Research Article

Conservation status of plant resources of Hazar Nao hills, district Malakand, Pakistan

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Abstract

In the present study, data collected for the conservation status following the International Union for Conservation of Nature (IUCN, 2001) dealt with 77 species that belonged to 42 families. It was noted that 20 species (25.97%) were found to be endangered, 23 species (29.87%) vulnerable, 15 species (19.48%) rare and 19 species (24.67%) infrequent. Due to overgrazing, excessive collection, burning and other anthropogenic activities the plant resources of Hazar Nao hills are under high pressure. Therefore, there is a dire need to establish a satisfactory *in-situ* conservation policy for the sustainable utilization of plant resources in the sampled region.

Keywords: Conservation; District Malakand; Hazar Nao hills; Plant resources; Pakistan

Introduction

Sustainability of forest resources is of utmost importance in the life of local communities as well as prevailing environmental conditions. Degradation of natural vegetation occurs due to unbalanced use of resources [1]. Deforestation and overgrazing are among the leading drivers which results in demised plant diversity and correspond to fragile ecosystems. Many plant species have either become threatened or endangered due to heavy pressure of anthropogenic activities, natural and managed overgrazing. Some forests have converted to scrubs and grasslands. Deforestation, overgrazing, uprooting of plants and terrace cultivation have not only accelerated soil erosion but

decreased plant diversity in the area [2]. Pakistan, having less than 4% of its area covered by forest is further threatened by an annual deforestation rate of 3%. More than 25% of Pakistani forests have been lost in last 3 decades [3]. Major cause of the current event is the habitat loss by various anthropogenic activities [4]. Plant extinction rate has reached to one species per day as a result of anthropogenic activities [3] and it is estimated that if no preventive measures are taken, 60,000-100,000 plant species are likely to disappear in the near future [4]. Plant preservation is a systemic approach towards the protection of biodiversity of plants by employing sustainable techniques [5]. In Pakistan, various workers have carried out

conservation studies in different parts of the country. [6] showed that the vegetation cover of the established communities in Push Ziarat area is depleting at a very high pace due to population explosion. [7] determined the conservation status of 45 species belonging to 26 families, in Tehsil Takht-e-Nasrati. [8] determined the conservation status of 27 plant species belonging to 19 genera from different localities of District Mardan. [9] reported 43 threatened plant species from Dir Kohistan valley. [10] evaluated the conservation status of plant species in Tehsil Katlang. [11] carried out a research for biodiversity conservation in the Himalayan region of Poonch Valley. [12] carried out conservation studies of 45 threatened medicinal plants in Mankial valley. [13] documented the conservation status of plant species in Tehsil Takht Bhai. A thorough review of literature clearly depicted that no such study has been conducted on the Hazar Nao hills. The present work was therefore important to explore the conservation status of this remote area.

Materials and methods

Study area

Malakand lies 34°35' N latitude and 71°57' E longitude. It is the gateway to Dir, Chitral, Swat Districts, Mohmand and Bajaur Agencies. It extends from Hindukush mountain range down to the northern edge of the Peshawar Basin. The total area extends over 952 Km² with a population density of 596 people per Km². Malakand is 2705 feet above the sea level. The area is characterized by mountains. The climate of the area is dry. Hottest months are June, July and August. The maximum temperature during summer exceeds over 40° C and minimum in winter falls upto 6°C. Malakand falls under subtropical zone hosting association of *Dodonaea* and Chir pine [14]. Hazar Nao hills are located at about 23 kilometers west

of Tehsil Dargai, District Malakand [15]. The Hazar Nao hills are important mountains of Malakand district located between villages of Pir Khel, Mekhband, Totai, Kot, Maina, Brah, and Haryankot having about 2727 m altitude. The hills are thickly covered with forests and have its importance for botanical and medicinal plants studies (Figure 1) [16].

Field survey

The study was conducted by frequently surveying different sites of the research area. The area was divided into four sites viz; Kot, Maina, Brah, and Totai. Nature of habitat was analyzed by habitat destruction, soil erosion, fuelwood cutting, grazing, invasive species and impacts of other anthropogenic activities were noted [17].

Plant collection and preservation

Plant specimens were collected from different sites of the research area (Figure 3-13). Plants specimens were properly preserved and identified following [4]. The voucher specimens were deposited in the Herbarium, Department of Botany, University of Peshawar (UOP).

Questionnaire development

Information on demography (age, gender) and conservation status were gathered from each site by using a semi-structured questionnaire. The plants were classified according to their economic value through interviewing and filling questionnaires from drug dealers, shopkeepers, fuel wood seller, local hakims, and farmers but the priority was who were the real users and had a lot of information about the plants and their conservation status.

The data was classified, tabulated, analyzed and concluded for the final report. The conservation status of plants was determined according to IUCN [18], Red Data List Categories and Criteria.

The data was collected through following formula: CSP=A+C+ G+P (Khan, 2013).

Figure 1. Map of the research area, district Malakand

Results and discussion

The data was collected for various conservation parameters following IUCN (2001). It was noted that 20 species (25.97%) were found endangered, 23 plant species (29.87%) vulnerable, 15 species (19.48%) rare and 19 species (24.67%) were infrequent (Figure 2). Due to the excessive collection, overgrazing and other human influences in the investigated areas of Hazar Nao hills, none of the species was declared as dominant which highlight the miserable current situation of plant resources in the area (Table 1).

Endangered species

In the present study, 20 species (25.97%) were found endangered. The most important include *Justicia adhatoda*, *Caralluma tuberculata*, *Quercus incana*, *Melia*

azedarach, *Acacia modesta*, *Acacia nilotica*, *Albizia lebbeck*, *Ficus carica*, *Morus alba*, *Morus snigra*, *Olea ferruginea*, *Bauhinia variegata*, *Butea monosperma*, (Figure 6) *Dalbergia sissoo*, *Platanus orientalis*, *Ziziphus mauritiana*, *Ziziphus sativa*, *Salix tetrasperma*, *Monothea buxifolia* and *Ailanthus altissima* (Table 1). Endangered species in different parts of Pakistan were also reported by [5, 13, 19]. These plants were used for medicinal purposes, fuelwood (Figure 8), timber wood, furniture and agriculture, coupled with harsh climatic and habitat condition which has slow down their natural regeneration. Over-harvesting, destruction of habitat (Figure 10), population growth, urbanization and the unrestricted collection of medicinal plants from the wild

results in over-exploitation of natural resources [20].

Vulnerable species

Twenty-three plant species (29.87%) were vulnerable (Table 1). Plants like *Maytenus royleanus*, *Vitex negundo*, *Ziziphus nummularia* etc are intensively used as hedge. These have low regeneration capacity. Aridity of area and extensive clipping has pushed them into vulnerable categories. *Colebrookea oppositifolia*, *Mallotus phillipensis*, *Ricinus communis*, *Vitis Jacquemontii*, *Nerium oleander*, *Otostegia limbata*, *Periploca aphylla*, *Rhazya stricta*, *Xanthium strumarium* and *Dodonaea viscosa* are fuel wood species. *Chrysopogon aucheri*, *Saccharum griffithii* and *Indigofera heterantha* become vulnerable due to burning (Figure 5), grazing (Figure 4) and fodder use for livestock. *Ficus bengalensis*, *Myrtus communis*, *Phoenix sylvestris*, *Punica granatum*, *Pyrus pashia* and *Sageretia thea* are used for wild fruits, fuel, fodder etc. so become vulnerable. Some plants are used for medicinal purposes. Over collection as medicinal material and lack of suitable habitat has hampered their regeneration

leading them to vulnerable category. Earlier researchers also recorded vulnerable species in their studied areas [3, 10, 14].

Rare species

The present study explored 15 (19.48%) species rare (Table 1). Plants such as *Chrysopogon aucheri*, *Chrysopogon serrulatus*, *Saccharum griffithii*, *Calotropis procera*, *Cannabis sativa*, *Mentha arvensis*, *Mentha longifolia*, *Woodfordia fruticosa*, *Indigofera heterantha*, *Plantago lanceolata*, *Rubus fruticosus*, *Verbascum thapsus*, *Hyoscyamus insanus* and *Vitis Jacquemontii* were used for various purposes like fuel wood, fodder/forage and as health care medicines, leading them to rare category. [8] carried out conservation assessment in the remote Hindukush mountain region of District Swat. The study revealed that 49% of these economically valued medicinal plant species were threatened due to increased exploitation and unsustainable harvesting. [20] observed that the rare and threatened species of MAPs were collected in a highly unsustainable manner, therefore causing biodiversity loss and depletion of MAPs population.

Table 1. Ranking of species using IUCN criteria (2001) for conservation status of plants of Hazar Nao forest, district Malakand

No	Division/Family/ Species	Availability class	Collection status	Part used	Growth behavior	Total score	Conservation status
A	PTERIDOPHYTA						
1	Adiantaceae						
1	<i>Adiantum capillus-veneris</i> L.	1	3	4	4	12	Rare
B	GYMNOSPERMS						
2	Pinaceae						
2	<i>Pinus roxburghii</i> Sargent	3	2	1	0	6	Vulnerable
C	MONOCOTS						
3	Palmae						
3	<i>Nannorrhop sutchiana</i> (Griff.) Aitchison.	0	1	1	4	6	Vulnerable
4	<i>Phoenix sylvestris</i> (L.) Roxb.	1	3	0	2	6	Vulnerable
4	Poaceae						
5	<i>Chrysopogon aucheri</i> (Boiss.)	3	3	0	4	10	Rare
6	<i>C. serrulatus</i> Trin.	3	3	0	4	10	Rare
7	<i>C. jwarancusa</i> (Jones) Schult.	3	3	4	4	14	Infrequent
8	<i>Cynodon dactylon</i> (L.) Pers.	3	3	4	4	14	Infrequent
9	<i>Heteropogon contortus</i> (L.) Beauv.	3	3	4	4	14	Infrequent

10	<i>Saccharum griffithii</i> Munro ex Boiss.	3	1	2	4	10	Rare
D	DICOTS						
5	Acanthaceae						
11	<i>Justicia adhatoda</i> L.	1	1	2	0	4	Endangered
6	Amaranthaceae						
12	<i>Achyranthes aspera</i> L.	3	3	4	4	14	Infrequent
13	<i>Amaranthus caudatus</i> L.	3	3	4	4	14	Infrequent
7	Apocynaceae						
14	<i>Nerium oleander</i> L.	1	3	3	1	8	Vulnerable
15	<i>Rhazya stricta</i> Decne.	1	2	3	0	6	Vulnerable
8	Asclepiadaceae						
16	<i>Calotropis procera</i> (Willd) R.Br.	1	3	3	4	11	Rare
17	<i>Caralluma tuberculata</i> N. E. Brown	0	2	1	1	4	Endangered
18	<i>Periploca aphylla</i> Dcne.	2	2	3	1	8	Vulnerable
9	Asteraceae						
19	<i>Launaea procumbens</i> (Roxb.) Ramayya & Rajagopal	3	3	4	4	14	Infrequent
20	<i>Carthamus oxycantha</i> M. B.	3	3	4	4	14	Infrequent
21	<i>Xanthium strumarium</i> L.	1	3	3	0	7	Vulnerable
10	Berberidaceae						
22	<i>Berberis lycium</i> Royle	3	3	1	1	8	Vulnerable
11	Canabaceae						
23	<i>Cannabis sativa</i> L.	1	3	4	4	12	Rare
12	Celastraceae						
24	<i>Maytenus royleanus</i> (Wall. ex Lawson) Cuf.	1	2	2	1	6	Vulnerable
13	Chenopodiaceae						
25	<i>Chenopodium album</i> L.	3	3	4	4	14	Infrequent
14	Convolvulaceae						
26	<i>Convolvulus arvensis</i> L.	3	3	4	4	14	Infrequent
15	Euphorbiaceae						
27	<i>Euphorbia helioscopia</i> L.	3	3	4	4	14	Infrequent
28	<i>Mallotus philipensis</i> (Lam) Muell.	1	1	3	1	6	Vulnerable
29	<i>Phyllanthus emblica</i> L.	1	3	1	2	7	Vulnerable
30	<i>Ricinus communis</i> L.	1	3	1	0	5	Vulnerable
16	Fagaceae						
31	<i>Quercus incana</i> Roxb.	0	1	1	1	3	Endangered
17	Fumariaceae						
32	<i>Fumaria indica</i> (Hausskn.) Pugsley	3	3	4	4	14	Infrequent
18	Lamiaceae						
33	<i>Ajuga bracteosa</i> Wall. Ex Benth.	3	3	4	4	14	Infrequent
34	<i>Colebrookea oppositifolia</i> Smith	1	2	2	1	6	Vulnerable
35	<i>Mentha arvensis</i> L.	2	3	3	4	12	Rare
36	<i>Mentha longifolia</i> L.	2	3	3	4	12	Rare
37	<i>Otostegia limbata</i> (Bth.) Boiss.	4	2	2	0	8	Vulnerable
19	Lythraceae						
38	<i>Woodfordia fruticosa</i> (L) Kurz	0	3	3	4	10	Rare
20	Malvaceae						
39	<i>Malva neglecta</i> Wall.	3	3	4	4	14	Infrequent
21	Meliaceae						

40	<i>Melia azedarach</i> L.	0	1	1	1	3	Endangered
22	Mimosaceae						
41	<i>Acacia modesta</i> Wall.	1	1	1	0	3	Endangered
42	<i>A. nilotica</i> (L.) Delile	1	2	1	0	4	Endangered
43	<i>Albizia lebbek</i> (L.) Benth.	0	2	1	0	3	Endangered
23	Moraceae						
44	<i>Ficus carica</i> Hausskn. Ex. Boiss.	1	2	1	0	4	Endangered
45	<i>F. benghalensis</i> L.	1	2	1	1	5	Vulnerable
46	<i>Morus alba</i> L.	0	1	2	0	3	Endangered
47	<i>M. nigra</i> L.	0	1	2	0	3	Endangered
24	Myrtaceae						
48	<i>Eucalyptus camaldulensis</i> Schlecht	3	0	3	0	6	Vulnerable
49	<i>Myrtus communis</i> L.	0	2	3	2	7	Vulnerable
25	Nyctaginaceae						
50	<i>Boerhavia procumbens</i> Banks ex Roxb.	3	3	4	4	14	Infrequent
26	Oleaceae						
51	<i>Olea ferruginea</i> Royle	0	2	1	0	3	Endangered
27	Oxalidaceae						
52	<i>Oxalis corniculata</i> L.	3	3	4	4	14	Infrequent
28	Papilionaceae						
53	<i>Bauhinia variegata</i> L.	0	2	1	0	3	Endangered
54	<i>Butea monosperma</i> Lam. Taub.	0	2	1	1	4	Endangered
55	<i>Dalbergia sissoo</i> Roxb.	1	1	1	0	3	Endangered
56	<i>Indigofera heterantha</i> Wall. ex Brand.	1	3	3	4	11	Rare
29	Plantaginaceae						
57	<i>Plantago lanceolata</i> L.	2	3	3	4	12	Rare
58	<i>Platanus orientalis</i> L.	0	2	1	0	3	Endangered
30	Polygonaceae						
59	<i>Rumex hastatus</i> D. Don	3	3	4	4	14	Infrequent
31	Punicaceae						
60	<i>Punica granatum</i> L.	0	3	1	2	6	Vulnerable
32	Rhamnaceae						
61	<i>Sageretia thea</i> (Osbeck) M.C. Jhonston	1	3	1	2	7	Vulnerable
62	<i>Ziziphus mauritiana</i> Lam.	0	2	1	0	3	Endangered
63	<i>Z. sativa</i> Gaertn.	0	2	1	0	3	Endangered
64	<i>Z. nummularia</i> (Burm. f.) Wight & Arn.	1	3	2	0	6	Vulnerable
33	Rosaceae						
65	<i>Pyrus pashia</i> Ham. ex D. Don	0	3	1	2	6	Vulnerable
66	<i>Rubus fruticosus</i> Wallich	1	3	3	2	9	Rare
34	Salicaceae						
67	<i>Salix tetrasperma</i> Roxb.	0	1	1	0	2	Endangered
35	Sapindaceae						
68	<i>Dodonaea viscosa</i> (L.) Jacq.	3	0	3	0	6	Vulnerable
36	Sapotaceae						
69	<i>Monothea buxifolia</i> (Falc.) A. DC.	1	2	1	0	4	Endangered
37	Scrophulariaceae						
70	<i>Verbascum Thapsus</i> L.	1	3	2	4	10	Rare

38	Simarubaceae						
71	<i>Ailanthus altissima</i> (Mill.) Swingle	0	1	3	0	4	Endangered
39	Solanaceae						
72	<i>Hyoscyamus insanus</i> Stocks	0	3	4	4	11	Rare
73	<i>Solanum nigrum</i> L.	3	3	4	4	14	Infrequent
74	<i>Solanum surattense</i> Burm. f.	3	3	4	4	14	Infrequent
40	Verbenaceae						
75	<i>Vitex negundo</i> L.	1	3	3	0	7	Vulnerable
41	Vitaceae						
76	<i>Vitis jacquemontii</i> R. Parker	1	2	3	4	10	Rare
42	Zygophyllaceae						
77	<i>Tribulus terrestris</i> L.	3	3	4	4	14	Infrequent

Key:

1. Availability

0 = Uncommon or very rare

1 = Less common or rare

2 = Occasional

3 = Abundant

2. Collection

0 = More than 1000 kg/yr

1 = Consumed from 500-1000 kg/yr

2 = Consumed from 300-500 kg/yr

3 = Consumed from 100-200 kg/yr

3. Growth

0 = Regrowth in more 3 years

1 = Regrowth within 3 years

2 = Regrowth within 2 years

3 = Regrowth within 1 year

4 = Leaves/Gum/Latex

4. Part used

0 = Root/Whole plant

1 = Bark

2 = Seeds, Fruits

3 = Flowers

4 = Leaves/Gum/Latex

5. Total Score

6. 0 - 4 Endangered

7. 5 - 8 Vulnerable

8. 9 - 12 Rare:

9. 13 - 14 Infrequent

10. 15 - 16 Dominant

Figure 2. Conservation status of plant resources of Hazar Nao hills, district Malakand

Acacia nelotica

Ziziphus nummularia

Figure 3. Bushy appearance of *Acacia nelotica* and *Ziziphus nummularia* after grazing

Figure 4. Heavy grazing caused bushy appearance of *Saccharum griffithii*

A

B

C

D

Figure 5. (A, B, C, D) Fire an ecological factor clears the green belt of vegetation

Figure 6. A view of degraded plant of *Butea monosperma*

Figure 7. Soil erosion in the study area

Figure 8. Cutting of trees is a common practice leading to low species diversity and maturity

A

B

Figure 9. (A-B) Land sliding cause degradation of vegetation

A

B

Figure 10. (A, B) Road expansion is a threat to plant resources

Figure 11. Barren area emerged due to fuel wood cutting

Figure 12. (A) Mature *Acacia modesta* adopted bushy appearance after heavily grazed

Figure 13. View of heavily grazed *Monotheca buaxifolia*

Infrequent species

The infrequent species shared 19 species (24.67%). These include *Cymbopogon jwarancusa*, *Cynodon dactylon*, *Heteropogon contortus*, *Achyranthes aspera*, *Amaranthus caudatus*, *Launaea procumbens*,

Carthamus oxycantha, *Chenopodium album*, *Convolvulus arvensis*, *Euphorbia helioscopia*, *Fumaria indica*, *Ajuga bracteosa*, *Malva neglecta*, *Boerhavia procumbens*, *Oxalis corniculata*, *Rumex hastatus*, *Solanum nigrum*, *Solanum*

surattense and *Tribulus terrestris* (Table 1). In this dry arid environment, there is always a deficiency of forage and livestock graze every green soft textured plant (Figure 12, 13), resulting in their reduction and hampered regeneration, leading them to the infrequent category. [21] revealed that inhabitants of Kot Manzaray Baba valley use 82 plant species for different purposes. Vegetation of the area was under severe biotic pressure due to deforestation and overgrazing. [22] studied the patterns of species composition and diversity in the lesser Himalayan subtropical forests of Kashmir in relation to environmental variables and underlying anthropogenic influence. Severe grazing intensity was observed at all the study sites. According to the present studies, various parameters including over-exploitation, extensive harvesting, population explosion, low regeneration, poverty, ignorance, anthropogenic disturbances (Figure 11), deforestation, improper way of collection, fuel wood usage, habitat loss (Figure 7, 9), overgrazing (Figure 3), use as timber, medicinal usage, furniture, land sliding (Figure 9), road expansions (Figure 10) and unwanted incidental fire (Figure 5) are contributing to make the important plants threatened. Moreover, due to unsustainable and unscientific utilization, the forest resources are under immense pressure and are disappearing at an alarming rate.

Conclusions

It is concluded that flora of district Malakand comprise of diverse plants. The sampled localities revealed that 25% species were endangered, 29% vulnerable, 15% rare while 24% infrequent. The main causes for plant species vulnerability were recorded as overgrazing and extensive anthropogenic activities.

Authors' contributions

Designed & idea of the experiments: Z Muhammad, collected plant materials: H Ali, Identification of the specimen: W

Muhammad, analyzed data: Z Muhammad & A Majeed, Wrote Paper: Z Muhammad.

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