

## EVALUATION OF THE CONSERVATION STATUS OF *ULMUS WALLICHIANA* AND *U. VILOSA* IN PAKISTAN

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### Abstract

In the present study, conservation status of *Ulmus wallichiana* and *U. villosa* have been evaluated according to IUCN Red List Categories and Criteria 2001. In Pakistan, the genus is represented by three species i.e., *Ulmus wallichiana* Planch., *U. villosa* Brandis ex Gamble and *U. chumlia* Melville & Heybroek, endemic to Hindu Kush and Himalayas within a small geographical range. During the field surveys from 2017 to 2019, *Ulmus wallichiana* was recorded in 52 localities and *U. villosa* in 66 localities. All these localities collectively encompass an area of 1632 km<sup>2</sup> for *Ulmus wallichiana* and 2544 km<sup>2</sup> for *Ulmus villosa* as extent of occurrence. The estimated area of occupancy in the observed localities was 68 km<sup>2</sup> and 156 km<sup>2</sup> for *Ulmus wallichiana* and *U. villosa*, respectively. Moreover, the population size of *U. wallichiana* comprised of 70 individuals and 283 individuals of *U. villosa*. Based upon the aforementioned estimations and IUCN Red List Categories and Criteria 2001, *U. wallichiana* has been evaluated as Critically Endangered (CR) and *U. villosa* as Endangered (EN). For effective conservation of these species, immediate in-situ and ex-situ conservation efforts are proposed.

**Key words:** Conservation status, *Ulmus wallichiana*, *Ulmus villosa*, Critical Endangered, Endangered, Hazara division, Pakistan.

### Introduction

Owing to its distinct topography and peculiar geographic position, Pakistan possesses enormous floral diversity. More than 6000 species of vascular plant have been reported from this region (Rahman *et al.*, 2016a, 2019; Shaheen *et al.*, 2016) where some 400 taxa are reported as endemic to Pakistan (Ali, 2008). However, to date, only 53 taxa have been evaluated according to the IUCN Red List Categories and Criteria 2001 (Anon., 2001; Muhammad *et al.*, 2017). Of these, 21 species are Critically Endangered, 11 Endangered, 2 Vulnerable, 8 possibly extinct, 2 regionally extinct, 1 extinct and the remaining are Data Deficient (Ali, 2000; Abbas, 2010; Abbas *et al.*, 2010; Alam & Ali, 2009; Alam & Ali, 2010; Ali, & Qaiser, 2010a, 2010b, 2010c, 2011, 2012; Muhammad *et al.*, 2017). This hardly encompasses about 0.8% of the flora of Pakistan. Therefore, evaluation of the conservation status of the flora of Pakistan is warranted on urgent basis; and particularly the endemic taxa of Pakistan as the top priority.

Elms belong to the genus *Ulmus* L. (Ulmaceae Mirb.) are deciduous and semi-deciduous woody plants, native to the temperate and subtropics of Northern Hemisphere (Buchel, 2000; Ahmad, 2004). Globally, the genus is represented by some 45 species with widespread distribution in the Northern Hemisphere (Akhter, 1985), and three species extend into the tropics (Richens, 1983). In Pakistan, the genus is represented by three species i.e. *Ulmus wallichiana* Planch., *Ulmus villosa* Brandis ex Gamble and *Ulmus chumlia* Melville & Heybroek. *Ulmus wallichiana* is distributed from Afghanistan to Nepal within a range of 2200-3000 meters above the sea level

(Akhter, 1985). Several of the recent studies have shown that there is a continuous decline in the population of the *Ulmus wallichiana* (Ahmad, 2004; Batool *et al.*, 2014). *Ulmus villosa* is a medium to large size tree, distributed in the North West and Western Himalayas to Kulu within a range of 1200-2700 m. Compared to the *Ulmus wallichiana*, the species is relatively more common in Hazara and Kashmir regions of Pakistan (Akhter, 1985). Its wood is utilized in construction as well as in furniture industry and the population of the species is declining rapidly (Batool *et al.*, 2014).

Based on the field surveys carried out during 2017-2019, the current study aimed to evaluate the conservation status of *Ulmus wallichiana* and *Ulmus villosa* according to the IUCN Red List Categories and Criteria 2001 (Anon., 2001). Population size, quality of habitat, phenology, traditional uses and geographic distribution of the species was studied in their natural habitats.

### Materials and Methods

**Study area:** Hazara division comprises the Eastern part of Khyber Pakhtunkhwa (KP) Province of Pakistan (Fig. 1). Its boundaries join the Northern Areas and Azad Kashmir on the North and East (Rahman *et al.*, 2021). Islamabad and the Punjab province are on its South, whilst towards the West is rest of the KP. The river Indus runs through the division in a North-South line, forming much of the western border of the division. Six districts, i.e., Abbottabad, Battagram, Haripur, Mansehra, Kohistan and Torghar makes Hazara Division. Population of the area was estimated to be over 4.5 million in 2005 and the total area was about 18013 km<sup>2</sup> (Akber, 2014).

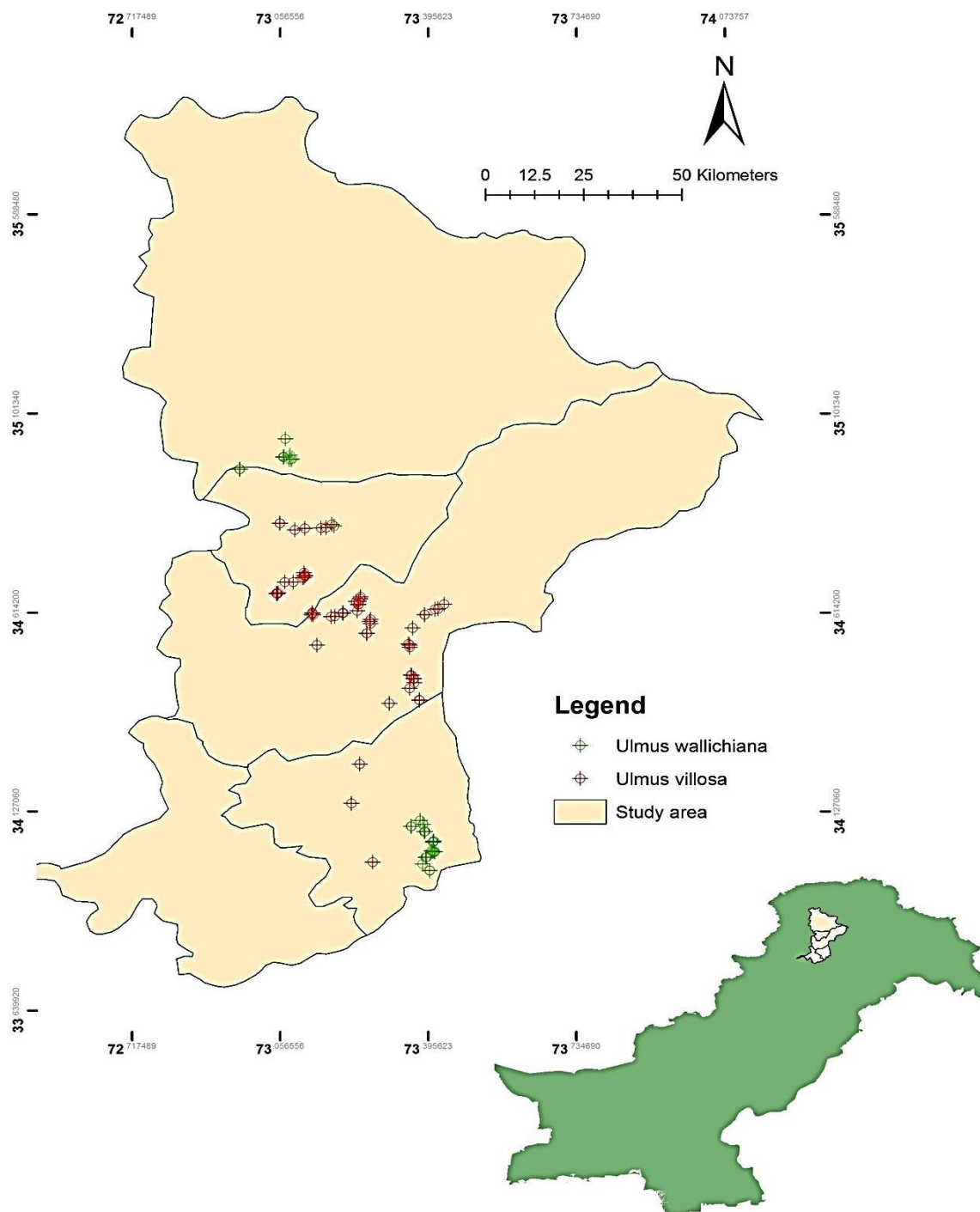


Fig. 1. Map of Hazara Division showing the distribution pattern of *Ulmus wallichinana* (in green) and *Ulmus vilosa* (in red), and the pale colour indicates the study area (Hazara division, KP, Pakistan).

**Experimental Design:** Detailed and comprehensive field surveys were conducted during 2017-2019. Information regarding distribution, presence localities, elevation, geographical coordinates, population size (Tables 1 and 2) type of habitat(s), distribution range, anthropogenic threats like grazing, uprooting pressure, over-exploitation and habitat degradation were recorded and studied in their natural habitats. For population size, number of mature individuals were counted per unit area; individual plants found in flowering or fruiting were considered as a mature individual (Muhammad *et al.*, 2017). Nature of habitat was determined by considering grazing impact, accessibility to the locality,

deforestation, soil erosion, and other anthropogenic impacts. Identification of specimens followed the Flora of Pakistan (Akhter, 1985) and conservation status of the taxon was evaluated following the IUCN criteria (Anon., 2001). Maps were drawn as per the GIS standard protocols for the estimation of Extent of Occurrence (EOO) and Area of Occupancy (AOO). Plant samples of both the species were collected, processed according to standard herbarium techniques (Ijaz, 2014; Ijaz *et al.*, 2016; Rahman *et al.*, 2016b, 2018a,b; Bano *et al.*, 2018; Khan *et al.*, 2018) and the specimens were deposited in the herbarium of Hazara University Mansehra, Pakistan.

**Table 1. Details of population size of *Ulmus wallichiana* in different known localities.**

S. No	District	Union council	Locality	Altitude (m)	N	E	Plant status (individuals)		
							2017	2018	2019
1.	Abbottabad	Nathia gali	Governor House	2406m	34.07665	73.3866	2	2	2
2.	Abbottabad	Nathia gali	Governor House	2400m	34.7776	73.3882	1	1	1
3.	Abbottabad	Nathia gali	Governor House	2391m	34.07788	73.38837	3	3	3
4.	Abbottabad	Nathia gali	Governor House	2402m	34.07798	73.38741	2	2	2
5.	Abbottabad	Nathia gali	Donga gali	2377m	34.05211	73.40651	2	2	2
6.	Abbottabad	Nathia gali	Donga gali	2388m	34.05415	73.40823	1	1	1
7.	Abbottabad	Nathia gali	Donga gali	2392m	34.05427	73.40806	1	1	1
8.	Abbottabad	Nathia gali	Donga gali	2376m	34.05249	73.40705	1	1	1
9.	Abbottabad	Nathia gali	Donga gali	2378m	34.0518	73.40672	3	3	3
10.	Abbottabad	Nathia gali	Donga gali	2376m	34.05177	73.40668	6	6	6
11.	Abbottabad	Namli maira	Namli maira	1874m	34.10485	73.37735	1	0	0
12.	Abbottabad	Namli maira	Ali pad Ghalari	1877m	34.1049	73.3775	1	0	0
13.	Abbottabad	Namli maira	Maira khurd	1967m	34.09528	73.38416	1	0	0
14.	Abbottabad	Namli maira	Maira khurd	1966m	34.09538	73.3843	1	1	0
15.	Abbottabad	Namli maira	Maira khurd	1956m	34.09528	73.38428	1	1	0
16.	Abbottabad	Pluck	Ayubia	2358m	34.0286	73.40633	1	1	1
17.	Abbottabad	Pluck	Ayubia	2366m	34.0286	73.40653	1	1	1
18.	Abbottabad	Baroot	Ayubia national park	2356m	34.02957	73.40524	1	1	1
19.	Abbottabad	Baroot	Ayubia national park	2363m	34.02812	73.40992	1	1	1
20.	Abbottabad	Baroot	Ayubia national park	2339m	34.0308	73.40259	1	1	1
21.	Abbottabad	Baroot	Ayubia national park	2359m	34.02818	73.41035	1	1	1
22.	Abbottabad	Baroot	Ayubia national park	2359m	34.02805	73.41012	1	1	1
23.	Abbottabad	Baroot	Ayubia national park	2355m	34.02813	73.41058	1	1	1
24.	Abbottabad	Baroot	Ayubia national park	2358m	34.02827	73.41059	1	1	1
25.	Abbottabad	Nagri bala	Bara gali campus	2314m	34.09019	73.35638	1	1	1
26.	Abbottabad	Nagri bala	Bara gali campus	2280m	34.09024	73.35679	2	2	2
27.	Abbottabad	Nagri bala	Bara gali campus	2294m	34.09031	73.35709	1	1	1
28.	Abbottabad	Nagri bala	Bara gali campus	2312m	34.09036	73.35634	8	8	8
29.	Abbottabad	Taj val	Kooza gali	2442m	34.01553	73.39209	1	1	1
30.	Abbottabad	Pluck	Kooza gali	2465m	34.01523	73.39202	1	1	1
31.	Abbottabad	Taj val	Kooza gali	2439m	34.01553	73.39196	4	4	4
32.	Abbottabad	Taj val	Kooza gali	2470m	34.01451	73.39091	3	3	3
33.	Abbottabad	Taj val	Moorti	2453m	34.01387	73.39003	1	1	1
34.	Abbottabad	Taj val	Moorti	2452m	34.01374	73.79007	1	1	1
35.	Abbottabad	Taj val	Moorti	2450m	34.01595	73.38027	1	1	1
36.	Abbottabad	Pluck	Changa gali	2507m	33.9984	73.38274	1	1	1
37.	Abbottabad	Seer mashriqi	Khara gali	2307m	33.982	73.3988	1	1	1
38.	Abbottabad	Seer mashriqi	Khara gali	2319m	33.98051	73.3975	1	1	1
39.	Abbottabad	Seer maghrabi	Khara gali	2337m	33.98331	73.39921	1	1	1
40.	Kohistan (Kuz palas)	Bar sheryal	Doga	2415m	34.99411	73.06381	1	1	1
41.	Kohistan (Kuz palas)	Bar sheryal	Doga	2460m	34.99447	73.06427	1	1	1
42.	Kohistan (Kuz palas)	Bar sheryal	Doga	2355m	34.99439	73.06582	2	2	0
43.	Kohistan (Kuz palas)	Bar sheryal	Madian chapri	2270m	34.98827	73.07742	1	1	1
44.	Kohistan (Kuz palas)	Bar sheryal	Youdoon abad bela	1965m	34.99816	73.078867	1	1	1
45.	Kohistan (Kuz palas)	Bar sheryal	Speen qala	2170m	34.987635	73.080962	1	0	0
46.	Kohistan (Kuz palas)	Bar sheryal	Thoki dheri nala	2097m	34.989346	73.0838	1	0	0
47.	Kohistan (palas)	Kuz sheryal	Kuz khurge	2128m	35.038653	73.068754	1	1	1
48.	Kohistan	Mada khell	Baila (Pallas)	2118m	34.964725	72.963767	1	1	0
49.	Kohistan	Mada khell	Baila (Pallas)	2090m	34.9642421	72.9641747	1	1	1
50.	Kohistan	Mada khell	Baila (Pallas)	2112m	34.964479	72.96456	1	1	1
51.	Battagram(Allai)	Rashange	Ganga val	1936m	34.82929	73.17526	5	5	3
52.	Battagram(Allai)	Rashange	Jabba ganga val	1980m	34.82487	73.18026	1	1	1

Table 2. Details of population size of *Ulmus villosa* in different known localities.

S.No	District	Union council	Locality	Altitude (m)	N	E	Plant status (individuals)		
							2017	2018	2019
1.	Mansehra	Chatter plain	Baila Ziarat	1597m	34.6085	73.12873	1	1	0
2.	Mansehra	Chatter plain	Baila Noor gul	1578m	34.61277	73.13036	1	1	1
3.	Mansehra	Chatter plain	Baila Noor gul	1574m	34.61234	73.13036	1	0	0
4.	Mansehra	Chatter plain	Lachi mang Ziarat	1588m	34.60814	73.13258	4	4	4
5.	Battagram	Shumli	Shumli Bazar	1498m	34.70391	73.11483	1	1	1
6.	Battagram	Shumli	Beesa khit	1526m	34.71107	73.11139	1	1	1
7.	Battagram	Battamori	Shingri	1212m	34.68866	73.0681	1	1	1
8.	Battagram	Battamori	Battamori	1281m	34.68851	73.08701	1	1	1
9.	Mansehra	Garlat	Lower narraha	976m	34.53662	73.35029	15	12	12
10.	Mansehra	Garlat	Usman Chowk Narraha	985m	34.53392	73.35365	4	2	2
11.	Mansehra	Garlat	Khawas	993m	34.52828	73.35372	1	1	0
12.	Mansehra	Shohal	Kot bala	939m	34.45985	73.3586	2	2	2
13.	Mansehra	Shohal	Kot bala	949m	34.46059	73.35648	1	1	1
14.	Mansehra	Thalata	Thalata	895m	34.45216	73.36149	2	2	2
15.	Mansehra	Thalata	Thalata	896m	34.45091	73.36244	32	30	30
16.	Mansehra	Thalata	Kagal	857m	34.44135	73.3638	20	14	14
17.	Mansehra	Gari Habib ullah	Gari pull	809m	34.39928	73.37648	1	1	1
18.	Mansehra	Gari Habib ullah	Eid gaha Chowk	775m	34.39999	73.37563	1	1	1
19.	Mansehra	Karnool	Jageer Gari Habibullah	835m	34.42842	73.35376	1	1	1
20.	Mansehra	Boogar mang	Boogar mang	1289m	34.56862	73.25709	1	1	1
21.	Mansehra	Boogar mang	Ghazi baba Ziarat	1207m	34.56302	73.25539	1	1	1
22.	Mansehra	Boogar mang	Ghazi baba Ziarat	1207m	34.56302	73.25559	1	1	1
23.	Mansehra	Boogar mang	Andrasi	1286m	34.58615	73.26382	1	1	1
24.	Mansehra	Jaboori	Booz baila	1303m	34.59195	73.26227	9	9	7
25.	Mansehra	Jaboori	Booz baila	1363m	34.59708	73.264	1	1	1
26.	Mansehra	Sachian	Sachian	1486m	34.61811	73.23317	5	4	4
27.	Abbottabad	Kehal	GPGC Abbottabad	1214m	34.14666	73.22042	1	1	1
28.	Abbottabad	Deeva minal	Saji kot ziarat	1436m	34.00293	73.26843	2	2	2
29.	Abbottabad	Baldheri	Olympia ferm	1246m	34.24299	73.23874	3	3	0
30.	Mansehra	Jaber Devli	Treeda	1675m	34.6404	73.23672	10	9	8
31.	Mansehra	Jaber Devli	Treeda	1711m	34.64179	73.23734	8	8	8
32.	Mansehra	Jaber Devli	Treeda	1695m	34.64704	73.23972	20	18	17
33.	Mansehra	Jaber Devli	Treeda	1712m	34.65224	73.24152	7	7	6
34.	Mansehra	Sachian	Nawaz Abad	1585m	34.64103	73.23092	37	37	27
35.	Mansehra	Sachian	Domel	1488m	34.63368	73.23587	10	8	7
36.	Mansehra	Sachian	Domel	1509m	34.63296	73.23542	50	47	47
37.	Mansehra	Ganool	Rajoori	1170m	34.57598	73.36041	6	4	4
38.	Mansehra	Ganool	Kolian	1365m	34.60821	73.38795	20	15	15
39.	Mansehra	Ganool	Dibria	1387m	34.60808	73.38766	5	5	3
40.	Mansehra	Kavai	Kavai mor	1489m	34.63407	73.43256	1	1	1
41.	Mansehra	Ganool	Doomdar	1385m	34.62251	73.41818	1	1	0
42.	Mansehra	Ganool	Gamoonaka kaghan road	1467m	34.6213	73.411	12	9	7
43.	Mansehra	Kavai	Rasha pull	1489m	34.66048	73.4706	1	0	0
44.	Mansehra	Hilkot	Sathian gali	1912m	34.61236	73.20141	3	2	2
45.	Mansehra	Hilkot	Sathian gali	1920m	34.61274	73.20134	2	2	2
46.	Mansehra	Hilkot	Sathian gali	1928m	34.61197	73.20053	3	2	2
47.	Mansehra	Hilkot	Sathian gali	1916m	34.61227	73.201	2	1	1
48.	Mansehra	Hilkot	Sumbul	1708m	34.60355	73.17332	1	0	0
49.	Mansehra	Malkian	Gali gadian	1839m	34.60458	73.18181	2	2	2
50.	Battagram	Ajmara	Dairy chapar gram	1123m	34.66123	73.05275	3	3	3
51.	Battagram	Ajmara	Chaper gram moh: Tal	1089m	34.66109	73.04856	5	4	2
52.	Battagram	Ajmara	Chaper gram moh: Tal	1094m	34.6596	73.05021	3	2	2
53.	Battagram	Ajmara	Chaper gram moh: Tal	1084m	34.66088	73.04893	3	3	3
54.	Battagram	Ajmara	Tamai Ziarat	1073m	34.65958	73.05016	1	1	1
55.	Battagram	Shumli	Beela tarla	1419m	34.69962	73.11137	1	1	0
56.	Battagram	Shumli	Beela tarla	1396m	34.69823	73.10862	1	1	1
57.	Battagram	Shumli	Moh: Amin Abad	1490m	34.70409	73.11385	1	0	0
58.	Battagram	Shumli	Bansair	1447m	34.70406	73.11129	1	0	0
59.	Mansehra	Icharian	Bai tarli wali Ziarat	1294m	34.53402	73.14091	2	2	2
60.	Mansehra	Attar sheesha	Attar sheesha Bazar	1099m	34.39156	73.30638	4	4	4
61.	Battagram(Allai)	Rashange	Jangri Ganga val	1848m	34.8214	73.16209	1	1	1
62.	Battagram(Allai)	Rashange	Sokai Rashange	1852m	34.82042	73.15033	2	2	2
63.	Battagram(Allai)	R ashange	Rashange khas	1597m	34.81982	73.11304	9	9	6
64.	Battagram(Allai)	Biri	Biri Khas	1492m	34.8159	73.0903	1	1	1
65.	Battagram(Allai)	Biri	Karag Bazar	1332m	34.83192	73.05662	1	1	1
66.	Battagram(Allai)	Biri	Karag Bazar	1341m	34.83184	73.05606	1	1	1

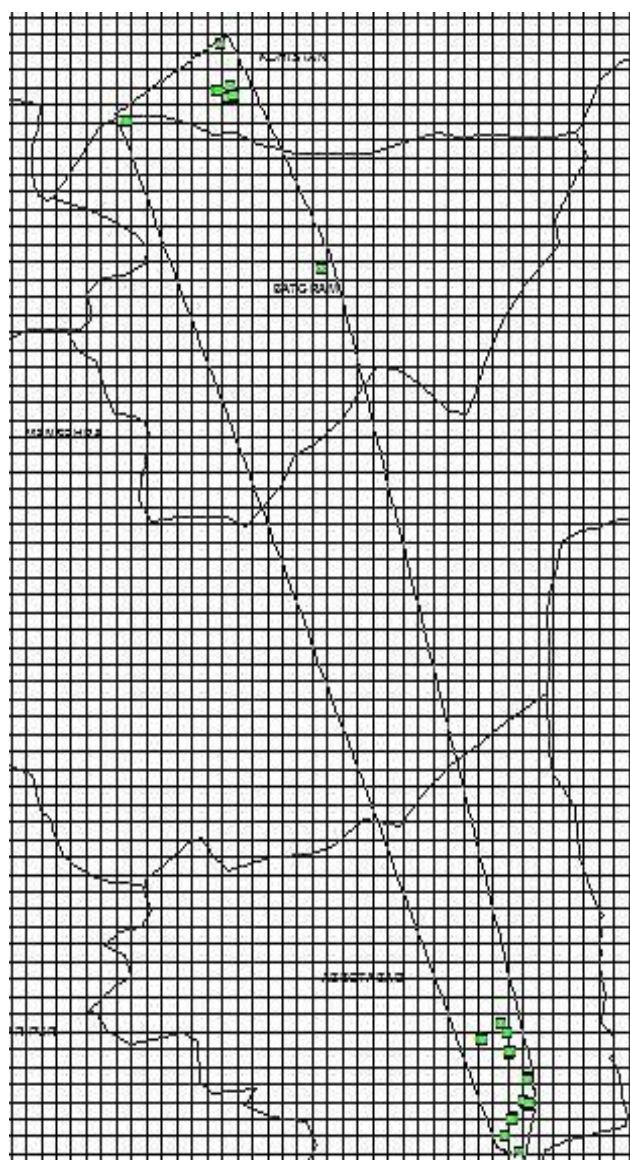


Fig. 2. Extent of Occurrence of *Ulmus wallichiana* in different localities of Hazara division.

**Results**

**Habit and habitat:** Elms are all woody perennials of allogamous and hermaphroditic reproductive nature, flowers being small, perfect and apetalous, are wind-pollinated. Flowers appear in late winter or early spring before foliation but a small number of species flower in late summer or fall. These species grow at an elevation range of 2200-3000m. Most individuals of the taxon were found growing in areas with slopes, on limestone cliffs and at the rocks edges in dense as well as in fragmented form.

**Distribution**

These taxa are confined to Himalayan ranges mostly. During the current study, *Ulmus wallichiana* was recorded in 52 localities (Table 1) and *U. villosa* in 66 localities (Table 2 and Fig. 1). The species were predominantly distributed on slopes as well as rocky areas. However, in some cases, some individuals of the taxon were found within the dense forests of *Pinus wallichiana*, *Abies*

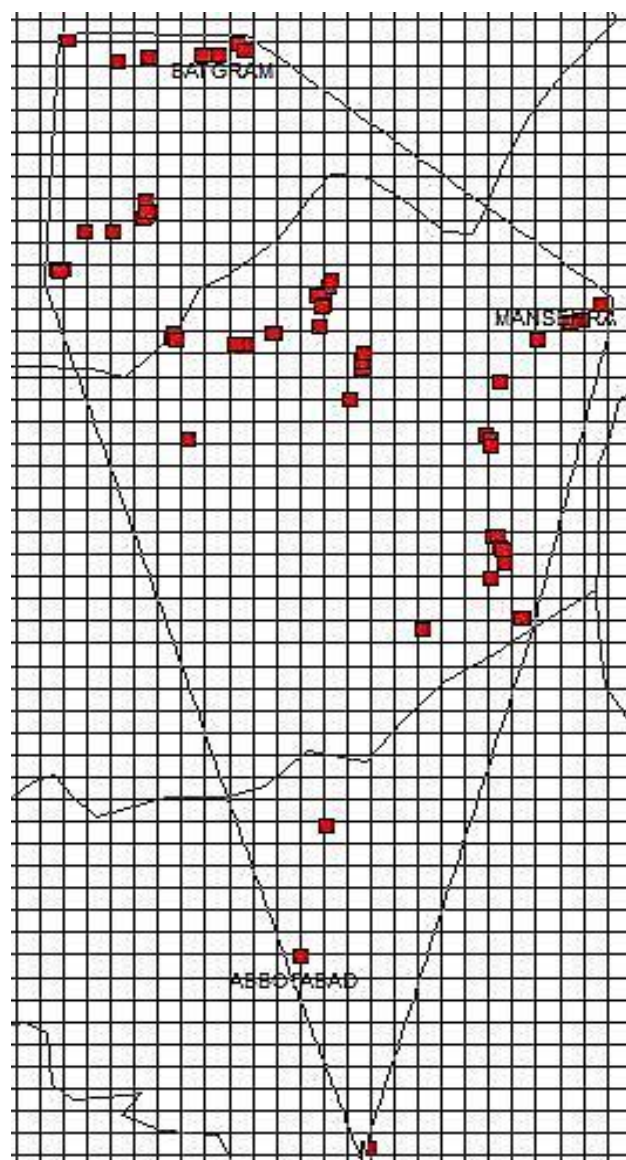


Fig. 3. Extent of Occurrence of *Ulmus villosa* in different localities of Hazara division.

*pindrow*, *Picea smithiana* and *Pinus roxburgii*. All these localities collectively encompassed an area of 1632 km<sup>2</sup> for *Ulmus wallichiana* and 2544 km<sup>2</sup> for *Ulmus villosa* as extent of occurrence (Table 3). The highest area of occupancy was observed in locality 4 followed by locality 6 and the remaining localities were less than 11 km<sup>2</sup> area. The estimated area of occupancy in the observed localities was about 68 km<sup>2</sup> and 156 km<sup>2</sup> for *Ulmus wallichiana* (Fig. 2) and *U. villosa* (Fig. 3) respectively.

**Population size:** Observed population size in different localities has been given in the Table 3. A total of 70 individuals of *Ulmus wallichiana* and 283 individuals of *U. villosa* were recorded in these localities (Table 4). Locality-wise, the highest number of *U. wallichiana* individuals (8) were observed in Bara gali (Abbottabad), followed by 6 individuals. The remaining localities had less than 6 plant individuals each (Table 3). Similarly, maximum number of individuals of *U. villosa* (47) were recorded in Domel, Mansehra.

**Natural threats:** As this taxon inhabiting in the subalpine zone where heavy snowfall damages the seedlings of taxon and young branches inclined due to the snow avalanches. Heavy rainfall is also a severe threat because of the greater run-off at higher altitude. The topsoil of the habitat is degraded due to heavy rainfall.

**Anthropogenic impact:** These taxa grows at high altitudinal ranges of the Hazara division and facing serious anthropogenic disturbances (Fig. 4). Due to the

harsh climatic condition and chilling weather in winter, the inhabitants mostly depend upon the fuel wood due to the lack of other alternative facilities. The taxa are mostly traded both for construction as timber as well as fuel wood which reflects in the habitat degradation and continuous decline in the survival of *U. wallichiana* and *U. villosa*. Roads are under construction in different parts of Hazara division, the CPEC has also been completed in November 2019 and those road crosses added serious threats in the habitat rich spots.



Fig. 4. Buildings and houses construction within the natural habitat of *Ulmus villosa*. Right hand side is an old tree of *U. villosa* struck by thunderstorm.

**Table 3. *Ulmus wallichiana* and *U. villosa*: Summary of geographical range (Extent of occurrence & Area of occupancy in km<sup>2</sup>).**

Investigated plant species	Extent of occurrence	Area of occupancy in km <sup>2</sup>
<i>Ulmus wallichiana</i>	1632 km <sup>2</sup>	68 km <sup>2</sup>
<i>Ulmus villosa</i>	2544 km <sup>2</sup>	156 km <sup>2</sup>

**Table 4. Summary of known localities, population size, geographical range and various anthropogenic and natural threat observed in the study taxa.**

Taxa	Known Localities	Population size (individuals)	Geographic range		Anthropogenic and natural threat				
			E.O Km <sup>2</sup>	A.O Km <sup>2</sup>	A	B	C	D	E
<i>Ulmus villosa</i>	52	283	2544	156	+	+	+	+	+
<i>Ulmus wallichiana</i>	66	70	1632	68	+	+	+	+	+

Key: E.O; Extent of occurrence, A.O; Area of occupancy, A) Deforestation, B) Soil erosion, C, Medicinal uses, D) Browsing, E) Road construction. (+ present: – absent).

## Discussion

Initial efforts of ecological significance and rapid decline in *U. wallichiana* population from its natural habitats in Pakistan were led by Ahmad (2004). The current assessed the conservation issues and biodiversity loss of *Ulmus* species. More recently, conservation of species has been one of the most serious issues around the world as conservation and biodiversity of species ensures the survival of human being itself (Sala *et al.*, 2000). Unfortunately, this issue has not been taken much seriously and it is particularly alarming in the developing

world including Pakistan. Over the years, only 55 taxa have been evaluated in Pakistan so far, in connection to the risks of extinction (Abbas *et al.*, 2010; Alam & Ali, 2009, 2010; Ali & Qaiser, 2010; Muhammad *et al.*, 2017). Moreover, these studies have highlighted that 51 taxa (92.60%) are endemic to Pakistan, while the remaining 4 taxa are rare for Pakistan (Muhammad, 2013).

Endemic species have less ability to compete as compared to the widely distributed species (Rabinowitz, 1981; Majid *et al.*, 2019). In case of the *Ulmus villosa* and *U. wallichiana*, their distribution is restricted to 1200-2700m and 2200-3000m altitudinal range, respectively.

Both the species were recorded in the Cliffs and dense forests. These results suggest that the taxon have the ability of competition and can easily survive in different habitats.

Fragmentation of habitat and deforestation is also considered to be a primary serious threat for survival of species (Anon., 2001; Barbosa & Marquet, 2002; Muhammad *et al.*, 2017). As for as the population size is concerned, 52 localities have been recorded for *U. wallichiana* which collectively support 70 individuals only. On the other hand, *U. villosa* was found in 66 different localities residing its 283 individuals (Table 4). These results suggest that, distribution pattern is not uniform and in major portion of the distribution range, individuals of the taxon are absent. Distribution pattern in connection with survival of a species in a habitat is a key component and strong and important parameter (Muhammad *et al.*, 2017). Moreover, these localities are alarmingly exposed to browsing and deforestation. Based on its distribution pattern, both the taxa faced mitigating natural and anthropogenic impact. Nonetheless, climate change, soil erosion and habitat fragmentation put severe pressure in this connection (Singh, 2009).

***Ulmus wallichiana*:** was thoroughly assessed based on IUCN Red Categories and Criteria 2001 (Anon., 2001). Criterion A could not be applied being data deficiency. As per criterion B Extent of Occurrence (EOO) was 1632 Km<sup>2</sup> (B1) along severely fragmented populations (a) and continuous decline in number of mature individuals (v). While area of occupancy (AOO) was determined to be 68 Km (less than 500 Km<sup>2</sup>) hence species qualifies for Endangered category [EN B1 ab(v)]. While applying Criterion C total number of mature individuals were reported to be 70 (<250) in final year of assessment having less than 50 individuals in largest sub population C2 a (i) thus qualified for Critically Endangered [CR C C2 a(i)]. Applying Criterion D number of individuals are less than 250 individuals thus classified as Endangered (EN D1). Criterion E Could not be applied due data deficiency. *U. wallichiana* is assigned Critically Endangered (CR) category. Keeping in view the IUCN guidelines stating that "the precautionary approach is to take the highest category shown".

***Ulmus villosa*:** was assessment is based on IUCN Red Categories and Criteria 2001 (Anon., 2001). As per criterion B Extent of Occurrence (EOO) was 2544 Km<sup>2</sup> (less than 5000 Km<sup>2</sup> (B1) along severely fragmented populations (a) and continuous decline in number of mature individuals (v). While area of occupancy (AOO) was determined to be 156 Km<sup>2</sup> (less than 500 Km<sup>2</sup>) hence species qualified for Endangered category [EN B1 ab(v)]. While applying Criterion C total number of mature individuals were reported to be 283 (<2500) in the last year having less than 250 individuals in largest sub population C2 a (i) thus qualified for Endangered category [EN C C2 a(i)]. While applying Criterion D, the number of individuals are 283 (<2500) assignning it in to a Vulnerable (VU D1) category. Criterion E Could not be applied due data deficiency. *U. villosa* is assigned Endangered (EN) category at regional level keeping in view the IUCN guidelines where precautionary approach may be applied.

## References

- Buchel, A. 2000. The species of the genus *Ulmus* L. In: *The Elms: Breeding Conservation and Disease Management* Kluwer Academic Publisher, Norwell Massachusetts USA.
- Abbas, H. 2010. Ex-situ conservation of some threatened endemic and rare plants of southern Pakistan through tissue culture. Ph.D. Thesis, University of Karachi, Pakistan.
- Abbas, H., M. Qaiser and J. Alam. 2010. Conservation status of *Cada heterotricha* Stocks (Capparidaceae): an endangered species in Pakistan. *Pak. J. Bot.*, 42(1): 35-46.
- Ahmad, H. 2004. Conservation status of ten endangered plant species of Hindu Raj Mountains. WWF-SC Project Report, WWFP, Ferozpur Road Lahore.
- Akber, N. 2014. Genetic analyses of the major tribes of Abbottabad and Mansehra Districts through dental morphology and DNA Analyses." PhD dissertation, Department of Genetics, Hazara University, Mansehra.
- Akhter, R. 1985. In: *Flora of Pakistan: Ulmaceae*, (Eds.): Nasir, E. and S.I. Ali. Volume 170, pp. 11. Department of Botany, University of Karachi.
- Alam, J. and S.I. Ali. 2009. Conservation status of *Astragalus gilgitensis* Ali (Fabaceae): a critically endangered species in Gilgit District, Pakistan. *Phyton* (Horn, Austria), 48: 211-223.
- Alam, J. and S.I. Ali. 2010. Contribution to the Red List of the Plants of Pakistan. *Pak. J. Bot.*, 42(5): 2967-2971.
- Ali, H. and M. Qaiser. 2010. Contribution to the Red List of Pakistan: A case study of *Astragalus gahiratisensis* Ali. (Fabaceae-Papilionoideae). *Pak. J. Bot.*, 42: 1523-1528.
- Ali, H. and M. Qaiser. 2010. Contribution to the red list of Pakistan: a case study of *Gaillonia chitralensis* (Rubiaceae). *Pak. J. Bot.*, (S.I. Ali Festschrift) 42(SI): 205-212.
- Ali, H. and M. Qaiser. 2010b. Contribution to the Red List of Pakistan: A case study of *Silene longisepala*. *Oryx-The Inter. J. Conservation*. (In press).
- Ali, H. and M. Qaiser. 2011. Contribution to the Red List of Pakistan: a case study of *Silene longisepala* (Caryophyllaceae). *Oryx*. 45(4): 522-527.
- Ali, H. and M. Qaiser. 2012. Contribution to the red list of the plants of Pakistan: A case study of a narrow endemic *Astragalus chitralensis* Ali (Fabaceae-Papilionoideae). *Pak. J. Bot.*, 44(5): 1741-1744.
- Ali, S.I. 2000. Impact of environmental degradation on biodiversity. In: *Proceedings Pakistan Academy of Science*, 37(1): 93-97.
- Ali, S.I. 2008. Significance of flora with special reference to Pakistan. *Pak. J. Bot.*, 40(3): 967-971.
- Anonymous. 2001. IUCN Red List Categories and Criteria: Version 3.1. IUCN Species Survival Commission IUCN, Gland, Switzerland and Cambridge, U.K.
- Bano, S., S.M., Khan, J. Alam, A.A. Alqarawi, E.F. Abd\_Allah, Z. Ahmad, I.U. Rahman, H. Ahmad, A. Aldubise and A. Hashem. 2018. Eco-floristic studies of the Beer Hills along the Indus River in the districts Haripur and Abbottabad, Pakistan. *Saudi J. Biol. Sci.*, 25: 801-810.
- Barbosa, O. and P.A. Marquet. 2002. Effects of forest fragmentation on the beetle assemblage at the relict forest of Fray Jorge, Chile. *Oecologia*, 132: 296-306.
- Batool, N., Y. Bibi and N. Ilyas. 2014. Current status of *Ulmus wallichiana*: Himalayan endangered Elm. *Pure Appl. Bio.*, 3(2): 60-65.
- Ijaz, F. 2014. Biodiversity and Traditional Uses of Plants of Sarban Hills, Abbottabad. M.Phil Thesis, Department of Botany, Hazara University Mansehra, Dhodial, Pakistan.
- Ijaz, F., Z. Iqbal, I.U. Rahman, J. Alam, S.M. Khan, G.M. Shah, K. Khan and A. Afzal. 2016. Investigation of traditional medicinal floral knowledge of Sarban Hills, Abbottabad, KP, Pakistan. *J. Ethnopharmacol.*, 179: 208-233.

- Khan, K.U., M. Shah, H. Ahmad, S.M. Khan, I.U. Rahman, Z. Iqbal, R. Khan, E.F. Abd\_Allah, A.A. Alqarawi, A. Hashem and A. Aldubise. 2018. Exploration and local Utilization of Medicinal Vegetation Naturally Grown in the Deusai plateau of Gilgit, Pakistan. *Saudi J. Biolog. Sci.*, 25: 326-331.
- Majid, A., H. Ahmad, Z. Saqib, I.U. Rahman, U. Khan, J. Alam, A.H. Shah, S.A. Jan and N. Ali. 2019. Exploring threatened traditional knowledge; ethnomedicinal studies of rare endemic flora from Lesser Himalayan region of Pakistan. *Revista Brasileira de Farmacognosia* 29: 785-792.
- Muhammad, S. 2013. Conservation status of Rhododendron species of Hazara division. M.Phil thesis, Department of Botany, Hazara University, Mansehra, Pakistan.
- Muhammad, S., J. Alam, F. Ijaz, Z.A. Iqbal, U.R. Inayat, A. Majid and N. Ali. 2017. Evaluation of the conservation status of *Rhododendron afghanicum* Aitch. & Hemsl.: A narrow endemic species for Pakistan. *Pak. J. Bot.*, 49(4):1387-1394.
- Rabinowitz, D. 1981. Seven forms of rarity. The Biological Aspects of Rare Plant Conservation. (Eds.): Syngé. Wiley & Sons Ltd. 205-217.
- Rahman, I.U., A. Afzal, E.F. Abd\_Allah, Z. Iqbal, A.A. Alqarawi, Abeer Hashem, E.S. Calixto, N. Ali and R. Asmarayani. 2021. Composition of plant communities driven by environmental gradients in alpine pastures and cold desert of Northwestern Himalaya, Pakistan. *Pak. J. Bot.*, 53(2): 655-664.
- Rahman, I.U., A. Afzal, Z. Iqbal, E.F. Abd\_Allah, A.A. Alqarawi, E.S. Calixto, N. Ali, F. Ijaz, R. Kausar, M.S. Alsubeie, M. Iqbal and M. Shah. 2019. Role of multivariate approaches in floristic diversity of Manoor Valley (Himalayan Region), Pakistan. *Appl. Ecol. & Environ. Res.*, 17(2): 1475-1498.
- Rahman, I.U., A. Afzal, Z. Iqbal, F. Ijaz, N. Ali and R.W. Bussmann. 2018b. Traditional and ethnomedicinal dermatology practices in Pakistan. *Clin. Dermatol.*, 36: 310-319.
- Rahman, I.U., A. Afzal, Z. Iqbal, F. Ijaz, N. Ali, M. Asif, J. Alam, A. Majid, R. Hart and R.W. Bussmann. 2018a. First insights into the floristic diversity, biological spectra and phenology of Manoor Valley, Pakistan. *Pak. J. Bot.*, 50(3): 1113-1124.
- Rahman, I.U., F. Ijaz, A. Afzal, Z. Iqbal, N. Ali and S.M. Khan. 2016a. Contributions to the phytotherapies of digestive disorders: Traditional knowledge and cultural drivers of Manoor Valley, Northern Pakistan. *J. Ethnophar.*, 192: 30-52.
- Rahman, I.U., F. Ijaz, Z. Iqbal, A. Afzal, N. Ali, M. Afzal, M.A. Khan, S. Muhammad, G. Qadir and M. Asif. 2016b. A novel survey of the ethno medicinal knowledge of dental problems in Manoor Valley (Northern Himalaya), Pakistan. *J. Ethnopharm.*, 194C: 877-894.
- Sala, O.E., F.S. Chapin, J.J. Armesto, E. Berlow, J. Bloomfield, R. Dirzo, E. Huber-Sanwald, L.F. Huenneke, R.B. Jackson, A. Kinzig, R. Leemans, D.M. Lodge, H.A. Mooney, M. Oesterheld, N.L. Poff, M.T. Sykes, B.H. Walker, M. Walker and D.H. Wall. 2000. Global Biodiversity Scenarios for the Year 2100. *Science*, 287(5459): 1770-74.
- Shaheen, S., Z. Iqbal, F. Ijaz, J. Alam and I.U. Rahman. 2016. Floristic composition, biological spectrum and phenology of Tehsil Havelian, District Abbottabad, Pakistan. *Pak. J. Bot.*, 48(5): 1849-1859.
- Singh, K.K. 2009. Notes on the Sikkim Himalayan rhododendrons: a taxa of great conservation importance. *Turk. J. Bot.*, 33(4).

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