

# Floristic changes at Khersan Glacier Territory, Alamkuh Mountain, Central Alborz, North of Iran

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**Abstract.** Kavousi K, Nejdassattari T, Asri Y, Ejtehadi H, Khavari-Nejad RA. 2016. Floristic changes at Khersan Glacier Territory, Alamkuh Mountain, Central Alborz, North of Iran. *Biodiversitas* 17: 11-15. Extensive investigation in subnival-nival area around Khersan glacier moraine introduced 71 vascular plant species. From this list 43 species have been listed in Noroozi et al. (2011) in “subnival-nival vascular plant species of Iran : a unique high mountain flora and its threat from climate warming” and the others are new for subnival-nival area of Iran. Among this plant list 31 species had introduced with Kotschy (1861a,b), Bornmuller (1906), Melchior (1937), Klein (1982), European researchers and the other is named for the first time from Khersan glacier territory. Many species such as *Astragalus macrosemius*, *Pseudocamelina kleinii*, *Crepis multicaulis* subsp. *congesta*, *Didymophysa fedtschenkoana* and *Draba melanopus* due to glacier condition have very sensitive habitat, vulnerable and only gathered from restrict area with conservation value. Vegetation change happened in many nival and subnival areas with upward movement in the same habitat and movement from lower altitude at alpine towards summit in subnival and nival. *Carex oreophila*, *Campanula stevenii*, *Bromus brachystachyus*, *Oxytropis immersa*, *Erigeron uniflorus*, *Trachydium pauciradiatum*, *Scorzonera radicata* and some other species are surprisingly movement to subnival area and many nival and subnival species such as *Didymophysa aucheri*, *Didymophysa fedtschenkoana*, *Dracocephalum aucheri* and *Arabis caucasica* have come significantly upward in nival. The movement is different in all side of Khersan glacier moraine in north, south and the east (beside moraine tongue) slopes and limited with presence of soil natural generation and other ecological remarks. Limitation for soil generation starts at different altitude in northern, southern and eastern slopes of Khersan glacier valley. This study examined changes of flora in Khersan glacier territory during recent decades according to extensive data gathering, full list of Khersan glacier territory introduced *Barbarea stricta*, *Draba melanopus*, *Pseudocamelina kleinii*, *Crepis multicaulis* subsp. *congesta* as new report for flora of Iran and flora Iranica area.

**Keywords:** Alamkuh, alpine, glacier territory, Khersan, moraine, subnival-nival

## INTRODUCTION

Alamkuh in Mazandaran province is the second high after Damavand peak in Iran which is protected as natural national monument with Iranian Department of Environment (Figure 1.A). There are 13 active glacier such as Haft-khan with 7 western glacial valley, Marji-kash with an eastern active moraine and parallel with Khersan valley, 4 Nordic moraines towards Sarchal valley, and Khersan glacier with an active longest and widest glacier in these series. Hasarchal is a plain at the base of Khersan glacier valley which surrounded by mountain series in north such as Alamkuh and Marji-kash, Khersan, Shane-kuh, Menar and Lashkarag in the south side of glacier moraine valley.

Khersan peak with 4620 m lead to Shane-kuh, Menar, Lashkarag in the east, Khersan glacier in the southeast and Alam peak and Marji-kash glacier in the western location. Biodiversity and abundance of native species is given high values to this location as a centre of biodiversity for plant species. In this paper Khersan glacier has been studied and presented with more detailed information with new plant record from Iran and Khersan glacier territories. Important location and study area of Khersan glacier shows in the

## Figure 1.B.

Botanical studies in this area was conducted in 1843 by Theodor Kotschy and after Kotschy (1861a,b), Bornmuller (1906), did gathering extensive in the area, the information that is given in the Flora Iranica. Melchior (1937) after in depth studies in Hasarchal has provided a great deal of taxonomic information. Klein (1982) completed Bornmuller (1906) information with an extensive data gathering in Alborz Mountains and has provided botanical and phytosociological data from Hasarchal and Khersan glacier territories.

The result of all previous study identified 31 plant species from nival and subnival area of Khersan glacier territories and Hasarchal around Khersan moraine. This data is the basis for judgment and interpreting the theory of plant movement and shift from lower altitude to highlands during the recent decades. According to recent studies since 2013, 71 plant species have been identified in this area. Of the 71 species 40 species are reported for the first time from Khersan glacier territory and 4 plant species are reported for the first time from Iran. This study focuses on the botanical condition in all sides of Khersan glacier territory during the recent year and suggests floristic

changes such as movement, elimination and plant species up warding.

## MATERIALS AND METHODS

Landsat ETM + has been used in this study to identify normal range of Khersan glacier and its changes and study area, GPS and fixed prefabricated quadrat (2m × 2m) has been used to record the location information for studies and comparing between present and past. European researcher collected information such as Kotschy (1861a,b) and Bornmuller (1906), including the location and their species nomenclature is used to replicate the recent studies and extensive field visit during 2013 to 2015 conducted this work studies.

Studies begin from the lower pilot in altitude 3800 m asl. towards the mountains in three access road around Khersan moraine with 38 quadrat in north, south and east slopes during 2013 to 2015. Quadrant size is determined based on standard curve for square size and number of species and fixed for each altitude. Plant species gathered from 38 square (12 in north and 15 in west, 11 in south and east) has been named with literatures from Komarov (1939), Assadi et al. (1988-2010), Rechinger (1963-2010), Breckle (2007), and Noroozi et al. (2008, 2010a,b, 2011, 2013), and has been updated according to extensive data gathering. Comparative study has done according to recent field visit and data which had been gathered with Kotschy (1861a,b), Klein (1982), Bornmuller (1906), Melchior (1937) and Rechinger (1963-2010) since 1843 for determine present or absent of plant species, biological characteristics changes, upward movement and etc.

## RESULTS AND DISCUSSION

### Results

The Table 1 is set for discussion present the species gathered from study area during 2013-2015. It lists the plant species collected since 1843 in Khersan glacier territory and has been compared with the last documents such as Noroozi et al. (2010a, 2011, 2013) about subnival- nival vascular plant of Iran, Flora Iranica and recent studies which is demonstrated in Khersan moraine column. Each row in the table shows the history of plant species since 1843 to the last gathered in summer 2015.

The list shows there are 71 vascular plant species in margin of Khersan moraine glacier from 4435 m asl. in the northern slope to lower elevation in borderline of subnival in 3900 m asl. around Khersan territory. About 50% of this plant list is endemic in Iran and 6 of those are mono-regional and have only known from one locality in Iran. This number is much more than of previous reports since 1982 with 31 species and this studies added 40 plant species to Khersan glacier territories. A group of these added species come upward from lower elevation and much of it dependent to appropriate collection during the past three years with authors.

According to the plant species list *Barbarea stricta*, *Crepis multicaulis* subsp. *congesta*, *Didymophsya fedtschenkoana*, *Draba melanopus* recorded for the first time from Iran. These species have very specific habit due to Khersan glacier territory and with very restricted distribution. Many species of list as above new records and some other species with low habit and endangered location affected by human activities classified in Critically Endangered (CR) class according to IUCN Red List Categories and Criteria (IUCN 2001) and need to conservation and protection program.

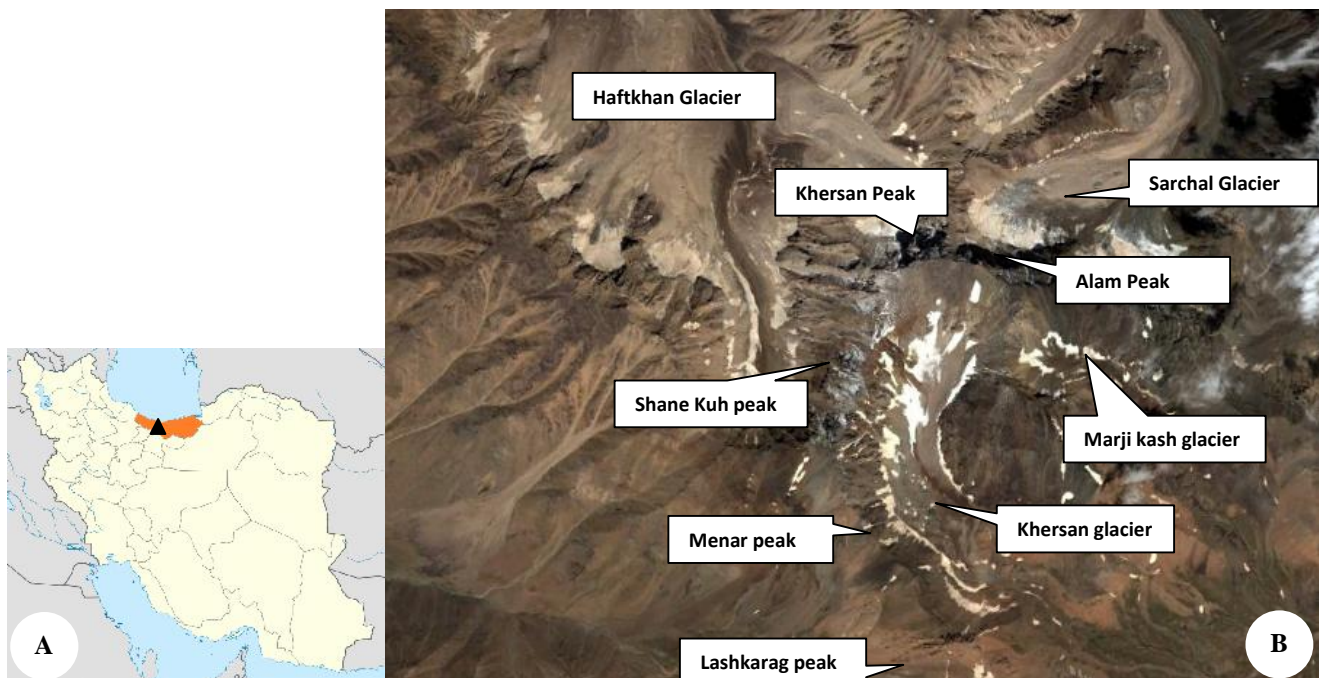


Figure 1. A. Alamkuh, Mazandaran province, Iran ( ), B. Highland condition with main peaks in Khersan glacier territory

**Table 1.** Alphabetical list for plant species in study area and it's history

Species	Family	Endemic	Mono-regional	Noroozi et al. (2011)	Collection reports		This study (2013-2015)
					Rehinger (1963-2010)	Other localities in Kherasan moraine	
<i>Acantholimon demavendicum</i>	Plumbaginaceae	*		*	*		*
<i>Achillea aucheri</i>	Asteraceae	*		*	*		*
<i>Achillea millefolium</i> subsp. <i>elbursensis</i>	Asteraceae	*			*		*
<i>Allium capitellatum</i>	Alliaceae	*		*	*		*
<i>Alopecurus textile</i>	Poaceae			*	*		*
<i>Arabis caucasica</i>	Brassicaceae			*	*	*	*
<i>Artemisia melanopsis</i>	Asteraceae	*		*	*	*	*
<i>Asperula glomerata</i> subsp. <i>bracteata</i>	Rubiaceae	*		*	*		*
<i>Astragalus aurea</i>	Fabaceae				*		*
<i>Astragalus macrosemius</i>	Fabaceae	*	*	*		*	*
<i>Astragalus monanthemus</i>	Fabaceae	*			*	*	*
<i>Asyneuma amplexicaule</i>	Campanulaceae	*			*	*	*
<i>Barbarea stricta</i>	Brassicaceae		*				*
<i>Bromus brachystachyus</i>	Poaceae				*		*
<i>Campanula stevenii</i>	Campanulaceae	*			*		*
<i>Carex oreophila</i>	Cyperaceae				*		*
<i>Catabrosa aquatica</i>	Poaceae				*		*
<i>Catabrosella parviflora</i>	Poaceae			*	*		*
<i>Cerastium cerastoides</i>	Caryophyllaceae			*	*		*
<i>Cousinia alferedii</i>	Asteraceae	*			*		*
<i>Crepis heterotricha</i> subsp. <i>lobata</i>	Asteraceae	*			*		*
<i>Crepis multicaulis</i> subsp. <i>congesta</i>	Asteraceae		*				*
<i>Crepis multicaulis</i> subsp. <i>multicaulis</i>	Asteraceae			*	*		*
<i>Cystopteris fragilis</i>	Woodsiaceae			*			*
<i>Didymophysa aucheri</i>	Brassicaceae	*		*	*		*
<i>Didymophysa fedtschenkoana</i>	Brassicaceae				*		*
<i>Draba melanopus</i>	Brassicaceae		*				*
<i>Draba pulchella</i>	Brassicaceae	*		*	*	*	*
<i>Draba siliquosa</i>	Brassicaceae			*	*	*	*
<i>Dracocephalum aucheri</i>	Lamiaceae	*		*	*	*	*
<i>Erigeron uniflorus</i> subsp. <i>elbursensis</i>	Asteraceae	*		*	*	*	*
<i>Erysimum nanum</i>	Brassicaceae	*			*	*	*
<i>Festuca ovina</i>	Poaceae				*		*
<i>Ficaria kochii</i>	Ranunculaceae				*	*	*
<i>Gagea soleimani</i>	Alliaceae	*		*	*	*	*
<i>Gallium aucheri</i>	Rubiaceae	*		*	*	*	*
<i>Gnaphallium supinum</i>	Asteraceae				*		*
<i>Gentiana pontica</i>	Gentianaceae			*	*	*	*
<i>Helichrysum plicatum</i>	Asteraceae				*		*
<i>Lepescheniella persica</i>	Boraginaceae	*		*	*		*
<i>Minuartia lineata</i>	Caryophyllaceae	*		*	*		*
<i>Oxyria digyna</i>	Polygonaceae			*	*	*	*
<i>Oxytropis hirsutiscula</i>	Fabaceae				*		*
<i>Oxytropis immersa</i>	Fabaceae			*	*	*	*
<i>Oxytropis takhti-soleimani</i>	Fabaceae	*		*	*		*
<i>Paraquilegia caespitosa</i>	Ranunculaceae	*		*	*		*
<i>Pedicularis caucasica</i>	Scrophulariaceae			*	*	*	*
<i>Pedicularis sibthorpii</i>	Scrophulariaceae				*		*
<i>Plantago atrata</i> subsp. <i>spadicea</i>	Plantaginaceae			*	*	*	*
<i>Poa bulbosa</i>	Poaceae				*		*
<i>Polygonum serpyllaceum</i>	Polygonaceae			*	*	*	*
<i>Potentilla argaea</i>	Rosaceae			*	*	*	*
<i>Potentilla aucheriana</i>	Rosaceae	*		*	*	*	*
<i>Potentilla polyschista</i>	Rosaceae	*		*	*	*	*
<i>Pseudocamelina kleinii</i>	Brassicaceae		*		*	*	*
<i>Ranunculus crymophyllus</i>	Ranunculaceae	*		*	*	*	*
<i>Ranunculus polyschista</i>	Ranunculaceae				*		*
<i>Saxifraga iranica</i>	Saxifragaceae	*		*	*		*
<i>Scorzonera radicata</i>	Asteraceae			*	*	*	*
<i>Scutellaria glecomoides</i>	Lamiaceae			*	*		*

<i>Scutellaria pinnatifida</i>	Lamiaceae			*		*
<i>Senecio vulcanicus</i>	Asteraceae	*	*	*	*	*
<i>Tarxacum crepidiforme</i>	Asteraceae		*	*	*	*
<i>Thymus caucasica</i>	Lamiaceae			*		*
<i>Trachydium depressum</i> subsp. <i>depressum</i>	Apiaceae		*	*	*	*
<i>Trachydium pauciradiatum</i>	Apiaceae	*		*	*	*
<i>Tragopogon kotschy</i>	Asteraceae	*		*	*	
<i>Veronica aucheri</i>	Scrophulariaceae	*	*	*		*
<i>Veronica gaubae</i>	Scrophulariaceae	*		*		*
<i>Veronica kurdica</i>	Scrophulariaceae	*	*	*		*
<i>Veronica paederotae</i>	Scrophulariaceae	*	*	*	*	*

Note: \* = present

Entering livestock around Khersan glacier margin above 3800 m asl. in the recent year, camping at Hasarchal more than of capacity, medicinal plant collection, consecutive changes of climbing rout toward peaks that makes mechanical erosion, and some other human activities and due to these activities affect extremely on Critically Endangered (CR) plant species habitat and should be controlled and preventing.

### Discussion

In the glacial valley to the accommodation camp at 3800 m asl., 71 plant species were collected, 35 species equivalent 50% are native to Iran. Two species *Pseudocamelina kleinii*, *Astragalus macrosemius* grow only in this area throughout the world and those are located on a very small area in the southern part of Khersan moraine. In addition to the above plant *Draba melanopus*, *Crepis multicaulis* subsp. *congesta* has only known from eastern area of Khersan moraine and *Barbarea congesta* has only distributed around major spring east of Khersan moraine with very restricted and vulnerable habitat.

The extensive survey since 2013 in Khersan territory has not collected again *Astragalus monanthemus*, *Asyneuma amplexicaule*, *Paraquilegia caespitosa* and *Tragopogon kotschy* from this area and it seems these species had disappeared. Plant species *Astragalus aurea*, *Achillea aucheri*, *Achillea millefolia* subsp. *elbursensis*, *Asperula glomerata* subsp. *bracteata*, *Acantholimon demavendicum*, *Alopecurus textilis*, *Allium capitellatum*, *Cerastium cerastoides*, *Carex oreophila*, *Catabrosa aquatica*, *Crepis heterotricha* subsp. *lobata*, *Crepis multicaulis* subsp. *multicaulis*, *Crepis multicaulis* subsp. *congesta*, *Campanula stevenii*, *Cystopteris fragilis*, *Catabrosella parviflora*, *Didymophysa aucheri*, *Scutellaria glecomoides*, *Scutellaria pinnatifida*, *Draba melanopsis*, *Bromus brachystachyus*, *Festuca ovina*, *Gnaphallium supinum*, *Helichrysum plicatum*, *Lepescheniella persica*, *Minuartia lineata*, *Poa bulbosa*, *Didymophysa fedtschenkoana*, *Barbarea stricta*, *Oxytropis hirsutiscula*, *Oxytropis takhti-soleimani*, *Ranunculus polyschista*, *Saxifraga iranica*, *Thymus caucasica*, *Veronica gaubae*, *Veronica aucheriana* and *Veronica kurdica* gathered for the first time from Khersan glacier territory. Many plant species such as *Astragalus aurea*, *Astragalus monanthemus*, *Achillea millefolia* subsp. *elbursensis*, *Catabrosa aquatica*, *Campanula stevenii*, *Draba melanopsis*, *Bromus brachystachyus*, *Erysimum nanum*,

*Festuca ovina*, *Gnaphallium supinum*, *Helichrysum plicatum*, *Pedicularis sibthorpii*, *Poa bulbosa*, *Pseudocamelina kleinii*, *Ranunculus polyschista*, *Scutellaria pinnatifida*, *Trachydium pauciradiatum*, *Thymus caucasica*, *Veronica gaubae* and *Ficaria kochii* has not included by Noroozi et al. (2010a, 2011, 2013) in the previous list of subnival and nival area of Iran while these species are growing in the highlands around Khersan glacier valley and probability these species growing in the other place around Alamkuh too. *Pseudocamelina kleinii* has gathered from Khersan moraine margin by Klein (1971) after Iranian flora of Brassicaceae has published. It has mono regional location in the world with low amount of population less than 20 and grows at altitude between 4119 and 4127 m asl.

Collecting of *Carex oreophila*, *Poa bulbosa*, *Catabrosa aquatica*, *Campanula stevenii*, *Bromus brachystachyus*, *Oxytropis immersa*, *Erigeron uniflorus* subsp. *elbursensis*, *Trachydium pauciradiatum*, *Scorzonera radicata* and many species of veronica in subnival-nival area which are naturally belong to alpine area proof entering Alpine species at the nival and subnival, phenomena which illustrate the occupation and disturbing of summit with invasive plants. During 2013-2015 *Draba melanopus* from the Khersan glacier tongue, *Crepis multicaulis* subsp. *congesta* on calcareous conglomerate at the southern area of moraine and *Didymophysa fedtschenkoana* in volcanic margin of Khersan between Alamkuh and Marji-kash peak has been collected for the first time. These thrice species added to actual Iranian subnival and nival plant species no mentioned with Noroozi et al. (2011).

In subnival-nival area place to live are limited and some late comer such as *Cousinia alferedii*, *Festuca ovina*, *Poa bulbosa* and *Alopecurus textilis* that have higher survival chance for living, reduce grow of the threatened species. *Pseudocamelina kleinii* has a low population is at risk of global threat. In addition the current growth point of this plant in Iran have also been collected from Azad-kuh in 1974 at altitude 3880 m asl. Central Alborz. Now the situation was not known and in the recent studies species has not been collected again. This species observed in Khersan glacier valley for the first time in 2013 and its habit and ecological condition has monitored in 2014 and 2015.

Plant species such as *Pseudocamelina kleinii*, *Arabica caucasica*, *Dracocephalum aucheri*, *Didymophysa aucheri* shows altitude displacement and do not affect the entry of

alpine invasive species but the displacement height with existing of soil in summit restricted. Many species didn't moved upward and log in alpine and sub alpine invasive plants species changed their habitat and will be destroy gradually.

The area is highly impacted by human activities and local livestock. Livestock disturb highlands ecosystem regulation and native people uses rare plant medicinal and edible and made pressure on natural ecosystem. Upward shift of grasses such as *Poa*, *Festuca* and *Alopecurus* species with wind, human, animal skins and livestock increase population and network nest of snow vole around of *Astragalus aurea* roots and some other similar plants, gradually, ice influencing around the root canal which made by mature Voles, plant roots freezing and dead after two or three winter. Livestock have main role in seed displacement and actually it improved by human activities. *Pseudocamelina kleinii*, *Astragalus macrosemius* with one address in the world and very restricted population classified as Critically Endangered (CR) in IUCN (2001) conservation categories and need to effective protection plan and monitoring program.

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mammals grazing food chain due to Khersan valley and conservation values.

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