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Species Diversity among Two Forests of Nainital, Kumaun Himalaya

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Abstract: Biodiversity has recently emerged as an issue of both scientific and political concern primarily because of an increase in extinction rates caused by human activities. Species richness patterns in relation to the environment need to be understood before drawing conclusions on the effect of biodiversity in ecosystem processes. An attempt has been done to estimate species richness among two different forest types around Nainital. Two site were selected Kelakhan, Oak (*Quercus leucotrichophora* A. Camus.) and Pines, Pine (*Pinus roxburghii* Sarg.) in Nainital region. The collected plants specimens were indentified with the help of different floras and manuscripts, standard literature and to estimate the species richness Menhinick's index were used. After extensive field survey 70 species in Oak forest Kailakhan, Nainital were recorded, Out of which 15 species were trees, 13 shrubs, 40 herbs and 2 climbers and 55 species in pine forest, pines, Nainital were recorded out of which 08 species were trees, 15 shrubs, 29 herbs and 3 climbers Present study shows that Oak forest have high species richness of tree (1.79)and herbs (4.78) in comparison of Pine forest while in case of shrub (2.02) and climber (0.40) pine forest showing maximum species richness than oak forest.

Keywords: Kumaun Himalaya, Species richness, Forest types, Pine forest, oak forest

I. INTRODUCTION

Biodiversity has recently emerged as an issue of both scientific and political concern primarily because of an increase in extinction rates caused by human activities ^[1]. Species richness patterns in relation to the environment need to be understood before drawing conclusions on the effect of biodiversity in ecosystem processes. Numerous problems regarding the study of species richness need to be clarified, including the role of disturbance ^{[2][3][4]}, and the relative importance of biotic versus abiotic factors ^{[2][5][6][3]} reviewed species richness extensively, and regarded patterns of species richness as being determined by the interaction of disturbance with environmental gradients and competitive exclusion. Although over any large region the distribution of species richness is likely to be governed by two or more environmental gradients ^{[7][8][9][10][11][12]}, species richness studies in relation to environmental gradients have been mainly single-factor studies. Recently various studies have been done on forest vegetation of Kumaun region by ^{[13][14][15][16][17]}. Species richness is a measure of the number of species found in a sample. Since the larger the sample, the more species we would expect to find. The main Objective of this study was to estimate species Richness among two Different Forest Types around Nainital.

II. MATERIAL METHOD

- 1) **Study Area:** Two site were selected Kelakhan, Oak (*Quercus leucotrichophora* A. Camus.) (Altitude 1906 m asl, 29°22'37.26"N, 79°28'46.66"E) and Pines, Pine (*Pinus roxburghii* Sarg.) (Altitude 1821m asl, 29°23'06.52"N, 79°29'04.39"E) in Nainital region (fig 1).



Fig 1. Map of the studies site (Source: Google earth)

- 2) **Data Collection and Sample Identification:** Extensive field survey was conducted for the collection of data and plant samples. The collected plants specimens were identified with the help of different floras and manuscripts, standard literature^{[18][19][20][21]}. The number of species is divided by the square root of the number of individuals in the sample. This particular measure of species richness is known as D, the Menhinick's index.

$$D = s / \sqrt{N}$$

Where s equals the number of different species represented in your sample, and N equals the total number of individual organisms in your sample.

III. RESULT AND DISCUSSION

After extensive field survey 70 species in Oak forest Kailakhan, Nainital were recorded, Out of which 15 species were trees, 13 shrubs, 40 herbs and 2 climbers and 55 species in pine forest, pines, Nainital were recorded out of which 08 species were trees, 15 shrubs, 29 herbs and 3 climbers (Table. II and Fig.2, 3). In both the studied sites Asteraceae family showing highest number of genus and species followed by Rosaceae. Soil properties of both forests were also analysed and results shows that Oak forests have better moisture content and water holding capacity in comparison of pine forest which is a positive sign for forest health and seed germination (Table I).

- 1) **Species Richness:** Present study shows that Oak forest have high species richness of tree (1.79) and herbs (4.78) in comparison of Pine forest while in case of shrub (2.02) and climber (0.40) pine forest showing maximum species richness than oak forest (Fig.3).

Table I. Soil Properties Of Oak Forest (OF) And Pine Forest (PF), Nainital

| Properties Site | Sand | Silt | Clay | Moisture content | WHC | pH |
|--------------------|--------|--------|--------|---------------------|-------|-----|
| OF | 43.72% | 35.22% | 21.06% | 16.28 % | 18.29 | 5.4 |
| PF | 52.96% | 34.87% | 12.17% | 8.15% | 9.23 | 6.6 |

Table: II. Species Found In Oak Forest (OF) Kailakhan And Pine Forest (PF) Pines, Nainital

| Local Name | Botanical Name | Family | OF | PF |
|------------------|---|-----------------|----|----|
| Kawgori (H) | Dicliptera bupleuroides Nees. | Acanthaceae | ✓ | ✓ |
| Jimla (H) | Strobilanthes atropurpureus Nees | Acanthaceae | | ✓ |
| Jhinti (H) | Barleria cristata L. | Acanthaceae | | ✓ |
| Putli (T) | Acer oblongum Wall. ex DC. | Aceraceae | ✓ | |
| Apamarg (H) | Achyranthes bidentata Blume. | Amaranthaceae | ✓ | ✓ |
| Kariu (S) | Asparagus curillus Buch.-Ham. ex Roxb. | Asparagaceae | ✓ | ✓ |
| Kach (H) | Solidago virgaurea L. | Asteraceae | ✓ | |
| Kala Basinga (H) | Eupatorium adenophorum Spreng. | Asteraceae | ✓ | ✓ |
| Jhuri (S) | Inula cuspidata (DC.) Clarke. | Asteraceae | ✓ | |
| Kapasi (H) | Gerbera gossypina (Royle) Beauv. | Asteraceae | ✓ | ✓ |
| Jhar (H) | Erigeron karvinskianus DC. | Asteraceae | ✓ | ✓ |
| Kandaya (H) | Cirsium wallichii DC. | Asteraceae | ✓ | |
| Kan Phool (H) | Taraxacum officinale Weber. | Asteraceae | ✓ | |
| Neel kanthi (H) | Senecio nudicaulis Buch.-Ham. ex D. Don | Asteraceae | | ✓ |
| Marchia Ghas (H) | Galinsoga parviflora Cav. | Asteraceae | ✓ | |
| Arka-Jhar (H) | Bidens bipinnata L. | Asteraceae | ✓ | |
| Karubuti (H) | Ainsliaea aptera DC. | Asteraceae | ✓ | ✓ |
| Gualsi (H) | Tragopogon gracilis D. Don | Asteraceae | ✓ | ✓ |
| Bakol (H) | Anaphalis adnata DC. | Asteraceae | ✓ | |
| Kilmora (S) | Berberis asiatica Roxb. ex DC. | Berberidaceae | ✓ | ✓ |
| Uti (T) | Alnus nepalensis D. Don | Betulaceae | | ✓ |
| Ban-laiyya (H) | Cardamine impatiens L. | Brassicaceae | ✓ | ✓ |
| Satpura (S) | Sarcococca saligna (D. Don) Muell.-Arg. | Buxaceae | ✓ | |
| - (H) | Campanula colorata Wall. | Campanulaceae | ✓ | |
| Tirmuya (S) | Viburnum continifolium D. Don | Caprifoliaceae | ✓ | |
| Tirmu (S) | Viburnum mullaha Buch.-Ham. ex D. Don | Caprifoliaceae | | ✓ |
| Badyau (H) | Stellaria media (L.) Vill. | Caryophyllaceae | ✓ | |
| - (H) | Stellaria monosperma Buch.-Ham. ex D. Don | Caryophyllaceae | | ✓ |
| - (H) | Stellaria patens D. Don | Caryophyllaceae | | ✓ |
| Makhhol (S) | Coriaria nepalensis Wall. | Coriariaceae | ✓ | ✓ |
| Khagsi (T) | Cornus macrophylla Wall. | Cornaceae | ✓ | |
| Gauntia (T) | Cornus oblonga Wall. | Cornaceae | ✓ | |

| | | | | |
|-------------------|--|------------------|---|---|
| Surai (T) | Cupressus torulosa D. Don | Cupressaceae | ✓ | |
| Gewai (S) | Elaeagnus parvifolia Wall. ex Royle | Elaeagnaceae | ✓ | |
| Anyar (T) | Lyonia ovalifolia (Wall.) Drude. | Ericaceae | ✓ | ✓ |
| Burans (T) | Rhododendron arboreum Sm. | Ericaceae | ✓ | ✓ |
| - (H) | Shuteria involucrata (Wall.) Wt. & Am. | Fabaceae | ✓ | |
| Tipatiya (H) | Trifolium repens L. | Fabaceae | ✓ | |
| Salprani (H) | Flemingia bracteata (Roxb) ex Aiton | Fabaceae | ✓ | ✓ |
| Banj (T) | Quercus leucotrichophora A. Camus | Fagaceae | ✓ | ✓ |
| Bhil- jhari (H) | Geranium ocellatum Boiss. | Geraniaceae | | ✓ |
| Jangli Pangar (T) | Aesulus indica (Wall. ex Cambess.) | Hippocastanaceae | ✓ | |
| Obani (S) | Hypericum oblongifolium Choisy. | Hypericaceae | ✓ | ✓ |
| Birchi (H) | Clinopodium umbrosum (M. Bieb.) C. Koch. | Lamiaceae | ✓ | |
| Garur buti (H) | Micromeria biflora (Buch.-Ham. ex D. Don.) | Lamiaceae | ✓ | |
| Kappu (H) | Scutellaria scandense Buch.- Ham.ex D. Don | Lamiaceae | ✓ | |
| Kaul (T) | Machilus duthiei King. | Lauraceae | | ✓ |
| Piuli (H) | Reinwardtia indica Dumort. | Linaceae | ✓ | ✓ |
| - (H) | Disporum cantoniensis (Lour.) Merrill. | Liliaceae | | ✓ |
| Beduli Bel (C) | Ficus hederacea Roxb. | Moraceae | ✓ | |
| Kaphal (T) | Myrica esculenta Buch.-Ham. ex D. Don | Myricaceae | ✓ | ✓ |
| Ghingne (S) | Myrsine africana L. | Myrsinaceae | ✓ | |
| Angu (T) | Fraxinus micrantha Lingelsh. | Oleaceae | ✓ | ✓ |
| Lal Phuliya (H) | Oenothera roesa L' Herit. ex Aiton | Onagraceae | ✓ | |
| Chalmori (H) | Oxalis latifolia Kunth. | Oxalidaceae | ✓ | ✓ |
| Deodar (T) | Cedrus deodara (Roxb. ex D.Don) G.Don | Pinaceae | ✓ | |
| Chir (T) | Pinus roxburghii Sarg. | Pinaceae | | ✓ |
| - (H) | Peperomia reflexa (L.f.) A. Dietr. | Piperaceae | | ✓ |
| Babil Ghas (H) | Eulaliopsis binata (Retz.) Hubb. | Poaceae | ✓ | |
| Ringal (H) | Arundinaria falcata Nees. | Poaceae | ✓ | |
| Ghas (H) | Oplismenus undulatifolius (Ard.) P. Beauv. | Poaceae | ✓ | |
| Pathar Phool (H) | Polygonum capitatum Buch.-Ham. ex D.Don | Polygonaceae | | ✓ |
| Bhilmora (H) | Rumex hastatus D. Don | Polygonaceae | ✓ | ✓ |
| Jangli Palak (H) | Rumex nepalensis Spr. | Polygonaceae | ✓ | |
| Silver oak (T) | Grevillea robusta A. Cunn. ex R. Br. | Proteaceae | ✓ | |
| Kawali Bel (C) | Clematis buchananiana DC. | Ranunculaceae | ✓ | ✓ |
| Makar Ghas (H) | Thalictrum foliolosum DC. | Ranunculaceae | ✓ | ✓ |
| Hisalu (S) | Rubus ellipticus Sm. | Rosaceae | | ✓ |
| Kala Hisalu (S) | Rubus niveus Thunb. | Rosaceae | ✓ | ✓ |
| Kall- Hinsar (S) | Rubus paniculatus Sm. | Rosaceae | ✓ | |
| - (H) | Agrimonia eupatoria L. | Rosaceae | ✓ | ✓ |
| Bhekal (S) | Prinsepia utilis Royle | Rosaceae | | ✓ |
| Jangli Mehal (T) | Pyrus pashia Buch-Ham.ex D. Don | Rosaceae | | ✓ |
| Majethi (C) | Rubia cordifolia L. | Rubiaceae | | ✓ |
| Kuri (H) | Galium aparine L. | Rubiaceae | ✓ | |
| Ghari (S) | Randia tetrasperma (Wall. ex Roxb.) | Rubiaceae | | ✓ |
| Pisumar (H) | Boenninghausenia albiflora (HK) Reichb. | Rutaceae | ✓ | ✓ |
| Timur (S) | Zanthoxylum armatum DC. | Rutaceae | | ✓ |
| Silphora (H) | Bergenia ciliata (Haworth) Sternb. | Saxifragaceae | ✓ | ✓ |
| Sitberu (S) | Daphne papyracea Wall. ex Steud. | Thymelaeaceae | ✓ | ✓ |
| Siar (S) | Boehmeria platyphylla D. Don | Urticaceae | ✓ | |
| Tusiara (S) | Debregeasia longifolia (Brum.f.) Wedd. | Urticaceae | ✓ | ✓ |
| Challu (H) | Pilea umbrosa Blume | Urticaceae | | ✓ |
| Bichhu-ghas (S) | Urtica parviflora Roxb. | Urticaceae | ✓ | ✓ |
| Sameo (H) | Valeriana wallichii DC. | Valerianaceae | ✓ | ✓ |
| Karwi (S) | Caryopteris foetida (D.Don) Thellung | Verbenaceae | | ✓ |
| Banafsa (H) | Viola canescens Wall.ex Roxb. | Violaceae | ✓ | |
| Banafsa (H) | Viola serpens Wall. | Violaceae | ✓ | ✓ |
| - (C) | Vitis capriolata D. Don Royle | Vitaceae | ✓ | ✓ |
| Ban Haldi (H) | Hedychium spicatum Buch.-Ham. ex J.E. Sm. | Zingiberaceae | ✓ | ✓ |

(H=Herb, S= Shrub, T= Tree, C= Climber, OF= Oak Forest,PF= Pine Forest)

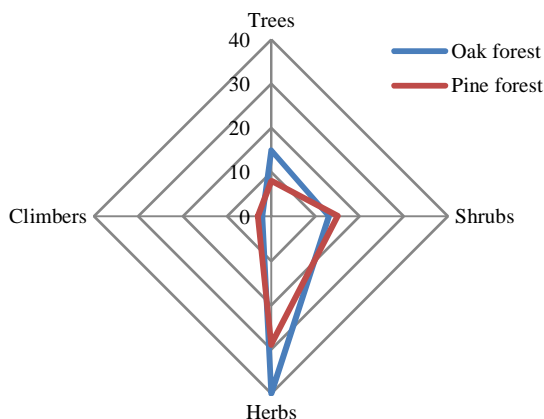


Fig 2: Habit Distribution in Oak and Pine Forest

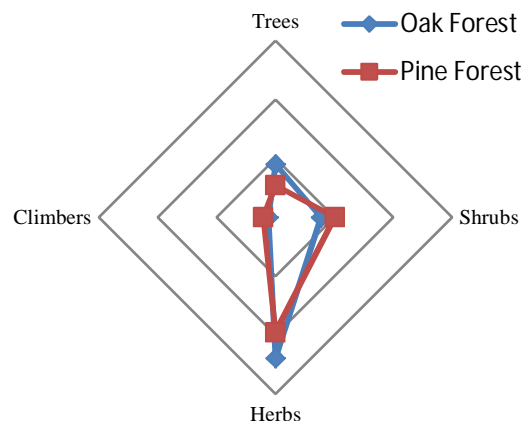


Fig 3: Species richness in Oak and Pine Forest

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