



## Conservation and ecological characteristic of Trees in Tehsil Karak Pakistan

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### Abstract

The present study documents the conservation status and ecological characteristic of 22 trees belonging to 16 families. Among these 12 species were found to be rare, vulnerable (6 species), Infrequent (2 species), endangered (one specie) and dominant (2 species) in Tehsil Karak, Pakistan. The conservation status of plants is determined according to IUCN 2001, Red Data List Categories and Criteria. After two years extensive field studies on the basis of questioner including availability of plant, collection of plant, growth of plant, plant parts, population size, geographic range and habitat we have concluded that *Salvadora oleoides* Decne. is endangered (EN) specie in Tehsil Karak.

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## Introduction

The conservation status of a group of organisms (for instance, a species) indicates whether the group is still extant (that is, members of it are still alive) and if yes, how likely the group is to become extant in the near future. Many factors are taken into account when assessing conservation status: not simply the number of individuals remaining, but the overall increase or decrease in the population over time, breeding success rates, known threats, and so on. The scale of measure has been criticized because, with the lowest rating being "Least Concern", it fails to have a 'nil' measure. Therefore it fails to reflect the scenario where a species is plentiful and thriving. The International Union for Conservation of Nature (IUCN) has calculated the percentage of endangered species as 40 percent of all organisms based on the sample of species that have been evaluated through 2006 (Anon., 2008). Native plants are key components of the global biological diversity, these plants are an integral part of our ecosystem in which they are facing multiple threats i.e. habitat loss and degradation, introduction of alien species, pollution and diseases, over-exploitation and climate change (Wilcove et al., 1998; Sala *et al.*, 2000; Sudharsan et al., 2003).

It is estimated that some 270,000-425,000 vascular plant species are already known (Govaerts, 2001) with perhaps a further 10-20% still to be discovered and described (Hawksworth and Kalin-Arroyo, 1995). Pakistan's scenario is not different from the rest of the world. Plant biodiversity is also under tremendous pressure due to its population explosion, unplanned urbanization, deforestation and over-exploitation of natural resources. Unfortunately, very little work has been done on threatened plants of Pakistan and extremely limited information is available on this subject (Alam and Ali, 2009). According to Nasir (1991) 580-650 flowering plant species (i.e. 12%) are expected to be threatened. Chaudhri & Qureshi (1991) reported 709 taxa as threatened plants from Pakistan. However, both these studies are mainly based on field observation and literature, without any support of quantitative data. In contrast, the recent red list of IUCN (Anon., 2008) only 19 flowering plants species have been listed from Pakistan. Regarding Pakistan, previous workers have classified the plant species as threatened or rare on the basis of literature or herbarium specimen. No work has been done according to IUCN red list categories or criteria (Anon., 2001) except Alam and Ali (2009), who classified *Astragalus gilgitensis* as a Critically Endangered (CR).

The Tehsil Karak is situated at 32° 47 to 33° 28 North and 70 ° 30 to 71 ° 30 East. Tehsil Karak is bounded by Tehsil Banda Daud Shah on the North West, District Kohat on the North East, Tehsil Takht-e-Nasrati on the South East, and Tribal area Adjoining Bannu District on the South West (Fig 1). The total population of district Karak is about 536000. The total area of district is 264,775 ha (Khan et al., 2011). Physiography of the area is uneven and can be divided into mountainous area, the plain and the small hillocks. The soil is generally clayey or sandy. The fertile loamy soil is very rarely found. Although the hills are very dry, but it is a fact that it contains precious minerals like salt, gypsum and gas etc. The salt quarries are mostly at Noshpo salt mine where the hills present great amount of exposed rocks salt. There is shortage of drinking water due to salinity (Fig 2a & b) and low rain fall in the area, so the people bring water from remote area (Figure 3). The Rainfall is scanty in the area. In the year 2005, 300 to 400 mm of rainfall per annum recorded on district level (Table 1). The area is very hot in summer and very cold in winter. In the year 2005 the mean maximum temperature was 42°C, in the month of the June, where as the mean minimum temperature was as low as 4°C, in the month of December and January, recorded on district level (Table 1) (Khan 2007).

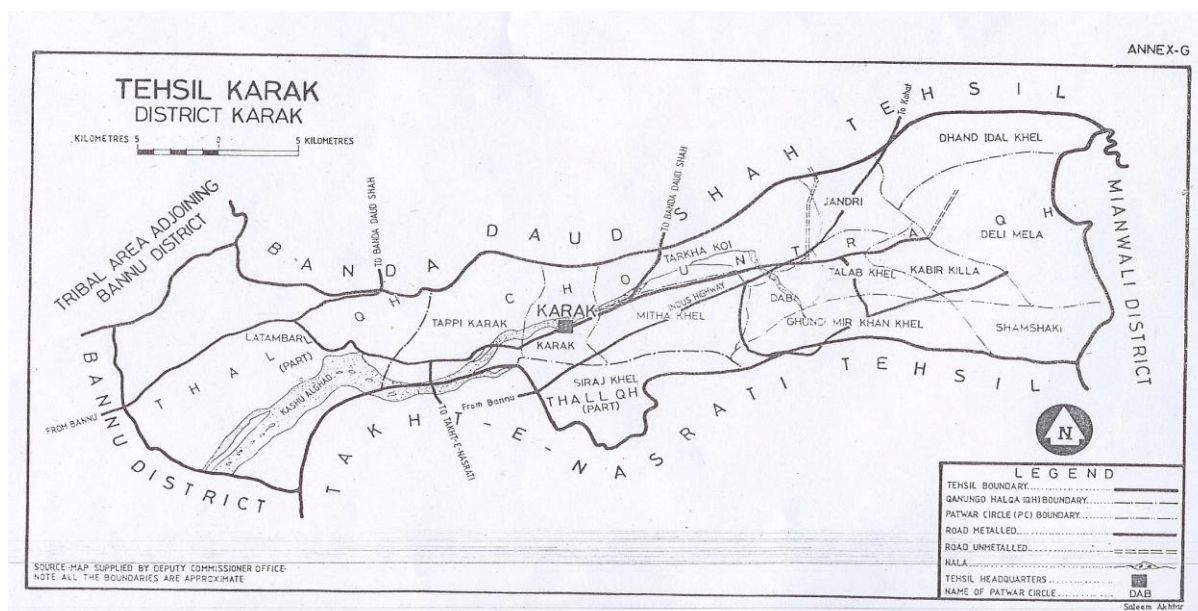


Fig 1. Tehsil Karak.

Table 1. Climatic data of District Karak for the year 2005.

Months	Temperature (°C)				Rainfall (mm)	Relative humidity (%)		Soil Temperature (°C) Average	Wind speed (Km Per Hour)
	Mean maximum	Highest recorded	Mean minimum	Lowest recorded		5 A.M	5 P.M		
January	16.9	20	4	0	64.8	83.1	37.2	4.6	2.4
February	16.8	24	7	2	95.1	82.6	42.7	6.8	2.7
March	24.38	29	12.6	10	80.6	85	39	13.2	3.3
April	32	38	16	10	14.6	65.9	24.3	22.1	3.4
May	33.2	39	20.8	16	34.8	58.7	28	15.4	6.2
June	42	49	26	19	19.8	47.2	22	22	5.3
July	36.7	41	26.1	22	19.8	77.4	38.6	22.7	4.6
August	37	41	26.1	21	73.40	79.6	40.5	23.22	4.2
September	35.9	40	24.7	19	82.2	75.6	39.5	23.1	3.1
October	33.1	37	18.3	10	54	65.3	28.4	17.7	4.2
November	26	29	10	9	-	62	35	11.2	3.8
December	22.9	26	4	1	-	60	30.3	5.8	3.6

## Materials and methods

### Field survey

The study was conducted by frequently surveying in winter, spring and summer during 2005 to 2007. The area is divided into plain and mountain and saline area. Habit, habitat, altitudinal range, population size, distribution range, impacts of multiple threats like habitat destruction, erosion, fuel wood cutting, grazing, poultry farms and invasive species have been studied for two years in the habitat.

### Plant collection and determination

Plant specimens were collected from different parts of Tehsil Karak. The population size was determined

by counting the mature individuals. The seedlings were also counted separately. Nature of habitat was analysed by soil erosion, invasive species and impacts of anthropogenic activities.

### Questioner development

Information on demographic (age, gender) and conservation status was gathered from each site by using a semi-structured questionnaire. Information about the availability of plant, collection of plant, growth of plant, plant parts i.e. root, stem etc, local uses of the species as medicinal, fuel wood, timber and fodder etc were obtained through random sampling by interviewing 500 respondents from

different aged and young gender and sex. During survey personal observation was also recorded.

#### *Life form*

Habit and life form of tree in the habitat was also recorded and classified according to Raunkier's System of Classification.

#### *Conservation classes*

The plants were divided on basis of conservation status into five classes i.e.

1. Endangered: An endangered species is a population of organisms which is at risk of becoming extinct because it is either few in numbers, or threatened by changing environmental or predation parameters.
2. Vulnerable: A vulnerable species is a population of organisms which is unprotected against attack. It is categorised by the International Union for Conservation of Nature (IUCN) as likely to become Endangered unless the circumstances threatening its survival and reproduction improve.
3. Rare: A rare species is a group of organisms that are very uncommon or scarce.
4. Infrequent: An Infrequent species is a group of organisms that are common in the area.
5. Dominant: A Dominant species is a group of organisms that are very common in the area.



**Fig. 2a.** The lesser the vegetation the greater depth of wells.



**Fig. 2b.** Deepening of well due to low water table.

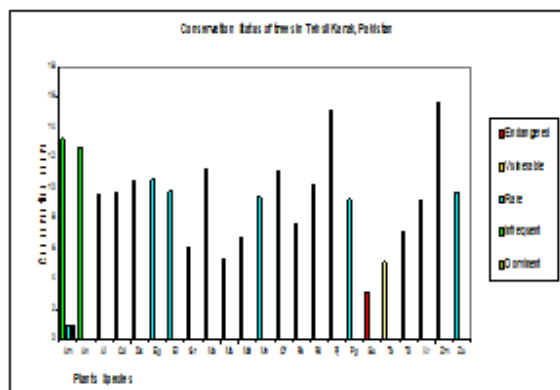
#### **Result**

In the present study the conservation status of trees in Tehsil Karak were determined. Total 23 species belonging to 16 families were found. The Mimosaceae with 4, Moraceae, Myrtaceae, Rhamnaceae and Tamaricaceae with 2, Caesalpiniaceae, Cappariaceae, Celastraceae, Meliaceae, Oleaceae, Palmae, Papilionaceae, Punicaceae, Salvadoraceae, Sapotaceae and Vitaceae with single specie (Table 2). The plants were divided on basis of conservation into five classes i.e. endangered, vulnerable, rare, infrequent and dominant. In the present investigation the 12 species were found to be rare, vulnerable (6 species) Infrequent (2 species), dominant (2 species) and single specie was endangered (Fig 4). The biological spectrum showed that megaphanerophytes (22 spp) and nanophanerophytes (1 sp) had occurrence in the investigated area. Leaf spectra of plants consisted of microphylls (13 spp), mesophylls (5 spp), leptophylls (4 spp) and nanophylls (1 sp).

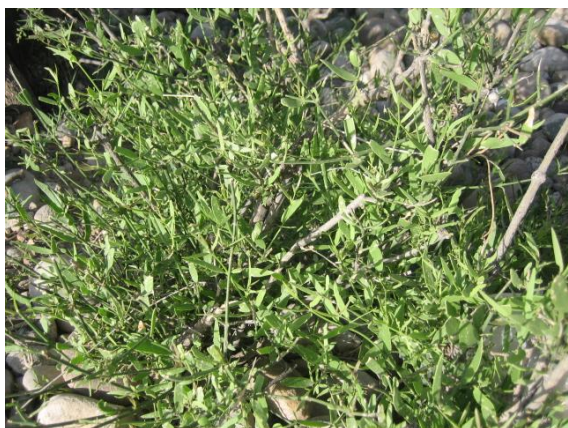


**Fig. 3.** In search of water that become extinct due to excessive use of natural resource.





**Fig. 4a.** Conservation status of tree.



**Fig. 4b.** *Salvadora oleoides* Decne.



**Fig. 5a.** Gully erosion is common in area.

### Discussion

The area is mostly divided into hilly area, sandy soils, river banks, plain and saline area with limestone silt. From the present investigation it is suggested that each species have specific habitat and confined to a narrow distribution range. The plant species habitat changes with the change in environment. A large

scale stone excavation and road construction activity was the major cause of disturbance and destruction in the habitat of plant in the area. Gully erosion (Fig 5 a & b) was causing a severe damage during rains, individuals of plants species growing in sandy and river bank were found more prone to erosion than the plants found on rocky slopes and cliffs. According to Sala *et al.*, (2000) the prime cause of plant extinction around the globe is the fragmentation and disturbance of species habitat. Our observations were agreed with the workers (Myers, 1988; Sala *et al.*, 2000) they reported the species from almost similar habitats from other parts of the world.

In the plain area habitat change with the invasion of invasive species. In Tehsil Karak *Prosopis juliflora* was found as invasive species. According to Huston, (1994) the invasion of invasive species is widely considered as second greatest cause of species endangerment and extinction after habitat loss around the globe. The invasion of *P. juliflora* was a great ecological problem in the area it changed the habitat of native flora. It is found through out the plain area. *Prosopis juliflora* was also observed as aggressively growing invasive species in the habitat of native flora. However, concentration of the population was mostly found on sandy areas rather than hilly area. The process is still occurring in South Africa, Australia and coastal Asia (Pasiecznik, 1999) and having serious consequences on ecological, economic and social systems (Primental *et al.*, 2000). Due to devastating effects of *Prosopis juliflora*, it has been included in the IUCN's list of 100 world's worst invasive species (Pallewatta *et al.*, 2003). According to El-Keblawy & Al-Rawai (2007) *Prosopis juliflora* is causing extirpation of the native flora, resulting in the reduction of species richness and diversity. Noor *et al.*, (1995) reported that *Prosopis juliflora* is playing a vital role in Pakistan in the elimination of natural vegetation due to its allelopathic effects.

**Table 2.** Floristic list, Ecological characteristic and conservation status of tree in Tehsil Karak.

Species Name	Family	Ecological characteristic		Conservation classes				
		LF	LS	End	Vul	R	Inf	Dom
<i>Acacia modesta</i> Wall.	Mimosaceae	Mp	Le	-	-	-	+	-
<i>Acacia nilotica</i> (L.) Delice.	Mimosaceae	Mp	Le	-	-	-	+	-
<i>Albizia lebbeck</i> (L.) Benth.	Mimosaceae.	Mp	Le	-	-	+	-	-
<i>Capparis deciduas</i> (Forssk). Edge worth.	Capparidiaceae	Mp	Na	-	-	+	-	-
<i>Dalbergia sissoo</i> Roxb.	Papilionaceae	Mp	Mic	-	-	+	-	-
<i>Eucalyptus globules</i> L.	Myrtaceae	Mp	Mes	-	-	+	-	-
<i>Eucalyptus lanceolatus</i> L	Myrtaceae	Mp	Mic	-	-	+	-	-
<i>Gymnosporia royleana</i> Wall.	Celastraceae	Np	Mic	-	+		-	-
<i>Melia azedarach</i> L.	Meliaceae.	Mp	Mic	-		+	-	-
<i>Monothea buxifolia</i> (falk) A.DC.	Sapotaceae.	Mp	Mic	-	+	-	-	-
<i>Morus alba</i> L.	Moraceae	Mp	Mes	-	+	-	-	-
<i>Morus nigra</i> L.	Moraceae	Mp	Mes	-	-	+	-	-
<i>Olea ferruginea</i> Royle.	Oleaceae	Mp	Mic	-	-	+	-	-
<i>Parkinsonia aculeate</i> L.	Caesalpinaceae	Mp	Le	-	+		-	-
<i>Phoenix dactylifera</i> L.	Palmae	Mp	Mic	-	-	+	-	-
<b>Prosopis juliflora</b> (Sw.) DC.	Mimosaceae	Mp	Mic	-	-	-	-	+
<i>Punica granatum</i> L.	Punicaceae	Mp	Mes	-	-	+	-	-
<i>Salvadora oleoides</i> Decne.	Salvadoraceae.	Mp	Mic	+	-		-	-
<i>Tamarix aphylla</i> (L.) Karst.	Tamaricaea	Mp	Mic	-	+		-	-
<i>Tamarix decidua</i> Roxb.	Tamaricaea	Mp	Mic	-	+		-	-
<i>Vites vinifera</i> L.	Vitaceae.	Mp	Mes	-	-	+	-	-
<i>Zizyphus maurtiana</i> Lam.	Rhamnaceae	Mp	Mic	-	-		-	+
<i>Zizyphus oxyphylla</i> Edgew	Rhamnaceae	Mp	Mic	-	-	+	-	-

LF: Life Form, LS: Leaf Size, Mp: megaphanerophytes, Np: nanophanerophytes, Mic: microphylls, Mes: mesophylls, Le: leptophylls, Na: nanophylls, End: Endangered, Vul: Vulnerable, R: Rare, Inf: Infrequent, Dom: Dominant.

Grazing is another ecological problem observed, more in hilly area than plain area to change the habitat of native flora. Grazing activity was observed in the habitat (Fig 6), but its impact was quite prominent and devastating for tree species. Uncontrolled and expanding grazing activities have a deep and long term impact on the local vegetation and it is disastrous for the local plant wealth which is already in stress. It was also observed that the erosion was increased proportionally with increasing the grazing. According to Pieper (1994) impact of grazing ranges from almost undetectable removal of plant material to severe depletion of vegetational resources and extensive erosion.

**Fig. 5b.** Gully erosion was causing a severe damage.



**Fig. 6.** Uncontrolled grazing.

Cutting of trees was another ecological problem in the area due to the demand of fodder and fuel wood. The people of the area were very poor and due to unavailability of natural gas the local communities depend upon the native tree for both purposes (Fig 7a & b). It was observed that the precise trees like *Olea ferruginea* Royle and others plants were decreases in numbers. Over-exploitation of plant species for fodder and fuel wood purpose by local communities and nomads is a complex problem and a major cause of plant extinction (Hirway & Goswami, 2007; Engler, 2008). Regarding impacts of unsustainable use of plant species, no accurate information has been published (Davis *et al.*, 1995), but there is no doubt about its consequences. Another major concern is that, local inhabitants and commercial scale poultry farms have no access to the natural gas and electricity for maintaining their living. Fuel wood chopping exercise is quite prominent in the habitat of tree species, thus badly affecting its population and in next decat the rare tree will become vulnerable. Rabinowitz (1981) suggests that those species which are found over a wide geographic range but are consistently rare throughout their distribution need immediate attention as they are more vulnerable from extinction point of view.

Another ecological problem in the area is dryness. The area is very hot in summer and cold in winter. The rain is very scanty in the area (Table 1). Due to dryness the herbs species are very rare because the

plants cannot reached to there reproductive stage in the area so the animal directly depend upon the tree species. According to Baggs and Maschinski (2000) population size is often affected by dry periods during the growing season, when plants may not produce any viable seed and there will be no natural recruitment. No natural recruitment was observed in *Salvadora oleoides* during field studies of 2005–2007. Hence, it is concluded that the population sizes of rare trees are continuously reducing at an alarming rate, without having natural recruitment.



**Fig. 7a.** Tampering of trees so bad for growth.



**Fig. 7b.** Gas pipeline: A hope to reduce pressure on vegetation.

Many threatened plant species are predisposed to threat due to their small population sizes (Rabinowitz, 1981; Kruckeberg and Rabinowitz, 1985). The conservation status of a species was mainly based on the number of mature individuals of some species. The current study was conducted, according to the IUCN red list categories and criteria



(Anon., 2001), which describes in detail that if population size is fewer than 250 mature individuals with a continuous decline in their number along with no sub-populations, making the tree species eligible to be placed under Critically Endangered (CR) category. *Salvadora oleoides* with a population size of 35 is placed under Critically Endangered category and is under threat of extirpation. These findings suggest that low population size along with continuous decline in their numbers without having any subpopulations is critical for its survival.

On the basis of geographic range and number of localities the conservation status of tree species was also determined. The extent of occurrence of *Salvadora oleoides* was 87.56 km<sup>2</sup>. From the point of view of number of localities the *Salvadora oleoides* was reported from single locality. Based on the small geographic range and single locality, *Salvadora oleoides* was placed under Endangered Category. According to Anon., (2001) the conservation status of a tree species was also based on the geographic range and number of localities/sub-populations. The categories and criteria clearly explain that if a plant species had less than 500 km<sup>2</sup> extent of occurrence with one locality or severely fragmented localities should be considered as Endangered (EN) in addition to other parameters. These findings according to IUCN criteria suggest that the restricted distribution range of concerned *Salvadora oleoides* and other rare tree species in a single locality is critical for its survival. On the basis of multiple threats i.e., habitat specificity, restricted distribution range, habitat loss through commercial scale stone excavation activities, invasion of invasive species i.e., *Prosopis juliflora*, over exploitation in the form of grazing and fuel wood cutting and low population size along with negligible natural recruitment, the current study concluded that *Salvadora oleoides* was highly prone to extirpation and eligible to be placed under Endangered (EN) category and other rare tree were protected from vulnerable species. In context with global biodiversity, conservation of a rare species at

national level is very important. Hence, urgent conservation steps should be taken as suggest below, to avoid its extirpation from Tehsil Karak, Pakistan.

1. The *Salvadora oleoides* should be included in the Red Data list of threatened species for karak, Pakistan.
2. Conservation status assessment of the *Salvadora oleoides* and other rare tree species in other area of Pakistan should also be initiated to assign the category in international perspective.
3. Efforts should be made to protect the *Salvadora oleoides* by minimizing the anthropogenic activities in the habitat (i.e. stone excavation, fuel wood cutting, grazing and poultry business).
4. Seeds of the *Salvadora oleoides* and other trees species should be preserved in local seed banks and also distributed to other regional conservation organizations, so that in case of any natural disaster it can be protected and recovered.
5. Protocols for *in vitro* conservation as a backup support, should be designed, initiated and established on urgent basis to fulfill the *ex-situ* conservation strategy.
6. Alternate environmentally friendly and sustainable jobs should be provided for the local inhabitants for maintaining their living properly.
7. Alternate means of energy like electricity and natural gas (Fig 5) should be provided in the area to reduce the wood cutting activities.
8. The study of plant conservation should be done on small scale in Pakistan.

### Conclusion

The method and technique of Hybridization and Grafting should be introduced which will be a good effort in conservation and expansion of many species i.e *Olea ferruginea* should be grafted with valuable oil yielding species *Olea europea*. A lot of fruits, especially *Zizyphus* Species, *Peganum hermala* L, *Withania coagulans* (Stocks) Dunal, *Monothea buxifolia* (falk) A.DC, *Fagonia cretica* L and *Acacia nilotica* (L) Delice are wasted annually due to non-availability of market. The market availability



has good effect on plants and on people. Medicinal farm should be set up in the study area to promote the vital importance of the plants and its conservation. The plants should be introduced in botanic gardens for public display. Alternate environmentally friendly and sustainable jobs should be provided for the local inhabitants for maintaining their living properly. Alternate means of energy like electricity and natural gas should be provided in the area to reduce the wood cutting activities.

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### References

- Alam J, Ali SL. 2009.** Conservation status of *Astraglus gilgitensis* Ali (Fabaceae): a critically endangered species in Gilgit district, Pakistan. *Phyton* **48(2)**, 211-223.
- Anonymous. 2001.** *IUCN Red List Categories: Version 3.1.* Species Survival Commission. IUCN, Gland, Switzerland & Cambridge, UK.
- Anonymous. 2008.** IUCN Red List of threatened species, [www.iucnredlist.org](http://www.iucnredlist.org) cited on December 27th 2009.
- Baggs JE, Maschinski J. 2000.** Annual report on the long-term research on *Purshia subintegra* in the Verde Valley for 1999. Report to Arizona Department of Transportation, Phoenix, Arizona, USA.
- Chaudri MN, Qureshi RA. 1991.** Pakistan's Endangered Flora –II. *Pakistan Systematics* **5(1- 2)**, 1-84.
- Davis SD, Heywood VH, Hamilton AC. 1995.** Centres of Plant Diversity: a guide and strategy for their conservation, Vol. 2 (Asia, Australasia and the Pacific). Cambridge: IUCN.
- El-Keblawy A, Al-Rawai A. 2007.** Impacts of the invasive exotic *Prosopis juliflora* (Sw.) D.C. on the native flora and soils of the UAE. *Plant Ecology* **190(1)**, 23-35.
- Engler M. 2008.** The Value of International Trade. *Traffic Bulletin* **22(1)**, 4-5.
- Govaerts R. 2001.** How many species of seed plants are there? *Taxon* **50(4)**, 1085-1090.
- Hawksworth DL, Kalin-Arroyo MT. 1995.** Magnitude and distribution of biodiversity. In: *Global Biodiversity Assessment*. (Ed.): V.H. Heywood. Cambridge University Press, Cambridge, UK; 107-192.
- Hirway I, Goswami S. 2007.** Valuation of Coastland Resources. The Case of Mangroves in Gujrat. Academic Foundation. India.
- Huston MA. 1994.** Biological Diversity: The Coexistence of Species on Changing Landscape. Cambridge University Press, Cambridge.
- Khan M (2007).** Ethnobotany of Tehsil Karak NWFP PAKISTAN. M.Phil Thesis. Kohat University of Science and Technology, Kohat, Khyber Pakhton Khawa, Pakistan.
- Khan M, Musharaf S, Shinwari ZK. 2011.** Ethnobotanical importance of halophytes of Noshpho salt mine, District Karak, Pakistan. *Research In Pharmaceutical Biotechnology* **3(4)**, 46-52.
- Kruckeberg AR, Rabinowitz D. 1985.** Biological aspects of endemism in higher plants. *Annual Reviews of Ecological Systematics* **16**, 447-479.
- Myers N. 1988.** Threatened Biotas: "Hotspots" in tropical forests. *Environmentalist* **8**, 1-20.

- Nasir YJ. 1991.** Threatened plants of Pakistan. In: Plant Life of South Asia. (Eds.): S.I. Ali & A. Ghaffar. Shamim Press, Karachi, 229-234.
- Noor M, Salam U, Khan MA. 1995.** Allelopathic effects of *Prosopis juliflora* Swartz. Journal of Arid Environments. **31(1)**, 83-90.
- Pallewatta N, Reaser JK, Gutierrez AT. 2003.** Invasive alien species in South-Southeast Asia: National Reports & Directory of Resources. Global Invasive Species Programme, Cape Town, South Africa.
- Pasiecznik N. 1999.** *Prosopis* - pest or providence, weed or wonder tree? European Tropical Forest Research Network Newsletter. **28**, 12-14.
- Pieper RD. 1994.** Ecological implications of livestock grazing. In: Ecological Implications of Livestock Herbivory in the West. (Eds.): M. Vavra, W.A. Laycock and R.D. Pieper. Society for Range Management, Denver, CO, 177-211.
- Primental D, Lach L, Zuniga R, Morrison D. 2000.** Environmental and economic costs of non-indigenous species in the United States. Bioscience **50**, 53-65.
- Rabinowitz D. 1981.** Seven forms of rarity. In: *The Biological Aspects of Rare Plant Conservation*. (Ed.): H. Synge. Wiley & Sons Ltd. 205-217.
- Sala OE, Chapin FS, Armesto JJ, Berlow E, BloomfieldJ, Dirzo R, Huber-Sanwald E, Huenneke LF, Jackson RB, KinzigA, Leemans R, LodgeDM, Mooney HA, Oesterheld M, Poff NL, Sykes MT, Walker BH, Walker N, Wall DH. 2000.** Global Biodiversity Scenarios for the Year 2100. Science **287(5459)**, 1770-74.
- Sudharsan C, Abo El-Nil M, Hussain J. 2003.** Tissue culture technology for the conservation and propagation of certain native plants. Journal of Arid Environments **54**, 133-147.
- Wilcove DS, Rothstein D, Dubow J, Phillips A, Losos E. 1998.** Quantifying threats to imperiled species in the United States. Bioscience **48**, 607-615.