

2019

Temporal Change in Tree Species Composition in Chamba Forest Division of Chamba Circle, Himachal Pradesh

Status Report

Dr.S.S. Randhawa, Harish Bharti, Kiran Lata, Aditi Panatu
State centre on climate change
Himachal Pradesh Council for Science, Technology and Environment
(HIMCOSTE), Vigyan Bhawan Bemloe, Shimla-01 H.P.



Contents

Introduction	4
Forests of Himachal Pradesh	5
Study area and method	7
District Chamba – A Background	7
Climate	7
Forest	8
Methods	10
Chamba Forest Division –	10
Forests of Chamba:	10
Data Sources and Techniques	13
Assessment techniques	14
Tree Community-based Variations	14
Results & Findings	15
Chamba Forest Division	15
1. <i>Pinus roxburghii</i> tree community:	16
2. <i>Pinus wallichiana</i> tree community:	16
3. <i>Cedrus deodara</i> tree community:	17
4. <i>Picea smithiana</i> tree community:	18
5. <i>Quercus leucotrichophora</i> tree community:	19
6. <i>Quercus semecarpifolia</i> tree community:	20
7. Other Broad leaved mixed tree community:	21
8. <i>Cedrus deodara-Quercus leucotrichophora</i> mixed tree community:	21
9. <i>Pinus roxburghii-Quercus leucotrichophora</i> mixed tree community:	22
10. <i>Abies pindrow-Quercus floribunda</i> mixed tree community:	23
11. <i>Quercus leucotrichophora-Other Broad Leaved</i> mixed tree community:	24
12. <i>Pinus wallichiana-Other Broad Leaved</i> mixed tree community:	24
13. <i>Abies pindrow-Other Broad Leaved</i> mixed tree community:	25
14. <i>Cedrus deodara-Picea smithiana</i> mixed tree community:	26
15. <i>Picea smithiana-Other Broad Leaved</i> mixed tree community:	27
Conclusion	27

Table of Tables

Table 1: Forest Classifications for Himachal Pradesh	5
Table 2: Profile – Chamba Forest Circle	8
Table 3. Detail on Tree Community and respective Altitudinal gradients, Forest Compartments, Area Assessed under Chamba Forest Division	13

Table of Figures

Figure 1: Beat-wise map of Chamba Forest Division, Chamba Forest Circle.....	9
Figure 2. Density Variations in Species Composition in <i>Pinus roxburghii</i> community, Chamba Forest Division, 1994-2016.....	16
Figure 3. Density Variations in Species Composition in <i>Pinus wallichiana</i> community, Chamba Forest Division, 1994-2016.....	17
Figure 4. Density Variations in Species Composition in <i>Cedrus deodara</i> community, Chamba Forest Division, 1994-2016.....	18
Figure 5. Density Variations in Species Composition in <i>Picea smithiana</i> community, Chamba Forest Division, 1994-2016.....	19
Figure 6. Density Variations in Species Composition in <i>Quercus leucotrichophora</i> community, Chamba Forest Division, 1994-2016	20
Figure 7. Density Variations in Species Composition in <i>Quercus semecarpifolia</i> community, Chamba Forest Division, 1994-2016	20
Figure 8. Density Variations in Species Composition in Other Broad Leaved community, Chamba Forest Division, 1994-2016	21
Figure 9. Density Variations in Species Composition in <i>Cedrus deodara-Quercus leucotrichophora</i> community, Chamba Forest Division, 1994-2016	22
Figure 10. Density Variations in Species Composition in <i>Pinus roxburghii-Quercus leucotrichophora</i> community, Chamba Forest Division, 1994-2016	23
Figure 11. Density Variations in Species Composition in <i>Abies pindrow-Quercus floribunda</i> community, Chamba Forest Division, 1994-2016	24
Figure 12. Density Variations in Species Composition in <i>Quercus leucotrichophora</i> – Other Broad Leaved community, Chamba Forest Division, 1994-2016	24
Figure 13. Density Variations in Species Composition in <i>Pinus wallichiana</i> -Other Broad Leaved community, Chamba Forest Division, 1994-2016	25
Figure 14. Density Variations in Species Composition in <i>Abies pindrow</i> -Other Broad Leaved community, Chamba Forest Division, 1994-2016	26
Figure 15. Density Variations in Species Composition in <i>Cedrus deodara-Picea smithiana</i> community, Chamba Forest Division, 1994-2016	26

Figure 16. Density Variations in Species Composition in *Picea smithiana*-Other Broad Leaved community, Chamba Forest Division, 1994-201627

Copyright

Introduction

The Himalayas cover a vast expanse of 595,000 square kilometres with 2,400 km of parallel mountain ranges encompassing parts of India, Pakistan, Afghanistan, China, Bhutan, Nepal, and Tibet. Situated between 720- 910 E Longitudes and 270-360 N Latitudes, the Himalayas separate the alluvial plains of Indian subcontinent on the south from the Plateau of Tibet to the north; and connects the mountains of near East and Central Asia with those in the East Asia. Further, the Himalayan landscape is characterised with a unique geographic and ecological profile and serves as a home to an array of rivers such as Yangtze Ganga, Brahmaputra, Ganga, Indus, Yarlung, Yangtze, Yellow, Mekong, and Nujiang, which serve as a critical water source for Asian countries.

The Himalayan ecological diversity is altitude dependent where climatic and topographic effects on ecosystems and biota become more pronounced with increasing gradient. Further, there exist stark differences between the eastern and the western Himalayas in altitude, precipitation, and vegetation patterns. The eastern Himalayas are four-times wetter than the western Himalayas with higher snowline, and rich biodiversity. Meanwhile, the western Himalayan ranges are farther apart from the plains with precipitous landscape and colder-drier climate. The altitude gradient and climatic conditions play a decisive role in determining the vegetative pattern in the bio-diverse rich ecology of the Himalayas. At the mountain foothills, there are tropical and sub-tropical broadleaf forests; temperate broadleaf mixed forests with a dominant canopy of oak and maple at the middle; and coniferous, sub-alpine, and alpine vegetation at the higher altitudes adorned with pine, hemlock, spruce, and fir conifers. Areas under inaccessible landscapes are characterised with alpine grasslands, high-altitude meadows, scrubland which is followed by snowline.

The Indian Himalayan Region (IHR) is home to over 72 million people living in over 10 states covering 95 districts in a total geographic area of 5 lacs square km. With its foot-hills in Shivaliks at the south, the vast Himalayan region expands to the Tibetan Plateau on the north, thus, serving as a natural northern boundary for India. According to the State Forest Report, 2011, around 42 per cent of the total IHR area is covered under forests (one-third of the total

forest area in India) offering invaluable ecological security and resources to the country. As per the State of Forest Report 2017, around 22 per cent of India's total geographical area was found to be under forest cover, of which 2.99 per cent was under Very Dense Forest, 9.38 per cent under Moderately Dense Forest, and 9.18 per cent under Open Forest Area.

Forests of Himachal Pradesh

Himachal Pradesh is a mountainous state in the northernmost part of India, situated in the western Himalayas between latitude 30° 22' 40" N to 33° 12' 40" N and longitude 75° 45' 55" E to 79° 04' 20" E. Two-thirds of Himachal Pradesh's area (55,673 square km) comes under recorded forest area, however, only 27.12 per cent of this area is accounted under forest and tree cover. One-third of the state's geographic area remains permanently under snow glaciers and inaccessible cold deserts, thus is permanently beyond the tree line. Administratively, the forests are classified as Reserved (5.13 per cent), Protected (89.46 per cent), and Un-classed forest (5.41 per cent), within which certain areas are categorised for specific wildlife, flora, and natural ecosystem protection.

Table 1: Forest Classifications for Himachal Pradesh

Forest Type	Altitude	Rainfall	Dominant Forests
Tropical Dry Deciduous Forests	>1000 m above mean sea level	100-150 cm/annum	<i>Shorea robusta</i> and other associates such as <i>Acacia catechu</i> , <i>Aegle marmelos</i> , <i>Feronia limonia</i> , <i>Anogeissus latifolia</i> , <i>Buchanania lanzan</i> , <i>Woodfordia fruitcosa</i> , <i>Indigofera pulchella</i> , <i>Eulaliopsis binata</i>
Tropical Moist Deciduous forests	>1000 m above mean sea level	100-200 cm/annum	<i>Olea cuspidate</i> , <i>Acacia modesta</i> and other associates such as <i>Pyrus pashia</i> , <i>Coriaria nepalensis</i> , <i>Rhus continus</i> , <i>Indigofera gerardiana</i> , <i>Prinsepia utilis</i>
Subtropical	1000-1800m	90-250	<i>Pinus roxburghii</i> and other

Pine Forests	above mean sea level	cm/annum	associates such as <i>Terminalia chebula</i> , <i>Mallotus philippensis</i> , <i>Pyrus pashia</i> , <i>Syzygium cumini</i> , <i>Albizzia chinensis</i> , <i>Emblica sp.</i> , <i>Acacia catechu</i> , <i>Murraya spp.</i> , <i>Rosa moschata</i>
Himalayan Moist Temperate Forests	1500-3300m above mean sea level	150-250 cm/annum	Chief Oaks - <i>Quercus leucotrichophora</i> , <i>Q. dilatata</i> other associates such as <i>Rhododendron</i> , <i>Acer</i> , <i>Aesculus</i> , <i>Cedrus deodara</i>
Himalayan Dry Temperate Forests	>1,700m above mean sea level	< 100 cm/annum	<i>Conifers</i> - <i>Cedrus deodara</i> , <i>Pinus gerardiana</i> , <i>Junipers</i> , <i>Abies</i> , <i>Pinus wallichiana</i> . <i>Broad-leaved</i> - <i>Acer</i> , <i>Quercus</i>
Sub-Alpine Forests	2,900-3,500m above mean sea level		<i>Conifers</i> - <i>Abies</i> , <i>Pinus wallichiana</i> , <i>Deciduous trees</i> - <i>Betula utilis</i> , <i>Quercus semecarpifolia</i> , <i>Rhododendron</i>
Moist Alpine Scrub	>3,350 m above mean sea level		<i>Betula utilis</i> , <i>Berberis</i> , <i>Salix</i> , <i>Rosa</i> , <i>Aconitum</i> , <i>Lonicera</i>
Dry Alpine Scrub	>6,000 m above mean sea level		<i>Juniperus</i> , <i>Artemisia</i> , <i>Lonicera</i> , <i>Salix</i> , <i>Myricaria</i>

Himachal Pradesh is blessed with a rich biodiversity adorned with diverse natural ecosystems comprising 8 forest types, 38 sub-types, which are home to 3,295 plant species of the 45,000 found in India. 95 per cent of these species are endemic to the State and only 5 per cent known as exotic species have been introduced in the last 150 years. The state's forest ecosystem offers critical ecological, environmental, economic, and social support to the populace serving as a primary source of food, fuel, fodder, timber, and other non-timber forest produce for both urban and rural population.

However, these forest resources are currently experiencing greater stress with increasing pressure from burgeoning population and rising impact of anthropogenic activities. This temporal study was designed to get a preliminary insight into the current status of vegetation viz. species composition in Chamba Forest Division under the Chamba Forest Circle.

The next section outlines the details on study area and the adopted methodology with information on data sources and applied techniques of assessments. Following which, the section on Results and Findings discusses the outcomes for Chamba Forest divisions. The report concludes with a categorised and consolidated snapshot of species composition in the Chamba Forest Circle with information on tree community level variation.

Study area and method

District Chamba – A Background

Chamba is located between latitude of 32°11'30" and 33°13'6" North and longitude 75°49' and 77°3'30" East. Area of Chamba district is about 6528 square km and whole area is mountain area, altitude ranging between 2 to 21 thousand feet surrounded by lofty hill ranges. Ravi is a major river of this region which passes through Chamba town. Pir Panjal is main mountain range of Chamba district. The famous Dhauladhar range separates Chamba from Kangra district.

CLIMATE

The climate is in general temperate with well-marked season. However, there are local variations depending upon altitude and aspect. The places at higher elevations and on northern aspect are cooler than those situated at lower elevations and on southern aspects. The winter lasts from December to February, both months inclusive and is characterized by frequent and heavy snowfalls. March and April are generally cool and bright but snowfall occurs at higher elevations during these months. The temperature begins to rise rapidly from middle of April to last week of June or 1st week of July when monsoon break in. Monsoon continues till the end of August or middle of September. During these months the area receives bulk of precipitation in the shape of rainfall. Atmosphere is usually misty, very humid and remains cloudy. The snowfall may occurs

any time from October onwards on higher hills but does not generally come down to low levels till middle of December.

Temperature in this region is moderate in summers and varies from 20 to 39 degrees whereas in winters it's really cool and temperature is around 0 to 15 degrees. Pangri and Bharmaur are heavy snowed area of Chamba district, whereas snowfall in this region is moderate. This region comes under tribal area due to its adverse geography.

FOREST

Table 2 below gives a snapshot of forest profile for Chamba Forest Circle with specific details on ecological zones, land use, forest administrative setup and ecosystem for the four forest divisions.

Table 2: Profile – Chamba Forest Circle

Forest Profile –Chamba Forest Circle			
Key Biodiversity Areas	Gamgul Siahbehi Wildlife Sanctuary		
	Kugti Wildlife Sanctuary		
	Sechu Tuan Nala Wildlife Sanctuary		
	Tundah Wildlife Sanctuary		
	Kalatop Khajjiar Wildlife Sanctuary		
Forest Divisions and ranges	<i>Forest Circle</i>	<i>Forest Division</i>	<i>Forest Range</i>
	Chamba	Chamba	Masrund Tikri Lower Chamba Upper Chamba

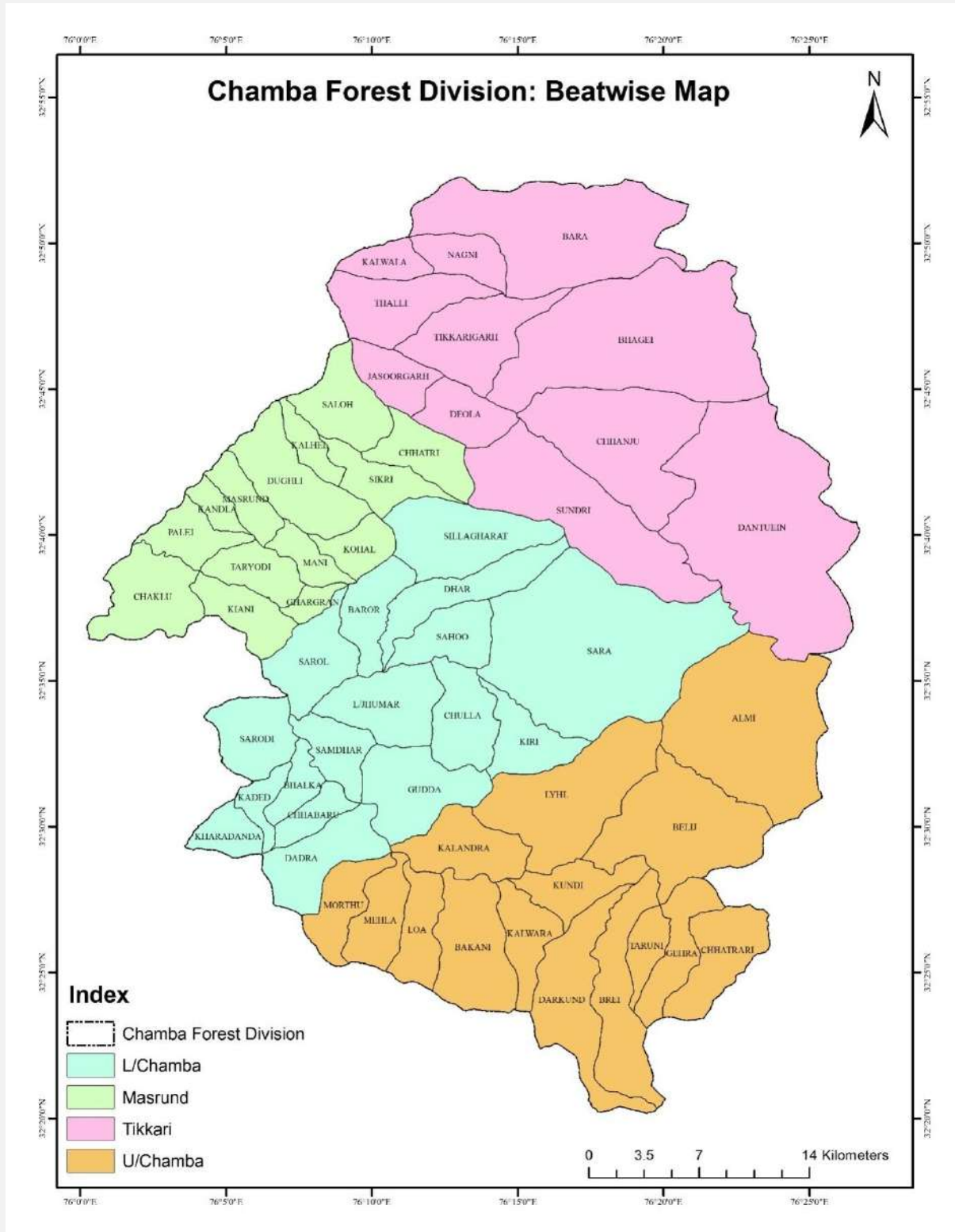


Figure 1: Beat-wise map of Chamba Forest Division, Chamba Forest Circle

Methods

To ascertain the temporal changes in different tree species composition in Chamba Forest Division of Chamba Forest Circle, tree community based variation has been studied.

There are five forest divisions in Chamba forest circle viz., Pangi, Bharmour, Dalhousie, Chamba and Churah Forest Division. Due to the non-availability of data records in Pangi and Churah Forest Division, only Chamba and Dalhousie (Tree species composition in another status report) Forest Division was assessed for this study. Hence, enumerated data was collected and analysed for their respective forest ranges for the Chamba Forest Division only.

Chamba Forest Division – There are four forest ranges in this division viz., Masrund, Tikri, Lower Chamba and Upper Chamba. The total area of forest assessed for the study was 3509.06 ha.

Forests of Chamba:

Occurrence and distribution of species: A large difference in altitudinal zone ranging from 680m on confluence of river Ravi and Satluj River to 4882m on the highest peak of Dhar Chandrauni, coupled with aspect and biotic influence brings with it a variety of vegetation varying from northern tropical dry deciduous forests to area under permanent snow. The distinct zones of temperature on these mountains, which are tropical at lower, subtropical at middle elevation and temperate at higher elevation, result in development of three distinct primary types of forests namely tropical, subtropical and temperate. Some of important species are discussed below with their specific zones of occurrence and the factor influencing them.

a) Deodar (*Cedrus deodara*):

It is the most beautiful and important tree amongst all the tree species found in the track noted for its valuable timber and aesthetic beauty. It yields very durable timber extensively used for buildings, furniture and general carpentry especially in hilly area. It occurs at elevation varying between 1500 to 2300m where it tends to pure in composition. Altitudinal range is higher on southerly then on northerly aspects.

- b) **Kail (*Pinus wallichiana*):** it is one of the most beautiful pines in the world; tend to become ragged in old age. It yields timber of good quality less durable than deodar but easily worked and used for buildings especially interior work, furniture and general carpentry. It occurs pure as well as mixture with deodar and fir/spruce in most of the forests of whole track. It occasionally, ascends to 4300m as in Dhar Chandrauni of Belj block. Common broad leaved associates are Oaks, *Rhododendron arboreum*, *Lyonia ovalifolia*, *Populus*, *Aesculus indica*, Ash species. Kail being a pioneer species, it comes naturally on areas devastated by fire on exposed spurs with deodar, Fir and Spruce trees.
- c) **Fir (*Abies pindrow*):** Fir does not find a place with Deodar and Kail as regards its timber value but mostly used for packing cases and paper industry. It occurs generally mixed with Spruce at elevation ranging from 2200-2900m on northern aspects, sometimes ascends to Kharsu zone up to 3300m and confined to moist situations.
- d) **Spruce (*Picea smithiana*):** Its timber can be equated with that of Fir and generally used for planking, packing cases, wood pulp and also suitable for use in aeroplane provided wood is free of Knots and uniformly but not too fast grown. Spruce generally mixed with Fir but also forms pure forests and intrudes in Deodar, Kail forests. It is usually present in association with Kharsu-oak. Due to its more adaptability the regeneration can be seen in plenty where the canopy is sufficiently open.
- e) **Chil (*Pinus roxburghii*):** Chil is principle resin producing pine and its timber can be used for building, common furniture, boxes and general carpentry. It occupies the elevations ranging from 900- 1800m and rarely ascends to 1950m. Chirpine which is remarkably indifferent to soil is found on an extremely wide range of rocks but in hilly topography, adequate drainage is the chief essential for this species. The Chil forests are remarkable pure, practically with no other tree occurring in the top canopy. There is only sprinkling of other species representing second storey. The broad leaved species met are *Cedrela serrata*, *Quercus leucotrichophora*, *Grewia oppositifolia*, *Pistacia integerrima*, *Rhododendron arboreum*, *Pyrus pashia*, *Albizia stipulata*, *Lyonia ovalifolia*. The common

shrubs are *Berberis lycium*, *Dodonaea viscosa*, *Woodfordia floribunda*, *Colebrookia opositifolia*, *Rubu sellipticus*, *Princepia utilis*, *Indigofera*, *Flemingia fruticose*, *Placranthus regosus*, *Zanthoxylum*. Climbers are almost absent.

- f) **Ban Oak (*Quercus leucotrichophora*):** Ban Oak forests play a significant role in moisture conservations. This species is highly valued for its fuel, fodder and other uses such as agricultural implements. It occurs all over the track but is reduced in extent and proportion due to excessive lopping pressure. However, along periphery of village it is preserved by villagers and is met with in small patches. In forests it occurs pure as well as mixed with other species. Pure forests are met with between elevations of 1000 to 2100m.
- g) **Moru Oak (*Quercus floribunda*):** It occurs between elevations of 1700 to 2500m. Like Ban, too is well known for its fuel/fodder value. Its fuel is, however, thought inferior to Ban. It occurs pure as well as in mixture. In pure form it is off course mixed with Spruce which is present as an associate. Like Ban, Moru tree are also noted along various villagers where these are preserved by the villagers.
- h) **Kharsu Oak (*Quercus semecarpifolia*):** The upper most oak, Kharsu too is known for its fuel and fodder value but due to its location in high lying area is not being used much. The species generally forms thick pure large stands occurring on elevations of 2600 to 3700m. On North aspects it dislikes depressions which give way to fir there. It also forms a mixture with fir on northern aspects and comes down to 2600m.
- i) **Other Broad Leaved Species:** There is a host of other broad leaved species which are found in association with mentioned commercially important species. These broad leaved species find varied uses right from fuelwood up to sports, furniture and other industries. The important ones in the lower elevations are Shisham, *Albizia*, *Grewia* etc. and the higher are Toon, *Carpinus*, Ash, Maple, Chirindi, Walnut, Piak, *Pistacia* etc. There are no pure stands of these but are found in mixture forming local consociation in the lower portion of the area. *Albizia* and *Grewia* are of immense utility as fodder is for rope making. Walnut and *Aesculus indica* though rare are also present in some forests of higher elevations. *Pistacia*, a species known for its medical value like hot places and is

present on southern aspects at elevations 800 to 1600m. Kainth a robust species of the tract is good for fuel. It also provides a rootstock for Nashpati grafting. The species occurs on both cold as well as warm aspects.

Data Sources and Techniques

Working plans from the Himachal Pradesh Forest Department and Compartment History files were consulted and the species composition change during the successive working plans was analysed for the said forest division.

Chamba Forest Division: 1994-2016

Respective files were collected from the Library of Himachal Pradesh Forest Department, and offices of the Chamba Forest Divisions and their respective ranges.

Based on the information from the Working Plans for the Chamba Forest Circle and information from the Compartment History files, tree communities were identified.

Working plan is a written scheme of management that aims to ensure continuity of policy action, and controlled treatment of a forest. Within a working plan, Forest Division is the basic unit. This document is utilized to evaluate status of forests and the biodiversity resources within a particular division.

Table 3. Detail on Tree Community and respective Altitudinal gradients, Forest Compartments, Area Assessed under Chamba Forest Division

S.N.	Communities	No. of Forest/Compartment	Area (ha)	Forest Ranges
1	<i>Cedrus deodara</i> (CD)	11	450.5	Masrund, Lower Chamba, Upper Chamba
2	<i>Picea smithiana</i> (PS)	5	401.19	Lower Chamba, Upper Chamba
3	<i>Pinus roxburghii</i> (PR)	9	382.64	Masrund, Lower Chamba, Upper Chamba
4	<i>Pinus wallichiana</i> (PW)	3	154.89	Masrund, Upper Chamba
5	<i>Quercus leucotrichophora</i> (QL)	5	295.82	Masrund, Lower Chamba, Upper Chamba
6	<i>Quercus semecarpifolia</i> (QS)	2	112.51	Upper Chamba

7	Other Broad Leaved	13	840.77	Tikkari, upper Chamba
8	<i>Cedrus deodara-Quercus leucotrichophora</i> (CD-QL)	3	185.35	Masrund, Lower Chamba, Upper Chamba
9	<i>Pinus roxburghii-Quercus leucotrichophora</i> (PR-QL)	1	30.35	Masrund
10	<i>Abies pindrow-Quercus floribunda</i> (AP-QF)	1	56.66	Lower Chamba
11	<i>Quercus leucotrichophora-Other Broad Leaved</i> (QL-OBL)	1	72.7	Tikkari
12	<i>Pinus wallichiana-Other Broad Leaved</i> (PW-OBL)	1	26.71	Tikkari
13	<i>Abies pindrow-Other Broad Leaved</i> (AP-OBL)	2	321.81	Tikkari
14	<i>Cedrus deodara-Picea smithiana</i> (CD-PS)	1	38.04	Upper Chamba
15	<i>Picea smithiana-Other Broad Leaved</i> (PS-OBL)	2	139.12	Tikkari, Masrund
	Total	60	3509.06	

For the assessment purpose, the forests were categorized according to the delineated communities i.e. if for a single species the relative density is more than 50 per cent, then the tree community was identified as single species dominant community. For cases where more than one species collectively accounted for 50 per cent of the relative density, the tree community was referred as mixed community. Species composition was assessed for changes in the Tree Density, where individuals per hectare (Ind/ha) were calculated for the two time period i.e., 1994-2016.

The next section elaborate the employed assessment technique for 1) *tree community based variation*

Assessment techniques

Tree Community-based Variations

Each forest division constitutes different tree communities where dominant species is identified based on its relative density (more than 50 per cent categorised as dominant community; and a collective majority as mixed community). For each of the identified pure species in Chamba Forest Division, variations in density were determined for the two time periods i.e. 1994 and 2016.

Key Terminologies

Tree community: Group or association of populations of two or more different tree species that occupy the same geographical area at a particular time period

Forest compartment: A section of forest with homogeneous growth conditions and tree species

Results & Findings

This section presents the findings from the assessment of the tree community composition for Karsog Forest Divisions and their respective species.

Chamba Forest Division

Based on the assessment of Working Plans from the Himachal Pradesh Forest Department and Compartment History files from Masrund, Tikri, Lower Chamba and Upper Chamba forest ranges, six pure communities (having one dominant species) *i.e.* *Pinus roxburghii* (PR), *Pinus wallichiana* (PW), *Cedrus deodara* (CD), *Picea smithiana* (PS), *Quercus leucotrichophora* (QL), *Quercus semecarpifolia* (QS), tree community and eight mixed communities *viz.* *Cedrus deodara-Quercus leucotrichophora*, *Pinus roxburghii-Quercus leucotrichophora*, *Abies pindrow-Quercus floribunda*, *Abies pindrow-Quercus floribunda*, *Quercus leucotrichophora-Other Broad Leaved*, *Pinus wallichiana-Other Broad Leaved* (PW-OBL), *Abies pindrow-Other Broad Leaved*, *Cedrus deodara-Picea smithiana*, *Picea smithiana-Other Broad Leaved* mixed tree community including one separate category of Broad leaved (covering all broad leaved species except oak which is already covered in pure community) were identified.

As highlighted earlier in

these tree communities were assessed from 60 forest compartments spread over a total area of 3509.06ha.

Tree Community based Variations

The following section discusses the tree community based variations in density for the species identified.

1. *Pinus roxburghii* tree community:

The data were collected from 9 forest compartments covering total area 382.64 ha. *Pinus roxburghii* (PR) tree community occurs in three forest ranges viz. Masrund, Lower Chamba and Upper Chamba. As illustrated in Figure, in its dominant tree community, density of *Pinus roxburghii* is decreased from 712 Ind/ha to 200.4 Ind/ha. In these forest compartments, representation (density) of other species is as follows –density of *Cedrus deodara* decreased from 35.9 Ind/ha in 1994 to 12.9 Ind/ha in 2016, density of Other Broad Leaved decreased from 23.2 Ind/ha to 8 Ind/ha.

The density of *Picea smithiana* also decreased from 11.9 Ind/ha in 1994 to 0.9 Ind/ha 2016 where *Pinus wallichiana* and *Quercus leucotrichophora* showed increase from 9.6 Ind/ha to 23.3 Ind/ha and 20.5 Ind/ha to 23.7 Ind/ha in 1994-2016 respectively as shown in Figure2.

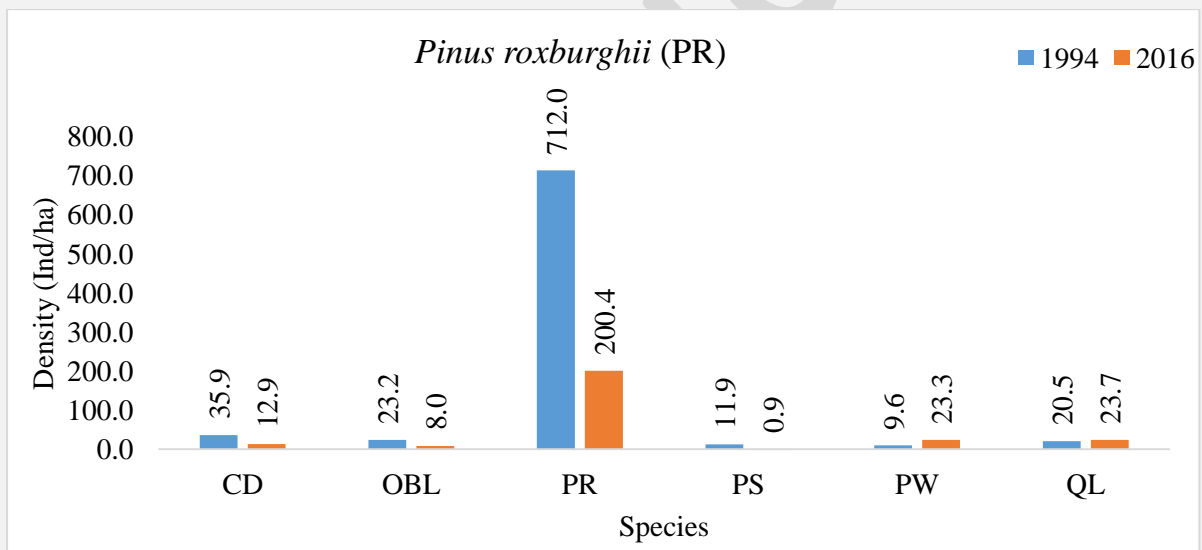


Figure 2. Density Variations in Species Composition in *Pinus roxburghii* community, Chamba Forest Division, 1994-2016

Abbreviations: CD=*Cedrus deodara*; OBL= Other Broad-leaved; PR=*Pinus roxburghii*; PS=*Picea smithiana*, PW=*Pinus wallichiana*, QL=*Quercus leucotrichophora*

2. *Pinus wallichiana* tree community:

The numbers of forest compartments in *Pinus wallichiana* tree community were 3, covering area 154.89 ha. This tree community were falling only in two forest ranges of Chamba Forest Division i.e. Masrund and Upper Chamba forest range.

The density of *Pinus wallichiana* was increased from 57.9 Ind/ha to 185.8 Ind/ha from year 1994-2016 respectively (Figure 3). The *Cedrus deodara*, Other Broad leaved, *Pinus roxburghii*, *Quercus leucotrichophora* and *Picea smithiana* showed increase in density as from 7.4 Ind/ha to 17.4 Ind/ha, 2.3 Ind/ha to 6.7 Ind/ha, 0.2 Ind/ha to 1.4 Ind/ha, 1.5 Ind/ha to 1.9 Ind/ha and 1.2 Ind/ha to 4.0 Ind/ha respectively in comparison to year 1994-2016 as shown in the Figure 2.

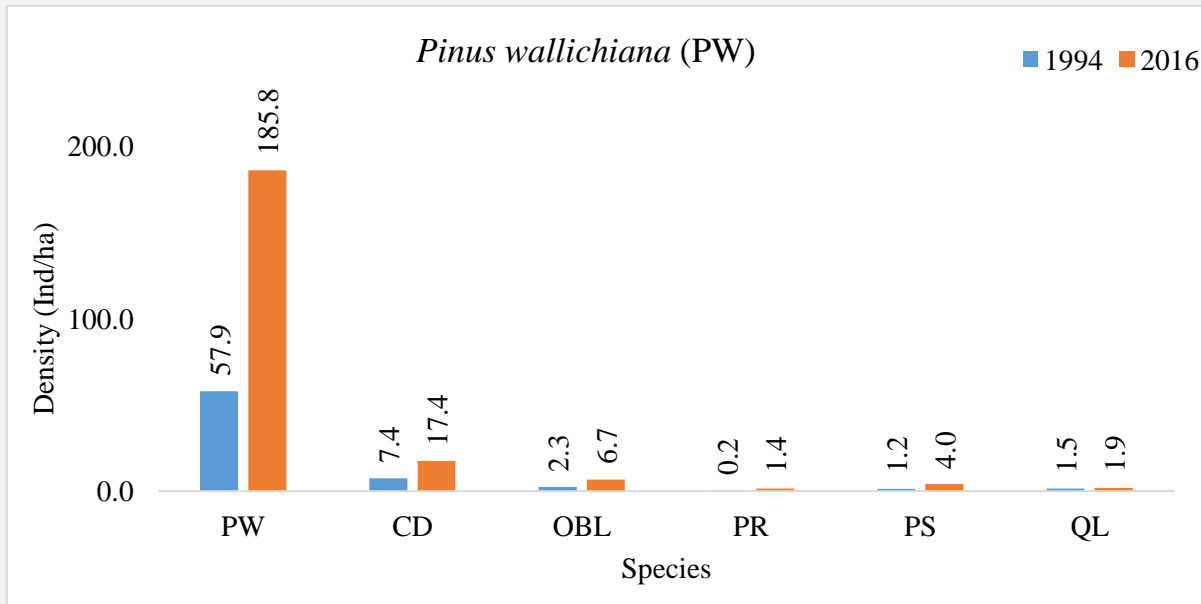


Figure 3. Density Variations in Species Composition in *Pinus wallichiana* community, Chamba Forest Division, 1994-2016

Abbreviations: PW=*Pinus wallichiana*, CD=*Cedrus deodara*; OBL= Other Broad-leaved; PR=*Pinus roxburghii*; PS=*Picea smithiana*, QL=*Quercus leucotrichophora*

3. *Cedrus deodara* tree community:

The deodar tree community comprises 11 forests/compartments covering an area of 450.5 ha spread over three forest ranges (Masrund, Lower Chamba and Upper Chamba). In *Cedrus deodara* tree community, the density decreased from 224.2 Ind/ha in year 1994 to 198.1 Ind/ha in year 2016.

The density of *Abies pindrow*, *Pinus roxburghii*, *Pinus wallichiana* *Picea smithiana*, *Quercus semecarpifolia* showed increase in tree density whether Other Broad leaved and *Quercus leucotrichophora* showed slight decrease in tree density in comparison to year 1994 to 2016 as shown in Figure 4.

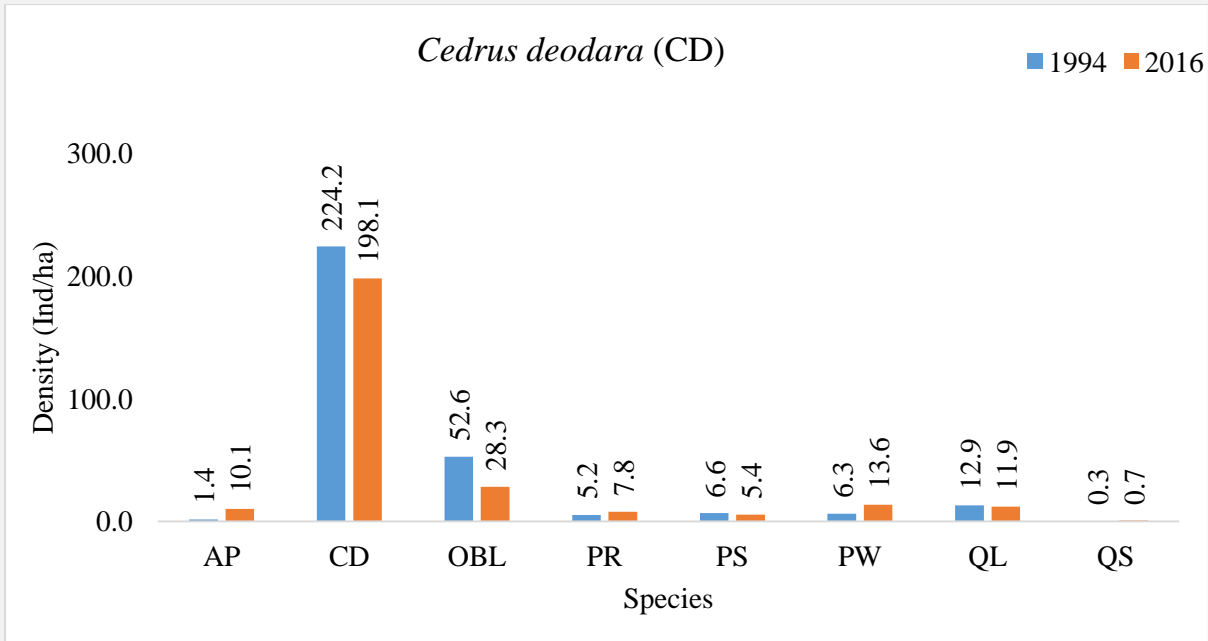


Figure 4. Density Variations in Species Composition in *Cedrus deodara* community, Chamba Forest Division, 1994-2016

Abbreviations: AP= *Abies pindrow*; CD=*Cedrus deodara*; OBL= **Other Broad-leaved**; PR=*Pinus roxburghii*; PS=*Picea smithiana*; PW=*Pinus wallichiana*; QL=*Quercus leucotrichophora*; QS=*Quercus semecarpifolia*

4. *Picea smithiana* tree community:

The data collected from 5 forest compartments covering total area of 401.19 ha which falls in Lower Chamba and Upper Chamba of Chamba Forest Division. This tree community comprises six species viz., *Abies pindrow*, *Cedrus deodara*, Other Broad-leaved, *Picea smithiana*, *Pinus wallichiana*, *Quercus leucotrichophora* including the dominant species. The density of *Picea smithiana* showed increased density from 144.2 to 178 Ind/ha with a light increase in *Cedrus deodara* and other broad leaved as shown in figure 5. The density of other species like *Pinus wallichiana* and *Quercus leucotrichophora* decreased however, *Abies pindrow*, *Cedrus deodara* and other broad leaved were increased.

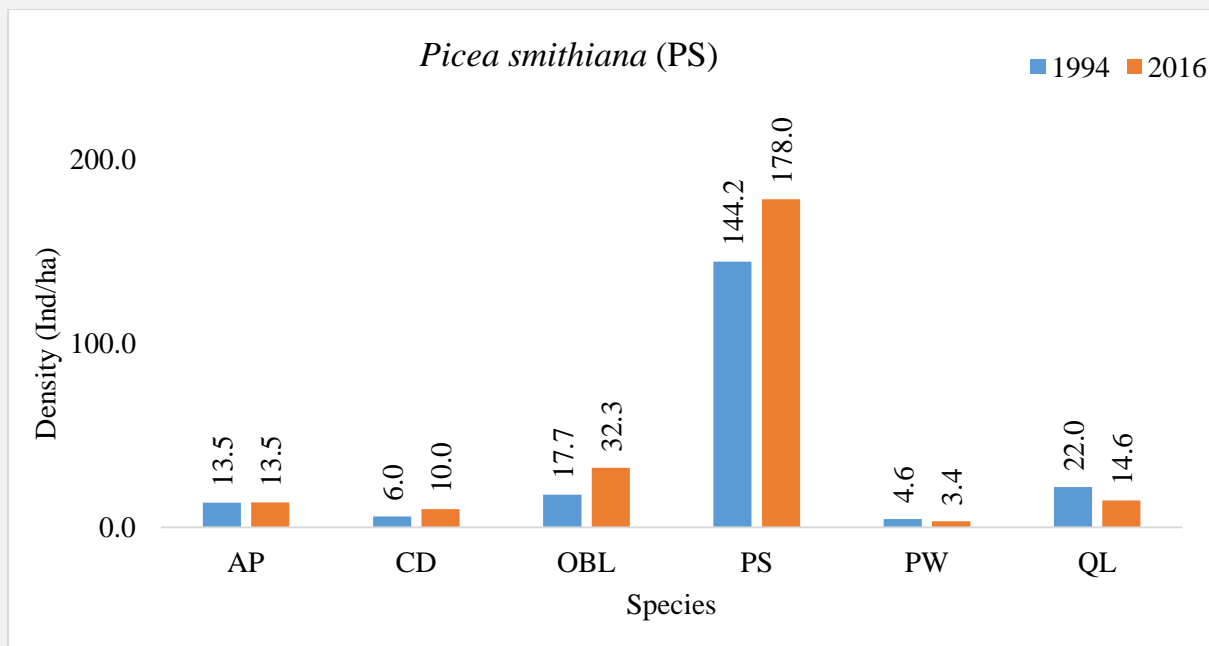


Figure 5. Density Variations in Species Composition in *Picea smithiana* community, Chamba Forest Division, 1994-2016

Abbreviations: AP=*Abies pindrow*; CD=*Cedrus deodara*; OBL= **Other Broad-leaved**; PS=*Picea smithiana*; PW=*Pinus wallichiana*; QL=*Quercus leucotrichophora*

5. *Quercus leucotrichophora* tree community:

The data collected from 5 forest compartments covering total area of 295.82 ha which falls in three ranges *i.e.*, Masrund, Lower Chamba and Upper Chamba of Chamba Forest Division. The density of *Quercus leucotrichophora* is decreased from 89.9 Ind/ha to 81.7 Ind/ha in year 1994-2016 respectively.

The density of Other Broad Leaved increased from 31.5 Ind/ha to 41.8 Ind/ha and *Cedrus deodara* showed slight increase in the tree density whether *Picea smithiana* showed minor decrease in the year 1994-2016 as shown in Figure 5.

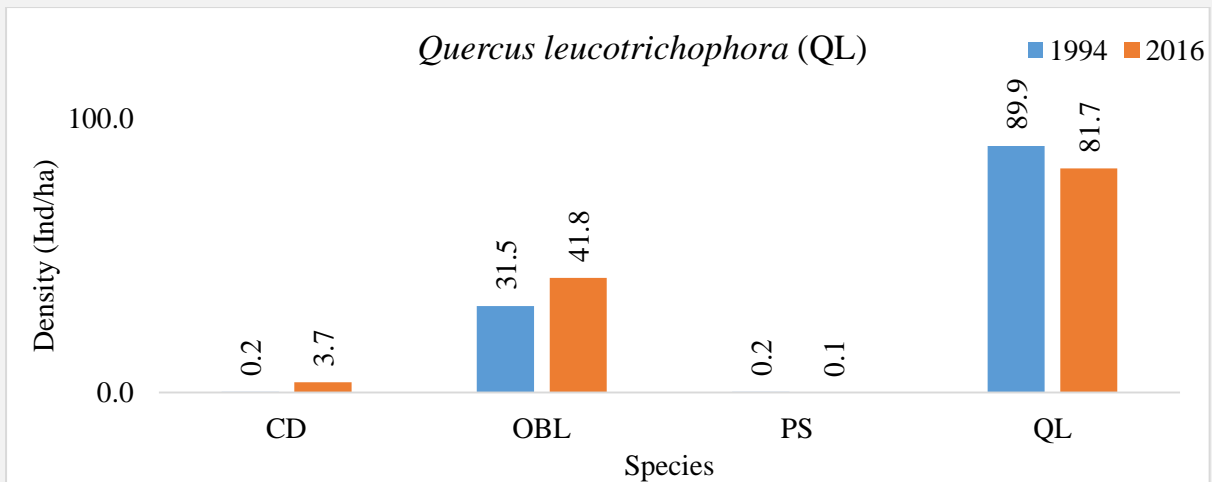


Figure 6. Density Variations in Species Composition in *Quercus leucotrichophora* community, Chamba Forest Division, 1994-2016

Abbreviations: CD=*Cedrus deodara*; OBL= Other Broad-leaved; PS=*Picea smithiana*; QL=*Quercus leucotrichophora*

6. *Quercus semecarpifolia* tree community:

There were only two comparable forest compartments of Upper Chamba forest range which have an area of 112.51 Ind/ha. The density of this species is decreased from 85.7 Ind/ha to 62.4 Ind/ha (for year 1994 to 2016 respectively). However, two other comparable species i.e. Other Broad Leaved and *Picea smithiana* showed decreased density from 10.5 to 0.4 Ind/ha and 1.3 to 0.1 Ind/ha respectively (See Figure 7).

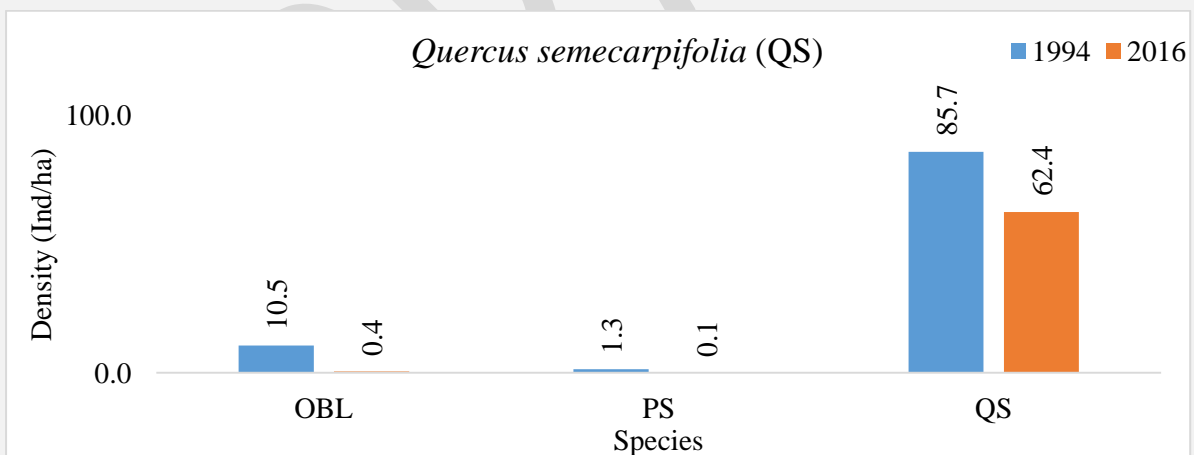


Figure 7. Density Variations in Species Composition in *Quercus semecarpifolia* community, Chamba Forest Division, 1994-2016

Abbreviations: OBL= Other Broad-leaved; PS=*Picea smithiana*; QL=*Quercus semecarpifolia*

7. Other Broad leaved mixed tree community:

The Other Broad Leaved category of tree species is a large group of species covering all broad leaved tree species viz. Shisham, *Albizia*, *Grewia*, Toon, *Carpinus*, Ash, Maple, Chirindi, Walnut, Piak, *Pistacia*. *Pistacia*, Kainth and *Aesculus indica*. This group fall in 13 forest compartments of Tikkari and Upper Chamba ranges of Chamba Forest Division covering an area of 840.77 Ind/ha. The density of Other Broad Leaved was greatly increased from 78.2 to 115.8 Ind/ha from year 1994 to 2016. However, the other species of this categories viz. *Abies pindrow*, *Cedrus deodara*, *Picea smithiana*, *Pinus wallichiana*, *Quercus floribunda*, *Quercus leucotrichophora* and *Quercus semecarpifolia* showed slight changes in the density as shown in Figure 8.

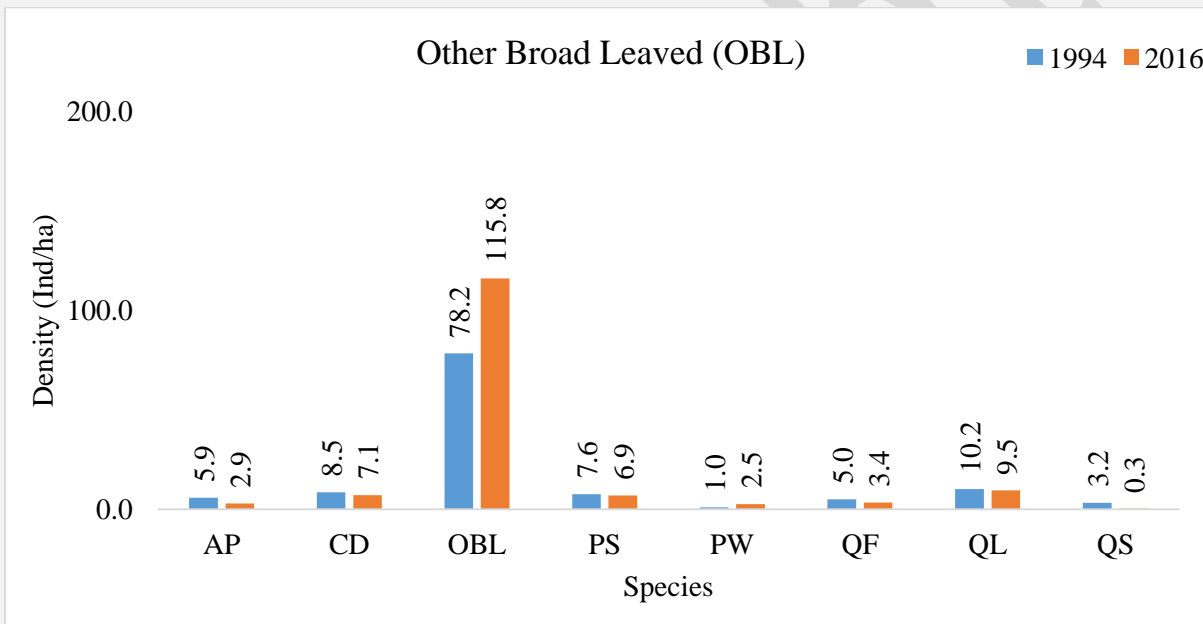


Figure 8. Density Variations in Species Composition in Other Broad Leaved community, Chamba Forest Division, 1994-2016

Abbreviations: AP=*Abies pindrow*; CD=*Cedrus deodara*; OBL= Other Broad-leaved; PS=*Picea smithiana* PW=*Pinus wallichiana*, QF= *Quercus floribunda*; QL=*Quercus leucotrichophora*; QS=*Quercus semecarpifolia*

8. *Cedrus deodara-Quercus leucotrichophora* mixed tree community:

The data was collected from three forest compartments of Masrund, Lower Chamba and Upper Chamba forests ranges with an area of 185.35ha. There are two major species in three forest compartments i.e. *Cedrus deodara* and *Quercus leucotrichophora*, both the

tree species of this mixed community showed increased density from 38.9 Ind/ha to 45.3 Ind/ha and 54.4 Ind/ha to 63.1 Ind/ha respectively. Other species viz., Other Broad Leaved, *Pinus roxburghii*, *Picea smithiana* and *Pinus wallichiana* in this tree community also showed increased density as shown in Figure 9. In aggregate all species showed increased density by comparing year 1994 to year 2016.

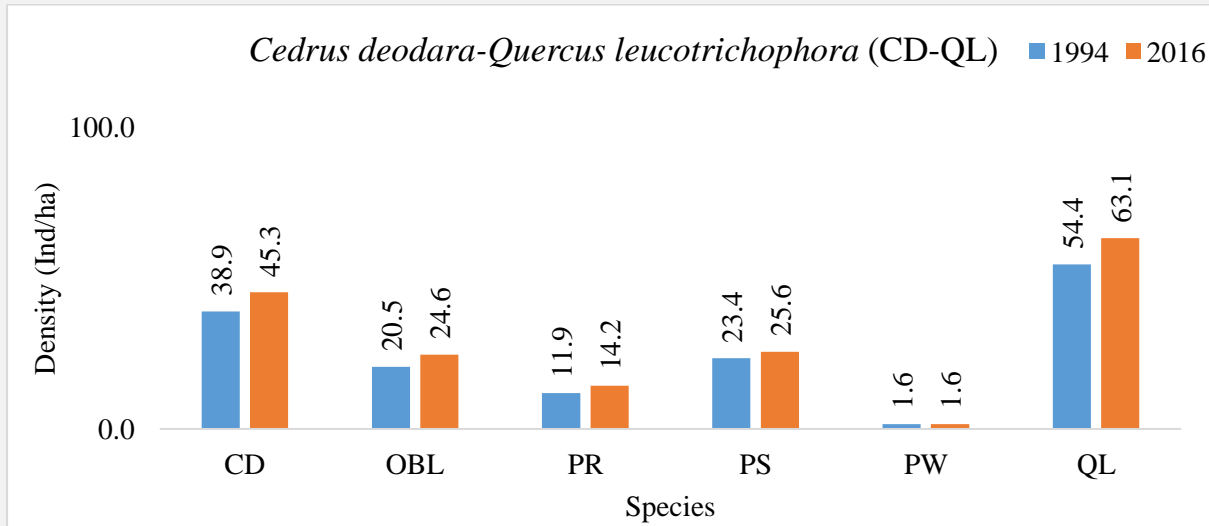


Figure 9. Density Variations in Species Composition in *Cedrus deodara-Quercus leucotrichophora* community, Chamba Forest Division, 1994-2016

Abbreviations: CD=*Cedrus deodara*; OBL= Other Broad-leaved; PR=*Pinus roxburghii*; PS=*Picea smithiana*, PW=*Pinus wallichiana*, QL=*Quercus leucotrichophora*

9. *Pinus roxburghii-Quercus leucotrichophora* mixed tree community:

There was only forest compartment of Masrund forest range which shows this type of combination with an area of 30.35 ha. *Pinus roxburghii* showed great decrease in the density from 243.4 Ind/ha to 140.4 Ind/ha while the other representative species i.e. *Quercus leucotrichophora* significantly increased from 28.6 Ind/ha to 137.1 Ind/ha for year 1994 to 2016 respectively. The Other Broad Leaved also increased from 19.1 to 59 Ind/ha shown in Figure 10.

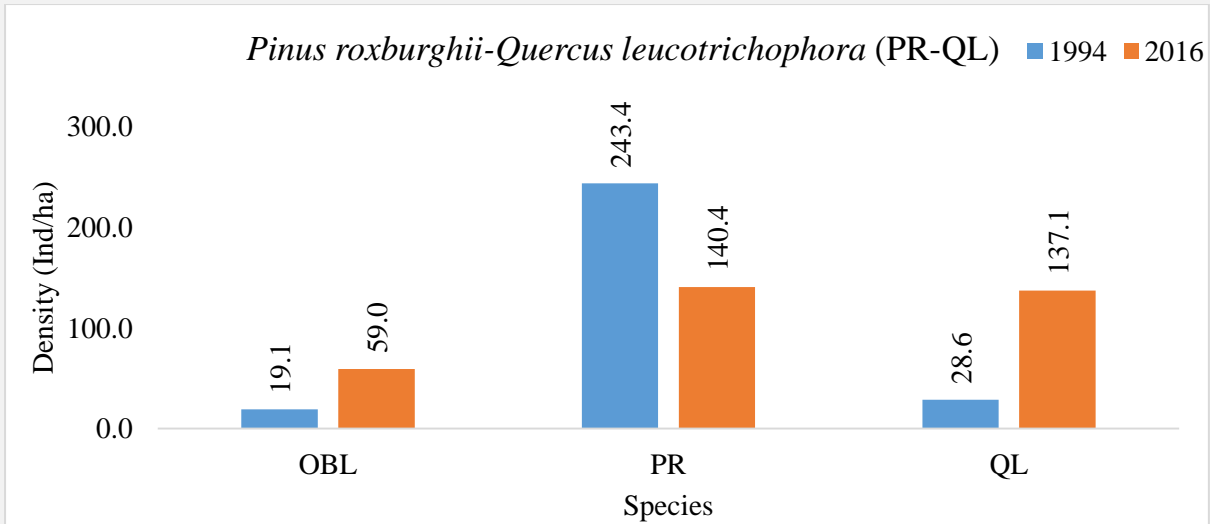


Figure 10. Density Variations in Species Composition in *Pinus roxburghii-Quercus leucotrichophora* community, Chamba Forest Division, 1994-2016

Abbreviations: OBL= **Other Broad-leaved**; PR=*Pinus roxburghii*; QL=*Quercus leucotrichophora*

10. *Abies pindrow-Quercus floribunda* mixed tree community:

This tree community comprise one forest compartment of Upper Chamba forest range with an area of 56.66 ha. The density of both representative species i.e. *Abies pindrow* and *Quercus floribunda* showed increased density from 185.1 Ind/ha to 202.5 Ind/ha and 79.3 Ind/ha to 89.7 Ind/ha respectively. *Cedrus deodara* and Other Broad Leaved of the tree community showed increased density (from 3.3 to 7.9 Ind/ha and 39 to 66.9 Ind/ha respectively) while the *Picea smithiana* decreased significantly from 126.7 to 79.6 Ind/ha from year 1994 to 2016 respectively (Figure 11).

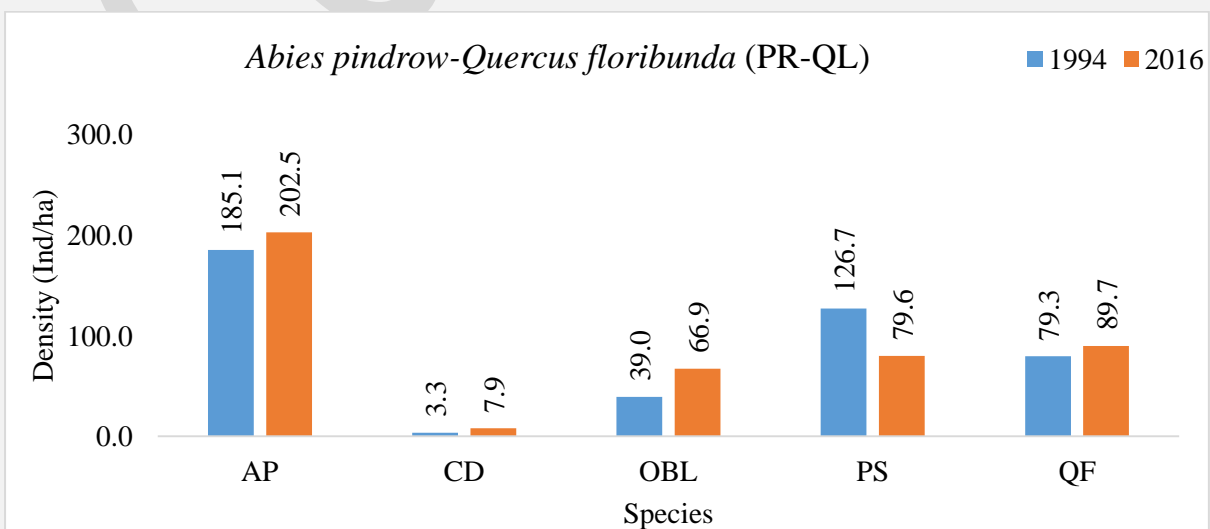


Figure 11. Density Variations in Species Composition in *Abies pindrow-Quercus floribunda* community, Chamba Forest Division, 1994-2016

Abbreviations: AP=*Abies pindrow*; CD=*Cedrus deodara*; OBL= Other Broad-leaved; PR=*Pinus roxburghii*; PS=*Picea smithiana*, PW=*Pinus wallichiana*, QL=*Quercus leucotrichophora*

11. *Quercus leucotrichophora*-Other Broad Leaved mixed tree community:

The mixed tree community have only compartment of Tikkari forest range having an area of 72.7 ha. Both the representative species of the tree community showed slight increase in the density as showed in Figure 12. All the species of the mixed tree community showed a very slight change in the density between two different years of enumerations (1994 to 2016). The other species are *Abies pindrow*, *Cedrus deodara*, *Picea smithiana*, *Pinus wallichiana* and *Quercus floribunda*.

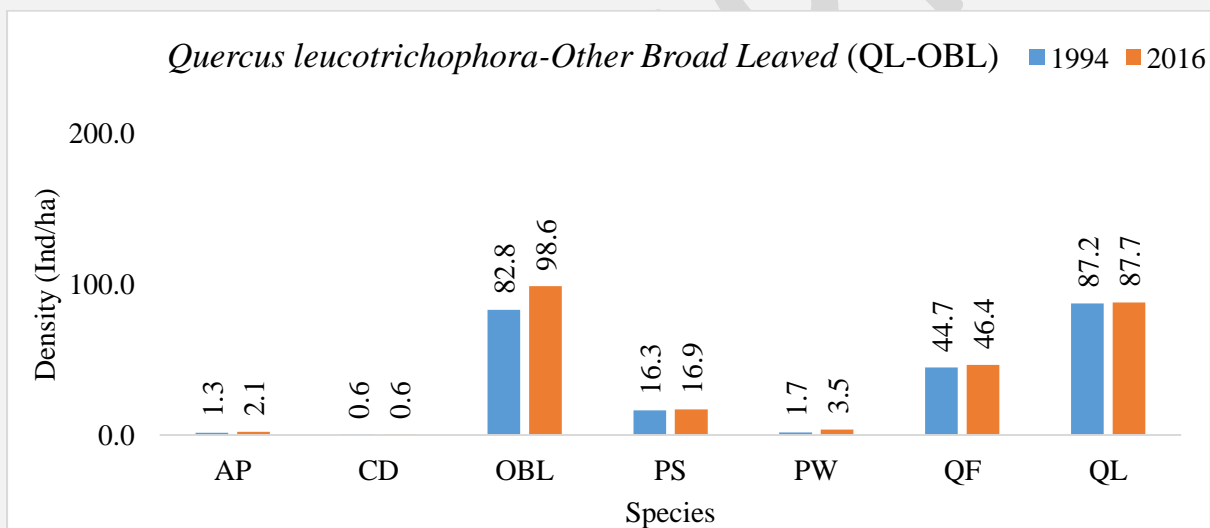


Figure 12. Density Variations in Species Composition in *Quercus leucotrichophora* – Other Broad Leaved community, Chamba Forest Division, 1994-2016

Abbreviations: AP=*Abies pindrow*; CD=*Cedrus deodara*; OBL= Other Broad-leaved; PS=*Picea smithiana*; PW=*Pinus wallichiana*, QF= *Quercus floribunda*; QL=*Quercus leucotrichophora*

12. *Pinus wallichiana*-Other Broad Leaved mixed tree community:

This community also have only one forest compartment of Tikkari forest range with an area of 26.71 ha which have four species namely *Cedrus deodara*, *Picea smithiana*, *Pinus*

wallichiana and Other Broad Leaved. All species of the forest compartment showed significant decrease in density from year 1994 to 2016 as shown in Figure 13.

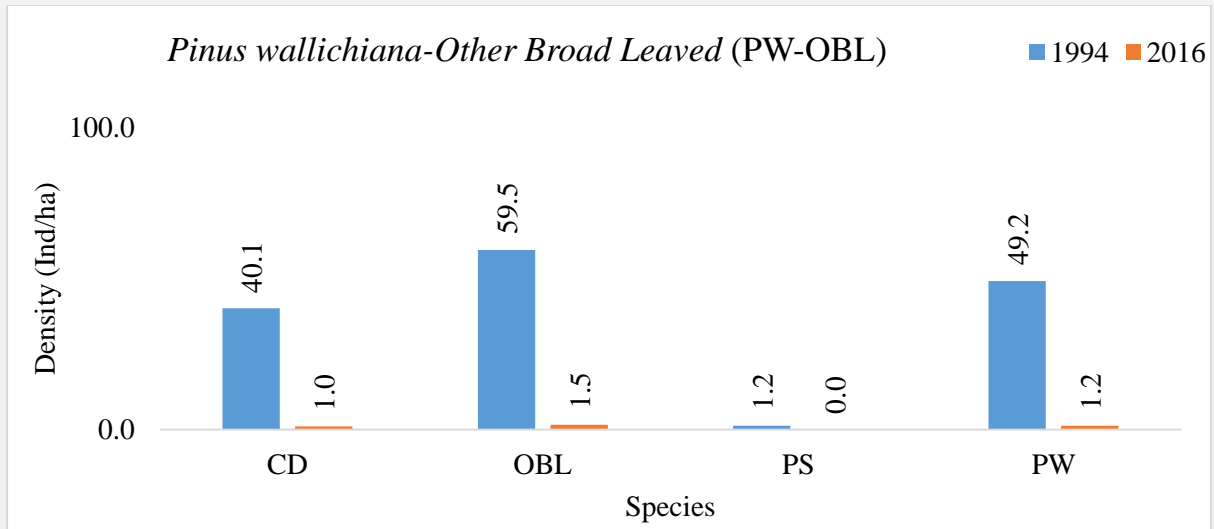


Figure 13. Density Variations in Species Composition in *Pinus wallichiana*-Other Broad Leaved community, Chamba Forest Division, 1994-2016

Abbreviations: CD=*Cedrus deodara*; OBL= Other Broad-leaved; PS=*Picea smithiana*; PW=*Pinus wallichiana*

13. *Abies pindrow*-Other Broad Leaved mixed tree community:

This is also a rare combination of *Abies pindrow*-Other Broad Leaved mixed tree community of Tikkari forest range with two forest compartment having an area of 321.81 Ind/ha. Both the representative species are in good number, *Abies pindrow* slightly increased from 113.2 to 122.5 Ind/ha but the density of Other Broad Leaved decreased from 134.3 Ind/ha to 126.4 Ind/ha from year 1994 to 2016 respectively. The density of *Cedrus deodara* was decreased from 14.6 Ind/ha to 8.6 Ind/ha but *Picea smithiana* and *Pinus wallichiana* was increased from 26.2 Ind/ha and 0 to 1.3 Ind/ha respectively but *Quercus semecarpifolia* remain unchanged as shown in Figure 14.

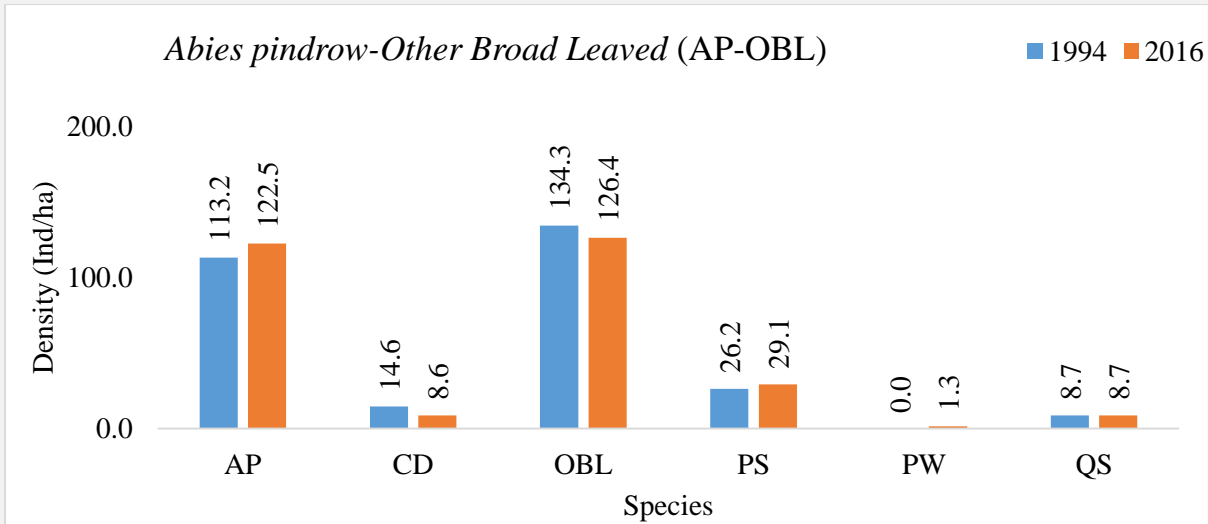


Figure 14. Density Variations in Species Composition in *Abies pindrow*-Other Broad Leaved community, Chamba Forest Division, 1994-2016

Abbreviations: AP=*Abies pindrow*; CD=*Cedrus deodara*; OBL= Other Broad-leaved; PS=*Picea smithiana*; PW=*Pinus wallichiana*, QL=*Quercus leucotrichophora*

14. *Cedrus deodara*-*Picea smithiana* mixed tree community:

The data collected from one forest compartment of Upper Chamba forest range having an area of 38.04 ha. Both the representative species viz. *Cedrus deodara* and *Picea smithiana* showed visible increase in density from 28.2 Ind/ha to 130.2 Ind/ha and 8.0 Ind/ha to 136.1 Ind/ha respectively. While the others comparable species of this mixed community showed a slight variations in density as shown in Figure 15.

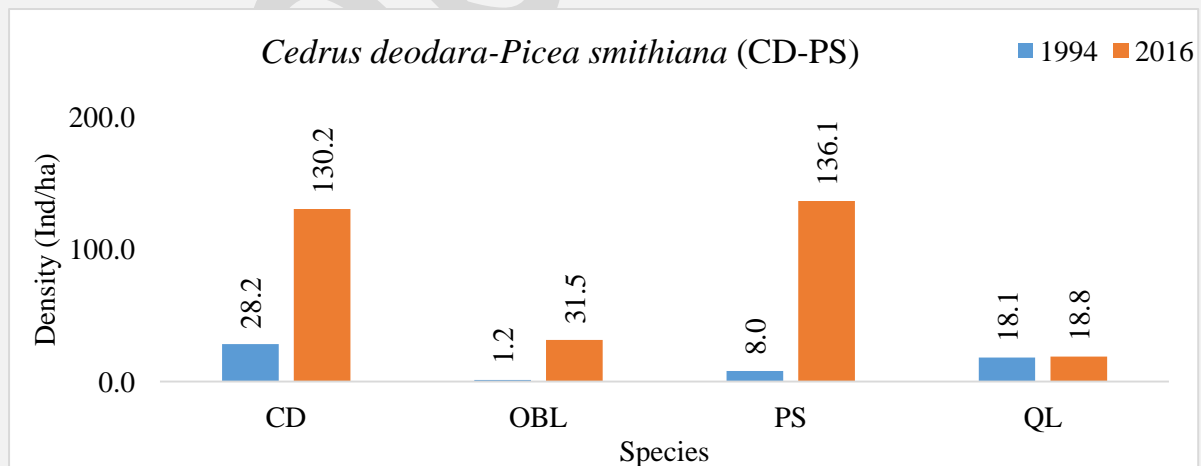


Figure 15. Density Variations in Species Composition in *Cedrus deodara*-*Picea smithiana* community, Chamba Forest Division, 1994-2016

Abbreviations: CD=*Cedrus deodara*; OBL= Other Broad-leaved; PS=*Picea smithiana*; QL=*Quercus leucotrichophora*

15. *Picea smithiana*-Other Broad Leaved mixed tree community:

The data collected from two forest compartments of Masrund and Tikkari forest range (139.12 ha) of Chamba Forest Division showed decreased density for *Picea smithiana* (138.9 Ind/ha to 110 Ind/ha) but increased for Other Broad Leaved (93.6 Ind/ha to 125.8 Ind/ha) for year 1994 to 2016 respectively. *Cedrus deodara* is decreased from 90.4 Ind/ha to 32.3 Ind/ha while the other species like *Abies pindrow*, *Pinus wallichiana*, *Quercus floribunda* and *Quercus leucotrichophora* were decreased from 4 Ind/ha to 4.9 Ind/ha, 5.6 Ind/ha to 7.7 Ind/ha, 16 Ind/ha to 16.7 Ind/ha and 9.3 Ind/ha to 15.6 Ind/ha respectively as shown in Figure 16.

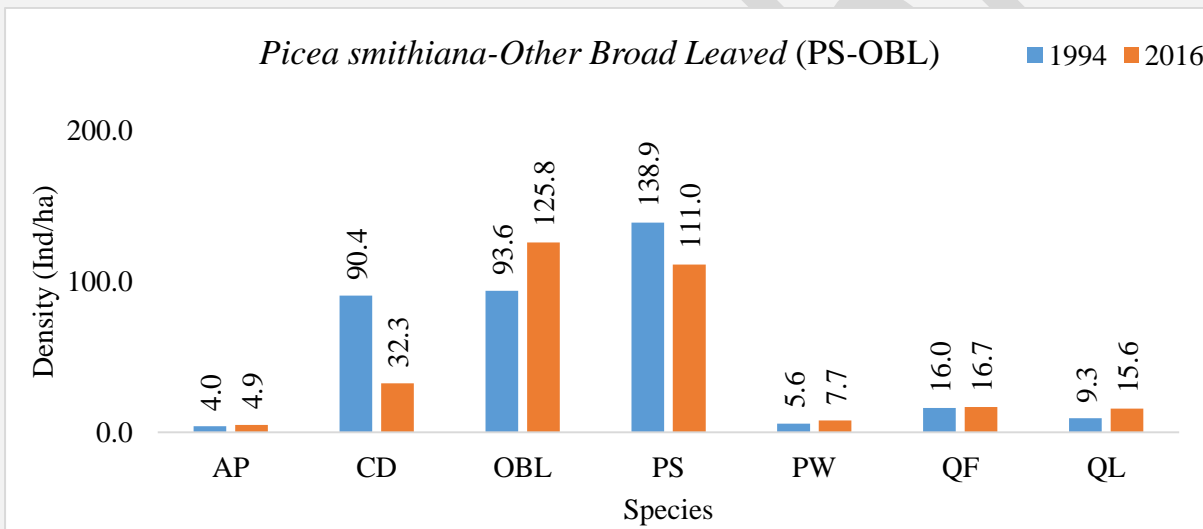


Figure 16. Density Variations in Species Composition in *Picea smithiana*-Other Broad Leaved community, Chamba Forest Division, 1994-2016

Abbreviations: AP=*Abies pindrow*; CD=*Cedrus deodara*; OBL= Other Broad-leaved; PS=*Picea smithiana*; PW=*Pinus wallichiana*, QF= *Quercus floribunda*; QL=*Quercus leucotrichophora*

Conclusion

The temporal study was commission with a view to get a preliminary insight in to the current status of vegetation viz., species composition in the Chamba Forest Division under the Chamba Forest Circle. To ascertain the temporal changes in different tree species composition, tree community based variation has been took place.

There were fifteen tree communities assessed at Chamba forest division which have comparable species composition out of which six were pure communities

(having one dominant species) and eight were mixed communities with one separate category of Broad leaved (covering all broad leaved species except oak which is already covered in pure community) were observed.

***Pinus roxburghii* (Chir Pine):**

Density of *Pinus roxburghii* is decreased from 712 Ind/ha to 200.4 Ind/ha in nine forest compartments having forest ranges viz., Masrund, Lower Chamba and Upper Chamba.

***Pinus wallichiana* (Blue Pine):**

For this species, only three forest compartments have been taken under study with forest area of 154.89 ha. These forest compartments falls only in two forest ranges of Chamba Forest Division i.e. Masrund and Upper Chamba forest range. The findings revealed that *Pinus wallichiana* is increased from 57.9 Ind/ha to 185.8 Ind/ha from year 1994-2016 respectively

***Cedrus deodara* (Devdar):**

The sample study there are eleven forest compartments which were under study showed decreased density of *Cedrus deodara* from 224.2 Ind/ha in year 1994 to 198.1 Ind/ha in year 2016 (in forest ranges i.e. Masrund, Lower Chamba and Upper Chamba).

***Picea smithiana* (Rai):**

There are only 5 forest compartments of *Picea smithiana* covering total area of 401.19 ha which falls in Lower Chamba and Upper Chamba of Chamba Forest Division. The density of *Picea smithiana* for the sample forests showed increased density from 144.2 to 178 Ind/ha.

***Quercus leucotrichophora* (Ban):**

The data collected from 5 comparable forest compartments of three ranges i.e., Masrund, Lower Chamba and Upper Chamba of Chamba Forest Division. Results revealed that the density of *Quercus leucotrichophora* is decreased from 89.9 Ind/ha to 81.7 Ind/ha in year 1994-2016 respectively.

***Quercus semecarpifolia* (Kharshu):**

There were only two comparable forest compartments of Upper Chamba forest range which have an area of 112.51 Ind/ha. The density of *Quercus semecarpifolia* is decreased from 85.7 Ind/ha to 62.4 Ind/ha (for year 1994 to 2016 respectively).

Other Broad leaved mixed tree community:

The Other Broad Leaved category of tree species is a large group of species covering all broad leaved tree species viz. Shisham, *Albizia*, *Grewia*, Toon, *Carpinus*, Ash, Maple, Chirindi, Walnut, Piak, *Pistacia*, *Pistacia*, Kainth and *Aesculus indica*. The data collected from 13 forest compartments of Tikkari and Upper Chamba ranges of Chamba Forest Division covering an area of 840.77 Ind/ha. The density of Other Broad Leaved was greatly increased from 78.2 to 115.8 Ind/ha from year 1994 to 2016.

The forest compartments for sample study or to know the status of forests and the temporal change in tree species composition at Chamba Forest Division showed that four important tree species (*Pinus roxburghii*, *Cedrus deodara*, *Quercus leucotrichophora* and *Q. semicarpifolia*) decreased. The general reason behind this change is that these species are most important species in consumption point of view therefore, the people, stakeholder and people community directly depend on that for timber wood, fuel wood, fodder and other forest products etc. However this decreased is observed in only those forest compartments which are taken under study.

Only two species i.e. *Pinus wallichiana* and *Picea smithiana* showed increasing trends for density, as people also depends on these species but not as the species mentioned above. Forest compartments under these species have good number of trees in the forests. Other reason behind its increase is that the selected compartments are less influenced by human activity/anthropogenic pressure.

The H.P. Forest Department has done various measures for maintaining the number of important tree species in Chamba forest division. As the fact that tree take long time to grow but the people demands are more as tree growth. However, the decrease rate is slow but there is great need to conserve these all species in the forests so that we can ensure its availability in the present and

future generation. This report tell us the overall status of the Chamba forest division which after discussion invites the policyholder to draw suitable action in favour of people and natural wealth.

Copyright