

Floristic Inventory of Woody Plants in Fresh Water Wetland of Doon Valley, Uttarakhand, India

Seema*

Junior Research Fellow, Forest Ecology & Environment Division
P.O. New Forest, Forest Research Institute Dehradun, Uttarakhand (India)-248006
Email: Seema.Fri@Gmail.Com

Dr. Prafulla Soni

Scientist G & Head, Forest Ecology & Environment Division
P.O. New Forest, Forest Research Institute, Dehradun, Uttarakhand (India)-248006
Email: sonip1405@gmail.com; Contact No. +91-135-2752674

Dr. Mridula Negi

Scientist B, Forest Ecology & Environment Division
P.O. New Forest, Forest Research Institute, Dehradun, Uttarakhand (India)-248006
Email: mridula@icfre.org; Contact No. +91-135-2224417

S.K.Kamboj

Forest Ecology & Environment Division, P.O. New Forest, Forest Research Institute
Dehradun, Uttarakhand (India)-248006

B.B.Rana

Forest Ecology & Environment Division, P.O. New Forest, Forest Research Institute
Dehradun, Uttarakhand (India)-248006

Abstract: In order to study the floristic diversity of woody plants in fresh water wetland of Doon Valley of Uttarakhand, India, four transect lines were set along moisture gradients using belt transect method. Floristic inventory and plant community was evaluated using standard techniques. Diameter at breast height (dbh) for all woody plants (>1 cm dbh) was recorded at 1.3m height. A total of 738 woody plants belonging to 28 families, 46 genera and 51 species were recorded. Species diversity as calculated using Shannon-Wiener diversity index was 2.82 for trees and 3.52 for shrub and basal area was 441.2 m² ha⁻¹ for trees and 5.601 m² ha⁻¹ for shrubs. The most abundant species was *Trewia nudiflora*, Linn (Euphorbiaceae), which accounted for 37% of the total sampled stems. *Albizia lebbeck*, Benth had the highest basal area with (313.23 m² ha⁻¹). Moraceae was the dominant family accounting for 7% of the stems. [Nature and Science 2010;8(11):75-81]. (ISSN: 1545-0740).

Key words: Doon Valley, wetland, fresh water, species diversity, floristic inventory.

Introduction

Wetlands are one of the most productive ecosystems (Leith and Whittaker, 1975) and thus subjective to human greed, which is yet another reason for the extinction. Wetlands are being disturbed and destroyed day by day by the practices of road building, urban and rural development, agriculture, and surface mining (Tiner 1984, Salvesen 1990). Over 50% of the pre-settlement wetlands in the U.S. alone have been lost to such activity (Tiner 1984, Dahl 1990). In order to compensate for those wetlands being lost or disturbed, many of the permits issued under the clean water Act (P.L. 95-217) that allow for the filling or draining of wetland are accompanied by mandates to create or restore wetlands. The preservation, restoration and creation of wetlands have become increasingly important to

offset ecological problems caused by past and current drainage of wetland areas worldwide. In the United States, for example, more than half of wetlands have been converted largely for agriculture and urbanization (Mitsch and others 1998; Mitsch and Gosselink 2000).

India is rich in wetland resources and exhibits significant ecological diversity, primarily because of variability in climatic conditions and changing topography. Unfortunately, many such areas have been converted for agriculture, industry or settlements. A great number have been affected by industrial effluents, sewage, household waste and sedimentation due to ecological degradation in catchment areas. Wetland of Kashmir is the home of rich biodiversity of flora and fauna. The country being a signatory of the Ramsar convention 1971 has

designated some wetlands as Ramsar sites (Ambasth, 2008).

In Doon valley there are many patches of freshwater swamps, which are recognized as integral part of wetland ecosystems. Kanjilal (1901) first emphasized on vegetation and botanical value of these swamps. The vegetation and soil texture of Mothronwala has been studied by Dakshini (1960a, 1960b, 1965, 1970, and 1974). Som Deva and Aswal (1974) studied the taxonomy and ecology of Mothronwala swamp. Deva (1974), Srivastava (1978) and Ghildiyal (1989) studied the vegetation of other swamps of Doon valley that include Golatappar and Manu swamp.

Materials and methods

Study area

Study site is located in Doon valley which is bound by lesser Himalayas in north and younger Siwaliks in the south and is limited by river Ganga and Yumuna in east and west respectively. It lies between longitude 77° 35' to 78° 24' east and latitude 29° 55' and 30° 30' north and covers an area of more than 2000 sq. km.

Doon valley is well known for its swamps. Present study was undertaken in Nakraunda wetland of Doon valley which is located at latitude 30° 14' 15'' north and longitude 78° 5' 55'' east about 25 km east of Dehradun on Doiwala road. It occupies an area of approximately 2 km². The Song river flows along its southern limits.

Methodology

The inventory and community composition of woody plants was prepared after taking up detailed phytosociological study in Nakraunda wetland of Doon valley. Ten quadrats of 10m x10m for trees and 5m x5m for shrubs were laid out in each site along the moisture gradients using Belt transect method (Misra, 1968). All the woody plant species >1cm dbh were considered as tree and shrub species.

Four sites were selected in the study area on the basis of topography, distance from source of water i.e. moisture gradients. On the basis of quantitative estimates of floristic composition of woody plants, following parameters have been calculated:

Richness, Diversity and Evenness:

Richness of a community in each site was determined as the total number of species present in it. Shannon-Wiener diversity index (Shannon and Wiener, 1963) was calculated from the IVI values using the formula as given by Magurran (1988).

$$H' = - \sum p_i \ln p_i$$

$$p_i = n_i/N$$

Where,

H' is Shannon- Wiener Index, and p_i is the proportion of i th species, n_i number of individual of a species, N= total number of all individuals of all species and \ln = logarithm to the base.

Fisher's α that is defined by

$$S = \alpha \ln (1 + N/ \alpha)$$

Where S = species number, N= individual number, \ln means the natural logarithm, and α is the sole parameter (Fisher *et al.* 1943). An estimate of α can be made for any pair of S and N using Newton's method (Condit *et al.* 1996).

Results and discussion

A total of 738 woody plants belonging to 28 families, 46 genera and 51 species, were recorded (Table 1). Of these 707 were shrubs belonging to 25 families, 39 genera and 44 species and 31 were trees belonging to 7 families, 7 genera and 7 species. These were all of >1 cm dbh. Most of the tree species were recorded with > 10cm dbh, there were 199 trees belonging to 12 families, 16 genera and 23 species. Similar observations have been made by Mohandas (2008) who recorded 78 species belonging to 28 families and 61 genera in Nilgiri montane swamps. 12 species were recorded from Poaceae family, whereas Cyperaceae had 11 species and Compositae had 6 species in Nilgiri montane swamps.

Fisher's Alpha for all the species of > 1 cm was 18.46 and for > 10 cm 5.86. For tree species of >1 cm diameter Fisher's Alpha value was 1.28 while for >10 cm 5.86. In case of shrubs for > 1 cm, the alpha value was 14.69 (Table 1) but no shrubs were recorded in >10 cm dbh. In the >1cm dbh class, basal area of all species of was 6.52 m² ha⁻¹ and 5.60 m² ha⁻¹ was for shrub and 0.917 m² ha⁻¹ for trees. For the > 10 cm dbh class the total basal area of all tree species was 441.2 m² ha⁻¹ (Table 1). Davidar *et al.* (2007) concluded that in tropical Montane forests of Western Ghats, Fisher alpha was 13.15 for trees and 4.54 for lianas. In the >1 cm dbh class, basal area of all species was 62.01 m² ha⁻¹ and of this 61.42 m² ha⁻¹ was for trees and 0.58 m² ha⁻¹ for lianas. For the >10 cm dbh class the basal area of all species was 58.76 m² ha⁻¹.

In the present study, the most abundant species in this wetland was *Trewia nudiflora*, Linn (Euphorbiaceae), which accounted for 37% of the stems sampled, followed by *Syzygium cumini* (Myrtaceae) which accounted for 23% of the stems (Table 3). *Albizia lebbcek*, Benth had the highest basal area. Similar results were also obtained by Ghildiyal *et al.* (1989) where they found that *Trewia nudiflora* was the most abundant tree specie present in Manu swamp area of Doon valley. Dhyani *et al.* (2007), in a study conducted in Karwapani fresh

water swamp forest in Doon valley, also observed that *Syzygium cumini* (Myrtaceae) is one of the abundant species.

The all woody plants of >1cm diameter the species diversity was 3.74 in this study site. The diversity indices for shrubs were 3.53 and for trees 1.81. The diversity of tree species with >10cm dbh was 2.83 (Table1).

Among the 38 families recorded in this site the contribution of different families was in the order Moraceae (7%)> Acanthaceae (6%) and Mimosaeae

(6%)each>Rutaceae (4%), Verbenaceae (4%), Urticaceae (4%), Tiliaceae (4%), Rosaceae (4%) and Euphorbiaceae (4%) (Table 2). Moraceae was the most rich species with (2 genera and 5 species) followed by Acanthaceae (4 genera and 5 species). Mimosaceae had the highest basal area (78.83 m² ha⁻¹, Table 2). Same families were found abundant by Sebastião Venâncio Martins *et al.* (2008) while studying Floristic composition of two wetland forests in Araguaian plain, was conducted Tocantins, Brazil, and comparison with other areas.

Table 1. Floristic Composition, Species richness, Diversity and Fisher's Alpha of woody plants in Nakraunda Wetland of Doon Valley

Category	All Species (dbh)		Tree species (dbh)		Shrub species(dbh)	
	> 1 cm	> 10 cm	>1 cm	> 10 cm	>1 cm	> 10 cm
No. of Individuals	738	199	31	199	707	nil
Species richness	51	23	7	23	44	nil
Number of genera	46	16	7	16	39	nil
Number of Family	28	12	7	12	25	nil
Fisher' s Alpha	18.46	5.86	1.28	5.86	14.69	nil
Diversity 'H'	3.74	2.83	1.81	2.83	3.53	nil
Basal area (m2 ha-1)	6.52	441.2	0.95	441.2	5.60	nil

Table 2. Family Level richness of woody plants in Nakraunda wetland.

Family	No. of Individuals ha ⁻¹	No. of Genera	Basal Area (m ² ha ⁻¹)
Acanthaceae	42	4	0.067
Anacardiaceae	3	1	0.023
Apocynaceae	18	2	0.041
Araliaceae	1	1	0.001
Arecaceae	91	1	0.570
Asclepiadaceae	4	1	0.056
Asteraceae	73	1	0.561
Berberidaceae	1	1	0.02
Boraginaceae	2	1	1.06
Caesalpinaceae	11	2	0.009
Combretaceae	1	1	0.45
Convolvulaceae	12	1	0.116
Cupressaceae	10	1	0.08
Ebenaceae	1	1	0.014
Ehretiaceae	1	1	0.029
Euphorbiaceae	118	3	2.33
Fabaceae	9	2	1.66
Flacourtiaceae	6	2	1.84
Lamiaceae	4	2	0.016
Lauraceae	17	2	0.21

Menispermaceae	3	1	0.052
Mimosaceae	9	4	78.83
Moraceae	47	5	15.27
Myrtaceae	116	1	0.228
Oleaceae	11	2	0.008
Plumbaginaceae	2	1	0.022
Ranunculaceae	3	1	0.083
Rhamnaceae	12	2	3.350
Rosaceae	9	3	0.25
Rutaceae	30	3	0.09
Salicaceae	1	1	0.2
Saxifragaceae	46	1	0.125
Solanaceae	8	1	0.035
Tamaricaceae	2	1	0.034
Tiliaceae	9	3	0.19
Ulmaceae	8	2	0.03
Urticaceae	40	3	0.21
Verbenaceae	225	3	0.983

Table 3. Floristic Composition of woody plant species (> 1cm dbh) recorded in swamp forest.

Species	Family	Habit	No. of individual ha ⁻¹	Basal Area (m ² ha ⁻¹)	Relative Density %
<i>Acacia catechu</i> , Willd.	Mimosaceae	Tree	3	1.64	5.17
<i>Acacia pennata</i> , Willd.	Mimosaceae	Shrub	3	0.008	0.87
<i>Adhatoda vasica</i> , Nees.	Acanthaceae	Shrub	16	0.054	3.33
<i>Albizia lebbek</i> , Benth.	Mimosaceae	Tree	1	313.23	1.64
<i>Albizia procera</i> , Benth.	Mimosaceae	Tree	1	0.44	2.13
<i>Asclepias curassavica</i> , Linn.	Asclepiadaceae	Shrub	4	0.056	2.17
<i>Bergenia ciliata</i> , Sternb	Saxifragaceae	Shrub	22	0.076	3.45
<i>Bergenia ciliata</i> , Sternb	Saxifragaceae	Tree	1	0.02	1.61
<i>Boehmeria regulosa</i> , Wedd.	Urticaceae	Shrub	23	0.197	4.54
<i>Caesalpinia bonducella</i> , Flem.	Caesalpiniaceae	Shrub	5	0.008	2.72
<i>Calamus tenuis</i> , Roxb	Arecaceae	Shrub	91	0.570	14.65
<i>Callicarpa longifolia</i>	Verbenaceae	Shrub	3	0.010	2.72
<i>Carissa carandas</i> , Linn.	Apocynaceae	Shrub	17	0.079	3.5
<i>Cassia occidentalis</i> , Linn	Caesalpiniaceae	Shrub	6	0.009	3.82
<i>Celtis australis</i> , Linn.	Ulmaceae	Shrub	6	0.021	0.91
<i>Celtis australis</i> , Linn.	Ulmaceae	Tree	1	0.03	2.13
<i>Clematis gouriana</i> , Roxb.	Ranunculaceae	Shrub	3	0.083	1.91
<i>Clerodendrum infortunatum</i> , Gaertn.	Verbenaceae	Shrub	140	0.203	23.43
<i>Cocculus laurifolius</i> , DC.	Menispermaceae	Shrub	3	0.052	1.63
<i>Colebrookia</i>	Lamiaceae	Shrub	2	0.028	1.09

<i>oppositifolia</i> ,Smith.					
<i>Cordia myxa</i> ,auct. Pl.,	Ehretiaceae	Shrub	1	0.029	0.63
<i>Cordia obliqua</i> , Willd.	Boraginaceae	Tree	2	1.06	3.28
<i>Cudrenia cochinchinensis</i>	Moraceae	Shrub	17	0.006	1.97
<i>Cudrenia cochinchinensis</i>	Moraceae	Tree	11	0.50	5.15
<i>Cupressus kashmiriana</i> ,	Cupressaceae	Tree	10	0.08	9.86
<i>Dalbergia sissoo</i> ,Roxb.	Fabaceae	Shrub	3	0.025	1.08
<i>Dalbergia sissoo</i> ,Roxb.	Fabaceae	Tree	1	0.65	1.64
<i>Debregeasia hypoleuca</i> , Wedd.	Urticaceae	Shrub	7	0.020	0.54
<i>Debregeasia hypoleuca</i> , Wedd.	Urticaceae	Tree	6	0.61	9.68
<i>Diospyros montana</i> , Roxb.	Ebenaceae	Shrub	1	0.014	0.64
<i>Eupatorium adenophorum</i> , Sprengel	Asteraceae	Shrub	73	0.561	39.67
<i>Ficus glomerata</i> ,Roxb	Moraceae	Tree	2	0.10	1.86
<i>Ficus glomerata</i> , Roxb.(sapling)	Moraceae	Shrub	3	0.004	0.67
<i>Ficus palmata</i> , Forsk(sapling)	Moraceae	Shrub	4	0.037	1.21
<i>Ficus religiosa</i> ,Linn.	Moraceae	Tree	1	1.30	1.64
<i>Ficus rumphii</i> ,Bl.(sapling)	Moraceae	Shrub	5	0.02	1.41
<i>Ficus rumphii</i> ,Bl.	Moraceae	Tree	4	104.93	3.28
<i>Flacourtia cataphracta</i> ,Roxb	Flacourtiaceae	Tree	5	1.64	8.62
<i>Flacourtia indica</i>	Flacourtiaceae	Tree	1	0.20	2.13
<i>Grewia optiva</i> , Burret.	Tiliaceae	Tree	2	0.72	3.45
<i>Grewia optiva</i> , Burret.(sapling)	Tiliaceae	Shrub	4	0.010	1.08
<i>Hedera nepalensis</i> , Koch.	Araliaceae	Liana	1	0.001	0.54
<i>Holarrhena antidysenterica</i> ,Wall.	Apocynaceae	Shrub	1	0.003	0.64
<i>Ipomoea muricata</i> ,Jacq. C	Convolvulaceae	Shrub	12	0.116	3.76
<i>Jasminum arborescens</i> .Roxb	Oleaceae	Liana	10	0.014	1.9
<i>Jasminum multiflorum</i> , Andrews	Oleaceae	Liana	1	0.001	0.54
<i>Jatropha curcas</i> ,Linn.	Euphorbiaceae	Tree	8	0.11	5.07
<i>Justicia simplex</i> , D.Don	Acanthaceae	Shrub	10	0.006	4.02
<i>Lantana camara</i> , Linn	Verbenaceae	Shrub	82	2.737	12.32
<i>Lepidagathis cuspidata</i> ,Nees.	Acanthaceae	Shrub	8	0.109	4.35
<i>Litsea chinensis</i> , Lamk.(sapling)	Lauraceae	Shrub	10	0.017	1.56
<i>Litsea chinensis</i> ,Lamk.	Lauraceae	Tree	6	0.21	5.4
<i>Mallotus philippensis</i> ,Muell.	Euphorbiaceae	Tree	10	0.44	6.09
<i>Mallotus, philippensis</i> Muell	Euphorbiaceae	Shrub	13	0.013	0.9

(sapling)					
<i>Miliusa velutina</i> , H.F.&Th.	Lauraceae	Tree	1	0.20	1.72
<i>Murraya koenigi</i> , Spreng.	Rutaceae	Shrub	25	0.079	3.69
<i>Murraya paniculata</i> , Jack	Rutaceae	Shrub	3	0.005	0.85
<i>Pogostemon bengalensis</i> , Kuntze	Lamiaceae	Shrub	2	0.004	1.27
<i>Psidium guajava</i> , Raddi.	Myrtaceae	Shrub	2	0.006	1.34
<i>Pyrus pashia</i> , Ham.(sapling)	Rosaceae	Shrub	3	0.001	0.63
<i>Pyrus pashia</i> , Ham.	Rosaceae	Tree	2	0.98	3.27
<i>Rosa moschata</i> , Mill.	Rosaceae	Liana	1	0.002	0.63
<i>Rubus ellipticus</i> , Sm.	Rosaceae	Shrub	3	0.014	2.01
<i>Rumex hastatus</i> , D.Don.	Plumbaginaceae	Shrub	2	0.022	1.09
<i>Salix tetrasperma</i> , Roxb.	Salicaceae	Tree	1	0.20	1.72
<i>Solanum nigrum</i> , L.	Solanaceae	Shrub	7	0.010	0.63
<i>Strobilanthes alatus</i> , Nees.	Acanthaceae	Shrub	8	0.098	4.35
<i>Syzygium cumini</i> , Skeels(sapling)	Myrtaceae	Shrub	63	0.068	2.31
<i>Syzygium cumini</i> , Skeels	Myrtaceae	Tree	51	0.61	23.05
<i>Terminalia tomentosa</i> , W.&A	Combretaceae	Tree	1	0.45	1.72
<i>Toona ciliata</i> , Roemer	Tiliaceae	Tree	1	0.02	1.61
<i>Trema politoria</i> , Blume	Ulmaceae	Shrub	1	0.005	0.54
<i>Trewia nudiflora</i> , Linn	Euphorbiaceae	Tree	87	8.76	37.09
<i>Trimax decidua</i>	Tamaricaceae	Shrub	2	0.034	1.09
<i>Triumfetta pilosa</i> , Roth	Tiliaceae	Shrub	3	0.015	2.01
<i>Urtica dioica</i> , L.	Urticaceae	Shrub	4	0.022	2.54
<i>Zanthoxylum alatum</i> , Roxb(sapling)	Anacardiaceae	Shrub	3	0.023	1.08
<i>Zanthoxylum alatum</i> , Roxb.	Anacardiaceae	Tree	2	0.19	1.64
<i>Ziziphus mauritiana</i> , Lam	Rhamnaceae	Shrub	2	0.020	1.27
<i>Zizyphus nummularia</i> , Wrght& Arn.	Rhamnaceae	Shrub	10	0.084	5.43

Conclusions

The Fresh water swamp forests form a distinct ecosystem in the Doon valley and have been regularly visited by various workers for vegetational and ecological studies (Dakshini, 1960a, b, 1965, 1970, 1974; Deva and Aswal, 1974; Deva and Srivastava, 1978; Srivastava *et al.*, 2000). Most of the land are under fresh water swamp has been converted into agriculture land (Dhyani and Joshi, 2007). Present study was conducted in Nakraunda, one of the fresh water swamp of Doon valley which is represented by diverse flora with 28 families, 46 genera and 51 species. Of these 707 were shrubs belonging to 25 families, 39 genera and 44 species and 31 were trees belonging to 7 families, 7 genera

and 7 species. Closeness of swamp forest to human habitations has a direct bearing on the floristic diversity as these swamp forests are in use for fuelwood, fodder, food, medicinal plants etc (Manhas *et al.*, 2009). Sharma and Joshi (2008) have also given similar reasons for the dwindling diversity and degradation of Mothronwala, another swamp of Doon valley.

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