

Floristics of a Riverine Ecosystem along Siwaliks, Dehradun India

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Abstract

Riverine flora of important rivulets 'Kheeree Rau', 'Semal Rau', 'Pathar Rau', 'Mohan Rau' of river Hindon have been worked out. The study is restricted to 50 m from either side of the Rau. A total of 193 plant species belonging to 153 genera and 54 families are recorded from the study area. Herbs appear to be dominant with 135 (69.9%) species followed by shrubs 38 (19.7%) species and 14 (7.3%) tree species and 06 (3.1%) climber species. The biological spectrum reveals that the vegetation of the area is thermo-phanerophytic. Therophytes represent the highest (50.3%) lifeforms followed by Phanerophytes (29.0%) and Hemicryptophytes (8.3%). The highest percentage of therophytes in the area may be due to low soil cover, low moisture owing to sandy soil and favourable period (rainy season) for the growth of annuals.

Keywords : Riverine, Raus, Biological Spectrum, Life-form

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Introduction

The most important natural and renewable resource for the human welfare are forests. They serve as an ecological unit influencing environment. Floristics of an area form the vegetation which is successively occupied in the form of plant community / communities. The floristics of an area is greatly influenced by soil as substrata. Anderson *et al.* (1991) have reported that the seed bank of any species is affected by the soil properties. Floristics helps us to understand the study of life-forms and ecological patterns in spatial variability (Farina, 1998). Singh (2002) have reported that diversity as such is essential for human survival and wellbeing alongwith the ecosystem function and stability.

Riverine areas are most diverse plant habitats due to their exposure to various direct and indirect pressures. Riverine forests of Africa support a rich diversity of flora and fauna (Hughes, 1988). The herb layer in the riverine forests serves as an important component of forest vegetation as it influences the micro-climate, affect tree seedling establishment and provide wildlife browsing. The riverine area in the present study show scattered patches of mixed-vegetation dominated by grasses. Dobhal *et al.* (2010) have reported diverse vegetation compositions in Tons river due to different micro-climatic and biotic features.

The floristics and change in its composition is a sensitive indicator of environment. Raunkiaer (1934) reported that 'Biological Spectrum' reflects its phyto-climatic conditions but in case of disturbance, it affects biotic operations (Pandeya, 1952). Attempts to study biological spectrum of various ecosystems in Uttarakhand were made (Rajwar and Gupta, 1984; Ghildiyal and Srivastava, 1990; Shahid and Joshi, 2015). However, in riverine ecosystems Prakriti *et al.* (2010) and Singh and Joshi (2014) have reported it from Song and Tons rivers respectively.

Study Site

The present study is carried out in Shivalik Range of Mohand Forest Block of Shivalik Forest Division, Saharanpur. The Shivaliks that form the southernmost part of Himalaya, form a long chain of narrow and low hills about 700-1320 m running almost parallel to Himalayas. The slopes in the study site are steep and rugged in the upper position but lower down they have quite easy gradients. There are many rivulets also known as 'Rau' traversing through the forest range and ultimately join river in Saharanpur. Among the rivulets 'Kheeree Rau', 'Semal Rau', 'Pathar Rau', 'Mohan Rau' are prominent. These rivulets are narrow when at Shivalik mountain but gradually become wider as they flow downwards. The study area is situated on the right side of Dehradun-Saharanpur road at the distance of nearly 19 km from Dehradun. The Kheeree Rau flows in the centre of Semal Rau and Pathar Rau. Scattered trees are found on either side of these rivulets.

Methodology

The study area was thoroughly investigated seasonally to cover all landscape features and landforms of all the three Raos. The plant specimens were collected from all the sites as per Jain and Rao (1977). Plant species were identified with the help of National Herbaria of BSI (BSD) and FRI (DD) located in Dehradun. Information of habit, habitat,

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flowering and fruiting period and organ of perennation was recorded by using Raunkiaer's classification (Muller-Dombois and Ellenberg, 1967).

Result and Discussion

The consistent increase in biotic activities in forest areas has resulted in over-exploitation of natural resources. This has resulted in imbalance of the delicate equilibrium that exists between living organisms and their environment. Biodiversity is essential for the ecosystem function and stability as well as human survival (Singh, 2002). Conservation of biological diversity is the essential step for understanding and managing the disturbance regimes of a landscape (Spies and Turner, 1999).

Riverine ecosystems are open to human interference and serve as areas for invasion and establishment of different plant species. In present study area, the availability of water for a brief period of 2-3 months in the forms of flooding and thereby sedimentation, influences the vegetation and its development. The floral diversity of the area has recorded 193 Angiosperms (144 dicots and 49 monocots) (Table 1) belonging to 54 families. Dicots contributed a total of 74.6% (Fig. 1). Among the plant growth forms herbs with 135 species emerged as dominant vegetation group followed by shrubs (38 species), trees (14 species) and climbers (06 species) (Fig.2). The maximum number of plant species belong to family Poaceae with 35 species followed by Fabaceae with 23 species.(Fig.3).

Life forms indicate environment of the area especially climatic conditions. The life form classes reflect vertical stratification of various layers. Rao (1968) reported that the stratification indicates the plant response to the unfavourable seasons for growth. The life form of the study area shows that therophytes emerged with highest percentage (50.3%) followed by phanerophytes (29%), hemicryptophyte (8.3%) and Chaemaphytes and Cryptophytes (each with 6.2%)(Fig.4).

The percentage of therophytes reported in the present study appear to be much higher in comparison to Raunkiaer (1934). Similarly the phanerophyte and hemicryptophytes reported in the study were lower to Raunkiaer (1934). The value of cryptophytes appeared to be similar to Raunkiaer's life forms (Fig.4). A comparison of riverine biological spectra from Uttarakhand (Table 3) indicates that in Song riverine area and Tons riverine area the life-form percentage indicates Thero-phanerophytic climate similar to present study.

Raunkiaer (1934) have reported dominance of phanerophytes in tropical vegetation. In the present study it is second dominant life-form that have adopted to the conditions of riverine ecosystem. Similar findings are reported by Dobhal *et al.* (2010) and Singh and Joshi (2014). The higher percentage of therophytes can be attributed to either dry sandy condition for most part of the year (Dadhich, 1982; Dobhal *et al.*, 2010 and Singh and Joshi, 2014)(Table 3) or due to biotic pressures (Dayama, 1987; Ghildiyal and Srivastava, 1990).

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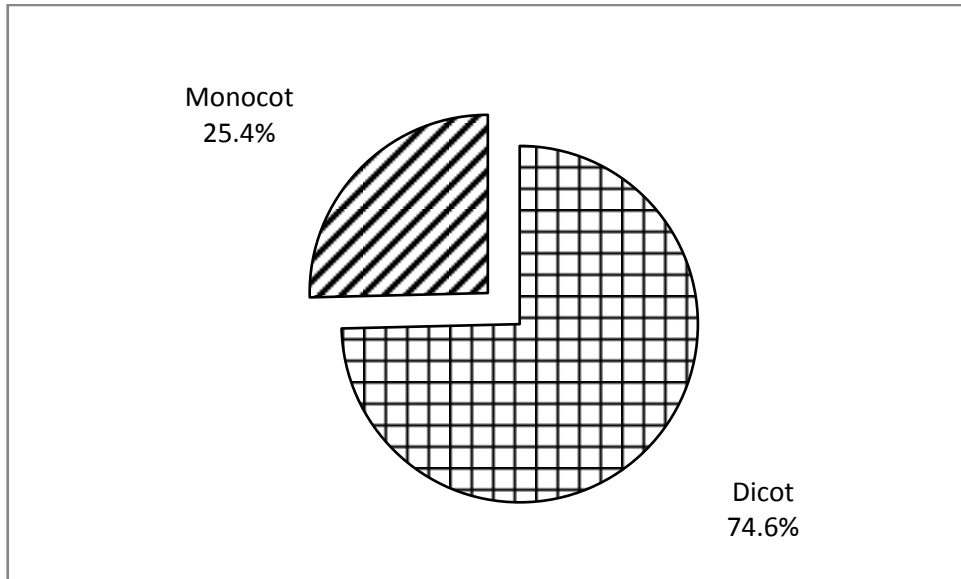


Fig. 1 : Percentage contribution of Dicots and Monocots from the Study Area

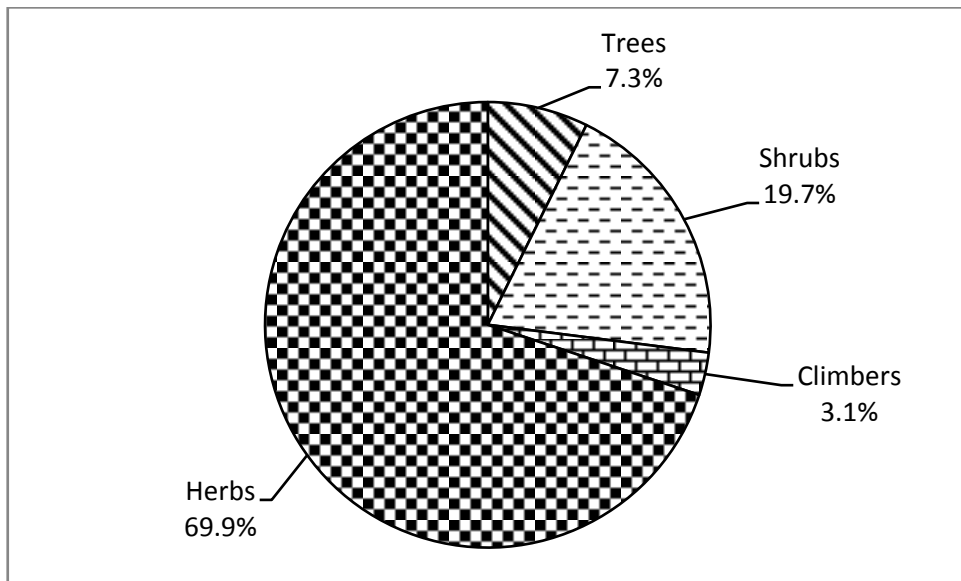


Fig. 2 : Percentage contribution of various growth forms from the Study Area

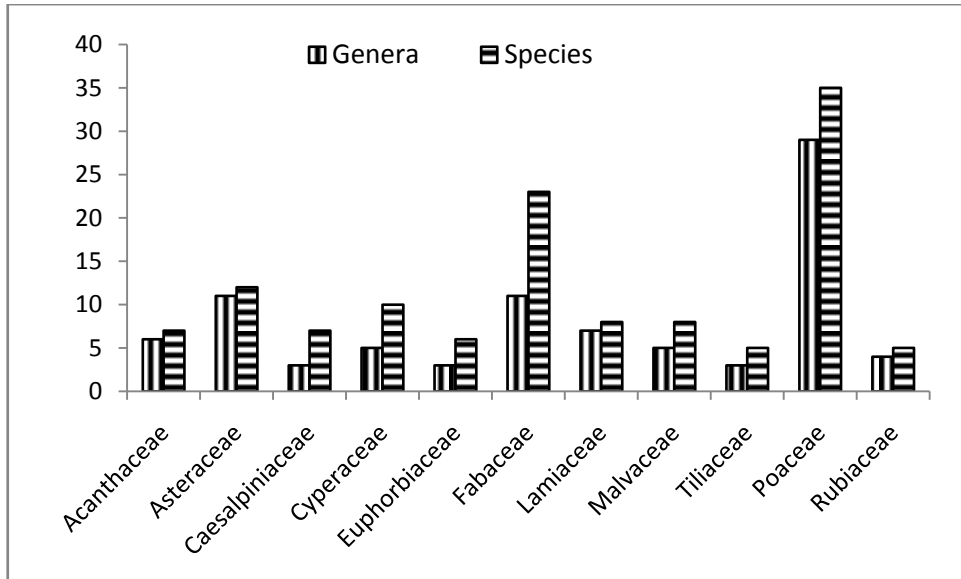


Fig. 3 : Dominant Families of the Study Area

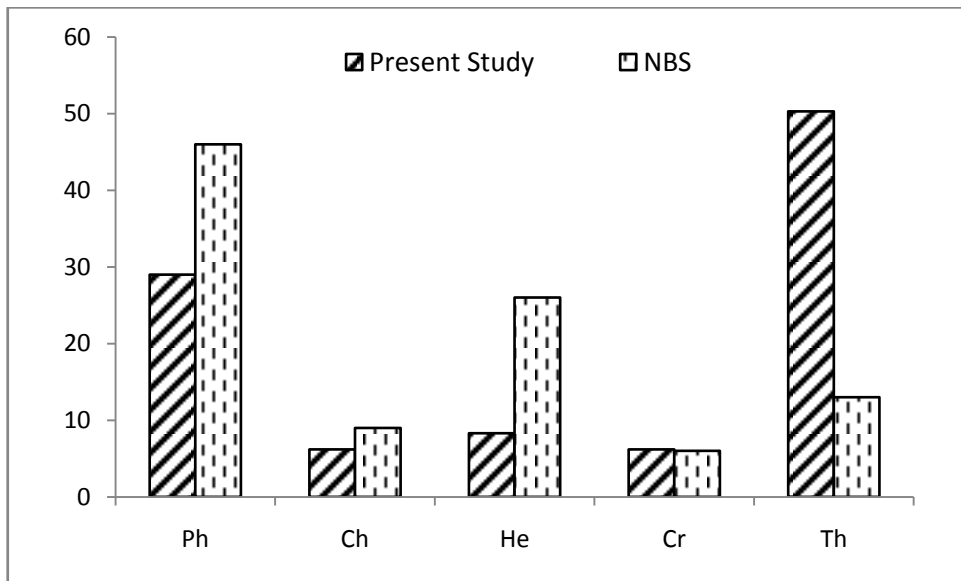


Fig. 4 : Comparison of Life-forms of Present Study Site with Raunkiaer's Life-form

Table 1 : Diversity of Taxa of the Study Site

Plant Groups	Family		Genera		Species	
	No.	%	No.	%	No.	%
Dicot	47	87	108	70.6	153	79
Monocot	07	13	45	29.4	54	21
Total	54		153		193	

Table 2 : Taxa at Species level from the Study Site

Family	Plant Species	Growth Form	Life Form
Acanthaceae	<i>Barleria cristata</i> L.	Shrub	Th
Acanthaceae	<i>Dicliptera bupleburoides</i> Nees	Herb	Th
Acanthaceae	<i>Justica simplex</i> D.Don	Herb	Th
Acanthaceae	<i>Lepidagathis incurva</i> Buch.-Ham. ex D.Don	Herb	He
Acanthaceae	<i>Lepidagathis cuspidata</i> Nees	Herb	He
Acanthaceae	<i>Peristrophe bicalyculata</i> (Retz.)Nees	Herb	Th
Acanthaceae	<i>Rungia pectinata</i> Clarke	Herb	Th
Amaranthaceae	<i>Achyranthes aspera</i> L.	Herb	Th
Amaranthaceae	<i>Aerva sanguinolenta</i> (L.)Bl.	Shrub	Ph
Amaranthaceae	<i>Amaranthus viridis</i> L.	Herb	Th
Apiaceae	<i>Bupleurum falcatum</i> L.	Herb	Th
Apocynaceae	<i>Carissa spinarum</i> L.	Shrub	Ph
Araceae	<i>Arisaema tortuosum</i> (Wall.)Schott.	Herb	Cr
Araceae	<i>Plesmonium margaritifera</i> (Roxb.)Schott.	Herb	Cr
Araliaceae	<i>Hydrocotyle asiatica</i> L.	Herb	He
Arecaceae	<i>Phoenix humilis</i> Royle	Tree	Ph
Asparagaceae	<i>Asparagus adsendens</i> Roxb.	Shrub	Ph
Asteraceae	<i>Ageratum conyzoides</i> L.	Herb	Th
Asteraceae	<i>Bidens biternata</i> (Lour.) Merr.& Sherff.	Herb	Th
Asteraceae	<i>Bidens pilosa</i> L.	Herb	Th
Asteraceae	<i>Blainvillea acmella</i> (L.) Philipson	Herb	Th
Asteraceae	<i>Blumeopsis flava</i> (DC.) Gagnep.	Herb	Th
Asteraceae	<i>Conyza stricta</i> Willd.	herb	Th
Asteraceae	<i>Eclipta prostrata</i> L.	Herb	Th
Asteraceae	<i>Emilia sonchifolia</i> (L.)DC.	Herb	Ph
Asteraceae	<i>Inula cappa</i> (Buch.-Ham. ex D.Don)DC.	Shrub	Th
Asteraceae	<i>Sonchus oleraceous</i> L.	Herb	Th
Asteraceae	<i>Tridax procumbens</i> L.	Herb	Th
Asteraceae	<i>Xanthium strumarium</i> L.	herb	Th
Begoniaceae	<i>Begonia picta</i> Smith	Herb	Th
Boraginaceae	<i>Cordia dichotoma</i> Forst.f.	Tree	Ph
Boraginaceae	<i>Cynoglossum lanceolatum</i> Forsk.	Herb	Th
Boraginaceae	<i>Trichodesma indicum</i> (L.)R.Br.	Herb	Th
Brassicaceae	<i>Arabidopsis thaliana</i> (L.) Heynh.	Herb	Th
Cactaceae	<i>Opuntia dillenii</i> Haw.	Shrub	Ph
Caesalpiniaceae	<i>Bauhinia vahlii</i> W. & A.	Climber	Ph
Caesalpiniaceae	<i>Bauhinia variegata</i> L.	Tree	Ph
Caesalpiniaceae	<i>Cassia occidentalis</i> L.	Shrub	Th

Caesalpiaceae	<i>Cassia pumila</i> Lamk.	Herb	Ph
Caesalpiaceae	<i>Cassia obtusifolia</i> L.	Shrub	Ph
Cannabaceae	<i>Trema politoria</i> Planch.	Tree	Th
Caryophyllaceae	<i>Arenaria serpyllifolia</i> L.	Herb	Th
Caryophyllaceae	<i>Stellaria cerastoides</i> L.	Herb	Th
Commelinaceae	<i>Cyanotis vaga</i> (Lour.)Schult. f.	Herb	Th
Commelinaceae	<i>Murdannia nudiflora</i> (L.)Bruckn.	Herb	Th
Convolvulaceae	<i>Ipomoea pestigridis</i> L.	Climber	Ph
Convolvulaceae	<i>Porana paniculata</i> Roxb.	Shrub	Ph
Cucurbitaceae	<i>Diplocyclos palmatus</i> (L.)Jeffrey	Climber	Cr
Cyperaceae	<i>Bulbostylis barbata</i> (Rottb.) Clarke	Herb	Cr
Cyperaceae	<i>Cyperus paniceus</i> (Rotta) Boeck.	Herb	Cr
Cyperaceae	<i>Cyperus pangorei</i> Rottb.	Herb	Cr
Cyperaceae	<i>Cyperus sanguinolentus</i> Vahl	Herb	Cr
Cyperaceae	<i>Cyperus brevifolius</i> (Rottb.) Hassk.	Herb	Th
Cyperaceae	<i>Cyperus rotundus</i> L.	Herb	Th
Cyperaceae	<i>Eriophorum comosum</i> (Wall.)Wall. ex Nees	Herb	Th
Cyperaceae	<i>Fimbristylis dichotoma</i> (L.) Vahl	Herb	Cr
Cyperaceae	<i>Cyperus pumilus</i> L.	Herb	Th
Cyperaceae	<i>Carex condensata</i> Nees	Herb	Ph
Dioscoreaceae	<i>Dioscorea bulbifera</i> L.	Herb	Ph
Dipterocarpaceae	<i>Shorea robusta</i> Gaertn.f.	Tree	Th
Euphorbiaceae	<i>Euphorbia hirta</i> L.	Herb	Th
Euphorbiaceae	<i>Euphorbia geniculata</i> Orteg.	Herb	Th
Euphorbiaceae	<i>Euphorbia hypericifolia</i> L.	Herb	Ph
Euphorbiaceae	<i>Mallotus philippensis</i> Muell.-Arg.	Tree	Th
Euphorbiaceae	<i>Phyllanthus debilis</i> Klein ex Willd.	Herb	Th
Euphorbiaceae	<i>Phyllanthus simplex</i> Retz.	Herb	Ch
Fabaceae	<i>Alysicarpus bupleurifolius</i> (L.)DC.	Herb	Ch
Fabaceae	<i>Alysicarpus ferrugineus</i> Hochst.& Steud.	Herb	Ch
Fabaceae	<i>Alysicarpus vaginalis</i> (L.)DC.	Herb	Ph
Fabaceae	<i>Cajanus scarabaeoides</i> (L.) Thouars	Climber	Ph
Caesalpiaceae	<i>Cassia fistula</i> L.	Tree	Ph
Caesalpiaceae	<i>Cassia laevigata</i> Willd.	Herb	Ph
Fabaceae	<i>Crotalaria alata</i> Buch.-Ham.ex D.Don	Herb	Ph
Fabaceae	<i>Crotalaria medicaginea</i> Lamk.	Herb	Th
Fabaceae	<i>Crotalaria calycina</i> Schrank.	Herb	Th
Fabaceae	<i>Crotalaria albida</i> Heyne ex Roth	Herb	Ch
Fabaceae	<i>Crotalaria juncea</i> L.	Herb	Ch
Fabaceae	<i>Crotalaria pallida</i> Aiton	Herb	Th
Fabaceae	<i>Crotalaria prostrata</i> Roxb.	Herb	Th

Fabaceae	<i>Desmodium pulchellum</i> (L.)Benth.	Shrub	Ph
Fabaceae	<i>Desmodium triflorum</i> (L.)DC.	Herb	Ph
Fabaceae	<i>Desmodium heterocarpon</i> DC.	Shrub	Th
Fabaceae	<i>Desmodium velutinum</i> (Willd.)DC.	Shrub	Ph
Fabaceae	<i>Indigofera linifolia</i> (L.f.)Retz.	Shrub	Th
Fabaceae	<i>Lathyrus aphaca</i> L.	Herb	Ph
Fabaceae	<i>Ougeinia delbergioides</i> Benth.	Tree	Th
Fabaceae	<i>Sesabania sesban</i> (L.)Merr.	Tree	Ph
Fabaceae	<i>Vicia hirsuta</i> (L.)Gray	Climber	Ph
Fabaceae	<i>Vicia sativa</i> L.	Climber	Th
Fabaceae	<i>Uraria picta</i> (Jacq.)Desv.	Shrub	Th
Fabaceae	<i>Zornia gibbosa</i> Span.	Herb	Th
Gentianaceae	<i>Canscora decussata</i> (Roxb.) Schult. & Schult.	Herb	Ph
Gentianaceae	<i>Gentiana aprica</i> Decne	Herb	Ch
Geraniaceae	<i>Geranium ocellatum</i> Cambess.	Herb	Th
Lamiaceae	<i>Ajuga macrosperma</i> Wall.	Herb	He
Lamiaceae	<i>Anisomelis indica</i> (L.)O.Kuntze	Herb	Th
Lamiaceae	<i>Caryopteris wallichiana</i> Schau.	Shrub	Th
Lamiaceae	<i>Clerodendrum viscosum</i> Vent	Shrub	Ph
Lamiaceae	<i>Leucas cephalotes</i> (Roth.)Spreng.	Herb	Ph
Lamiaceae	<i>Nepeta graciliflora</i> Benth.	Herb	Th
Lamiaceae	<i>Nepeta hindostana</i> (Roth.)Haines	Herb	Th
Lamiaceae	<i>Callicarpa macrophylla</i> Vahl	Shrub	Th
Linaceae	<i>Reinwardtia indica</i> Dumort.	Shrub	Ph
Linderniaceae	<i>Lindernia crustacea</i> (L.)F.Muell.	Herb	Ch
Linderniaceae	<i>Torenia cordiflora</i> Roxb.	Herb	Ph
Lythraceae	<i>Woodfordia fruticosa</i> (L.)Kurz.	Shrub	Ch
Malvaceae	<i>Helicteres isora</i> L.	Shrub	Th
Malvaceae	<i>Kediya calycina</i> Roxb.	Tree	Ph
Malvaceae	<i>Malvastrum tricuspidatum</i> (R.Br.)A.Gray	Sub Shrub	Ph
Malvaceae	<i>Sida cordifolia</i> L.	Sub Shrub	Ph
Malvaceae	<i>Sida orientalis</i> Cav.	Sub Shrub	Ph
Malvaceae	<i>Sida cordata</i> (Burm.f.)Borss.	Sub Shrub	Ph
Malvaceae	<i>Sterculia villosa</i> Roxb. ex Smith	Tree	Ph
Malvaceae	<i>Urena lagopus</i> DC.	Shrub	Ph
Menispermaceae	<i>Cissampelos pareira</i> L.	Climber	Ph
Moraceae	<i>Ficus auriculata</i> Lour.	Tree	Th
Myrtaceae	<i>Syzigium cumini</i> (L.)Skeels	Tree	Ph
Nyctaginaceae	<i>Boerhaavia diffusa</i> L.	Herb	Ph
Onagraceae	<i>Epilobium hirsutum</i> L.	Herb	Ph
Orchidaceae	<i>Habenaria marginata</i> Coleb.	Herb	Ph

Orobanchaceae	<i>Centranthera nepalensis</i> D.Don	Herb	Ph
Orobanchaceae	<i>Lindenbergia indica</i> (L.)O.Kuntze	Herb	Th
Orobanchaceae	<i>Striga asiatica</i> (L.) O.Kuntze	Herb	Th
Orobanchaceae	<i>Striga angustifolia</i> Lour.	Herb	Cr
Phyllanthaceae	<i>Phyllanthus urinaria</i> L.	Herb	Cr
Plantaginaceae	<i>Mesopates orontium</i> L	Herb	Th
Plantaginaceae	<i>Limnophila indica</i> (L.)Druce	Herb	Th
Plantaginaceae	<i>Veronica persica</i> Poir.	Shrub	Ch
Poaceae	<i>Alloteropsis angustata</i> Stapf.	Herb	Th
Poaceae	<i>Apluda mutica</i> L.	Herb	Th
Poaceae	<i>Arundinella nepalensis</i> Trin.	Herb	He
Poaceae	<i>Arundinella bengalensis</i> (Spreng.)Druce	Herb	Ph
Poaceae	<i>Arthraxon lancifolium</i> (Trin.)Hochst	Herb	Th
Poaceae	<i>Capillipedinum assimile</i> (Steud.) A.Camus	Herb	Th
Poaceae	<i>Chrysopogon serrulatus</i> Trin.	Herb	He
Poaceae	<i>Cymbopogon flexuosus</i> (Nees ex Steud.)Wats.	Herb	Th
Poaceae	<i>Cymbopogon martinii</i> (Roxb.) Wats.	Herb	Th
Poaceae	<i>Cyrtococcum accrescens</i> (Trin.)Stapf	Herb	Ch
Poaceae	<i>Digitaria longifolia</i> (Retz.)Pers.	Herb	Ph
Poaceae	<i>Digitaria sanguinalis</i> (L.)Scop.	Herb	Ch
Poaceae	<i>Digitaria ciliaris</i> (Retz.) Koeler	Herb	Cr
Poaceae	<i>Eleusine indica</i> (L.)Gaertn.	Herb	Cr
Poaceae	<i>Eragrostiella nardoides</i> (Trin.)Bor.	Herb	Th
Poaceae	<i>Eragrostis unioloides</i> (Retz.)Nees ex Steud.	Herb	He
Poaceae	<i>Eragrostis tenella</i> (L.)P.Beauv.	Herb	He
Poaceae	<i>Tripidium revennae</i> (L.) H.Scholz	Herb	He
Poaceae	<i>Erianthus filifolius</i> Nees ex Steud.	Herb	Th
Poaceae	<i>Hetropogon contortus</i> (L.)P.Beauv.	Herb	Th
Poaceae	<i>Imperata cylindrica</i> (L.)P.Beauv.	Herb	Th
Poaceae	<i>Neyraudia arundinacea</i> Hook.f.	Herb	Th
Poaceae	<i>Oplismenus compositus</i> (L.)P.Beauv.	Herb	Th
Poaceae	<i>Oplismenus burmannii</i> (Retz.)P.Beauv.	Herb	Th
Poaceae	<i>Panicum patens</i> Hochst.ex Steud.	Herb	Th
Poaceae	<i>Paspalum scrobiculatum</i> Hook.f.	Herb	He
Poaceae	<i>Saccharum spontaneum</i> L.	Herb	Th
Poaceae	<i>Setaria glauca</i> B.Beauv.	Herb	He
Poaceae	<i>Sorghum halepense</i> (L.)Pers.	Herb	He
Poaceae	<i>Themeda quadrivalvis</i> (L.)O.Kuntze	Herb	Th
Poaceae	<i>Thysanolaena maxima</i> (Roxb.)O.Kuntze	Herb	Th
Poaceae	<i>Chrysopogon zizanioides</i> (L.)Nash	Herb	Th
Poaceae	<i>Bothriochloa pertusa</i> (L.) A.Camus	Herb	Th

Poaceae	<i>Cynodon dactylon</i> (L.) Pers.	Herb	He
Poaceae	<i>Desmostachya bipinnata</i> (L) Stapf	Herb	Th
Polygalaceae	<i>Polygala chinensis</i> L.	Herb	Th
Polygalaceae	<i>Polygala furcata</i> Royle	Herb	Th
Polygonaceae	<i>Polygonum barbatum</i> L.	Herb	Th
Polygonaceae	<i>Polygonum flaccidum</i> Roxb.	Herb	He
Polygonaceae	<i>Polygonum plebejum</i> R.Br.	Herb	Th
Polygonaceae	<i>Rumex hastatus</i> D.Don	Herb	Th
Portulacaceae	<i>Portulaca oleracea</i> L.	Herb	Th
Primulaceae	<i>Anagallis arvensis</i> L.	Herb	Th
Primulaceae	<i>Androsace trifolia</i> Adams	Herb	Ch
Primulaceae	<i>Maesa indica</i> (Roxb.)A.DC.	Shrub	He
Ranunculaceae	<i>Clematis gouriana</i> Roxb. ex DC	Climber	Ch
Rhamnaceae	<i>Helinus lanceolatus</i> Brand.	Shrub	Ch
Rhamnaceae	<i>Zizyphus mauritiana</i> Lam.	Shrub	Th
Rhamnaceae	<i>Zizyphus nummularia</i> (Burm.f.)Wight&Arn.	Shrub	Ph
Rubiaceae	<i>Borreria stricta</i> G.F.W.May	Herb	Ph
Rubiaceae	<i>Spermadictyon suaveolus</i> Roxb.	Shrub	Ph
Rubiaceae	<i>Oldenlandia nudicaulis</i> Roth.	Herb	Ph
Rubiaceae	<i>Oldenlandia corymbosa</i> Hook.f.	Herb	Ph
Rubiaceae	<i>Pavetta indica</i> L.	Shrub	Th
Rutaceae	<i>Murraya koenigii</i> (L.)Spreng.	Shrub	Ph
Scrophulariaceae	<i>Mazus rugosus</i> Lour.	Herb	Th
Solanaceae	<i>Solanum surratense</i> Burm.f.	Herb	Th
Tiliaceae	<i>Corchorus aestuans</i> L.	Herb	Ph
Tiliaceae	<i>Corchorus tridens</i> L.	Herb	Ph
Tiliaceae	<i>Grewia glabra</i> Bl.	Tree	Th
Tiliaceae	<i>Triumfetta pilosa</i> Roth	Herb	Th
Tiliaceae	<i>Triumfetta rhomboidea</i> Jacq.	Shrub	Th
Verbenaceae	<i>Colebrookea oppositifolia</i> Smith	Shrub	Ph
Verbenaceae	<i>Lantana camara</i> L.	Shrub	Ph
Vitaceae	<i>Leea aspera</i> Edgew.	Shrub	Ph

Table 3 : Biological Spectrum of Various Riverine Areas in Uttarakhand and Raunkiaer's Normal Biological Structure

River	No. of Species	Life-form Classes					Phyto-climate	Source
		Ph	Ch	He	Cr	Th		
Song	341	29.33	7.33	4.68	5.87	52.79	Th-Ph	Dobhal <i>et al.</i> (2010)
Tons	341	37.00	7.05	2.42	4.63	48.90	Th-Ph	Singh & Joshi (2014)
Kheree, Son, Semal Rau	193	29.00	6.20	8.30	6.20	50.30	Th-Ph	Present Study