

Assessment of the Conservation Status of *Astragalus oihorensis* Ali: A Critically Endangered Narrow Endemic Species in Chitral, Hindu Kush Range, Pakistan

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Abstract- *Astragalus oihorensis* Ali (Fabaceae-Papilionoideae) is a narrow endemic species which is endemic to its type locality i.e. Ojhor Valley in District Chitral, at an altitudinal range of 11000 to 12500 ft. A total of 87 mature individuals of this species were observed in 2016, 102 in 2017 and 96 in 2018. The grazing index was 19.54% in 2016, 23.52% in 2017 and 37.50% in 2018 which indicates that it was less grazed in 2016 and moderately grazed in 2017 and 2018. On the basis of extensive floristic surveys for three consecutive years (2016-2018), extent of occurrence (8 km²), area of occupancy (3.801 km²), population data, soil erosion and grazing pressure, *Astragalus oihorensis* is categorized as Critically Endangered (CR) species according to IUCN Red List Categories and Criteria 2012. There is dire need to develop species-specific in-situ and ex-situ conservation strategies and their effective implementation at the national level in order to save this species from extinction.

Index Terms- Conservation status, *Astragalus*, Endemic, Critically Endangered, Chitral, Pakistan.

I. INTRODUCTION

Biodiversity, the variety of genes, taxa and their habitats, is the bounty of nature, which plays an important role in ecosystem. Global plant biodiversity is threatened and confronted with the risk of extinction due to boom in the human population, invasive species, pollution, habitat degradation and fragmentation, urbanization and overexploitation (Western, 2001). Furthermore, climate change has become another serious issue in this regard (Thomas *et al.*, 2004). The rate of plant extinction has reached to one species per day, as a result of anthropogenic activities and other biotic abiotic stresses and this is considered to be 1000-10000 times faster than naturally occurring extinction i.e. background extinction (Hilton-Taylor, 2000; Akeroyd, 2002). In coming 50 years 60,000 to 100,000 plants may vanish if extinction continued at this rate (Lopez-Pujol *et al.*, 2013; Yu Ya *et al.*, 2014; Soelberg and Jager, 2016). At global level, a total of 33,798 tracheophytes or vascular plants, which are 12.5 % of the world flora, are threatened and face the risk of extinction (Walter and Gillet, 1998; Ali, 2000; Schickhooff, 2006; Eberhart *et al.*, 2006). The current extinction phenomenon for which humans are almost wholly responsible is often referred to as "the sixth extinction". Endemics have long been focus and targets of conservation efforts by conservation biologists as these more exposed and vulnerable to threats due to their restricted

geographic range, low population size (Stattersfield *et al.*, 1998; Myers *et al.*, 2000; Vischi *et al.*, 2004). Areas are prioritized for conservation efforts and studies on the basis of species diversity, floristic endemism, or probability of species' extinctions in that area (Orme *et al.*, 2005; Myers *et al.*, 2000;). Endemic taxa deserve special attention regarding conservation as they are more exposed to threats and their distribution is restricted to limited geographic range. These taxa face a high risk due to their low population size and limited geographic distribution, and a single disturbance on a small scale might trigger their extinction (Vischi *et al.*, 2004).

II. MATERIALS AND METHODS

Location

Chitral is a rugged and irregular piece of mountainous territory which is located in the extreme northern tip of Pakistan. It lies between 35th and 37th parallels and between 71. 3° and 73.7° east with a total area of 14850 Km². It shares its border with Afghanistan to the north and western side, Swat and Dir to the south and Gilgit-Baltistan to the east. Wakhan Corridor which separates Chitral from Tajikistan lies in the north of Chitral. The average annual precipitation is c. 320mm Chitral as it lies beyond the effective range of summer monsoon and is characterized by dry temperate climate. Chitral is a region of great floristic diversity, covered by Central Asian and Sino-Japanese species with a good many endemics.

Experimental design:

Comprehensive floristic survey were carried out in Chitral for three consecutive years to study the population size, habitat, geographic coordinates, altitude, extent of occurrence, area of occupancy, habit and life form of associated species, sociability and assessment of various threats to the population of *Astragalus oihorensis*. For determination of population size, only mature individual plants were counted per unit area. Plants in flowering or fruiting stage were considered as mature individuals. Nature of habitat i.e. quality of habitat was determined by considering soil erosion, accessibility to the locality, deforestation, biotic pressure such as grazing and other anthropogenic impacts. Specimens were collected, processed and persevered following standard herbarium techniques. Plant specimens were identified with the help of

Flora of Pakistan (Nasir & Ali, 1970-1989). Assessment of the conservation status of the species was carried out with the help of (IUCN, 2012). The voucher specimens were deposited in Peshawar University Herbarium (PUP).

III. RESULTS

Astragalus oihorensis Ali is a perennial herb which grows in moist places among rocks and clayey slopes at an altitude of 11000 to 12500 ft. (Fig.1). *Astragalus oihorensis* Ali is a narrow endemic which is restricted only to the type locality i.e. Sosoom-Ojhor (Chitral). The extent of occurrence (EOO) of this species 8 km² and its area of occupancy (AOO) is 3.801 km² (Fig.2). The dominant observed associates of this species are *Acantholimon leptostachyum*, *Arenaria griffithii*, *Artemisia* sp., *Astragalus strobiliferus*, *Cousinia racemosa*, *Ephedra* sp., *Eremostachys edelbergii*, *Eremurus stenophyllus*, *Lonicera semenovii*, *Nepeta glutinosa*, *Onobrychis cornuta*, *Pedicularis dolichorhiza*, *Pedicularis pycnantha*, *Ranunculus pulchellus*, *Rhodiola heterodonta*, *Saussurea leptophylla* The habit and life form of the observed associates are mentioned in the Table 1. Flowering and fruiting phenology was observed in June in this species. During the survey period a total of 87 mature individuals of this species were observed in 2016, 102 in 2017 and 96 in 2018. The grazing index was 19.54% in 2016, 23.52% in 2017 and 37.50% in 2018 which indicates that it was less grazed in 2016 and moderately grazed in 2017 and 2018. This means that it is a very rare endemic species with a moderate fluctuation in population size during study period (Table 2).It is a palatable species therefore grazing was the main threat to its population. Therefore, based on the values of extent of occurrence, area of occupancy and population statistics it is placed under Critically Endangered Category (IUCN, 2012). The conservation status of *Astragalus oihorensis* is summarized according to the alphanumeric hierarchical numbering system of the criteria (IUCN, 2012) as: CR B B1a b (i) (ii) (iii) (v) B2 a b (i) (ii) (iii) (v) C Ci

Table 1: Habit and life form of the observed associates with *Astragalus oihorensis* Ali

S.No.	Botanical Name	Family	Habit	Life form
1.	<i>Acantholimon chitralicum</i> Rech. f. and Schiman-Czeika	Plumbaginaceae	Herb	Chamaephyte
2.	<i>Acantholimon leptostachyum</i> Aitch. & Hemsl.	Plumbaginaceae	Herb	Chamaephyte
3.	<i>Acantholimon lycopodioides</i> (Girard) Boiss.	Plumbaginaceae	Herb	Chamaephyte
4.	<i>Acantholimon</i>	Plumbaginaceae	Herb	Chamaephyte

	<i>munroanum</i> Aitch. & Hemsl.			
5.	<i>Adonis aestivalis</i> L.	Ranunculaceae	Herb	Therophyte
6.	<i>Allium chitralicum</i> Wang & Tang	Alliaceae	Herb	Geophyte
7.	<i>Androsace oihorensis</i> Y. Nasir	Primulaceae	Herb	Therophyte
8.	<i>Arenaria griffithii</i> Boiss.	Caryophyllaceae	Herb	Chamaephyte
9.	<i>Arenaria orbiculata</i> Royle ex.Edg.	Caryophyllaceae	Herb	Chamaephyte
10.	<i>Arnebia euchroma</i> (Royle ex Benth.) I.M. Johnston	Boraginaceae	Herb	Therophyte
11.	<i>Artemisia</i> sp.	Asteraceae	Herb	Chamaephyte
12.	<i>Astragalus lasiosemius</i> Boiss.	Papilionaceae	Herb	Chamaephyte
13.	<i>Astragalus staintonianus</i> Ali	Papilionaceae	Herb	Therophyte
14.	<i>Astragalus strobiliferus</i> Royle ex Benth.	Papilionaceae	Herb	Chamaephyte
15.	<i>Astragalus toppinianus</i> Ali	Papilionaceae	Herb	Hemicryptophyte
16.	<i>Calamagrostis emodensis</i> Griseb	Poaceae	Herb	Hemicryptophyte
17.	<i>Chesneya cuneata</i> (Benth.) Ali	Papilionaceae	Herb	Therophyte
18.	<i>Chorispora macropoda</i> Trautv	Brassicaceae	Herb	Geophyte
19.	<i>Cicer microphyllum</i> Benth.	Papilionaceae	Herb	Chamaephyte
20.	<i>Cousinia multiloba</i> DC.	Asteraceae	Herb	Chamaephyte
21.	<i>Cousinia racemosa</i> Boiss.	Asteraceae	Shrub	Chamaephyte
22.	<i>Cousinia subscaposa</i> Rech.f.	Asteraceae	Herb	Chamaephyte
23.	<i>Cousinia schughanica</i> Juz	Asteraceae	Herb	Chamaephyte
24.	<i>Draba pakistanica</i> Jafri	Brassicaceae	Herb	Therophyte
25.	<i>Ephedra</i> sp.	Ephedraceae	Shrub	Nanophanerophyte
26.	<i>Eremostachys edelbergii</i> Rech. f.	Lamiaceae	Herb	Chamaephyte
27.	<i>Eremostachys speciosa</i> Rech.f.	Lamiaceae	Herb	Chamaephyte
28.	<i>Eremurus stenophyllus</i> (Boiss. & Buhse) Baker	Asphodelaceae	Herb	Geophyte
29.	<i>Gypsophila sedifolia</i> Kurz	Caryophyllaceae	Herb	Therophyte
30.	<i>Lonicera semenovii</i> Regel	Caprifoliaceae	Shrub	Nanophanerophyte
31.	<i>Matthiola flavida</i> Boiss.	Brassicaceae	Herb	Therophyte
32.	<i>Nepeta glutinosa</i> Benth.	Lamiaceae	Herb	Therophyte
33.	<i>Onobrychis cornuta</i>	Papilionaceae	Herb	Chamaephyte

	(Linn.) Desv.			e
34	<i>Oxytropis chitralensis</i> Ali	Papilionaceae	Herb	Hemicryptophyte
35	<i>Oxytropis immersa</i> (Baker ex Aitch.) Bunge ex Fedtschenko var. <i>immersa</i>	Papilionaceae	Herb	Hemicryptophyte
36	<i>Pedicularis dolichorhiza</i> Schrenk	Scrophulariaceae	Herb	Geophyte
37	<i>Pedicularis pycnantha</i> Boiss.	Scrophulariaceae	Herb	Geophyte
38	<i>Ranunculus pulchellus</i> C. A. Mey	Ranunculaceae	Herb	Therophyte
39	<i>Rhodiola heterodonta</i> (Hook.f., & Thomson) Boriss	Crassulaceae	Herb	Geophyte
40	<i>Rosularia alpestris</i> (Kar. & Kir.) Boriss	Crassulaceae	Herb	Geophyte
41	<i>Saussurea leptophylla</i> Hemsl.	Asteraceae	Shrub	Chamaephyte

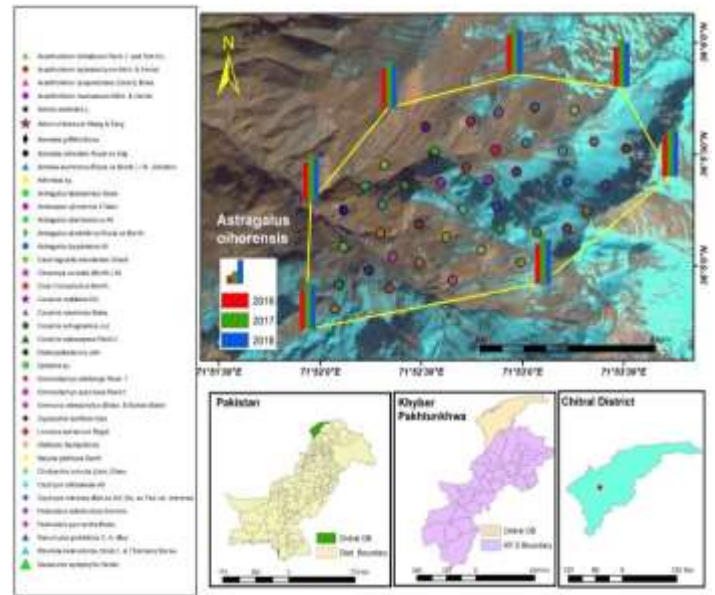


Fig. 2: Location, associated species, population statistics, extent of occurrence (EOO), area of occupancy (AOO) of *Astragalus oihorensis* Ali

Table 2: Locality, Altitude, Population statistics and GI of *Astragalus oihorensis* Ali

S. No.	Locality	Altitude and absolute location	Population size in June			Grazed individuals per year		
			2016	2017	2018	2016	2017	2018
1.	Sosoom -Ojhor	11000-12500 ft. 36° 05' 07.15"N 71° 51' 22.39"E	87	102	96	17	24	36
2.	Average		95			25.66		
3.	Grazing index (GI) per year					19.54%	23.52%	37.50%
4.	Symbol of Grazing index					+	++	++



Fig 1. *Astragalus oihorensis* Ali A. Habit and Habitat; B. Flowering shoot C. Calyx with black hairs.

IV. DISCUSSION AND CONCLUSION

Biodiversity loss and plant extinction is the most serious issue faced by the humans because the survival of human beings and other life forms is directly linked with the biodiversity conservation (Leakey & Lewin, 1995; Sala, 2000). Plant biodiversity loss and extinction is grossly high in developing countries including Pakistan. In Pakistan the conservation status of only 55 endemic and rare plant taxa has been evaluated in the last decade (Abbas *et al.*, 2010, Alam & Ali, 2009, 2010; Ali & Qaiser, 2010a, 2010b, 2010c; Muhammad, 2013; Shaheen *et al.*, 2016). Because of the narrow distribution and small population size, the endemics are more threatened and exposed to extinction as compared to eurychorous species (Rabinowitz, 1981; Kruckeber, 1985; Mills & Schwartz, 2005). Proper floristics and field observations are critical to the setting of conservation priorities and assessment of the conservation status of plant species (Golding & Smith, 2001; Hedenas *et al.*, 2002; Schatz, 2002; Willis *et al.*, 2003; Ungricht *et al.*, 2005). Conservation assessments based principally on herbarium collections may be misleading and it is probable that populations documented in herbarium collections may no longer exist. (Randrianasolo *et al.*, 2002). This holds good for relatively far-flung and inaccessible areas such as Chitral.

The north-facing slopes are less exposed to direct sunlight and the soil is more moisturized and damp as compared to south-facing slopes (Alam and Ali. 2009; Alam and Ali, 2010; Ali and Qaiser, 2012). Therefore, this species is sciophytic due to its presence on north-facing slopes. As *Astragalus oihorensis* is endemic to its type locality with its extent of occurrence (EOO) is 8 km² and area of occupancy (AOO) is 3.801 km². The dwindling population size and high grazing over a period of three

consecutive years makes this taxon more prone to extinction. Such narrow endemics taxa are more vulnerable to extinction due to their declining population, small geographic range, habitat fragmentation, grazing and soil erosion (Bernardos *et al.*, 2006 Fenu *et al.*, 2011 Martinell *et al.*, 2011).

According to the IUCN Red List Categories and Criteria (IUCN, 2012), this species is placed under B1 and B2 of Critically Endangered category because its extent of occurrence is less than 100 km² (i.e. 8 km²) and its area of occupancy is also less than 10 km² (i.e. 3.801 km²). Furthermore, as the number of mature individuals of the taxon in 2018 is 96 (less than 250), therefore it falls in the criterion "C" of Critically Endangered category. Therefore, the narrow and small geographic range and small population size with continuous decline recommend this taxon to be kept under Critically Endangered (CR) category at global level. The conservation status of *Astragalus oihorensis* according to the alphanumerical hierarchical numbering system of the criteria is: CR B B1a b (i) (ii) (iii) (v) B2 a b (i) (ii) (iii) (v) C Ci. Where: CR. Critically Endangered, B. Geographic range, B1. Extent of occurrence less than 100km², a. Found only at a single location, b. Continuous decline observed in i. Extent of occurrence, ii. Area of occupancy, iii. Number of subpopulations, v. Number of mature individuals, B2. Area of occupancy less than 10 km², a. Found only at a single location, b. Continuous decline observed in i. Extent of occurrence, ii. Area of occupancy, iii. Number of subpopulations, v. Number of mature individuals, C. Population size and decline, C1. An estimated continued decline of at least 25 %.

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