

## ‘Chakrata’: A Floristically Less Explored Pocket of Garhwal Himalaya

Jagbeer Cheema<sup>1</sup>, Aniket Bhattacharya<sup>2</sup> and Ashok Aggarwal<sup>1\*</sup>

<sup>1</sup>Department of Botany, Kurukshetra University, Kurukshetra, Haryana, India

<sup>2</sup> Department of Botany, Centre of Advanced Study, University of Calcutta, Kolkata  
West Bengal, India

\* [aggarwal\\_vibha@rediffmail.com](mailto:aggarwal_vibha@rediffmail.com)

**Abstract:** Chakrata Forest Division, located in Garhwal Himalaya, harbors a rich floristic diversity due to great variations in its topography, altitude and climate. Although from the vary past, many workers have focused on the exploration of floristic diversity of different places of Garhwal Himalaya but only a few reports are available on ‘Chakrata’. The available reports about this area are mainly concerned with the ecological and ethnobotanical aspects. So a great lacuna is prevailing in the scenario of the floristic study of this region. The flora of this region is undergoing great stress due to anthropogenic disturbances mainly from the rapid urbanization and tourism, making the situation alarming day by day. So, floristic study and diversity assessments are obligatory to understand the present diversity status and conservation of biodiversity. The present review paper gives a brief idea about the previous and present picture of the floristic diversity of this study area.

[Jagbeer Cheema Aniket Bhattacharya and Ashok Aggarwal. **Chakrata’: A Floristically Less Explored Pocket of Garhwal Himalaya.** *Researcher* 2014;6(8):45-50]. (ISSN: 1553-9865). <http://www.sciencepub.net/researcher>. 6

**Keywords:** Chakrata, Garhwal Himalaya, Floristic diversity, Taxonomist, Ethnobotanical

### 1. Introduction

Plant taxonomists are engaged in collecting information about diversity and distribution of plants throughout the world through floristic studies (Qureshi et. al., 2011). It helps in accumulation of valuable data which can be used for future studies. Floristic studies are the study of distribution, number, types and relationship of plant species over geographic areas. It helps us to evaluate the floral wealth of any given area. Taxonomy is an integral part of floristic studies and deals with identification, nomenclature and classification of plants (Subramanyam & Nayar, 1974). It may be considered as the oldest science in the world, as it has always been essential to distinguish the edible plants from those which are poisonous and inedible (Narayanan, 2012).

The history of floristic inventories dates back to 3000 BC in Eastern World, when Shen Nung, Emperor of China, wrote a pharmacopoeia, “Divine Husbandman's Materia Medica” including 365 medicines derived from minerals, plants, and animals. Wall paintings of medicinal plants, dating back around 1500 BC, have been discovered in Egypt. The paintings give us information about medicinal plants in old Egypt and their names. Theophrastus (370–285 BC) classified all known plants in his, “De Historia Plantarum”, which contained 480 species. Dioscorides (40–90 AD), Plinius (23–79 AD), Caesalpino (1519–1603), Bauhin brothers (1541–1631; 1560–1624), John Ray (1627–1705), Joseph Pitton de Tournefort (1656–1708) are some other workers who contributed in the

field of plant systematics. But Carl Linnaeus’s “Species Plantarum”, published in 1753 and the tenth edition of “Systema Naturae” in 1758 is regarded as the starting points of modern botanical taxonomy (Manktelow, 2010).

Flora is the characteristic assets and wealth of a nation (Panda, 2014) as it is meeting all kinds of crucial necessities of the people as food, fodder, fuel, drugs, timber, gums and oil, etc. (Ganorkar Ravindra, 2013) and procuring knowledge of it is of enormous scientific and commercial importance. Plant community assumes a vital role in the sustainable management by maintaining biodiversity and conserving the environment (Farooquee and Saxena, 1996). The knowledge of the floristic composition of the plant community is essential to understand the overall structure and function of any ecosystem. It likewise helps us to comprehend the fundamental aspects of biology such as speciation, isolation, endemism and evolution (Panda, 2014).

### 2. Previous Reports on Floristic Diversity of Garhwal Himalaya

Garhwal Himalaya is the mountain range located in the western part of Uttarakhand. It is situated at the transition zone of three biogeographical regions with their unique floristic composition, which are: Tibetan region in the North, Upper Gangetic Plain in the South and Eastern Himalayas in the East. Due to this type of biogeographic position, this area is very rich in floristic diversity and thus it is considered as one of

the important hubs for the taxonomists from long past.

The first record of floristic studies in Garhwal dates back to 1796 when Thomas Hardwicke, an English officer first collected plants from Alaknanda Valley (Burkill, 1965), followed by other Britishers, namely Royle (1824) and Jameson (1842- 1846). Hooker and Thomson (1855) cited a large number of taxa from this area in "Flora Indica". During 1872-1897, Hooker published his largest systematic outcome, 'Flora of British India' in seven volumes. The work was based on the collections made during 1848-1851 by several workers and dealt with the phanerogams of the former British India which also included plants from some areas of Garhwal.

The floristic studies in this region accelerated with the establishment of Botanical Garden at Saharanpur by Hastings in 1820 and Forest Research Institute in 1906. On the basis of collections made by Strachey and Winterbottom during the years 1846-1849, Duthie published a catalogue on the plants of Garhwal in 1906. This was followed by Marten (1909) and Allen (1919) who collected plants from Mussoorie. Some plant species of Garhwal have been illustrated by Collett (1921) in his "Flora Simlensis". Quite comprehensive information on the ferns has been provided by Stewart (1942) in "The Ferns of Mussoorie and Dehradun".

The establishment of Northern Circle of Botanical Survey of India at Dehradun in 1956 was still another landmark in the onward progress of floristic research in this area. It laid down the foundation for publication of numerous research papers and some important books on the Garhwal flora. In 1975, Rau published "High Altitude Flowering Plants of West Himalaya". Naithani collected plants during 1976- 1983 and published "Flora of Chamoli" (1984; 1985) citing 1934 species. Some illustrations of plants from this region have appeared in "Flowers of the Himalaya" by Polunin and Stainton (1984). Nayar and Sastry, (1990) has listed 619 species of vascular plants as threatened in India in "The Indian Red Data Book" and out of them 30 species belong to the Garhwal region. Dang (1993) also mentioned many plants from Garhwal in his "Flowers of Western Himalaya".

The notable publications on the flora of Garhwal are: Flowering Plants and Ferns of Northern Garhwal (Rau, 1961), A visit to Valley of Flowers and Lake Hemkund in North Garhwal (Rau, 1961), Forest Flora of Chakrata, Dehradun and Saharanpur forest division (Kanjilal, 1963), Plant Collection with the Kedarnath Parvat Expedition (Naithani, 1967), Flora of Dehradun (Babu, 1977), Herbaceous Flora of Mussoorie (Raizada & Saxena, 1978), Flora and Biological Spectrum of Khoh Valley, Dist. Pauri

(Rajwar & Gupta, 1981), Flowering Plants of Pauri and its Vicinity (Naithani & Tiwari, 1983), Alpine flora of Tugnath in Garhwal Himalayas (Semwal & Gaur, 1984), A contribution to the flora of Pokhari Block, Chamoli (Garhwal), Western Himalayas (Sharma & Gaur, 1984), Flora of Chamoli District (Naithani, 1984-85), A contribution to the Flora of Dodital- A high altitude lake in Garhwal Himalaya, Uttarkashi (Negi et al., 1985), A contribution to the flora of Khatling Glacier in the Garhwal Himalayas, (Dist. Tehri) (Negi et al., 1987), Forest Resources of Surkanda Devi, Garhwal Himalayas (Negi & Gupta, 1987), Floristic and Vegetational Composition in an Alpine Zone of North West Himalayas (Nautiyal et al., 1998), Flora of District Garhwal (1999), Phytodiversity (Angiosperms and gymnosperms) in Mandal- Chopta Forest of Garhwal Himalaya, Uttarakhand, India (Gairola et al. 2010) and An Inventory of the Flora of Binog Wildlife Sanctuary, Mussoorie, Garhwal Himalaya (Kumar et al. 2012)

Apart from the above work, a few Universities and Research Institutions also conducted floristic studies in Garhwal region. The floras of most of the districts of Garhwal are outcome of Ph.D. works viz., Forest flora of Tehri Garhwal (Biswas, 1984), Herbaceous flora of Uttarkashi district (Badoni, 1989), Forest flora of Pauri Garhwal (Bartwal, 1991), Taxonomic Survey of Grasses of Garhwal Himalaya (Nautiyal, 1996), etc.

Besides these general floristic studies ethnobotanical studies in several regions were also carried out. Notable ethnobotanical surveys from Garhwal were mainly conducted by Gaur et al., (1984), Gaur & Tiwari (1987), Negi et al., (1993), Maikhuri et al., (1997), Rana (2007), Rana et al., (2010 & 2013 ), Dangwal et al. (2011), and others.

### 3. Floristic Diversity of Chakrata: Past Scenario and the Present Status

Chakrata, also known as "Jaunsar- Bawar", is situated in Dehradun district in Garhwal Himalayas between 30 ° 31' to 31 ° 3' N latitudes and 77 ° 42' to 78 ° 5' E longitudes, covering an area of approximately 1,999.50 km<sup>2</sup>. Physiographically, it is a highly mountainous region located between the upper courses of river Yamuna and Tons. The altitude of the region at the confluence of river Yamuna and Tons is 463 m and rises to 3,048 m at Kharamba, the highest peak in the region (Porwal & Pant, 1989). The climate of Chakrata varies from sub- tropical to temperate. There are three predominant seasons; monsoon extends between end of June to September, winter lasts from December to February and summer spreads between March to June. The average summer rainfall is 142.5 cm and that of winters is only 25 cm (Singhal et. al., 1986).

Geologically, the rocks in Chakrata are complex mixture of mainly sedimentary pre- Cambrian to early- Paleozoic formations and the tertiary malasse deposits (Choubey et.al., 1990). The soils of Chakrata are formed as a result of long continued leaching under moist temperate climate and consist of clayey and sandy loam on the hills, and sandy and pebbly loam in the valleys and the entire area has moderately deep, non- calcareous and heavy textured soils. They are characterized by high water holding capacity, moderate to high nutrient retaining capacity and high content of organic matter, nitrogen and manganese (J.S.P. Yadav 1963).

Due to great variations in its topography, altitude and climate, Chakrata harbors diverse habitats which support a rich floristic diversity that has been used by local people for their day to day need. A number of forest products such as food, fodder, fiber, medicinal plants, spices, ornamentals, timber, and variety of other non-wood timber products are obtained from Chakrata Forests. The forest types found in this forest division, as per the classification by Champion & Seth (1968) falls under Himalayan Moist Temperate Forest Type (12C), with *Cedrus deodara* and *Quercus semicarpifolia* as dominant species. Other tree species include *Pinus Wallichiana*, *Pinus Roxburghii*, *Picea Smithiana*, *Abies pindrow*, *Quercus leucotrichophora* and *Quercus floribunda*. Agarwal S.C.(1959) divides grasslands of Chakrata into four zones: (1) Subtropical zone: having mostly the plains grasses like *Dichanthium annulatum*, *Bothriochloa pertusa*, *Chrysopogon montanus*, *Heteropogon contortus*, *Ergrostis viscosa*, *Cynodon dactylon*, *Chloris montana*, *Sporobolus pallidus*, *Eragrostiella nordioides*, *Digitaria marginata*, with subtropical grasses like *Arundinella setosa* and *Themada anathera*, (2) Temperate-chir zone: having generally the sub-tropical grasses like *Themada anathera* and *Arundinella setosa*, (3) Subalpine -deodar zone: which is a transition zone for the grass flora, with subtropical grasses like *Themada anathera* and *Arundinella setosa* associated with some of the plains grasses and some of the alpine grasses like *Argostis spp.*, *Festuca spp.*, *Bromus* etc., (4) The Alpine zone: has the alpine association of grasses like *Festuca rubra*, *F. bromoides*, *F. sibirica*, *Dactylis glomerata*, *Agropyron semicostatum*, *Agrostis spp.*, *Arthraxon species*, *Avena* and *Bromus species* etc.

As far as the flora of Chakrata is concerned, there is no detail account of the flora of Chakrata in particular. However, B.L. Gupta (1928) published "Forest Flora of the Chakrata, Dehradun and Saharanpur Forest Divisions" which was the revised edition of "Forest Flora of Shiwalik and Jaunsar Forest Division of the United Provinces of Agra and

Oudh" by U.N. Kanjilal (1911). The floristic account mainly dealt with the woody plants and listed 409 species from Chakrata, belonging to 234 genera and 81 families.

Apart from the aforementioned work, S.C. Agarwal (1959) published Grasslands of Chakrata Forest Division and classified the grasslands of Chakrata into four groups: Subtropical Zone, Temperate- Chir Zone, Subalpine- Deodar Zone and The Alpine Zone. Singhal et.al. (1986) analysed phytosociologically the woody species of Chakrata at twelve different sites supporting seven tree species viz., *Cedrus deodara*, *Pinus roxburghii*, *Picea smithiana*, *Pinus wallichiana*, *Quercus floribunda*, *Q. semicarpifolia* and *Abies pindrow* and concluded that species diversity is greatest in *Pinus wallichiana* forests followed by *Quercus floribunda*. Kumar and Raizada (1989) gave an account of Pteridophytes of Chakrata enumerating 10 species of Fern-allies belonging to 4 genera and 4 families and 93 species of Ferns belonging to 41 genera and 19 families.

Singh (1997) documented 58 plants from Chakrata used in the preparation of native medicines for the treatment of various diseases. More recently, Dobhal et. al. (2007) conducted ethnobotanical surveys in two villages (Utpalta and Kwara) of Chakrata and revealed that a total of 29 plants species distributed in 28 genera belonging to 20 different families are used to cure various skin diseases, diabetes, dysentery, dropsy, leprosy, etc. Joshi & Joshi (2011) conducted a survey on wild vegetable species consumed by tribals of Chakrata and recorded 17 plant species which are used as vegetables and few are used as spices and condiments.

The above works are mainly concerned with the ecological and ethnobotanical surveys of the forests of the area but very few studies have been performed particularly related to the floristic diversity of the region. The last work on floristic diversity of Chakrata has been done in 1928. So there is a large time gap regarding the subject of floristic exploration, which makes this area an interesting site for study.

Man has been modifying his environment since time immemorial in a number of ways without due considerations to the overall sustainability of the environment. In order to obtain food, fodder, or other eco- services, man has modified ecosystems by directing energy and materials from the system to serve his personal needs without giving much thought to the long term ecological consequences (Singh 1998). Most obvious changes embrace extinction of native species, changes in community structure and composition, and modification of biophysical features in a landscape. Floristic diversity of Chakrata is very much affected by local activities

such as heavy cuttings, grazing, loping, collection of medicinal plants, etc. The influence of urbanisation, climatic changes, tourism, etc. has altered the vegetation pattern of the area. Tourism is growing at a faster rate in Chakrata. There are obvious direct impacts of tourism on floral wealth such as clearing of vegetation for infrastructure, resorts blocking waterholes, roads built in wrong places, garbage dumped with impurities, damage from trampling and off road vehicles. There are doubtless additional severe indirect impacts further. This includes self-propagating spread of some weeds like *Verbescum*, *Ageratum*, etc. from trails and roads. It also includes the severe impact on native vegetation, including many rare and threatened plants, from spread of the plant diseases. This has undoubtedly affected flora adversely.

Thus there is urgent need for whole area under conservation and protection. So, floristic study and diversity assessments are obligatory to understand the present diversity status and conservation of biodiversity. Because, it is dangerous if we were to lose species simply because they had not been identified, studied and prioritized (Simlai, 2011).

#### 4. Conclusion:

The exact number of species available on the earth is still not known however, Wilson (1988) estimated that the total number of identified species is about 1.4 million. It was evaluated that around 7500 species of organisms are getting to be wiped out every year (Chatterjee, 1995) and a large portion of them vanish even before known to the scientific world (Myers *et al.*, 2000; Pimm & Raven, 2000). There are many causes for the loss of species, but the most important is the habitat loss and fragmentation. Floristic inventories and studies are important to comprehend the present diversity status and biodiversity conservation (Jayakumar, 2011). Biodiversity conservation has picked up prime attention everywhere throughout the world since the Rio Earth Summit in 1992 (Narayanan, 2012). The above all else process in documenting the biodiversity is the taxonomic treatment of living organisms. This can be accomplished only through the methodology involving far reaching exploration, identification and documentation (Sasidharan, 2002).

Prior floristic works in India brought about the compilation of national and regional floras. Regardless of the quickened floristic studies in Garhwal Himalaya during the last few decades, some parts are yet to be completely explored. The present study zone of Chakrata is chosen for the floristic studies on the grounds that it has not been fully explored.

It is accepted that once knowledge gaps are filled, a biodiversity data base might be established, with tools and protocols to distinguish changing patterns in biodiversity, recognizable proof of the approaching threats and the improvement of sound conservation strategies. Nonetheless, at present, because of our deficient knowledge base, the above all else errand would be to survey and document the biodiversity of this region.

#### Acknowledgements:

One of the authors (J.C.) is grateful to Kurukshetra University, Kurukshetra for providing laboratory facilities and other institutional support.

#### Corresponding Author:

Prof. Ashok Aggarwal  
Department of Botany  
Kurukshetra University  
Kurukshetra, Haryana 136119, India  
E-mail: [aggarwal\\_vibha@rediffmail.com](mailto:aggarwal_vibha@rediffmail.com)

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8/3/2014