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# PLANT BIODIVERSITY AND PHYTOSOCIOLOGICAL ATTRIBUTES OF GORAKH HILL (KHIRTHAR RANGE)

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**Abstract**

A study was conducted for the plant biodiversity and phytosociological attributes of the Gorakh hill. Gorakh hill is located in Dadu district and is about 5,688 ft high above the sea level. The primary goal of this study is to provide comprehensive inventory of the area. The study area was thoroughly surveyed throughout the year from time-to-time in order to study the plant biodiversity. Gorakh hill has never been explored for its plant biodiversity. Plants were collected from the study area, in different parts of the year particularly in winter, summer, and monsoon. Phenological status of each species i.e. flowering and fruiting condition was also observed. Quantitative analyses on species diversity in addition to phytosociological attributes analysis were conducted. Some ecological parameters such as, life forms, species density, species cover, species relative density and frequency were calculated. Within the study area 74 plant species representing 62 genera and 34 families were found.

## Introduction

Biodiversity is way of describing the diversity of life on earth, it includes all life forms and the ecosystem of which they are part. It forms the foundation for sustainable development, constitutes the basis for the environmental health of our land and is the source of economic and ecological security for our future generations. In the developing country, biodiversity provides the assurance of food, many raw materials such as fiber for clothing, materials, for shelter, fertilizer, fuel and medicines, as well as source of work energy in the form of animal traction. In addition, biodiversity maintains balance for planetary and human survival (Jafferies, 1997). The current contraction of biodiversity is cause for alarm, while disappearance is most serious. Biodiversity is continuously declining due to the activities of human kind (Krishnmurthy, 2003).

Pakistan is one of the few places on earth with such a unique biodiversity, comprising of different climatic zones with a wide range of plant species. Approx. 6000 plant species with medicinal properties are found in Pakistan. In Pakistan the continuous and progressive loss, fragmentation and degradation of natural habitats is leading to the disappearance of countless species. The forest area is already fragmented and degraded and is being subjected to further destruction, as are most rangelands and freshwater and marine ecosystems. Pakistan has five significant mountain systems: Western Himalayas, Karakoram, Hindukush, Suleiman and Khirthar range. It is typical of arid and semi-arid mountain terrenes. The mountains of Khirthar Range were 380 million years old while other mountains in Sindh were not older than 193 million years. Khirthar range is the evolutionary bed of Sindh civilization (Anon., 2005). Gorakh hill station is the second highest point of Khirther range, c. 5,688 ft. high. The entire Khirthar Range fall under Saharo-Sindian region (Ali & Qaiser, 1986). The vegetation and climatic conditions are different from the rest of the study area. The day temperature is between 25-30°C and at

night 10-12°C. There is no proper way points so working in the Gorakh hill station is very difficult. The area is mostly surrounded by High Mountain. Gorakh is 33 Km away from Wahi Pandi. Rocky slope and Hilltops are dominant habitat of the area. Gorakh hill never been explored botanically and the present study is the first attempt (Fig. 1).

There is no published report on flora of the region. However baseline study of Khirthar National Park was carried by Enright & Miller (2000), Environmental impact assessment for the Exploratory wells on Dumber-Khirthar was examined by Qaiser *et al*. (2002), Akhter, (2003) reported 502 species in plant guide of Khirthar National Park

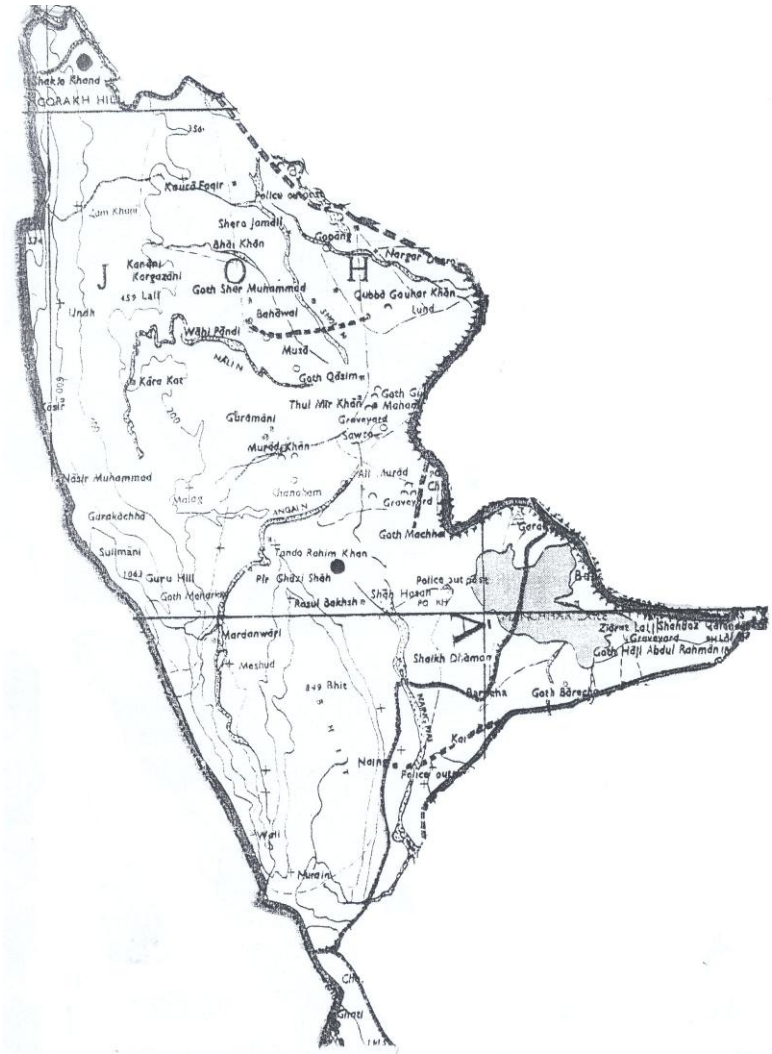


Fig. 1. Map of Johi-Dadu showing Gorakh Hill.

## Materials and Method

The study area was thoroughly surveyed throughout the year from time to time to study the botanical and ecological conditions. However, it was not possible to survey quantitatively the entire project area, even then every effort was made to include the entire representative, topographic and physiographic condition in the study area. The area was sampled by quadrate method, Random stratified sampling was done using 10 x 10 ft quadrate and in each community 5 to 10 quadrate were taken, frequency cover of each species was noted. The initial point of the first quadrate was randomly selected by tossing a nail. We made quadrates at regular interval of 10 steps. In some cases quadrate sampling linear was adjusted in shape but not size. Plants collection was done from each quadrate and also associate species, which were not even present in the quadrate. Plants were identified with the help of Flora of Pakistan. (Ali & Qaiser, 1995).

The important value Index (IVI) of all the plant species noted in the quadrates were manipulated. During the study some significant findings were noted. In addition to Phenological status of each species i.e., flowering and fruiting periods were also noted (Tables 1-4). The appropriate size for a quadrate was selected to give an accurate estimation of the number of individuals per unit area. The quadrate size was chosen to be large enough to include significant numbers of individuals, but small enough to separate, count and measure individual plants without duplication or omission of individuals.

## Results and Discussion

The Khirthar ranges consist of an ascending series of ridges running generally north. The highest ridge of ranges is from the boundary between Sindh and Balochistan. Gorakh hill is the second highest point of Khirthar range. The present condition of the area is not satisfactory due to many reasons. Little rainfall, poor soil condition, deforestation and grazing. These all factors neither support rich species diversity nor progressive growth. The indigenous people continuously cutting and chopping large shrub and trees for their fuel requirement.

During the present study 74 species belonging to 62 genera and 34 families are collected. Out of 34 families 3 families belong to monocot i.e., Poaceae, Palmae and Liliaceae and 31 to Dicots viz., Aizoaceae, Amaranthaceae, Apocynaceae, Asteracerae, Asclepiadaceae, Bignoniaceae, Boraginaceae, Caesalpiniaceae, Capparidaceae, Convolvulaceae, Cucurbitaceae, Euphorbiaceae, Labiatae, Malvaceae, Menispermaceae, Mimosaceae, Nyctaginaceae, Oleaceae, Papilionaceae, Rhamnaceae, Salvadoraceae, Sapindaceae, Scrophulariaceae, Solanaceae, Tamaricaceae, Tiliaceae, Umbelliferae, Verbenaceae, Urticaceae, Violaceae and Zygophyllaceae.

*Rhazya stricta* (Apocynaceae), *Withania coagulans* (Solanaceae), *Dodonea viscose*, (Spindaceae), *Fagonia indica* (Zygophyllaceae), *Grewia tenax* and *Grewia villosa* (Tiliaceae), were the common plants of the study area (Figs. 2&3).

Poaceae is the most dominant family with c.9 species, Asteraceae is the second largest family followed by Papilionaceae, Solanaceae, Boraginaceae, Capparidaceae and Mimosacea, whereas other families are rare in distribution.

No endemic species has been found from the study area, however, *Sophora alopecuroides* L. (Paplionaceae), *Asparagus gharoensis* Blatt (Liliaceae), *Salvadora persica* L. (Salvadoraceae), *Olea ferruginea* Royle (Oleaceae) were the significant finding from the study area.

## Result and Observations

**Table 1. List of the plant species found in the Gorakh Hill Station along with their life form, Abundance and Phenology studies.**

| Taxa | Life form | Abundance | Phenological status | |
|---|---|---|---|---|
| | | | Flowering | Fruiting |
| **Aizoaceae** | | | | |
| *Corbichonia decumbens* Scop. | Therophyte | Common | - | - |
| *Limeum indicum* Stocks ex T. Anders. | Therophyte | Infrequent | + | - |
| **Amaranthaceae** | | | | |
| *Aerva javanica* (Burmf.) Juss. ex Schult. | Chaemophyte | Infrequent | - | + |
| **Apocynaceae** | | | | |
| *Rhazya stricta* Decne. | Phanerophyte | Common | + | + |
| **Asteracerae** | | | | |
| *Dicoma tomentosa* Cass. | Chaemophyte | V. Common | - | + |
| *Echinops echinatus* Roxb. | Chaemophyte | Infrequent | - | - |
| *Eclipta prostrata* (L.) L. | Chaemophyte | Common | - | - |
| *Iphiona grantioides* (Boiss.) A. Anderberg | Chaemophyte | Common | + | + |
| **Asclepiadaceae** | | | | |
| *Caralluma edulis* (Edgew.) Benth. & Hook f. | Chamemophyte | Rare | - | - |
| *Leptadenia pyrotechnica* (Forssk.) Decne. | Phanerophyte | V. Common | + | - |
| *Periploca aphylla* Decne. | Phanerophyte | V. Common | - | + |
| **Bignoniaceae** | | | | |
| *Tecomella undulata* (Roxb.) Seem. | Phanerophyte | Infrequent | + | - |
| **Boraginaceae** | | | | |
| *Heliotropium crispum* Desf. | Chaemophyte | Common | - | + |
| *Heliotropium ophioglossum* Boiss. | Chaemophyte | Common | + | + |
| *Trichodesma africanum* (L.) R. Br. | Therophyte | Common | - | - |
| **Caesalpiniaceae** | | | | |
| *Senna holosericea* (Fresen.) Greuter | Chaemophyte | V. Common | - | - |
| **Capparidaceae** | | | | |
| *Capparis decidua* (Forssk.) Edgew. | Phanerophyte | Common | + | + |
| *Cleome scaposa* DC. | Therophyte | Common | - | - |
| **Convolvulaceae** | | | | |
| *Convolvulus glomeratus* Choisy | Chaemophyte | Infrequent | + | - |
| *Convolvulus spinosus* Burm. f. | Chaemophyte | Common | + | - |
| *Evolvulus alsinoides* L. | Chaemophyte | Rare | + | - |
| *Seddera latifolia* Hochst. & Sted. | Chaemophyte | Common | + | + |
| **Cucurbitaceae** | | | | |
| *Citrullus colocynthis* Mill. | Therophyte | Infrequent | - | + |
| *Cucumis prophetarum* L. | Therophyte | Infrequent | - | - |
| **Euphorbiaceae** | | | | |
| *Euphorbia caduicifolia* Haines | Phanerophyte | V. Common | - | + |
| *Euphorbia prostrata* Ait. | Therophyte | Common | - | - |
| *Euphorbia hirta* L. | Therophyte | Infrequent | + | - |
| *Euphorbia granulata* Forssk. | Therophyte | Common | + | + |
| **Labiatae** | | | | |
| *Salvia santolinaefolia* Boiss. | Chaemophyte | Infrequent | + | - |
| **Liliaceae** | | | | |
| *Asparagus gharoensis* Blatter | Climber | Rare | + | + |
| **Malvaceae** | | | | |
| *Hibiscus micranthus* L.f. | Therophytre | Common | + | + |
| *Pavonia arabica* Hocht. & Steud. | Chaemophyte | Rare | + | + |
| *Senra incana* Cav. ex Boiss. | Chaemophyte | Infrequent | - | + |
| **Menispermaceae** | | | | |
| *Cocculus pendulus* J. R. & G. Forst.) Diels. | Chaemophyte | Infrequent | - | - |
| *Cocculus hirsutus* L. | Climber | Infrequent | - | + |

**Table 1. (Cont'd.).**

| Taxa | Life form | Abundance | Phenological status | |
|---|---|---|---|---|
| | | | Flowering | Fruiting |
| **Mimosaceae** | | | | |
| *Acacia senegal* (L.) Willd. | Phanerophyte | V. Common | + | + |
| *A.nilotica* (L.) Delile | Phanerophyte | Common | - | - |
| *A.jacquemontii* Benth. | Phanerophyte | Infrequent | + | + |
| *Mimosa hamata* Willd. | Phanerophyte | Rare | - | - |
| **Nyctaginaceae** | | | | |
| *Boerhaavia procumbens* Banks ex Roxb. | Chaemophyte | Infrequent | - | - |
| **Oleaceae** | | | | |
| *Olea ferruginea* Royle | Phanerophyte | Rare | + | + |
| **Palmae** | | | | |
| *Nannorrhops ritichieana* (Griff.) Aitch. | Phanerophyte | Common | - | - |
| **Papilionaceae** | | | | |
| *Sophora alopecuroides* L. | Chaemophyte | Common | - | - |
| *Tephrosia uniflora* Pers. | Chaemophyte | Infrequent | + | + |
| *Rhynchosia minima* (L.) DC. | Climber | Infrequent | + | + |
| *Indigofera oblongifolia* Forssk. | Chaemophyte | Common | + | - |
| **Poaceae** | | | | |
| *Aristida adscensionis* L. | Therophyte | Common | - | + |
| *A.hystricula* Edgew. | Therophyte | Common | - | - |
| *Cenchrus setigerus* Vahl | Therophyte | Infrequent | + | - |
| *Cenchrus ciliaris* L. | Therophyte | Common | - | - |
| *Crysopogon aucheri* (Boiss.) Stapf | Therophyte | Common | + | + |
| *Dicanthium annulatum* (Forssk.) Stapf | Therophyte | Infrequent | - | - |
| *Tetrapogon villosus* Desf. | Hemicryptophyt | Infrequent | - | + |
| *Panicum turgidum* Forssk. | Chaemophyte | Infrequent | - | - |
| *Urochondra setulosa* (Trin.) C.E.Hubb. | Therophyte | Rare | - | - |
| **Rhamnaceae** | | | | |
| *Ziziphus nummularia* (Burm.f.) W. & Arn. | Phanerophyte | V. Common | - | - |
| **Salvadoraceae** | | | | |
| *Salvadora oleoides* Decne. | Phanerophyte | V. Common | - | - |
| *Salvadora persica* L. | Phanerophyte | Rare | - | - |
| **Sapindaceae** | | | | |
| *Dodonea viscosa* (L.) Jacq. | Phanerophyte | V. Common | - | - |
| **Scrophulariacerae** | | | | |
| *Kickxia ramosissima* (Wall.) Janchen | Chaemophyte | Infrequent | + | - |
| **Solanaceae** | | | | |
| *Solanum surattense* Burm.f. | Chaemophyte | Rare | + | + |
| *Withania coagulans* Dunal | Chaemophyte | V. Common | - | + |
| **Tamaricaceae** | | | | |
| *Tamarix dioca* Roxb. ex Roth. | Phanerophyte | Common | + | + |
| *T. stricta* Boiss. | Phanerophyte | Common | + | + |
| **Tiliaceae** | | | | |
| *Corchorus depressus* (L.) Stocks | Hemicryptophyte | Infrequent | + | - |
| *C. tridens* L. | Phanerophyte | Common | - | - |
| *Grewia tenax* (Forssk.) | Phanerophyte | V. Common | - | + |
| *Grewia villosa* | Phanerophyte | V. Common | + | + |
| **Umbelliferae** | | | | |
| *Psammogeton cabulicus* (Wog.) E. Nasir. | Therophyte | Infrequent | - | + |
| **Verbenaceae** | | | | |
| *Chascanum marrubifolium* Fenzl. ex Walp. | Chaemophyte | Rare | + | + |
| **Urticaceae** | | | | |
| *Forskahlia tenacissima* L. Decne. | Chaemophyte | Infrequent | - | - |
| **Violaceae** | | | | |
| *Viola stocksii* Boiss. | Therophyte | Rare | + | - |
| **Zygophyllaceae** | | | | |
| *Fagonia indica* Burm f. | Chaemophyte | V. Common | - | - |
| *Peganum harmala* L. | Chaemophyte | V. Common | + | + |
| *Tribulus terrestris* L. | Chaemophyte | Common | + | + |

**Table 2. Phytosociological attributes of plants occurring on dry rocky stream bed community.**

| Name of species | Locality: Gorakh Hill | | | | |
|---|---|---|---|---|---|
| | F1 | F3 | D3 | C3 | IVI |
| *Tamarix dioca* | 50 | 10.53 | 4.40 | 40.068 | 18.3229 |
| *Salvadora oleoides* | 50 | 10.53 | 2.20 | 22.162 | 11.628 |
| *Euphorbia caducifolia* | 25 | 5.26 | 1.10 | 16.706 | 7.689 |
| *Seddera latifolia* | 50 | 7.53 | 61.54 | 4.873 | 7.58 |
| *Ziziphus nummularia* | 25 | 5.26 | 1.10 | 12.274 | 6.211 |
| *Iphonia grantioides* | 50 | 10.53 | 4.40 | 0.014 | 4.978 |
| *Grewia tenax* | 50 | 10.53 | 3.30 | 0.555 | 4.792 |
| *Dicoma tomentosa* | 25 | 5.26 | 1.10 | 0.123 | 2.161 |
| *Rhazya stricta* | 25 | 5.26 | 1.10 | 0.123 | 2.161 |
| *Hibiscus micranthus* | 25 | 5.26 | 1.10 | 0.013 | 2.125 |

**Table 3. Phytosociological attributes of plants occurring in rocky-slope.**

| Name of species | Locality: Gorakh Hill | | | | |
|---|---|---|---|---|---|
| | F1 | F3 | D3 | C3 | IVI |
| *Aristida funiculate* | 40 | 14.81 | 14.00 | 29.86 | 19.55 |
| *Rhazya stricta* | 45 | 16.66 | 18.66 | 20.76 | 18.69 |
| *Convolvulus spionsus* | 40 | 14.81 | 13.33 | 16.30 | 14.81 |
| *Corbichonia decumbens* | 35 | 12.96 | 24.66 | 3.35 | 13.65 |
| *Echinops echinatus* | 20 | 7.40 | 8.00 | 6.30 | 7.23 |
| *Acacia senegal* | 15 | 5.55 | 2.00 | 10.11 | 5.88 |
| *Withania coagulans* | 20 | 7.40 | 3.33 | 4.72 | 5.15 |
| *Aerva javanica* | 10 | 3.70 | 4.00 | 5.13 | 4.27 |
| *Ziziphus nummularia* | 10 | 3.70 | 1.33 | 7.10 | 4.04 |
| *Fagonia indica* | 10 | 3.70 | 2.66 | 2.63 | 2.99 |
| *Trichodesma africanum* | 10 | 3.70 | 1.33 | 1.95 | 2.32 |
| *Grewia tenax* | 5 | 1.85 | 1.33 | 0.195 | 1.12 |
| *Cleome scaposa* | 5 | 1.85 | 1.33 | 0.09 | 1.09 |
| *Periploca aphylla* | 5 | 1.85 | 0.66 | 0.39 | 0.96 |

**Table 4. Phytosociological attributes of plants occurring in hill top community.**

| Name of species | Locality: Gorakh Hill | | | | |
|---|---|---|---|---|---|
| | F1 | F3 | D3 | C3 | IVI |
| *Grewia tenax* | 100 | 8.695 | 23.728 | 16.764 | 16.395 |
| *Capparis deciduas* | 50 | 4.347 | 3.389 | 24.880 | 10.872 |
| *Salvadora oleoides* | 50 | 4.347 | 1.694 | 19.123 | 8.388 |
| *Indigofera oblongifolia* | 50 | 4.347 | 5.084 | 11.713 | 7.048 |
| *Fagonia indica* | 100 | 8.695 | 6.779 | 3.474 | 6.316 |
| *Aerva javanica* | 50 | 4.347 | 13.559 | 0.191 | 6.032 |
| *Withania coagulans* | 50 | 4.347 | 1.694 | 11.713 | 5.918 |
| *Dodonea viscosa* | 100 | 8.695 | 5.084 | 3.251 | 5.676 |
| *Ziziphus nummularia* | 50 | 4.347 | 10.169 | 0.203 | 4.906 |
| *Rhynchosia minima* | 50 | 4.347 | 8.474 | 0.089 | 4.303 |
| *Grewia villosa* | 100 | 8.695 | 3.389 | 0.442 | 4.175 |
| *Trichodesma indicum* | 50 | 4.347 | 3.389 | 1.960 | 2.898 |

Abbreviation: + = Present, – = Absent, F1 = Frequency, F3 = Relative frequency, D3 = Relative density, C3 = Relative cover, IVI = Importance value index

Fig. 2. *Rhazya stricta*: A key species of Gorakh hill.

Fig. 3. *Dodonea viscose*: dominant species of the Gorakh gill.

The life form of each species depending on the position of perennation buds has also been determined according to Raunkiaer system of classification (Raunkiaer, 1934). Within the flora chameophytes are the most dominant class of life forms, followed by Phanerophytes, Therophytes and Hemicryptophytes (Table 1). The grazing pressure is slightly low at higher altitude as compared to lower altitude in the study area.

There are 10 rare species found in the study area viz., *Viola stocksii*, *Chascanum marrubifolium*, *Solanum surattense*, *Salvadora persica*, *Urochondra setulosa*, *Olea ferruginea*, *Caralluma edulis*, *Evolvulus alsinoides*, *Asparagus gharoensis* and *Mimosa hamata*.

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