

## A NEW QUANTITATIVE ETHNOECOLOGICAL APPROACH TO ASSESSING THE CONSERVATION STATUS OF PLANTS: A CASE STUDY OF DISTRICT TOR GHAR, PAKISTAN

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**Abstract.** Ethnoecological knowledge refers to the local wisdom, innovations, traditional life style and practices of aboriginal communities. This knowledge also contributes a lot to understanding of conservation status of culturally significant flora of a region. The present research work is the first one to focus on this particular aspect of cultural knowledge to assessing preliminary conservation status of 295 culturally significant plant species of district Tor Ghar. In such remote and less privileged areas interaction between plants and people is much stronger. Multistage random selection of 700 informants was made. The data was obtained through EPA, group discussion and semi structured interviews. The conservation status of all culturally significant plant species were assessed quantitatively by developing a new special mathematical relation that is  $CS = K(OC + AV + CE)/TF \times RP$ . A scale was devised on the basis of CS value index and all 295 species were assigned to different IUCN categories. According to this classification 20 species were found critically endangered, 35 endangered, 56 vulnerable, 58 near threatened (rare) and 126 least concerned (secure). This categorization depicts a miniature of ethno-conservation of plants at local level. The current study leads to an enhanced understanding of cultural knowledge on mountain vegetation within the context of anthropogenic impacts and the role of indigenous communities in regional plant conservation strategies and future outlooks.

**Keywords:** *local wisdom, aboriginal, endangered, threatened, ethno-conservation*

### Introduction

Biodiversity and culture of a region affect each other reciprocally. Local wisdom of communities popularly known as traditional knowledge, cultural knowledge, indigenous knowledge or local ecological knowledge. The body of knowledge usually includes understandings, beliefs, and practices that human societies develop longitudinally in relationship with their natural environment, and which are dynamic and co-evolving with social and ecological changes (Berkes, 2000; Zent, 2001; Von, 2011). This knowledge incorporates spiritual connections with the natural environment and the sustainable use of natural resources, and association between people, which are reflected in their language, narratives, social organisation, values, beliefs, and cultural

laws and customs (Andrews, 2006). Every aspect of life is touched and covered by the culture of a particular region. According to Larid (1999) culture facilitates the association between humans and their environment. The perception of culture provides the basis of scientific disciplines such as ecological anthropology and scientific concepts such as bio-cultural diversity (Berkes et al., 2000).

According to Declaration of Belem (1988) there is an “inextricable link” between biological and cultural diversity. The term bio-cultural diversity was coined to describe the concept indicating the link (Posey, 1999). Human beings and their societies are an essential part of biodiversity, and according to their way of utilizing natural resources, they can be promoters of its sustainable use or drivers of its loss (Calvo, 2003). Wild biological resources are especially important for populations in rural areas, because these people depend directly on the extraction of local species to fulfill part of their daily requirements, such as wood, food, medicine, and timber (Boom, 1987; Prance et al., 1987; Phillips et al., 1994).

Participation of indigenous communities in decision making related to natural resource management has been regarded as a potential effort that can boost local well-being without harming biodiversity and ecosystem functions (United Nations, 1992; Schwartzman et al., 2000; Adams and Hutton, 2007; Berkes, 2007).

Local communities have more close association with biodiversity and their cultural practices and life styles influence biodiversity greatly. According to Convention on Biological Diversity, local communities showing a socially and geographically defined group of people may not homogeneous, living close to biodiversity and protected areas. They may have customary rights of use, distinctive knowledge and skills and direct impact on biodiversity as individuals or groups of individuals. These people are also described as having a close and unique relationship to their natural resources as a community. Locals communities may be dynamic in response to changing rural conditions, and therefore, may change their cultural practices and their perspectives on the importance of natural resources and biodiversity (Wiersum and Shackleton, 2005).

In order to protect and manage a particular ecological system, its cultural context is considered to be the most important one. Human relation to the natural environment has so far been studied mostly in biophysical terms; but there is now a growing acknowledgment that societies themselves have created detailed procedures to conserve and manage their resources. These methods are entrenched in their cultural values that have to be taken in to consideration if sustainable and reasonable human development is to become a truth (Bridgewater, 2002). These new trends have resulted in a change from a top down to a more community- based approach which aims to work closely with local people, depend on their cultural knowledge, and contribute to their livelihoods (Grimble and Laidlaw, 2002).

The convention on Biological Diversity (CBD) from 1992 stressed on parties to respect, preserve, and maintain knowledge, innovations and practices of indigenous and local communities having traditional lifestyles relevant for the conservation and sustainable use of biological diversity, and facilitate their wider involvement with the approval of bearers of such knowledge, innovations and practices, and encourage the reasonable sharing of the gains obtaining from the use of such knowledge, innovations and practices (McNeely, 2000).

Global environmental conservation policies and discourses have been increasingly influenced since 1980s, either verbally or practically, by the idea that conservation demands the coexistence of humans and nature (Adams et al., 2004; Wells and

McShane, 2004). According to Cotton (1996) over long time, indigenous people have developed their own locality specific knowledge on plant use management and conservation. The United Nations Convention Environment and Development (UNCED, 1992) mentioned the important roles that indigenous populations play in both the conservation and sustainable use of natural resources while in turn maintaining biodiversity. Current use of cultural knowledge in conservation led to the novel idea of “ethnoconservation” in the late 1990s which is now well known conservation approach around the world (Rajeswar, 2001; Jules et al., 2008; Negi, 2010).

In a context where numerous conservation goals must be attained, local ecological knowledge can be a donor to a multidisciplinary conservation approach as well as foster transdisciplinary approaches when locals become partners and co-workers (Aswani, 2018). Assessment of conservation status cannot be absolute and needs periodic revision but taking various criteria at a time validates the conclusion for a considerable period of time or for a specific geographic locality (Domínguez Lozano et al., 2003; Broennimann et al., 2005).

In the present investigation local ecological knowledge has been incorporated in IUCN red list and used as a tool for assessing conservation status of culturally significant flora of district Tor Ghar with special reference to the following objectives.

1. To assess the existing threats to culturally significant plants in the study area
2. To evaluate how the cultural values of plant biodiversity contribute towards conservation.
3. To quantify the local wisdom regarding conservation status of the flora

## **Materials and methods**

### ***Study area***

District Tor Ghar, a rigorous mountainous area of northern Pakistan located between 34° 32' and 34° 50' N, and 72° 48' and 72° 58' E in Lesser Himalayas having strong cultural and traditional background besides rich plant biodiversity. The study area is inhabited by five well known tribes namely Basikhel, Akazai, Nusratkhel, Hassanzai and Medakhel (*Fig. 1*). Plants and peoples of the study area have close association and plants provide a number of societal benefits. Human culture is the main driver of plant biodiversity. Hence cultural knowledge was used as a tool for assessing conservation status of ethnospecies of the district.

### ***Data collection***

Villages of each tribal society as well as informants were selected randomly. 700 informants shared their cultural knowledge related to conservation status through semi structured interviews, questionnaires, Ethnobotanical Participatory Appraisal (EPA) and group discussion.

### ***Field trips***

Extensive field trips of the study area were carried out during 2014 and 2015. Threatened and secure plant species were studied in their local habitats. Threatening factors and conservation efforts of indigenous tribes were recorded. Pressed, dried and poisoned specimens in triplicate deposited in herbarium of Hazara University, Mansehra, Pakistan.



**Figure 1.** Map of district Tor Ghar showing different tribal belts

### **Data analysis**

Recorded data from the questionnaires was shifted on Microsoft Excel sheet for further processing and evaluation. Whole conservation related data was analyzed successfully by developing a new simple mathematical relation named as CS equation.

### **Development of a new equation**

A new mathematical equation was developed for assessment of conservation status, which is a novel approach in the field of ethnobiology for quantification of local wisdom. The idea was born during data collection and field visits that local wisdom if quantified properly to assessing conservation status of a plant species in a particular

area, it would depict its conservation in a better way. During the study it has also been observed that locals adopted conservatory measures for protecting plant biodiversity. They protect the plants of their interest from fire and grazing and also cultivate useful plants. In this regard, a questionnaire was designed to get maximum information from the locals about conservation status of culturally significant flora of the area. Availability for the last ten years was recorded (increased, decreased or persistent). Occurrence of a plant species (abundance, moderate or rare) was noted. The most cited three important threatening factors of the study area (over exploitation, fire and grazing) were enlisted. Similarly, information regarding regeneration potential (high, moderate and low) was gathered. Data obtained from informants was cross checked by direct field observations during extensive field trips and analyzed by the following mathematical relation developed first time by the authors (Eq. 5).

As Conservation Status (CS) of a species is directly proportional to Occurrence (OC), Availability (AV) and Conservation Efforts (CE). This may be expressed mathematically as:

$$CS \propto OC + AV + CE \quad (\text{Eq.1})$$

Similarly Conservation Status (CS) is also directly proportional to Reproductive Potential (RP) of a species and can be represented as follows:

$$CS \propto RP \quad (\text{Eq.2})$$

where CS is inversely proportional to Threatening Factors (TF) shown mathematically as:

$$CS \propto 1 / TF \quad (\text{Eq.3})$$

By combining *Equations 1, 2 and 3*, the following equation obtained:

$$CS \propto (OC + AV + CE) / TF \times RP \quad (\text{Eq.4})$$

By substituting the sign of proportionality with constant K, the final equation was thus obtained.

$$CS = K (OC + AV + CE) / TF \times RP \quad (\text{Eq.5})$$

where CS is the conservation status of a plant species, OC is occurrence, AV is availability for the last ten years, CE is conservation efforts by locals, TF is threatening factors and RP is regeneration potential of a plant species in a particular habitat.

The constant K was assigned a value 1. Degree of occurrence was evaluated by giving values 3 for abundance, 2 for moderate and 1 for rare. Values for availability for the last ten years are 3 for increasing, 2 for persistent and 1 for decreasing. The most cited four conservation efforts by locals were considered in this equation and assigned a sum of value 4 to these (1 for each conservation effort). Conservation efforts are protection from grazing, cutting and fire. Cultivation of a plant species is also a conservation effort. Threatening factors considered in this formula on the basis of local perception were Over-exploitation, fire and overgrazing/overbrowsing. Each threatening

factor was assigned a value 3 for extensive, 2 for moderate, 1 for low and 0 for absence of a threatening factor. Similarly, the values assigned to regeneration potential were 3 for high, 2 for moderate and 1 for low.

All 295 culturally significant plant species of the study area were assessed by the equation of CS in order to quantify the local wisdom. Keeping in view the CS index values, a scale was devised for assigning IUCN categories to the flora under investigation.

### 2-scale for IUCN categories

On the basis of C S values index plant species were described according to IUCN classification as critically endangered, endangered, vulnerable, near threatened (rare) and least concerned (secure) (Table 1).

**Table 1.** Scale for IUCN categories

Name of category	C S values
Critically endangered	0.1 to 1
Endangered	1.1 to 1.5
Vulnerable	1.6 to 2.0
Rare	2.1 to 2.5
Least concerned (secure)	2.6 and above

## Results

Conservation status of 295 plant species was assessed tribewise and mean value was calculated for each recorded species (Table 2).

**Table 2.** Tribewise CS values and IUCN categorization

Name of species	Habit	Tribe wise CS values						Mean	Categories
		Basikhel	Nusratkhel	Akazai	Hassanzai	Medakhel			
<i>Podophyllum emodi</i> Wall. ex Royle.	Herb	0.5	0.5	0.5	0.5	NR	0.5	CE	
<i>Gentiana kurroo</i> Royle.	Herb	0.85	0.85	NR	NR		0.85	CE	
<i>Dioscorea deltoidea</i> Wall.exKunth.	Herb	0.66	1.33	0.66	0.132	2	0.95	CE	
<i>Incarvella emodi</i>	Herb			0.6		1.32	0.96	CE	
<i>Arisaema utile</i> Hook.f.ex. Schott.	Herb	1					1	CE	
<i>Picris hieracioides</i> L.	Herb			1			1	CE	
<i>Citrullus colocynthis</i> (Linn.) Schrad.	Herb	1			1.32	1	1.1	E	
<i>Asparagus officinalis</i> L.	Herb			1.3	1.5	1	1.2	E	
<i>Caralluma tuberculata</i> N.E. Brown.	Herb	1	1.5	1.3	1.32	1.5	1.32	E	
<i>Asparagus adscandens</i> Roixb.	Herb	0.5			1.5	2	1.33	E	
<i>Astragalus graveolens</i> Buch.-Ham.exBenth.	Herb	2	0	2			1.33	E	
<i>Colchicum luteum</i> Baker.	Herb	1	2	1			1.33	E	
<i>Allium griffithianum</i> Boiss.	Herb				1.5	1.2	1.35	E	
<i>Arisaema flavum</i> (Forssk.)Schott.	Herb	1	2	1.33			1.44	E	
<i>Aerva sanguinolenta</i> (Linn.) Blume.	Herb				1	2	1.5	E	
<i>Agave sisalana</i> Perrine ex Engelm.	Herb				2	1	1.5	E	
<i>Crotolaria mediginea</i> Lamk.	Herb					1.5	1.5	E	
<i>Geranium lucidum</i> L.	Herb					1.5	1.5	E	
<i>Rumex vesicarius</i> L.	Herb	1.5			1	2	1.5	E	

Name of species	Habit	Tribe wise CS values						
		Basikhel	Nusratkhel	Akazai	Hassanzai	Medakhel	Mean	Categories
<i>Geranium wallichianum</i> D.Don ex Sweet.	Herb	1.6	1.6		1.5		1.56	V
<i>Salvia lanata</i> Roxburgh.	Herb	1	1	1.5		3	1.62	V
<i>Impatiens bicolor</i> Royle.	Herb	2	1.5				1.75	V
<i>Bergenia ciliate</i> Sternb.	Herb	1.3	2	2			1.76	V
<i>Asparagus capitatus</i> Baker.	Herb	1	1.2		2	3	1.8	V
<i>Polygonatum verticillatum</i>	Herb	2.6		1			1.8	V
<i>Hypericum perforatum</i> L.	Herb	1.6	2	2			1.86	V
<i>Salvia moorcroftiana</i> Wall.ex Benth.	Herb	2	2	2	1.5		1.87	V
<i>Valeriana jatamansi</i> Jones.	Herb	1.5	1.2	2.4	2.6		1.92	V
<i>Arthraxon prionodes</i> (Steud.) Dandy.	Herb					1.98	1.98	V
<i>Alliaria petiolata</i> (M.Bieb)Cavara& Grande.	Herb	2	2				2	V
<i>Arisaema jacquemontii</i> Blume.	Herb	2					2	V
<i>Cichorium intybu</i> sL.	Herb	2	2				2	V
<i>Codonopsis clematidea</i> (Schrenk) C.B.Clarke.	Herb					2	2	V
<i>Convolvulus arvensis</i> L.	Herb	2	2				2	V
<i>Corchorus trilocularis</i> L.	Herb				2	2	2	V
<i>Erophila verna</i> L.	Herb	2					2	V
<i>Euphorbia hispida</i> Boiss.	Herb					2	2	V
<i>Evolvulus alsinoides</i> (L.)	Herb				2		2	V
<i>Fumaria officinalis</i> L.	Herb					2	2	V
<i>Mirabilis jalapa</i> L.	Herb					2	2	V
<i>Poa bulbosa</i> L.	Herb	2	2	2			2	V
<i>Polygonatum multiflorum</i> (L.) All.	Herb	2	2				2	V
<i>Swertia ciliata</i> (G. Don) B.L. Burtt.	Herb	2	2				2	V
<i>Thymus linearis</i> Benth.	Herb	2					2	V
<i>Vicia hirsute</i> (Linn.) S.F.Gray.	Herb					2	2	V
<i>Viola odorata</i> L.	Herb	2.4	1.6				2	V
<i>Bistorta amplexicaulis</i> (D.Don) Greene.	Herb	3	0	2.6	2.6		2	V
<i>Cissampelo spareira</i> L.	Herb				2.6	1.5	2	V
<i>Artemisia scoparia</i> Waldst. & Kit.	Herb	2	2		2	2.25	2	V
<i>Ajuga bracteosa</i> Wall., Benth.	Herb	2	1.6	2.6			2	V
<i>Tulipa clusiana</i> (Hook.) Regel.	Herb	2	2	2.4	2		2.1	R
<i>Taraxicum officinale</i> Webb.	Herb	2	2	2	2.25	2.4	2.13	R
<i>Aristida depressa</i> Retz.	Herb	2.14	2.14	2.14			2.14	R
<i>Narcissus tazetta</i> L.	Herb	3	1.5			2	2.16	R
<i>Astragalus amherstianus</i> Royle ex Benth.	Herb	2	2	2.6			2.2	R
<i>Calendula arvensis</i> L.	Herb	2	2	2.6			2.2	R
<i>Cardamine hirsute</i> L.	Herb	2	2			2.6	2.2	R
<i>Clematis Montana</i> Buch.	Herb	2	2.6	2			2.2	R
<i>Dicliptera bupleuroides</i> Nees.	Herb	2.6	2	2			2.2	R
<i>Lepidium aucheri</i> Boiss.	Herb	2	2		2.6		2.2	R
<i>Silene vulgaris</i> (Moench) Garcke.	Herb	2.4			2		2.2	R
<i>Vernonia Sinerea</i> (L.)Lees.	Herb	2.4		2			2.2	R
<i>Brachiaria ramosa</i> (Linn.) Stap.	Herb				1.98	2.49	2.23	R
<i>Bothriochloa ischaemum</i> (L.) Keng.	Herb					2.25	2.25	R
<i>Commelina benghalensis</i> L.	Herb	2.5	2.5	2	2		2.25	R
<i>Apluda aristata</i> L.	Herb	2.14	2.14	2.14	2.5	2.49	2.28	R
<i>Commelina poludosa</i> Blume.	Herb	1.6			3		2.3	R

Name of species	Habit	Tribe wise CS values						
		Basikhel	Nusratkhel	Akazai	Hassanzai	Medakhel	Mean	Categories
<i>Cynoglossum lanceolatum</i> Forssk.	Herb	2.6	2				2.3	R
<i>Senesio chrysanthemoides</i> DC.	Herb	2	2.6				2.3	R
<i>Verbena officinalis</i> L.	Herb				2	2.6	2.3	R
<i>Sisymbrium irrio</i> L.	Herb	1.6	1.6	2.6	2.8	3	2.32	R
<i>Artemisia absinthium</i> L.	Herb	2	2	3			2.33	R
<i>Achillea millifolium</i> L.	Herb	2.6	2.6	2			2.4	R
<i>Achyranthus aspera</i> L.	Herb	3	2	2	2.6		2.4	R
<i>Acorus calamus</i> L.	Herb	2	2.6		2.6		2.4	R
<i>Tragus roxburghii</i> Panigrahi.	Herb					2.4	2.4	R
<i>Stellaria media</i> (L.) Vill.	Herb	2.4			2.25	2.6	2.41	R
<i>Calamagrostis decora</i> Hook. f., Fl. Bri.	Herb	2.4	2.4	2.4	2.5	2.4	2.42	R
<i>Deschampsia caespitosa</i> L.	Herb	2.4	2.4	2.4	2.5	2.4	2.42	R
<i>Trifolium pratense</i> L.	Herb	2.5			2.4	2.4	2.43	R
<i>Datura stramonium</i> L.	Herb	2.6	2	2	2.6	3	2.44	R
<i>Imperata cylindrical</i> (L)P. Beauv.	Herb	2.66		2.4	2.4		2.48	R
<i>Dactyloctenium aegyptium</i> (L) P.Beauv.	Herb	2.4	2.4	2.4	3	2.25	2.49	R
<i>Chrysopogon serrulatus</i> Trin.	Herb					2.49	2.49	R
<i>Eragrostis ciliaris</i> (L.) R.Br.	Herb					2.49	2.49	R
<i>Agrostis stolonifera</i> L.	Herb	2.5	2.5	2.5		2.49	2.49	R
<i>Euphorbia wallichii</i> Hk.	Herb	2.5	2.5				2.5	R
<i>Impatiens edgeworthii</i> Hk. F.	Herb	3	2				2.5	R
<i>Phragmites australis</i> (Cay.) Trin.	Herb				2.4	2.6	2.5	R
<i>Colocasia esculenta</i> (Linn.) Schott.	Herb	2.6	3		1.5	3	2.5	R
<i>Ricinus communis</i> L.	Herb	3	2		2.6	2.6	2.5	R
<i>Carthmusoxycantha</i> M.Bieb.	Herb	2	2	2.6	3.32	3	2.58	S
<i>Avena fetua</i> L.	Herb	3		2.4	1.98	3	2.59	S
<i>Achyranthes bidentata</i> Blume.	Herb	2.6	2.6				2.6	S
<i>Amaranthus spinosus</i> L.	Herb	3	2		2.4	3	2.6	S
<i>Borreria articularis</i> (L.F.) FN . Will.	Herb					2.6	2.6	S
<i>Caltha alba</i> Camb.	Herb	2.6					2.6	S
<i>Campanula benthamii</i> Wall.	Herb					2.6	2.6	S
<i>Cardiospermum halicacabum</i> L.	Herb	2.6			2.6	2.6	2.6	S
<i>Centaurea iberica</i> Trevir&Spreng.	Herb	2.6					2.6	S
<i>Gagea lutea</i> (L) Ker-Gawl.	Herb	2.6					2.6	S
<i>Galium aparine</i> L.	Herb	2.6					2.6	S
<i>Lactuca serriola</i> L.	Herb	2.6					2.6	S
<i>Oenothera rosea</i> L.	Herb					2.6	2.6	S
<i>Onosma hispida</i> Wall. Ex G. Don.	Herb	2.6	2.6				2.6	S
<i>Persicaria hydropiper</i> (L.) Spach.	Herb					2.6	2.6	S
<i>Polygonum aviculare</i> L.	Herb	2.6	2.6	2.6			2.6	S
<i>Polygonum plebejum</i> R. Br.	Herb					2.6	2.6	S
<i>Stachys parviflora</i> Benth.	Herb	2.6	2.6		2.6	2.6	2.6	S
<i>Torilis leptophylla</i> (L.) Reichb.	Herb					2.6	2.6	S
<i>Sorghum halepense</i> (L) Pers.	Herb	2.66		2.4	3	2.4	2.61	S
<i>Phalaris minor</i> Retz.	Herb	3		2.5	2.5	2.49	2.62	S
<i>Fumaria indica</i> (Hausskn) Pusley.	Herb	2.5	2.5		2.6	3	2.65	S
<i>Aethusa cynapium</i> L.	Herb	2.66					2.66	S
<i>Bupleurum falcatum</i> L.	Herb	2.66					2.66	S
<i>Nepeta cataria</i> L.	Herb	2.66					2.66	S
<i>Dichanthium annulatum</i> (Forssk) Stapf.	Herb	3		3	2.15	2.5	2.66	S
<i>Artemisia vulgaris</i> L.	Herb	2.5	2.5			3	2.66	S



Name of species	Habit	Tribe wise CS values						
		Basikhel	Nusratkhel	Akazai	Hassanzai	Medakhel	Mean	Categories
<i>Cuscuta gigantea</i> Griff.	Herb	3			3	2	2.66	S
<i>Mentha spicata</i> L.	Herb	3	3			2	2.66	S
<i>Pulicaria crispa</i> (Forssk.) Oliv.	Herb	2			3	3	2.66	S
<i>Silene conidia</i> L.	Herb	3	3		2		2.66	S
<i>Digitaria nodosa</i> Perl.	Herb	2.5	3	3	2.5	2.49	2.69	S
<i>Cynodon dactylon</i> ( L) Pers.	Herb	2.5	2.5	3	2.5	3	2.7	S
<i>Viola canescens</i> Wall. ex Roxb.	Herb	3		2.4			2.7	S
<i>Rumex hastatus</i> D. Don. Prodr.	Herb	2.4	3	3	2.4	3	2.76	S
<i>Medicago polymorpha</i> L.	Herb	3	3	3	2.5	2.4	2.78	S
<i>Clematis grata</i> Wall.	Herb	2.6				3	2.8	S
<i>Fragaria nubicola</i> (Hook.f.) Lindl. ex Lacaíta.	Herb	3		3	2.4		2.8	S
<i>Chenopodium murale</i> L.	Herb	3			3	2.6	2.86	S
<i>Rumex acetosa</i> L.	Herb	2.6	3	3			2.86	S
<i>Solanum incanum</i> L.	Herb	3			2.6	3	2.86	S
<i>Chenopodium album</i> L.	Herb	2.4	2.4	3		3.75	2.88	S
<i>Desmostachya bipinnata</i> (L) Stapf.	Herb	3	3	3	3	2.49	2.89	S
<i>Rumex dentatus</i> L.	Herb	3	3	3		2.6	2.9	S
<i>Ajuga reptans</i> L.	Herb	3					3	S
<i>Alloteropsis cimicina</i> (L.) Stapf.	Herb					3	3	S
<i>Asplenium septentrionale</i> (Linnaeus) Hoffmann.	Herb	4	2				3	S
<i>Canna indica</i> L.	Herb					3	3	S
<i>Chenopodium botrys</i> L.	Herb	3				3	3	S
<i>Cleome scaposa</i> DC. Prodr.	Herb					3	3	S
<i>Coronopus didymus</i> (L.) Sm.	Herb	2	2	5		3	3	S
<i>Euphorbia hirta</i> L.	Herb	4			2	3	3	S
<i>Euphorbia prostrata</i> Aiton.	Herb					3	3	S
<i>Lathyrus aphaca</i> L.	Herb	3	3	3	3		3	S
<i>Leptochloa panicea</i> (Retz.) Ohwi	Herb					3	3	S
<i>Malva neglecta</i> Wall.	Herb	3	3	3	3	3	3	S
<i>Malva sylvestris</i> L.	Herb	3			3	3	3	S
<i>Marrubium vulgare</i> L.	Herb	4		2			3	S
<i>Melilotus officinalis</i> (L.)Desr.	Herb	3	3	3			3	S
<i>Oxalis corniculatus</i> L.	Herb	3	3	3	3	3	3	S
<i>Plantago major</i> L.	Herb	3	3				3	S
<i>Trifolium repens</i> L.	Herb	3	3	3	3	3	3	S
<i>Verbascum thapsus</i> L.	Herb	3			4	2	3	S
<i>Trichodesma indicum</i> (L.) R. Br. Prodr.	Herb	2.6			3.9	2.6	3	S
<i>Sonchus asper</i> (L) Hill.	Herb	3	2	3.6	3	3.75	3	S
<i>Aerva javanica</i> (Burm.f) Juss.	Herb	2	4	4	2	3.75	3.15	S
<i>Amaranthus caudatus</i> L.	Herb	3	3.75	3	3	3	3.15	S
<i>Duchesnea indica</i> (Andr.)Focke.	Herb	3.75	2.5	3	3	3.75	3.2	S
<i>Plantago lanceolata</i> L.	Herb	3		3	3.9	3	3.2	S
<i>Amaranthus viridis</i> L.	Herb	3.5	3				3.25	S
<i>Chamaemelum nobile</i> (L.) All.	Herb	3.3					3.3	S
<i>Cuscuta reflexa</i> Roxb.	Herb	2.6	2.6		4	4	3.3	S
<i>Equisetum ramosissimum</i> Desf.	Herb	3			3	4	3.33	S
<i>Solanum nigrum</i> L.	Herb	2.5	3	3.75	3.75	3.75	3.35	S
<i>Nasturtium officinale</i> R. Br.	Herb	3.75	3	5	3	2.25	3.4	S
<i>Conyza canadensis</i> (L.) Corgn.	Herb	3.75	3.75		3.75	2.5	3.43	S
<i>Arundo donax</i> L.	Herb	3	3.75	3.75	3.75	3	3.45	S

Name of species	Habit	Tribe wise CS values						Categories
		Basikhel	Nusratkhel	Akazai	Hassanzai	Medakhel	Mean	
<i>Neslia apiculata</i> Fisch.	Herb				3.9	3	3.45	S
<i>Capsella bursa-pestoris</i> L.	Herb	2.6	2.5		3.75	4.98	3.45	S
<i>Cyperus cyperoides</i> L.	Herb	2.5	2.5		4.98	4	3.49	S
<i>Anisomeles indica</i> (L.) O. Kuntze.	Herb	4		3			3.5	S
<i>Urtica dioica</i> L.	Herb	3		4			3.5	S
<i>Chenopodium ambrosioides</i> L.	Herb	3			3.9	4	3.63	S
<i>Aloe vera</i> (L.) Burm.	Herb	3	4		4	4	3.75	S
<i>Cannabis sativa</i> L.	Herb	4		4	3.75	4	3.93	S
<i>Silybum marianum</i> (L) Gaertn.	Herb	5	2.6	3.9	4.98	3.32	3.96	S
<i>Adiantum incisum</i> Forssk.	Herb	4					4	S
<i>Galinsoga parviflora</i> Cavanilles.	Herb				4		4	S
<i>Portulaca oleracea</i> L.	Herb	4					4	S
<i>Pteris cretica</i> L.	Herb				4		4	S
<i>Ranunculus arvensis</i> L.	Herb	4		4			4	S
<i>Ranunculus scleratus</i> L.	Herb	4				4	4	S
<i>Solena amplexicaulis</i> (Lam.)Gandhi.	Herb	4					4	S
<i>Boenninghausenia albiflora</i> (Hook.) Reichb.	Herb	4					4	S
<i>Foeniculum vulgare</i> Mill.	Herb	4.5	4		3.75		4	S
<i>Adiantum capillus- veneris</i> L.	Herb	5	4		4		4.33	S
<i>Xanthium strumarium</i> L.	Herb	5	5	3.3			4.43	S
<i>Mentha longifolia</i> (L.) Huds.	Herb	5	4	4		4.98	4.49	S
<i>Mentha arvensis</i> L.	Herb	5	5	5	4		4.75	S
<i>Adiantum venustum</i> D. Don.	Herb				5		5	S
<i>Eryngium Sp.</i> L.	Herb	5					5	S
<i>Polystichum lonchitis</i> L.	Herb	5					5	S
<i>Ranunculus muricatus</i> L.	Herb	5	5				5	S
<i>Euphorbia helioscopia</i> L.	Herb	7.5			4.98	4.98	5.82	S
<i>Skimmia laureola</i> (DC.) Sieb. &Zucc. ex Walp.	Shrub	0.5	0.4	0.5	0.5	0.5	0.48	CE
<i>Woodfordia fruticosa</i> (L.)S.Kurz.	Shrub	1	0.33	0.4	1	1.2	0.78	CE
<i>Periploca aphylla</i> Dcne.	Shrub	1	0.66	1			0.88	CE
<i>Opuntia dillenii</i> Haw.	Shrub	1	0.75	1	1	1.32	1	CE
<i>Hedra nepalensis</i> K.Koch.	Shrub	0.5	1	1.5			1	CE
<i>Nannorrhops ritchieana</i> (Griff.) Aitchison.	Shrub				1	1	1	CE
<i>Vitis Jacquemontii</i> Parker.	Shrub		1				1	CE
<i>Viburnum grandiflorum</i> Wall. ex DC.	Shrub	0.6		1.5			1	CE
<i>Viburnum cotinifolium</i> D. Don.	Shrub	1.2	1.2		1		1.13	E
<i>Buxus wallichiana</i> Bill.	Shrub	1		1.3			1.15	E
<i>Buddleja crispa</i> Bth.	Shrub	1	1	2	1.5	1.5	1.4	E
<i>Vitis parvifolia</i> Roxb.	Shrub			1.5			1.5	E
<i>Carissa opaca</i> Stapf. en Haines.	Shrub	1.5	2	1	1.2	2	1.54	V
<i>Hypericum oblongifolium</i> L.	Shrub	2		1	1.2	2	1.55	V
<i>Colebrookia oppositifolia</i> Smith.	Shrub	0.75	0.75	1	2.6	3.32	1.68	V
<i>Cotoneaster bacillaris</i> Wall. ex Lindl.	Shrub	1.5		2			1.75	V
<i>Justicia adhatoda</i> L.	Shrub	2	1.5	2	2	1.5	1.8	V
<i>Caesalpinia decapitata</i> (Roth) Alston.	Shrub	1.5		2	1.5	2.4	1.85	V
<i>Cotoneaster nummularia</i> Fish &Mey.	Shrub	1.2		2	2.4		1.86	V
<i>Bambusa glaucescens</i> (Willd.) Sieb.	Shrub	1			3		2	V
<i>Daphne mucronata</i> Royle.	Shrub	2			2	2	2	V
<i>Jasminum nudiflorum</i> Lindl.	Shrub	2	2				2	V

Name of species	Habit	Tribe wise CS values						
		Basikhel	Nusratkhel	Akazai	Hassanzai	Medakhel	Mean	Categories
<i>Ostostegia limbata</i> (Bth) Boiss.	Shrub	2		2	2	2	2	V
<i>Yucca aloifolia</i> L.	Shrub				2	2	2	V
<i>Ziziphus oxyphylla</i> Edgew.	Shrub	2					2	V
<i>Maytenus royleanus</i> (Wall. ex Lawson) Cufodontis.	Shrub	2	2	1.6	2.6	2	2	V
<i>Berberis lycium</i> Royle.	Shrub	2.5	2.1	2.4	1	2.49	2	V
<i>Debregeasia salicifolia</i> (D.Don) Rendle.	Shrub	2.4	1.6	2.4			2.1	R
<i>Isodon rugosus</i> (Wall. ex Benth.) Codd.	Shrub	2	2	2.6		2	2.15	R
<i>Sarcococca saligna</i> (D.Don) Muell.	Shrub	2	3	1.5			2.16	R
<i>Nerium oleander</i> L.	Shrub	2.6	2			2	2.2	R
<i>Rubus fruticosus</i> Hook .f.	Shrub	2	2.5	2.4		2	2.25	R
<i>Andrachne cordifolia</i> (Wall. ex Decne.) Muell.	Shrub	2.4	2.4	2	2.6	2	2.28	R
<i>Jasminum humile</i> L.	Shrub	2		2	3		2.33	R
<i>Vitex negundo</i> L.	Shrub	2	2.6	2.5	2	2.6	2.34	R
<i>Zanthoxylum armatum</i> DC.	Shrub	2	2.6	3	2	2.4	2.4	R
<i>Cotinus coggyria</i> Scop.	Shrub	2.4	2.4	2.6	2.4		2.45	R
<i>Vitis vinifera</i> L.	Shrub	2.6					2.6	S
<i>Myrsine Africana</i> L.	Shrub	3	3	3	2.4	2.4	2.76	S
<i>Indigofera heterantha</i> Wall.ex rand.	Shrub	2.5	2.5	3	2.5	3.6	2.82	S
<i>Calotropis procera</i> (Ait.) Ait. F.	Shrub	2.6	2.6	4	2	3	2.84	S
<i>Rubus ellipticus</i> Smith.	Shrub	2.5		3	3	3	2.87	S
<i>Ziziphus nummularia</i> (Burm. f.) Wight & Arn.	Shrub	2.6			2.4	3.75	2.91	S
<i>Withania somnifera</i> (L.) Dunal.	Shrub					3	3	S
<i>Dodonaea vescosa</i> (L.) Jacq.	Shrub	3.75	2.6	3	3	3	3	S
<i>Mallotus philippensis</i> (Lam.)Muess.	Shrub	4	3.75	2	3.75	3	3.3	S
<i>Nerium indicum</i> Mill.	Shrub	4				2.6	3.3	S
<i>Cedrus deodara</i> (Roxb. ex D. Don), G. Don.	Tree	0.5	0.4	0.5	0.66	0.66	0.54	CE
<i>Pistacia integerrima</i> J.L.Stewart. Brandis.	Tree	0.66	0.5	0.66	0.66	0.66	0.62	CE
<i>Taxus wallichiana</i> (Zucc.)Pilger.	Tree	0.66		1			0.83	CE
<i>Ficus carica</i> Forsk.	Tree	0.66		1	0.66	1.32	0.91	CE
<i>Cornus macrophylla</i> Wall. ex Roxb.	Tree	1	1	1			1	CE
<i>Bauhinia variegata</i> L.	Tree	1.2	1.2	1	1	1	1	CE
<i>Quercus dilatata</i> Lindle. ex Royle.	Tree	1.2		1			1.1	E
<i>Quercus leucotrichophora</i> A. Camus.	Tree	0.75		1.5			1.12	E
<i>Quercus floribundla</i> Lindl.	Tree	1		1.3			1.15	E
<i>Quercus incana</i> Roxb.	Tree	1	0.6	1.3		2	1.22	E
<i>Populus alba</i> L.	Tree	1.3	1.3		1.3	1.3	1.3	E
<i>Abies pindrow</i> Royle.	Tree	0.66		2			1.33	E
<i>Picea smithiana</i> (Wall.) Boiss.	Tree	0.66		2			1.33	E
<i>Butea monosperma</i> (Lam.) O. Kuntz.	Tree	1		1.5	1.5	1.5	1.37	E
<i>Grewia optiva</i> Drummond .exBurret.	Tree	1.6	0.75	1.42	1.6	1.66	1.4	E
<i>Bombax ceiba</i> L.	Tree	1	0.75	2	2.6	1	1.47	E
<i>Celtis australis</i> L.	Tree	1.2	1.2	1.5	2	1.5	1.48	E
<i>Alnus nitida</i> (Spach.) Endl.	Tree	0.66	1	3	1.32		1.49	E
<i>Cydonia oblonga</i> Miller.	Tree	1.5				1.5	1.5	E
<i>Morus alba</i> L.	Tree	1.5		1.5	2	1	1.5	E
<i>Phoenix dactylifera</i> L.	Tree			1.5			1.5	E
<i>Phoenix sylvestris</i> (L.) Roxb.	Tree				1	2	1.5	E

Name of species	Habit	Tribe wise CS values						Mean	Categories
		Basikhel	Nusratkhel	Akazai	Hassanzai	Medakhel			
<i>Pinus wallichiana</i> A. B. Jackson.	Tree	1.5	1.5	1.5	1.5	1.5	1.5	E	
<i>Sapindus mukorossi</i> Gaertn.	Tree	1.5					1.5	E	
<i>Acacia nilotica</i> L.	Tree	1	1	2	2	2	1.6	V	
<i>Ficus benghalensis</i> L.	Tree	1.5	1.5	2	1.5	1.5	1.6	V	
<i>Aesculus indica</i> (Wall. ex Camb.) Hk.	Tree	1.33		1.5		2	1.61	V	
<i>Albizia procera</i> (Roxb.) Benth.	Tree	1.5	1.5	3	1.5	1	1.7	V	
<i>Pyrus communis</i> L.	Tree	1.5		2			1.75	V	
<i>Ziziphus jujube</i> Mill.	Tree	1.6	1.6	2	1.2	2.6	1.8	V	
<i>Albizia lebbek</i> (L.) Benth.	Tree	1.5		2	2		1.83	V	
<i>Pyrus pashia</i> Ham ex D. Don.	Tree	2	1.33	2	2	2	1.86	V	
<i>Ficus racemosa</i> L.	Tree	2	2	2	2		2	V	
<i>Ilex dipyrena</i> Wall.	Tree	2					2	V	
<i>Cedrella serrata</i> Royle.	Tree	2		1.5	3	2	2.12	R	
<i>Azadirachta indica</i> L.	Tree	2.66	3.3	2	1	2	2.19	R	
<i>Delbergia sisso</i> Roxb.	Tree	2	2	2.6	2.6	2.5	2.34	R	
<i>Punica granatum</i> L.	Tree	2.5	2.6	2	2	2.6	2.34	R	
<i>Diospyros lotus</i> L.	Tree	2.5	2.3	2.5			2.43	R	
<i>Salix tetrasperma</i> Roxb.	Tree	1.5			2	4	2.5	R	
<i>Olea ferruginea</i> Royle.	Tree	3	2.4	2.5	3	3	2.78	S	
<i>Pinus roxburghii</i> Sargent.	Tree	2	2	3.32	3.32	3.32	2.7	S	
<i>Ficus palmate</i> Forsk.	Tree	3	3.5	2.5	3	2.5	2.9	S	
<i>Ailanthus altissima</i> (Mill.) Swingle.	Tree	3	3	2	4		3	S	
<i>Robinia pseudoacacia</i> L.	Tree	3	2.25	3	2.5	4.5	3	S	
<i>Morus nigra</i> L.	Tree	3	3	3.5	3	2.8	3	S	
<i>Melia azedarach</i> L.	Tree	3	3.5	3	3	3	3.1	S	
<i>Acacia modesta</i> Wall.	Tree	3	3	3.75	3	3	3.15	S	
<i>Juglans regia</i> L.	Tree	3	4.2	3	3	3	3.24	S	
<i>Prunus armeniaca</i> L.	Tree	3	3.6				3.3	S	
<i>Euclaptus</i> sp.	Tree	2			6	4	4	S	
<i>Broussonetia papyrifera</i> (L.) L' Herit ex Vent.	Tree	4.5	4.5	5	4.98	4.98	4.79	S	
<i>Platanus orientalis</i> L.	Tree	5					5	S	

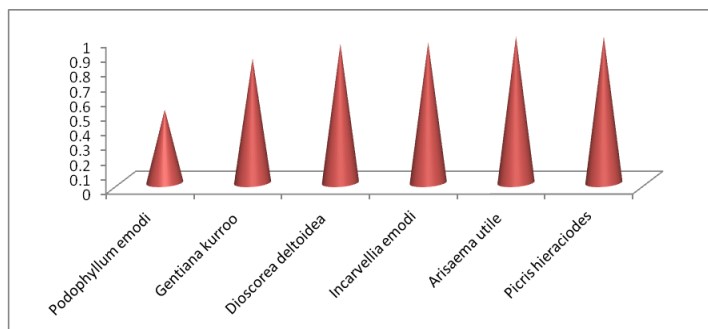
NR: not reported, CS: conservation status, CE: critically endangered, E: endangered, V: vulnerable, R: rare, S: secure

### Conservation status of herbs

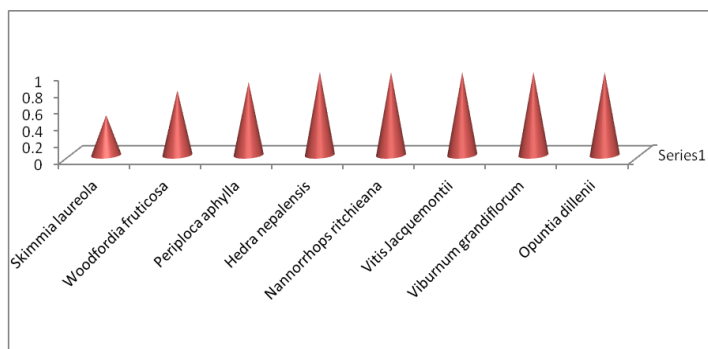
Six species of herbs were found critically endangered (CE) showing CS values up to 1.0. These species are *Podophyllum emodi* (0.5), *Gentiana kurroo* (0.85), *Dioscorea deltoidea* (0.88), *Incarvillea emodi* (0.96), *Arisaema utile* (1.0) and *Picris hieracioides* (1.0) (Fig. 2). Thirteen species of herbs were mentioned as endangered ranging CS values from 1.1 to 1.5. Vulnerable species were found 31, rare 41 and secure 104 (Table 2).

### Conservation status of shrubs

Among shrubs 9 species were found critically endangered. These were *Skimmia laureola* (0.48), *Woodfordia fruticosa* (0.78), *Periploca aphylla* (0.88), *Hedra nepalensis* (01), *Nannorrhops ritchieana* (01), *Vitis Jacquemontii* (01), *Viburnum grandiflorum* (01) and *Opuntia dillenii* (01) (Fig. 3). Endangered species were recorded 4, vulnerable 15, rare 11 and secure 9 (Table 2).



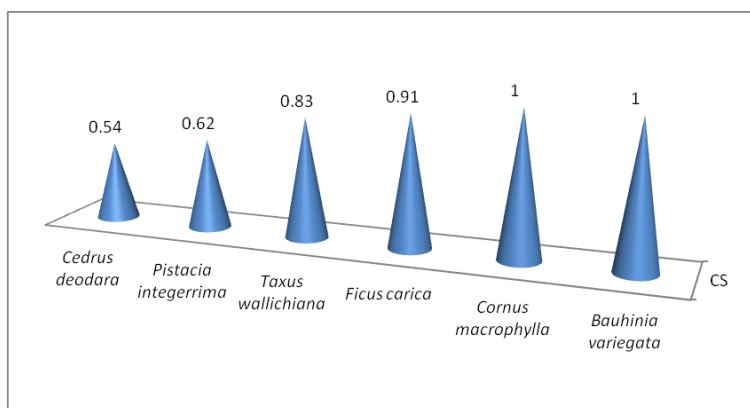
**Figure 2.** Critically endangered herbs of district Tor Ghar



**Figure 3.** Critically endangered shrubs of district Tor Ghar

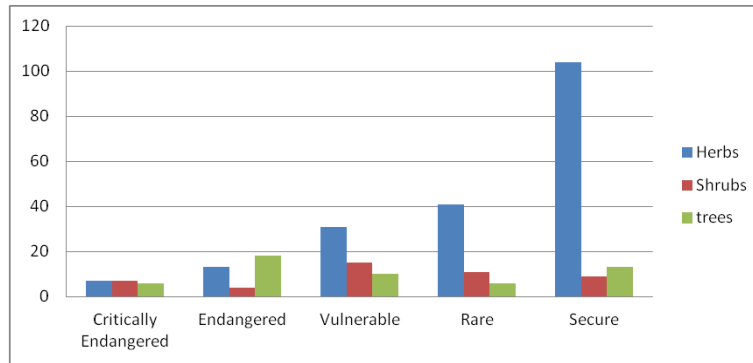
### Conservation status of trees

Six trees species were declared critically endangered. These were *Cedrus deodara* (0.54), *Pistacia integerrima* (0.62), *Taxus wallichiana* (0.83), *Ficus carica* (0.91), *Cornus macrophylla* (1) and *Bauhinia variegata* (1) (Fig. 4). Eighteen species of trees were mentioned as endangered, 10 vulnerable, 6 rare and 13 secure (Table 2).



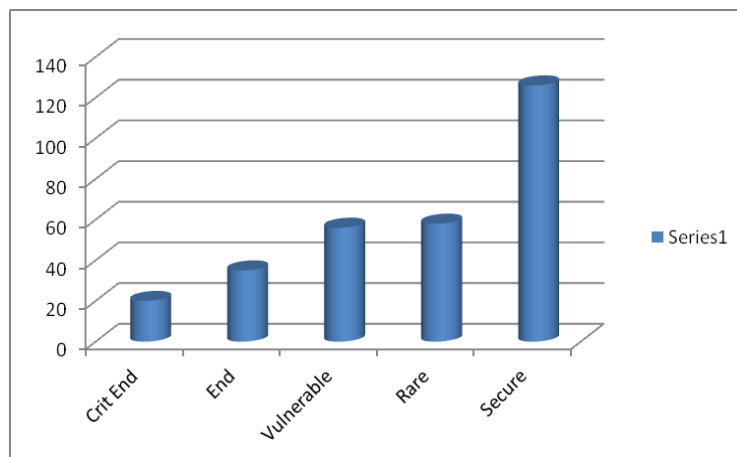
**Figure 4.** Critically endangered trees of district Tor Ghar

Herbs are found secure mostly in the region and least critically endangered whereas trees are more endangered and least critically endangered and rare. Shrubs are more vulnerable and least endangered (Fig. 5).



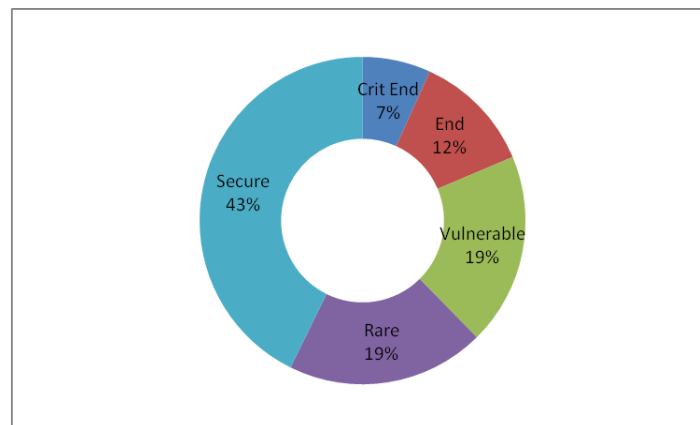
**Figure 5.** Number of species of all life forms and IUCN categories

Overall 20 species of all life forms were declared critically endangered, 35 endangered, 56 vulnerable, 58 rare and 126 secure (Fig. 6).



**Figure 6.** Total number of species assigned to IUCN categories

The percentage of threatened flora 38% (7% critically endangered, 12% endangered, 19% vulnerable) 19% near threatened (rare) was higher as compare to secure (least concerned) flora 43% (Fig. 7).



**Figure 7.** Percentage of threatened and secure species of Tor Ghar

## Discussion

The current investigation finds out the role of ethnoecological knowledge in evaluating the conservation status of culturally significant flora of district Tor Ghar. The United Nations Convention Environment and Development (UNCED, 1992) also highlighted the important roles that indigenous peoples play in both the conservation and sustainable use of natural resources while in turn maintaining biodiversity. In the present study local wisdom was explored and conservation status of 295 plants species in terms of IUCN categories was calculated on the basis of newly developed equation. The results depict 7% critically endangered flora, 12% endangered, 19% vulnerable and 19% near threatened (rare). The rest of the flora that is 43% found secure (least concerned). Such categorization was also found in a number of other ethnobotanical studies (Gilani et al., 2006; Afzal et al., 2009; Haq, 2012; Akhter et al., 2013; Bibi et al., 2014; Shah et al., 2015). Hamayun et al., (2006) also evaluated conservation status of 49 medicinal plant species and found 24 species threatened. Out of which 9 were found endangered, 7 vulnerable and 8 rare. The study also revealed that locals particularly plants collectors had useful information about plants occurrence, distribution and sites of their maximum availability. This information was cross checked through field surveys and visits. The field observations include, range extent and area of occupancy, exploitation level, availability, habitat alteration, conservation efforts, plant collection methods, part collected, invasive species and threats to plant biodiversity. On the basis of these observations, the species were then categorized according to IUCN categories as critically endangered, endangered, vulnerable, rare (near threatened) and secure (least concerned).

The results obtained by applying this equation show accuracy and found in accordance with the majority of results of other studies conducted in adjacent areas as well as different parts of Pakistan. According to this equation six species of herbs were found critically endangered (CE) showing CS values up to 1. These species are *Podophyllum emodi* (0.5), *Gentiana kurroo* (0.85), *Dioscorea deltoidea* (0.88), *Incarvillia emodi* (0.96), *Arisaema utile* (1) and *Picris hieracioides* (01). Thirteen species of herbs were mentioned as endangered ranging CS values from 1.1 to 1.5. Vulnerable species are 31 (1.6-2), rare 41 (2.1-2.5) and secure 104 (CS value above 2.5). Gilani et al. (2006) documented 21 ethnomedicinal herbs from Ayubia National Park, district Abbottabad and found *Podophyllum emodi* and *Viola canescens* vulnerable species due to overexploitation. While according to the findings of the present study *Podophyllum emodi* (0.5) is critically endangered but *Viola canescens* (2.7) is secure. *Podophyllum emodi* is under great harvesting pressure, showing minimum occurrence, availability for the last 10 years decreases and its regeneration potential could not keep pace with its overexploitation. Whereas *Viola canescens* shows the criteria of secure in this study. Afzal et al. (2009) studied that some plant species *Colchicum luetum*, *Bergenia ciliata*, *Pimpinella stewartii*, *Valleriana jatamonsii*, *Viola serpens* and *Dioscorea deltoids* etc. are rapidly depleting and may become locally extinct in near future. Some of these have also been reported and assessed in present investigation. *Colchicum luetum* (1.33), *Bergenia ciliate* (1.76) and *Valleriana jatamonsii* (1.92) were found vulnerable. While *Dioscorea deltoids* (.95) found critically endangered at local level.

Among shrubs 8 species were found critically endangered. These are *Skimmia laureola* (0.48), *Woodfordia fruticosa* (0.78), *Hedra nepalensis* (1.0), *Nannorrhops ritchiana* (1.0), *Vitis jacquemontii* (1.0), *Periploca aphylla* (01), *Opuntia dillenii* (01)

and *Viburnum grandiflorum* (1). Endangered species are 4, vulnerable 15, rare 11 and secure 9 (Table 2).

Six trees species were declared critically endangered. These are *Cedrus deodara* (0.54), *Pistacia integerrima* (0.62), *Taxus wallichiana* (0.83), *Ficus carica* (0.91), *Cornus macrophylla* (1) and *Bauhinia variegata* (1.0). Eighteen species of trees were declared as endangered, 10 vulnerable, 6 rare and 13 secure (Table 2).

Similarly Haq (2012) also conducted ethnoconservation survey of 12 threatened species from district Battagram (adjacent district to Tor Ghar). These species were *Acer caesium*, *Betula utilis*, *Cedrus deodara*, *Opuntia dilleni*, *Paeonia emodi*, *Pistacia integerrima*, *Populus alba*, *Quercus glauca*, *Skimmia laureola*, *Taxus wallichiana*, *Ulmus wallichiana* and *Viscum album*. Their conservation status was assessed through direct field observation and the information gathered by locals. The present research work also declared 6 plants *Cedrus deodara*, *Opuntia dilleni*, *Pistacia integerrima*, *Populus alba*, *Skimmia laureola* and *Taxus wallichiana* as critically endangered species of district Tor Ghar.

Shah et al. (2012) explored *Olea ferruginea* along with mixed tree species of *Monothecha buxifolia* and *Acacia modesta* as dominant ethnoflora of sacred jungles of Kurd sharif and Sho of district Karak showing a traditional way of conserving plant biodiversity. Similar findings of this research show *Olea ferruginea* (2.78) and *Acacia modesta* (3.15) as secure species of the study area. *Olea ferruginea* is protected in graveyards and considered one of the most important sacred plant species of Graveyards and is not cut for any purpose. *Olea ferruginea* is also protected by locals from fire by making small circular stony walls around trees (Shah et al., 2015)

Ahmad et al. (2012) found 5 plants species critically endangered, 6 endangered, 10 vulnerable, 11 secure and 6 rarely distributed in Sharda, Neelam valley Azad Jammu and Kashmir. This study further revealed the over exploited species are *Aconitum heterophyllum*, *Geranium wallichianum*, *Ajuga bracteosa*, *Traxicum officinale*, *Quercus incana*, *Berberis lycium*, *viola canescens* and *Dyosporus lotus*. Majority of them are at the verge of local extinction due to extensive harvesting pressure. The CS values index also shows *Geranium wallichianum* (1.56), *Ajuga bracteosa* (02) and *Berberis lyceum* (02) as vulnerable species, whereas *Traxicum officinale* (2.13) and *Dyosporus lotus* (2.4) as rare species. Whereas *Quercus incana* (1.22) as endangered species and *viola canescens* (2.7) as secure species. The result of *viola canescens* (2.7) as secure species is only different. It may be due to its habitat adjustment or reduced overexploitation. Therefore, *viola canescens* (2.7) is not considered the threatened species of the district. The field observations also show its moderate occurrence.

In Chakesar valley district Shangala, a plant resource assessment project was carried out ethnobotanically to explore conservation status of some important medicinal plants. Conservation of 127 plant species was evaluated through IUCN criteria. Among these species 47 were endangered (E), 32 vulnerable (VU), 36 rare (R) and 12 species were infrequent (IF). Some of the important endangered species of the region are *Abies pindrow*, *Acer oblongum*, *Aesculus indica*, *Alnus nitida*, *Berberis kunawarensis*, *Celtis australis*, *Desmodium elegans*, *Hedrane palensis*, *Juglan regia*, *Olea ferruginea*, *Paeonia emodi*, *Picea smithiana*, *Pinus gerardiana*, *Pistacia integrima*, *Quercus semicarfifolia*, *Viburnum grandiflorum* and *Woodfordia fruticosa* (Shah and Hussain, 2012). When the results of this study were compared with the results of present research, majority of the species showed similarity in results and however, a few species showed different conservation status e.g. *Abies pindrow*, *Alnus nitida*, *Celtis australis*



and *Picea smithiana* were declared as endangered species while *Hedrane palensis*, *Viburnum grandiflorum* and *Woodfordia fruticosa* as critically endangered species of the research area. *Aesculus indica* was mentioned as vulnerable species of the district. In these results category of threatening is different. However, *Juglan regia* and *Olea ferruginea* showed different results being culturally significant species. These are well protected by local culture and therefore, attained the secure status. *Juglan regia* is the most popular wild edible plant of the study area. This tree species provides a number of services to the locals in the form of furniture wood, cosmetics and tasteful dry fruit having prolonged storage life. This important species is facing overexploitation pressure but due to cultivation and protection by locals showing secure status in the district Tor Ghar (Shah et al., 2015).

Akhtar et al. (2013) assessed ethnobotanically that *Aconitum violaceum*, *Colchicum luteum* and *Jasminum humile* as vulnerable due to over exploitation. According to the present study *Colchicum luteum* (1.33) is endangered and *Jasminum humile* (2.33) is rare. However, *Aconitum violaceum* was not reported by any tribe in the current study.

Bibi et al. (2014) pointed out the highest under pressure species *Caralluma tuberculata*, *Citrullus colocynthis*, *Malva neglecta* and *Mentha longifolia* in district Mastung of Baluchistan. *Caralluma tuberculata* (1.32) and *Citrullus colocynthis* (1.1) were also declared as endangered species, whereas *Malva neglecta* (3) and *Mentha longifolia* (4.49) as the most secured species of the area showing highest values of CS. *Malva neglecta* is an agricultural land associated plant species and is found abundantly in the study area. Similarly, *Mentha longifolia* was found secure and grows excessively near aquatic habitats of Tor Ghar.

Mussarat et al. (2014) indicated *Morus alba* and *Dalbergia sissoo* under great overexploitation pressure and threatened species in the area. While in the present exploration *Morus alba* (1.5) is endangered and *Dalbergia sissoo* (2.3) is rare. *Dalbergia sissoo* is under great overexploitation pressure especially for furniture wood. *Morus alba* is also depleting alarmingly in the region. No conservatory measures are taken to secure *Morus alba* in Tor Ghar.

Amjad et al. (2015) indicated *Ajuga bracteosa*, *Mallotus philippensis*, *Micromeriabiflora*, *Butea monosperma* and *Zanthoxylum armatum* as critically endangered in Kotli, Azad Jammu and Kashmir. The present research work show *Ajuga bracteosa* (2) as vulnerable, *Mallotus philippensis* (3.3) as secure, *Butea monosperma* (1.37) as endangered species and *Zanthoxylum armatum* (2.4) as rare species.

In the current study *Taxus wallichiana* (0.83) was found critically endangered while *Pinus wallichiana* (1.5) and *Abies pindrow* (1.33) were found endangered. The study of Adnan et al. (2006) also mentioned these species as rapidly decreasing species in Miandam vally of district Swat.

*Cedrus deodara* in this study showing (0.54) CS value and declared critically endangered. Sheikh et al. (2002) also pointed out that *Cedrus deodara* had completely eradicated from Naltar valley, northern western Karakorum range.

When the results of present study were matched with IUCN red list criteria at regional level two species were found critically endangered (CE) in the study area. These species were *Cedrus deodara* (0.54) and *Gentiana kurroo* (0.85). Two species were found Endangered/Threatened (EN) in the region i.e., *Picea smithiana* (1.33) and *Viburnum cotinifolium* (1.13). While *Geranium wallichianum* (1.56) and *Salvia moorcroftiana* (1.87) were mentioned endangered in IUCN criteria but vulnerable species at district Tor Ghar level. *Bergenia ciliata* (1.76) is vulnerable in IUCN list as

well as in the present research. *Pinus wallichiana* (1.5) was found endangered in this study but vulnerable in IUCN red list. *Viola canescens* (2.7) is considered as secure locally but vulnerable regionally. This species showed quite different conservation status from the published literature and IUCN red list indicating its conservation status secured locally.

## Conclusion

Local ecological knowledge has been proved a successful tool for evaluating conservation status of flora of the study site. This empirical study revealed that a higher proportion (57%) of flora is undergoing various degrees of threatening at local level that is 7% critically endangered, 12% endangered, 19% vulnerable and 19% rare in terms of IUCN categories. However, forty three percent flora of the district is secure. The findings of the present study indicating that flora of Tor Ghar is under high anthropogenic pressure. This is first ever attempt of quantifying the local wisdom regarding conservation status of the plants. Local perception of the flora also reflects its conservation status which may be considered in future researches as base line study. The above discussion revealed that the mathematical relation designed during the study has been proved useful tool for evaluating ethno-conservation of local flora. The equation can be generalized and applied to any floristic area of the world. Conservation researchers should quantify the local wisdom while applying IUCN criteria to any floristic territory especially where anthropogenic disturbances are at alarming rate. This will reinforce the results and more clarify the picture of conservation status of plant biodiversity of a region.

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