Liverworts and Hornwort Flora of District Kathua, J&K, India

Ashni Devi, P.K. Rao and R.K. Manhas

Abstract: Bryophytes, called as Lilliputians and amphibians of plant kingdom, are considered first land dwellers which originated in Devonian period of Palaeozoic era since then they have been surviving and evolving in varying climatic conditions. They are of immense biological, ecological, and phylogenetic significance. The present study was conducted in district Kathua, J&K, India. A total of 24 taxa (foliose and thallose including 3 hornworts) belonging to 12 families and 4 orders were found in the study site.

Key words: Liverworts; hornworts; Kathua.

1. Introduction

Bryophytes called as Lilliputians of plant kingdom aren't just small Tracheophytes but the most diverse group of land plants with more than 20,000 species worldwide (Sharma and Langer, 2014). Currently, about 2489 taxa of bryophytes (including interaspecific taxa), comprising 1786 species in 355 genera of mosses, 675 species in 121 genera of liverworts and 25 species in six genera of hornworts are reported from India (Dandotiya *et al*., 2011). They are pioneers of the terrestrial vegetation. Bryophytes are of immense ecological and high aesthetic value. They grow in variety of life forms contributing to the main component of montane forest due to high degree of soil binding capacity besides the water retention characteristics (Smith, 1982; Alam, 2011).

The Jammu and Kashmir state, a part of north-west Himalayas, shows a great diversity of liverworts. It is divided into three regions namely Jammu, Kashmir and Ladakh. Bryofloristic studies have been done extensively in Kashmir and Ladakh regions (Stephani, 1900-1924; Kashyap, 1929 & 1932; Robison, 1965; Kaul & Dhar, 1968; Srivastava, 1979; Bandey *et al.*, 1998; Tanwir and Langer, 2006) whereas in Jammu region, scattered studies have been done in the Rajouri, Poonch, Jammu and Udhampur districts (Langer and Tanwir, 2002; Tanwir and Langer, 2002; Langer *et al*., 2003; Tanwir and Langer, 2006; Tanwir *et al.*, 2008; Rashid *et al.*, 2012).

During past few decades, the entire Himalayas range has suffered severe habitat destruction on the account of tourism, urbanization, over exploitation of the forest resources and deforestation due to which large number of these plants has disappeared from their natural habitats. Therefore, taxonomic and habitat studies and listing of these species is the most important job in the hands of the researchers. This information can be utilized to study the impact of changing climate and to protect and conserve these valuable plants from the threat of extinction. The present study was undertaken to enlist the various bryophytes growing in Kathua district.

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2. Material and methods

2.1 Study site

District Kathua, the gateway to the state of Jammu and Kashmir is located between 32º 00′ 17″- 32º 00′ 55″ N latitude and 75° 01′ 00″ to 76° 00′ 16″ E longitude, encompasses 2,651 km^2 area. Geographically, the district covers a part of middle Himalayas (Bani Tehsil), Doon area, Shiwaliks (Billawar and Basohli tehsils)

and piedmount region (Kathua and Hiranagar tehsils). District Kathua experiences sub-polar, temperate and tropical monsoon type of climate. Winters are very cold with higher reaches experiencing heavy snowfall while summers are extremely hot in the paramount region with mercury touching 45º C in the month of June (Rao *et al.*, 2015). The annual rainfall varies from 912 to 1801 mm (Sharma *et al.*, 2012).

2.2 Material and methods

Field surveys were undertaken during different seasons. The collected plant material was press dried in papers and pasted on the herbarium sheets. The identification of species has been done by consulting Schuster (1984), Asthana and Srivastava (1991), Zhu (2005) and Daniels (2010). The identified specimens were than list alphabetically.

3. Results and discussion

Preliminary survey of various locations of district Kathua has yielded 21 liverworts and 3 hornwarts. These taxa have been enumerated. Schuster (1984) system of classification was followed for the arrangement of order and families. The genera within the family and species within the genus are sequenced alphabetically.

Metzgeriales Chalaud

Fossombroniaceae Hazsl. *nom. conserv*.

Fossombronia wondraczekii (Corda) Dumort. ex Lindb., Helsingf. Dagbl. 1873.

Location: Gulakh; Moist shady soils of pine forest.

Pelliaceae H.Klinggr.

Pellia endiviifolia (Dicks.) Dumort., Recueil Observ. Jungerm.: 27, 1835.

Location: Bani, Kandla, Kardoo and Pernala. Moist shady soil, stone in water or bank of river.

Jungermanniales H.Klinggr.

Jungermanniaceae Rchb.

Jungermannia lanceolata L. Syst. Samml. Krypt. Gewiichse 2: 4, 1797; non *J. lanceolata* L., Spec. Plant., p. 1131, 1753

Location: Kardoo, Jarminala and Kadla; Moist soil covering cemented wall or rocks.

Jungermannia truncata Nees, Enum. Pl. Crypt. Jav. 29, 1830.

Location: Parnala and Sukrala; moist soil.

Jungermannia kanaii Amakawa, *J. Hattori Bot. Lab*. 30: 194, 1967.

Location: Galakh and Satwain; on moist soil, concrete walls or rocks.

Solenostoma gollanii Steph., Spec. Hepat. 6: 81. 1917. Syn: *Jungermannia (Luridae) tenerrima* Steph., *Spec. Hepat*. 6: 93, 1917.

Location: Satwain; on moist soil concrete walls or rocks.

Geocalycaceae H.Klinggr.

Heteroscyphus pandei S.C. Srivast. et A. Srivast., Lindbergia 15 (6): 197, 1989.

Location: Bani; on moist surface of rock or stone.

Plagiochilaceae Müll.Frib

Plagiochila gollanii Steph., Bull. Herb. Boissier (sér. 2) 5 (10): 938 (588), 1905.

Location: Karroh; moist slightly exposed concrete wall.

Jubulaceae H. Klinggr.

Frullania muscicola Steph., Hedwigia 33 (3): 146, 1894.

Location:Galakh and Bani; on moist shady soil or epiphyte on tree trunk.

Marchantiales Limpr.

Aytoniaceae Cavers

Asterella angusta (Steph.) Mahab. & Bhate, J. Univ. Bombay 13(5): 5, 1945.

Location: Parnala, Dinga Amb, Galakh, Satwain, Rihalta and Jhoterd; on moist soil covered rock or moist exposed soil.

Asterella pathankotensis (Kash.) Kachroo

Mannia foreaui Udar & Chandra, Can. J. bot. 43 (1): 148, 1965.

Location: Dinga Amb, Bani and Basohli; on moist exposed soil and on concrete walls.

Plagiochasma appendiculatum Lehm. et Lindenb., Nov. Stirp. Pug. 4: 14, 1832.

Location: Dinga Amb, Thain Dam, Kareloo, and Basohli; on moist shady or slightly exposed rock or concrete wall.

Plagiochasma intermedium Lindenb. et Gottsche, Syn. Hepat. 4: 513, 1846.

Location: Sukrala, Dinga Amb, Parnala, Salan and Marto Nagrota; on moist shady soil, concrete walls or rocks.

Reboulia hemisphaerica (L.) Raddi, Opusc. Sci. 2 (6): 357, 1818.

Location: Dinga Amb and Bani; on moist soil, concrete walls or rocks.

Conocephalaceae Müll.Frib. ex Grolle

Conocephalum conicum (L.) Dumort., Commentat. Bot. (Dumortier): 115, 1822.

Location: Bani; on moist shady soil near water or under water.

Marchantiaceae Lindl.

Dumortiera hirsuta (Sw.) Nees, Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur. 12 (1): 410, 1824.

Location: Dumi-nala, Karooh and Bani; on moist and shady soil, rocks near the water.

Marchantia paleacea Bertol., Opusc. Sci. 1: 242, 1817.

Location: Bani, Karooh, Dumi-nala and Kadla; grow on moist shady soil, and covered rocks near small water fall or water stream.

Marchantia polymorpha L., Sp. Pl. 1: 1137, 1753.

Location: Phinter; on moist and shady soil near water canal.

Ricciaceae Rchb.

Riccia discolor Lehm. et Lindenb., Nov. Stirp. Pug. 4: 1, 1832.

Location: salan, Galakh and Bani; on moist soil, concrete wall or rock slightly exposed to sunlight.

Cyathodiaceae Stotler et Crand.-Stotl.

Cyathodium cavernarum Kunze, Nov. Stirp. Pug. 6: 18, 1834.

Location: Galakh and Salan; on moist soil or concrete wall.

HORNWARTS

Anthocerotales Limpr.

Anthocerotaceae Dumort.

Anthoceros erectus Kashyap, New Phytol. 14 (1): 9, 1915.

Location: Dumi River; on moist and shady soil.

Notothyladaceae Müll.Frib. ex Prosk.

Notothylas himalayensis Udar et D.K.Singh, J. Bryol. 11 (3): 451, 1981.

Location: Dinga Amb; on moist and shady soil.

Phaeocerotoideae Hässel

Phaeoceros laevis (L.) Prosk., Bull. Torrey Bot. Club 78 (4): 347, 1951.

Location: Dumi River; on moist and shady soil.

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Ethnomedicinal plants of Tehsil Nowshera, District Rajouri, J&K, India

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Abstract: A total of 32 ethnomedicinal plants from 24 families and 32 genera were collected from the Nowshera tehsil. The most dominant family was Liliaceae with 2 genera and 3 species. Other important families were Caesalpiniaceae, Euphorbiaceae, Lamiaceae, Myrtaceae, Rutaceae and Solanaceae.

Key words: Ethnomedicinal plants; Nowshera; Liliaceae; Rajouri.

1. Introduction

Traditional botanical knowledge of indigenous communities relating to the uses and management of wild plant resources is extensive (Cotton 1997). The field of ethnobotany has seen much advancement over the past decade. New methods and theories have been introduced, and more and more attention is being given to the study of cultures in underdeveloped lands. Furthermore, the subject matter has been broadened to include data not only from anthropology and botany, but also from pharmacology and phytochemistry (Cotton 1997).

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Medicinal plants play an important role in the health care of people around the world, especially in developing countries. Until the advent of modern medicine, humans depended on plants for treating human and livestock diseases.

Human societies throughout the world have accumulated a vast indigenous knowledge over centuries of the medicinal uses of plants and related uses, including as poison for fish and hunting, for purifying water, and for controlling pests and diseases of crops and livestock. About 80% of the population of most developing countries still use traditional medicines derived from plants to treat human diseases (Ali *et al*., 1998; Abbasi *et al*., 2012). About 12.5% of the 422,000 plant species documented worldwide are reported to have medicinal value. The proportion of medicinal plants to the total documented species in different countries varies from 4.4% to 20% (Rehman *et al.*, 1986).

A number of ethnomedicinal studies (Kant and Sharma, 2001; Kumar *et al*., 2009; Tantray *et al*., 2009; Bhat *et al*., 2012; Baig *et al*., 2013; Jeelani *et al*., 2013; Lone *et al*., 2013; Hassan *et al*., 2013; Bhatia *et al*., 2014; Lone *et al*. 2014; Bhatia *et al*., 2015; Rao *et al*., 2015) have listed the medicinal plants of various local areas of Jammu and Kashmir. Nowshera is one of the remotest tehsils of district Rajouri but ethnomedicinal studies are lacking in the region. Therefore, the present study was conducted in tehsil Nowshera with an aim to list the locally used medicinal plants.

2. Material and Methods

2.1 Study site

The present study area is located situated at latitude of 33O -10' and longitude of 740 -41' at an elevation range of 470-1200 m. asl. The boundaries of tehsil Nowshera is bounded on the eastern side with Kalakote and Sunderbani blocks, on the northern side with Rajouri, its southern and western boundaries are bounded with Pakistan.

2.2 Methodology

An extensive ethno-botanical survey was carried out in different villages of the Kathua district during March 2014 to March 2015 for collection of information on ethnomedicinal plant species being used by the locals in the study area. Information was gathered by conducting interviews and group discussions on the indigenous uses of plant species as medicine. All the discussions were made with the informants in *Dogri* or *Punjabi* language for their ease. The information collected included common diseases curable by plants, local name of plant species, ethnomedicinal use and mode of administration. The final list of the plants was prepared following the International Plant Names Index (http://www.ipni.org).

3. Results and discussion

A total of 32 ethnomedicinal plants from 24 families and 32 genera were collected from the Nowshera tehsil. The most dominant family was Liliaceae with 2 genera and 3 species. Other important families were Caesalpiniaceae, Euphorbiaceae, Lamiaceae, Myrtaceae, Rutaceae and Solanaceae. Details of these species along with ethnomedicinal plants as follows:

***Achyranthes aspera* L.,** Sp. Pl. 204. 1753. (Local name: *Puthkanda*; Common name: Devil's horse, Prickly chaff, flowerwhip; Family: Amaranthaceae)

Uses: The plants are used for several diseases such as piles, colic and boils. Root is used for pyorrhea, and also treats cough and fevers.

***Aegle marmelos* Correa ex Roxb.,** in Trans. Linn. Soc. 223. 1800. (Local name: *Bil*; Common name: *Stone apple*, *Bengal quince*; Family: Rutaceae)

Uses: The ripe fruit is eaten as astringent, coolant and laxative. The unripe or half-ripe fruit is astringent, stomachic, antiscorbutic and digestive. It is best given in chronic cases of diarrhea and dysentery and in irritation of the elementary canal. A *shurbat* (drink prepared from the pulp) is given for constipation and dyspepsia. The *shurbat* is also taken as coolant in summers as it helpful against sun-stroke.

***Allium cepa* L.,** Sp. Pl. 300. 1753. (Local name: *Ganda*, *Pyaz*; Common name: Onion, shallot, scallion; Family: Liliaceae)

Uses: The bulb of onion is stimulant, diuretic and expectorant. Its juice is given to treat piles. Decoction of onion is given in cough. Raw bulb taken with salt is a common remedy for colic and scurvy. It is also used to treat obstruction of the intestine. The bulb is cooked in wood charcoal and given against fever.

***Allium sativum* L.,** Sp. Pl. 296. 1753. (Local name: *Lahsun*, *Lassan*; Common name: Garlic; Family: Liliaceae)

Uses: Garlic is given in fevers, cough, whooping cough and dilated bronchitis. It is diuretic. A decoction of garlic made in milk and water is given in small doses in hystoria, flatulence, and sciatica. The pickle prepared from the bulb or inflorescence bud is used against rheumatism and also reduces weight. Its juice is used in earache. Garlic bulb is fried in oil and this oil is applied on joint pains.

***Aloe vera* L.** Sp. Pl. 1: 320. 1753. (Local name: *Ghee kanwar*; Common name: Medicinal aloe, Burn plant; Family: Liliaceae)

Uses: Extract of the plant is useful in the treatment of wound and burn healing, minor skin infections and diabetes.

***Bauhinia variegata* L.,** Sp. Pl. 375. 1753. (Local name: *Karar*, *Kachnar*; Common name: *Mountain ebony*, *Purple orchid tree*; Family: Caesalpiniaceae)

Uses: The flower of *B. variegata* are edible and considered laxative , tonic astringent to the bowels and used to treat biliousness, ulcers and tuberculosis glands. Bark of the tree is used in dysentery, piles, diarrhea, worms and skin diseases. The root juice is given for snake bite.

***Bryophyllum pinnatum* (Lam.) Kurz** -- J. Asiat. Soc. Bengal, Pt. 2. Nat. Hist. 40 1871 (Local name: *Pathar choor*; Common name: Life plant, Cathedral bells; Family: Crassulaceae)

Uses: The leaf juice is given in diarrhea, dysentery and cholera. The leaves are styptic, astringent and antiseptic. They are toasted slightly before applying on wounds, bruises, boils, cuts, ulcers, and bites of venomous insects. By applying this toasted leaves the swelling is

prevented and incised wound heal rapidly and irritation is allayed.

***Calotropis procera* (Willd.) R. Br.,** in Ait. f. Mort. Kew. 2: 78. 1811. (Local name: *Desi ak*; Common name: Swallow wort; Family: Asclepiadaceae)

Uses: Leaves and roots have multiple uses. Latex provides relief against inflammation. Roots are used as antidote against snake bite and scorpion poisoning.

***Cannabis sativa* L.,** Sp. Pl. 1027. 1753. (Local name: *Bhang*, *Sukha*; Common name: Hemp, Marijuana Family: Cannabinaceae)

Uses: It is been used to treat a variety of ailments including pain, glaucoma, nausea, asthma, depression and neuralgia.

***Cassia fistula* L.,** Sp. Pl. 377. 1753. (Local name: *Amaltas*; Common name: Golden shower tree, Indian laburnum; Family: Caesalpiniaceae).

Uses: The pulp of the pods is used as purgative for children and pregnant mother. Its confections are given in diabetes. The leaf juice is used against ringworm.

Catharanthus rosea* G. Don.,** Syst. 4: 95. 1837. (Syn. ***Vinca rosea). (Local name: *Sadabahar*; Common name: Madagascar periwinkle, Pink perwinkle; Family: Apocynaceae)

Uses: Leaves are taken raw against diabetes. It is also used against wasp sting.

***Coriandrum sativum* L.,** Sp. Pl. 256. 1753. (Local name: *Been*, *Dhania*; Common name: Coriander; Family: Apiaceae)

Uses: The fruit is aromatic, stimulant, carminative, antispasmodic, corrective, diuretic, aphrodisiac and refrigerant. A decoction of dried fruits is given in flatulent colic, rheumatism and neuralgia. The decoction of fresh leaves is taken against diabetes. The watery paste of the seeds is used as gargle for the cure of ulcers of the mouth and throat.

***Curcuma longa* L.,** Sp. Pl. 2. 1753. **(**Local name: *Haldi*; Common name: Turmeric**;** Family: Zingiberaceae)

Uses: The rhizome is given in diarrhea, intermittent fevers, dropsy, jaundice, liver disorders and urinary troubles. The fresh juice of rhizome is used as an antihelmint. It is commonly used for curing foul ulcers. The powder of *C. longa* is applied directly on bleeding site to stop the flow of blood. The powder mixed in milk treats internal injuries and also relieves psoriasis.

***Datura metel* L.,** Sp. Pl. 179. 1753. (Local name: *Kala tatoora*; Common name: Devil's trumpet, metel; Family: Solanaceae)

Uses: The dried leaves and twigs are smoked against asthma, whooping cough, bronchitis and other respiratory disorders. Juice of the fruits is applied on the scalp for reducing dandruff.

***Eucalyptus citriodora* Hook. --** J. Exped. Trop. Australia [Mitchell] 235. 1848. (Local name: *Safeda*; Common name: Eucalyptus; Family: Myrtaceae)

Uses: The essential oil extracted from the leaves of the plant is used as antiseptic and antifungal (candida, ringworm). It is also used to cure respiratory disorders like cold and cough, and viral infections.

***Euphorbia helioscopia* L.,** Sp. Pl. 1: 459. 1753. (Local name: *Dudhi*; Common name: Madwoman's Milk; Family: Euphorbiaceae)

Uses: Oral intake of root extract useful in the expulsion of intestinal worms. Latex is applied on warts and fungal infections like ring worms.

***Ficus palmata* Forssk.,** Fl. Aeg.- Arab. 179. 1775. (Local name: *Phagara*; Common name: Punjab fig; Family: Moraceae)

Uses: Fruits are eaten as aperients. Ripe fruits are taken in a glass of water, kept overnight and consumed as '*sharbat*' against fever, cold, cough, leucoderma and leprosy.

***Fumaria indica* (Haussk.) Pugsley,** in Journ. Linn. Soc. Bot. 44: 313. 1919. (Local name: *Pitpapra*; Common name: Indian Fumitory; Family: Fumariaceae)

Uses: Decoction of aerial parts is filtered and filtrate used for bathing to cure rheumatic pain. Juice of the plant is given in jaundice, nausea and vomiting.

***Justicia adhatoda* L.,** Sp. Pl. 15. 1753. (Local name: *Brainkar*, *basuti*; Common name: Malabar Nut; Family: Acanthaceae)

Uses: The decoction prepared from the tender leaves is used against cough and bronchitis. The leaf extract is also used to cure chronic whooping cough. The twigs are chewed and used as *datum* to cure bleeding gums and prevents tooth decay.

***Mentha arvensis* L.,** Sp. Pl. 577. 1753. (Local name: *Pudina*; Common name: Mint; Family: Lamiaceae)

Uses: It is stimulant and carminative, used for allaying nausea and flatulence, and externally

applied in rheumatism, neuralgia, congestive headache and toothache. The *chutney* prepared from the leaves of the plant improves digestion and relieves stomach inflammation.

Momordica dioica Roxb. ex Willd., Sp. Pl. 4:605. 1805. (Local name: *Karela*; Common name: Bitter gourd; Family: Cucurbitaceae)

Uses: It is use for the treatment of tumours, wounds, rheumatism and vaginal disorders. It is also used against diabetes and as a blood purifier.

***Ocimum sanctum* L.,** Mant. Pl. 1: 85. 1767. (Local name: *Tulsi*; Common name: Holy basil, sacred basil; Family: Lamiaceae)

Uses: The decoction prepared using leaves is stimulant, diaphoretic, antiperiodic, diuretic, antiseptic and expectorant. It is also one of the most common treatments against cough, cold, headache, asthma, leucorrhoea and fever. Seeds are used in genitor-urinary disorders. Oil obtained from leaves is used as antibacterial and insecticidal.

***Phyllanthus emblica* L.,** Sp. Pl. 982. 1753. (Local name: *Amla*, *Aula*, *Amlika*; Common name: Indian gooseberry tree; Family: Euphorbiaceae)

Uses: The fruit is used as one of the richest source of vitamin C. Fresh fruit is eaten as refrigerant, tonic, antiscorbutic, diuretic and laxative. It is used in fevers, vomiting indigestion, habitual constipation and other digestion troubles. The dried fruit is a good astringent and blood purifier. The dried fruit powder of *P. emblica* along with *Terminalia bellirica* and *Terminalia chebula* is used against constipation. The dried fruits are also used for hair wash as they prevent the hair loss and dandruff. The infusion of seeds is used for washing eyes in ophthalmic diseases.

***Pinus roxburghii* Sargent**, Silva N. Amer. 2: 9. 1897. (Local name: *Chir*; Common name: *Chir-Pine*; Family: Pinaceae)

Uses: The oleo-resin popularly known as *ganth-biroza*, is stimulant, stomachic and diuretic. It is given in gonorrhea and other disorders of the genitor-urinary organs. This is also used for dressing of foul ulcers.

***Psidium guajava* L.,** Sp. Pl. 470. 1753. (Local name: *Amrood*; Common name: Guava; Family: Myrtaceae)

Uses: The guava fruit is used against cold, work problem, constipation, mouth boils, toothache, headache, diarrhea, gum pain, teeth bleeding and diabetes, and is also a good blood purifier. The twigs are chewed to relieve toothache and bleeding gums. Leaves are also taken against diabetes.

***Prunus persica* (L.) Batsch.,** Beytr. Entw. Pragm. Gesch. Nat. Reich. 1: 30. 1801. (Local name: *Aru*; Common name: Peach; Family: Rosaceae)

Uses: Leaves are crushed and the paste so formed is applied on cuts, wounds, burns and boils to smooth inflammation and also used for quick healing.

***Solanum nigrum* L.,** Sp. Pl. 186. 1753. (Local name: *Kayan-kothi*; Common name: Black nightshade; Family: Solanaceae)

Uses: Juice of the herb is used to treat fever & relieve pain.

***Terminalia bellirica* Roxb.,** Pl. Cor. 2: 54. t. 198. 1798. (Local name: *Bhara*, *Bahera*; Common name: Belliric Myrobalan, Bastard myrobalan, Beach almond, Bedda nut tree; Family: Combretaceae)

Uses: The ripe dry fruit is given in piles, dropsy, diarrhea, leprosy, dyspepsia and headache. The dried fruit powder of *T. bellirica* along with *P. emblica* and *Terminalia chebula* is used against constipation.

***Tribulus terrestris* L.,** Sp. Pl. 387. 1753. (Local name: *Gokhru*, *Ponkhrha*, *Bhakhra*; Common name: Puncture vine, Goat head caltrop; Family: Zygophyllaceae)

Uses: Decoction of the fruit is used for the treatment of urinary disorders and male impotency.

***Verbascum thapsus* L.,** Sp. Pl. 177. 1753. (Local name: *Giddar Tamakoo*; Common name: Great Mullein, Adam's Flannel, Beggar's Blanket, Candlewick Plant; Family: Scrophulariaceae)

Uses: Flowers are kept in water overnight and this infusion is taken to cure cough, asthama, bronchitis and pneumonia. Leaf extract is used as eardrop. Leaf paste in mustard oil is applied on abscess.

***Viola odorata* L.,** Sp. Pl. 934. 1753. (Local name: *Banaksha*; Common name: Sweet Violet; Family: Violaceae)

Uses: The flowers are demulcent, astringent, diuretic, emollient, diaphoretic and laxative. Decoction of the plant is given in biliousness and lung troubles. The decoction of flower is also used for the treatment of cough, sore throat, kidney diseases, liver disorders and infantile affections.

***Zanthoxylum armatum* DC.,** Prodr. 1: 727. 1824. (Local name: *Timru*, *Timar*; Common name: Winged Prickly Ash, Prickly ash, Tumbru, Toothache Tree, Tejbal, Yellow wood; Family: Rutaceae)

Uses: Fruits are used for the treatment of indigestion in humans as well as cattle. Juice obtained from bark of branches is used for the treatment of various gum diseases and as mouth freshener. *Datun* of the *timar* is good against teeth decay.

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Change detection during 1959 to 1999 (40 yrs.) for Barkot forest range and its peripheral area, Dehradun, India

P.S. Chauhan, M.C. Porwal, J.D.S. Negi and R.K. Manhas

Abstract: Remote Sensing is the art and science of obtaining information about an object, area or phenomenon through the analysis of data acquired by a remote device. Remote sensing along with Geographical Information System (GIS) is an important tool for change detection over a period of time. The present study was conducted in the Barkot Range of Dehradun Forest Division, Dehradun, Uttarakhand, India. Results of the present study reveal that nearly 34% of the total area was under the inter classes change. The most prominent change was observed in Forest to Agriculture class and Sal/Sal Misc. (Dense) to Sal/Sal Misc./Misc. Sal (Medium) class contributed 11.40% and 10.10%, respectively.

Key words: Barkot Forest Range; Dehradun; GIS; Remote Sensing.

1. Introduction

Remote Sensing is the art and science of obtaining information about an object, area or phenomenon through the analysis of data acquired by a device that is not in contact with the object, area or phenomenon under investigation (Lillesend & Kiefer, 2000). Although, there are several definitions of remote sensing but fundamentally the major concept is the same.

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GIS is an information technology which stores, analyze and displays both spatial and non-spatial data. The main objectives of GIS are: maximise the efficiency of planning and decision making, provide efficient means for data distribution and handling, eliminate the redundant, data base, integrate information from many sources, perform the complex analysis on geographically referenced data and finally generate new information including spatial modeling.

RS and GIS together have potential to provide comprehensive information on various facts of forests management in India (Roy, 1999). It can be said that remote sensing and GIS are twins of advanced technologies. Thus, it is undisputed that GIS is complementary to remote sensing technology and as well as a tool for spatial representation of information obtained from remotely sensed data which are essential as management input. Hence, in the present study RS and GIS applications were used to find Change detection during 1959 to1999 (40 yrs.) for Barkot forest range and its peripheral area.

2. Material and Methods

2.1 Study Area

Dehradun Forest Division (Fig. 1) is a sub-tropical region with a little temperate climate than surrounding areas due to the altitudinal

range of 600-800 m above mean sea level (amsl). The annual temperature of the study area ranges between 1.8 °C (January) to 40 °C (June) whereas annual rainfall is around 191.8 cm. The frost is quite common in winter nights. Severe frost occurs in January and February affecting the Sal regeneration. The area lies between 77° 52' E to 78° 20' E and 30° 02' N to 30° 21' N Longitude while average altitude of the Dehradun Forest Division is 600 m amsl.

Champion and Seth (1968) classified the Doon valley into three Sub-types on the basis of Sal forests, viz., Moist Shiwalik Sal forest, Moist Bhabhar Doon Sal forests and Dry Shiwalik Sal forests (Roy, 1999). The Sal of this region is typically of II/III quality and advance growth is generally adequate. However, the seeding regeneration is very poor (Bisht, 1989). Sal is the dominant plant species and its associates are *Mallotus phillippinensis, Ehretia laevis, Syzygium cumini, Terminalia alata, Litsea glutinosa, Ardisia solanacea, Flacourtia indica* (Salim and Ullsten, 1999).

2.2 Methodology

Standard mapping methodology using aerial and satellite images has been used in the present study. Aerial photographs of 1976 and satellite data of IRS 1C, LISS III False Colour Composite (FCC) of March 1999 on 1: 50,000 scale was used for mapping purpose. Ancillary information from Forest Department like Forest range map of Dehradun Forest Division and Rajaji National Park on 1: 50,000 scale was used. Besides, Working Plans of Dehradun Forest Division and Rajaji National Park proved to be an asset (Singh, 1986; Srivastava *et al*., 2002).

The reconnaissance survey of the study area was initially carried out to remain familiar with the study site. Ground truth observations were made to prepare the interpretation Key, which is essential in forest cover and forest canopy density classification. Garmin GPS (Global Positioning System) was used to locate the latitude, longitude and altitude of the study sites.

Remote sensing data such as IRS 1C LISS III images were visually interpreted using image elements for the forest type and density classification as well as other landuse types. The whole study area was classified in 4 (four) classes in terms of forest density viz., Dense, Medium, Open and Degraded and into 10 (ten) landuse classes on the basis of interpretation key viz., Sal, Sal Miscellaneous, Miscellaneous Sal, Miscellaneous, Riverine, Shrub, Scrub, Plantation, Agriculture/Fallow and *Rao* (seasonal streams)/ Water Body.

The maps generated by using remote sensing data were digitised by using SPANS and exported in Dxf format, which was imported in ILWIS (Integrated Land & Water Information System) as a segment map (Vector form). The segment map was subsequently converted into polygon by using point map and finally in raster layer. The raster layers were used for crossing of themes through map calculation function. The output layers generated after crossing thematic layers were used to find out the change in forest type and density classes.

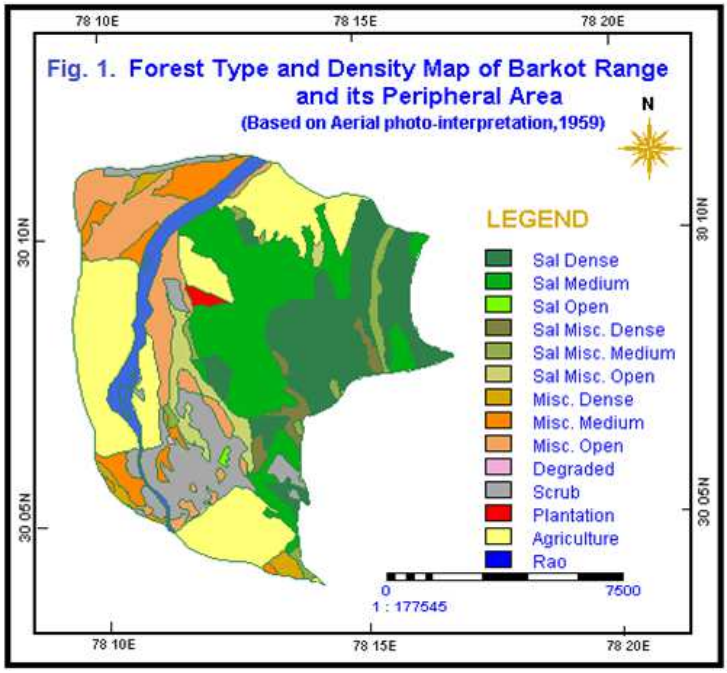
3. Results

Forest type and density map of Barkot and its peripheral area for the year 1959 based on Aerial Photographs on 1:50,000 scale prepared by Forest Survey of India, (Fig. 1, Table 1) revealed that out of total area of 10582.63 ha the contribution of Sal Medium was max. (19.20%) followed by Sal Dense (17.20%).

Other major classes were Misc. Open and Scrub contributing 10.60% and 9.02% respectively. In the non-forest category maximum contribution was of Agriculture i.e. 24.40% followed by Rao i.e. 5.14%. The minimum value (0.05%) was observed under degraded category.

Forest type and density map of the same area (1999) based on interpretation of IRS-IC LISS-III, FCC, on 1:50,000 scale (Fig. 2, Table

1) revealed that Sal Medium contributed the maximum (21.30%) area followed by Sal Misc. Medium (12.50%). Other major class was Sal Dense (10.70%) while Sal Open, Sal Dead, Sal Misc. Dense, Misc. Sal Dense Misc. Sal Medium contributed approximately equal area ranging only between 0.50-0.60%. On the other hand 3 classes i.e. Misc. Dense, Misc. Sal Dense and Orchard contributed to 0.21%, 0.22% and 0.33% respectively. In the non-forest area maximum contribution was observed in Agriculture (36.10%) followed by Plantation (7.25%). Rao contributed 4.91% and the minimum value (0.04%) was observed in the case of shrub class while comparing the 1959 and 1999 information it is evident that there is a significant decrease of area under Sal Dense. It had reduced to 10.70 % in 1999 from 17.20 % in the year 1959. The detailed analysis of changes is explained further in this chapter.



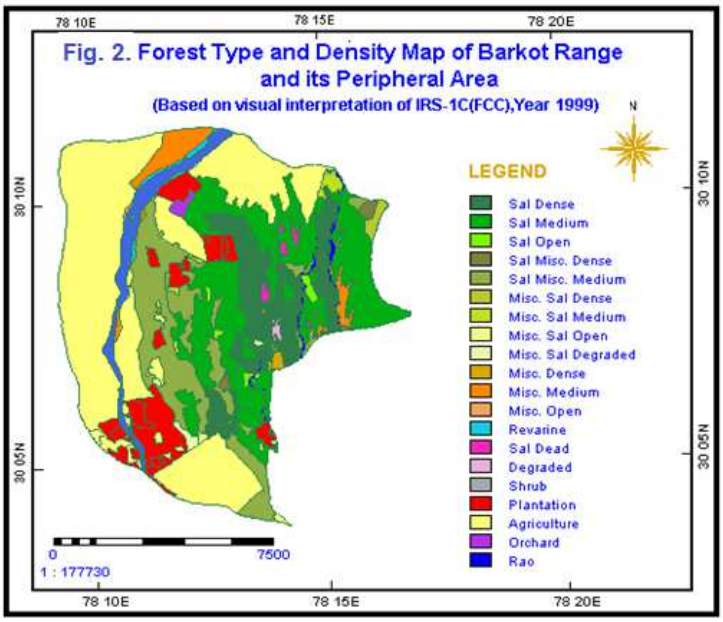


Table 1: Distribution of forest/landuse classes between 1959 and 1999 of the Barkot & its peripheral Area.

S. No.	Forest / landuse classes	1959		1999	
		Area (ha.)	Area (%)	Area (ha.)	Area (%)
1.	Sal Dense	1818.01	17.20	1128.03	10.70
2.	Sal Medium	2026.81	19.20	2257.21	21.30
3.	Sal Open	14.80	0.14	52.3	0.49
4.	Sal Dead	-	-	48.93	0.46
5.	Sal Misc. Dense	209.52	1.98	57.43	0.54
6.	Sal Misc. Medium	244.09	2.31	1325.62	12.50
7.	Sal Misc. Open	342.89	3.24	-	-
8.	Misc. Dense	138.61	1.31	22.7	0.21
9.	Misc. Medium	523.2	4.94	298.77	2.82
10.	Misc. Open	1126.81	10.60	4.92	0.05
11.	Misc. Sal Dense	-	-	47.71	0.45
12.	Misc. Sal Medium	-	-	64.61	0.61
13.	Misc. Sal Open	-	-	23.25	0.22
14.	Misc. Sal Degraded	-	-	29.99	0.28
15.	Riverine	-	-	52.74	0.50
16.	Degraded	4.80	0.05	16.68	0.16
17.	Scrub	954.18	9.02	-	-
18.	Shrub	-	-	4.58	0.04
19.	Plantation	50.25	0.47	767.57	7.25
20.	Agriculture	2584.97	24.40	3825.30	36.10
21.	Orchard	-	-	34.79	0.33
22.	Rao	543.69	5.14	519.50	4.91

Source: Based on Remote Sensing & GIS

Fig. 3 and Table 2 show that nearly 34% of the total area was under the inter classes change. The most prominent change was observed in Forest to Agriculture class and Sal/Sal Misc. (Dense) to Sal/Sal Misc./Misc. Sal (Medium) class contributed 11.40% and 10.10% respectively. Other major class under the change was Forest to Plantation, which constituted 6.70%.

The minor changes were observed in case of Sal (open) to (0.10%) Sal Misc. (Medium) class (0.41%) Agriculture to Rao (0.12%) and Rao to Riverine (0.10%) classes.

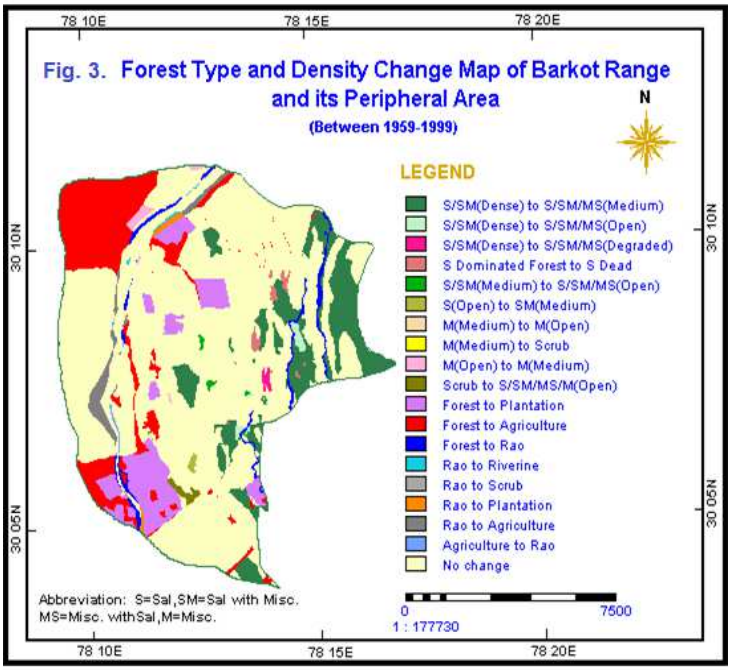


Table 2: Change distribution of forest/ landuse classes during 1959 and 1999 of the Barkot and its Peripheral Area.

S. No.	Forest/landuse change classes during (1959-1999)	Area (ha.)	Area (%)
1.	S/SM (Dense) to S/ SM/ MS (Medium)	1065.24	10.10
2.	S/SM (Dense) to S/ SM/ MS (Open)	41.92	0.40
3.	S/SM (Dense) to S/ SM/ MS (Degraded)	19.60	0.19
4.	S Dominated to Forest to S Dead	48.93	0.46
5.	S/SM (Medium) to S/SM/MS (Open)	18.78	0.18
6.	S (Open) to SM (Medium)	13.03	0.12
7.	M (Medium) to M (Open)	4.53	0.04
8.	M (Medium) to Scrub	0.06	0.00
9.	M (Open) to M (Medium)	43.63	0.41
10.	Scrub to S/SM/MS/M (Open)	31.98	0.30
11.	Forest to Plantation	712.40	6.73
12.	Forest to Agriculture	1205.62	11.40
13.	Forest to Rao	179.59	1.70
14.	Rao to Riverine	10.99	0.10
15.	Rao to Scrub	0.39	0.00
16.	Rao to Plantation	31.53	0.30
17.	Rao to Agriculture	151.59	1.43
18.	Agriculture to Rao	12.76	0.12
19.	No Change	6990.03	66.10

Source: Based on Remote Sensing & GIS

Three classes namely Misc. (Medium) to Misc. (Open), Sal (Medium) to scrub and Rao to Scrub showed very minor changes in the values i.e. 4.53 ha, 0.06 ha and 0.39 ha respectively. Because of this minimum values these classes are showing as the negligible percentage i.e. 0.00%.

4. Discussion

The change analysis during 1959-1999 (40 yrs) showed heavy destruction of Forest to Plantation and Sal/SM (Dense) to Sal/SM/MS (Open) classes contributing 11.40% and 10.10%, respectively. The above figures are in conformity that mixed deciduous forest, which acts as corridor for Sal, vanished. The forest cover decline was also worked out by Sedha & Dutt (1982) and Sharma & Sharma (1982).

Sal mortality area have also been delineated from the remote sensing data of the year 1999 and the area was 100.18 ha, while using spatial analysis or modelling revealed that four factors played important role regarding Sal mortality i.e. Elevated zone, Southern aspect, Slope (3-5%) and Eroded soil. Extraction through spatial analysis or modelling showed that Sal mortality prone area was nearly 32%, which is alarming.

Reduction of mixed deciduous forest encircling moist Sal especially in Barkot has ultimately affected the microclimate by way of increasing air temperature. This increase in air temperature since 1960 onward has created a stressful environment for Sal community in general and Sal in particular. Consequently as a result of stressful environment the drying of Sal has come into appearance since 1990 in the form of patch mortality.

There is an urgent need of the immediate action. So that suitable measurements can be taken in time. Planting some suitable broad leaved species including some soil binder grasses can reduce this very problem. Other major prescription is to reduce biotic interference.

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Some Ethnomedicinal Plants of Nagrota Village of Basohli, Kathua, J&K, India

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Abstract: Shiwalik ranges (Kandi region) of Kathua district are inhabited by diverse life-forms of plants. They are of immense value to the locals and an important part of their life. The present study was carried out in Shiwalik hills of Nagrota village of Basohli Tehsil, Kathua. Ethnomedicinal usage of total 21 plants was told by the villagers.

Key words: Basohli; ethnomedicinal plants; Nagrota village; Shiwalik ranges.

1. Introduction

Shiwalik ranges (Kandi region) of Kathua district are inhabited by diverse life-forms of plants. They are of immense value to the locals and an important part of their life. These plants are used by them as vegetable, fruit, fibre, medicine, and in religious and magical rituals. The wild species of the Kandi region are widely used as medicines. But, with the urbanization of the region and increasing trend of allopathic medicines, the knowledge of these medicinal plants is slowly and steadily disappearing from the system.

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The knowledge of medicinal plants of our surroundings is very important for us, as it provides benchmark information for their further studies and also helps in finding solutions of many unsolved medical puzzles. Sustainable use of these resources and strategies to conserve them is very essential, because with their extinction the gene pool also vanishes.

Ethnomedicinal studies have been carried by various workers (Sharma, 1992; Sharma and Gupta, 1996; Sharma and Gupta, 1997; Manhas and Rao, 2012; Sharma *et al.*, 2012; Bhatia *et al.*, 2014; Bhatia *et al.*, 2015; Rao *et al.*, 2015; Sharma and Manhas, 2015) in the Kandi region of Jammu and Kashmir. The present study was carried out with an aim to enlist some the important medicinal plants of Kandi regions of Basohli tehsil of Kathua district along with their uses.

2. Material and Methods

2.1 Study Site

Kathua district (Jammu and Kashmir) is one of the important districts of Kandi region of Jammu province. The district is situated in extreme south of Jammu and Kashmir and is popularly known as “gateway of the state” since it provides the much needed rail and road link rest of the country. The district is spread over 2, 651 km^2. It comprises of tehsils of Kathua, Hiranagar, Billawar and Basohli. The present investigation was restricted to tehsil Hiranagar.

2.2 Methodology

The area of work was investigated a number of times and locals especially elderly people, Vadya and Hakims were interviewed for the plant used by them in treating different types of ailments. The plants were gathered and their uses in different ailments were recorded.

3. Results

1. *Achyranthes aspera* Linn. (Family: Achyranthaceae)

Local Name : *Parkanda*
Part Used : Leaves
Used for : Whooping cough and fever
Method of Use : The leaves of *Achyranthes aspera* and *Adhatoda vasica* are burnt to obtain ash which is put in the pot containing water for four hours. Then it is filtered and used with *Ghee* in the preparation of *Halva* and taken to cure whooping cough and fever.

2. *Achorus calamus* Linn. (Family: Araceae)

Local Name : *Barian*
Part Used : Rhizome
Used for : Vermifuge
Method of Use : The dry rhizome is chewed and sap is taken in to expel intestinal worms. The rhizome is also chewed against infection of throat.

3. *Adhatoda vasica* Nees (Family: Acanthaceae)

Local Name : *Brankar*
Part Used : Leaves and Roots
Used for : Asthma, chest diseases, diarrhea, dysentery, cough and malaria.
Method of Use : The dried leaves are smoked for curing asthma, cough and chest diseases. Fresh leaves are grinded and the juice is taken to cure diarrhea and dysentery. Roots are boiled and the extract is given to cure malaria fever, chest diseases and cough. It has expectorant action, which gives relief in bronchitis.

4. *Azadiracta indica* A. Juss. (Family: Meliaceae)

Local Name : *Neem/Nim*
Part Used : Entire plant
Used for : Skin diseases, fever, tonic, antiseptic and insecticide.
Method of Use : Seeds are source of Margosa oil, used against skin diseases. Bark and cortex acts as tonic and is used against fever. The very bitter leaves are used as antiseptic. Extract obtained from leaves is used as a tonic. The leaves are used as insecticides. Powdered root bark is considered astringent and febrifuge.

5. *Butea monosperma* (Lamk.) Thunb. (Family: Fabaceae)

Local Name : *Palah*
Part Used : Flower and leaves
Used for : Urinary troubles
Method of Use : The flowers are boiled in water and extract is given to cure urine troubles. Gum exuded from the wounds is astringent, mild in operation, adapted to children.

6. *Calotropis procera* Linn. (Family: Aslepiadaceae)

Local Name : *Desi Ak*
Part Used : Stem
Used for : Skin pimples and allergy.
Method of Use : The stem is boiled in water, the extract is cooled and the cream obtained is massaged on the affected parts of the body.

7. *Curcuma domestica* Linn. (Family: Zingiberaceae)

Local Name : *Basaar or Haldi*
Part Used : Rhizome
Used for : Clotting of blood
Method of Use : The powder of dry rhizome mixed with mustard oil is used for clotting of blood.

8. *Emblica officinalis* Gaertn. (Family: Euphorbiaceae)

Local Name : *Amla*
Part Used : Fruit
Used for : Asthma, piles, fever, flatulence, constipation and vomiting.
Method of Use : The Dry fruits of *Terminalia chebula* (*harad*), *Terminalia bellirica* (*bahera*) and *Emblica officinalis* are taken in the ratio of 1:2:4 and grinded to powder (*trifla*). The powder is taken variously to cure Asthma, piles, fever, flatulence, constipation and vomiting. The dry fruit powder is also taken as blood purifier and refrigerant.

9. *Mentha piperita* Linn. (Family: Lamiaceae)

Local Name : *Ban putna*
Part Used : Leaves
Used for : Cholera.

Method of Use : The leaves of *Mentha piperita* and seeds of *jowain* are boiled in water filtered and kept in bottle. One cup is given to adult while two spoons are given to children to cure cholera.

10. *Murraya koenigii* (Linn.) Spreng. (Family: Rutaceae)

Local Name : *Dhrankru*
Part Used : Leaves and Roots
Used for : To remove pus.
Method of Use : The leaves warmed with mustard oil are tied on the abscesses (pimples) to remove pus. The roots are used as substitute for *mulathi* in the preparation of local medicines. The stem is also used as *datum* (tooth brush).

11. *Ocimum gratissimum* Linn. (Family: Lamiaceae)

Local Name : *Ban tulsi*
Part Used : Leaves
Used for : Rheumatism, seminal weakness & gonorrhoea.
Method of Use : The herb is used for aromatic baths of fumigations in treatment of rheumatism and paralysis. Decoction of the leaves is used in seminal weakness; for gonorrhoea. The decoction of leaves is also used to cure common cold and fever.

12. *Sesamum indicum* Linn. (Family: Pedaliaceae)

Local Name : *Til*
Part Used : Seeds
Used for : Joint pain and rheumatism.
Method of Use : The seed oil (*mitha tel*) is warmed and is massaged on the body to get relief from joint pains and rheumatism.

13. *Solanum nigrum* Linn. (Family: Solanaceae)

Local Name : *Kaein Kothi*
Part Used : Leaves
Used for : Eye troubles and burnt injuries.
Method of Use : The leaves are crushed and sap obtained is dropped into sore eyes and also applied in case of burnt injuries.

14. *Terminalia bellirica* Retz. (Family: Combretaceae)

Local Name : *Bahera*
Part Used : Fruit
Used for : Chest diseases, Eye tonic and hair growth tonic.
Method of Use : Fruits are grounded in water and paste is applied on burnt spots. It is one of the constituents of *trifla* used as tonic for eye and hair growth. Also used as blood purifier and to cure chest diseases.

15. *Terminalia chebula* Retz. (Family: Combretaceae)

Local Name : *Harad*
Part Used : Fruit
Used for : Toothache, bleeding and ulceration of gums
Method of Use : Fruits are dried, grounded and the powder is used for curing toothache, bleeding and ulceration of gums. It is one of the constituent in the preparation of *Trifla*, which is given against asthma, vomiting, dysentery and flatulence.

16. *Thalictrum foliosum* DC. (Family: Ranunculaceae)

Local Name : *Kronkal jari*
Part Used : Roots
Used for : Ear troubles.
Method of Use : The roots are boiled in mustard oil; cooled and three to four drops of it are dropped into the ear to remove out any insect. The oil is also used to cure ear pain.

17. *Trachyspermum ammi* (Linn.) Sprague ex Turrill (Family: Apiaceae)

Local Name : *Jowain*
Part Used : Seeds
Used for : Dyspepsia, indigestion and flatulence.
Method of Use : Seed are taken with warm water in the indigestion, flatulence and dyspepsia. Seeds of *jowain*, *sounf* (*Foeniculum vulgare*), and *pudina* (*Mentha longifolia*) is given in cholera, diarrhea and indigestion. Seeds of *Jowain* and *til* are taken in as antidiuretic.

18. *Viola odorata* Linn. (Family: Violaceae)

Local Name : *Banksha*
Part Used : Flower
Used for : Cough and sore throat.
Method of Use : The flowers are boiled in water and the ark (decoction) is given to cure sore throat. The flowers are used as an ingredient in tea which is given to cure cold

and cough. It is also laxative and checks bleeding.

19. *Vitex negundo* Linn. (Family: Verbenaceae)

Local Name : *Vanna*
Part Used : Leaves
Used for : Abscesses, fever and stomach pain.
Method of Use : Leaves are warmed with mustard oil in a pot and applied on the abscesses (pimples). The leaves are boiled in water and steam is taken in to remove general fever. The leaves are grounded and the sap is mixed with *gur* which is given to cure stomach pain in cattle.

20. *Zanthoxylum alatum* Roxb. (Family: Rutaceae)

Local Name : *Timru*
Part Used : Seeds
Used for : Relief from toothache.
Method of Use : The seeds are chewed for relief from toothache. The stem is used to clean teeth.

21. *Zea mays* Linn. (Family: Poaceae)

Local Name : *Kukri/Mak*
Part Used : Cob silk
Used for : Urinary troubles.
Method of Use : The dried styles are boiled in water and decoction is given to cure non-passage of urine.

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A study of transport properties of L-arginine in aqueous solutions of D-maltose monohydrate at 298.15 K: A viscometric approach

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Abstract: Viscosities of L-arginine in water and in aqueous–D-maltose monohydrate (MM) (2%, 4% and 6% of MM, w/w in water) mixed solvents have been determined as a function of molal concentration of L-arginine at 298.15 K. The viscosity values have been analysed on the basis of the Jones–Dole equation; and viscosity B-coefficients were calculated. The Gibbs free energies of activation of viscous flow per mole of solvent, $\Delta\mu^{\circ}_{1}{}^{\#}$, per mole of solute, $\Delta\mu^{\circ}_{2}{}^{\#}$, were also calculated using viscosity data. The calculated Jones-Dole B-coefficients and activation free energy, $\Delta\mu^{\circ}_{2}{}^{\#}$, results have been interpreted in terms of ionic–hydrophilic, hydrophilic-hydrophilic and hydrophilic–hydrophobic interactions. It has been observed that there exist strong solute–solvent interactions in these systems, which increases with increase in MM concentration in solution.

Key words: Viscosity; L-arginine; D-maltose monohydrate; Viscosity B-coefficients; Activation free energy

1. Introduction

The polyhydroxy compounds play a very important role in stabilizing the native conformations of proteins/enzymes [1-3]. Saccharides are widely distributed in various forms of life as essential moieties of glycoproteins, glycolipids, nucleic acids and polysaccharides. Because of conformational flexibility, saccharides play significant roles in many biological processes such as signaling, cell-cell recognition and molecular and cellular communication [4-6]. The stabilization of native conformations of proteins has been related to various non-covalent interactions like hydrogen bonding, electrostatic and hydrophobic interactions [7, 8].

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The study of these interactions provides important insight into the conformational stability and folding/unfolding of globular proteins [9] and are found implicated in several biochemical and physiological processes of a living cell [10-12]. Lee and Timasheff [13] studied the thermal transitions of α-chymotrypsin, chymotrypinogen and ribonuclease in sucrose and argued that the sucrose stabilize proteins against thermal damage. The complex conformational and configurational factors determining the structure of proteins in sugar solution makes the study of protein-sugar interactions difficult. Therefore interactions of the model compounds of proteins, i.e., amino acids in aqueous saccharide solution are investigated. Since amino acids are the model compounds of protein molecules, their thermodynamic and transport properties in aqueous solutions provide valuable information on solute-solute and solute-solvent interactions that are useful in studying the stability of proteins. Keeping this in mind, a lot of work has been done on amino acid–sugar interactions involving the viscometric technique. Nain et al. have studied the viscometric studies of L-methionine in aqueous D-glucose solutions [14]; L-threonine in aqueous glucose solutions [15]. Pal et al. have studied the viscosities of diglycine in aqueous xylose, L-arabinose, and D-ribose solutions [16]; of glycine, L-alanine, L-valine and L-leucine in aqueous lactose

solutions [17]; of glyglyglycine in aqueous sucrose and fructose solutions [18]. Palani et al. have studied the viscosities of L-serine, L-glutamine and L-asparagine in aqueous D-glucose solutions [19]. Ali et al. have measured the viscosities of glycine, DL-alanine, L-serine, and DL-valine in aqueous D-glucose solution [20]. Zhao et al. have studied the viscosities of arginine in aqueous D-glucose and sucrose solutions [21]. Riyazuddeen et al. have reported the viscosities for L-alanine, L-threonine and L-glycylglycine in aqueous D-glucose and D-sucrose solutions [22]. But, to the best of our knowledge, there are very few studies on the transport properties of amino acid–sugar interactions with positively charged side chain in aqueous solutions [21,23,24,25] and no viscometric studies have been done on L-arginine in aqueous–D-maltose monohydrate solutions with varying maltose concentrations at 298.15 K. These considerations led us to undertake the viscometric study of L-arginine (with positively charged R group) in aqueous-D-maltose monohydrate solutions.

The present investigation focuses on studying the interactions of L-arginine in water and aqueous-D-maltose monohydrate (MM) (2%, 4% and 6% MM, w/w in water) solvents as a function of molal concentrations of L-arginine at 298.15 K employing the viscometric technique. Using the viscometric data, the Jones–Dole viscosity B-coefficients and activation free energy values have been computed. The obtained viscosity, viscosity B-coefficients and activation free energy values have been discussed in terms of ionic–hydrophilic groups, hydrophilic–hydrophilic groups and hydrophilic–hydrophobic groups interactions operative in the studied systems.

2. Experimental

L-Arginine and D-Maltose monohydrate, herein abbreviated as MM, was used as such (Table 1) without further purification, except drying in an oven for 24 h. The aqueous-saccharide solutions (2%, 4% and 6% of MM, w/w in water) were prepared using triple distilled water with specific conductance less than 1 x 10^{-6} S cm^{-1}. The saccharide solution was used as solvent to prepare L-arginine solution of eight different molal concentrations (ranging from 0.0 m to 0.2 m). An electronic single pan five digit analytical balance (Mettler; Model AE-240) with a precision of ±0.00001 g was used for weighing. All the solutions were prepared with care and stored in special airtight bottles to avoid the exposure of solution to air and evaporation. The possible error in the mole fraction is calculated to be less than ±1x10^{-4}. The densities of solutions were measured using a single-capillary pycnometer (made of Borosil glass) having a bulb capacity of ~10 mL. The capillary, with graduated marks had a uniform bore which could be closed by a well-fitted glass cap. The pycnometer was calibrated by measuring the density of triply distilled water at 298.15 K. The uncertainty in density measurements was within ±0.03 kg m^{-3}. The viscosities of the solutions were measured by using Ubbelohde type suspended level viscometer. The test solution in the viscometer was allowed to stand for about 30 min in a thermostatic water bath so that the thermal fluctuations in viscometer were minimized. The time of flow was performed using an electronic watch with the resolution of 0.01 s. The average of at least four readings reproducible within 0.1 s was used as the final efflux time. The viscosities of water at different temperatures were taken from the literature [24]. The uncertainty in viscosity measurements was within ±1x10^{-6} N s m^{-2}. The accuracies in measurements of the viscosity values have been ascertained by comparing the measured values for the water with the corresponding literature values at different temperatures. The temperature of the sample solutions was maintained to an accuracy of ±0.02 K in an electronically controlled thermostatic water bath (Model: TIC-4000N, Thermotech, India).

3. Results and discussion

The experimental values for density, ρ of L-arginine in water and aqueous-MM (2%, 4% and 6% MM, w/w in water) solvents as a function of molal concentrations of L-arginine at 298.15 K are listed in the Table 2. The experimental values for viscosity of L-arginine in water and aqueous-MM (2%, 4% and 6% MM, w/w in water) solvents as a function of molal concentrations of L-arginine at 298.15 K are listed in the Table 3.

Table 1. Provenance and purity of the chemical samples studied.

Chemical name	Provenance	Purification method	Final mass fraction purity
L-Arginine	Sigma Aldrich, India	Used as received	> 0.998
D-Maltose Monohydrate (MM)	Sigma Aldrich, India	Used as received	> 0.998

Table 2. Densities (ρ/kg m^{-3}) of solutions of L-arginine in water, aqueous–MM (2%, 4% and 6%) as function of molality (m/ mol kg^{-1}) of L-arginine at 298.15 K.

m	L-Arginine in water (MM)	L-Arginine in 2% (MM)	L-Arginine in 4% (MM)	L-Arginine in 6% (MM)
0.000	997.07	1004.26	1011.64	1020.59
0.025	998.35	1005.50	1012.86	1021.78
0.050	999.63	1006.74	1014.08	1022.97
0.075	1000.91	1007.98	1015.30	1024.16
0.100	1002.19	1009.22	1016.52	1025.35
0.125	1003.47	1010.46	1017.74	1026.54
0.150	1004.75	1011.70	1018.96	1027.73
0.175	1006.03	1012.94	1020.18	1028.92
0.200	1007.31	1014.18	1021.40	1030.11

Table 3. Viscosities (η x 10^3/N s m^{-2}) of solutions of L-arginine in water, aqueous–MM (2%, 4% and 6%) as functions of molality (m/ mol kg^{-1}) of L-arginine at 298.15 K.

m	L-Arginine in water (MM)	L-Arginine in 2% (MM)	L-Arginine in 4% (MM)	L-Arginine in 6% (MM)
0.000	0.8903	0.9355	0.9838	1.0365
0.025	0.9005	0.9486	1.0008	1.0580
0.050	0.9108	0.9618	1.0179	1.0796
0.075	0.9210	0.9750	1.0350	1.1012
0.100	0.9313	0.9883	1.0521	1.1229
0.125	0.9416	1.0015	1.0693	1.1446
0.150	0.9519	1.0148	1.0865	1.1663
0.175	0.9623	1.0282	1.1037	1.1881
0.200	0.9727	1.0415	1.1209	1.2100

The viscosities of L-arginine in water and aqueous-MM (2%, 4% and 6% MM, w/w in water) solvents at 298.15 K are plotted in Fig. 1. The Jones–Dole [26] equation describes the relative viscosities of solutions as functions of their concentration and viscosity results were analysed by using equation of the form

$$\eta_r = \frac{\eta}{\eta_o} = 1 + Am^{1/2} + Bm \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots.. 1$$

where η_r is the relative viscosity of the solution; m is the molal concentration of solution; η and η_o are the viscosities of solution and solvent, respectively; A, the Falkenhagen coefficient, reflects the solute–solute interactions

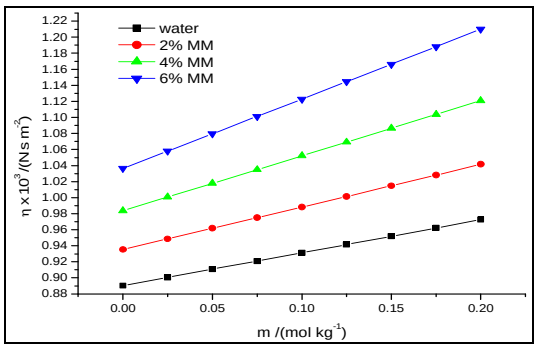

Fig. 1. Variation of viscosity (η) with molality (m) of L-arginine in water, and MM + water solutions at 298.15 K

associated with the size and shape of solute, and B, the Jones-Dole coefficient, is a measure of structural effect induced by solute–solvent interactions [27,28] The B-coefficients have been given in Table 4.

Table 4. B-coefficients (dm^3 mol^{-1}) of L-arginine in water and aqueous-MM (2%, 4% and 6% maltose, w/w in water) solutions at 298.15 K.

Solute	Solvent	298.15 K
L-Arginine	Water	0.465
L-Arginine	2% aq. MM solution	0.570
L-Arginine	4% aq. MM solution	0.700
L-Arginine	6% aq. MM solution	0.841

The Falkenhagen A-coefficients which represents solute–solute interactions, are found to be much smaller in magnitude as compared to Jones-Dole B-coefficients and therefore can be considered negligible in case of non-electrolytes [22,29]; therefore, it is often ignored in non-electrolyte systems. Hence A = 0 has been taken in this study. The plots of $(\eta_r-1)/m^{1/2}$ versus $m^{1/2}$ (Fig 2) have been found to be linear at all temperatures for the studied systems in accordance with the Jones–Dole equation.

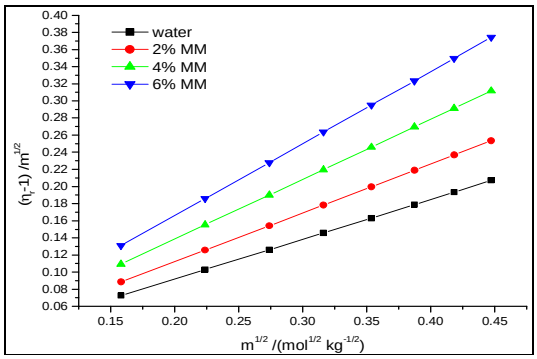

Fig. 2. Variation of $[(\eta_r-1)/m^{1/2}]$ with molality (m) of L-arginine in water, and MM + water solutions.

The Jones-Dole B-coefficient has significance in the description and understanding of ionic processes, e.g., solvation effects of cations and anions. It is an empirical term which measures the size, shape and charge effects as well as the structural effect induced by solute–solvent interactions.

The viscosity B-coefficient values are positive for L-arginine in water and aqueous-MM (2%, 4% and 6% MM, w/w in water) solvents at all the molal concentrations and at temperature of study. The viscosity B-coefficients of L-arginine in 2.5%, 5% aqueous D-xylose and 2.5%, 5% aqueous L-arabinose solutions at 298.15 K are 0.508, 0.582 and 0.525, 0.599 [24] (dm^3 mol^{-1}), respectively, while in aqueous medium it has been reported as 0.404 [24] (dm^3 mol^{-1}). The viscosity B-coefficients of L-arginine in 0.5 M aqueous sucrose [30], 1.0 m aqueous glucose, 0.3 m aqueous glucose, 0.3 m aqueous ascorbic acid [21], 0.3 m aqueous galactose, 0.3 m aqueous maltose, 0.3 m aqueous lactose [31] solutions at the same temperature are reported as 0.826, 0.752, 0.731, 0.649, 0.763, 0.357, 0.348 (dm^3 mol^{-1}), respectively.

The viscosity B-coefficient gives valuable information regarding the solvation of the solutes and their effects on the structure of solvent in the surrounding of the solute molecules. Large and positive B values indicate a structure to allow the solute to act on the solvents. B coefficient increase when water is replaced by MM; i.e., these saccharides are acting as water structure-maker by hydrogen bonding. The viscosity B-coefficients increase with increasing concentration of MM (Fig. S1 of supplementary material) due to increase in friction that may prevent water flow with increasing concentration of maltose. Thus, the inference drawn from the values of viscosity B-coefficients supports the behaviour that there exist strong solute–solvent interactions as compared to solute–solute interactions in these solutions.

Thermodynamics of viscous flow

According to Erying's simple model [34], the average activation free energy of a single solute in a pure solvent can be calculated from the following equation.

$$\eta_o = \left(\frac{hN_A}{V^\circ_1}\right) \exp\left(\frac{\Delta\mu^{\circ\#}_1}{RT}\right) \ldots\ldots\ldots\ldots\ldots\ldots 2$$

This can be rearranged as

$$\Delta\mu^{\circ\#}_1 = RT \ln\left(\frac{\eta_o V^\circ_1}{hN_A}\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

where h, N_A, T, and R are Planck's constant, Avogadro's number, the temperature, and universal gas constant, respectively. V°_1 (= M/ρ_o) is the apparent (partial) molar volume of the solvent (aqueous-MM); M is the molar mass of solvent; ρ_o is the density of the solvent; and $\Delta\mu^{\circ\#}_1$, is chemical potential or Gibbs free energy of activation per mole of the solvent at temperature of 298.15 K. The $\Delta\mu^{\circ\#}_1$, and V^o_1 values are listed in Table 5. The activation Gibbs free energy, $\Delta\mu^{\circ\#}_1$, for the viscous flow of L-arginine in the solvent is related to viscosity B-coefficients as reported by Feakins et al. [35,36] in the following way.

$$B = \frac{(V^\circ_1 - V^\circ_2) + V^\circ_1(\Delta\mu^{\circ\#}_2 - \Delta\mu^{\circ\#}_1)/RT}{1000} \ldots. 4$$

Table 5. Apparent (partial) molar volume of solvent (V^o_1), free energy of activation for solvent ($\Delta\mu^{\circ\#}_1$) and free energy of activation for solution ($\Delta\mu^{\circ\#}_2$) at 298.15 K.

T/298.15 K	$V^o_1 \times 10^6$ (m^3 mol^{-1})	$\Delta\mu^{\circ\#}_1$ ($kJmol^{-1}$)	$\Delta\mu^{\circ\#}_2$ ($kJmol^{-1}$)
L-Arginine in water	18.07	9.16	87.30
L-Arginine 2% aq. MM solution	18.29	9.32	100.99
L-Arginine 4% aq. MM solution	18.51	9.47	117.38
L-Arginine 6% aq. MM solution	18.72	9.63	135.11

Equation (4) rearranges to give the Gibbs free energy of activation per mole of the solute, $\Delta\mu^{\circ\#}_2$,

$$\Delta\mu^{\circ\#}_2 = \Delta\mu^{\circ\#}_1 + \left(\frac{RT}{V^\circ_1}\right)[1000B - (V^\circ_1 - V^\circ_2)] \ldots .5$$

where $V^o_2 = V^\circ_\phi$, is the limiting apparent (partial) molar volume of the solute. $\Delta\mu^{\circ\#}_2$, is Gibbs free energy of activation per mole of the solute for viscous flow of solution. The $\Delta\mu^{\circ\#}_2$, values are given in Table 5. According to Feakins, if a solute is completely coordinated in the ground-state solvent, formation of the transition state involves solute–solvent bond breaking and a reduction in the coordination number of the solute takes place. The $\Delta\mu^{\circ\#}_2$ values are large and positive than those of $\Delta\mu^{\circ\#}_1$ in L-arginine in water and aqueous-MM (2%, 4% and 6% MM, w/w in water) solvents indicating stronger solute–solvent interactions and suggesting that formation of transition state is less favoured in the presence of L-arginine. This implies that the formation of the transition state is accompanied by the rupture and distortion of the intermolecular bonds in the solvent structure. This further suggests that the interactions between L-arginine and aqueous-MM (2%, 4% and 6% MM, w/w in water) solvents molecules in the ground state are stronger than in the transition state. The $\Delta\mu^{\circ\#}_2$, values increases with rise in % of maltose for L-arginine solutions (Fig. S2 of supplementary material), indicating that solute–solvent interactions increases with rise in % of maltose thus making the flow easier [37]. Therefore, the conclusions drawn from $\Delta\mu^{\circ\#}_2$ are in agreement with those drawn from the trends of B values.

4. Conclusions

The viscosities, η, of solutions of L-arginine in aqueous-MM solvents 2%, 4% and 6% of MM, w/w in water, were measured at 298.15 K. From the experimental results, viscosity B-coefficients, the Gibbs free energies of activation of viscous flow per mole of solvent, $\Delta\mu^{\circ\#}_1$, per mole of solute, $\Delta\mu^{\circ\#}_2$ were calculated. The viscosity B-coefficients of L-arginine in water and aqueous-MM (2%, 4% and 6% MM, w/w in water) solutions have been found to be positive for all the systems. The positive and large $\Delta\mu^{\circ\#}_2$ values of L-arginine in water and aqueous-MM (2%, 4% and 6% MM, w/w in water) solutions than those of $\Delta\mu^{\circ\#}_1$ at 298.15 K suggest that solute–solvent interactions are stronger than solvent solvent interactions in all the studied systems.

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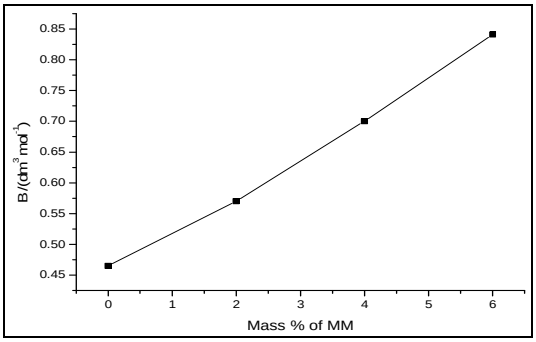

Fig. S1. Variation of Jones-Dole coefficient (B) with mass % of MM for L-arginine in water and aqueous - MM solution at 298.15 K.

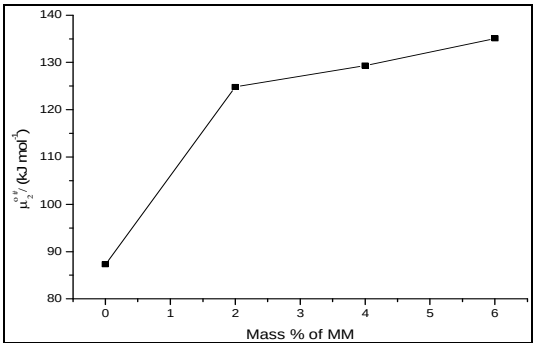

Fig. S2. Variation of Gibbs free energy of activation per mole of the solute ($\Delta\mu^{\circ\#}_2$) with mass % of MM for L-arginine in water and aqueous - MM solution at 298.15 K.

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Fishing Gears used in River Jhelum – A Case Study of District Baramulla

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Abstract: River Jhelum, also known as "life line of Kashmir" is the mightiest lotic water body of Kashmir valley. River Jhelum originating from the Verinag spring in the foot hills of Pir Panjal travels a distance of 724 km before merging in river Chanab at Bunji Pakistan. River Jhelum flows through the major cities and towns of Kashmir including Baramulla. In Baramulla river Jhelum travels a distance of 90 km. The river Jhelum in habitats the diverse fish fauna ranging from indigenous *Schizothorax* and *Mahseer* to exotic *Cyprinus carpio* (Common carp). The river Jhelum has been a source of livelihood for many fishermen living in the vicinity of river Jhelum. Various types of fishing gears are employed to harvest the fish wealth of River Jhelum. The present paper gives an account of major fishing gears used in the section of River Jhelum flowing through district Baramulla.

Key words: Jhelum; fish fauna; gears; Kashmir.

1. Introduction

The valley of Kashmir, also known as "Paradise of Earth" is surrounded by high mountains of Himalayas, which vary in their heights between 1000 feet to 1800 feet above mean sea level, extending from 33^{o} 22′ N to 34^{0} 43′ N and 73^{0} 52′ E to 75^{0} 42′ E covering an area of about 15948 Sq. Km. The Kashmir is blessed with enormous and rich aquatic resources in the shape of rivers, lakes, streams, high altitude lakes, springs and low lying areas covering a total water spread area of about 32765.3 hectares which is nearly 2% of total area of the Kashmir Valley.

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The major water bodies of Kashmir include the giant river Jhelum, India's largest fresh water lake Wular, world famous Dal lake, Manasbal lake, Anchar lake, Nageen lake, Springs like Achabal, Kokernag and Verinag, Streams like Erin, Sind, Madhumati and Bringi and high altitude lakes like Gangabal, Kishansar, Vishansar etc. The river Jhelum is the major water body of the Kashmir. River Jhelum was known as **"Vatista"** in ancient India and **"Vyth"** in Kashmiri language. It is considered as the life line of the Kashmir as it flows through the entire Kashmir valley from South to North and catering the requirements of the 25% of the population of the Valley. Its water is used for drinking, domestic activities, irrigation and generation of electricity. The river starting its journey from Verinag spring, travels first 241 kms in Kashmir, next 162 km in POK (Pakistan Occupied Kashmir) and remaining 321 km in Pakistan, travelling a total distance of about 724 km before merging into river Chenab at Bunji in Pakistan. The river Jhelum flows at a moderate speed from Khanabal (Anantnag) to Khadnayar (Baramulla) making it ideal for fishing activities. The Jhelum beyond Khadnayar flows through a george with rapid current makes the process of fishing impossible with the routine gears, but fishing is done only through angling. The river Jhelum has a catchment area of about 12,75,696 hectares and is joined by many tributaries. At Khanabal in Anantnag the river, Jhelum is joined by two snow-fed streams

namely Bringi and Arapath. The Jhelum receives Lidder and Veshav tributaries at Sangam (Anantnag). On its way in Srinagar near Dal Gate, the Jhelum is linked with Dal Lake through "Tsont Kol" which receives the surplus water of Dal Lake. At the lower end of the Srinagar city, Jhelum is joined by another stream Dudganga. The river is also connected with Manasbal Lake through a small channel near Sumbal town of Bandipora. The Jhelum merges into Wular Lake at Banyari Bandipora. The river takes a pass out of Wular Lake at Sopore Baramulla. The Wular Lake plays a vital role in maintaining the fish stock in the river Jhelum. The river receives the Pohru stream at Doobgah Sopore. In Baramulla two major hydro electric power projects are constructed on the river Jhelum. At Uri the Jhelum is joined by a Bandi Nala stream. After completing its journey in the valley, the Jhelum crosses the LOC (line of control) at Lalpul, the last village on the bank of river Jhelum.

2. Materials and Method

During the research work, the survey was conducted along the course of river Jhelum to gather first hand information from the locals particularly from fishermen community about the fish and fisheries of the river Jhelum. The design, structure and working of gears used for harvesting fish wealth for river Jhelum in district Baramulla was thoroughly investigated. The area covered under study is the stretch of river Jhelum flowing from Sopore to Baramulla town.

3. Observations and discussion

The river Jhelum travels a distance of about 90 km in district Baramulla flows through Sopore town, Baramulla town and Uri region. From Sopore to Khadnayar Baramulla river Jhelum flows at a moderate speed making it ideal for fishing activities. The Jhelum beyond Khadnayar flows through a george with rapid current making the harvest of fish possible only through angling. Besides the speed of flow, this stretch of River Jhelum had large boulders in it.

Fish Fauna: The river Jhelum provides habitat to wide variety of fish including both indigenous and exotic varieties. In Baramulla, the river Jhelum is inhabitated by both indigenous and exotic fish fauna. At present the fish catch of river Jhelum is dominated by Common carp. The stretch of river Jhelum beyond Khadnayar Baramulla used been enriched with Golden Mahseer (*Tor putitora*) few decades back, but the species has now almost disappeared because of construction of Mangla dam in Mirpur in POK (Pakistan Occupied Kashmir), which prevented the annual breeding migration of the fish.

Table- 1: Fish Fauna of River Jhelum

Fish Species	**Local Name**
Schizothorax ecocinus	Schuru gad
Schizothorax plagiostomous	Ale gad
Schizothorax niger	Ale gad
Schizothorax curvifrons	Satter gad
Schizothorax labiatus	Chush
Labeo dero	Ropet
Bangana diplostomous	Ropet
Crossochielus diplochilus	Tethar
Tryplophysa mermerata	-
Glyptothorax	Annur
Nemachielus	Ara guran
Tor putitora	Mahseer
Cyprinus carpio Specularis	Parim gad
Cyprinus carpio communis	Punjaib gad

Fishing gears used:

Different fishing gears are used to harvest fish from river Jhelum. Cast nets (locally known as Khul jal, Danshoh jal, Pouhkal jal) are the most common and widely used fishing gears for commercial fishing. Drag net (locally known as Khur jal / Khuk jar), hand net (Locally Known as Ath Jal or Thap jal) and long lines (locally known as Walraz) are the other gears used in the harvest of fish wealth from river Jhelum. Usually two fishermen are involved in the fishing operation with cast net, one person ores the boat while other casts the net. The hand nets used in river Jhelum are conical basket shaped nets attached to a wooden frame and having a wooden handle.

(i) Cast net

Cast nets are locally known as Khul jal, Danshoh jal, Pouhkal jal and Gilvan jal. It is most commonly used net. It is made up of nylon and cotton thread, generally the fishermen use nylon made cast net. It is circular having the shape of an umbrella. The size range used is between 1.0 to 2.0 m in diameter. The

size varies between 1.2 to 3.0 cms bar to bar. The net is provided with iron or lead sinkers of about 5.0 kgs. weight around the peripheral cord. The fishermen operate this gear throughout the year.

(ii) Lift net/Dip net

This is a type of dip net is having circular or triangular mouth. The diameter of mouth as well as the pouch depth and the length of bamboo handle are 1 meter each. This type of lift net is locally as "Kochibi jal or Khur jal". Any other type with larger diameter and deeper bag is called "sagean". These nets are used to catch fish near the water falls.

(iii) Drag Net

Drag net is locallyknown as Khur jal / Khuk jal. It also an Important fishing gear used in River Jhelum. It is a long net piece dragged in the water column from running boat. The net is automatically stretched in water column with the help of sinkers fixed along the foot rope.

(iv) Long line

Locally known as walrus, long line is a primitive gear used to harvest fish. According to the Department of Fisheries Govt. of Jammu and Kashmir the length of the long line permitted is 500 mt. The distance from one hook to other hook is 1 mt. The line rope is nylon made. Hook is either made up of stainless steel or iron. In order to sink the rope in water stone having weight 50-60 grams are used, the distance between one stone to other stone is 1 mt. Hooks of a standard numbers containing earthworms are attached to the line to lure the fish. Sometimes maize flour mixed with candy (Gur) is also used as baits. The period of fishing with long line ranges from 4-6 hours. This method usually used to catch *Schizothorax* and *Cyprinus carpio* . In River jhelum the line fishing is mainly done during April to October months.

(v) Gill net

These are the most suitable nets for fishing in deeper regions. The gill nets locally called Thani are 15 to 40m long and 1.5 to 3m wide with mesh size ranging between 45 mm and 75 mm. The use of these nets has seriously affected the regenerative capacity of the fish fauna. The Department of Fisheries have imposed ban on gill net, according to the Clause 7F of Fisheries Act.

Miscellaneous gears

Apart from the above mentioned gears, some other gears used in the sector under study are:

(i) *Panzri* (Multiple head spears)

Panzri are divided into parts one part is called *manther* having multiple spears 9-15, each having length 13 inch. The spears are made up iron. Other part is called *Shum*, which is made up of wood mainly *boudhal*, it is used to handle the net to catch the fish; its length is 10-12 ft.

This type of fishing catch method is mainly operated in Nov. - January, when water will be less. This type of fish catching method is prohibited by the authorities. This gear is

operated mainly in Wular Lake. In river Jhelum its use is confined to the stretch close to the Wular Lake.

(ii) Narsoo

The gear containing 3-5 spear headed fixed on a solid pole or deodar or bamboo about 3.5-5.0 meters long. The iron spear is made up of iron. It is used to catch mainly the big sized endemic or exotic fishes.

(iii) Guran Thap Jal

Guran thap jal is a type of hand nets used in river Jhelum. It is conical basket shaped nets attached to a wooden frame and having a wooden handle. It is a small net used for capture of fish fry. It a fixed installed at the shallow areas where fish fry are abundant. It has atotal length of 3 feet and a diameter of 4 feet.

(iv) Naushut Jal

It is a basket net, oval in shape, used to harvest the fish from shallow water. It has a height of 1.5 – 2 feet, with a diameter of 2 feet.

(v) Naskhul Jal

It is a square shaped basket net relatively larger than Naushat Jal.

Catch composition: During the survey it is found that Common Carp (*Cyprinus carpio Specularis*) dominates the overall catch, contributing about 60% of total fish landings. The *Schizothorax* contributes about 35% and others only 5% of the total fish landings.

During the survey it was further observed that the production of Indigenous *Schizothorax spp.* is maximum during winter months from nov. to feb., while the production of exotioc *Schizothorax* is same throughout the year with a slight increase in the production during the summer months.

During the research work it was also observed that there are three major fishing spots in the investigated stretch – Pohru, Dalina Ghat and Gantamulla

Conclusions

River Jhelum is an ideal habitat of variety of fish fauna. In the stretch of river Jhelum from Sopore to Baramulla Common Carp (*Cyprinus carpio*) and Snow Trout (*Schizothorax* spp.) are most dominating fish species. Cast net is the most used gear followed by lift net and drag net. Apart from these gears trap net, long line are other miscellaneous gears are used. The gill net which is prohibited by the State Govt. is also used by pouchers.

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Petrographic Characteristics of the Mineralized and Barren Igneous bodies of the Tosham Igneous Complex, Bhiwani district, Haryana, Northwestern India

Sukh Chain Sharma and Ashish Bhardwaj

Abstract: The Khanak and Tosham are the two main igneous bodies of Tosham Igneous Complex of the northwestern India. The complex exhibit ring like structures of the plutonic and volcanic igneous phases. The plutonic and volcanic igneous phases of Tosham igneous body shows intense post magmatic alteration effect, however the rock types of the Khanak igneous body are devoid from such post-magmatic alteration effect. At Khanak the igneous body is barren, whereas porphyry type Sn-W±Cu mineralization is associated with the Tosham. Petrographically, the plutonic and volcanic rocks of the Tosham and Khanak igneous bodies show more or less similar mineral assemblages. High content of quartz, total alkalies, muscovite and important accessories like, topaz, fluorite, and halite have been identified in the Tosham, whereas the rocks from the Khanak contains some proportion of amphiboles, pyroxenes and comparatively more biotite with less accessory minerals. The petrographic study suggests that the granites of the both the area are S-type, subsolvus two-feldspar granites containing minor plagioclase and dominant alkali feldspars. The mineralogical in the rocks of the Tosham and Khanak area indicates that rocks of the Tosham area are more magmatically differentiated than the rocks of the Khanak area. This might be the reason for the presence of mineralization in the Tosham and devoid of any mineralization in the Khanak area.

Key words: Haryana; Khanak; Petrographic characteristics; Tosham

Introduction

Tosham Igneous Complex (TIC) located in the northwestern part of the Indian shield. These rocks have been dated 940±20 ma old by Kochhar (1974), suggesting them to be pre-Malanies but post-Delhis. This igneous suite comprises the acid volcanis and high-level co-magmatic granites. The TIC comprises the overall at least five granite plutons of variable dimensions showing elliptical and/ or circular outcrop pattern of the plutonic and volcanic igneous phases. These granite plutons occur over a 16km from north and south and about 13km in width. Most of these plutons are very small in dimension and only the Khanak and Tosham are larger in size, which have been choose for comparative petrographic and Geochemical studies in the present paper. The presence of quartz porphyry ring dykes, association of explosion breccia with the felsite, and plutonic rocks suggest the ring type structure of the TIC. The igneous bodies of the TIC are mostly barren, however, at Tosham Sn-W±Cu mineralization is present. Many features of mineralization in the area show the similarity with the porphyry type of Precambrian mineralization. These features are epizona setting of granites; association of acid volcanics, wall rock alteration pattern, sharp contact between quartz porphyry and felsite and between granite and felsite which does not

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shows any metamorphic effects and also the association of the mineralization with the explosion breccia. Kochhar (1983, 1985) have suggested the porphyry type Cu and Sn mineralization in the area.

In the present paper two major igneous bodies of the TIC, which forms a part of Malani igneous suite situated at Tosham (mineralized) and Khanak (barren) area studied for their petrographic and geochemical characteristics. The purpose of study is to know whether the mineralized and barren igneous bodies (Tosham and Khanak), which have been considered to be a part of the Tosham Igneous Complex, belongs to the same source of the magma chamber or they belongs to the different source.

Geological Setting

Regional Geology

The present area formed a part of the Aravalli–Delhi metallogenic province in Northwestern India. The geology of the area is summarized in the **Table-1**.

Table 1. Geochronology of the Precambrian rocks in the Western Peninsular India

Rocks	Age
Vidhyan system (Jodhpur sandstone)	1400-500 Ma
Malani Igneous suite (acid volcanic and granites)	
Tosham area	750 Ma
Kirana area	870 Ma
Delhi System	1650 Ma
Raialo series	Unconformity
Aravalli System	20000-2500 Ma
Bundelkhand granite	2500 Ma
Berach granite Banded Gseiss Complex (BGC)	>2500 Ma

The Precambrian rocks of this province have been subjected to two major orogenic events during the Proterozoic; these are Aravalli Fold Belt and Delhi Fold Belt, which comprise the Aravalli and Delhi Supergroups respectively. Banded Gneiss Complex (BGC) forms the Archean basement for these fold belts. The basement has also been referred as Bhilwara Supergroup (Gupta et al., 1980) or Mewar Gneissic Complex (Roy and Kroner, 1996) due to lack of unanimity on basement–cover relationships. The Aravalli Supergroup unconformable overlies the basement. The exact age of Aravalli Supergroup is not well constrained; however, based on the basement–cover relationship of the Berach granites (2.5 Ga), a model age for the Aravalli sequence Dewaka metabasalt (2.5 Ga: MacDougall et al., 1984), and the age of the Darwal synkinamatic granite (1.8 Ga: Crawford, 1970), Sinha-Roy et al (1998) suggested a time range of 1.8–2.5Ga for the Aravalli Supergroup. Pb-Zn mineralization at Zawar and Rampura Agucha and SEDEX type mineralization at Rajpura-Dariba are associated with the Aravalli Fold Belt.

The Middle - Upper Proterozoic rock sequence of Aravalli - Delhi metallogenic province is confined to a narrow linear fold belt known as Delhi Fold Belt. This belt, represented by Delhi Supergroup, extends from Gujarat in the south to Haryana in the north and hosted a number of granite plutons ranging in age from 1600 Ma to 730 Ma (Tobisch, 1994; Choudhary et al., 1984). This Late Proterozoic felsic magmatism commenced with the intrusion of the Erinpura granite (900 Ma: Choudhary et al., 1984). Sinha-Roy et al. (1998) suggested that the emplacement of the Erinpura granite and its equivalent along and adjacent to the South Delhi Fold Belt was caused by intense compressive tectonism that followed the Delhi Supergroup sedimentation. Culmination of this magmatism is represented by widespread and dominantly felsic (locally mafic) volcanism and plutonism collectively termed the Malani Igneous Suite (745 ± 10 Ma: Bhushan, 2000). Because of the contemporaneity of ages, Choudhary et al. (1984) suggested a common mechanism for the evolution of this suite. Available geochemical data for some of these granites suggest S- or A-type chemistry (Roy, 1988). Some of these granites plutons host the W±Sn mineralization in this belt **(**Srivastava and Sinha, 1997), Bhattacharjee et al. (1993) has named it Balda–Tosham Tungsten Belt. This 500 km-long linear belt contains several small W-Sn-mineralized plutons, including the Tosham tin-tungsten deposit also Bhattacharjee et al., (1993) Fig.1.

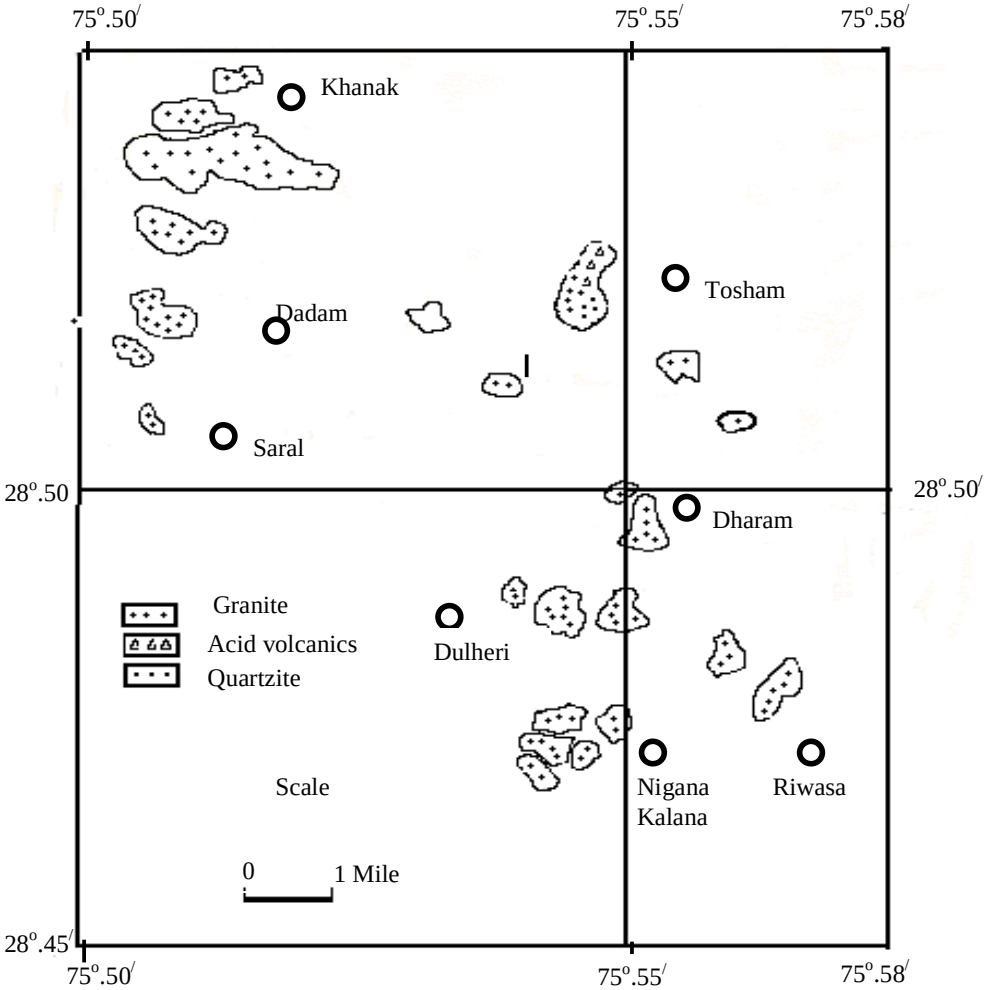

Fig.1. Regional Geological map of the area showing distribution of tungsten deposit in the Balda-Tosham tungsten belt (after Sugden et al., 1990).

Local Geology

Tosham Igneous Complex (TIC) is located on the northwestern part of the Indian Shield about 160km WNW of Delhi. This Igneous Complex comprises the small scattered (more than 5) elliptical granite bodies, which exhibit ring like structures. All these igneous bodies are barren except Tosham Igneous body, which hosts Sn-W-Cu mineralization. The geological map of the Tosham and Khanak Igneous bodies is given in Fig. 2. The outcrop of the Tosham is in form of isolated dome shaped hillock surrounded by aeolian sand and covers small area of 1.56sq.km. A barren igneous body is exposed at Khanak, which is 5 km west to the Tosham hill comprising the hillock in otherwise a flat alluvial terrain. Khanak is the largest igneous body in the TIC. The trend of the Khanak is E-W, whereas the Tosham hillock shows NE-SW. The Tosham and Khanak hillocks are separated by aeolian sand and no connectivity between the two hillocks is seen on the surface. Both Tosham and Khanak hillocks comprises same rock varieties. The area consists of two major lithounits, which comprises the plutonic and volcanic phases and the other is metasediments. The TIC is intruded into the meta- sediments of Delhi Supergroup. The nature of contact between the different phases in the area are well seen which varies considerably. The metasediments are represented by quartzite and quartz -mica - schists, which are exposed on the eastern and northwestern side of the hillock. The Tosham and Khanak pluton is texturally as well as mineralogically heterogeneous and is comprised of biotite granite, medium to coarse-grained granite, K-feldspar porphyry and quartz feldspar porphyry whereas the volcanic phase consists the felsites, explosion breccias and rhyolite.

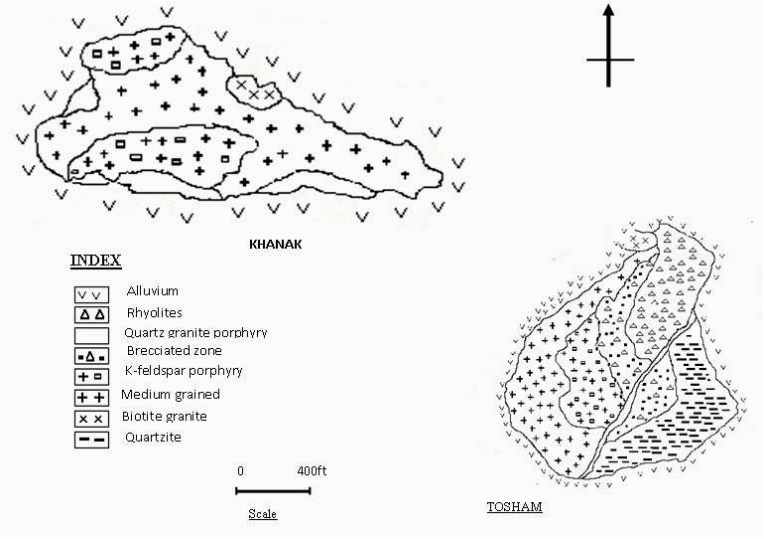

Fig. 2. Geological Map of the area (after Gupta and Eisdon, 1994)

Hydrothermal Alteration

Though the rock varieties of the Tosham and Khanak igneous bodies are same but one of the major differences between the two is the post magmatic hydrothermal alteration. However at Tosham, post magmatic hydrothermal alterations effect is observed. The intensity effect of the alteration in the different rock types varies. Mica granite shows least effect of post magmatic alteration effect, whereas the acid volcanic (rhyolite), porphyritic varieties of in the area are highly affected by the K-alteration (Fig. 3a). The various types of the alteration, which have been observed in the field and under the microscopic examination, are potassic alteration, sericitization and kaolinization, which show the overlapping, pattern. The rhyolite contains the small patches of the granite. The periphery of these granite patches shows intense potassic alteration effect (Fig. 3b). In the periphery of the mineralized quartz veins the wall rock alteration effect such as sericitization, tourmalinization and muscovitization has been observed (Fig. 3c). This post magmatic hydrothermal alteration effect has not been observed in the field as well as under the microscopic examination of the Khanak rocks.

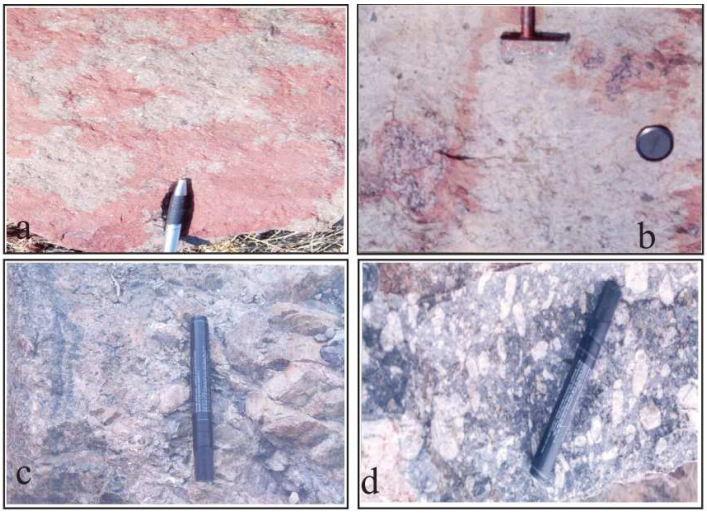

Fig. 3. Field photographs of the Tosham igneous body showing hydrothermal alteration effect. **(a)** intensive shows K- alteration effect in the rhyolite, **(b)** shows the patches of the granite within the rhyolite which are surrounded by intensive k-alteration effect, **(c)** shows the wallrock alteration effect near the mineralized quartz vein, and **(d)** shows the field photograph of quartz feldspar porphyry containing the phenocrysts of quartz and feldspar.

Mineralization

The mineralization in the Tosham has been studied by the Kochhar (1985) according to him the mineralization in the present area is porphyry type copper and tin deposit. The mineralization contains the Sn-W and associated sulfide mineralization, which is present in disseminated form and also in quartz veins. However, in the Khanak area mineralization is totally absent. In the dissemination type of mineralization at Tosham tin and tungsten mineralization is present in form of cassiterite and wolframite, which occurs as minute grains, specks, blades, massive, and dissemination in mica granite, and quartz feldspar porphyry and explosion breccias. The copper mineralization is in form of malachite and azurite occurs as encrustations and even as disseminations along the western contact of the central rhyolite and mica granite whereas the primary sulphide minerals occurs (chalcopyrite) in disseminated form. The vein type mineralization is present on the western side of the hillock in form of quartz-biotite-sulphide veinlets and small networks of quartz-cassiterite veins. These mineralized veins intruded in the quartz feldspar porphyry and mica granite in the area. The tin and tungsten mineralization in the veins occurs as erratically distributed cassiterite and wolframite ores as disseminations and/or pockets of thin bladed crystals in the quartz veins.

Petrographic Characteristics

The petrographic study of the different rock varieties in the Tosham and Khanak area is done in order to know the different mineral assemblages and textural variations in rock types. The model composition of the different rock types in the Tosham Igneous Complex, which also includes the Khanak, is given in Table 2.

Table 2. Modal composition of the Khanak and Tosham Igneous bodies of the Tosham Igneous complex

Rock type/	S. No	Quartz	Alkli feldspars	Plagiocase feldspars	Muscovite	Biotite	Pyroxenes & Amphiboles	Groundmass	Clasts	Accessories	Total
Medium grained granite	T41	30.8	30.2	6.4	3.5	10.2	0.0	13.2	-	0.5	99.0
	T32	31.1	35.2	5.1	11.2	4.6	0.0	14.3	-	1.2	99.2
	T16	31.5	30.8	7.0	4.1	7.6	0.0	12.6	-	1.5	99.1
	K6	32.2	30.1	5.3	11.3	3.2	1.3	9.7	-	1.1	99.9
	K7	30.6	29.2	5.7	9.0	8.5	3.1	9.1	-	0.8	99.4
	K8	30.1	34.6	6.1	10.2	4.0	1.6	10.4	-	0.5	99.6
	K12	32.2	30.1	6.3	10.1	6.8	1.2	11.2	-	0.4	99.8
	K13	32.7	30.0	5.4	11.1	8.8	2.8	4.0	-	0.9	99.4
Biotite Granite	T70	32.8	30.2	7.2	2.9	10.8	3.5	5.9	-	1.0	99.9
	T69	33.1	29.8	6.8	3.3	11.1	4.0	5.6	-	1.2	99.9
	T65	29.2	30.8	4.9	3.5	10.5	3.1	5.2	-	0.5	99.8
	K20	29.1	27.6	5.7	2.3	11.4	3.8	4.8	-	0.1	98.6
	K21	29.6	28.5	7.5	2.5	12.6	4.1	3.8	-	0.0	98.8
	K14	30.2	32.4	4.6	0.5	13.2	0.0	4.6	-	0.6	99.8
K-feldspar porhyry	T38	28.7	24.5	5.6	0.0	1.3	0.0	67.7	-	0.3	99.8
	T35	1.3	27.9	4.1	0.2	0.2	0.0	70.3	-	0.5	100
	T30	5.9	30.3	3.0	0.3	1.1	0.0	66.8	-	0.0	99.3
	T8	6.0	5.4	0.5	0.4	0.3	0.0	62.1	-	0.4	99.8
	K19	1.2	26.3	0.0	0.5	0.8	0.2	69.0	-	0.4	98.4
	K18	3.6	24.4	0.5	0.9	0.7	0.1	69.2	-	0.3	99.9
	K10	2.2	25.7	1.2	1.0	0.6	0.0	60.2	-	0.4	99.0
	K9	3.0	26.6	1.0	0.8	0.1	0.0	60.1	-	1.0	99.7

Quartz-feldspar porphyry	T74	14.0	17.0	2.3	5.2	4.6	0.0	49.5	-	1.3	99.9
	T6	17.8	14.2	3.1	4.2	5.2	0.0	50.0	-	0.0	99.6
	T9	18.1	18.6	3.6	4.8	6.1	0.0	49.1	-	0.0	99.0
	T5	19.0	17.5	3.5	5.3	1.3	0.0	50.2	-	0.0	99.4
	K17	18.0	17.9	2.3	1.2	7.3	0.1	47.2	-	0.0	99.7
	K16	19.8	18.1	3.2	2.4	6.4	0.2	51.0		0.0	99.3
	K15	20.4	19.4	3.6	2.1	3.4	0.0	50.2	-	0.0	99.1
Rhyolite	T80	4.6	6.9	0.1	0.0	0.6	0.0	69.8	15.3	0.0	99.9
	T31	5.1	7.0	0.0	0.0	0.5	0.0	69.3	14.3	0.0	99.6
	T28	3.9	6.5	0.2	0.0	1.9	0.0	69.3	16.3	0.0	98.7
	T13	3.2	7.6	0.0	1.0	4.2	0.0	70.2	13.5	0.0	100
	T75	3.0	6.2	0.0	1.0	4.2	0.0	68.6	14.8	0.0	98.1

The Modal composition plot is shown in Fig. 4. The scattering of the Tosham samples is due to the alteration effect in the rocks, whereas the Khanak samples shows clustering in the Syno-granite field.

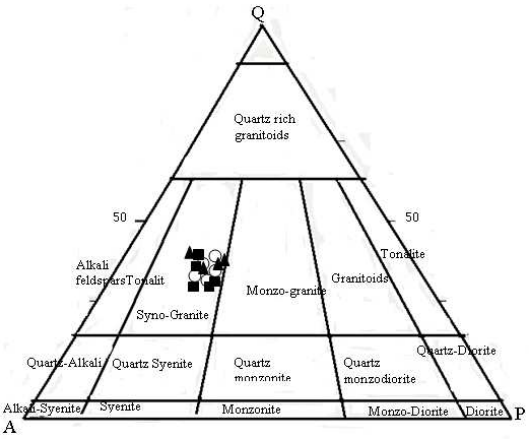

Fig. 4. Q-A-P classification diagram for Tosham and Khanak igneous bodies (Field after Streckeisen, 1973).

K-feldspars porphyry: This granite variety of the Tosham area is weathered. It also shows pervasive post-magmatic hydrothermal alteration effect. The phenocrysts of orthoclase and microcline with corroded margin are embedded within the cryptocrystalline to finely crystalline groundmass, whereas the phenocrysts of quartz are rare. The microcline phenocrysts show kaolinization effect. Along the margin of the biotite flakes chlorotization effect is observed. The modal composition of this rock is quartz, 1- 6%, k-feldspar 24-30%, plagioclase 3-5%, and muscovite and biotite, 0-1% with ground mass 62-72%. Tourmaline, allanite (Fig. 5a) and fluorite are important accessories present with rare occurrence of apatite. The ground mass is composed of quartz and feldspars, sericite and muscovite. The granite shows intergrowth between quartz and orthoclase (graphic texture) (Fig. 5b).

The K- feldspar granite of the Khanak is fresh without any alteration effect and consists phenocrysts of microcline occasionally orthoclase. There is little difference in its mineralogy from the Tosham variety. It contains quartz phenocrysts (1-2%), k-feldspars (24-26%), plagioclase (0-1%), biotite and muscovite less than 1%, and important accessories like zinnwaldite, zircon and beryl**.**

Quartz-feldspar porphyry: In the field quartz porphyry shows sharp contact with felsite and rhyolite. In the hand specimen it contains phenocrysts of quartz and plagioclase feldspars embedded in the medium to fine-grained matrix of quartz, feldspars, muscovite and biotite. The modal composition comprises the quartz 14-18%, plagioclase feldspars 2-3%, alkali-feldspars 14-18%, muscovite, 4-5%, and biotite 0.1-6% and ground mass 49-50%. The feldspars phenocrysts show oscillatory zoning (Fig. 5c). The plagioclase feldspars are altered and sericitised. Zircon which shows compositional zoning (Fig. 5d) and apatite are the important accessory mineral content present.

The quartz porphyry of the Khanak is composed of quartz and plagioclase feldspars phenocrysts. These phenocrysts are embedded into the medium to fine grained matrix of quartz, feldspars, muscovite and biotite. The quartz phenocrysts shows corroded margin. The modal composition of the different mineral

shows quatz 19-20%, plagioclase feldspars 2-3%, alkali-feldspars 18-19, muscovite, 1-2%, and biotite 6-7% and groundmass 49-50%. The plagioclase feldspars are much altered than highly altered into sericite and kaolinite. The important accessory minerals are zircon, tourmaline.

Coarse to medium grained granite: The coarse-grained granite variety is hypersolves two-mica granite containing equigranular grains of the quartz, muscovite, biotite, microcline and plagioclase. The modal composition is quartz (27-31.5%), alkali feldspars (30.1-35.2%), plagioclase (5.1-7%), biotite (3.2-10%) and muscovite (3.1-11.2%) with groundmass (10.2-14.3%). Biotite flaks are corroded and decomposed to a green chloritic pseudomorphs and secondary magnetite is developed along the cleavage planes. Mirmekite texture is the important feature of this granite (Fig. 5e).

In the Khanak area the coarse to medium grained granite constitutes the major portion the Khanak igneous body. It is hard compact and fresh without weather and postmagmatic alteration effects. It contains orthopyroxenes and amphiboles, which are absent or rare in the Tosham granites. It is composed of quartz (30-32.7%), k-feldspars (microcline with minor orthoclase) (29-34.6%), plagioclase (5-6%), biotite (3-4%), muscovite (10-11%), orthopyroxene (Fig. 5f), and amphiboles (1-3%).

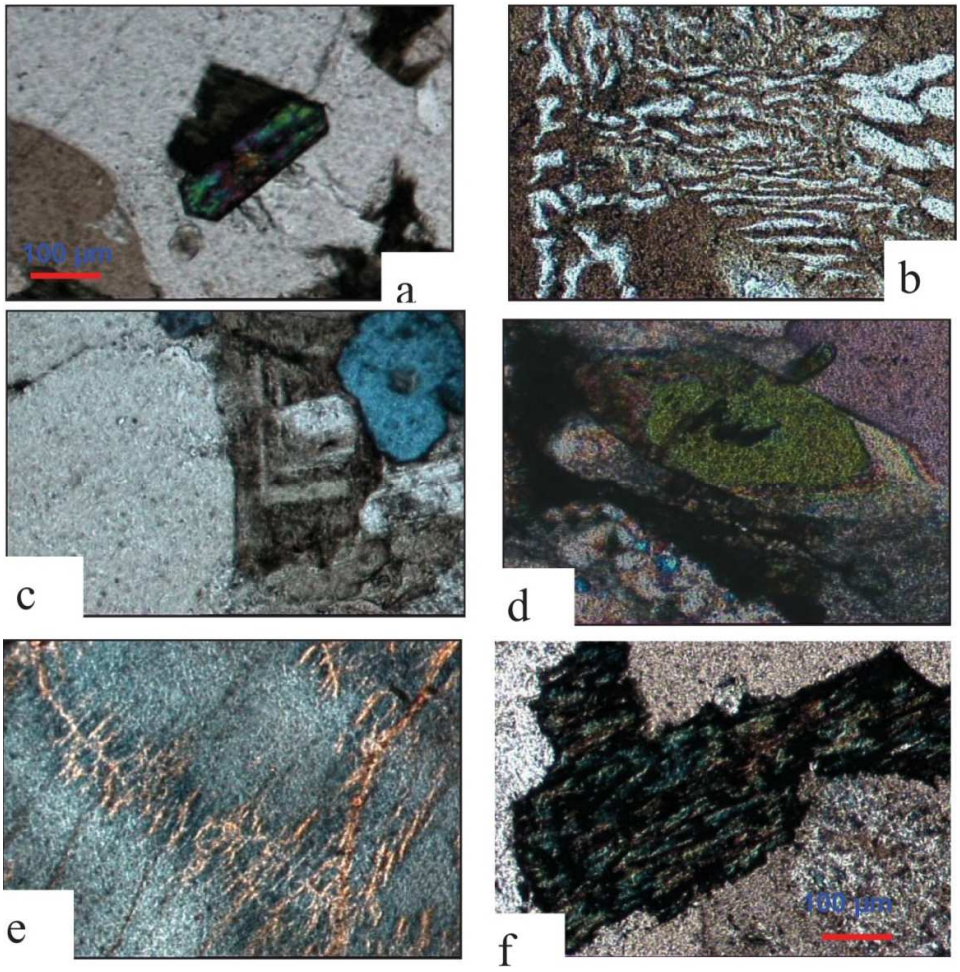

Fig. 5. Photomicrographs show the Petrographic characteristics of the Tosham and Khanak igneous bodies. **(a)** Allanite crystal within the untwined feldspar crystal, **(b)** photographs showing graphic intergrowth of quartz and k-feldspar of the k-feldspar porphyry **(c)** Presence of zoning within the feldspar crystal, **(d)** Shows typical zoning in zircon crystal, **(e)**, Mirmetic texture of the coarse grained granite of the Tosham area. **(f)**, Pyroxene crystal in the coarse to medium grained granite of the Khanak area.

Biotite granite: A small patch of this granite variety, which is hard compact, is present on the northwestern slope of the Tosham hillock. The mineralogy of the biotite granite is same as muscovite granite but the distinction between the two granite varieties is that former contains more biotite content than later, more over the plagioclase feldspars are untwined in the muscovite granite. Also in the field coarse-grained granite shows more weathering and alteration affect whereas the biotite granite is medium grained hard compact melanocratic with least weathering and alteration effect. Zircon and tourmaline (Fig. 6a) is major accessory mineral present.

In the Khanak area this granite variety also occupies the small portion and texturally appears the same but mineralogically it shows some difference from the Tosham. Some pyroxene and amphibole minerals have been observed in good proportion in the Khanak. It is composed of quartz (29-30%), k-feldspars (microcline with minor orthoclase) (27-32%), plagioclase (4-7%), biotite (11-13%), muscovite (2.5-3%), orthoprroxene**,** and amphiboles (3-4%) (Riebeckite Fig. 6b), with important accessories like sphene (Fig. 6c), zircon and beryl (Fig.6d) which is present in the orthopyroxene**.**

Rhyolite/felsites: Rhyolite constitutes the major rock units in the Tosham igneous body. It occupies the central and apical portion of this hillock and shows sharp contact with adjacent rock types. It contains fragments of the plutonic rocks indicating its younger age than plutonic phase in the area. Rhyolite contains quartz (3-5%), clasts 13-15% and k-feldspars (6-7%) phenocrysts embedded in a groundmass (69-70%), which is glassy to cryptocrystalline showing spherulitic texture (Fig. 6e).

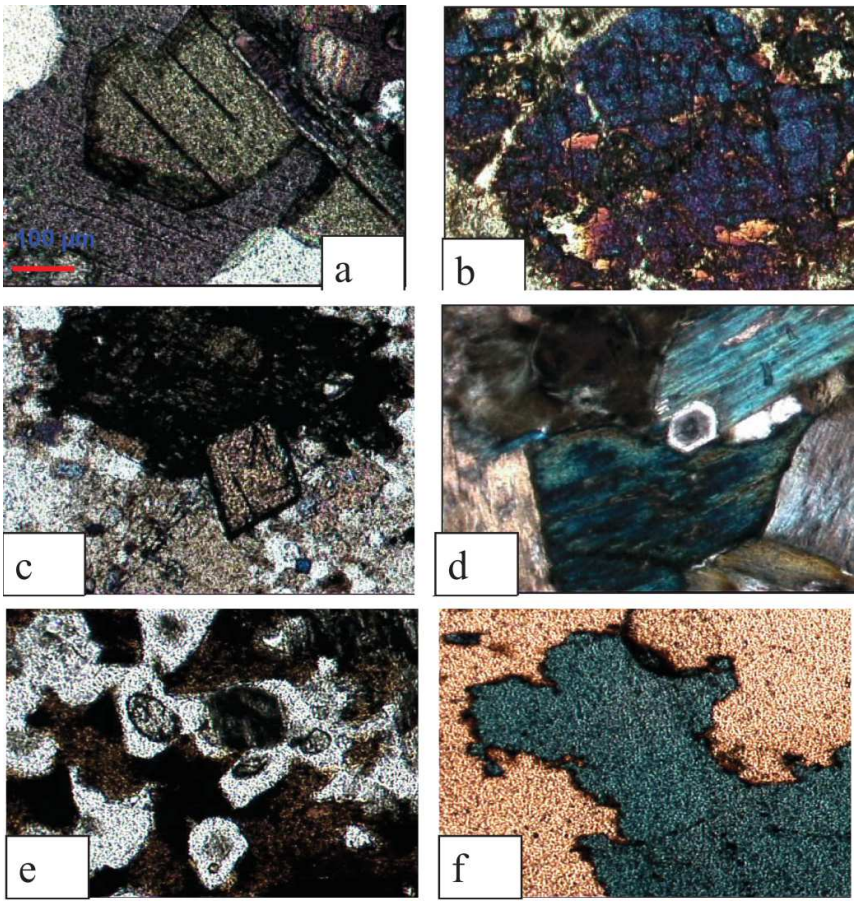

Fig. 6. Photomicrographs show the Petrographic characteristics of the Tosham and Khanak igneous bodies. **(a)** Zonning in the tourmaline, **(b)** rebeckite in the Khanak coarse to medium grained granite, **(c)** presence of sphene, **(d)** presence of beryl in the pyroxene, **(e)** Spherulitic texture of rhyolite, and **(f)** Corroded margin of quartz in rhyolite.

The quartz phenocrysts are sub idiomorphic to idiomorphic in shape sometimes with corroded margin (Fig. 6f). Micas are very less (1-4%).

Volcanic Ash and Tuffs: These volcanics occurs in small bodies in the rhyolite phase are soft and friable consisting angular to sub-rounded quartz (3-5%) which are corroded and cracked, k- feldspars (3-6%), plagioclase >1, micas (4-6%) and sub rounded glass shards (7-8%) embedded in fine grained groundmass (75-76%) which is composed of quartz and feldspathic material.

Explosion breccia: The volcanic breccia is important rock variety in the area, which contains the fragments and clasts of both the granitic and volcanic phase. The clasts are angular to sub-round in shape and are of different size of quartzite, mica granite, k-feldspars porphyry, quartz-feldspars porphyry and rhyolite. The volume percent of the clasts and ranges from (15-22%). The matrix contains the phenocrysts of quartz, k-feldspar. The blocks of the different rock types show sharp contact with the matrix. The sub- rounded shape of blocks is due to fluid activity.

In the Tosham igneous body mineralization is present in form of quartz-biotite- sulphide veinlets and small networks of quartz-cassiterite veins intruded in the quartz feldspar porphyry and mica granite and associated intense hydrothermal alteration effect indicated the evolution of the hydrothermal fluid in the late stage of the magmatic evolution. The physical association of the Sn-W mineralization with the granite porphyry and rhyolite indicates the evolution of the mineralizing fluids from the granitic magma. This evidence is well supported by the presence of the three types of the fluid inclusions in the quartz of the granites as well as of the mineralized quartz veins and their high homogenizing temperature. The mineralogical and geochemical difference in the rocks of the Tosham and Khanak area indicates that rocks of the Tosham area are more magmatically differentiated than the rocks of the Khanak area. This might be the reason of the presence of the mineralization in the Tosham and devoid of any mineralization in the Khanak area.

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Study of avian diversity of Summer Hills, Shimla, Himachal Pradesh

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Abstract: Himachal Pradesh, a hilly state lying between 30° 22' to 33° 12' North latitude and 75° 47' to 79° 04' East longitude elevation rainging from 350-6500 metre from sea level and total area of state 55673 sq. km. In comparison to the summer Hill elevation is 6500 feet and total area is 20 hectares. The present study was aimed at knowing the current status of birds in different pockets of Summer Hill, Shimla.

Key words: Avian diversity; Summer Hills; Shimla.

1. Introduction

Birds are one of the most fascinating creatures of the nature, which are cosmopolitan in their distribution. They not only act as destroyers of insect pests but play an important role as bio-control agents and efficient pollinators of crops.

Over the centuries birds have inspired artist and bird images generally used to adorn everyday objects. Birds are good indicators of bio-diversity, and are a measure of sustainability of human civilization of natural environment.

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A bird has been described as a "Feathered Biped". They are warm blooded animals, (whose temperature remains more or less constant and independent of surrounding). To assist in maintaining an even temperature, the body of the bird is covered with non-conducting feathers. They lack sweat glands and extra heat produced is eliminated through the lungs and air seas. Air seas are cavities, a feature peculiar to birds, found in various parts of body and indirectly connected with lungs. One of the functions of air sac is to promote internal perspiration. Water vapours diffuse from the blood into these cavities and pass out by way of the lungs. Moreover, the forelimbs of birds have been evolved to serve as perfect agents of propulsion wings. The senses of sight and hearing are most highly developed in birds, whereas of taste is comparatively poor, but smell they sense is practically absent.

Birds form and important component of rich Indian bio-diversity due to its unique biogeographical location and diversified climatic conditions. At present biodiversity is better understood for birds in many respect than any other major group of organisms because they probably inspire more extreme interest in humans, relatively easily observed and not too cryptic to identify. India ranks amongst one of the bio-diverse countries in the world from bird diversity point of view. Currently 13 species of breeding, staging and wintering birds spread over 88 families and 22 orders, occupy a wide array of natural, semi-natural urban habitats are known from India. It corresponds to as many as 13% of the world's birds. These include 141

endemic species, a total comprising of over 10% of the regions avi-fauna (Grimmett et. al. 1999).

Relation of human with animal and bird biodiversity is as old as the evolution of man itself. Man has been dependent upon the biodiversity for fulfillment of his entire livelihood needs. But degradation of the Indian Himalayas of which Himachal Pradesh is a part is having profound influence on all eco-systems of the region resulting in loss of bio-diversity. It is therefore very important to conserve the ecology and bio-diversity of the deteriorating fragile ecosystem. Many valuable animal resources including birds and several of these are being threatened due to large scale destruction of their habitats. The habitat loss is affecting nearly all bird species classified as critical, endangered or vulnerable. This is the biggest threat overall to forest birds.

At present, India has a total 74 restricted range species of which 39 are confined to the geographical boundaries of country (Stallers = field et. al, 1998). Besides, 79 Indian birds species are globally threatened with extinction. Of these 9 are critical, 10 species are endangered, 57 are vulnerable, 2 are conservation dependent and 1 is data deficient. A large proportion of the bird species in India are rapidly declining and there is an urgent need of conserving these threatened species.

Like India, the faunal/floral diversity in H.P. University also so rich and diversified, primarily due to varied climate conditions ranging from tropical in the foot hills to trans Himalayan region. There is pronounced dominance or Palaearctic & endemic animals above timber line (3000 m). Largely oriental and some other open elements at lower and middle altitudes, thus rich diversity of Himachal Pradesh has sustained population and hill communities from time in memorial. But in recent years, the state has come under a strong threshold of development. Natural ecosystem have been over exploited and even destroyed by rapidly increasing human population.

Many investigators have conducted detailed biological studies on different aspects of bird life in different countries of world. Most of the work in Himachal Pradesh has always been focused on different aspects of Pheasants. Only a few studies have been conducted on diversity, distribution, abundance and status of other birds life present in the state. Therefore, it is very important to study different biological aspects especially the diversity of birds in the Himalayan belt.

Present investigations were undertaken with special reference to Summer Hill, covering an area of 20 hectares, at an altitude 6500 ft. divided into no. of small pockets like, Sangti (Middle), Summer Hill, Railway Station with an objective to study the diversity of birds in Summer Hill, Shimla (H.P.) The study will be very useful in terms of bio-diversity conserving.

2. Materials and Methods

Avian study was mainly aimed at knowing the current status of birds in different pockets of the Summer Hill, Shimla. An attempt has been made to know the avian diversity.

Himachal Pradesh, a hilly state lying between 33° 22’ to 33° 12’ North latitude and 75° 47’ to 79° 04’ East longitude, elevation ranging from 350-6500 meter from sea level and total area of states 55673 sq. km. In comparison to the Summer Hill elevation is 6500 feet and total area 20 hectares.

Various natural eco-systems/habitats like forests and human habitations are selected for the study i.e. University Campus near Library, Agricultural Co-operative, City Inn, Middle Sangti, Pratham Sangti etc. Areas/sites supported by forest cover of *deodar*, *pine*, *shodoevdrn* and oak etc.

Avifauna of Summer Hill was explored based upon extensive avian studies, which involved the detailed survey of avifauna in different study sites. The other most important aspect kept in consideration was the activity of birds. Since the peak activity in most of birds lasts for 1 or 2 hours after sunrise or before sunset

The birds were observed and photographed with the help of digital camera of 7.2 mega pixel. Field identification were carried out with the help of locals and field guides. Identifications were mainly based on morphological characters and no bird was caught or hunt during observations.

3. Results/Observation

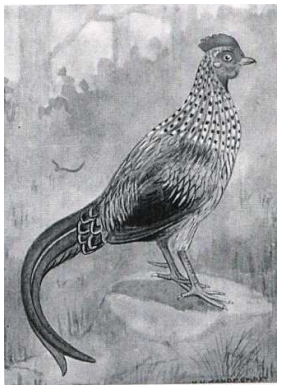
Extensive avifaunal studies conducted in different areas of Summer Hill, Shimla (H.P.) revealed that 11 species of birds belonging to 11 genera, spread over 09 families and 06 orders. Exploration further showed that family Phasianidae represented maximum number of bird species, followed by *Passeridae, Columbidae, Sturnida, Corvidae, Pycnonotidae, Cuculidae, Upupidae, Hirundinidae.*

Taxonomical details of avifauna

Present work embodies a detailed depiction of each bird species recorded:

1. Jungle fowl (*Gallus gallus* Linnaeus)

Order Galliformes; Family: Phasianidae, includes the so called game birds.

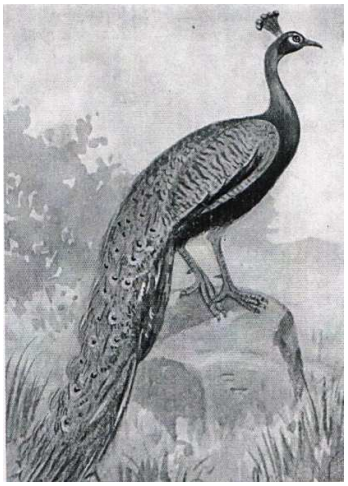


Male has orange red upper part with long neck heckles. Tail laterally compressed. Met with singly, in pairs, or in small groups in forest especially in the neighborhood of cultivation. It seldom ventures far from cover. The crow of cock is a loud. Red crown and heckles are present in male. A medium sized, red & metallic black with red wattles & pale lappets. Pairs or flocks, glassy orange red above with yellow hackles and elongate feathers on rump. Black tail with long sickle shaped feathers paler rufous crown & head. Rest of plumage dark Brown with Buff & Black streaks. Habitat, Deciduous forests and secondary scrub with cultivation.

2. Common Pea fowl (Pavo cristatus Linn.**)**

Order: Galliformes; Family: Phasianidae

Male with shinning blue neck and breast, a tuft of spatula like feathers on head, a train of metallic green long upper tail coverts having oceli. Pea fowl inhabits dense scrub jungle



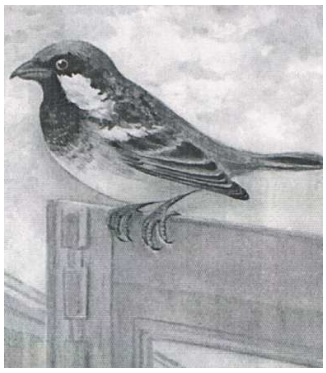
and forest well provided with nature of shyness. The dance of the peacock with his gorgeous train spread like a fan is well known. The cock's cry is an ugly shrieking.

Female smaller, greenish neck, whitish below.

Habitat: Deciduous forests, secondary forests with grass & scrub cultivation & around villages.

3. House Sparrow (*Passer domesticus* or *Fringilla domestica* Linn)

Order: Passeriformes; Family: Passeridae; Sub-family: Passerinae



The bird freely entering and nesting in houses and making a thorough nuisance of themselves. Bill short and stout. Tail dark brown with grayish brown rump.

4. Blue Rock Pigeon (*Columba livia* Gmelin**)**

Order: Columbiformes; Family : Columbidae (Pigeons & Doves)

Bluish grey, broad blackbars across the wings. This Species ranks with house crow and Sparrow as one of the most familiar birds in towns, nesting in building, gorges, dams and

bridges. Their flight is swift, short and strong. Their call notes are well known and familiar: a deep *gootr-goo*. They feed in pairs or in large flocks. They are monogamous and after the pair formation. The partners separate out of the flock and remain attached to each other feeding & roosting together.

5. Common Myna (*Acridothes tristis* Linn.)

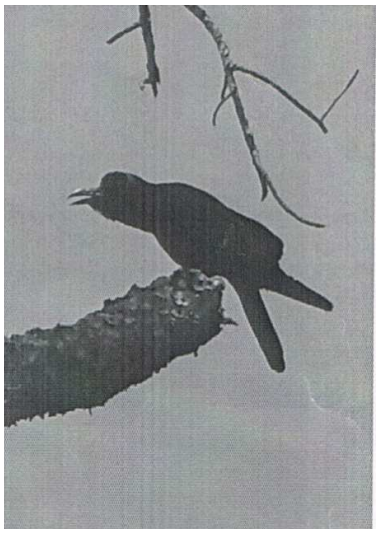
Order: Columbiformes; Family: Sturnidae

A familiar, medium sized, brownish bird with black head neck and breast, bright yellow legs and a bright yellow patch below legs. One of the commonest birds about human inhabitation. It is sociable. Commonly seen feeding in pairs or small flocks in fields often following cattle. The birds nest in holes in the walls and ceilings of dwellings.

6. House Crow (*Corvus splendus* Vieillot)

Order: Columbiformes; Family: Corvidae

One of our most familiar birds with grayish neck and breast found in every type of country



close to human habitations except dense forest. It sits on a exposed perch like a telegraph wire or pole from where it makes and rallies to capture moths and winged insects in the air. The species is high beneficial to agriculture because of its insect pests destruction.

7. **Bulbul** (*Pycnonotus jocosus* Linn.)

Order Passeriformes; Family: Pycnonotidae (Bulbuls)

Bill equal to, usually shorter than tarsus. The white cheeks dark olive green upper parts and yellow patch under the tail are some of the peculiar features. A well groomed bird of gardens with erect and forwardly curving crest and crimson patch under the tail. It is found in the neighborhood of habitations especially in the hill station. Also seen amongst the hedgerows and bushes away from habitations. A pleasant and cheerful bird flutters about in search of crumbs and also throws flight for berries, insects such as ants, beetles and creeping things amongst leaves.

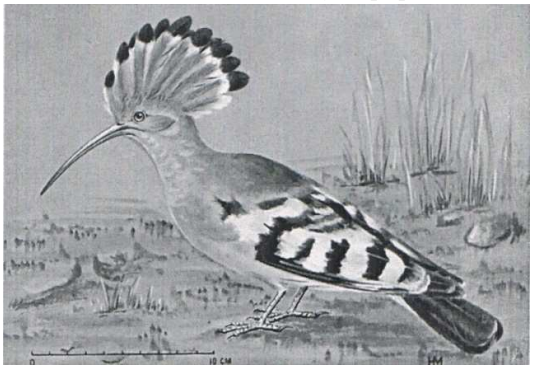
8. Koel (*Eudynamys scolpacea* Linn.)

Order: Cuculiformes; Family: Cuculidae (Cuckoos & Coucals)

It is arboreal in habit. It frequents gardens and open country where there are large leafy trees. The birds habit of laying its eggs in the nest of crows and foisting on then the responsibility for raising its young is well known from ancient times. Found singly or in pairs. Remains silent during the non breeding season. Females, mottled and barred.

9. Hoope (*Upupa epops* Linn.)

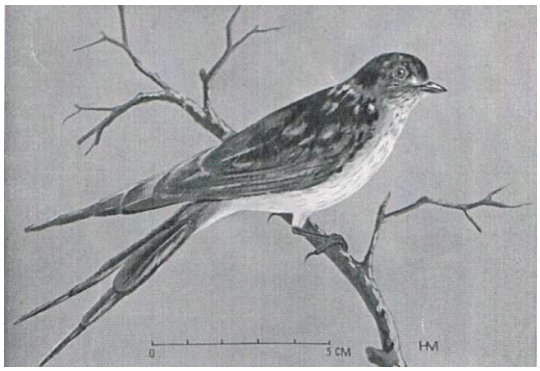
Order: Coraciiformes; Family: Upupidae



Bright rufus black and white birds, keep in pairs and small group, feeding on ground, running about with a quail like, probing the soil with their slender bills for worms etc. On alarm the crest (fan-like) is jerked. The call is soft and musical. Bird with black and white zebra markings on back. Wings black and white and tail fan shaped when erected. It produces a loud hooting call *–hud-hud-hud*. Seen grubbling about on lawns/ flower beds, nesting in outhouses and cavities in walls.

10. Common swallow (*Hirundo rustical* Linn.)

Order: Piciformes; Family: Hirundinidae



The birds are Sociable, perching in rows. They have several pleasant twittering notes. Glossy blue with a deeply forked tail. Blue black breast band. They add charm to a place. They are seen to flit in and out of the typical canopy of tree in summer hills. Freely fly across the dwelling houses in the study sites.

11. *Pyrrohocorax pyrrohocorax* Chough

Family: Corvidae

Vermilion Bill is long and curved which is main characteristic differentiating from corvus splendens though feathers on the body in both cases are black. Red billed coughs become solitary, split from the larger flocks, therefore less gregarious than the yellow billed species. Sharp eye for seeds or succulent insects. These are ever ready to prick up scraps from the camp site, but are shy in their approach.

4. Discussion

The present study undertaken to know the diversity of avian fauna of Summer Hill Shimla (H.P.) Various sites were selected, timing of observation was also fixed i.e. early in the morning and late in the evening. As total 11 species of birds belonging to 11 genera, spread over 09 families were observed during the study. Members of families Phasianidae & Corvidae were observed two each while other families like passeridae, Columbidae, Sturnidae Pycnonotidae, Cuculidae, Upupidae and Hirundinidae, one each. More stress and intensive study with regard to exploration of avian fauna in this very area is recommended. Moreover there was no report by the investigator with regard to the presence of the endangered animals namely cheer pheasant, Monal and Western Tragopan etc. Hence area

needs to be exploited for the same. It is unending aspect because some birds are migratory and resident ultimately reflected the frequency of distribution in particular area.

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Degradation of Wet lands in Kashmir Valley Aggravated Floods Fury

Nater Singh Raina

The ecosystems of wetlands of Kashmir valley is under tremendous anthropogenic pressure since more than four decades. The loss of wet lands of Kashmir valley were acting as a buffer for floods, aggravated the present situation of flood fury. The disastrous damage caused to life and property could have been minimized if the water bodies like Wuller, Ancha, Dal, Nagin, Mansabal and other wetlands that had been preserved. All these wetlands act as a sponge that retains excess waters. Wullar, Dal, Anchar, Nagin, Manasbal and other small lakes are classical example of that.

During the British and Maharaja period used to consider Wuller and other lakes as a buffer for the flood where water cab be absorbed. A century ago, Wuller extended up to almost 190 Km^2 and would spread to over 270 Km^2 during floods. Human encroachments into the lake are the chief reason for the lake shrinking. Wullar Lake which was once spread across 20200 hectares now remains restricted to a mere 2400 hectares. In the last 30 years, nearly 50% of the wetlands in the Kashmir valley has been encroached upon or severely. The Wullar wet land area has reduced from 157.74 Km^2 to 58.71 Km^2 during 1911 to 2010. Some of the reclaimed marshland measuring about 25 Km^2 has been transformed in to willow plantation by the state.

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A survey was conducted in 2006 under court orders revealed that 60,000 kanals area in the lake have been encroached mainly by raising plantation under social forestry programmes of forest department. Wuller has lost its capacity to regulate water flows leading to increased floods in valley. In addition the sewage from Srinagar and other towns upstream passing into river Jhelum that flows through Wullar has degraded the lakes water quality. Due to disturbance in the ecosystem of Wullar lake has aggravated the flood phenomena in the Kashmir valley.

The Jammu and Kashmir state experienced catastrophic rainfall on 1st of September to 7th of September 2014. The onset of monsoon over J&K region takes place by Ist July and with draws by mid- September. On September 4th 2014 J&K experienced 30 hours long rainfall has broken the record of many decades, the major parts of the state recorded an average of 250 to 300 mm rainfall. It indicates that some parts of the state have experienced more than 450 mm of rainfall in 3 days. Even moderate rainfall also recorded in Ladakh. Kashmir valley has experienced such floods fury in the past. Geological and historical records reveal that wetlands of the Kashmir had played significant role to control the floods. A worth mentioning phenomena was observed that there was delaying in the flood peak by one or two days. Water level of flood hit area start rising after 5th September. It was a final point, which can be made in connection with influence of drainage net work on runoff concerns. Presence of Lakes (Wullar, Dal, Mansabal and others small lakes) played their role for delay in peak of flood and absorb (store) high runoff peaks. History of Kashmir valley has buried the evidences of wet lands of the Kashmir valley have played a vital in controlling the floods in Kashmir valley.

The value of Gods –*Kashmira*, Sanskrit poet Kailidasa writes about Kashmir valley (translation) “The place is more beautiful than

the heaven and is the benefactor of supreme bliss and happiness. It seems to me that I am taking a bath in the lake of nectar here "*Kalhana*" has also discuss about floods in Kashmir valley in *Rajatarangini*. He has discussed about lakes and river Jhelum of Kashmir. Aryans while immigrating to Bharatvarsha had crossed this river (Indus) which is considered the base for Indus valley civilization. Both these rivers Indus and Jhelum (Sindhu and Vitasta) are in mentioned in Rig Veds. In "*Nilmat Puranam*" Sindhu gets mentioned thus "*Ganga Sindhu tu vijneya Vitasta Yamuna tatha*"

Vitasta (Wyeth-Jhelum). River Vitasta (present Jhelum) has been called variously as "*Vitasta*" in Veds, "*Hydaspes*" of Aryans and central Asian's and "*Bidaspes*" of Ptolemy. Mugal emperor Jahangir called it "*Bebat*". The present river is generally now known as Jhelum after a place called Jhelum, now in Pakistan.

In Nilmat Puranam there is a description of Wullar (*Mahapadamasar*) and river Jhelum (*Vitasta*) ' As *Vitasa* meanders from its abode of *Nila Kunda* (spring Verinag), many rivers *Vishoka, Rambh, Ara, Romish, Dud Ganga, Lidder, Aral, Stunt kol, Aran, Pohra* and many other join it. As per Nilmat Puranama legend the area of *Mahapadmsar* was then named *Candrapura* ruled by king *Visvagasva* (Kalhan also mentions a large city *Candrapura*) submerged under the Wuller (*Mahapadmsar*)

There are references that during 12th century King Prahlad built Prateshwara temple in the island of Mahapadmsar. The water rose again as the tributaries to Mahapadmsar had increased including Vitasta (Jhelum) and one of those days flash floods again increased the volume, submerging the temple indicates that the water level was much below the level of the base of the submerged temple, when the temple was constructed which rose suddenly and gave no chance for retrieval of idols. This could have been between 12th and 14th century.

In Rajatarangini there are references of fluctuation of water level of the lakes and floods in Kashmir valley. The imprints of glacio-fluvial geomorphic landforms (modified by glacier and river) reveals that Kashmir valley has experienced floods and heavy precipitation in the past geological time.

The major ailment of the Wullar wet land is siltation , large quantities of silt are regularly deposited by the Jhelum , Madhumati , Erin , Phore and other streams entering the lake. The rate of siltation has been estimated a 3.33 acre per ft. per year. Siltation has already claimed about 90% of it and the remaining 10% will disappear unless corrective measures are taken. Deforestation in the catchment areas of Jhelum and its tributaries has increased the siltation rate many times higher than the calculated rates with the result there was Wullar has lost its capacity to store water leading to floods in the valley. The entry of raw sewage and plant nutrients are continuously adding the nutrients pool resulting in serious weed infestation.

Anchar lake is a single basined connected on the eastern side with Dal lake through an inflow channel nallah Amir Khan via Gilsr and Khushalsar. A network of channels of Sindh enters the lake on its western shore forming delta. The lake is also fed by springs with in basin and alone the periphery. Further, a number of channels from agricultural field's effluents from the settlements and surface drains from catchment area flow directly in to it. The lake outfalls in river Jhelum at Sangam on its northeast direction. The total catchment was 66 Km^2.

In recent year significant encroachment have been taken within the lake. According to Lawrence the area of the lake in 1893-94 was 19.54 Km^2 has now been reduced hardly to 6.8 Km^2 of which 3.6 Km^2 are marsh. Unabated encroachments still continue at alarming rate. The main disturbance in the lake is from the heavy silt flowing from Sind nallah. The siltation process has greatly affected the lake ecology and storage capacity of the lake. The entry of raw sewage from the immediate catchment and managed carrying of sewages from the adjoining areas amount to a daily load of 2.0 tones of nitrogen and 1.7 tones of Phosphorus resulting serious weed infestation and water quality deterioration.

The lake Dal is located within catchment area covering 316 Km^2 in the Zabarwan mountain valley in the foot hill of Himalayan range, which surrounded it on three sides. The average elevation of the Lake is 1583 m. Dal Lake in Srinager has seen numerous reclamation all along its periphery in marshy

areas which has drastically reduced the lake area to just about 1200 hectares almost half of its earlier spread. The depth of the water varies from 6 mts (20 ft) at its deepest at Nagin Lake to 2.5 m (8.2 ft), the shallowest at Gagribal. The length of the lake is 7.44 km with a width of 3.5 km. The lake has a shore length of 15.5 km and road run all alone the periphery. Irreversible changes through urban expansion and road building have been made alone the shore line to accommodate the tourist growth. Two Islands build in the basin have further restriction on the flow of the lake and as a result marshy lands have emerged on the peripheral zones, notably in the foothill area of Shankaracharya and Zaharbwan hills. These marshy lands have since been reclaimed and converted in to large residential complexes.

Dal lake is nicknamed the Jewel in a crown of Kashmir or Srinagars Jewel. The lake covers an area of 18 Km^2 and is a part of natural wetland which covers 21.1 Km^2 including its floating gardens. The latest data reveals that the lake, which has shrunk from 75 Km^2 to mere 11.56 Km^2. There are more than 350 floating gardens which are known as "Rad" in Kashmiri. The wetland is divided by causeways in to four basins. Gagribal, Lokud Dal, Bod Dal (although Nagin is considered an independent lake) Lokud Dal and Bod Dal each have an Island in the centre is known as *Rup lank* (or Char Chinari) and *Sona lank*, respectively.

Houseboats in Kashmir were first introduced in the 19th century by the British raj officials. As per some houseboats owners, the first houseboat on Dal Lake was built soon after the Indian mutiny of 1857. The first recorded houseboat was said to date back to 1888.

Geology: There are two theories regarding the formation of Dal lake. One version is that it is the remnants of a post glacial lake which has under gone drastic changes in size over the years .Second view is that it is a fluvial origin from a old flood spill channel or oxbows lake of the Jhelum river. The dendritic drainage pattern of the catchment signifies that its rocks strata have low level of porosity.

The Dachigam-Telbal nallah system is conjectured to follow two major lineaments. Discontinuity surfaces represent the angular and parallel drainage pattern. The water table cuts the hill slopes, which is evidenced by the occurrence of numerous springs in the valley. Seismic activities is recorded under Zone V of the seismic zoning map of India, the most severe where frequent damaging earthquakes of intensity IX could be expected. Kashmir valley has already experienced an earthquake of the 7.6 on Richter's scale in 2005 (Muzzaferabad earthquake). But there is no existence of disaster management provision in Jammu and Kashmir.

Hydrology: The shallow, open- drainage of Dal lake is fed by Dachigam- Telbal nallah (with perennial flow) Dara nallah and many other streams. The lake is classified as "warm monomictic" under the sub-tropical lake category. The complex land use pattern of the valley is reflected in urbanized Srinagar in its north with rice fields, orchards and garden in the lower slopes, and barren hills beyond steep sloping hills. The flat topography also has an impact on drainage conditions. It receives an average annual rain fall of 65.5 cm in catchment area. The average annual flow, according to discharge measurements has been estimated 291.9 million cubic metres with Telbal nallah accounting for 80 % of the total and 20 % contributed by other sources. There are two outlets from the lake, namely the Dalgate and Amir Khan Nallah that connects the lakes of Nagin and Anchar. Dalgate is controlled by weir and lock system. The out flow from these two outlets has been estimated as 275.6 MCM. Further, the silt load has been estimated at 80,000 tonnes per year with 70 % contributed from the Telbal nallah, with 36,000 tonnes recorded as settling in the lake.

The major environmental problem facing the lake is eutrophication, which has required immediate remedial measures to combat it. Alarmingly, the size of the lake has shrunk from its original area of 22 Km^2 to present are of 18 Km^2 and there is concerning rate of sediment deposition due to deforestation in the catchment area. The water quality has also deteriorated due to intense pollution caused by untreated sewage and solid waste that is fed in to lake from peripheral areas and from the settlements and house boat. Encroachments of

water channels and consequent clogging has diminished the circulation and in flow into lake, so with the building up of phosphates and nitrogen, this has led to extensive weed growth and consequences negative effect on the biodiversity of the lake.

Manasbal Lake is located in the Jhelum valley, north of Srinagar city in the state of Jammu and Kashmir. It is deepest lake (at 13 m) in Kashmir valley. The lake is surrounded by the Baladar Mountains on the east, by an elevated plateau known as Karewa comprising lacustrine, fluviatile and loessic deposits on the north and bounded the Ahtung hills in the south.

The drainage basin for the lake, covering an area of 33 Km^2 has no major inlet channels and is thus fed mainly by precipitation and springs (more than 1200 springs) Lake water outflows to the Jhelum river through a regulated out flow channel. World Wide Funds (WWF) conducted an extensive survey of the lake in 1997 attributed the reasons for the deterioration of the lake, particularly on its banks, gradually turning it in to a stinking marsh, due to the following.

1. Large scale illegal encroachment on the periphery on Ganderbal and Qazibagh sides in the form of 1000 of trees, vegitable gardens, toilets, residential structures, garbages dumping sites.
2. Siltation due to noxious run off from adjoining fields, stone quarries and lime kilns.
3. The flow of sewage and use of fertilizers in the agricultural fields in its adjoining villages.
4. Eighty percent of the lake was seen under the thick blanket of weed.

All rivers like Vishoka, Rambh, Ara, Romish, Dud Ganga, Lidder, Aral, Stunt kol, Aran, Pohra and many other tributaries of the Jhelum are depositing huge amount of siltation in the lakes of the valley with the results shrinkage of wetlands storage capacity. The Jhelum has changed its course and caused lateral erosion. All the newly developed colonies are located on the old channel, flood plains, meander core and terraces of the Jhelum and dry beds of the lakes. When you will not respect the River and Lakes you have face such disasters.

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Taxonomic Characterisation of Flowering Plant Species

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Taxonomy is defined as that branch of science which deals with the identification, nomenclature and classification of biological (living) organisms on the basis of their similarities and differences. Etymologically, Taxonomy owes its origin to two Greek words – "*Taxis*" = arrangement and "*nomos*" = rules or laws i.e. arrangement as per rules or laws. It serves as the pedestal for entire biology and hence can be considered as the mother of all biological sciences. Even in our daily life, a man behaves as a taxonomist while identifying and naming a particular food to eat; a beverage to drink or clothes to wear, etc. Identification of a particular biological entity is, therefore, a fundamental pre-requisite for carrying out any further study or research in it. However, identification is inconceivable without a proper system of nomenclature.

Any object known to human intelligence must possess a name for describing and communicating ideas about it in order to ascertain its relationships. There are two types of names which have been assigned to biological objects since ancient times – the common or vernacular (local) names and the scientific name. The former have been handed down from generation to generation and are derived from regional or native languages of a particular country. For example '*seib'* and '*kutta'* (vernacular Hindi names) of India are known as 'apple' and 'dog' in USA, respectively. Moreover, widely distributed organisms bear a large number of common names. In India alone, a large number of local names exist due to the multi - linguistic nature of its people. Thus vernacular names are neither methodical nor universal and could prove quite misleading in their application. To overcome such limitations, every known biological species is given a legitimate scientific name based on universally accepted International code of binomial system formalized first in mid- 18th century by Carolus Linnaeus, the father of Taxonomy. According to this binomial system, the first name implies name of the 'genus' (a substantive noun) and the second as 'specific epithet' (an adjective or noun). Thus *Homo sapiens* and *Mangifera indica* represent scientific name of man and mango in which *Homo* and *Mangifera* indicate generic names where as *sapiens* and *indica* imply their specific epithets respectively. In actual practice all the rules of International code of Biological nomenclature are followed for providing a scientific name to a biological species which is, however, a technical discourse.

A biological species represents the basic unit of taxonomy and is defined as a group of closely related individuals which are morphologically similar, genetically distinct and reproductively isolated. Many workers consider Taxonomy as synonymous with Systematics; the latter, however, leans more upon phylogenetic (evolutionary) considerations. More recently, a new code known as 'phylocode' based on phylogeny (ancestry and descent) has been proposed for naming organisms. However, it is yet to replace the conventional code in view of its inherent queries and criticism. Although taxonomic analysis is applicable to every living organism yet its treatment in the present context has been limited to the world of plants particularly flowering plants comprising about 2,45,000 species throughout the world. A few sources for designating the specific epithets of some of these plants are outlined on next page:

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Table 1. Taxonomic Characterisation of specific epithets in some flowering plants

Character/ Choice	Specific epithet	Scientific Name	English name	Vernacular Name/s
a. Nativity				
		i. Continent:		
Asia	*asiatica*	*Centella asiatica*	Asiatic Penny wart	Brahmi Bhuti (D)
Europe	*europaea*	*Cuscuta europaea*	Large Dodder	Wazul Kukli poat (K)
Africa	*africana*	*Kigelia africana*	African sausage tree	Kakdi (D)
Australia	*australis*	*Celtis australis*	Hackberry	Brimij (K)
		ii. Country:		
India	*Indica*	*Aesculus indica*	Horse chestnut	Han Doon (K)
	indicum	*Nerium indicum*	Red Oleander	Gandela (D)
China	*chinensis /*	*Ixora chinensis*	Chinese Ixora	Van Jwala (D)
	sinensis	*Hibiscus rosa-sinensis*	China rose	Gudhal (D)
Japan	*japonica*	*Lonicera japonica*	Japanese honey suckle	Madhu sondhi (D)
Philippines	*philippensis*	*Mallotus philippensis*	Monkey face tree	Kamila (D), Kaimbil (K)
Nepal	*nepalense /*	*Geranium epalense*	Nepal Geranium	Bhanda (D)
	nepalensis	*Rumex nepalensis*	Broad leaved Dock	Abuj (K), Aarbal (D)
Tibet	*tibeticum /*	*Tanacetum tibeticum*	Tansy	Khamchu (L)
	tibetica	*Arabis tibetica*	Tibetan Rock-cress	----
Sri Lanka / Ceylon	*zeylanicum*	*Cinnamomum zeylanicum*	Cinnamon	Dalcheen (K)
Italy	*italica*	*Setaria italica*	Indian millet / Foxtail millet	Shola (K), Kangni (D)
Germany	*germanica*	*Iris germanica*	German Iris	Mazar bhuti (D)
Mexico	*mexicana*	*Argemone mexicana*	Mexican prickly poppy	Peeli Kandyari (D)
Canada	*canadensis*	*Solidago canadensis*	Golden Rod	Sondandi (D)
America	*americana*	*Agave americana*	Century Plant	Kaoida (D)
		iii. State:		
Mysore	*mysorensis*	*Thunbergia mysorensis*	Mysore Clock vine	----
Bengal	*benghalensis*	*Ficus benghalensis*	Banyan tree	Bargat / Bardh (D)
Sikkim	*sikkimensis*	*Corydalis sikkimensis*	----	----
		iv. Province:		
Kashmir	*kashmiriana /*	*Iris kashmiriana*	Kashmir Iris	Mazar Mund, Sossan (K)
	kashmirianum	*Fagopyru kashmirianum*	Kashmir Buckwheat	Troumba (K)
Ladakh	*ladakense*	*Taraxacum ladakense*	Dandelion	----
		v. Locality:		
Zanaskar	*zanaskarensis*	*Astragalus zanaskarensis*	Milk Vetch	Deyanko (L)
Bannihal	*bannehalensis*	*Artemisia bannehalensis*	Worm wood	Banahali Tschimber (D)
Kishtwar	*kishtwariense*	*Geranium kishtvariense*	Cranes bill	----
Pahalgam	*pahalgamensis*	*Impatiens pahalgamensis*	Balsam	----
		b. Mountain Range		
Alpine region	*alpinum /*	*Thalictrum alpinum*	Alpine Meadow rue	Dharu Bini (D)
	alpina	*Arabis alpina*	Alpine Rock- cress	----
Altai	*altavicum /*	*Callianthemum altavicum*	Callianthemum	----
	altaica	*Draba altaica*	Whitlow grass	----
Pamir	*pamirica*	*Atriplex pamirica*	Orach	----
Tian Shan	*tianshanica*	*Gentiana tianshanica*	Tienshan Gentian	----
Caucasus	*caucasica*	*Arabis caucasica*	Garden Arabis	----
Pyrenees	*pyrenaicum*	*Lilium pyrenaicum*	Pyrenean Lily	----
Himalaya	*himalaica*	*Plantago himalaica*	Himalayan Plantain	Khil Chakarpo (L)
	himalayensis	*Ermania himalayensis*	----	----
	himalayanus	*Astragalus himalayanus*	Himalayan Milk-Vetch	----
	himalaicus	*Eremurus himalaicus*	Fox tail Lily / Desert Candle	----
Nilgiri	*neelgherrensis*	*Arcyosperma sneelgherrensis*	----	Bulun (K)
		c. Habitat		
Aquatic	*aquatica*	*Ipomoea aquatica*	Railway creeper	Nali (D)
Sea Shores	*maritime /*	*Crambe maritima*	Sea Kale	----
	maritimum	*Eryngium maritimum*	Sea Holly	----

Character/ Choice	Specific epithet	Scientific Name	English name	Vernacular Name/s
Terrestrial	*terrestris*	*Tribulus terrestris*	Land Celtrops,	Pakhadi (D); Mitcher Kaind (K)
Amphibious	*amphibium*	*Polygonm amphibum*	Knot weed	Rumach (K)
Swamps	*palustris*	*Caltha palustris*	Marsh Marigold	Guttal (D)
Lakes/Ponds	*lacustris*	*Scirps lacustris*	Club rush	----
Mountains	*montana / montanum*	*Clematis montana* *Baliospermum montanum*	Mountain Clematis ----	Chandha (D) Danti (D)
Rocks	*rupestris*	*Viola rupestris*	Teesdale Violet	----
Woods	*sylvestris*	*Malva sylvestris*	Common Mallow	----
Common/ Waste Places	*vulgare*	*Marrubium vulgare*	Hore Hound	Trouper, Gandhsoi (K)
Deserts	*desertii*	*Agave desertii*	----	----
Cultivated fields	*sativus*	*Crocus sativus*	Saffron/Zafron	Koung (K)
	sativa	*Oryza sativa*	Paddy	Munjie (D), Dhani (K)
	sativum	*Allium sativum*	Garlic	Thoam (D), Ruhan (K)
Field edges	*arvensis*	*Conovolvulus arvensis*	Field bind weed	Hiran Padi (D);Hiranghe /Thurae Posh(K); Teiktelkma (L)
Under-ground	*hypogea*	*Arachis hypogea*	Ground nut	Dodiyan (D); Jalgoz (K)
		d. Habit / Form		
Robust	*robusta*	*Shorea robusta*	Sal	Sal (D)
Woody	*arboreum*	*Rhododendron arboreum*	Rose tree	Burau (D), Chaunh (K)
Grand	*grandis*	*Tectona grandis*	Teak	Sagaun (D)
Erect	*erecta*	*Tagetes erecta*	Big Marigold	Gutta (D); Jafir Posh (K)
Minute /	*minutissima*	*Primula minutissima*	Minute Primula	----
Small	*minima*	*Anagalis minima*	Chaffweed	----
Creeping	*repens*	*Trifolium repens*	Dutch clover	Batak Nuer (K)
Prostrate	*prostrata*	*Euphorbia prostrata*	Prostrate spurge	Suhidudli (D)
Climbing	*vinifera*	*Vitis vinifera*	Grape vine	Dachh (K); Daakh (D)
		e. Leaf		
Small	*microphylla*	*Pilea microphylla*	Artillery Plant	----
Large	*macrophylla*	*Achillea macrophylla*	Sneeze wort	----
Pinnate	*pinnata*	*Azolla pinnata*	Water fern	Lal Kandori (D)
Palmate	*palmata*	*Ipomoea palmata*	Railway creeper;	Ishki Paicha (D)
Narrow	*angustata*	*Typha angustata*	Lesser Indian Reed mace	Dibb/ Aera (D); Paech (K)
Broad (ovate)	*ovata*	*Plantago ovata*	Plantain	Ismagul (K)
Dissected	*dissectum*	*Taraxacum dissectum*	Cut leaved Dandelion	----
Cylindrical	*cylindrica*	*Sansevieria cylindrica*	Spear Sansevieria /Rhino Horn	----
Round	*rotundifolium*	*Geranium rotundifolium*	Round leaved cranesbill	----
Lanceolate	*lanceolata*	*Plantago lanceolata*	Rib wart Plantain	Gu-li (K)
Cordate	*cordata / caudatus*	*Swertia cordata* *Amaranthus caudatus*	Charaita Amaranth	Charaita (D) Leisi (K), Dorusoil (D)
Filiform	*filiformis*	*Juncus filiformis*	Thread Brush	----
Glabrous	*glabra*	*Glycyrrhia glabra*	Liquorice	Malhati (D), Shanghir (K)
Pubescent	*pubescens*	*Brachyactis pubescens*	----	Tsathi (K)
Tomentose	*tomentosa*	*Waldheimia tomentosa*	----	Solocarpo/Ma kungla (L)
Hairy	*hispidum*	*Onosma hispidum*	Golden drop	Deemok (L)
Spiny	*spinosa*	*Capparis spinosa*	Caperbush	Kalbada (D), Kapra (L)
Variegate	*variegata*	*Bauhinia variegata*	Variegated Bauhinia / Mountain ebony	Katroad (D)
Opposite	*oppositifolia*	*Colebrookea oppositifolia*	----	Chiti suhali (D)
Perforated	*perforatum*	*Hypericum perforatum*	Common St. John's wart	Basantlu (D); Basant (K)

Character/ Choice	Specific epithet	Scientific Name	English name	Vernacular Name/s
		f. Flower		
Large	*grandiflora*	*Magnolia grandiflora*	Bull bay/Great Laurel	Baraf Champa (D)
Elegant	*elegans*	*Zinnia elegans*	Youth & old age plant	----
Fragrant	*fragrans*	*Myristic fragrans*	Nutmeg	Japhal (D)
Odorous	*odorata*	*Viola odorata*	Sweet violet	Bunafsha (K)
Foetid	*foetidus*	*Helleborus foetidus*	Stinking Hellebore	----
Aromatic	*aromaticum*	*Syzygium aromaticum*	Clove	Raung (K)
Globose	*globosa*	*Gompherena globosa*	Bachelor's button	Gultam (D), Maharaz Posh (K)
Stellate	*stellata*	*Tulipa stellata*	Tulip	Maghuna (D)
White	*alba*	*Rosa alba*	Indian white rose	Safed Gulab (K)
Rosy	*roseus*	*Catharanthus roseus*	Periwinkle	Sada suhagan (D)
Violet	*violaceum*	*Aconitum violaceum*	Aconite	Mori, Mohand (K)
Purple	*purpureus*	*Crocus purpureus*	Purple crocus	----
Golden Yellow	*aureus*	*Epipremnum aureus*	Devils Ivy/ Golden Pothos	----
		g. Fruit		
Large	*maxima*	*Cucurbita maxima*	Pumpkin	Parim Al (K)
Cylindrical	*cylindrica*	*Luffa cylindrica*	Vegetable Sponge	Tori (D)
Black	*niger /*	*Hyoscyamus niger*	Henbane	Gayal Matang (L), Bazir Bhangh (K)
	nigrum	*Solanum nigrum*	Black night shade	Kambiae (K), Kayankothi (D)
Hollow	*fistulosa*	*Cassia fistulosa*	Indian laburnum / Golden Shower	Krangal (D), Faloose (K)
4-Seeded	*tetrasperma*	*Vicia tetrasperma*	Smooth Tare	----
		h. Religious/Sacred		
	religiosa	*Ficus religiosa*	Peepal	Pipal (D)
	sanctum	*Ocimum sanctum*	Holy Basil	Tulsi (D)
	sacra	*Saussurea sacra*	Sacred Saussurea	Juge Padsha (K)
		i. Commemorational		
Hooker	*hookeriana*	*Iris hookeriana*	Hooker's blue	Taigma (L)
Benthem	*benthami*	*Arnebia benthami*	Rattanjot	Gao-zaban (K)
Roxburgh	*roxburghii*	*Putranjiva roxburghii*	Child life tree	Jeopota (D)
Wallich	*wallichii*	*Cirsium wallichii*	Horse Thistle	Bagoul (D)
	wallichiana	*Ulmus wallichiana*	Himalayan elm	Manu (D), Bran (K)
Royle	*Roylei*	*Delphinium roylei*	Larkspur	Mori (K), Nirbisi (D)
Anderson	*andersonii*	*Thalaspi andersonii*	Pennycress	----
Duthie	*duthiei*	*Kobresia duthiei*	----	----
Aitchinson	*aitchisonii*	*Epilobium aitchisonii*	Willow Herb	----
De-Candolle	*candolii /*	*Bupleurum candolii*	Hares Ear	Jadh-jari (D)
	candolleanus	*Astragalus candolleanus*	Milk-Vetch	Mouch kanda (D)
Drummond	*drummondii*	*Phlox drummondii*	Pride of Texas	Taara phool (D)
Thomson	*thomsonii*	*Swertia thomsonii*	----	----
Moorcroft	*moorcroftiana*	*Salvia moorcroftiana*	Moorcroft Sage	Thuth (D), Sholer (K)
Strachey	*stracheyi*	*Allium stracheyi*	Mountain Garlic	Keir (D)
Falconer	*falconeri*	*Cirsium falconeri*	Silver thistle	Dharu bous (D)
Jacquemont	*jacquemontiana*	*Parrotiopsis jacquemontiana*	Hazel tree	Pohu (K)
	jacquemontianus	*Senecio jacquemontianus*	Ragwort	Pahand (K)
Hardwick	*hardwickii*	*Valeriana hardwickii*	Valerian	----
Hoffmeister	*hoffmeisterianus*	*Rubus hoffmeisterianus*	Bramble	----
Stapf	*stapfiana*	*Poa stapfiana*	Rap grass	----
Griffith	*griffithii*	*Chrysanthemum griffithii*	Daisy (guldaudi)	Tschakairkah (L)
Stewart	*stewartii*	*Veronica stewartii*	Speedwell	-----
Inayatullah	*inayati*	*Primula inayati*	Primrose	-----
Hartmann	*hartmanii*	*Festuca hartmanii*	Fescue	-----
Meebold	*meeboldii*	*Saxifraga meeboldii*	Saxifrage	-----
Winter-bottom	*winderbottomii*	*Draba winterbottomii*	Whitlow grass	----
Kachroo	*kachrooi*	*Allium kachrooi*	-----	----
Schlaginweit	*schlaginweitii*	*Euphrasia schalginweitii*	Eyebright	----

Vernacular names: D = Dogri, L = Ladakhi, K = Kashmiri

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Papers in Edited Books, Symposia Proceedings, etc.

Srivastava, M.M., Joshi, S.P., Ghildiyal, J.C., Manhas, R.K. and Kumar, Vinod. 2000. Demography & successional trends in fresh water swamps of Dehradun Valley (UP) India. *In: Landmarks of Botany in India* (eds.: P. Soni & N.R. Dasturiya). Surya Publications Dehradun: pp 113-123.

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Bennet, S.S.R. 1886. *Name changes in Flowering Plants*. Triseas Publishers, Dehradun, India.

Bhellum, B.L. and Magotra, R. 2012. *An Annotated Catalogue of Flowering Plants of Doda, Kishtwar and Ramban Districts of Jammu and Kashmir (Kashmir Himalayas)*. Bishen Singh Mahendra Pal Singh, Dehradun, India (in press).

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