VEGETATION LOSS IN MURREE FOREST, PAKISTAN.

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خلاصہ

پاکستان ایک ایسے ملک ہے جہاں پہاڑوں کے ساتھ پہاڑوں اور والوں پر مشتمل ہوتا ہے، لیکن یہ تنوع انسان سے متعلق واقعات کی طرف سے خطرے میں ہے. مری پہاڑیوں کو پاکستان میں کثیر فصلیاتی جگہ سمجھا جاتا ہے، جس کی خوبصورتی اور سیاحت کے لئے جانا جاتا ہے. گزشتہ چند سالوں میں، مری جنگل کی پودوں میں ایک بہت بڑا تبدیلی ہوئی ہے، جس میں جیوویوجویت میں نقصان کا اشارہ ہے. ہم نے جنگل میں ان کی موجودگی / فریکوئنسی کی سطح کی بنیاد پر پلانٹ پر جاتیوں کی تحقیقات کی اور ان اشارے کو پچھلے کام تک موازنہ کیا. ہمارے مطالعے نے 22 نئے تارکین وطن پلانٹ کی اقسام (درختوں، بوڑھوں، اور گھاس سمیت) ریکارڈ کیا اور پچھلے نتائج میں موجود 78 پودوں کی نوعیتیں اب ان جنگلوں سے غیر حاضر ہیں. غیر حاضر شدہ پر جاتیوں کی تعداد تارکین وطن سے متعلق نقصانات کی نشاندہی، نقل مکانیوں کی تعداد سے زیادہ ہے. انسانی مداخلت کی وجہ سے 37 پر جاتیوں کی موجودگی ہے جو ختم ہونے کے بہت قریب ہیں. اس مضمون کا مقصد اس نقصان کی حد کی وضاحت کرنا ہے، جو مری جنگل میں جیوویوید کو بچانے کے لئے حفاظتی اقدامات کے عمل کے لئے ضروری ہے.

Abstract

Pakistan is a country with great mountains and valleys consists of a lush green variety of plants but this diversity is under threat by human-related events. Murree Hills are considered as one of the multi-floristic place in Pakistan, known for its beauty and tourism. Over the past few years, there has been a drastic change in the vegetation of Murree forest, indicating a loss in biodiversity. We investigated plant species on the basis of their presence/frequency level in the forest and compare these indices to the previous work. Our study recorded 22 new immigrant plant species (including trees, shrubs, and grasses) and 78 plant species that were present in previous findings are now absent from these forests. The number of absent species is greater than the number of immigrated species, indicating biodiversity loss. There are 37 species which are very close to extinction due to human interference. The goal of this article is to explain the extent of this loss, which is important for the implementation of conservation measures to rescue biodiversity in the Murree forest.
Key word: Biodiversity, threatened species, deforestation, anthropogenic activities.

Introduction

Pakistan is consisted of a large variety of plants including native as well as exotic species in the country. Approximately 5,600 vascular plant species (Ali, 1978; IUCN, 1997) and more than 6,000 species (Flora of Pakistan, 1999) inhabit Pakistan. The northern and western parts of Pakistan are especially interesting due to their high rates of endemism. IUCN (1997) listed about 400 species that are endemic to these regions. According to Mehring *et al.,* (2012), around the world, vegetation diversity is threatened by human-related events, deforestation and due to increasing human population. Pakistan is not an exception. Chaudhri (1963) confirmed that Murree forest is home of high levels of vegetation diversity compare to the rest of Pakistan. Moist temperate area of Murree used to covered with thick conifers, Angiosperm trees, vascular shrubs, herbs, grasses and lower plants and is located on the Himalayan ranges between Punjab and Khyber Pukhtoonkhwah (KPK). The annual precipitation is 1,789 mm (70.4 in). The highest elevation is 2,291m (7,517ft) above sea level in North altitude 33◦54'30" and East longitude 73◦26'30".

Only non-temporal data on the status of plant species in least disturbed Murree is available (Siddiqui, 2011; Ahmed *et al*., 2006, 2009; Hussain & Illahi, 1991). Changes in vegetation diversity in highly disturbed Murree forest may provide a useful indicator for changes in vegetation diversity in similar areas of Pakistan. Therefore, to better quantify the threat to vegetation diversity in the Murree forest, we provided the needed cross-temporal data. For evaluation of temporal data, this article provides a species inventory that summarizes the past and current status of plant species. Increase in tourism and other human-related activities in Murree forest are threats to this diversity.

Materials and Methods

Quantitative sampling was conducted in 30 different locations of Murree Hills to determine current status of plants. In each area a one hectare square (100x100) quadrate was established and ignoring lower plants, names of each species were recorded. The past status and current status for each plant species in Murree forest was determined by their relative frequency (%) in the area. These relative frequencies are classified under sixfactors: "most abundant" (81–100%), "abundant" (61–80%), "frequent" (41–60%), "occasional" (21–40%), "rare" (1–20%), and "absent" (0%). This six-factor classification scheme for trees and ground flora species is given by Braun-Blanquet (1965) and followed by Ahmed (1986). The data for the past status of each species was originally collected by Siddiqui (2011), Siddiqui *et al*., (2009) and Ahmed *et al*., (2006).

Results and Discussion

Table 1 presents the past and current status for tree and understory species present in Murree forest, including disturbed and least disturbed areas. *Pinus wallichiana* and *Adiantum capillus* were the most abundant species throughout the entire study area. Previous inventories of the plant species in Murree reported 117 species while currently there are 61 species present in disturbed areas and most of them are close to extinction. Our inventory reports an increase in total number of species: up to 139 species. However, this increase is partly due to the fact that we found 22 new plant species that were not reported in previous inventories, considering them newly immigrant in the disturbed forest. Introduction of new species in disturbed areas may be due tourism. As humans and animals brought seeds and plants from other places to Murree by sticking in their bodies, vehicles and other accompanied materials. The frequencies of these immigrant species are rare now but it may be increased in future. These ecological impacts on natural flora are not known therefore detailed investigation is necessary on these species. Moreover, our inventory reports that out of 61 species, 13 species were occasionally present in disturbed areas, while 37 were rare and 78 were completely absent from the disturbed sites in current status, only one non tree species was abundantly recorded while nine species were frequently present showing poor condition of ground flora summarized in Fig.1.
While some important species, expected to be absent in near future from Murree Hills are shown in Fig. 2.

Species Name	Past status	S.No	Current status
1. *Abies pindrow* (Royle ex D.Don) Royle.	Most abundant	1	1.Occasional
2. *Acacia modesta* Wall.	Abundant		Absent
3. *Acer ceasium* Wall.	Frequent	2	2.Occasional
4. *Adiantum capillus-veneris* L.	Most abundant	3	3.Abundant
5. *Adiantum incisum* Forssk.	Frequent		Absent
6. *Adiantum venustum* D.Don.	Rare		Absent
7. *Aesculus indica* Wall. ex Camb. Hook	Abundant	4	4.Occasional
8. *Agaricus compestris* L.Ex.Fr.	Rare		Absent
9. *Andropogon lancifolius* L.	Rare		Absent
10. *Andropogon tristis* Nees ex Hack	Rare		Absent
11. *Anemone falconeri* T.T	Rare		Absent
12. *Aqualegia vulgaris* L	Absent	5	5.Occasional
13. *Argemone mexicana* L	Occasional	6	6.Rare
14. *Aristida adscensionis* L	Occasional		Absent
15. *Aristida cyantha* Nux ex. Stand	Rare	7	7.Rare
16. *Artemesia brevifolia* Wall. Ex DC.	Frequent		Absent
17. *Asplenium adiantum nigrum.* L	Rare		Absent
18. *Asplenium trichomanes* L	Rare		Absent
19. *Asplenium viride* Huds.	Rare		Absent
20. *Aster molliusculus* (D C) C.B. Clarke	Rare		Absent
21. *Athyrium atkinsonii* Bedd.	Rare		Absent
22. *Athyrium filix foemina* (L)	Occasional		Absent
23. *Barberis kunawerensis* Royle	Frequent	8	8.Rare
24. *Barberis lycium* Royal I.C.	Most abundant	9	9.Frequent
25. *Bellis perennis* L.	Most abundant		Absent
26. *Bothriochloa bladhii* (Retz)	Rare		Absent
27. *Brassica compestris* L	Rare		Absent
28. *Brassica nigra* (L) Kotch.	Rare		Absent
29. *Butmendis alunthus* L	Absent	10	10.Rare

30. *Campanula tenuissima* Dunn	Rare	11	11.Rare
31. *Canabis sativa* L	Absent	12	12.Frequent
32. *Carissa opaca* stapf ex Haines	Rare		Absent
33. *Carum carvi* (Gracile) Wolff	Occasional	13	13.Rare
34. *Cassia glauca* Lam	Absent	14	14.Rare
35. *Cedrus deodara.* (Roxb.)G. Donf.	Most abundant	15	15.Occasional
36. *Chrysanthemum vulgare* Lam	Most abundant	16	16.Rare
37. *Chrysopogon aucheri* (Boiss.) Stapf	Rare		Absent
38. *Chrysopogon echinulatus* Nees ex Stued	Occasional		Absent
39. *Companula latifolia* L	Rare		Absent
40. *Companula tenuissima* Dunn	Occasional	17	17.Rare
41. *Cornus microphylla*	Absent	18	18.Rare
42. *Cotoneaster microphylla* Wall ex Lindle	Abundant	19	19.Occasional
43. *Cotonester nummularius* (Fisch & C. A.) Megel.	Abundant	20	20.Rare
44. *Crotolaria juncea* (Sunn hemp)	Absent	21	21.Rare
45. *Cupressus sempervirens* L.	Absent	22	22.Rare
46. *Cymbopogon jawarencusa* (Jones) Schult	Frequent		Absent
47. *Delphinium uncinatum* H & T	Rare		Absent
48. *Dicanthium annulatum* (Forssk)	Occasional		Absent
49. *Diospyros lotus* L.	Absent	23	23.Rare
50. *Dryopteris barbegera* (Moore) O.Kze	Rare		Absent
51. *Duchesnea indica* (Andr)	Occasional		Absent
52. *Echinophs nivens* Wall ex D.C.	Occasional	24	24.Rare
53. *Ephedra gerardiana* Wall Ex Stapf	Rare		Absent
54. Erianthus griffithii	Rare		Absent
55. *Euphorbia cornigera* Boiss	Abundant		Absent
56. *Euphorbia hispida* Boissier	Rare		Absent
57. *Ficus palmata* Forssk	Occasional		Absent
58. *Ficus auriculata* Lour	Absent	25	25.Rare
59. *Fragaria nubicola* (Hook. f.) Lindl. Ex Lcaita	Abundant		Absent
60. *Fragaria vesca* (Hook. f.) Lindl. Ex Lcaita	Absent	26	26.Occasional
61. *Galium aparine* L.	Frequent		Absent
62. *Galium boreale* L.	Frequent		Absent
63. *Galium elegans* Wall ex Roxb	Frequent		Absent
64. *Genum verum* L.	Frequent		Absent
65. *Geranium wallichianum* D. Don	Rare		Absent
66. *Gloriosa superba* L	Occasional		Absent
67. *Hedera nepalensis* K. Koch	Most abundant	27	27.Rare
68. *Hypericum dyeri* Rehder	Rare		Absent
69. *Indigofera gerardiana* Wall Ex Baker	Rare		Absent
70. *Indigofera hebepatela* Baker	Abundant	28	28.Rare
71. *Jasminum grandiflorum* L	Rare		Absent
72. *Juglans regia* L	Occasional	29	29.Occasional
73. *Lolium perenne* L	Abundant		Absent
74. *Lycopodium selago* L	Rare		Absent
75. *Magnolia champaca* (L) Baill. Ex Pierre	Absent	30	30.Rare
76. *Morus alba* L	Occasional		Absent
77. *Myrsine Africana* L.	Most abundant	31	31.Frequent
78. *Olea ferugenia* Royle	Most abundant	32	32.Frequent
79. *Paeomia emodi* Royle	Absent	33	33.Rare
80. *Picea smithiana* (Wall.) Bioss	Frequent		Absent
81. *Pinus roxburghii* Sarg	Frequent	34	34.Frequent
82. *Pinus wallichiana* A.B.Jackson	Most abundant	35	35.Most abundant
83. *Plantago asciatica* L	Frequent	36	36.Rare
84. *Platanus orientalis* L	Absent	37	37.Occasional
85. *Pleopeltis clathrata* (clarke) Bedd	Rare		Absent
86. *Poa alpina* L	Abundant		Absent
87. *Podophylum emodi* L	Occasional		Absent

88. *Polygala abyssimica* R.Br.Ex Fresen	Rare		Absent
89. *Polygala erioptera* (DC)	Rare		Absent
90. *Polygonatum multiflorum*(L.) All	Most abundant		Absent
91. *Polygonum amplexicaule* D. Don	Rare		Absent
92. *Polygonum caespitosum* BI	Rare		Absent
93. *Polygyla sibrica* L	Rare		Absent
94. *Polyporus abietinus* Fr.	Rare		Absent
95. *Populus ciliata* Wall. Ex Royle.	Absent	38	38.Frequent
96. *Populus nigra* L.	Absent	39	39.Frequent
97. *Prunus cornuta* (Wall. Ex Royle) Steud	Abundant		Absent
98. *Prunus domestica* L.	Absent	40	40.Rare
99. *Pteridium aquilinum* (L)	Rare		Absent
100.*Pteris cretica* L mant	Abundant		Absent
101.*Punica granatum* L.	Abundant	41	41.Frequent
102.*Pyrus pashia* L.	Frequent	42	42.Rare
103.*Quercus baloot* Griffith	Absent	43	43.Occasional
104.*Quercus dilatata* Lindl.ex Royle	Occasional	44	44.Frequent
105.*Quercus ilex* Griff., Itin.	Occasional		Absent
106.*Quercus incana* Roxb	Frequent	45	45.Frequent
107.*Rannunculus acris* L.	Absent	46	46.Occasional
108.*Rannunculus diffuses* DC.	Most abundant	47	47.Rare
109.*Rannunculus muricatus* L	Frequent		Absent
110.*Ribes alpestra* Dcne. Ex Jacq.,	Rare		Absent
111.*Rosa burnonii* Lindl	Abundant	48	48.Rare
112.*Rosa macrophylla* Lindl	Abundant		Absent
113.*Rosa moschata* Herrm	Absent	49	49.Occasional
114.*Rosa webbiana* Wall ex Royle	Most abundant	50	50.Rare
115.*Rubus antennifer* Hk.f	Rare		Absent
116.*Rubus biflorus* Ham ex Sm.	Most abundant		Absent
117.*Rubus ellipticus* Smith	Abundant	51	51.Rare
118.*Rubus macilentus* Camb	Occasional		Absent
119.*Rubus nivens* Hk.F	Frequent	52	52.Occasional
120.*Rubus ulmifolius* Schott.	Abundant		Absent
121.*Rumex nepalensis* Spreng	Abundant		Absent
122.*Sacharrum bengalense* Retz.	Abundant		Absent
123.*Salix australis* L.	Absent	53	53.Rare
124.*Salix dendiculata* Wallich ex Andersson	Absent	54	54.Rare
125.*Selaginella jacquemontii* P. Beauv	Rare		Absent
126.*Selaginella sanguinlenta* (L.) Spring.	Occasional		Absent
127.*Sinapis arvensis* L.	Rare		Absent
128.*Sonchus asper* (L.) Hill	Occasional		Absent
129.*Sophora mollis* (Royle) Baker.	Absent	55	55.Rare
130.*Taxus wallichiana* Zucc	Occasional		Absent
131.*Tetrapogon villosus* HUds/Desf	Rare		Absent
132.Thalictrum alpinum var microphyllum	Abundant	56	56.Rare
133.*Thymus serephyllum*.L	Abundant	57	57.Rare
134.*Urtica dioca* L	Frequently	58	58.Rare
135.*Ulmus wallichiana* Planch	Rare	59	59.Rare
136.*Veronica biloba* L.	Abundant		Absent
137.*Viburnum contifolium* L.	Most abundant	60	60.Rare
138.*Viola biflora* L.	Frequent		Absent
139.*Viola odorata*L.	Rare	61	61.Rare

Note: S.No = Serial number of recently found species.

Fig. 1:Abundance of flora in past v/s present regimes

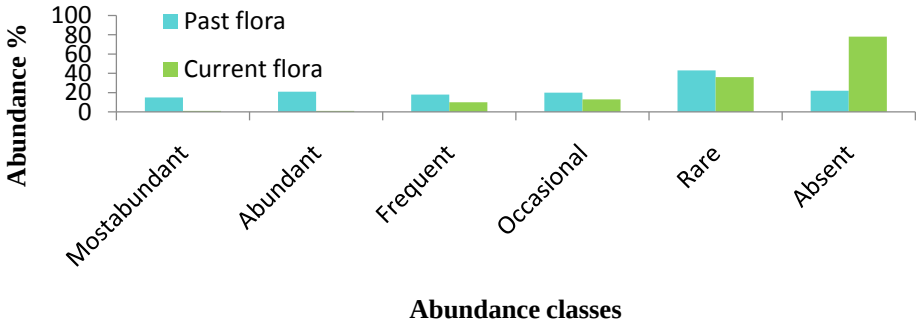

Fig.1: Showing relative abundance of plant species in past and present.

Fig 2. Some known Himalayan species that are expected to be rare or absent in Murree, Pakistan.

Table. 2: Economic importance of some absent species.

S.No.	Name of species	Economical/Medicinal importance
1.	*Artemesia brevifolia*	Commonly used as herbal medicine against jaundice, intermittent fever, vermifuge. (Kirtikar & Basin, 1975). Also used in treatment of Helminth infection (Hammond *et al.,* 1997).
2.	*Bellis perennis*	Used as preventive drug against ischemic disease and anti-obese (Morikawa *et al.,* 2010).
3.	*Cymbopogon jwarancusa*	Widely used all over the world for fragrance, flavouring agent, in the form of tea. It is also a herbal medicine for hypotension, analgetic diseases, antirheumatic problems. It is also used as antiseptic. Extracts are used for gastrointestinal and nervous disorders (John, 1984).
4.	*Fragaria nubicola*	Edible. Its extract used in treatment of pubic disorders in females. Also used to treat blemishes in tongue (Manadhar, 2002)
5.	*Galium aparine*	Edible as leafy vegetable. Grains are dried and roasted to make coffee with less caffeine. Medicinally used for skin problems and treatment of poisonous bites (Duke, 2001).
6.	*Galium boreale*	Edible. Leaves are used as tea. Its roots are used for making red dye. Plant as whole used as stuffing material in mattresses. Plant is used in treatment of diuretic diseases (Moerrman, 1998)
7.	*Galium elegans*	Used as herbal medicine for the treatment of pneumonia in children (Khan *et al.,* 2012).
8.	*Genum vernum*	Used as folk medicine as astringent and anti-inflammatory diseases. Produce clove like aroma useful in beverages mostly alchoholic (Strzelecka and Kowalski, 2000).
9.	*Geranium wallichianum*	Rheumatism can be treated by aqueous root extract. General weakness can be recovered by rhizome powder (Khan *et al.,* 2012).
10.	*Lolium perenne*	Seeds are cooked as cereal. Plant extract is used for treatment of cancer, diarrhea, malaria (Kunkel, 1984).
11.	*Polygonatum multiflorum*	Leaves, young shoot and roots are used for edible purpose. Plant used in cosmetics industry. Used for treatment of inflammation, chronic, dysentery, tissue repair (Grieve, 1984).
12.	*Pteris cretica*	An ornamental species. plant is generally used to remove Arsenic from soil (Elless *et al.,* 2007).
13.	*Rubus biflorus*	Fruit is edible and used in making dye (Grae, 1974)
14.	*Rubus ulmifolius*	Fruit is edible and used to produce orange dye (Niebuhr, 1970).
15.	*Rumex nepalensis*	Leaves and roots are edible. Plant used for making dark green, brown, grey dyes. Medically used to treat headaches, swollen gums, body pain relieving. Roots are applied on dislocated bones (Manadhar, 2002).
16.	*Saccharrum bengalense*	Edible. Known for effective use to cure kidney stones as folk medicine (Khan *et al.,* 2012).
17.	*Veronica biloba*	Edible. Used for treatment of bronchial, respiratory diseases, allergies and asthma (Ernest, 1967).
18.	*Viola biflora*	Leaves extract used as antiseptic. Flowers locally used to treat cough. Aqueous extract used to cure jaundice and fever (Khan *et al.,* 2012).

Table.2 shows 18 absent species which were previously reported by different workers from nearby areas of least disturbed forests in the same region as most abundant, abundant and frequently present species. Such species include *Artemesia brevifolia, Bellis perennis, Cymbopogon jwarancusa, Fragaria nubicola, Galium aparine, Galium vernum, Galium elegans, Genum urbanum Geranium wallichianum, Lolium perenne, Polygonatum multiflorum, Pteris cretica, Rubus biflorus, Rubus ulmifolius, Rumex nepalensis, Saccharrum bengalense, Veronica biloba, Viola biflora.* Medicinal or economic importance of these species indicated the loss of economic resources due to disturbance.

In a phytosociological survey of Murree and other moist temperate zones of Pakistan, Naqvi (1976), Siddiqui *et al*., (2009), and Ahmed *et al*., (2006, 2009) found *Pinus wallichiana, Abies pindrow, Picea smithiana, Quercus incana, Olea ferugenia, Myrsine africana, Adiantum capillus*, and *Acacia modesta* are abundant or most abundant in these forest. Our findings reveal two major issues in the Murree forest. The first is the appearance of new species in such highly disturbed conditions. These new species include those herbs and shrubs that are adapted to moist temperate regions. Among the newly recorded species, we found a few exotic

types: *Crotolaria juncea, Ficus auriculata, Cassia glauca, Prunus cornuta, Celix australis, Urtica dioca* and *Viola odorata*.

There are several possible causes of the arrival of these new species: e.g. (1) they were accidentally introduced along with noxious weeds (Hens & Boon, 2003), (2) they were dispersed by grazing animals and agricultural activities of villagers from nearby areas, (3) their dormant seeds found opportunities to grow while thinning occurred in the forest, (4) seeds introduced by tourism. These new species may create environmental disasters on natural flora and fauna of the area due to aggressive growth, behavior or allelopathy. Therefore, these impacts on natural plant and soil should be explored.

The second issue is that the number of lost species is greater than the number of immigrant species. This signals the gradual loss in Murree's plant diversity. The most abundant species were *Pinus wallichiana* and *Adiantum capillus* while most of the other species were found in rare condition. This is an indication of land loss, habitat loss, and consequently biodiversity loss. Records show higher number of absent and rare species in study area as compared to least disturbed nearby sites. Absence of economically important plants in the study areas indicating the loss of resources (Khan 2011), due to anthropogenic disturbances in addition to biodiversity degradation. Loss of plant cover or reduction in number of species in hilly areas and slopes increase the risk of soil erosion in rainy season which results in land sliding, destruction of infrastructure and loss of human life. Therefore, the areas should be protected by increase in cover of native trees, shrubs, herbs and grasses.

Our findings raise concern for the future of the Murree forest and, to the extent that its situation is representative of Pakistan's moist temperate zone and its vegetation diversity. Of course, the best response to this concern remains an open question. Spierenburg (2012) and Mehring *et al*., (2012, 2017) argue that understanding the etiology of biodiversity loss requires inter-disciplinary research because it can involve multiple underlying societal factors. Even if we can identify these factors, though, they may resist simple intervention. Martin-Lopez *et al*., (2014), Poe *et al*., (2014), Gavin *et al*., (2015), and Silvertown (2015) argue that these socio-cultural values are maintained by exploiting nature—financially, economically, or environmentally. The solutions to these problems were far beyond the scope of this article. We only hope that our findings elucidate the nature and magnitude of the problem in the context of the Murree forest.

Conclusion

Current study is a detailed scenario of existing vegetation and its future perspective in Murree forest. The forest need extensive management strategies to conserve its flora. The conifer species alongwith ground flora is gradually depleting, however, the vegetation composition consists of a wide range of species that are not only maintaining the ecosystem of the forest but also possess ethnobotanical, medicinal and economically important biota. This article enlisted the species formerly present in the forest and those that have remained occasional and rare hence claiming the migration or depletion of relatively greater number of than the reminants. Therefore, it is concluded that the forest requires conservation of its natural habitat.

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