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RESEARCH ARTICLE

Taxonomic diversity of *Astragalus* L. in Alpine and Sub-alpine zones in Talesh Mountains, Northwest Iran

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Abstract

The largest genus in Iran has investigated in Talesh Mountains. These mountains are located along the transition area between Irano-Turanian and Hyrcanian phytochoria in the northwest Iran. *Astragalus* with 61 species belong to 20 sections represents in Talesh Mountains alpine and subalpine zones, 21 are endemic, and 27 taxa either in the country's or the state's Red Lists of categories. The results provides checklist of *Astragalus* species, a taxonomic comments for some species, also recorded some species from NW Iran and report new localities for recently introduced *Astragalus* species.

Keywords: Flora, Fabaceae, Conservation, Checklist, High altitude, Distribution

Introduction

Astragalus L., a genus belong to the Tribe Astragaleae of Leguminosae is one of the largest genera of vascular plants in the world. It is represented by approximately 2900 taxa in more than 250 sections (Zarre & Azani 2013; Mabberley 2008). The arid and semi-arid mountainous parts of the Northern Hemisphere and South America seem to be the center diversity of this genus (Polhill 1981). The majority of its species are widespread in the south-western Asia mainly Iran and turkey, south-central Asia, the Central Asian, the western North America and along the Andes in South America (Polhill 1981; Lock & Simpson 1991; Maassoumi 1998).

Astragalus is the largest genus in Iran, where it is represented about 830 taxa, over 400 of them endemic in political territory, and is classified in 63 sections (Maassoumi 1998; Ghahremaninejad 2015). The sections with the most species in the flora of Iran are *Caprini* De Candolle, followed by *Malacothrix* Bunge and *Incani* De Candolle (Zarre et al. 2008; Maassoumi 2005).

In the recent years, a large number of publications have been brought out on the genus, both on regional and global basis (*Astragalus* of Iran 2018). While the study area has been poorly investigated botanically. However, the study area has been visited by several collectors in the past (e.g. Collectors of Flora Iranica and flora of Iran), in addition this study following previous investigations in the neighboring area (Maassoumi et al. 2015; Bagheri et al. 2011), which focused on the genus *Astragalus* to aimed complete distribution largest genus in Iran.

The present work provides a synopsis of the *Astragalus* diversity in Talesh Mountains. It provides comments only on those species that's distributed in the Alpine and

sub-alpine habitat and have been collected from 2007 to 2017 by authors.

Materials and Method

Study area

Talish Mountains forms the northwest section of the Elburz Mts, extending southeast ward from the Azerbaijan border to the lower part of the Sefid-Rud in NW Iran (**Fig. 1**). These Mountains have an interesting phytogeographical position in the transitional zone between the Hyrcanian (Hyr) and Irano-Turanian (Ir-Tur). So that, in three consecutive peaks inserted from Hyrcanian into Irano-Turanian region respectively Bakrodagh (3200 m a.s.l.), Palangah (2950 m a.s.l.) and Aq-dagh (3330 m a.s.l.).

In eastern steeps of this area have relatively humid but the western steeps have dry and high lands climate. This climatic difference has resulted in completely different vegetation types in the Eastern to Western parts. Totally, climate of those areas usually is cold and snowy in winter and moderate climate in summer. In general, study areas mainly belong to Irano-Turanian floristic region (Zohary 1973). There are two protected areas in the Talesh Mountains, Lisar and Aq-dagh Protected Areas. This work focused on both protected area. The altitude of the area ranges between 2100 to 3330 m. The mean annual rainfall is 359.32 mm and annual temperature is 4.42°C. The coldest month is February with a minimum temperature of -11.88°C and the hottest month is August with a maximum temperature of 21.15°C.

Sample collection

During vegetation and floristic studies on the alpine and subalpine zones of the Talesh Mountains, we focused on *Astragalus*, with the largest diversity in study area. Besides floristic sampling of some specific species, the flora was recorded in 240 relevés followed the Braun-Blanquet approach, the numbers of relevés and their size were related to site area and followed the minimal area. Sampling has done across the six faces in three line or mountain peak from Hyrcanian to Irano-Turanian phytochoria.

In this research 850 specimens were collected. The exact location and altitude have been determined using GPS with the addition of notes on the vegetation and habitat. The specimens transferred to the herbarium and identified according to the *Astragalus* in the Old World, Check List (Maassoumi 1998), Flora of Iran (Maassoumi 2003), Genus *Astragalus* in Iran (Maassoumi 1986-2005); Flora Iranica (Podlech 1999,2010; Podlech et al. 2001; Zarre et al. 2008), Flora of Turkey and taxonomic revision of the genus *Astragalus* (Podlech & Zarre 2013). The specimens were deposited in the FAR, T, and TARI Herbaria. Here, GPS points have provided for species that were collected only from one location, for more distribution species, based on **Fig. 1**, six distribution sites or growing area have been determined (**Fig. 1**). The following sites have been detected based on six main faces from Hyrcanian to Irano-Turanian phytochoria:

Results

During the course of present study, 61 species belong to 20 section of *Astragalus* were recognized in the Talesh Mountains high altitude. Out of these, 10 species (18%) belong to sect. *Malacothrix* Bunge, 7 (11.5%) species to sect. *Carpini* DC., 6 (10%) species to sect. *Onobrychoidei* DC., 6 (10%) species to sect. *Incani* DC., 5 (8%) species to sect. *Rhacophorus* Bunge, 5 (8%) species to sect. *Hymenostegis* Bunge, 5 (8%) species to sect. *Adiaspastus* Bunge and 17 (27.5%) species belonging to the other sections (**Fig. 2 and 3**).

Some of the widespread species in the study area occur in many plots and dominant in this area. Species that represent in more than 13 plots (like, *Astragalus aureus* 68 p; *A. ochrochlorus* 49 p; *A. aegobromus* 32 p; *A. lilacinus* 30 p; *A. pinetorum* 28 p; *A. curvirostris* 22 p; *A. lisaricus* 21p), and

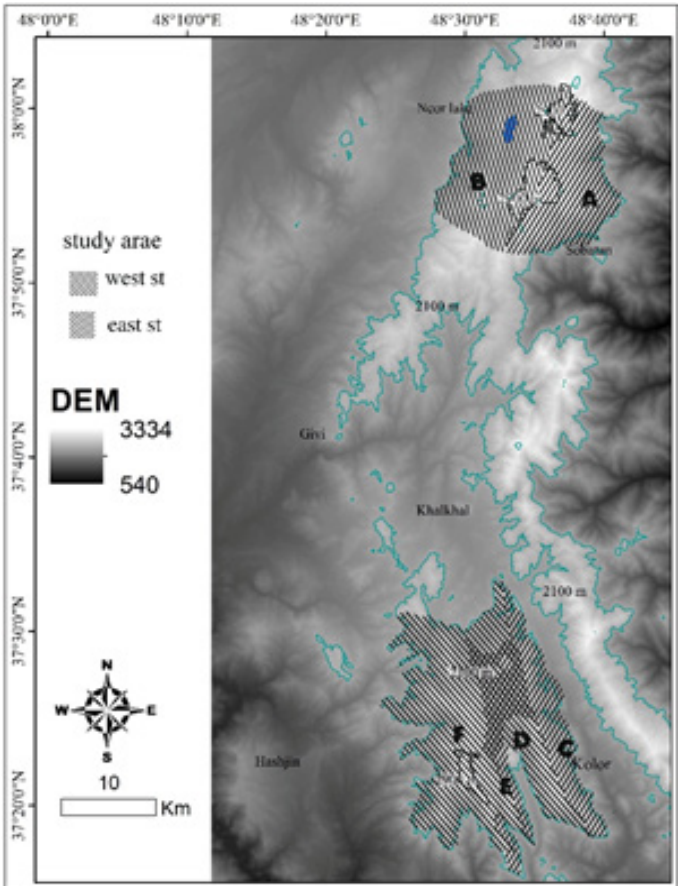

Figure 1. Study areas with six site or face from Hyrcanian to Irano-Turanian phytochoria: **A-**Gilan province. Lissar Protected Area, The slope leading to the hyrcanian forest (Eastern slope); **B-**Ardabil province. Lissar Protected Area, The slope leading to the Neor Lake (Western Slope); **C-**Ardabil province. Aq-Dagh. Protected Area, Palangah, The slope leading to the Shahrood River, (Eastern slope); D-Ardabil province. Aq-Dagh. Protected Area, The slope leading to the Lerd River (Western slope); **E-**Ardabil province. Aq-Dagh. Protected Area, The slope leading to the Lerd village, (Eastern slope); **F-**E. Ardabil province. Aq-Dagh. Protected Area. Aq-Dagh Mountain The slope leading to the Hashjin districts (Western slope).

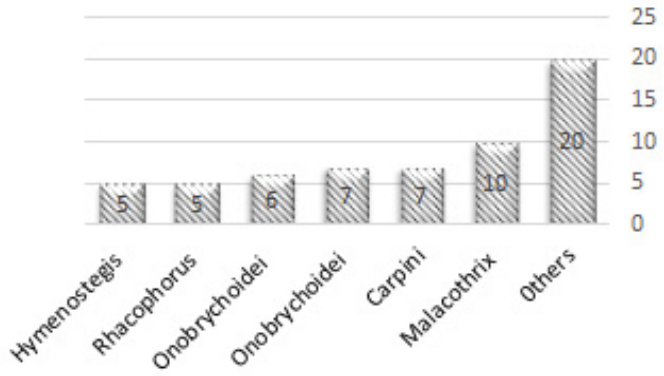

Figure 2. Frequency of species belongs to main sections.

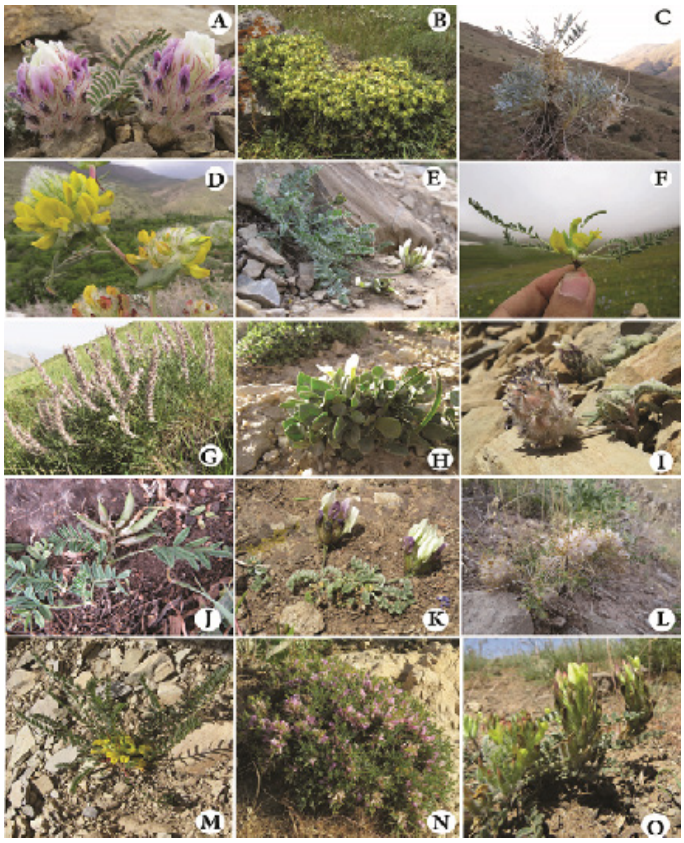

Figure 3. Habit of **A**-*andabilensis*; **B**-*A. aureus*; **C**-*A. compactus*; **D**-*A. macrocephalus*; **E**-*A. beckii*; **F**-*A. pinetorum*; **G**-*A. nervistipulus*; **H**-*A. khadem-kandicus*; **I**-*A. nezva-montis*; **J**-*A. fragrans*; **K**-*A. lisaricus*; **L**-*A. karabaghensis*; **M**-*A. angustiflorus*; **N**-*A. ochrochlorus*; **O**-*A. taleshensis*.

also some represent in 6 to 9 plots and others occur in 1 to 4 plots or gathered in floristic sampling.

In this mountain snow-bed and scree are two main Alpine habitats. Alpine vegetation occur continuous and discontinuous in the scree and snow-bed habitats mostly above 2900 m a.s.l., that surrounded by sub-alpine thurn- cushion vegetation. Six species grow in the Alpine zone (2900 to 3320 m a.s.l.) and the rest of species can be found in subalpine and montane zones (2100 to 2900 m a.s.l.). species namely *A. andabilensis*, *A. nezva-montis* are representing in screes and the species like *A. fragrans*, *A. angustiflorus*, *A. lisaricus* and *A. pinetorum* are growing in the snow-beds.

Most of the species dominant in sub-alpine habitat as well some species can see in montane zone. In lower altitudes or sub-alpine region, cushion formation of *Astragalus* spp. provide a variety of habitats favorable for the growth of a large number of other species as nurse plants. Most of the species belong to section *Adiaspastus bunge* (*A. aureus*, *A. karabaghensis* and *A. ochrochlorus*), *Hymenostegis* bunge (*A. nervistipulus*, *A. recognitus* , *A. tabrizianus*), Sect. *Campylanthus* Bunge (*A. tricholobus*) and predominantly in lower elevation Sect. *Rhacophorus* Bunge (*A. microcephalus*).

Some of species contains important fodder and herbaceous plants, occurring in sub-alpine region specially species belong to. Sect. *Carpini* DC. (*A. aegobromus*, *As. pinetorum* and *A. angustiflorus*), Sect. *Erioceras* Bunge (*A. barnassari*), Sect. *Incani* DC. (*A. refractus*, *A. curvirostris*), sect. *Malacothrix* Bunge (*A. beckii* , *A. lisaricus*, *A. podocarpus*), Sect. *Onobrychoidei* DC. (*A. lilacinus*).

In recent years, several new species of *Astragalus* are introduced in study area and their adjacent region. Some introduced species were again collected and according to the morphological characters confirmed their existence and recorded new location for their distribution area *A. andabilensis* Ranjbar & Mahmoudian (Ranjbar et al. 2013) recorded again from Aq-Dagh Alpine zone, *A. zarjabadensis* Ranjbar (Maassoumi & Ranjbar 1996) recorded again from Lerd village. *A. taleshensis* Bidarlord, F.Ghahrem. & Maassoumi has described as a new species during this invetigation (Bidarlord et al. 2016) here, we added new locality for this species.

During this study some species recorded from northwest Iran, *A. nezva-montis* Podlech & Zarre was previously reported from northeastern and *A. ochrochlorus* Boiss. & Hoiihn and *A. recurvatus* Podlech was reported respectively from north, center and center of Iran. Record species marked with an asterisk in following list.

In Flora Iranica the name *A. lisaricus* Maassoumi treated as synonym for its relative species *A. becki* Bornm. (Podlech et al. 2010). Besides morphological traits such as plant size, leaf shape (angusti-ellipticis vs. oblongi-ovatis), stipule and calyx size, ecological differences in the distribution of these species is also visible. *A. lisaricus* mainly grows in snow-beds, acid soil, and lower organic matter. While *A. becki* grows in subalpine region with more diverse soils.

Nearly 34.5 percent of the cited *Astragalus* species are endemic to the Iranian political borders and sub-endemic that distributed in Iran and nearest country borders, for example *Astragalus tricholobus* subsp. *hohenackeri* and *Astragalus beckii* some restricted to Iran and republic of Azerbaijan. Besides the endemism and distribution, some of the species characterized as IUCN threatened categories like, critically endangered (CR), endangered (EN), vulnerable (VU), near threatened (NT) (IUCN, 2014). These categories inserted with the abbreviation for each

species in the following. There are 11 vulnerable, 8 Near Threatened, 3 Endangered and 3 Critically Endangered species within investigated species (**Tab. 1**).

Following checklist represent our finding species in the study area under their sections and provide respectively their distribution in the world and Iran, habitat distribution in study area, collector name with herbarium number, status of species in IUCN threatened categories.

Sect. *Adiaspastus* Bunge

1-*Astragalus aureus Willd.*; Transcaucasia, Anatolia, Talish, N, NW, W, C Iran, Alpine and subalpine, 68 plots in A, B, C, D, E, F sites, Bidarlord 15807 to 15809 (T)

2-*Astragalus karabaghensis* Bunge; Armenia, Republic of Azerbaijan, NW Iran, Alpine and subalpine, 20 plots in B, C, D, E, F sites , Bidarlord 15810 to 15812 (T)

3-**Astragalus ochrochlorus* Boiss. & Hoiihn; Endemic to N,C, NW Iran, subalpine, 49 plots in A, B, C, D, E, F sites, Bidarlord 15813 to 15816 (T)

4-*Astragalus polyanthus* Bunge subsp. polyanthus Endemic to NW Iran, subalpine, 37°20´09˝N, 48°37´26˝E, Bidarlord 15813 (T), NT

5-*Astragalus caspicus* Bieb.; Transcaucasia (Azerbaijan), Anatolia orientalis, Iraq, Talish, N, NW, W, C Iran; subalpine/ Montane, 37°28´58˝N, 48°33´06˝E, Bidarlord 15816 (T)

Sect. *Alopecuroidei* DC

6-*Astragalus zarjabadensis* Ranjbar; Endemic to NW Iran, subalpine/Montane, 37°21´03˝N, 48°39´26˝E, Bidarlord 15814 (T), EN

7-*Astragalus macrocephalus* Willd. Anatolia, Transcaucasia, Libanon, Lraq. NW, W, C Iran, subalpine/ Montane, ́37°20´57˝N, 48°38´33˝E, Bidarlord 15890 (T)

Sect. *Astragalus*

8-*Astragalus caragana* Fischer & C.A. Mey.; Anatolia, Transcaucasia, Persia, Talish, N, NW, W, C Iran, subalpine/Montane, ́37°20´09˝N, 48°37´26˝E, Bidarlord 15815 (T)

Sect. *Campylanthus* Bunge

9-*Astragalus tricholobus* DC subsp. tricholobus; Endemic to W, C, NW Iran, subalpine/Montane, 9 plots in A, B, C, D, E, F sites, Bidarlord 15817 (T), NT

10-*Astragalus tricholobus* DC subsp. *hohenackeri* (Boiss.) Tietz

Syn. *Astragalus hohenackeri* Boiss.; restricted to Republic of Azerbaijan and N, NW, W, C Iran, subalpine/ Montane, 5 plots in C, D, E sites, Bidarlord 15818 (T), NT

Table 1. IUCN risk categories of endemic species growing study area.

Endemic species			
CR	VU	*A. elegans*	*A. recognitus*
A. andabilensis	*A. xerophilus*	*A. seidabadensis*	*A. polyanthus*
A. taleshensis	*A. eriopodus*	*A. xerophilus*	*A. ochrochlorus*
A. nezva-montis	*A. lisaricus*	NT	*A. karabaghensis*
EN	*A. pauperiflorus*	*A. beckii*	*A. recognitus*
A. recurvatus	*A. iranicus*	*A. tricholobuss*	*A. polyanthus*
A. lilacinus	*A. supervisus*	*A. hohenackeri*	
A. zarjabadensis	*A. tabrizianus*	*A. rubrocalycinus*	

Sect. *Carpini* DC

11-*Astragalus aegobromus* Boiss. & Hohen.; Anatolia, Iraq, Caucasus, Transcaucasia, N, NW, W, C Iran, subalpine, 32 plots in B, C, D, E, F sites, Bidarlord 15819, 15820 (T)

12-*Astragalus angustiflorus* K.Koch subsp. *angustiflorus*; Anatolia, Iraq, Persia, Transcaucasia, C, NW Iran, Alpine 5 plots in B, D, E, F sites, Bidarlord 15821, 15822 (T)

13-*Astragalus basilicus* Maassoumi & Podlech, Endemic to NW Iran, subalpine and lower altitude, 37°22´20˝N, 48°32´10˝E, Bidarlord 15823 (T), NT

14-*Astragalus ovinus* Boiss.; Anatolia, Iraq; W, C, NW Iran, subalpine and lower altitude 37°22´30˝N, 48°44´10˝E, Bidarlord 15824 (T)

15-*Astragalus pinetorum* Boiss. subsp. *pinetorum*; Anatolia, Libanon, Syria, Iraq, Caucasus, Transcaucasia, N, NW, C Iran, Alpine, 28 plots in A, B, E, F sites, Bidarlord 15825 (T)

16-*Astragalus rubrocalycinus* Maassoumi & Podlech, Endemic to NW Iran, subalpine and lower altitude 37°26´31˝N, 48°29´10˝E, Bidarlord 15825 (T), NT

17-*Asragalus urmiensis* Bunge; Transcaucasia, N, NW, C Iran, subalpine, 37°22´27˝N, 48°34´10˝E, Bidarlord 15826 (T)

Sect. *Erioceras* Bunge

18-*Astragalus barnassari* Grossh.; Iraq, Talish, N, NW, C Iran, Alpine/ subalpine, 8 plots in E, F sites, Bidarlord 15827, 15828 (T)

Sect. *Grammocalyx* Bunge

19-*Astragalus lineatus* Lam. Transcaucasia, Anatolia,, Iraq, N, NW, C Iran, subalpine, 37°23´37˝N, 48°33´34˝E Bidarlord 15829 (T)

Sect. *Hololeuce* Bunge

20-*Astragalus alyssoides* Lam.; Transcaucasia, Anatolia, Turcomania, N,NW, W, C,E Iran, subalpine, 37°58´17˝N, 48°33´14˝E, Bidarlord 15831 (T)

Sect. *Hymenostegis* Bunge

21-*Astragalus recognitus* Fisch.; Endemic to N, NW Iran, subalpine, 7 plots in B site, Bidarlord 15832, 15833 (T), NT

22-*Astragalus tabrizianus* Fisch; Endemic to N, NW Iran, subalpine, 5 plots in B site, Bidarlord 15834, 15835 (T), VU

23-*Astragalus seidabadensis* Bunge; Endemic to NW Iran, subalpine, 38°00´10˝N, 48°36´33˝E, Bidarlord 15836 (T), VU

24-*Astragalus chrysostachys* Boiss.; Anatolia, NW, E, C Iran, subalpine, 38°00´30˝N, 48°31´34˝E, Bidarlord 15837 (T)

25-*Astragalus nervistipulus* Boiss.; Iraq, NW, W, C Iran, subalpine, 4 plots in C, E sites, Bidarlord 15838 (T)

Sect. *Hypoglottidei* DC

26-**Astragalus nezva-montis* Podlech & Zarre; Endemic to N, NW Iran, Alpine, 37°22´30˝N, 48°33´10˝E, Bidarlord 15839 (T), CR

Sect. *Incani* DC.

27-*Astragalus curvirostris* Boiss.; Iraq, NW, W, C, S Iran, Alpine/subalpine, 22 plots in A, B, C, D, E, F sites, Bidarlord 15840, 15843 (T)

28-*Astragalus khadem-kandicus* Maassoumi & Podlech; Endemic to N, NW Iran, subalpine, 37°23´30˝N, 48°38´10˝E, Bidarlord 15847 (T)

29-*Astragalus refractus* C.A.Mey; Endemic to NW Iran, Armenia, subalpine, 12 plots in C, D, E sites. Bidarlord 15849, 15850 (T), VU

30-*Astragalus rostratus* C.A. Mey; Azerbaijan, Talish, N, NW Iran, subalpine, 37°22´20˝N, 48°39´30˝E, Bidarlord 15851 (T)

31-*Astragalus supervisus* (Kuntze) Sheld.; Endemic to subalpine, NW, W, C,E, S Iran, 37°20´30˝N, 48°30´10˝E. Bidarlord 15853, 15855 (T), VU

32-*Astragalus robustus* Bunge; Anatolia, Caucasus, N, NW, C Iran, subalpine, 37°33´25˝N, 48°34´29˝E, Bidarlord 15856 (T).

Sect. *Macrophyllium* Boiss.

33-*Astragalus oleaefolius* DC.; Transcaucasia, Anatolia, Lebanon, Syria, Palaestina, Jordania, Iraq, W. NW Iran, subalpine, 37°21´40˝N, 48°39´50˝E, Bidarlord 15857 (T)

34-*Astragalus peymanii* Maassumi; Endemic to N Iran, subalpine, 37°21´30˝N, 48°42´10˝E . Bidarlord 15858 (T), VU

Sect. *Malacothrix* Bunge

35-*Astragalus beckii* Bornm.; Restricted to Republic of Azerbaijan (Talesh) and N, C, NW Iran, subalpine, 20 plots in A, B, C, D, E, F sites, Bidarlord 15859, 15860 (T), NT

36-*Astragalus elegans* Bunge; Endemic to NW Iran, Armenia, subalpine, 37°26´10˝N, 48°31´25˝E, Bidarlord 15861 (T)

37-*Astragalus eriopodus* Boiss.; Syria, Turkey, Armenia, to W, NW, C Iran, subalpine/ Montane. 37°18´15˝N, 48°31´12˝E. Bidarlord 15863 (T), VU

38-*Astragalus iranicus* Bunge.; Turkey (Van), N, NW, W, C Iran, subalpine 37°57´10˝N, 48°31´40˝E Bidarlord 15864 (T), VU

39-*Astragalus lisaricus* Maassoumi; Endemic to N, NW Iran, Alpine, 21 plots in A, B, E, F sites. Bidarlord 15865, 15869 (T), VU

40-*Astragalus macrourus* Fisch. & C.A.Mey.; Transcaucasia, N, NW Iran, Anatolia, subalpine/ Montane, 38°01´37˝N, 48°32´10˝E, Bidarlord 15870 (T)

41-*Astragalus pauperiflorus* Bornm.; Endemic to NW Iran, Alpine and subalpine, 37°22´15˝N, 48°35´23˝E, Bidarlord 15871 (T), VU

42- *Astragalus podocarpus* C.A.Mey.; Republic of Azerbaijan and NW, C Iran, subalpine/ Montane, 9 plots of F, E, D, Bidarlord 15872, 15874 (T)

43-*Astragalus taleshensis* Bidarlord, F.Ghahrem. & Maassoumi, Endemic to NW Iran, subalpine 38°01´10˝N, 48°30´50˝E., 37°23′ N, 48°38′ E, CR. Bidarlord 15883, 15884 (T, TARI)

44-*Astragalus* sp., *subalpine*. 38°01´10˝N, 48°30´50˝E, Bidarlord 15815875 (T)

Sect. *Onobrychoidei* DC

45-*Astragalus aduncus* Willd.; Libanon, Syria, Anatolia, Iraq, NW, C Iran, subalpine/ Montane, 37°57´55˝N, 48°29´57˝E, Bidarlord 15876 (T)

46-*Astragalus brevipes* Bunge, Armenia, Azerbaijan (Nakhichevan), Anatolia, NW, W Iran, subalpine/ Montane, 37°58´45˝N, 48°34´55˝E, Bidarlord 15877 (T)

47-*Astragalus effusus* Bunge; Armenia, NW, C Iran, subalpine/ Montane, 37°57´23˝N, 48°33´33˝E, Bidarlord 15878 (T)

48-*Astragalus lilacinus* Boiss.; Endemic to N, C, NW Iran, subalpine, 30 plots in B, C, D, E, F sites, Bidarlord 15879, 15880 (T), NT

49-*Astragalus shagalensis* Grossh.; Anatolia, Armenia, NW Iran, subalpine, 37°57´43˝N, 48°33´20˝E, Bidarlord 15881 (T)

50-*Astragalus xerophilus* Ledeb.; Anatolia, NW Iran, subalpine/ Montane, 38°01´04˝N, 48°35´23˝E. Bidarlord 15885 (T), VU

Sect. *Ornithopodium* Bunge

51-*Astragalus jodostachys* Boiss. & Buhse; Turkey, NW, C Iran , subalpine, 37°53´37˝N, 48°37´40˝E, Bidarlord 15887 (T)

52-**Astragalus recurvate* Podlech; Endemic to NW, C Iran , subalpine, 37°18´27˝N, 48°35´15˝E, Bidarlord 15888 (T), EN

Sect. *Platonychium* Bunge

53-*Astragalus denudatus* Steven; Daghestan, Gruzia, N, NW, W, C, S Iran, subalpine/ Montane37°20´37˝N, 48°37´40˝E, Bidarlord 15889 (T)

Sect. *Rhacophorus* Bunge

54-*Astragalus compactus* Lam.; Gruzia, Armenia, Azerbaijan, Anatolia orientalis, Iraq, N, NW, W, C, S Iran, subalpine, 37°20´31˝N, 48°37´25˝E, Bidarlord 15890 (T)

55-*Astragalus meyeri* Boiss.; Transcaucasia (Azerbaijan), NW Iran, subalpine/ Montane, 37°56´30˝N, 48°31´36˝E, Bidarlord 15891 (T)

56-*Astragalus rhodosemius* Boiss. & Hausskn Endemic to N, NW, W, C, S Iran, subalpine, 37°21´02˝N, 48°41´11˝E, Subalpine, Bidarlord 15892 (T)

57-*Asragalus microcephalus* Willd. .subsp. *microcephaliis*; Bulgaria, Gruzia, Armenia, Azerbaijan, Anatolia, Iraq, N, NW, W, C Iran, subalpine/ Montane, 15 plots in B, C, D, E, F sites, Bidarlord 15892, 15898 (T)

58-*Astragalus paralipomenus* Bunge; Anatolia, N, NW, W Iran, subalpine, 8 plots in B, C, D, E sites, Bidarlord 15894, 15895 (T)

Sect. *Stereothrix* Bunge

59-*Astragalus andabilensis* Ranjbar & Mahmoudian, Endemic to NW Iran, Alpine, 12 plots in C, E, F sites, Bidarlord 15896, 15899 (T), CR

Sect. *Synochreati* DC.

60-*Astragalus fragrans* Willd.; Transcaucasia, Anatolia, NW Iran, Alpine, 8 plots in A site, Bidarlord 15805, 15806 (T)

Sect. *Uliginosi* A .Gray

61-*Astragalus odoratus* Lam.; Macedonia to Kazakhstan, N, NW, W, C Iran, Alpine, 37°27´03˝N, 48°33´26˝E, Bidarlord 15897 (T)

Discussion

Maassoumi et al. (2015) have mentioned 75 species belong to 29 sections from Bozghoush Mountain, situated in west of this study area and Bagheri et al. (2011) have listed 116 species belong to 28 sections from Zanjan province, the east of study area. By comparing our finding with the results of mentioned neighboring areas respectively 30 and 25 species are common in the three studied area. It should be noted that this study exclusively focused to the high altitude of Talesh Mountains. Noroozi et al. (2008, 2018) recorded 78 species for Alpine zone of Iran. Their results do not include any of our finding species. Some of the species that they reported from Alpine areas are seen in the sub-Alpine zones of our study area.

In Iran *A. aureus* is distributed generally on the central Alborz to Azerbaijan often at 2000 to 3600 m a.s.l. with *Onobrychis cornuta* (L.) Desv. and *A. karabaghensis*, *A. ochrochlorus*, they are formed the Thorn-cushion formation in the Alpine and sub-alpine areas (Maassoumi 1995). This plant and companion plants growing mostly in the sub-alpine zone and thorn-chusion. They have dominant Thorny-cushion formation. They act as nurse plant. In stressful environments nurse plants Provide microclimates of within their canopies and thus this conditions increase species richness, abundance, diversity, and species survival (Liczner and Lortie 2014). Representing species with cushion formation

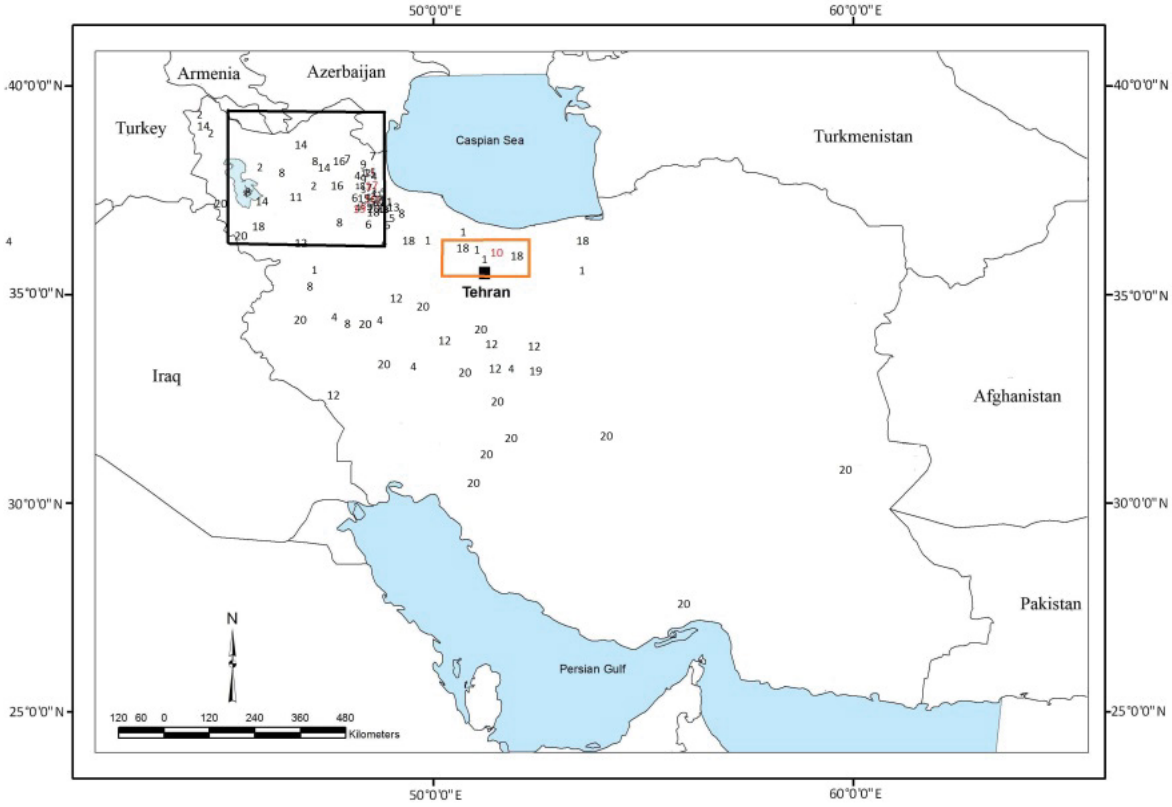

Figure. 4. Distribution endemic species in Iran, *Astragalus ochrochlorus* (1), *A. polyanthus* Bunge subsp. *Polyanthus* (2), *A. zarjabadensis* (3), *A. tricholobus* DC subsp. *Tricholobus* (4), *A. basilicus* (5), *A. rubrocalycinus* (6), *A. recognitus* (7), *A. tabrizianus* (8), *A. seidabadensis* (9), *A. nezva-montis* (10), *A. khadem-kandicus* (11), *A. supervises* (12), *A. peymanii*(13), *Astragalus elegans* (14), *Astragalus* lisaricus (15), *A. pauperiflorus* (16), *A. taleshensis* (17), *A. lilacinus* (18), *A. recurvatus* (19), *A. rhodosemius* (20), *A. andabilensis* (21). Two hotspot-within-hotspot (Azerbaijan and Alborz) in Iran have been marked.

also provide suitable conditions for soil conservation, especially on slopes.

Endemic levels are not the same throughout the study area. In Alpine and the nearest areas, the concentration of endemic species is higher. Study area is located of Irano-Anatolian Hotspot (Noroozi et al. 2018). According to endemic species distribution (**Fig. 4**), It can be concluded that the study area is part of Azerbaijan hotspots-within-hotspots and has many common species with Alborz hotspots-within-hotspots. It is worthy of mention that for comprehensive protection management detection hotspots-within-hotspots is needed (Cañadas et al. 2014).

Our results provide information regarding the potential distribution of rare endemic species. This information is critical for the conservation of the Talesh mountain vegetation. Based on rare species classification by Fiedler and Ahouse (1992), most of the rare species in study area are narrow distribution and small population sizes. Currently, the protection of endemic and rare plant species in study area is not guaranteed by protected program. While study area is the only recorded locality for *A. taleshensis, A. andabilensis* and *A. zarjabadensis*. This area can be considered as hot spot for some endemic and rare plant.

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