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# TECHNICAL REPORT

## PRELIMINARY GAP ANALYSIS OF AFGHANISTAN FLORA

**Charles R. Hatch**

**December 2009**



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PRELIMINARY GAP ANALYSIS OF AFGHANISTAN FLORA

FOR USE IN IDENTIFYING

RESEARCH PRIORITY ZONES IN AFGHANISTAN

Analysis Conducted by

Charles R. Hatch

under the

Biodiversity Support Program for NEPA

December 2009

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## **INTRODUCTION**

The Environment Law mandates NEPA to (1) prepare lists of harvestable and protected species occurring in the country, and (2) develop a comprehensive plan for the national protected areas system. In collaboration with the Wildlife Conservation Society (WCS), and with the support of the United Nations Development Programme (UNDP), Global Environment Facility (GEF), United Nations Environment Programme (UNEP) and others, NEPA has begun to implement both of these mandates. The BSP/NEPA is one of the collaborating partners working with NEPA to assist them in achieving these two legislated requirements.

WCS, in collaboration with NEPA, organized an Afghanistan Wildlife Executive Committee (AWEC) to establish within Afghanistan a process for species listings, so that NEPA and its collaborating partners are able to comply with the requirement to update such lists as appropriate. Along with the AWEC activities, NEPA in collaboration with WCS is implementing a project titled Program of Work for Protected Areas (PoWPA) sponsored by UNDP-GEF. Two PoWPA project activities include:

1. Conduct a National Protected Areas Gap Analysis in order to identify gaps in representation and knowledge associated with the current list of proposed protected areas in Afghanistan, and to record biodiversity actions requiring priority attention.
2. Produce a National Protected Areas System Plan based on the results of the Gap Analysis, to ensure that areas of interest from a biodiversity conservation perspective have adequate and/or appropriate representation in the national system of protected areas.

NEPA has asked the BSP/NEPA to support both the PoWPA and AWEC processes, and collaborate in the plant-based assessment of the National Protected Areas Gap Analysis that aims to identify key Priority Zones across Afghanistan for immediate or on-going research.

## **AFGHANISTAN PLANT SPECIES INFORMATION**

A general shortage of information about current Afghanistan plant distribution, abundance and diversity makes it very difficult to assess which species are most threatened. Extensive field collections were undertaken through the 1970s but they are largely housed at the University of Toulouse in France, the University of Munich and University of Kassel in Germany, the Museum of Natural History in Vienna Austria, and the Royal Botanic Garden Edinburgh in the United Kingdom. These collections are believed to hold more than 10,000 specimens of approximately 4-7,000 species but very few of these records are accessible through electronic databases. There are no systematic, nation-wide plant population surveys underway at this time although there are targeted surveys being undertaken by the Food and Agriculture Organization of the United Nations (FAO), and the USAID Pastoral Engagement, Adaptation and Capacity Enhancement (PEACE) project.

## **APPROACH TO THE PLANT SPECIES GAP ANALYSIS**

The objective is to identify plant species that are most threatened so that the geographical areas in Afghanistan that contain those species are used to identify

potential Research Priority Zone sites. To achieve this objective the analysis included the following steps:

1. Create a List of Plant Species in Afghanistan
2. Confirm the Presence of Plant Species in Afghanistan
3. Forecast the Distribution of Plant Species in Afghanistan
4. Identify Locations of Plant Species in Afghanistan

### Create a List of Plant Species in Afghanistan

A gap analysis for plants should begin by creating a list of plant species occurring in Afghanistan followed by the development of a scoring matrix to prioritize the list of plants species with the highest need for protection. Current efforts are underway to construct a list of Afghanistan plant species but that work is only in its initial stages.

The Afghanistan Wildlife Executive Committee (AWEC) used such an approach and developed species selection criteria. The Convention on International Trade in Endangered Species (CITES) listing status and the IUCN Red List of Threatened Species status were two important components in their selection criteria. Although their activities have focused on fauna, they have included a limited number of plants in their species assessment activities and used the scoring matrix to select species for consideration.

The absence of a plant species list precluded the possibility of using a scoring matrix to select candidate species. To overcome this limitation the priority species list identified for use in this analysis was developed using plant species analyzes done by AWEC, CITES and IUCN. The starting point for identification of a priority species list was:

- The four (4) plant species that have been proposed for protection by the AWEC (Annex A)
- The six (6) plant species that were included on the CITES list for Afghanistan (Annex A)
- The eighty-three (83) plant species that were included on the IUCN Red List for Afghanistan, Iran, Pakistan, Tajikistan, Turkmenistan and Uzbekistan (Annex B)

Note: Twenty-six (26) of the 83 plant species were listed as occurring in Afghanistan

Using these lists a total of ninety (90) different species were identified as candidate species for protection in Afghanistan.

### Confirm the Presence of Plant Species in Afghanistan

Two steps were undertaken to confirm the historical presence in Afghanistan of the 90 plants on the initial species list developed above. First a search was conducted for each of the species in the following electronic databases:

- eFloras.org
- Encyclopedia of Life [EOL]
- Flora of Pakistan
- Plant Information Center (Royal Botanical Gardens, Kew) [ePIC]

- Royal Botanic Garden, Edinburgh [RBGE]
- UNEP World Conservation Monitoring Center [UNEP-WCMC]

If one or more of the databases had a record of the species and it was reported to occur in Afghanistan, then the species was retained in the analysis. Otherwise the species was eliminated from further consideration. At this step, two exceptions were made to this rule. First, if the AWEC has recommended that the species be protected it was retained. Second, if CITES reported it as a species in Afghanistan it was retained. Annex C lists the forty-nine (49) species that were retained in the analysis following this initial screening. A group of local professionals from Kabul University, FAO and the international community was then convened to review the 49 plant species, identify data sources that might confirm their existence in Afghanistan, and further assess the importance of considering these plants for protection. This group reaffirmed the need to develop a comprehensive plant species list for Afghanistan and to facilitate the initiation of nation-wide plant surveys. They also endorsed further analysis of the 49 plant species in Annex C. No additional species were added to the list.

The second step in the screening involved confirming that the 49 species in Annex C were either collected or sighted in Afghanistan. This was achieved if:

- German Professor Podlech had collected the species in Afghanistan
- German Professor Breckle had reported the presence of the species in Afghanistan
- Flora Iranica<sup>1</sup> had a collection record of the species from Afghanistan

Each of the 49 species was compared to species lists derived from the above sources. The species was retained in the analysis if one or more matches occurred. Two exceptions were made to this rule. First, if the AWEC has recommended that the species be protected it was retained. Second, if one or more matches existed for a plant, but all the collection records were associated with cultivated collections or the collection records were doubtful, the plant was eliminated from further consideration. Table 1 lists the final thirty-three (33) species that had confirmed collection records in Afghanistan based on this analysis. These 33 species then became the focal point for the gap analysis.

### Forecast the Distribution of Plant Species in Afghanistan

To support a gap analysis, the distribution throughout Afghanistan of the 33 species identified in Table 1 was needed. Since information on the current distribution of these plants was not available, an attempt was made to determine their historical distribution. This was accomplished using two information sources:

- Map of the Potential Natural Vegetation<sup>2</sup> of Afghanistan prepared by Breckle utilizing Freitag's original vegetation classification
- The World Wildlife Fund (WWF) Terrestrial Ecoregion Profiles<sup>3</sup>

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<sup>1</sup> Ehrendorfer, F, E. Schönbeck-Temesy, C. Puff and W. Rechinger. 1963 - 2005. Flora Iranica - Plants of Iran (Persia). Volumes 1 – 176. Edited by K.H. Rechinger, Flora Iranica Project. Naturhistorisches Museum Wien.

<sup>2</sup> Breckle, S.W. 2007. Flora and Vegetation of Afghanistan. Basic and Applied Dryland Research 1, Vol 2, p. 155-194

<sup>3</sup> [http://www.worldwildlife.org/wildworld/profiles/terrestrial/im/imXXXX\\_full.html](http://www.worldwildlife.org/wildworld/profiles/terrestrial/im/imXXXX_full.html) and [http://www.worldwildlife.org/wildworld/profiles/terrestrial/pa/paXXXX\\_full.html](http://www.worldwildlife.org/wildworld/profiles/terrestrial/pa/paXXXX_full.html)

Breckle identified 17 main Potential Natural Vegetation Types in Afghanistan and 16 WWF Ecoregions in Afghanistan were also used in the analysis (Annexes D). One or more WWF Ecoregions was identified with each of Breckle's main Vegetation Types. This resulted in the identification of forty-three (43) separate Vegetation/Ecoregion units within Afghanistan. Each of these 43 separate units ranged in size from a few square kilometers to several hundred square kilometers. Based on knowledge about the biological and geophysical requirements of the 33 plant species in Table 1, each species was associated with one or more of the 43 separate Vegetation/Ecoregion units as shown in Table 2.

### Identify Locations of Plant Species in Afghanistan

To identify historical locations of the 33 plant species within in Afghanistan, available collection records were used. These records provided the location of the collection sites associated with the plant species and frequently included the elevation of the collection site. Based on these records, 395 locations were associated with 31 of the 33 plant species. The number of locations associated with each plant species is shown in Table 1.

Given the limited number of plant locations, it was not possible to confirm the historical presence of these 33 plant species throughout the 43 Vegetation/Ecoregion units in Afghanistan. Therefore, the distribution of species by Vegetation/Ecoregion unit as shown in Table 2 is unconfirmed, and this classification was not used in the gap analysis.

### **PLANT SPECIES GAP ANALYSIS**

The GAP analysis was undertaken in collaboration with WCS. To identify candidate sites for inclusion in Afghanistan's Research Priority Zones, WCS placed a 50 kilometer by 50 kilometer grid over Afghanistan. Afghanistan's fauna and ecoregions were assessed within each of the associated 313 2500 km<sup>2</sup> grid squares, as well as the human settlement density across the country. These same grid squares are used to assess Afghanistan's flora.

The Important Plant Area (IPA) program<sup>4</sup> criteria were used to guide the analysis of Afghanistan's plant data. Because of the uncertainty associated with the present condition of flora in Afghanistan, the limited number of plant species that were identified as threatened or endangered in Afghanistan, and the lack of recent plant survey data, two of the IPA criterion were emphasized in this analysis and one was included indirectly. All three criteria and their use are discussed below.

Criterion A – Threatened Species. The site holds significant populations of one or more species that are of global or regional conservation concern.

Afghanistan Analysis Limitations: This criterion is not directly considered in the gap analysis because the very limited amount of threatened and endangered plant location information would potentially bias the Priority Zone identification. The separate ecoregional analysis conducted by WCS was used to include this criterion in the plant gap analysis.

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<sup>4</sup> <http://www.plantlife.org.uk/international/plantlife-ipas.html>

Criterion B – Exceptional Species Richness. The site has an exceptionally rich flora in a regional context in relation to its bio-geographic zone, and provides a refuge where bio-geographically and bio-climatically restricted plants could ‘retreat to’ in the face of global climatic change. Afghanistan Analysis Limitations: The ‘exceptionally rich flora’ part of this criterion is not considered in the gap analysis because of the lack of current information on Afghanistan flora. The ‘refuge’ part of this criterion is considered in the gap analysis.

Criterion C – Threatened Habitats. The site is an outstanding example of habitat or vegetation type of global or regional plant conservation importance. Afghanistan Analysis Limitations: This criterion is considered in the gap analysis on the basis of potential vegetation types rather than actual vegetations types. Also, this criterion is indirectly incorporated in the separate ecoregional analysis conducted by WCS since WWF ecoregions delineation also relied heavily on Freitag’s original vegetation classification.

In the Priority Zone analysis these criteria were applied separately to each individual grid square based on factors used to measure each criterion. The method used to develop factors for each criterion is described below. For each factor used in the analysis, a score was computed for that factor within a grid square, and the percentile rank of each of the 313 grid squares was computed based on that factor score. The factors, the factor scores, and the grid square rank are derived as follows:

1. The IUCN Risk Status of species within a grid square. This factor is related to IPA Criterion A, Threatened Species.

Initially each of the 33 threatened or endangered species identified in Table 1 was assigned a score relative to its risk status. A score for each grid square was computed for this factor by summing the individual species scores for species with locations within the square grid, and the percentile rank of each of the 313 grid squares was computed based on that factor score. A value of 1 to 4 was assigned to each of the 313 grid squares based on its 25<sup>th</sup>-percentile class. Because there were only 395 locations for these plants identified throughout Afghanistan, when the 25<sup>th</sup>-percentile class was computed all grid squares containing plants fell in the same 25<sup>th</sup>-percentile class. It was believed that continuing to use this method for computing an individual grid square rank in the analysis could potentially bias the results because of the very limited number of observed plant locations. Therefore, it was not used.

WCS conducted a separate ecoregional analysis on each of the 313 grid squares. This analysis considered the risk status of each of the WWF ecoregions as defined by Olson *et. al.*<sup>5</sup> Since there is a direct relationship between the WWF ecoregion risk status and the IUCN risk status of threatened and endangered plants within an ecoregion, the separate ecoregional analysis grid square rank was used to consider IPA criterion A in the plant gap analysis.

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<sup>5</sup> Olson, D.M, E. Dinerstein, E.D. Wikramanayake, N.D. Burgess, G.V.N. Powell, E.C. Underwood, J.A. D’amico, I. Itoua, H.E. Strand, J.C. Morrison, C.J. Loucks, T.F. Allnutt, T.H. Ricketts, Y. Kura, J.F. Lamoreux, W.W. Wettengel, P. Hedao and K.R. Kassem. 2001. Terrestrial eco-regions of the world: A new map of life on Earth. *BioScience* 51(11):933-937.

2. The number of different species within a grid square. This factor is related to IPA Criterion B, Exceptional Species Richness.
 

Initially the total number of different species with locations within a square grid was used as a proxy for species richness and provided the grid square score for this factor, and the percentile rank of each of the 313 grid squares was computed based on that factor score. A value of 1 to 4 was assigned to each of the 313 grid squares based on its 25<sup>th</sup>-percentile class. Because there were only 395 locations for these plants identified throughout Afghanistan, when the 25<sup>th</sup>-percentile class was computed all grid squares containing plants fell in the same 25<sup>th</sup>-percentile class. It was believed that continuing to use this method for computing an individual grid square rank in the analysis could potentially bias the results because of the very limited number of observed plant locations. Therefore, this factor was not considered in the Priority Zone analysis.
  
3. The difference in the elevation of the highest and lowest points within a grid square. This factor is related to IPA Criterion B, Exceptional Species Richness.
 

The difference in elevation within a grid square was used as a proxy for the ability of the site to serve as a refuge and continue to support a plant's habitat in the face of global climate change. The difference between the highest and lowest points within each grid square was determined, and the difference is the grid square score for this factor. A percentile rank of each of the 313 grid squares was computed based on that factor score. A value of 1 to 4 was assigned to each of the 313 grid squares based on its 25<sup>th</sup>-percentile class.
  
4. The number of Breckle's potential vegetation types contained within a grid square. This factor is related to IPA Criterion C, Threatened Habitats.
 

The number of potential vegetation types within a grid square was used as a proxy for the long-term viability and diversity of the habitat, and is the grid square score for this factor. A percentile rank of each of the 313 grid squares was computed based on that factor score. A value of 1 to 4 was assigned to each of the 313 grid squares based on its 25<sup>th</sup>-percentile class.

The risk status of the WWF Ecoregions contained within each grid square was an important criterion in the ranking of that square in the analysis of Priority Zones. Thus, the grid square rank obtained in the ecoregional analysis conducted by WCS also incorporates IPA criterion C. However, it was not included as a separate factor in the plant gap analysis.

The grid square 25<sup>th</sup>-percentile class value for factors 3 (difference in elevation) and 4 (number of vegetation types) were combined with similar grid square 25<sup>th</sup>-percentile class values for factors associated with Afghanistan's fauna and ecoregions in order to determine the ecological importance of each grid square. The results of this joint flora, fauna and ecoregional analyses are described in detail in a WCS report on the identification of Research Priority Zones in Afghanistan.

## **CONSTRAINTS AND CONCLUSIONS**

This analysis has several limitations and should be viewed as a very data-limited, initial approach to forecast the potential distribution of a few selected, and likely threatened and endangered, plant species in Afghanistan. Four of the major limitations are mentioned below.

The analysis identifies areas within Afghanistan where protected plant species historically may have been or were distributed. It does not address the abundance of the species at those sites nor does it confirm the existence today of the plant species in Afghanistan or on those sites.

The IUCN Red List of plant species in Afghanistan tends to be biased towards shrubs and trees. Medicinal plants, forbs and grasses were largely omitted from this analysis.

The species included in this analysis are species that were largely identified by the international community as being threatened and endangered throughout the region, and limited current local knowledge and information has been incorporated into these assessments.

Plant locations are derived from collection site information recorded by different individuals over several years. The precision of the derived locations varies with the collection site information.

As more detailed lists of plant species in Afghanistan become available, it will be possible to expand this analysis and, with the use of a scoring matrix, focus on an array of plant species that need to be considered for protection. An analysis with a broader array of plant species, collected recently with known locations, will expand and strengthen the justification for including specific areas in Afghanistan's Research Priority Zones.

## **ACKNOWLEDGEMENTS**

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Table 1. Thirty-three (33) threatened and endangered plant species

Family	Species	IUCN Risk Status	Podlech	Breckle	Flora Iranica	No. Locations
Pinaceae	<i>Abies spectabilis</i>	LR/lc	*		*	13
Aceraceae	<i>Acer caesium ssp. caesium</i>	DD			*	2
Rosaceae	<i>Amygdalus bucharica</i>	V	*	#	*	7
Pinaceae	<i>Cedrus deodara</i>	LR/lc	*	#	*	12
Ulmaceae	<i>Celtis caucasica</i>	LC	*		*	39
Caesalpineaceae	<i>Cercis griffithii</i>	DD	*	*	*	27
Fumariaceae	<i>Corydalis adiantifolia</i>	AWEC				0
Fumariaceae	<i>Corydalis hindukushensis</i>	AWEC			*	7
Dioscoraceae	<i>Dioscorea deltoidea</i>	CITES			*	3
Ebenaceae	<i>Diospyros lotus</i>	LC	*		*	11
Moraceae	<i>Ficus carica</i>	LC	*			1
Juglandaceae	<i>Juglans regia</i>	NT	*	*	*	12
Cupressaceae	<i>Juniperus communis</i>	LR/lc	*		*	15
Cupressaceae	<i>Juniperus excelsa</i>	LR/lc	*	#	*	57
Cupressaceae	<i>Juniperus semiglobosa</i>	LR/lc	*	#	*	10
Cupressaceae	<i>Juniperus squamata</i>	LR/lc	*	#	*	4
Zygophyllaceae	<i>Malacocarpus crithmifolius</i>	DD	*		*	9
Pinaceae	<i>Picea smithiana</i>	LR/lc	*	#	*	9
Pinaceae	<i>Pinus gerardiana</i>	LR/nt	*	#	*	17
Pinaceae	<i>Pinus wallichiana</i>	LR/lc	*		*	8
Anacardiaceae	<i>Pistacia vera</i>	NT	*	#	*	16
Platanaceae	<i>Platanus orientalis</i>	LR/lc	*		*	11
Salicaceae	<i>Populus pruinosa</i>	NT	*		*	5
Punicaceae	<i>Punica granatum</i>	LC	*		*	17
Rosaceae	<i>Pyrus korshinskyi</i>	CE	*		*	5
Ericaceae	<i>Rhododendron afghanicum</i>	Na		#		0
Papilionaceae	<i>Sophora mollis</i>	LC	*	*	*	48
Tamaricaceae	<i>Tamarix androssowii</i>	LC	*			1
Taxaceae	<i>Taxus wallichiana</i>	LR/lc	*			1
Ulmaceae	<i>Ulmus wallichiana</i>	V			*	4
Vitaceae	<i>Vitis vinifera</i>	LC	*		*	3
Rhamnaceae	<i>Ziziphus jujuba</i>	LC	*	*	*	19
Zygophyllaceae	<i>Zygophyllum bucharicum</i>	CE			*	2

**IUCN Risk Status Codes:** LC – Least Concern, LR/lc –Low Risk/least concern, NT – Near Threatened, LR/nt – Low Risk/near threatened, V – Vulnerable, E – Endangered, CE – Critically Endangered, DD – deficient data, na – not available (also includes CITES and AWEC listings)

\* Collection record exists

# Reported observation (Breckle, S.W., 2007, Basic and Applied Dryland Research 1, Vol 2)

Table 2. Forty-three (43) Vegetation/Ecoregion Units in Afghanistan

Breckle Code	WWF Ecoregion	Probable Species	Characteristics
1a	PA1306		
1a	PA1326		
1b	PA1326		
1c	PA0808	<i>Juniperus communis</i> <i>Juniperus semiglobosa</i> <i>Pyrus korshinskyi</i>	
1c	PA1301		
1c	PA1306		
1c	PA1313		
1c	PA1326		
1d	PA1306		
1d	PA1322		
2	PA1301		
2	PA1307	<i>Juniperus communis</i> <i>Juniperus semiglobosa</i> <i>Zygophyllum bucharicum</i>	1500-2000 m 1500-2000 m 1500-2000 m
2	PA1309	<i>Juniperus communis</i> <i>Juniperus semiglobosa</i> <i>Zygophyllum bucharicum</i>	
2	PA1313	<i>Tamarix androssowii</i> <i>Zygophyllum bucharicum</i>	
2	PA1326	<i>Tamarix androssowii</i> <i>Zygophyllum bucharicum</i>	
3	PA1307		
4a	PA1306	<i>Amygdalis bucharica</i> <i>Cercis griffithii</i> <i>Pistacia vera</i>	
4a	PA1322	<i>Amygdalis bucharica</i> <i>Celtis caucasica</i> <i>Cercis griffithii</i> <i>Juniperus excelsa</i> <i>Pistacia vera</i> <i>Platanus orientalis</i>	600-1600 m 600-1600 m 600-1600 m 600-1600 m 600-1600 m 600-1600 m
4b	PA1307	<i>Amygdalis bucharica</i> <i>Juniperus communis</i> <i>Juniperus semiglobosa</i>	1500-2000 m 1500-2000 m 1500-2000 m
4b	PA1309	<i>Cercis griffithii</i> <i>Juniperus excelsa</i> <i>Pistacia vera</i> <i>Sophora mollis</i>	Valley slopes
5a	PA0808	<i>Acer caesium</i> ssp. <i>caesium</i> <i>Juglans regia</i> <i>Pyrus korshinskyi</i>	2000-3000 m 2000-3000 m 2000-3000 m
5a	PA1306	<i>Amygdalis bucharica</i> <i>Cercis griffithii</i> <i>Pistacia vera</i>	

Breckle Code	WWF Ecoregion	Probable Species	Characteristics
5a	PA1322	<i>Amygdalis bucharica</i> <i>Cercis griffithii</i> <i>Juniperus excelsa</i> <i>Pistacia vera</i> <i>Platanus orientalis</i>	
5b	PA1018	<i>Juniperus excelsa</i> <i>Pinus gerardina</i>	2000-3000 m 2000-3000 m
5b	PA1309	<i>Amygdalis bucharica</i> <i>Cercis griffithii</i> <i>Ficus carica</i> <i>Malacocarpus crithmifolius</i> <i>Platanus orientalis</i> <i>Sophora mollis</i>	2000-3000 m 2000-3000 m 2000-3000 m 2000-3000 m 2000-3000 m 2000-3000 m
6	PA1018	<i>Acer caesium</i> ssp. <i>caesium</i> <i>Diospyros lotus</i> <i>Juglans regia</i> <i>Juniperus communis</i> <i>Pinus gerardina</i> <i>Pinus wallichiana</i>	River valleys River valleys River valleys 2000-3300 m 2000-3300 m 2000-3300 m
6	PA1307	<i>Acer caesium</i> ssp. <i>caesium</i> <i>Celtis caucasica</i> <i>Diospyros lotus</i> <i>Juglans regia</i> <i>Juniperus communis</i> <i>Juniperus semiglobosa</i> <i>Punica granatum</i> <i>Taxus wallichiana</i> <i>Ulmus wallichiana</i> <i>Vitis vinifera</i>	River valleys 1500-2000 m 1500-2000 m River valleys 1500-2000 m 1500-2000 m 1500-2000 m 1500-2000 m 1500-2000 m 1500-2000 m
7	IM0502	<i>Abies spectabilis</i> <i>Acer caesium</i> ssp. <i>caesium</i> <i>Cedrus deodara</i> <i>Picea smithiana</i> <i>Pinus gerardiana</i> <i>Pinus wallichiana</i> <i>Rhododendron afghanicum</i>	2500-3300 m River valleys 2500-3300 m 2500-3300 m 2100-2500 m 2500-3300 m
7	PA0506	<i>Abies spectabilis</i> <i>Cedrus deodara</i> <i>Dioscorea deltoidea</i> <i>Juniperus semiglobosa</i> <i>Picea smithiana</i> <i>Pinus gerardiana</i> <i>Pinus wallichiana</i>	2500-3300 m 2500-3300 m 2100-2500 m 3100-3300 m 2500-3300 m 2100-2500 m 2500-3300 m
8	PA1005	<i>Juniperus squamata</i> <i>Rhododendron afghanicum</i>	
8	PA1018	<i>Juniperus squamata</i> <i>Rhododendron afghanicum</i>	
9	PA1004		
9	PA1005	<i>Corydalis adiantifolia</i> <i>Corydalis hindukushensis</i>	above 3000 m above 3000 m
9	PA1006	<i>Corydalis adiantifolia</i> <i>Corydalis hindukushensis</i>	

Breckle Code	WWF Ecoregion	Probable Species	Characteristics
9	PA1012		
9	PA1014	<i>Corydalis adiantifolia</i> <i>Corydalis hindukushensis</i>	
10	PA1004		
10	PA1005	<i>Corydalis adiantifolia</i> <i>Corydalis hindukushensis</i>	above 3000 m above 3000 m
10	PA1006	<i>Corydalis adiantifolia</i> <i>Corydalis hindukushensis</i>	
10	PA1012		
10	PA1014	<i>Juniperus semiglobosa</i> <i>Corydalis adiantifolia</i> <i>Corydalis hindukushensis</i>	South-facing slopes
11a		<i>Acer caesium</i> ssp. <i>caesium</i> <i>Populus pruinosa</i> <i>Tamarix androssowii</i>	River valleys River valleys River valleys
11b		<i>Tamarix androssowii</i> <i>Zygophyllum bucharicum</i>	Wetlands, Marshes Wetlands, Marshes

## ANNEX A - AWEC & CITES SPECIES

### Afghanistan Wildlife Executive Committee (AWEC)

The following species have been recommended for protection:

*Corydalis adiantifolia*  
*Corydalis hindukushensis*  
*Ulmus wallichiana*  
*Taxus wallichiana*

### Convention of International Trade in Endangered Species (CITES)

The following are listed and designated as Afghanistan flora:

AMARYLLIDACEA	<i>Sternbergia fischeriana</i>
DIOSCORAECEAE	<i>Dioscorea deltoidea</i>
ORCHIDACEAE	<i>Dactylorhiza majalis</i> <i>Eulophia turkestanica</i> <i>Habenaria josephii</i>
TAXACEAE	<i>Taxus wallichiana</i>

## ANNEX B - IUCN RED LIST OF THREATENED SPECIES

The following native, introduced, vagrant or uncertain species are listed in Afghanistan, Iran, Pakistan, Tajikistan, Turkmenistan and Uzbekistan:

	<i>Abelia corymbosa</i>	LC			<i>Lonicera paradoxa</i>	E
*	<i>Abies pindrow</i>	LR/lc			<i>Lophopetalum wightianum</i>	LR/lc
*	<i>Abies spectabilis</i>	LR/lc		*	<i>Malacocarpus crithmifolius</i>	DD
	<i>Acer caesium</i> ssp. <i>caesium</i>	DD		*	<i>Malus niedzwetzkyana</i>	E
	<i>Aflatunia ulmifolia</i>	LC			<i>Malus sieversii</i>	V
	<i>Amygdalus bucharica</i>	V		*	<i>Picea smithiana</i>	LR/lc
	<i>Amygdalus petunnikowi</i>	LC		*	<i>Pinus brutia</i> var. <i>eldarica</i>	DD
	<i>Aquilaria malaccensis</i>	V		*	<i>Pinus gerardiana</i>	LR/nt
	<i>Armeniaca vulgaris</i>	E			<i>Pinus roxburghii</i>	LR/lc
	<i>Betula pamirica</i>	V		*	<i>Pinus wallichiana</i>	LR/lc
	<i>Betula schugnanica</i>	CE		*	<i>Pistacia vera</i>	NT
	<i>Betula tianschanica</i>	E		*	<i>Platanus orientalis</i>	LR/lc
	<i>Calligonum calcareum</i>	CE			<i>Platycladus orientalis</i>	LR/nt
	<i>Calligonum elegans</i>	E		*	<i>Populus pruinosa</i>	NT
	<i>Calligonum matteianum</i>	E			<i>Prunus tadzhikistanica</i>	E
	<i>Calligonum molle</i>	E			<i>Pterocarya pterocarpa</i>	LR/lc
	<i>Calligonum paletzianum</i>	V		*	<i>Punica granatum</i>	LC
	<i>Calophaca soongorica</i>	DD			<i>Pyrus asia-mediae</i>	DD
*	<i>Cedrus deodara</i>	LR/lc			<i>Pyrus cajon</i>	E
	<i>Celtis caucasica</i>	LC			<i>Pyrus korshinskyi</i>	CE
	<i>Cercis griffithii</i>	DD			<i>Pyrus tadshikistanica</i>	CE
	<i>Commiphora wightii</i>	DD			<i>Restella alberti</i>	LC
	<i>Crataegus darvasica</i>	CE			<i>Rhamnella gilgitica</i>	V
	<i>Crataegus korolkowi</i>	LC			<i>Rhus coriaria</i>	V
*	<i>Crataegus necopinata</i>	CE			<i>Ribes janczewskii</i>	LC
	<i>Crataegus pontica</i>	LC			<i>Ribes malvifolium</i>	CE
	<i>Cupressus sempervirens</i>	LR/nt			<i>Shorea robusta</i>	LR/lc
	<i>Cupressus torulosa</i>	LR/nt			<i>Sorbaria olgae</i>	DD
	<i>Diospyros lotus</i>	LC		*	<i>Sorbus persica</i>	LC
	<i>Euonymus koopmannii</i>	LC			<i>Sorbus tianschanica</i>	LC
	<i>Euonymus verrucosus</i>	LC			<i>Sorbus turkestanica</i>	DD
	<i>Ficus carica</i>	LC			<i>Swida darvasica</i>	CE
*	<i>Fraxinus sogdiana</i>	NT			<i>Tamarix androssowii</i>	LC
	<i>Holarrhena pubescens</i>	LC			<i>Taxus baccata</i>	LR/lc
*	<i>Juglans regia</i>	NT		*	<i>Taxus wallichiana</i>	DD
*	<i>Juniperus communis</i>	LR/lc		*	<i>Ulmus wallichiana</i>	V
*	<i>Juniperus excelsa</i>	LR/lc			<i>Vitis vinifera</i>	LC
	<i>Juniperus oxycedrus</i>	LR/lc			<i>Zelkova carpinifolia</i>	LR/nt
*	<i>Juniperus recurva</i>	LR/lc			<i>Ziziphus jujuba</i>	LC
*	<i>Juniperus semiglobosa</i>	LR/lc			<i>Zygophyllum bucharicum</i>	CE
*	<i>Juniperus squamata</i>	LR/lc		*	<i>Zygophyllum darvasicum</i>	CE
*	<i>Keyserlingia mollis</i>	LC				

\* Listed in Afghanistan

## ANNEX C - THREATENED OR ENDANGERED PLANT SPECIES

Forty-nine (49) Threatened or Endangered Plant Species Stated to Occur (\*) or Expected they might Occur (?) in Afghanistan

Species	AWEC	CITES	IUCN Red List	eFlora	EOL	Flora of Pakistan	ePIC	RBGE	UNEP-WGMC
<i>Abies pindrow</i>			*	*	*	*		*	
<i>Abies spectabilis</i>			*	*	*	*			
<i>Acer caesium</i>			?						
<i>Aflatunia ulmifolia</i>					*				
<i>Amygdalus bucharica</i>							*		
<i>Cedrus deodara</i>			*	*	*	*		*	
<i>Celtis caucasica</i>				*	*	*			
<i>Cercis griffithii</i>			?						
<i>Corydalis adiantifolia</i>	*								
<i>Corydalis hindukushensis</i>	*							*	
<i>Crataegus darvasica</i>					*				
<i>Crataegus necopinata</i>			*						
<i>Dactylorhiza majalis</i>		*							
<i>Dioscorea deltoidea</i>		*		*		*			
<i>Diospyros lotus</i>				*		*			
<i>Eulophia turkestanica</i>		*							
<i>Ficus carica</i>				*	*	*			
<i>Fraxinus sogdiana</i>			*						
<i>Habenaria josephii</i>		*							
<i>Juglans regia</i>			*	*	*	*			
<i>Juniperus communis</i>			*					*	
<i>Juniperus excelsa</i>			*	*	*	*		*	*
<i>Juniperus recurva</i>			*						
<i>Juniperus semiglobosa</i>			*	*	*			*	
<i>Juniperus squamata</i>			*	*	*	*		*	
<i>Malacocarpus crithmifolius</i>			*						
<i>Malus niedzwetzkyana</i>			*						
<i>Picea smithiana</i>			*	*	*	*			*
<i>Pinus brutia</i>			*						*
<i>Pinus gerardiana</i>			*	*	*	*			*
<i>Pinus roxburghii</i>				*	*	*			*
<i>Pinus wallichiana</i>			*	*	*	*		*	*
<i>Pistacia vera</i>			*	*	*	*		*	
<i>Platanus orientalis</i>			*	*	*	*			*
<i>Populus pruinosa</i>			*						
<i>Punica granatum</i>			*	*		*			
<i>Pyrus korshinskyi</i>									*
<i>Rhododendron afghanicum</i>				*		*		*	
<i>Sophora mollis</i>			*						
<i>Sorbus persica</i>			*						
<i>Sorbus tianschanica</i>				*	*				
<i>Sternbergia fischeriana</i>		*							
<i>Tamarix androssowii</i>				*		*			
<i>Taxus wallichiana</i>	*	*	*	*	*	*			
<i>Ulmus wallichiana</i>	*		*						*
<i>Vitis vinifera</i>				*	*	*			
<i>Ziziphus jujuba</i>				*	*	*			
<i>Zygophyllum bucharicum</i>									*
<i>Zygophyllum darvasicum</i>			*						

**NOTE:** *Sophora mollis* is synonymous with *Keyserlingia mollis* (Flora Iranica)

## ANNEX D - BRECKLE'S VEGETATION TYPES AND WWF ECOREGIONS

### Breckle's Potential Natural Vegetation Types in Afghanistan

- 1a *Calligonum-Aristida* - Sand Desert
- 1b *Haloxylon salicornicum* – Desert
- 1c Other Deserts (rich in Chenopod)
- 1d Ephemeral Desert
- 2 Dwarf *Amygdalus* – Semidesert
- 3 Subtropical Dry Scrub and Savannah
- 4a *Pistaci vera* – Woodlands
- 4b *Pistacia atlantica* – Woodlands
- 5a *Juniperus* – Woodlands
- 5b *Amygdalus* – Woodlands
- 6 Sclerophyllous Oak Forests
- 7 Conifer Forests
- 8 *Rhododendron* – Krummholz
- 9 Thorny Cushions, Subalpine and Alpine Semideserts and Meadows
- 10 Nival Belt, Glaciers
- 11a Azonal Riverine Vegetation
- 11b Swamps, Salt swamps, Lakes

### The World Wildlife Fund's Terrestrial Ecoregions in Afghanistan

	IUCN Risk Status	
IM0502	V	Western Himalayan Subalpine Conifer Forests
PA0506	V	East Afghan Montane Conifer Forests
PA0808	CE	Gissaro-Alai Open Woodlands
PA1004	V	Ghorat-Hazarajat Alpine Meadow
PA1005	V	Hindu Kush Alpine Meadow
PA1006	V	Karakoram-West Tibetan Plateau Alpine Steppe
PA1012	Stable	Northwestern Himalayan Alpine Shrub and Meadows
PA1014	V	Pamir Alpine Desert and Tundra
PA1018	Stable	Sulaiman Range Alpine Meadows
PA1301	CE	Afghan Mountains Semi-desert
PA1306	CE	Badghyz and Karabil Semi-desert
PA1307	CE	Baluchistan Xeric Woodlands
PA1309	CE	Central Afghan Mountains Xeric Woodlands
PA1313	V	Central Persian Desert Basins
PA1322	V	Paropamisus Xeric Woodlands
PA1326	V	Registan-North Pakistan Sandy Desert