erysimun* sp. (J-2022), *Fibigia suffruticosa* (Vent.) Sweet (J-2134), *Goldbachia laevigata* (M. Bieb.) DC. (J-2163), *Hesperis hyrcana* Bornm. & Gauba (A-13978, J-1920), *H. persica* Boiss. (J-2078), *Isatis cappadocica* Desv. (J-2182), *I. kotschyana* Boiss. & Hohen. (J-2472b), *Malcolmia africana* (L.) R. Br. var. *africana* (J-2108), *M. strigosa* Boiss. (J-2067), *Matthiola alyssifolia* (DC.) Bornm. (J-2233), *M. farinosa* Bunge ex Boiss. (A-13946, J-2018), *Rapistrum rugosum* (L.) All. (J-1975), *Sterigmostemum ramosissimum* (O. E. Schulz) Rech. f. (J-2016), *Thlaspi arvense* L. (J-1502), *Th. hastulatum* (Stev. ex) DC. (J-1504), *Th. perfoliatum* L. (J-1610), *Th. stenocarpum* (Boiss.) Hedge (J-1722), *Th. umbellatum* (Stev. ex) DC. (J-1866), *Turritis glabra* L. (J-1928).

Campanulaceae: *Campanula glomerata* L. (J-2383), *Campanula lourica* Boiss. (J-2232).

Capparidaceae: *Capparis spinosa* L. (J-2425), *Cleome coluteoides* Boiss. (J-2133).

Caprifoliaceae: *Lonicera bracteolaris* Boiss. & Buhse (J-2123), *Lonicera floribunda* Boiss. & Buhse (J-2230), *Lonicera iberica* M. Bieb. (J-2481), *Sambucus ebulus* L. (J-2386), *Viburnum lantana* L. (A-13705, J-1965-2).

Caryophyllaceae: *Acanthophyllum glandulosum* Bunge ex Boiss. (J-2337), *Arenaria insignis* Litw. (J-2219), *Arenaria leptoclados* (Reichenb.) Guss. (J-2198), *Arenaria polycnemifolia* Boiss. (J-2127), *A. serpyllifolia* L. (J-1819), *Cerastium semidecandrum* L. (A13872b), *Dianthus orientalis* Adams (A-13700, J-2355), *Gypsophila aretioides* Boiss. (J-2422), *Gypsophila* sp. (J-2224), *Herniaria cashemiriana* J. Gay (J-1563), *Holosteum glutinosum* (M. Bieb.) Fisch. & C. A. Mey. (J-1613), *H. umbellatum* L. (J-1634), *Mesostemma kotschyanum* (Fenzl in Boiss.) Vved. (J-2223), *Minuartia hamata* (Hausskn.) Mattf. (J-2460), *M. lineata* Bornm. (A-13949, J-2051), *M. meyeri* (Boiss.) Bornm. (2458), *Petrorhagia saxifraga* (L.) Link (A-13701, J-2459), *Scleranthus orientalis* Rössler (J-2282), *Silene coronaria* (L.) Clairv. (J-2416), *S. cyri* Schischk. (J-2381), *S. guntensis* B. Fedtsch. subsp. *guntensis* (J-2220), *S. indeprensa* Schischk. (J-

2079), *S. latifolia* Poir. subsp. *eriocalycina* (Boiss.) Greuter & Burdet (J-1708), *S. marschallii* C. A. Mey. subsp. *marschallii* (J-2080), *S. schafta* Gmel. jun. ex Hohen. (J-1512), *S. swertiifolia* Boiss. (J-2222), *Stellaria media* (L.) Vill. (J-1912).

Celasteraceae: *Evonymus latifolia* (L.) Mill. (A-13975, J-2312), *E. velutina* (C. A. Mey.) Fisch. & C. A. Mey. (J-2314).

Chenopodiaceae: *Chenopodium foliosum* Asch. (J-2437), *Krascheninnikovia ceratoides* (L.) Gueldenst. (J-2330).

Cistaceae: *Helianthemum nummularium* (L.) Miller (J-2006).

Convolvulaceae: *Convolvulus arvensis* L. (J-2109), *C. cantabricus* L. (J-1963), *Convolvolus* sp. (J-2297).

Cornaceae: *Cornus sanguinea* L. subsp. *australis* (C. A. Mey.) Jáv. (J-2537).

Crassulaceae: *Pseudosedum multicaule* (Boiss. & Buhse) Boriss. (J-2061), *Rosularia sempervivum* (M. Bieb.) Berger (J-1993-1), *Sedum hispanicum* L. (J-2298), *S pentapetalum* Boriss. (J-2193), *S stoloniferum* S. G. Gmel. (J-2529), *Sempervivum iranicum* Bornm. & Gauba (J-2407).

Cucurbitaceae: *Bryonia aspera* Stev. ex Ledeb. (J-2060).

Dipsacaceae: *Cephalaria microcephala* Boiss. (J-2420), *Dipsacus strigosus* Willd. ex Roemer & Schultes (J-2395), *Scabiosa columbaria* L. (J-2249), *S. rhodantha* Kar. & Kir. (J-2144).

Elaeagnaceae: *Elaeagnus angustifolia* L. (J-2143).

Euphorbiaceae: *Euphorbia amygdaloides* L. (J-1892), *E. bungei* Boiss. (J-1597), *E. helioscopia* L. (J-1840), *E. seguieriana* Neck. (J-2028), *E. szovitsii* Fisch. & Mey. (J-2195).

Fabaceae: *Astragalus aegobromus* Boiss. & Hohen. (A-13942, J-1583), *A. confusus* Bunge (J-1748), *A. grammocalyx* Boiss. & Hohen. (A-13921, J-1788), *A. jolderensis* B.Fedtsch. (A-13937, J-1800), *A. macropelmatus* Bunge (A-13922), *A. masenderanus* Bunge (J-2103), *A. megalocystis* Bunge (J-2354), *A. odoratus* Lam. (J-2090), *A. paralipomenus* Bunge (J-2176), *A. podolobus* Boiss. & Hohen. (J-2082), *A. pseudoindurascens* Širj. & Rech. f. (J-2131), *A. siliquosus* Boiss. subsp. *siliquosus* (A-13931), *A. subalpinus* Boiss. & Buhse (J-1575), *A. sumbari* Popov (J-1617), *A. verus* Olivier (J-1625), *A. weirianus* Aitch. & Baker (J-2129), *Cicer tragacanthoides* Jaub. & Spach (J-2152), *Colutea buhsei* (Boiss.) Shap. (J-1926), *C. porphyrogramma* Rech. f. (J-2153), *Coronilla varia* L. subsp. *hirta* (Bunge ex Boiss.) Rech. f. (J-1500), *Lathyrus laxiflorus* (Desf.) O. Kuntze (J-1674), *Lotus corniculatus* L. Subsp. *corniculatus* (J-2026), *Medicago minima* (L.) Bartalini (J-1942), *M. orbicularis* (L.) Bartal., (A-13982), *M. sativa* L. (J-2340), *Melilotus officinalis* (L.) Pall. (J-2170), *Onobrychis cornuta* (L.)

Desv. subsp. *cornuta* (J-1744), *O. transcaspica* V. Nikitin (A-13980), *Oxytropis suavis* Boriss. (J-1778), *Pisum sativum* L. subsp. *elatius* (M. Bieb.) Ascherson & Graebner (J-1586), *Sophora alopecuroides* L. subsp. *tomentosa* (Boiss.) Yakovlev (J-2151), *Trifolium caucasica* Tausch (J-2247), *Vicia crocea* (Desf.) B. Fedtsch. (A- 13966, J-1760), *V. hirsuta* (L.) S. F. Gray (J-1827), *V. sativa* L. var. *cordata* (Wulf. ex Hoppe) Arcangeli (J-2031), *V. tetrasperma* (L.) Schreb.

Fagaceae: *Fagus orientalis* Lipsky (A-13972, J-1951), *Quercus castaneifolia* C. A. Mey. (J-1996), *Q. macranthera* Fisch. & C. A. Mey. ex Hohen. (J- 1995).

Fumariaceae: *Corydalis angustifolia* (M. Bieb.) DC. (A-13908, J-1560), *C. chionophila* Czernjak. (A-13909, J- 1909), *C. hyrcana* Wendelbo (J- 1590), *C. marschalliana* (Pall.) Pers. (A-13889, 13900, 13908, J-1571), *Fumaria asepala* Boiss. (J- 1972).

Gentianaceae: *Gentiana cf. sempedfida* Pall. (Shakiba. s.n.).

Geraniaceae: *Erodium cicutarium* (L.)L'Hér. ex Aiton (J- 1861), *Geranium kotschy* Boiss. (J-1773), *G. lucidum* L. (A-13985), *G. purpureum* Vill. (J-1936), *G. pyrenaicum* Burm. f. (J-1505).

Hypericaceae: *Hypericum androsaemum* L. (Robson in Fl. Iranica 49: 5., 1968), *H. elongatum* Ledeb. subsp. *elongatum* (J-2183), *H. perforatum* L. (J-2251), *H. scabrum* L. (J-2229).

Juglandaceae: *Juglans regia* L. (J-1919), *Pterocarya fraxinifolia* (Poir.) Spach. (Browicz in Fl. Iranica 121: 2, 1976).

Lamiaceae: *Acinos graveolens* (M. Bieb.) Link (J-2491b), *Ajuga chamaecistus* Ging. ex Benth. subsp. *tomentella* (Boiss.) Rech. f. (J- 2050), *Ajuga comata* Stapf. (J-1777), *Ballota nigra* L., *Calamintha grandiflora* (L.) Moench (J-2394), *Clinopodium umbrosum* (M. Bieb.) C. Koch (J-2318), *C. vulgare* L. (J-1530), *Dracocephalum thymiflorum* L. (J-1955), *Eremostachys glabra* Boiss. (J-2508), *Hymenocrater calycinus* (Boiss.) Benth. (J-2074), *Lamium album* L. (J-1867), *L. amplexicaule* L. (J-1768), *L. purpureum* L. (J-1647), *Marrubium anisodon* C. Koch. (J-2424), *M. astracanicum* Jacq. (J-1941), *M. parviflorum* Fisch. & C. A. Mey. (J-2049), *Mentha aquatica* L., *M. longifolia* (L.) Hudson var. *chlorodictya* Rech. f. (J-2391), *Nepeta glomerulosa* Boiss. subsp. *glomerulosa* (J- 2404), *N. pungens* (Bunge) Benth. (J-2072), *N. scrophularioides* Rech. f. (J-2353), *N. sintenisii* Bornm. (J-2396), *Origanum vulgare* L. subsp. *viride* (Boiss.) Hayek (J-2272), *Perovskia abrotanoides* Karel. (J-2343), *Phlomis herba-venti* L. subsp. *pungens* (Willd.) Maire ex De Fillips (J-2369), *Prunella vulgaris* L. (J-2259), *Salvia aethiopis* L. (J-2317), *S. atropatana* Bunge (J-2323), *S. chloroleuca* Rech. f. & Aell. (J-2073), *S. glutinosa* L. (A-13703, J-2400), *S. multicaulis* Vahl (J-2500), *S. nemorosa* L. (2235), *S. sclarea* L. (J-2373), *S. virgata* Jacq. (J-2265), *Scutellaria pinnatifida* A. Hamilt. (J-2213), *S. tournefortii* Benth. (J-2288), *Stachys annua* (L.) L. (J-1839), *St. byzantina* C. Koch (J-2264), *St. inflata* Benth. (J- 2074), *St. lavandulifolia* Vahl (J-2169), *St. laxa* Boiss. & Buhse (J-2008), *St. persica* Gmel. jun. ex C. A. Mey. (J-2385), *St. sylvatica* L. (J-1529), *St. turcomanica* Trautv. (J-2494), *Teucrium chamaedrys* L. subsp.

syspirense (C. Koch.) Rech. f. (J-2261), *T. hyrcanicum* L. (J-2257), *T. polium* L. var. *tonsum* Stapf (J-2260), *Thymus kotschyanus* Boiss. & Hohen. (J-2451), *Ziziphora clinopodioides* Lam. subsp. *rigida* (Boiss.) Rech. f. (J-2339), *Z. tenuior* L. (J-2212).

Linaceae: *Linum austriacum* L. (J-2306).

Loranthaceae: *Arceuthobium oxycedri* (DC.) M. Bieb. (J-2132), *Viscum album* L. (J-1793).

Lythraceae: *Lythrum salicaria* L. (J-2271).

Malvaceae: *Malva neglecta* Wallr. (J-2277).

Oleaceae: *Fraxinus excelsior* L. (J-1991), *Jasminum fruticans* L. (J-1598).

Onagraceae: *Epilobium hirsutum* L. (J-2393).

Paeoniaceae: *Paeonia wittmanniana* Hartw. ex Lindl. (A-13920, J-1651).

Papaverceae: *Chelidonium majus* L. (A-13979, J-1930), *Glaucium elegans* Fisch. & C. A. Mey. (J-2106), *G. oxylobum* Boiss. & Buhse (J-2066), *G. pulchrum* Stapf (J-2191), *Hypecum pendulum* L. (J-2172), *Papaver armeniacum* (L.) DC. (J-2024), *P. dubium* L. (J-2177), *Roemeria refracta* DC. (J-2036).

Plantaginaceae: *Plantago lanceolata* L. (J-1831), *P. major* L. (J-2167).

Plumbaginaceae: *Acantholimon raddeanum* Czernjak. (J-2216).

Polygalaceae: *Polygala anatolica* Boiss. & Heldr. (A- 13971, J-1672).

Polygonaceae: *Atraphaxis spinosa* L. (J-2154), *Atraphaxis* sp. (J-2540), *Polygonum aviculare* L. (J-2174), *P. convolvulus* L. (J-2252), *P. hyrcanicum* Rech. f. (J-2034), *P. patulum* M. Bieb. (J-2155), *P. rottboellioides* Jaub. & Spach (J-2199), *P. serpyllaceum* Jaub. & Spach (J-2107), *Rumex crispus* L. (J-2285), *R. obtusifolius* L. subsp. *subalpinus* (Schur) Čelak. (J-2382), *R. patientia* L. (J-1905), *R. pulcher* L. subsp. *onodontus* (Hausskn.) Rech. f. (J-2278).

Primulaceae: *Androsace maxima* L. (J-1729), *Cyclamen coum* Miller subsp. *caucasicum* (C. Koch) O. Schwarz (J-1539), *Primula heterochroma* Stapf (A- 13904, J-1503).

Ranunculaceae: *Adonis aestivalis* L. (J-1916a), *A. scrobiculata* Boiss. subsp. *velutina* (Lipsky) C. Steinb. ex Rech. f. (J-2010), *Anemone caucasica* Willd. ex Rupr. (A-13916, J-1726), *Ceratocephala testiculata* (Grantz) Roth. (J-1734), *Clematis orientalis* L. (J-2215), *Consolida orientalis* (Gay) Schröd. (J-1857), *C. teheranica* (Boiss.) Rech. f. (J-1509), *Delphinium elbursense* Rech. f. (J-2384), *Delphinium ursinum* Rech. f. (J-2415), *Ficaria kochii* (Ledeb.) Iranshahr & Rech. f. (A- 13961, J-2446), *Nigella arvensis* L. (J-

2367), *Ranunculus cicutarius* Schlechtend. (A-13976, J-1856), *Thalictrum minus* L. (J-2377), *Th. sultanabadense* Stapf. (A-13953).

Resedaceae: *Reseda lutea* L. (J-1914).

Rhamnaceae: *Frangula grandifolia* (Fisch. & C. A. Mey.) Grubov (J-1692), *Paliurus spina-christi* Miller var. *spina-christi* (J-2414), *Rhamnus cathartica* L. (J-2410), *Rhamnus pallasii* Fisch. & C. A. Mey. subsp. *sintenisii* (Rech. f.) Browicz & J. Zielińsky (J-2471).

Rosaceae: *Cerasus pseudoprostrata* Pojark. (J-1781), *C. microcarpa* (C. A. Mey.) Boiss. subsp. *microcarpa* (J-1738), *Crataegus melanocarpa* M. Bieb. subsp. *melanocarpa* (J-1515), *C. microphylla* C. Koch (J-1517), *C. pseudomelanocarpa* M. Pop. ex A. Pojark. (J-1606), *Cydonia oblonga* Miller (Schönbeck-Temesy in Fl. Iranica 66: 26, 1969), *Fragaria vesca* L. (J-1670), *Geum rivale* L. (J-1720), *Geum urbanum* L. (J-1945), *Mespilus germanica* L. (J-1687), *Potentilla anserina* L. (A-13955, J-1790), *P. bungei* Boiss. (A-13936, J-1774), *P. micrantha* Ramond (J-1567), *P. reptans* L. (J-1514), *P. szovitsii* Th.Wolf, *Prunus divaricata* Ledeb. subsp. *divaricat* (J-1587), *Pyrus boissieriana* Buhse (A-13928, J-1967), *Rosa canina* L. (J-2228), *R. foetida* J. Herrmann (J-2088), *R. hemisphaerica* J. Herrmann (J-2122), *R. persica* Michx. ex Juss. (J-2084), *Sanguisorba minor* Scop. subsp. *muricata* (Spach) Briq. (J-2025), *Sorbus torminalis* (L.) Grantz (J-2313).

Rubiaceae: *Asperula arvensis* L. (J-1582), *A. gorganica* Schönb.-Tem. & Ehrend. (J-2296), *Callipeltis cucularis* (L.) Rothm. (J-2205), *Crucianella gilanica* Trin. subsp. *elbursensis* (Ehrend.) Ehrend. & Schönb.-Tem. (J-2071), *C. platyphylla* Ehrend. & Schönb.-Tem. (J-1894), *Cruciata laevipes* Opiz (J-1663), *C. taurica* (Pall. ex Willd.) Ehrend. subsp. *persica* (DC.) Ehrend. (J-2005), *Galium humifusum* M. Bieb. (J-2428), *G. hyrcanicum* C. A. Mey. (J-2113), *G. odoratum* (L.) Scop. (J-1662), *G. spurium* L. subsp. *ibicinum* (Boiss. & Hausskn.), Ehrend. (J-1637), *G. verum* L. subsp. *glabrescens* Ehrend. (J-2307), *Rubia florida* Boiss. (J-2189), *R. rechingeri* Ehrend. (J-2117).

Salicaceae: *Populus caspica* Bornm., *P. nigra* L. (J-2094), *Salix aegyptiaca* L. (J-1874), *S. alba* L. (J-1808).

Santalaceae: *Thesium arvense* Horv. (J-2114).

Saxifragaceae: *Saxifraga wendelboi* Schönb.-Tem. (A-13944, 13951, J-2489).

Scrophulariaceae: *Digitalis nervosa* Steud. & Hochst. ex Benth. (A-13704, J-2430), *Euphrasia pectinata* Ten. (J-2284), *Pedicularis sibthorpii* Boiss. (J-2171), *Rhynchocorys maxima* K. Richt. (A-13893, J-1855), *Scrophularia gaubae* Bornm. (J-1944), *S. variegata* M. Bieb. subsp. *cinerascens* (Boiss.) Grau (J-2027), *S. vernalis* L. subsp. *clausii* (Boiss. & Buhse) Grau (A-13902, J-1822), *Verbascum gossypinum* M. Bieb. (J-2255), *Veronica anagallis-aquatica* L. subsp. *oxycarpa* (Boiss. in Kotschy) A. Jelen (J-2166), *V. argute-serrata* Rech. & Schmalh. (J-1807), *V. campylopoda* Boiss. (J-1638), *V. ceratocarpa* C. A. Mey. (J-1924), *V. crista-galli* Stev. (J-1645), *V. mazanderanae* Wendelbo (J-1779), *V.*

orientalis Miller (J-1776), *V. persica* Poir. (J-1513), *V. polita* Fries (J-1640), *V. rechingeri* M. A. Fischer (A-13939, J-1714), *V. rubrifolia* Boiss. subsp. *respectatissima* M. A. Fischer (J-2208).

Solanaceae: *Atropa acuminata* Royle ex Miers (J-1918-4), *Atropa* sp. (A-13963), *Hyoscyamus niger* L. (J-1932), *H. reticulatus* L. (J-2159), *H. turcomanicus* Pojark (J-2482), *Physalis alkekengi* L. (A-13764).

Tamaricaceae: *Myricaria germanica* (L.) Desv. (J-2045), *Tamarix ramosissima* Ledeb. (J-2124).

Tiliaceae: *Tilia platyphyllos* Scop. subsp. *caucasica* (Rupr.) Loria (J-1688)**.**

Urticaceae: *Parietaria judaica* L. (J-2038), *P. officinalis* L. (J-2526).

Valerianaceae: *Valeriana sisymbriifolia* Vahl. (J-1998), *V. falcariifolia* Boiss. (Rechinger in Fl. Iranica 62: 19, 1969), *Valerianella dentata* (L.) Poll. (Rechinger in Fl. Iranica 62: 16, 1969), *V. uncinata* (M. Bieb.) Durf. (J-1999).

Violaceae: *Viola alba* Bess. subsp. *sintenisii* (W. Becker) W. Becker (J-1684), *V. jordanii* Hanry (J-1691), *V. occulta* Lehmann (J-2207), *V. rupestris* F.W. Schmidt (J-1759a), *V. sieheana* W. Becker (A-13901, J-1869), *V. suavis* M. Bieb. (A-13912, J-1562).

Zygophyllaceae: *Peganum harmala* L. (J-2173).

Monocots

Alliaceae: *Allium chelotum* Wendelbo (J-1973), *A. derderianum* Regel (J-2104), *A. erubescens* C. Koch. (J-2267), *A. paradoxum* (M. Bieb.) G. Don (A-13983, J-1543), *A. rubellum* M. Bieb. (J-1766), *A. scabriscapum* Boiss. & Kotschy (J-2328).

Amaryllidaceae: *Galanthus transcaucasicus* Fomin (J-1544), *Ixiolirion tataricum* (Pall.) Herb. (J-2040).

Araceae: *Arum rupicola* Boiss. var. *virescens* (Stapf) P.C. Boyce (A-13930, 13897, J-1904).

Colchicaceae: *Colchicum speciosum* Steven (J-1561), *C. trigynum* (Steven ex Adam) Stearn (J-1538).

Cyperaceae: *Bolboschoenus affinis* (Roth) Drob. (J-2100), *Carex digitata* L. (A-13974, J-1682), *C. diluta* M. Bieb. (J-2097), *C. divulsa* Stokes (J-1642), *C. flacca* Schreb. subsp. *serrulata* (Biv.-Bern.) Greuter (J-1837), *C. grioletti* Roemer (A-13890, J-1923), *C. hallerana* Asso (J-1792), *C. orbicularis* Boott subsp. *kotschyana* (Boiss. & Hohen.) Kukkonen (J-2161), *C. pendula* Huds. (A-13894, J-1700), *C. phyllostachys* C. A. Mey. and *C. remota* L. (Kukkonen in FL. Iranica 173: 176, 203 (1998), *C. sylvatica* Huds. (J-

1683), *Eleocharis uniglumis* (Link) Schultes (J-2236), *Schoenoplectus lacustris* (L.) Palla subsp. *tabernaemontani* (C. C. Gmelin) A. & D. Löve (J-2165).

Dioscoreaceae: *Tamus communis* L. (J-2533).

Hyacinthaceae: *Muscari caucasicum* (Griseb.) Baker (J-2087), *M. neglectum* Guss. (A-13941, J-1736), *Ornithogalum bungei* Boiss. (A-13943, J-1934), *O. orthophyllum* Ten. (J-1960), *O. sintenisii* Freyn (A-13917, J-1732), *Scilla gorganica* Speta (A-13918, 13960, J-1542).

Iridaceae: *Crocus speciosus* M. Bieb. (J-1524), *Iris pseudocaucasica* Grossh. (J-2105), *I. reticulata* M. Bieb. (J-1537).

Juncaceae: *Juncus inflexus* L. (J-2273), *Luzula forsteri* (Smith) DC. (J-1903).

Juncaginaceae: *Triglochin palustris* L. (J-2164).

Liliaceae: *Fritillaria kotschyana* Herbert (A-13947, J-1706), *Gagea confusa* A. Terr. (A-13913, 13914, J-1765), *Gagea gageoides* (Zucc.) Vved. (J-1739), *G. lutea* (L.) Ker-Gawl. (A-13911, 13962, J-1711), *G. reticulata* (Pall.) Schultes & Schultes fil. (J-1746), *G. tenuifolia* (Boiss.) Fomin (J-1576), *Tulipa biebersteiniana* Schultes & Schultes fil. (A-13948, J-1754), *T. hoogiana* B. Fedtsch. (A-13932, J-1771).

Orchidaceae: *Cephalanthera caucasica* Kränzl. (J-2447), *C. longifolia* (L.) Fritsch (J-1879), *C. rubra* (L.) L. C. Rich. (J-2535), *Epipactis microphylla* (Ehrh.) Swartz (J-2401), *Listera ovata* (L.) R.Br. (J-2431), *Neottia nidus-avis* (L.) L. C. Rich. (J-2534), *Ophrys apifera* Hudson, *O. scolopax* Cav., *O. sphegodes* Miller subsp. *transhyrcana* (Czernjak.) Soó (Renz, in Fl. Iranica 126: 70, 74, 79), *Orchis adenocheila* Czernjak. (A-13970, J-2530), *O. coriophora* L. (Renz in Fl. Iranica 126: 108, 1978), *Orchis mascula* L. subsp. *pinetorum* (Boiss. & Ky.) Camus (J-1952), *O. palustris* Jacq. (J-2095), *O. simia* Lam. (Renz l.c. p. 111), *Steveniella satyrioides* (Stev.) Schlter. (A-13968, J-1890).

Poaceae: *Aegilops cylindrica* Host. (J-2145), *A. tauschii* Cosson (J-2239), *A. triuncialis* L. (J-2379), *Agropyron cristatum* (L.) Gaertn. subsp. *pectinatum* (M. Bieb.) Tzvelev (J-2055), *Agrostis canina* L. (J-2295), *Alopecurus arudinaceus* Poir. (J-2044), *A. textilis* Boiss. (J-2140), *Arrhenatherum kotschyi* Boiss. (J-2000), *Avena wiestii* Steud. (J-2243), *Boissiera squarrosa* (Banks & Soland.) Nevski (J-2110), *Brachypodium sylvaticum* (Hudson) P. Beauv. (J-2294), *Bromus benekenii* (Lange) Trimen (J-1845), *B. briziformis* Fisch. & C. A. Mey. (J-2001), *B. danthoniae* Trin. (J-2148), *B. gedrosianus* Pénzes (J-2238), *B. sterilis* L. (J-2042), *B. tectorum* L. (J-1940), *Calamagrostis epigejos* (L.) Roth (J-2203), *C. pseudophragmites* (Hall. f.) Koel. (J-2352), *Dactylis glomerata* L. subsp. *hispanica* (Roth) Nyman (J-2244), *Elymus leptourum* (Nevski) Grossh. (J-2185), *E. longe-aristatus* (Boiss.) Boiss. (J-2324), *E. repens* (L.) P. Beauv. (J-2378), *Eremopoa persica* (Trin.) Roshev. (J-2202), *Eremopyrum distans* (C. Koch) Nevski (J-2054), *Festuca sclerophylla* Boiss. & Hohen. (J-2056), *F. valesiaca* Gaud. (J-2225), *Glyceria plicata* Fries (J-2175), *Hordeum bulbosum* L. (J-2240), *Koeleria macrantha* (Ledeb.) Schult. (J-2302), *Lolium multiflorum* Lam. (J-2245), *L. perenne* L. (J-2303), *Melica*

ciliata L. (J-2075), *M. jacquemontii* Decne ex Jacquem. subsp. *hohenackeri* (Boiss.) Bor (J-2334), *M. uniflora* Retz. (J-1681), *Milium vernale* M. Bieb., *Phleum paniculatum* Hudson (J-2201), *Ph. pratense* L. (J-2380), *Piptatherum holciforme* (M. Bieb.) Roem. & Schult. (J-1970), *P. virescens* (Trin.) Boiss. (J-2304), *Poa araratica* Trautv. (J-2301), *Poa bulbosa* L. (J-2112), *P. nemoralis* L. (J-1852), *P. pratensis* L. (J-1899), *Psathyrostachys fragilis* (Boiss.) Nevski (J-2111), *Sclerochloa dura* (L.) P. Beauv. (J-1902), *Secale montanum* Guss. (J-1980), *Stipa arabica* Trin. & Rupr. (J-2333), *St. hohenackerana* Trin. & Rupr. (J-2014), *St. holosericea* Trin. (J-2076), *Taeniatherum caput-medusae* (L.) Nevski (J-2138), *Trisetum bungei* Boiss., *T. flavescens* (L.) P. Beauv. (J-2241).

Ruscaceae: *Danaë racemosa* (L.) Moench (J-1891), *Polygonatum glaberrimum* C. Koch (A-13898, 13967, J-1893), *P. orientale* Desf. (A-13899, J-1758), *Ruscus hyrcanus* Woron. (A-13892).

Typhaceae: *Typha minima* Funk (J-2098).

Gymnosperms

Cupressaceae: *Juniperus communis* L. (J-1519), *J. excelsa* M. Bieb. (A-13949), *J. sabina* L. (A-13949, J-1735).

Ephedraceae: *Ephedra intermedia* Schrenk. & C. A. Mey. (J-2520), *E. major* Host. (J-2120).

Taxaceae: *Taxus baccata* L. (A-13935, J-2438).

Pteridophytes

Aspleniaceae: *Asplenium adiantum-nigrum* L. (J-1535), *A. trichomanes* L. (J-2439), *Phyllitis scolopendrium* (L.) Newman (J-2443).

Dryopteridaceae: *Dryopteris pallida* (Bory) C. Chr. ex Maire & Petit. (J-2397), *Polystichum aculeatum* (L.) Roth. (J-2308).

Equisetaceae: *Equisetum arvense* L. (J-1814), *E. palustre* L. (J-2275), *E. ramosissimum* Desf. (J-2096), *E. telmateia* Ehrh. (J-1660).

Polypodiaceae: *Polypodium interjectum* Shivas (J-1536), *P. vulgare* L. (J-1756).

Pteridaceae: *Pteris cretica* L. (J-1547).

Woodsiaceae: *Cystopteris fragilis* (L.) Bernh. (A-13713).

Appendix 2

List of locations of studied plants arranged according to herbarium numbers.

H. Akhani:

13699-13702: ca. 22 km SE of Gorgan, road to Chaharbagh, junction of Bagh-e Shah and Ghozlogh rivers, E-facing steep slopes, 36º 42'50"N, 54º35'30"E, ca. 860-1015 m, 10.9.1999.

13703-13704: ca. 25 km SE of Gorgan, road to Chaharbagh, montane forest along the road, 36º 41'26"N, 54º34'26"E, ca. 1600 m, 10.9.1999.

13705-13715: ca. 30 km SES of Gorgan, ca. 10 km NE Chaharbagh, Pir-Gerdeh Kuh, 36º 39'19"N, 54º34'35"E, rocky steep to subvertical N-facing slopes, ca. 2500-2600 m, 10.9.1999.

13764: ca. 22 km SE of Gorgan, road to Chaharbagh, junction of Bagh-e Shah and Ghozlogh rivers, E-facing steep slopes, 36º 42'50"N,54º35'30"E, ca. 860-1015 m, 10.9.1999.

13888-13897: S. Kordkoy towards Deraznow, 36º42'31"N, 54º6'20"E, 900m, 19.4.2000.

13898-13903: S. Kordkoy towards Deraznow, 36º40'48"N, 54º5'45"E, 1549m, 19.4.2000.

13904-13905: N Deraznow towards Kordkoy, 36º40'24"N, 54º7'22"E, 1975m, 19.4.2000.

13906-13920: Deraznow (Radar), 36º39'54"N, 54º9'39"E, 2352m, 19.4.2000

13921-13930: Near Mile Radkan (Radkan tower), 36º37'47"N, 54º6'19"E, 1359m, 20.4.2000.

13931: Westernmost of the area, Radkan valley, Goldin Junction, 36º37'28"N, 54º8'6"E, 1360m, 20.4.2000.

13932: Westernmost of the area, Radkan valley, Rahdarkhaneh, 36º37'41"N, 54º10'31"E, 1391m, 20.4.2000.

13933-13949: Highlands above Atashan rocks (Tigheh Atashan), 36º41'N, 54º15"E, 1900-2000, 20.4.2000.

13950-13959: Between Serahe Hajiabad and Serahe Chaman Saver, Asb Neyzeh, steep rocky slopes, along river valley, 36º36'34"N, 54º17'10"E, 1630m, 20.4.2000.

13960-13963: ca. 30 km N of Gorgan towards Chaharbagh, 36º39'59"N, 54º34'13"E, 2300m, 21.4.2000.

13964-13975: 27 km N Gorgan towards Chaharbagh, East of Jahan-Nama Protected Area, 36º41'24"N, 54º34'26"E, montane forest dominated by *Fagus orientalis* and *Ilex spinigera* and along the road, 1734m, 21.4.2000.

13976-13977: 21 km N of Gorgan road towards Charbagh, East of Jahan-Nama Protected Area, 36º42'11"N, 34º34'48"E, 1200m, 21.4.2000.

13978-13985: 18 km N of Gorgan road towards Charbagh, East of Jahan-Nama Protected Area, 36º42'44"N, 34º35'8"E, 937m, 21.4.2000.

S.M. Jafari:

1500: Near Jahan Nama conservation station, 36°39'49"N, 54°18' E, 1927 m, 10.11.2005.

1501-1505: SW Jahan Nama plain, Chelestan mountains, among *Juniperus* trees, 36º39’20”N, 54º17’14”E, 2143 m, 10.11.2005.
1506-1509: Jahan Nama plain, 36º39’55”N, 54º17’31”E, 1818 m, 12.11.2005.
1510-1532: Jahan Nama plain towards Chelestan and Kalkat, 36º41’06”N, 54º18’14”E, 1748 m, 12.11.2005.
1533-1536: About 2 km after Ziarat village, 36º41’01”N, 54º27’39”E, 1177 m, 17.3.2005.
1537-1538/ 1542: Sides of road from Derazno toward Emamzadeh Hezar Manzel, 36º39’37”N, 54º7’29”E, 2408 m, 19.3.2005.
1539/ 1545-1548: About 1 km to Derazno from Kord Kuy, 36º42’47”N, 54º5’53”E, 1670-2000 m, 18.3.2005.
1543-1544: From Takhte Mirza towards Yarali, 36º42’22”N, 54º14’32”E, 1820 m, 18.3.2005.
1545-1559: Derazno towards Dakal, 36º39’59”N, 54º07’32”E, 2000 m, 15.4.2006.
1560-1573: Derazno towards Dakal, deciduous montane forest of *Quercus macranthera*, 36º39'57 N, 54º07'36 E, 2339 m, 15.4.2006.
1574-1582: Near Dakal from Derazno, 36º40'19”N, 54º10'15”E, 2615 m, 15.4.2006.
1583-1594: Derazno towards Radkan , 36º39'41”N, 54º07'08”E, 2316 m, 15.4.2006.
1595-1621: Before Mille Radkan from Radkan, 36º38'05”N, 54º05'31”E, 1524 m, 15.4.2006.
1622-1640: Beginning of Maghazi valley from Serahe Chaman Savar, disturbed places near cultivated fields, 36º37’39”N, 54º11’25”E, 15.4.2006, 1730m.
1641-1678: Openings of Tarkat deciduous montane forest, 36º40'59”N, 54º18'43”E, 1535m, 15.4.2006.
1679-1707: Tarkat deciduous montane forest, near Tarkat plain, 36º41'13”N, 54º19'29”E, 1573 m, 16.4.2006.
1708-1722: ca. 5 km S Jahan Nama village, around Dorrieh spring, *Berberis* scrub, 36º40' 09”N, 54º18'26”E, 1919 m, 17.4.2006.
1723-1726: Dorrieh towards Paiizsar, *Fagus-Carpinus* forest, 36º39'58”N, 54º18'26”E, 2039 m, 17.4.2006:
1727-1728: Paiizsar, transition forest of *Carpinus orientalis* and *Juniperus communis*, 36º39' 52”N, 54º18'57”E, 2255 m 17.4.2006.
1729-1732: Paiizsar towards Olange Hajiabad, montane overgrazed steppes dominated by cushion forms, 36º39'02”N, 54º19'41”E, 2452 m, 17.4.2006.
1733-1737: Olange Hajiabad towards Tork Meidan, montane meadows near Hajiabad village, 36º39'N, 54º21'80”E, 2364 m, 17.4.2006.
1738-1744: Tork Meidan, montane *Artemisia* steppe, 36º39'40”N, 54º22'98”E, 2364 m, 17.4.2006. 2430: Derazno, 36º39'57”N, 54º07'36”E, 2339 m, 4.7.2006.
1745-1750: Tork Meidan towards Mazookesh, montane *Artemisia* steppe, transition to deciduous montane forest, 36º39'40”N, 54º23'32”E, 2165 m, 17.4.2006.
1751-1762: Mazookesh, humid place around Mazookesh spring and opening of Sharbat deciduous montane forest, 36º40'32”N, 54º24'36”E, 2223 m, 17.4.2006.
1763-1764: Sharbat, deciduous montane forest, about 7 km far from Mazookesh towards Ziarat river, 36º39' 61”N, 54º25'08”E, 2123 m, 17.4.2006. 2436-2437: Chahar Bagh village, 36º36′25”N, 54º29′05”E, 2147 m, 24.5.2007.
1765-1788: Dakal towards Mamootchal, timber line of *Juniperus excelsa* woodland, tip of ridges from Dakal to Emamverdi, 36º40'33”N, 54º10'65”E, 2619 m, 19.4.2006.

1789-1803: Mamootchal towards Maghazi spring, *Juniperus excelsa* woodland, 36º39' 89 N, 54º12'25 E, 2124 m, 19.4.2006.

1804-1811: Around Maghazi and between spring and road from Serahe Chaman to Jahan Nama plain, *Juniperus excelsa* woodland, 36º39'N, 54º12"E, 2124 m, 19.4.2006.

1812-1851: Transition of Jahan Nama herbaceous communities to Atashan rocks, humid areas at the banks of Atashan river and rocky habitats, *Fagus orientalis* forest and *Carpinus* scrub, 36º41' 16"N, 54º18'12"E, 1793 m, 20.4.2006.

1852-1864: Jahan Nama plain, montane herbaceous communities dominated by *Stachys byzantina* and *Marrubium astracanicum*, open area around Jahan Nama village, 36º40' 41"N, 54º18'19"E, 1786 m, 21.4.2006.

1865-1876: Dorrieh, around spring itself and scrub valley west of spring, 36º40'14"N, 54º18'44"E,1923 m, 21.4.2006.

1877-1900: Atashan towards Sandoogh Posht, deciduous montane forest, highlands above Atashan rocks, 36º41'74"N, 54º18'58"E, 1923 m, 21.4.2006.

1901-1905: Sandoogh Posht, closed montane forest, around Mash Safar resting station, 36º42'36"N, 54º19'15"E, 1596 m, 21.4.2006.

1906: Shoor-e Tarkat, about 3 km from Jahan Nama conservation station towards Tarkat plain, dense closed montane forest, 36º40' N, 54º18'15"E,1782 m, 21.4.2006.

1907-1916a: Gholgholi & Khersdarreh, about 5 km SW Jahan Nama village, montane steppes and *Juniperus sabina* carpet like scrub mixed with *Onobrychis cornuta*, 36º40' 36" N, 54º16'E,1772 m, 21.4.2006.

1916b-1933: Tarkat plain at low elevation and about 5 km far from it towards Jahan Nama plain, 36º41'16"N, 54º20'49"E ,1240 m, 3.5.2006.

1934-1938: Between Jahan Nama plain and Shoor-e Tarkat, closed montane forest, about 4 km far from village in forest, 36º41'09"N, 54º19'35"E,1545 m, 3.5.2006.

1939-1947: Around Dorrieh spring, overgrazed parts towards the Shah Pasand, 36º40'10"N, 54º18'18"E, 1845 m, 4.5.2006.

1948-1964: Between Dorrieh and Jiling Biling, before Asb Neize, 36º39' 49"N, 54º18'06"E, 2045 m, 4.5.2006.

1965-1974: Jiling Biling and Chelestan, S Kalkat, 36º39'14"N, 54º17'02"E, 1992-2100 m, 4.5.2006.

1975-1988: Jahan-Nama plain, meadows of Jahan Nama plain, 36º40'41"N, 54º18'19"E, 1786 m, 5.5.2006.

1989-1992: Shahpasand western hills, about 3 km far from Jahan Nama plain towards Shah Pasand peak, 36º40' 06"N, 54º18'48"E, 1930 m, 5.5.2006.

1993-2016: Tajin Dasht, 36º40' 03"N, 54º14'27"E,1840 m, 6.5.2006.

2017-2025: Along Jahan Nama road, Maghazi valley, *Juniperus excelsa* woodland, 36º39'38"N, 54º13'54"E, 1903 m, 7.5.2006.

2026-2046: Serahe Chaman Savar, meadows and rocks south of road near river, 36º37'39"N, 54º11'23"E, 1497 m, 7.5.2006.

2047-2089: Between Chahar Bagh and Shahkuh, montane steppes of *Artemisia*, 36º36'N, 54º28'28"E ,2107 m.

2090-2100: Lat Bakat towards Tange Alireza, about 5 km entrance of Lat Bakat valley, 36º35'15"N, 54º24'53"E, 1998 m, 24.5.2006.

2101-2142: Chahar Bagh towards Shahkuh, about 5-7 km to Chahar Bagh, 36º36'05"N, 54º27'28"E, 2053 m, 24.5.2006.

2143-2158: Lat Bakat towards Tange Alireza, along the Lat Bakat river, sides of cultivated fields and *Juniperus excelsa* woodland, 2 km Tange Alireza from Lat Bakat, 36º35’34”N, 54º26’14”E, 2035 m, 24.5.2006.

2159-2175: Chahar Bagh village, along Chahar Bagh river and village overgrazed and disturbed steppes dominated by cushion forms, 36º36’25”N, 54º29’05”E, 2147 m, 24.5.2006.

2176-2192: Shahkuh towards Hajiabad, Chal Khaneh, 36º38’18”N, 54º29’53”E, 2305 m, 25.5.2006.

2193-2214: Shahkuh towards Hajiabad, Reza Gholi hills, 36º36’54”N, 54º20’14”E, 1892 m, 25.5.2006.

2215-2234: Tange Alireza and Spi Darreh, 36º35’58”N, 54º21’34”E, 1866m, 26.5.2006.

2235: Shahkuh village, 36º33’35”N, 54º25’11”E, 2326 m, 26.5.2006.

2236-2270: Jahan Nama plain, montane herbaceous communities around the Jahan Nama village, 36º40’47”N, 54º18’27”E, 1720 m, 16.6.2006.

2271-2275: Between Jahan Nama plain and Chakalsar rocks, banks of the river, 36º40’ 47” N, 54º18’27”E, 1720 m, 16.6.2006.

2276-2281: Jahan Nama plain, 36º40′47”N, 54º18′27”E, 1720 m, 16.6.2006.

2282-2297: Atashan, Chakalsar vertical cliffs, southern slopes, in shade of rocks, 36º41′36”N, 54º18′14”E,1750-2000 m, 18.6.2006.

2298-2326: Atashan rocks towards Emamverdi hill, 36º40′59”N, 54º16′29”E, 1750-1900 m, 18.6.2006.

2327-2349: Chahar Bagh towards Shahkuh, *Juniperus excelsa* woodland, 36º34′24”N, 54º26′39”E, 2096 m, 29.6.2006.

2350-2366: Shahkuhe Paein (lower) towards Tange Alireza, in montane *Artemisia* steppe, 2-5 km to Shahkuh towards Tange Alireza, 36º34′56”, 54º23′37”, 2005 m, 30.6.2006.

2367-2368: Serahe Chaman Savar, 36º37′35”N, 54º11′21”E, 2005 m, 1.7.2006.

2369-2381: Tajin Dasht, *Juniperus sabina* carpet like scrub, north of Tajin Dasht, 36º40′19”N, 54º4′44”E,1930 m, 2.7.2006.

2382-2400: Dorrieh and between Dorrieh and Paiizsar, *Berberis* scrub, *Fagus-Carpinus* forest and montane forest, 36º40′19”N, 54º18′25”E, 1840 m, 3.7.2006.

2401-2406: Paiizsar, closed montane forest, towards the Shah Pasand, SE Jahan Nama plain, 36º39′41”N, 54º19′08”E, 2297 m, 3.7.2006.

2407-2413: Tajin Dasht towards Maghazi, *Carpinus-Juniperus* forest with dense ground layer of *Juniperus communis*, 36º40′03”N, 54º14′17”E, 1957 m, 4.7.2006.

2414-2429: Maghazi valley, along the ridges N road, below vertical cliffs, in *Juniperus excelsa* woodland, 36º39′13”N, 54º12′44”E, 1662 m, 4.7.2006.

2431-2434: Tarkat, about 2 km after Jahan Nama conservation station towards Tarkat plain, deciduous montane forest, 36º41'12”N, 54º20'29”E, 1290m, 16.4.2007.

2435: ca. 20 km from Chahar Bagh towards Tuskestan, near waterfall , 36º42'06”N, 54º34'46”E, 1310 m, 16.3.2007.

2438-2439: From Takhte Mirza towards Yarali, 36º42'22”N, 54º14'32”E, 1820 m, 18.3.2005.

2440: Derazno towards Dakal , 36º39'57 N, 54º07'36 E, 2339 m, 15.4.2007.

2441-2442: ca. 2 km to Jahan Nama conservation station towards Tarkat plain, deciduous closed montane forest, 36º41'12”N, 54º20'29”E, 1290m, 16.4.2007.

2443: ca. 1 km to Derazno from Kordkuy, 36º42'47"N, 54º5'53"E, 1670-2000 m, 18.3.2005.

2444-244: Chahar Bagh village towards Sare-Aliabad, near station of Natural Resource Organization, among *Juniperus* trees, 36º38'32"N, 54º30'52"E, 2334 m, 16.4.2007.

2447-2448: ca. 3 km to Derazno from Kordkuy, 36º40'33"N, 54º07'34"E, 2003 m 27.5.2007.

2449-2456: Between Emamverdi hills and Saadabad Mahalleh, open plain below *Fagus* forest, 36º40'52"N, 54º16'43"E, 1805 m 28.5.2007.

2457-2465: Between Emamverdi hills and Tajin Dasht, temperate mixed forest of *Carpinus & Juniperus* cf. *sabina ,* 36º41'N, 54º15'39"E, 1945 m, 28.5.2007.

2466-2477: Between Tajin Dasht and Maghazi valley and Maghazi among *Juniperus* trees, 36º39'37"N, 54º13'48"E, 1960 m, 28.5.2007.

2478-2481: ca. 500 m to Serahe Chaman from Maghazi valley, disturbed montane meadows below *Juniperus excelsa* woodland, 36º39'12"N, 54º12'42"E, 1662 m, 28.5.2007.

2482-2484: Between Serahe Chaman-Savar and Zardaloo Bagh, margins of cultivated fields, 36º37'46"N, 54º14'20"E, 1573 m, 28.5.2007.

2485-2500: Between Zardaloo Bagh and Tange Alireza, before Serah-e Hajiabad, on the rocks and hills both sides of the road, 36º36'34"N, 54º17'16"E, 1638 m, 28.5.2007.

2501-2510: Between Spi Darreh and Tange Alireza, on the rocks and hills, 36º36'07"N, 54º21'22"E, 1850 m, 28.5.2007.

2511-2512: Along Darreh Geda from Chahar Bagh village towards Morad Cheshme, 36º36'36"N, 54º28'27"E, 2225 m, 29.5.2007.

2513-2521: Morad Cheshme towards Bala Chal rocks and hills, 36º37'21"N, 54º27'11"E, 2663 m, 29.5.2007.

2522: Below Talanbar peak from Morad Cheshme and Bala Chal rocks and hills, 36º37'44"N, 54º27'23"E, 2935 m, 29.5.2007.

2523: Rocks in front of Morad Cheshme, 36º37'18"N, 54º27'26"E, 2250 m, 29.5.2007.

2524-2538: Ziarat village, hills on the left side of the road from village towards Ziarat waterfall, 36º40'30"N, 54º27'53"E, 1250 m, 30.5.2007.

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