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Original Research Article

Examining the gymnosperms of district Bilaspur of Himachal Pradesh, India

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ABSTRACT
Gymnosperms and angiosperms are two categories of spermatophytes, which are plants that produce seeds. There are 1079 species and 83 genera in the group of naked seed-bearing plants known as gymnosperms. As far as I'm aware, this is the first quantitative analysis of the district's gymnosperm variety. *Araucaria columnaris, Cedrus deodara, Cupressus sempervirens, Cycas revoluta, Pinus patula, Pinus roxburghii, Pinus wallichiana,* and *Platycladus orientalis* are the eight distinct gymnosperm species that were gathered and identified from the District Bilaspur in Himachal Pradesh during the field survey. These gymnosperm species are recognized for their ecological, ethnobotanical, and economic significance. Given the variety of gymnosperms and their applications, the current study and survey are significant. The local population may become more aware of the value of plants and their sustainable use as a result of this endeavor.

1. Introduction

Plants having bare ovules are known as gymnosperms. This paper's primary goal is to identify the gymnosperms found in Himachal Pradesh's District Bilaspur. This article discusses their systematics, common names, colloquial names, citations, morphological traits, flowering (Cones/Strobili) and seed seasons, collection locations, habitat, distribution around the world, India, and Himachal Pradesh, as well as its economic significance. Of the twelve districts in Himachal Pradesh, Bilaspur is the second smallest (Figure 1). This is located in the Western Himalayan Shivalik Hills. About 90 kilometers of the Satluj River pass through the Bilaspur district. This river leaves the district of Bilaspur in the hamlet of Neila, next to the Bhakhra Dam, after entering at Karahi Ka Gharat, close to the village of Kasol, which is now well-known for the Kol Dam. Its elevation ranges from 290 to 1980 meters above mean sea level, and its area is 1167 square kilometers. It is renowned for the variety of its climate, geography, and flowers.

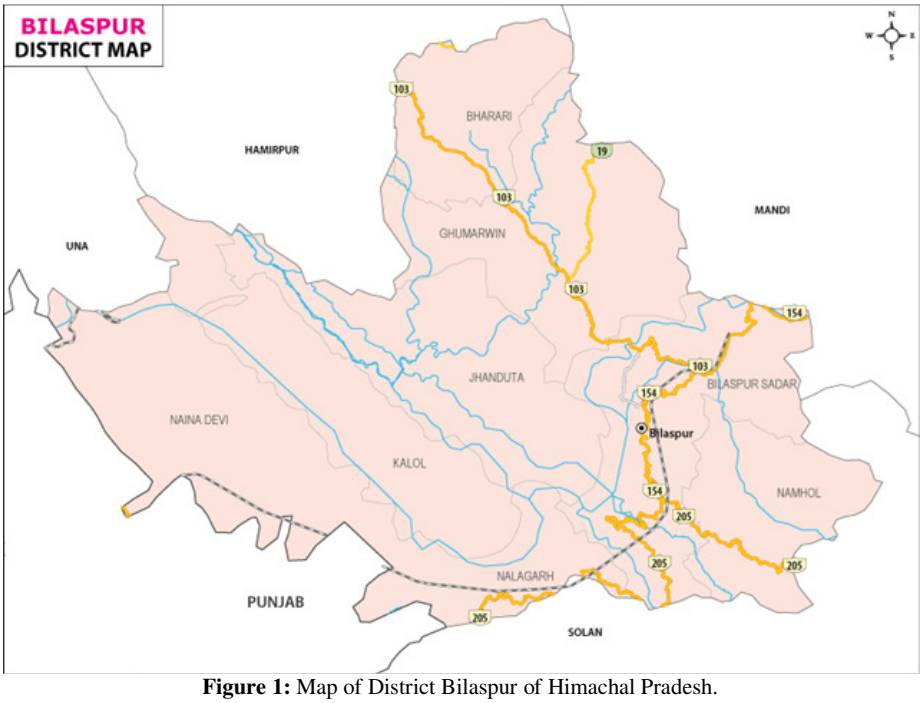

Figure 1: Map of District Bilaspur of Himachal Pradesh.

2. Materials and methods

In order to investigate the diverse gymnosperm species, a thorough field survey of the District of Bilaspur was conducted during various seasons. Gymnosperms were collected, preserved, and identified according to standard protocols. In the field, key characteristics of gymnospermic plants were noted and colored photos were taken. Mounts from the herbaria were produced for documentation and identification. To describe and identify the plants, we have utilized the terms that have been used by a number of research organizations [1–4]. The International Plant Names Index (IPNI), The Plant List, and the International Code of Nomenclature (ICN) are all followed in their nomenclature [5]. This work has adhered to the Natural System of Classification of Spermatophytes, as proposed by Bentham and Hooker [6] and updated by recent changes [7]. An alphabetical description of the identified gymnospermic plants has been provided.

3. Observations

From 2021 to 2024, a thorough survey of the district of Bilaspur was conducted at various times of the year. In all, eight species from six genera and four families have been identified within this district's boundaries. It has been stated that seven gymnosperm species produce timber, four are ornamental, and one species (Cycas) is the source of sago. With four genera, the Pinaceae is the most dominant family. The Cupressaceae has two genera, while the Araucariaceae and Cycadaceae have one each. For the first time, Pinus patula has been documented from this area. At a height of 375 meters, two *Cedrus deodara* plants are flourishing in the ACC Ltd. Barmana nursery yard. There is evidence of a dense *Pinus wallichiana* and *Cedrus deodara* forest in Bahadurpur (1980 meters). The most common gymnosperm in this region is *Pinus roxburghii*. The Swarghat, Ghumarwin, Bharari, Jhandutta, and Kalol Forest Ranges are home to large populations of this species. But in the Sadar Forest Range, it is less prevalent. The area's attractive gymnosperms include *Platycladus*, *Cupressus*, *Cycas*, and *Araucaria*.

4. Results and discussion

In the Himachal Pradesh district of Bilaspur, eight distinct gymnosperm species—*Araucaria columnaris*, *Cedrus deodara*, *Cupressus sempervirens*, *Cycas revoluta, Pinus patula, Pinus roxburghii, Pinus wallichiana*, and *Platycladus oriental*—were gathered and identified. Below is a description of these:

1. Araucaria columnaris

A tree that is between 30 and 61 meters tall and has the odd tendency of losing its lower branches and growing new ones from adventitious buds. This creates the appearance of a dense green column that spreads out quickly from the top. Horizontal branches with long, slender, whip-like lateral branchlets. The leaves on juvenile shoots are triangular or lance shaped, up to 0.5-0.7 cm long, and pointy. The leaves on older stems are broadly ovate, 0.2–0.4 × 0.12 cm, rigid, tightly overlapping, and curving inward. Male Strobili (Catkins) are arranged in a cup-like pattern of leaves and measure 2.5–7 cm in length and 0.5–0.1 cm in width. Female cones are ellipsoid, 12–15 cm long, 9–11 cm wide, and, when partially developed, teasel-like due to the scale appendages. The scales are about 3.3 cm across, with well-developed wings surrounding the central seed. Each scale is about 1.5 cm wide, and the terminal spines are about 1.8–2 cm long.

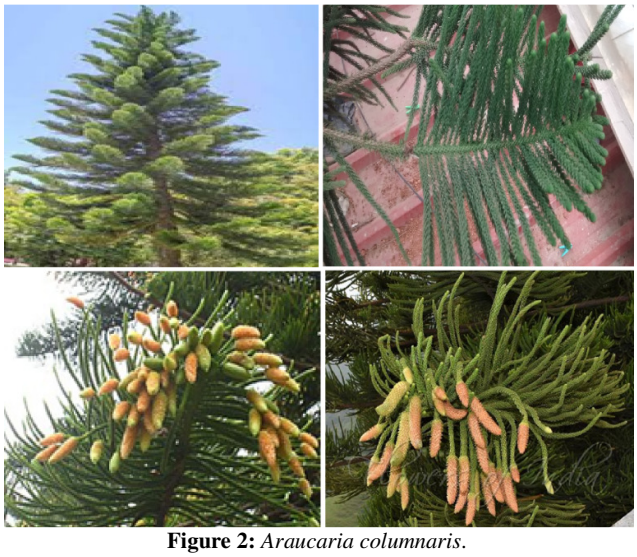

Figure 2: *Araucaria columnaris*.

Flowering and Fruiting: February-May.

Specimens Examined: Bilaspur, 26 July, 2021.

Habitat: A fast-growing, low-lying tree thrives in arid, exposed slopes and plains. In home gardens and lawns, it is also grown for aesthetic reasons.

Distribution: indigenous to Polynesia and New Caledonia. During his Pacific voyage, Captain Cooke made the discovery. It is widely introduced in the sub-continent. India: Grown for decorative reasons all over India.

Altitude: 400-1500 m.

Economic and Ethnobotanical Uses: A common landscape tree, it is grown as an ornamental plant in homes, gardens, and a variety of public and private establishments [8, 9]. For carpentry work, wood is utilized [10].

2. *Cedrus deodara*

Large, long-lived, evergreen trees that can reach heights of 80–90 m and girths of 12–15 m. Young trees have a cone-like look, while older trees typically have flattened, rounded tops. Young trees have green or gray bark that is thin and smooth, but older trees have rough, deeply furrowed bark that is 0.5–3 cm thick, dark brown, often reddish or black, and divided into irregular oblong scales or plates with both vertical and diagonal fissures. Blaze is pinkish brown and measures 3.8–5 cm. Branch tips and leading shoots typically droop, and branches are uneven, horizontal, and slightly ascending, falling, or spreading. They are never in whorls. In March or early April, young or new branches with grayish down and pale green leaves emerge. Branchelets (shoots) are dimorphic. lengthy shoots or shoots with infinite growth are thin, lengthy, and bear foliar leaves that are spirally organized, scaly, and dwarf. The short, thick tufts of leaves (15–20) in pseudo whorls are characteristic of dwarf or limited-growth shoots. It grows a little longer each year and adds a new whorl of leaves; a ring of recurved bud scales marks each new growth year. It occasionally produces flowers or grows into long branches. Even after the emergence of young leaves, the little, ovoid, brown-scaled winter buds remain on the shoots. With two rows of peripheral resin canals on the inner surface, the dark green, 2.5–5 cm long, acicular, stiff or inflexible, sharply pointed, triquetrous (3-sided), glaucous or silvery leaves are

amphistomatic and durable, lasting one to six years. When the cones ripen in May, or occasionally in October or November, leaves begin to shed. Cones or flowers, or strobili, are terminal, erect, solitary, and borne on short stems. They develop in July and August and mature in late September. They are unisexual, dioecious, and occasionally monoecious; in the latter case, they are borne on distinct branches. Male cones are terminal on dwarf shoots, oblong, ovoid, or cylindrical, 2.5–4.5 cm long and 1–1.5 cm in diameter. They are pale green when young, turning yellowish-green with a purplish tint when mature. Each stamen is made up of many microsporophylls, or stamens, arranged in a spiral pattern on a broad central axis. Each stamen has two oblong microsporangia, or pollen sacs, positioned abaxially, and its connective tissue develops into a flattened ovate, obtuse, upturned, beak-like appendage with an irregularly crenulate margin. Male cones appear from March to June and release their pollen from September to October, depending on the season, location, and altitude. They quickly grow to 5–7.5 cm in length and turn yellow prior to shedding. The pollen grains are yellow and have wings. In October, pollination takes place. In August, young female strobili or cones emerge. They are erect, solitary, terminal on dwarf shoots, and they grow progressively each year toward the terminal end on the upper side of horizontal branches. The young cones are surrounded by scaly leaves of varying sizes, each of which has a broad central axil on which spirally arranged bract scales are present, along with fan-shaped ovuliferous scales that have two inverted ovules on the adaxial surface. At the base and apex, a large number of ovuliferous scales are sterile. Due to their lack of prominence and partial concealment by leaf rosettes, the cones are challenging to locate during pollination. The bract scales, which are larger than the ovuliferous scales and frequently enlarge after flowering, are constricted to a claw-like process at the base. They are oblong or ovoid, 1.2–2 cm length, 0.6 cm in diameter, and pale glaucous green. However, because the ovules are visible and the scales are oriented perpendicular to the axis, they are in an open position to receive pollen grains. Following pollination, the cone compacts and eventually closes, and the sporophylls expand somewhat. Growth stops until March of the next year, which is the next spring. They take on a barrel shape by the beginning of May and grow to 8–12 cm in length and 5-8 cm in diameter. Their ovuliferous scales are fan-shaped and 3–3.5 cm wide. They reach maximum size and turn pale bluish green by the end of June or early July. They turn chocolate-brown in August, ripen from September to November, and then turn brown and woody. Therefore, it takes roughly 12 to 13 months from the female strobili's initial appearance to the cones ripening. Mature and ripe Large, 10–15 cm by 7.5–10 cm, erect, barrel-shaped, ovoid, ellipsoidal or cylindrical, brown, resinous, on short, sturdy stalks, with tiny or nonexistent bracts and woody, closely overlapping, fan-shaped ovuliferous scales with a claw resembling a basal stalk. The cone scales and winged seeds break off from the tree and fall off, with the central axis remaining on the tree for a long time. The seeds are triangular, pale brown, have two ovuliferous scales, and are winged. They are each 0.8–1.6 cm long (with wings 2.5–3.8 cm long), with a broad, membranous apical wing that is larger than the seeds (1.7–2.5 cm). Epigeous germination. In certain areas, seed shedding continues until December. When the tree sheds, the cone disintegrates, releasing scales and seeds to the ground and leaving a persistent woody axis on the branches for years.

Figure 3: *Cedrus deodara*.

Specimens Examined: Bahadurpur, 18 April, 2020.

Habitat: Usually gregarious, evergreen pyramidal trees are frequently found in pure stands on temperate slopes. They are also occasionally found with oaks, maples, cherries, chestnuts, and other broadleaved species, and they are frequently planted in hill stations across Europe, America, and other continents.

Distribution: Afghanistan, Asia Minor, Atlas mountains (Africa, Algeria), Cyprus, Mediterranean mountains, Nepal, Pakistan, Syrian mountains, W. Himalayas. India: Jammu & Kashmir, Uttarakhand, and Himachal Pradesh.

Altitude: 1200-3300 m.

Economic and Ethnobotanic Uses: Near temples, where they are revered and shielded from harm, you may typically find the largest deodars. There are not many trees in the world that are comparable to deodars as ornamental trees. According to Ayurveda, every part is bitter, hot, pungent, light oleagenous, and helpful for a variety of conditions, including belching, inflammations, hiccups, insomnia, fever, urine discharges, ozoena, bronchitis, itching, elephantiasis, tuberculous glands, leucoderma, ophthalmia, piles, mental disorders, and skin and blood diseases. When applied to tuberculous glands, the leaves reduce inflammation. Needles produce an essential oil and contain ascorbic acid [11–13]. Among coniferous woods, its timber is the best, strongest, and most valuable. Beams, floor boards, posts, cooperage, door and window frames, furniture, packing boxes, spars and shingles, and railway sleepers are just a few of the many uses for this crucial building material. Sleepers often live for 15 years. Along with many other uses, it is also utilized in the construction of wagons, carriages, brush backs, and bridges. It can be used for second-grade pencils, battery separators, poles for transporting high tension lines, and pattern manufacturing [14, 15]. Wood is used to treat rheumatism, piles, palsy, epilepsy, kidney and bladder stones, prolapsusracti, fever, flatulence, heart palpitations, paralysis, dropsy, and urinary disorders. It is also bitter, diuretic, diaphoretic, carminative, and expectorant [16]. Its infusion is used as a potent substitute for turmeric and guggulu (Commiphora mukul) in the treatment of rheumatism, gout, syphilis, and gonorrhea [17]. White ants and fungi rarely attack seasoned heartwood because of its oil content, which makes it resilient [18]. In Kangra, the

paste is administered to the temple to treat headaches after the wood is pounded with water on a stone [17]. An oleoresin and Himalayan Cedar wood oil, a golden yellow, reddish brown, or dark-colored essential oil with a distinctive balsamic scent, are produced by steam distillation of the wood [16]. It has been utilized for centuries in the Yunani and Ayurvedic medical systems to treat skin conditions, ulcers, and rheumatoid arthritis. It is also used to massage urticaria and lumbago. Although it is extremely costly, the oil is used in soap perfumery as a replacement for real cedar wood oil. It has anti-inflammatory properties as well. The oil has analgesic, diaphoretic, and alexipharmic properties and can be used to treat skin conditions, boils, TB glands, and bruises and joint injuries. The bark is used to treat dysentery and diarrhea. Bark aqueous preparation is applied externally to piles and used for digestive issues [12].

3. *Cupressus sempervirens*

It is a 20–30 m tall tree with a columnar crown and spreading habit similar to a cedar or erect branches almost parallel to the stem. A long-lived tree that grows very slowly; records place its age between 2000 and 3000 years. Its trunk is upright. The thin, smooth, greyish-brown, fibrous bark is longitudinally wrinkled and fissured. Branches are not whorled; they are climbing. The final division is 4-angled and deep green, with alternating, tripinnate, irregularly spreading branchlets. The leaves are blunt, arranged in four equal tiers, frequently have a longitudinal furrow on the back, and have tightly packed tips that prevent the branchlets from feeling rough to the touch. Male strobili are yellow, about 2.5 mm long, and have about 10 pairs of stamens. Female cones are solitary or clustered together, about 3–4 cm in diameter, sub-globose or ovoid on short, curving stalks, and shiny brown or greyish. They have 8–14 scales that rise to a point in the center or flatten with a thin ridge-like process. Each scale has 8–20 seeds that are about 0.42 cm long, winged, and devoid of resin tubercles. The maturation of the cones takes two years. It comes in two common varieties: the pyramidal or columnar form, var. sempervirens, and the spreading form, var. horizontalis.

Figure 4: *Cupressus sempervirens*.

Flowering: Male strobili ripen and shed in January and February after appearing in August and October.

Fruiting: In the second year, female cones ripen. August to December is when the cones open and shed.

Specimens Examined: Auhar, 8 May, 2023.

Habitat: In areas that border the eastern Mediterranean, it grows wild. It is commonly grown as a decorative plant in gardens throughout India.

Distribution: Asia Minor, Burma, Bulgaria, Cypress, France, Greece, Italy, N. Persia, Portugal, Russia, Sicily, Spain, Switzerland, Syria. India: Extensively cultivated in Agra, Dehradun, Delhi, Srinagar, Shimla.

Altitude: 924–2400 m.

Economic and Ethnobotanical Uses: As an ornamental tree, it is commonly planted [19]. The essential oil extracted from the leaves is used to treat whooping cough and in soap and perfumes [20]. Wood is utilized for construction, furniture, and boxes [10]. It has anthelmintic and astringent properties. Muscle aches can be massaged using seed oil. Cones are helpful in piles and have anthelmintic properties [20].

4. *Cycas revoluta*

The largest known trees, which are 8 meters tall, are found in Tokyo's Tyugeji Temple. Dioecious trees or shrubs range in height from 3 to 6 meters. The cylindrical trunk is covered in compacted woody petiole bases and has a crown of glossy, fern-like, rigid but beautifully revolute pinnate leaf margins. The leaves are pinnate, oval, laciniate, and nearly to the midrib with 12–20 linearly curved spinous segments or leaflets; the petiole is 0.3–0.5 m long, and the short distant spines are at right angles to the petiole or slightly deflexed near the base. Twelve to twenty pairs of leaflets, each 10 to 25 cm long and 5 to 9 mm wide, have flat or sharp borders. Microsporophylls are 2.5–4 cm long, 1–1.2 cm broad, ovate-deltoid, extended into an up-curved subulate spine, covered with a brown tomentum on the outside and glabrous on the inside. Male cones are 23 cm long, 4-6 cm in diameter, and mature to 30 cm in length in July. Megasporophylls are densely hairy, forming as a rosette-shaped apical crown with 4-6 ovules covered in thick brown hairs on a stalk longer than the blade.

Figure 5: *Cycas revoluta.*

Specimens Examined: Barmana, 5 April, 2018.

Habitat: It is a palm-like tree that grows slowly. The Indian subcontinent, which includes Sri Lanka, is where this cycad is most commonly grown in gardens.

Distribution: China, S. Japan, Taiwan. India: Commonly the female trees are found introduced in India. A few male trees are planted in the Botanical Garden of the Forest Research Institute Dehradun. Himachal Pradesh: Mostly cultivated as an ornamental plant in gardens.

Economic and Ethnobotanic Uses: The most common use for this cycad is as a decorative plant in gardens [10]. Sago is produced from the pith, and the protein-rich seeds are edible. After being silvered, the leaves are used to make funeral wreaths. Starch is found in root tubers [21].

5. *Pinus patula*

Large and evergreen, it can reach a height of 40 meters and a diameter of 1 meter below breast height. stem in closed canopy stands that often has a single, straight, thin trunk. Higher order branches are slender and drooping, while the final branches are pendent. First-order branches are long, slender, spreading, or slightly ascending. When the leaf fascicles have fallen, the foliage shoots are yellow or red-brown, with noticeable, decurrent pulvini, and they are rough and scaly. Cataphylls are dark, early deciduous, subulate, recurved at the apex, scarious, and have erose-cliate margins. The terminal bud is 15–20 mm long, the lateral buds are shorter, brown, and not resinous, and the vegetative buds are oblong-cylindrical. The subulate scales have ciliate borders and are spreading. In mature fascicles, the sheaths of the fascicles are originally 20–30 mm long with 6–8 imbricate, chartaceous, white-yellow or orange-brown scales. These sheaths eventually shorten to 12–15 mm and weather to a grey-brown color. Young trees have thin, scaly, reddish-brown bark; adult trees have thick, dark grey-brown, rough, scaly bark with huge, elongated plates and deep longitudinal cracks. Thin, lax, drooping-pendent, serrulate at the margins, acute, pale-dark green, triangular in outline, with stomata on both sides, the leaves are found in fascicles of three, occasionally four, five, or six, in drooping tufts, in two rows on either side of the upturned plant, and they last for two to three years. Men Cones that are ovoid-oblong to cylindrical, 15–20 × 5–6 mm, pink-yellow, and eventually yellow-brown, are clustered close to the proximal end of young shoots, spreading, and supported by spherical bracts. Female cones are sub-terminal or lateral, with peduncles up to 20 mm long, seldom solitary, permanent, or deciduous, and in whorls of two to numerous. Young cones are ovoid, grow in two seasons, and have persistent calaphylls on recurved peduncels. They are purple at first, then pale brown. Mature cones are 5–12 × 3–6 cm when open, narrowly oval when closed, and slightly bent at the base. The proximal megasporophylls are connate, purple-brown to dark brown, with adaxial light brown lines left by the seed wings. The megasporophylls are woody, oblong, usually curved while spreading, serotinous or separating sometime after mature, and tenacious or deciduous with the peduncle. Apophysis is rhomboid, flat to slightly elevated, transversely keeled, gibbous on proximal sporophylls, with an abaxial surface that is smooth or striate, lustrous or yellow-brown, and an acute or obtuse-rounded upper edge. Dorsal, flat or raised, umbo is recessed into the apophysis and measures 3–7 mm in width. The articulate seed wings are obliquely ovate-oblong, 12–18 × 5–8 mm, light brown with dark stripes, and are attached to the seed by two oblique claws.

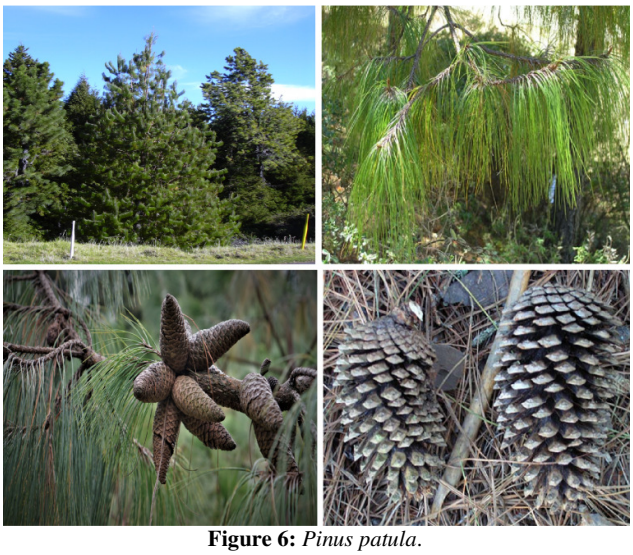

Figure 6: *Pinus patula*.

Specimens Examined: Barmana, 24 May, 2019.

Distribution: originated in Mexico. Ecuador, Bolivia, Colombia, Kenya, Tanzania, Angola, Zimbabwe, Papua New Guinea, and Hawaii are among the countries that plant it at high elevations. It is grown at lower elevations in Argentina, India, South Africa, and Brazil. Australia's New South Wales and New Zealand have both adopted it. In the United Kingdom, it is grown as a decorative tree. Himachal Pradesh, India.

Economic and Ethnobotanic Uses: Wood is used as timber. Green dye is derived from needles. In addition to rheumatic diseases, turmeric oil is utilized to treat bladder and renal issues. It is also helpful for TB, influenza, colds, and coughs.

6. *Pinus roxburghii Sarg*

It is a huge tree that may grow up to 55 meters tall and 4 meters in diameter. It is primarily evergreen, though in arid areas it can occasionally become partially deciduous. Tall and straight, the trunk can occasionally be twisted and stunted. Up until middle age, the crown is long and somewhat pyramidal; beyond that, it becomes spreading, rounded, or umbrella-shaped, with a huge branch system. The bark of older trees is darker, reddish or reddish brown, turning light-grey when exposed, and shedding in large plates up to 61 cm in length and 23 cm in width. The bark of young trees is dark grey and exfoliates in rough, longitudinally elongated plates that are up to 6 cm thick and deeply and irregularly fissured. In mature trees, branches up to middle age stretch out in whorls with poorly defined verticels. There are two types of dimorphic shoots. Long or infinitely growing stems that are grey or pale brown when young and covered in scale leaves that last for years; they also have buds and foliar spurs. Dwarf or limited-growth stems have three leaves and are surrounded by two prophylls and eight to fifteen spirally organized, imbricate, chartaceous, acuminate, fimbricate cataphylls (scales), which are initially white or green before turning brown or grey. Prophylls and cataphylls make up the persistent basal sheath that surrounds the leaves, which is 1.3–2.5 cm long. Dwarf shoots emerge in April, shortly after pollen shedding, however they first appear in March or April. Developed in October or November, winter buds are small, ovoid, non-resinous, and

light-reddish brown. They are shielded by tightly packed brown scales with fibrillar borders, but growth doesn't resume until December or early January. Faintly triquetrous, with one side rounded and two sides flat, with marginal resin canals and several faint lines of stomata on all three surfaces, the leaves are light to deep green, nonglaucous, needle-like, slender, and 15–40 cm long. The margins are minutely but closely serrulate (i.e., finely toothed), and the apex narrows into a long, fine point. The needles last for one and a half to three years, with new ones emerging in January. In May and June, leaves start to fall off. In January, male strobili are found at low elevations in groups, spirally arranged on the current year's shoots in 5/8 phyllotaxy. The entire inflorescence is 2.5–10.2 cm long by 3.8–5.1 cm in diameter, with each male cone taking the place of a dwarf shoot and being carried in the axil of a prominent brown scale or a scale leaf (which falls as soon as the cone matures). Four prominent and numerous small, light-brown, acuminate scales with fimbricate margins protrude. Because they are trapped between the closely spaced other cones, these bracts continue to grow. Each cone has two abaxial microsporangia and 90–140 spirally organized microsporophylls with scaly, upward-bending tips. The microsporophylls are born on a central axis. Cones are yellowish green and globular when young, 1.3-1.8 cm long when ripening, and light brown, acuminate scales with fimbriate borders that are cylindrical, ovoid, elongated, and light-reddish brown once the pollen is shed. The central axis elongates significantly just before shedding, reaching a length of 3–4 cm, particularly at the base. Depending on the season, location, and elevation, pollen shedding occurs from February to April. Large amounts of pollen are released, which guarantees pollination through wind. On the apices of new shoots, female strobili that emerge in early February at low elevations are carried individually or in pairs in one or two whorls of three each. Prior to pollination, young cones are tall, ovoid, and covered in involucral bracts (in 5/8 phyllotaxy), which last for a year. They are initially pale-green or faintly purplish. Both bract and ovuliferous scales are found in the cone. The ovuliferous scales quickly surpass the bracts, but before pollination, the bract scales are longer than the ovuliferous scales and roughly perpendicular to the cone axis. Cones are 1.5–2 cm long and turn green within a month following pollination. By the end of October, they are 1.8–2.6 cm long by 1.5–2 cm in diameter, turn grayish or light brown on the outside while staying green on the inside, and are pretty soft (they cut readily with a knife). The cone is subsequently pushed horizontally from its upright position by a reddish-light-brown bud that develops at the tip of the cone bearing shoot. Throughout the winter, they stay in this horizontal orientation, hidden among the fully developed new leaves. Cones shut as a result of the ovuliferous scales' quick growth and enlargement (thickening of cell walls). This closure is further aided by copious resin secretion, which keeps the immature ovules from drying out and appears as big, gleaming drops on the scales. Cones turn green and active once more. Cones that are a year old by March are soft, green, and measure 2.5–4.6 cm by 2.5–3.8 cm. They have brown tips and subtly bent scales, which are remnants of the winter stage. They are delicate, green, 7.5–10.5 cm long, and have recurved scales. By mid-April, they resemble adult cones in general. The cones are still green by June or July, but they have grown to their full size. Cones are completely grown, hard, and brown at the start of winter. Throughout the winter, they stay in this state. When compared to cones at lower heights, the cones at higher elevations may emerge six weeks later. Mature female cones (in the spring of the third season, 24 months after pollination) Light-brown, long, ovoid, 11.5–21 cm long, 6.4–14 cm in diameter, on short, sturdy stalks, solitary or 2-5 together horizontally, pendulous or erect on branches, each with a central axis and 95–115 spirally arranged pairs of bracts and ovuliferous scales, the former a membranous structure at the base of ovuliferous scales, which are very thick, hard, and woody, pyramidal or rhomboidal, with two winged seeds at the base on the abaxial side and a prominent exposed part (umbo) with a pyramidal, pointed curved or reflexed beak. Cones only open in dry weather during the third-year months of March through May, closing again in the event of rain. Cones that are open can measure up to 24 cm by 18 cm. Despite the quick opening, seeds need a breeze to shake them well and need two to three weeks (or up to July in cold climates) to fully escape. Therefore, it takes about 26–27 months from the time female cones first develop till they ripen and open. Cones that are empty and dry can stay on the tree for a year or more. These seeds are 0.7–1.6 cm long by 0.5–0.6 cm wide. They have wings that are 2.5–4.5 cm long and have a long, thin, membranous wing that is 0.7–1 cm wide.

Figure 7: *Pinus roxburghii Sarg.*

Flowering and Fruiting: The life cycle lasts three years: January–February for male cones, February–April for pollen shedding, February–April for females in their first year and pollination, March for second-year green, fertilized cones, and March–July for third-year brown, mature, woody female cones that are ready to drop seeds. The dry cones stay on the tree for a long time.

Specimens Examined: Chanjhiar, 28 August 2021.

Habitat: Because Himalayan chir pines need monsoon rainfall, they are not found in inner valleys where the monsoon does not reach. As soon as the monsoon season begins, the seeds that fall in the hot weather begin to sprout. It is a gregarious species that, although it occurs intermingled with other species at lower and upper limits, produces pure forests to a large extent. With an approximate total area of 8730 kilometers over the tropical, subtropical, and temperate Himalayas, it is the most significant pine. Twisted-fibered trees are also found in Uttarakhand and Himachal Pradesh.

Distribution: Afghanistan, Bhutan, Nepal, Pakistan, West and East Himalayas. India: Jammu & Kashmir NEFA along the Kameng Frontier division, Siwalik hills flanking the Himalayas, Uttarakhand, and Himachal Pradesh.

Altitude: 450–2450 m, thriving best at 610–1525 m.

Economic and Ethnobotanic Uses: It creates resin with significant commercial value. The money made from resin is significantly more than that from its fuel or timber under ideal circumstances. The resin is applied to abscesses and buboes to promote suppuration, and it is used internally as a stomachic and topically as a plaster. Both internally and physically, the resin is stimulating. It mostly affects the genito-urinary organs' mucous membrane on the inside. Rosin is utilized in the production of linoleum, sealing wax, oil cloth, lubricating compounds, and inks, as well as in the making of soap and paper and cloth sizing [20]. Turpentine oil is used as a solvent for paints and varnishes, as well as in the pharmaceutical, fragrance, synthetic pine oil, disinfectant, insecticide, and denaturant industries. The oil is listed in the Indian Pharmacopoeia and is valuable in medications. It helps with chronic bronchitis and has mild antibacterial and expectorant properties. It is particularly advised for the treatment of lung gangrene, has been shown to be helpful as a carminative for flatulent colic, and stops little bleeding in the nose and tooth sockets [22]. Sweet, bitter, pungent, acrid, heating, oleagenous, purgative, carminative, aphrodisiac, fattening, diuretic, anthelmintic, analgesic, intestinal antiseptic; causes biliousness; beneficial for conditions of the head, eyes, ears, throat, blood, and skin; good for bronchitis, dyspepsia, ulcers, diaphoresis, giddiness, scabies, the body's foetid odor, inflammations, and itching. Asthma, chronic bronchitis, ozoema, piles, liver and spleen illnesses, gleets, urinary discharges, earache, toothache, lumbago, tuberculous glands, scabies, epilepsy, and other conditions can all benefit from the gum's emmenagogue, expectorant, and unpleasant taste and smell. Oil from the chir pine needles is said to have antibacterial properties against a variety of organisms. For tanning, bark is utilized [17]. Joinery, shingles, packing boxes, building, light furniture, home furnishings, pattern manufacturing, lamin board cores, drawing boards, and plane tables are all made with chir wood [23]. Railway sleepers are made of treated wood, which can survive for 16–17 years. The wood is thought to be diaphoretic, stimulating, and helpful for ulcers, coughing, fainting, and body burning. It has been suggested that oleoresin and wood can be used to cure snake bites. "Khir," a remedy for insomnia that promotes restful sleep, is made by boiling the seeds of unripe female cones in milk. On heel cracks, resin is used [14].

7. *Pinus wallichiana*

It is regarded as one of "the most beautiful" pines in the world and is a tall, evergreen, graceful, or elegant tree that can reach 50 meters in height and 3 meters in girth. Branches are uninodal or multinodal, whorled, spreading, and typically rising in young trees. In older trees, they may be horizontal or drooping with upturned tips. Young trees have thin, smooth, resinous bark that is 1.3–2.8 cm in length, greenish-white, greenish-grey, or slate-colored; older trees have grey or greyish-brown, corky, rough, scaly bark that is superficially or shallowly fissured and divided into tiny, rectangular plates. Winter buds are small, cylindric-conical, and range in length from 0.6 to 1.3 cm. They have many lanceolate, fibrillar scales that are either free or tangled with resin. There are two types of dimorphic shoots. Long or infinitely growing shoots that develop in March or early April (depending on the location), glaucous, green or light-brown, then deepen with maturity. Persistent, less than a millimeter in length, dwarf shoots, shoots of limited growth, or foliar spurs are carried on long shoots in the axils of scaly leaves. They have five needles and are surrounded by two prophylls and eight to ten spirally arranged (in 2/5 phyllotaxy) cataphylls, with the innermost being the largest and the outermost the smallest. Both prophylls and cataphylls are deciduous, measuring 1.3–2.3 cm in length, and form a basal sheath around the needles, which has a prominent midrib. The leaves are persistent, lasting three to four years, erect and pointed upwards in young trees, but spreading or drooping and slightly bent in older trees; slender (thin and delicate), triquetrous, convex surface green, bluish or greyish-green, and glaucous on the inner surface, giving the foliage its characteristic bluish tinge (color); 10 to 21 cm long, shorter in stunted and diseased trees; ridged (ridges are epidermal projections between which the stomata are arranged in longitudinal rows); white stomatic lines on flat surfaces; or resin canals marginal. May through July, and occasionally October through December, is when leaves shed. In March or April, new shoots emerge, and by August or September, they reach their maximum size. Strobili, which include flowers, catkins, and cones, are monoecious and unisexual. At the base of current year's young long shoots, male strobili in catkins appear in October-November in 15–35 spirally arranged clusters, 1.3–5.1 cm long. Each cone replaces a dwarf shoot and arises in the axil of a green, scaly leaf, surrounded by involucres of 8–12 equally prominent greenish-white, imbricate scales that stick to the catkins when they fall. When the cones are young, they are typically green, occasionally dark reddish-purple, ovoid or oblong, 0.7–1 cm long; when ripe, they are yellow, light-brown or dark-brown, and frequently pink towards the apex, elongated, and fall shortly after ripening. On a central axis, each cone is made up of 85–115 spirally arranged microsporophylls, or stamens. Each stamen is 0.1–0.15 cm long, with its tip twisted and stretched upward, and it has two microsporagia, or pollen sacs, on its abaxial side. Depending on the location, time of year, and height (the lower the altitude, the earlier the cones shed their pollen), pollination occurs from April to June. When they replace the terminal or sub-terminal bud(s) of the current year's young, long shoots, which are pale green, erect, and protected by an involucre of bracts, the female strobili terminal or sub-terminal, solitary or 2–3 together, and occasionally more forming a whorl around the terminal bud, appear in February. At the time of pollination, the pale or glaucous green turns to deep-pink or reddish purple, and finally to greenish-brown. The cone axis elongates in April, and cones that are 1.5–2 cm long and 0.8–1 cm in diameter with scales open to collect pollen emerge from the involucre. The cones close after pollination, which occurs at the end of April or the beginning of June. By August, they are 2.5–5.1 cm long by 1–1.3 cm in diameter, with a 2.5–3.8 cm long peduncle or stalk that elongates significantly. The cones are pendulous and bluish-green, with a small, crude brown umbo at the tip of each scale. Mature and ripe Female cones are pendulous on stalks that are 3.3–7.5 cm long, cylindrical, 15–33 cm long, and 3.0–6.5 cm in diameter before expansion. They are light-brown, highly resinous, and have 80-90 spirally arranged pairs of bracts and ovuliferous scales (megasporophylls) on a central axis. The

latter arise in the axils of the former, while the bract scales are small and membranous, while the ovuliferous scales are fleshy, measuring about 3.8–6.5 cm long and 2.0–3.8 cm broad, wedge-shaped, rhomboidal or spathulate, exposed portion longitudinally grooved with a thickened apex, occasionally reflexed, and each bearing two-winged seeds on its abaxial side. Later on, ovuliferous scales get woody and hard, though not as hard as those of Pinus roxburghii. In the second year, the seeds ripen, open, and shed between September and November. About 18 months pass between the female flower's initial appearance and the cone's maturing, and another 22 months pass between the seeds being shed. Membranous, obliquely truncate, compressed, bluish or dark brown, ovoid, 0.5–1 cm by 0.3–0.5 cm, winged, 0.7–1 cm broad with wings, roughly three times the length of the seeds, and the size of the seeds with wings is 1.5-4 cm. Epigeous germination occurs.

Figure 8: *Pinus wallichiana*.

Flowering and Fruiting: Cones have a two-year life cycle that includes October to November for males, February for females in their first year, April to June for pollen shedding and pollination, and September to November for the second year for ripening, opening, and seed shedding. Cones stay on the branches for a long time after the seeds have fallen.

Specimens Examined: Bahadurpur, 18 April, 2019.

Habitat: Common in pure and mixed forests on alpine slopes; also found with Abies pindrow and Picea smithiana. Due to bending with snow, it becomes stunted and takes on a shrubby prostrate form at higher elevations. It may grow in regions with yearly rainfall as low as 25 cm, like the Suliman range, or as high as 510 cm, like Apa Tanang in the Eastern Himalayas. It also has a wider range of elevations (1200–3700 m) than any other Himalayan conifer.

Distribution: They are native to the greater Himalaya (West, Central, and East), which stretches through the hills of Pakistan, Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Nepal, Sikkim, Bhutan, and Southeast Tibet from Kafiristan (Baluchistan, Afghanistan) in the West to Arunachal Pradesh (India) in the East. It has a latitude range of 250N to 360N and a longitude range of 680E to 1000E. From Garhwal, it spreads westward through Jaunsar, Chakrata, Mussoorie, Shimla, Bushahr, Kullu, Chamba, Kashmir (in India); Murree Hills, Waziristan, Hazara (in Pakistan); and Kafiristan (in Afghanistan). It is plentiful in the West Himalayas between 1830 and 2555 meters. It can be found in the Central Himalayas at elevations of up to 3600 meters along the Namchebazar and Thengopoche (Nepal) regions. It stretches eastward in the East Himalayas from the Chumbi Valley across the Sikkim border, through the lower Rangeet Valley above the river Tista, and then through Bhutan, where it is abundant in small, dispersed areas north and east of the Brahmputra in the NEFA at 1500–1830 m at Kameng division, Khalaktang area, Rupa valley, Dirang–Dzong valley (500 m), Subansri division, and Apatanang valley.

Altitude: 1200-3800 m or more.

Economic and Ethnobotanical Uses: The plant is an intestinal antiseptic; it helps with bronchitis, diaphoresis, giddiness, ulcers, inflammations, itching, and other conditions that affect the eye, ear, throat, blood, and skin [20]. It has decent timber. The heartwood is light brown, while the sapwood is white. In addition to being used for various construction purposes, inexpensive pencils, battery separators, violins, joinery work, pattern making, cores for lamin boards, drawing boards, and plane tables, Kail wood is regarded as the best wood after deodar for internal fittings and planking of residential homes, furniture, packing cases, match boxes, drawing boards, fermentation vats, truck bodies, shingles, and railway sleepers. For the majority of applications, blue pine is typically regarded as slightly better wood. Railway sleepers are made of treated wood, which can survive for 16–17 years. Sometimes it is preferred to deodar as it is not so oily. It produces high-quality charcoal. For torches, the wood's more resinous sections are mostly utilized. In the interior Himalaya, where there are no trees, chips and little pieces of wood are known as "lashi or clanshing." The wood is thought to be diaphoretic, stimulating, and helpful for ulcers, coughing, fainting, and body burning [10, 16]. Oleoresin, sometimes known as gum, is a bitter, acrid, heating, oleagenous, purgative, carminative, expectorant, aphrodisiac, fattening, diuretic, anthelmintic, and analgesic substance that causes biliousness. It is also helpful in treating inflammations, as well as diseases of the liver, spleen, vagina, uterus, head, and eye; it is also beneficial for scabies, lumbago, scabies, scabies, scabies, and epilepsy. The resin is used to abscesses and buboes to promote suppuration and is a good treatment for gonorrhea. It is also used internally as a stomachic and externally as a plaster. It is used to treat rheumatic pain. The young saplings' resin is used as a liniment to treat cuts and wounds. Oleoresin produces rosin and turpentine oil. Oleoresin is utilized in paints and varnishes. Rosin is utilized in the production of soap, paper and textile sizing, sealing wax, oil cloth, lubricating compounds, and inks. Although chir pine yields around half as much oleoresin and turpentine oil, the oil is of excellent quality, contains a high pinene concentration, and may be utilized for any purpose that calls for American turpentine oil. It is advised to use the wood and oleoresin to treat scorpion odor and snake bites [16, 20]. Blacksmiths utilize bark as fuel. It has a respectable amount of coloring material. Huts are roofed with the bark. The bark of pole-sized plants is removed in circular cylinders and used as a plaster for humans, cattle, sheep, and goats to bandage shattered or dislocated bones. In addition to facilitating calcification and the unification of fragmented fragments, the glue and round bark knotted to the organ hold the bones in place [20]. People

in the area gather cones for medical purposes and use them to light fires.

8. *Platycladus orientalis* (L.)

It can grow up to 9–15 m as a bush or small ornamental tree with a dense structure that occasionally has a columnar shape or frequently branches into several stems from close to the base. thin red-brown bark. It differs from cypress in that its branches (shoots) are erect and frequently as long as the main stem. Branchlets are upright, with the secondary branch positioned obliquely. The persistent, scale-like, opposing leaves are 1.5 mm in size, gland-free, and clearly grooved on the back. They are triangular in shape, ending in a blunt point, and are not pushed to the stem. They are green on both sides, have tiny stomata, and when damaged, have a faint, resinous smell. Ovoid, meaty, and glaucous before maturing, strobilus or cones have two to three wingless seeds on each of their typically six to eight scales, the lower one of which is fertile. Thick, woody scales have a powerful hooked or rolled boss close to the apex that eventually opens wide to release the seeds. Seeds are round and have no wings.

Figure 9: *Platycladus orientalis* (L.)

Flowering and Fruiting: May-October.

Specimens Examined: Nihal, 6 May, 2023.

Habitat: It is primarily planted in gardens and close to government buildings as a decorative tree.

Distribution: Native of NW. China. It is cultivated in N. America and N-E. Asia. India: Cultivated throughout India. Himachal Pradesh: Kangra (throughout Kangra cultivated in gardens), Shimla (Rohru, Shimla).

Altitude: 900–2800 m.

Economic and Ethnobotanic Uses: An essential oil is produced from seeds and roots. Fatty oil is also produced by seeds. Additionally, leaves produce an essential oil that has antipyretic, diuretic, and tonic properties. Leaves and twigs contain a lot of tannin. Wood is used to make barrels, casks, fence posts, furniture, and buildings. It is a species that is widely grown and used for garden topiary. In the vicinity of public and private institutions, it is grown locally as an ornamental plant [10, 14, 15].

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