

Wild and Exotic Gymnosperms of Uttarakhand, Central Himalaya, India

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Abstract: The paper deals with the diversity of gymnosperms in Uttarakhand; both wild and exotic species. A total 63 species belonging to 10 families were reported, of these 47 species are exotic to the state. Origin-wise status of both exotic and wild gymnosperms demonstrated that 26.98% species are of American origin followed by the Indian Subcontinent (19.04%), China (11.11%), Japan (9.52%), Asia-temperate and Europe (7.93%), Africa (6.34%), Australia (4.76%), Indo-China and the Mediterranean region (3.17%). The genera and species are alphabetically arranged and taxonomically updated. Other information such as vernacular name, english name, habit, origin, altitudinal region and district wise distribution are also given.

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Introduction

Gymnosperm is an extremely important division in the plant kingdom. Economically, they are of outstanding value, furnishing the greater proportion of our timber as well as resin requirement. Most of the timber used in modern buildings is derived from conifers because of their straight grain and ease of manipulation. They are also the dominant forest makers of the world and in addition to all these, they also play a leading role in the preservation of the environment. Some of its members are resistant to pollution (Sahni 1990).

The gymnosperms (gymno= naked; sperms= seeds; the terminology coined by Theophrastus) are the intermediates of pteridophytes and angiosperms and hence occupy an extremely important place in the plant kingdom. They are considered as the predecessors of angiosperms, though they have much lesser economic value than the angiosperms and less preferred by the gardeners and the plant lovers heavy trunks and typical reproductive apparatus and other such characteristics; but thanks to their gregarious looks, attractive foliage etc. they still are the chief ornamental plants.

Living gymnosperms are one of the great antiquities and include about 700-800 species belonging to 70-75 genera. Among gymnosperms, conifers dominate the lot with about 550-600 species belonging to its 60 genera and tend to form most of the dominant forests. Conifer forests are typical of Himalayas and provide a cool and soothing environment for recreation and health (Dar and Dar 2006). Uttarakhand Himalayas also exhibit some excellent conifer forests that are well scattered throughout the region but even so, thorough and careful detailed taxonomic studies have not been carried out

till date. Though flowering plants and ferns were well studied and documented, gymnosperms remained neglected. Besides the indigenous gymnosperms, members of these species have recently been introduced in the region in large numbers and are grown for ornamental purposes in gardens, parks and along roadsides; hence their correct identification, assessment and documentation still remains to be done.

The gymnospermous flora of Uttarakhand are described by Hooker (1888); Duthie (1906); Osmaston (1927); Kanjilal (1928); Raizada and Sahni (1958); Chonker and Bisht (1961); Gupta (1968); Pande (1991); Singh and Mudgal (1997); Pandey and Pande (1999); Uniyal and Awasthi (2000); Singh and Prakash (2002); Rana et al. (2003); Pande and Joshi (2005); Uniyal et al. (2007), Tripathi (2008) Tewari et al. (2010) and Recently Negi and Hajra (2008) have again reported large numbers of alien floras in Dehradun district including gymnosperms. Osmaston (1927) has given detailed information about the taxonomy and distribution of the indigenous gymnosperms of Kumaun forest division, but he did not include cultivated species of gymnosperms in his excellent forest flora. Later on there is no evidence of either their collection by workers or the study of the gymnosperms in greater details in this part of Himalayas. Therefore, the present attempt is to give more comprehensive account of the gymnospermic flora of the state, which includes wild, cultivated as well as the varieties introduced by the state forest department. Besides this, it was also supplemented with information such as the distribution, local name, altitudinal distribution, details about their origin and phenology. We hope this information will lead to better understanding of the

diversity and distribution of the gymnosperm wealth in this part of Himalayas.

Materials and Methods

Study area

Uttarakhand lies between latitudes 28° 43' N to 31° 28' N and Longitude 77° 34' E to 81° 03' E. The state is borders Himachal Pradesh in the northwest, Uttar Pradesh in the South and has international borders with Nepal and China. The state encompasses an area of 53,483 km² and in which 19% is under permanent snow cover, glaciers and steep slopes and hence it is not possible to grow any tree species here. The state consists of 13 districts namely Pithoragarh, Almora, Nainital, Bageshwar, Champawat, Uttarkashi, Udham Singh Nagar, Chamoli, Dehradun, Pauri, Tehri, Rudraprayag and Haridwar. The state can be divided into three physiographic zones namely, the Himalayas, the Siwaliks and the Terai region. The state has a temperate climate except for the plain areas that have a subtropical type of climate and the average annual rainfall is 1,550mm. The alpine zone undergoes a long period of snowfall in the colder months. Champion and Seth (1968) categories of forest vegetation in the state are Moist Alpine Scrub, Sub-alpine Forests, Himalayan Dry Temperate Forests, Himalayan Moist Temperate Forests, Sub-Tropical Pine Forests, Swamp Forests, and Tropical Deciduous Forests. The total area of the forest in Uttarakhand is 34,662 km², which works out to 64.79 per cent of the state's geographical area.

Data collection

Data were collected from various sources: specimens deposited in various herbaria, taxonomic literature and field surveys. Apart from this the state forest department nurseries were also visited to collect information about exotic species, which are being introduced in the state. Additional information such as English name/ vernacular name, distribution, habit, status (exotic or native) and district wise distribution are provided.

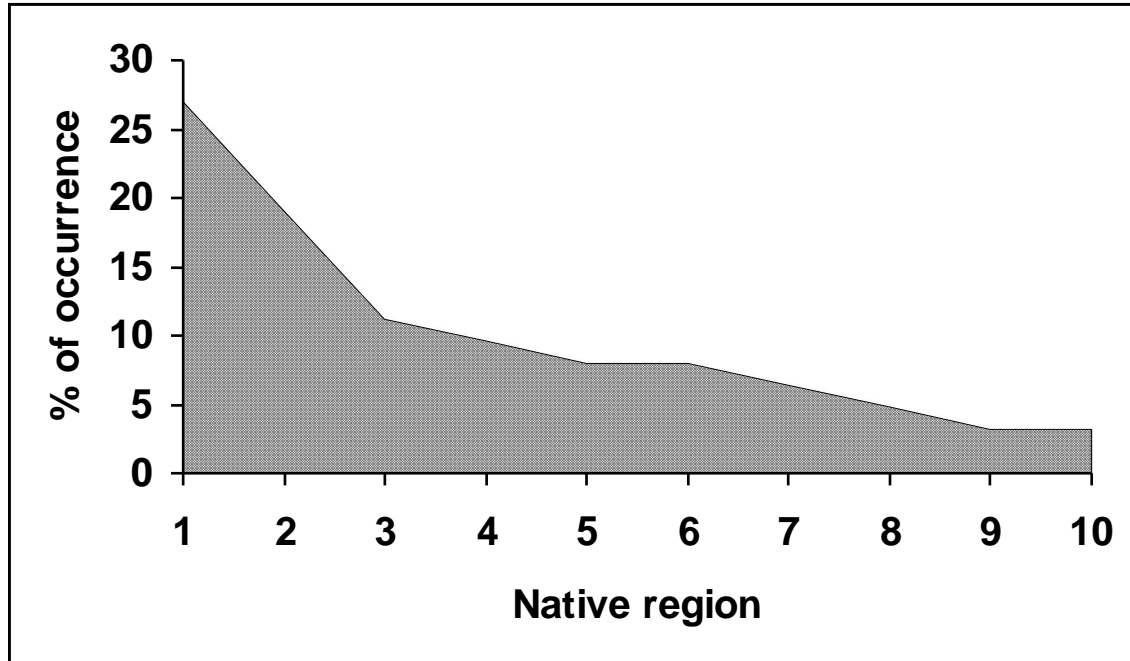
Results and Discussion

The present paper records 63 species representing 19 genera and 10 families. Out of these species 16 species are wild and rest 47 species are

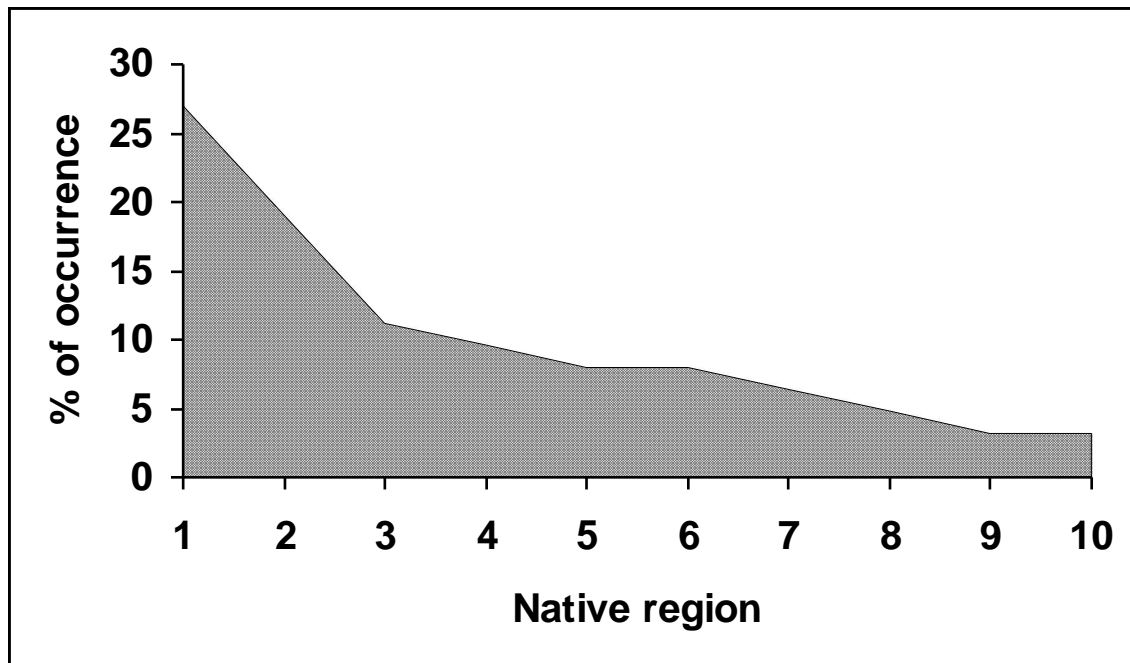
exotic to the state (Table 1). Of the 10 families, 3 are represented by single species. All the recorded species by habit are tree except four species viz. *Cryptomeria japonica*, *Cycas revoluta*, *Ephedra gerardiana* and *Juniperus indica* are shrubs. The study revealed that 25% species are in wild occurrence and rests 75% are introduced in the state. Recently 12 species of exotic pines have been introduced in Kalika experimental garden at Ranikhet in Kumaun hills. Their phenology and taxonomy need to be studied in greater details. Many exotic gymnosperm like *Araucaria angustifolia*, *Cryptomeria japonica*, *Cupressus cashmeriana*, *Cycas revoluta*, *Ginkgo biloba*, *Juniperus bermudiana*, *Juniperus procera*, and *Pinus merkusii* are growing luxuriantly in the many parts of the state and are traded internationally for their specific and varied utility. These exotic species were introduced from different parts of the world during the British period and have become important contributors today to the economy of the state. For example, one *Ginkgo biloba* cutting sells in nurseries for Rs. 200 per plant and similarly one potted *Cycas revoluta* costs Rs. 200-500 depending upon the size and age of the plant.

Origin-wise status of both exotic and wild gymnosperms is shown in Figure 1. It is demonstrated that 26.98% species are of American origin followed by the Indian Subcontinent (19.04%), China (11.11%), Japan (9.52%), Asia-temperate and Europe (7.93%), Africa (6.34%), Australia (4.76%), Indo-China and the Mediterranean region (3.17%).

In the state, species such as *Taxus baccata*, *Ephedra gerardiana* and *Juniperus macropoda* are highly important gymnosperms with respect to medicine. *Ephedra gerardiana* contains alkaloids that are effective in the treatment of asthma and hay fever. Similarly leaves of *Juniperus macropoda* are used as incense in the religious ceremonies by some communities which seriously damages the prospects of the regeneration of these valuable plants. *Taxus baccata* is a highly toxic plant that has occasionally been used medicinally, mainly in the treatment of chest complaints. Modern research has shown that these plants contain the substance 'taxol' in their shoots. Taxol has shown exciting potential as an anti-cancer drug, particularly in the treatment of ovarian cancers.



(1. American, 2. Indian Subcontinent, 3. Chiniies, 4. Japanese, 5. Asia-Temperate, 6. European, 7. African, 8. Australian, 9. Indo-China and 10. Mediterranean)



(1. American, 2. Indian Subcontinent, 3. Chiniies, 4. Japanese, 5. Asia-Temperate, 6. European, 7. African, 8. Australian, 9. Indo-China and 10. Mediterranean)

Figure 1. The gymnosperm species and their native region

Table 1. List of Gymnosperms recorded from the state.

Sl.	Name of species	Origin	Status	Habit	Local/English name	Altitude (m)	Distribution
Araucariaceae							
1	<i>Araucaria angustifolia</i> Bertal	Brazil	C	T	Candelabra pine (E)	600-2000	Dehradun
2	<i>Araucaria bidwillii</i> Hook.	Australia	C	T	False monkey puzzle (E)	1500-2000	Nainital
3	<i>Araucaria columnaris</i> (Forst.) Hook.	New Caledonia	C	T	Cook Pine (E)	1000-2000	Almora, Nainital
4	<i>Araucaria cunninghamii</i> Sweet	Australia	C	T	Hoop pine (E)	1000-2000	Nainital
5	<i>Agathis robusta</i> (C.Moore) F.M.Bailey	Brazil	C	T	Queensland kauri (E)	600-2000	Dehradun
Cephalotaxaceae							
6	<i>Cephalotaxus barringtonia</i> Koch	Japan	C	T	Cow-tail Pine (E)	2000-3700	Dehradun
7	<i>Cephalotaxus griffithii</i> Hook.f.	Japan	C	T	Griffith's Plum Yew (E)	2000-3700	Dehradun
Cupressaceae							
8	<i>Callitris columellaris</i> F. Muell.	Australia	C	T	White Cypress-pine (E)	1200-2000	Dehradun, Nainital
9	<i>Cupressus arizonica</i> Greene	Mexico	C	T	Arizona smooth cypress (E)	1760-2400	Dehradun
10	<i>Cupressus cashmeriana</i> Royle ex Carrie	China (Tibet)	C	T	Kasmir cypress (E)	1760-2400	Dehradun, Nainital
11	<i>Cupressus funebris</i> Endl.	China	C	T	Chinese weeping cypress (E)	1760-2400	Almora, Nainital
12	<i>Cupressus goveniana</i> Gord	California	C	T	Gowen Cypress (E)	1760-2400	Dehradun
13	<i>Cupressus lusitanica</i> Mill.	Mexico	C	T	Mexican Cypress (E)	1760-2400	Dehradun
14	<i>Cupressus sempervirens</i> L.	Cyprus	C	T	Blue Italian Cypress (E)	1760-2400	Dehradun
15	<i>Cupressus torulosa</i> D.Don	Bhutan	C	T	Himalayan cypress (E)	1500-2500	Almora, Nainital, Pithoragarh
16	<i>Juniperus bermudiana</i> L.	Bermuda	C	T	Bermuda Cedar (E)	1700-3400	Dehradun
17	<i>Juniperus chinensis</i> L.	China	C	T	Chinese Juniper (E)	1700-3400	Dehradun
18	<i>Juniperus communis</i> L.	Northern hemisphere	C	T	Common juniper (E)	2500-4500	Bageshwar, Pithoragarh
19	<i>Juniperus deppeana</i> Steud.	Mexico	C	T	Aligator juniper (E)	1700-3400	Dehradun
20	<i>Juniperus indica</i> Bertol.	Himalaya	W	S	Black Juniper (E)	2700-4600	Bageshwar, Pithoragarh
21	<i>Juniperus macropoda</i> Hook.f.	Himalaya	W	T	Pencil cedar (E)	2000-2500	Mussoorie, Tehri Garhwal
22	<i>Juniperus oxycedrus</i> L.	Syria	C	T	Cade juniper (E)	1700-3400	Dehradun
23	<i>Juniperus phoenicea</i> L.	Algeria	C	T	Phoenician juniper (E)	1700-3400	Dehradun
24	<i>Juniperus procera</i> Hochst.	Kenya	C	T	African Juniper (E)	1700-3400	Dehradun
25	<i>Juniperus recurva</i> Buch.- Ham ex D. Don	Himalaya	W	T	Drooping Juniper (E)	3300-4300	Almora, Bageshwar, Pithoragarh
26	<i>Juniperus scopulorum</i> Sarg.	USA	C	T	Moonglow Juniper (E)	1700-3400	Dehradun
27	<i>Juniperus semiglobosa</i> Regel	Central Asia	W	T	Himalayan Pencil Juniper (E)	1700-3400	Dehradun
28	<i>Juniperus squamata</i> Buh.-Ham. ex D.Don	Himalaya	W	T	Himalayan Juniper (E)	2700-4200	Pithoragarh
29	<i>Thuja occidentalis</i> Bailey	Canada/USA	C	T	American arborvitae (E)	600-2400	Dehradun
30	<i>Thuja orientalis</i> Linn	China	C	T	Chinese arborvitae (E)	600-2600	Dehradun, Nainital
Cycadaceae							
31	<i>Cycas revoluta</i> Thunb.	South Japan	C	S	Sago palm (E)	600-2000	Nainital, Dehradun
Ephedraceae							
32	<i>Ephedra Gerardiana</i> Wall.ex Stapf.	Europe, Asia	W	S	Somlata (L)	2000-4500	Pithoragarh, Dharchula
Ginkgoaceae							
33	<i>Ginkgo biloba</i> L.	China	C	T	Maidenhair tree (E)	1800-2400	Nainital, Dehradun, Almora, Ranikhet, Mussoorie
Pinaceae							
34	<i>Abies pindrow</i> Royle	W.Himalaya	W	T	Fir (L)	2400-3700	Uttarkashi, Dehradun, Chamoli, Pithoragarh
35	<i>Abies spectabilis</i> (D.Don) Spach	Asia Temperate	W	T	Himalayan Silver Fir (E)	3000-3600	Bageshwar (Dwali), Nainital.
36	<i>Cedrus deodara</i> (Roxb. ex D.Don) G.Don	W.Himalaya	W	T	Deodar (L)	2000-3200	Champawat, Nainital, Pithoragarh, Chamoli, Dehradun, Uttarkashi
37	<i>Picea smithiana</i> (Wall.) Boiss	Southern Asia	W	T	Himalaya spruce (E)	2000-3300	Almora (Lamghara), Nainital

38	<i>Pinus canariensis</i> Sm.	Canary Island	C	T	Canary Island Pine (E)	1800-2100	Kalika in Ranikhet
39	<i>Pinus caribea</i> Mor.	Cuba	C	T	Caribbean pine (E)	1800-2100	Kalika in Ranikhet
40	<i>Pinus densiflora</i> Sieb. & Zucc.	Japan	C	T	Japanese red pine (E)	1800-2100	Kalika in Ranikhet
41	<i>Pinus echinata</i> Mill.	Mexico	C	T	Arkansas Pine (E)	1800-2100	Kalika in Ranikhet
42	<i>Pinus elliotti</i> Engler	USA	C	T	Florida Slash Pine (E)	1800-2100	Kalika in Ranikhet
43	<i>Pinus gerardiana</i> Wall.	NW Himalaya	W	T	Kail (L), Chilgoza Pine (E)	1800-2100	Kalika in Ranikhet
44	<i>Pinus halepensis</i> Mill.	Cyprus	C	T	Aleppo pine (E)	1800-2100	Kalika in Ranikhet
45	<i>Pinus hartwegii</i> Lindl.	Mediterranean	C	T	Canadian red pine (E)	1800-2100	Kalika in Ranikhet
46	<i>Pinus kesiya</i> Role	Myanmar	C	T	Benguet Pine (E)	1800-2100	Kalika in Ranikhet
47	<i>Pinus merkusii</i> Jungh & de Vries	Myanmar	C	T	Sumatran Pine (E)	1800-2100	Nainital
48	<i>Pinus oocarpa</i> Schiede	Mexico	C	T	Mexican yellow pine (E)	1800-2100	Kalika in Ranikhet
49	<i>Pinus patula</i> (Shide) Deppe	Mexico	C	T	Mexican weeping pine (E)	1800-2100	Kalika in Ranikhet
50	<i>Pinus radiata</i> D.Don	USA	C	T	Monterey Pine (E)	1800-2100	Kalika in Ranikhet
51	<i>Pinus roxburghii</i> Sarg.	NW Himalaya	W	T	Chir (L)	600-2200	All districts
52	<i>Pinus wallichiana</i> A. B. Jackson	NW Himalaya	W	T	Raisalla (L), Blue pine (E)	1800-3900	Pithoragarh
53	<i>Tsuga dumosa</i> (D.Don) Eichler	Asia	W	T	Himalayan Hemlock (E)	2400-3000	Darma, Pithoragarh
	Podocarpaceae						
54	<i>Podocarpus gracilior</i> Pilger	Kenya	C	T	African Fern Pine (E)	1500-3000	Dehradun
55	<i>Podocarpus latifolius</i> (Thunb.) R.Br. ex Mirb.	Kenya	C	T	Real Yellowwood (E)	600-1550	Dehradun
56	<i>Podocarpus macrophylla</i> (Thunb.) D.Don	Chian, Japan	C	T	Big leaf Podocarp (E)	1000	Nainital
57	<i>Podocarpus nerifolius</i> D.Don	china	C	T	Brown pine (E)	300-1500	Dehradun
	Taxaceae						
58	<i>Taxus baccata</i> L.	Western Europe, Asia, Afganistan	W	T	Thuner (L), Yew (E)	2000-3400	Uttarkashi, Chamoli, Pithoragarh
59	<i>Taxus wallichiana</i>	Himalaya	W	T	Himalayan Yew (E)	2000-3000	Pithoragarh
	Taxodiaceae						
60	<i>Cryptomeria japonica</i> (Linn. f.) D.Don	Japan, China	C	S	Japanese cedar (E)	1100-2500	Dehradun
61	<i>Cunninghamia lanceolata</i> (Lambert) Hook	China	C	T	China Fir (E)	600-2200	Dehradun
62	<i>Taxodium distichum</i> (L.) Rich.	Florida	C	T	Baldcypress (E)	600-2000	Dehradun
63	<i>Taxodium mucronata</i> Tenore	Mexico	C	T	Marshy Cyperus (E)	600-2000	Dehradun

Abbreviations: C- Cultivated, W- Wild, T- Tree, S- Shrub, L- Local name and E- English name.

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