

# Plant Species Diversity and Composition of Fresh Water Wetland of Doon Valley, Western Himalaya, India

Saurabh Kumar<sup>1</sup> and Pramod Kumar<sup>2</sup>

<sup>1,2</sup>Ecology, Climate Change and Forest Influence Division, Dehradun  
E-mail: <sup>1</sup>saurabhfri9@gmail.com

**Abstract**—Fresh water swamps are the unique ecosystems having very specific vegetation. Doon Valley has many fresh water swamps due to its unique topography surrounded by lesser Himalaya and Siwalik range. The present study was conducted at Golatappar subtropical fresh water wetland (swamp forest) of Doon Valley, Uttarakhand. At present it is under immense biotic pressure due to anthropogenic activities. A total of 152 species belonging to 59 family and 135 genera were recorded in the present study. The richness of herb species (65) was higher than the trees (32) and shrubs (48). Poaceae (10 genera/12 species) was the most dominant family. *Diospyros malabarica* recorded the highest tree density (326 ind. ha<sup>-1</sup>) followed by *Shorea robusta* (149 ind. ha<sup>-1</sup>). *Clerodendron viscosum* had highest shrub density (5044 ind. ha<sup>-1</sup>) followed by *Urena lobata* (1456 ind. ha<sup>-1</sup>) and *Oplismenus compositus* had highest herb density (45800 ind. ha<sup>-1</sup>) followed by *Ageratum conyzoides* (35500 ind. ha<sup>-1</sup>). The dominant tree species was *Diospyros malabarica* with highest IVI value (83.21) followed by *Shorea robusta* (46.91). In shrub layer *Clerodendron viscosum* had highest IVI (50.2) followed by *Lantana camara* (20.95 IVI) and in herb layer *Oplismenus compositus* had highest IVI (22.6) followed by *Ageratum conyzoides* (16.6 IVI). Shannon diversity index for trees was 2.25, for shrubs were recorded 2.98 and for herbs was recorded as 3.29. Increased richness and density of herbaceous and invasive species such as *Ageratum conyzoides*, *Urena lobata*, *Eupatorium adenophorum* and *Lantana camara* shows high degree of degradation which in turn is altering the structure and composition of the forest and reversing the process of succession. If this rate of degradation continues many native and endemic forest species may become extinct in near future, therefore conservation of these forests and their biodiversity should be the top priority.

**Keywords:** Wetlands, Swamp forest, biodiversity, Invasive species

## 1. INTRODUCTION

A wetland is an ecosystem distinguished by water that either covers or saturates the ground in the root zone for at least part of the year. Swamps are marshy areas with typical habitats where water oozes out in perennial streams at constant level throughout the year. Fresh water swamps are the unique ecosystem having very specific vegetation. Doon valley has many fresh water swamps due to its unique topography

surrounded by lesser Himalaya and Siwalik range. Kanjilal, 1901 [1] for the first time drew attention to the swamp forests near Dehradun like, Doodpani, Golatappar, Gularghati, Manu swamp, Mothronwala, Nakraunda, and Karwapani and emphasized on vegetation and botanical value of these swamps. Since then a number of studies have been conducted by various workers on floristic diversity [2-6, 7, 8, 9, 10, 11, 12], community dynamics [13, 11]. The rich and luxuriant vegetation of the area has been subjected to severe degradation in the past due to population growth and urbanization. The present study provides an overview of floristic diversity and community composition of Golatappar swamp forest.

## 2. MATERIALS AND METHODS

### Study Area

The study was conducted in fresh water wetland (swamp forest) of Doon Valley i.e. Golatappar in Barkot forest range bound by lesser Himalayas in north and younger Shiwaliks in south. Golatappar swamp forest lies on the left of Dehradun-Haridwar road approximately 50 km from Dehradun city. The swampy zone (bottomland) lies in a depression and is surrounded on all sides except south by a clay bed of immense thickness overlying great mass of the gravel deposit. It is surrounded by Chidderwala and Khiri villages. The forest is main source of fodder, fuelwood and medicinal plants. Due to anthropogenic activities these forests are under immense pressure in terms of their biodiversity as well soil and water quality.

### Vegetation Sampling

The phyto-sociological surveys were carried out during the years 2013- 2014. To avoid under sampling particularly herbaceous species due to seasonal variations, the sampling was done twice a year (spring and autumn). Ten sampling sites were selected systematically at 100m distance. The transects were laid down from these sampling points perpendicular to the edge to the interior of forests. Each transect here represents

a single sampling unit. In every transect, five 10 x 10 m plots or quadrats at 10, 50, 100, 200 and 300 meters from the edge to the interior of the forest were marked and along these transects plots were laid according to Misra, 1968 [14], 10x10 m quadrat for tree layer, 3x3 m quadrat for shrub layer and 1x1 m quadrat for herb layer. This sampling design is adopted so as to cover those plants (mainly shrubs and herbs) which were found on the edges of forest and invade deep in to forests and represent the disturbance due to anthropogenic activities such as agriculture, settlements, grazing of cattle. The density, frequency and basal cover of all tree species were determined and the Important Value Index (IVI) was calculated as the sum of their relative values [15, 14]. Species diversity index [16] was calculated using the formula given by Magurran, 1988 [17].

### 3. RESULTS AND DISCUSSION

#### Floristic diversity of Golatappar swamp forest

The vegetation is tropical fresh water swamp forest type (Type - 4C/FS2) according to the classification given by Champion and Seth, 1968 [18]. A total of 152 species belonging to 59 family and 135 genera (including seven species of Pteridophytes) were recorded in the present study. Dicotyledons dominate the angiosperm diversity i.e 82.23 % of all the species, out of all dicots herbs form the major portion (36%). The species richness of trees, shrubs, herbs and grasses/sedges are 32, 48 and 65 respectively. Poaceae (10 genera/12 species) was the most dominant family in Golatappar swamp. The other important families are Fabaceae (8 genera/11 species), Asteraceae (10 genera/10 species), Acanthaceae (8 genera/8 species) and Moraceae (3 genera/ 8 species). The floristic diversity is less as compare to diversity of other swamps studied previously [2-6, 7, 8]. The swamp forest is dominated by *Shorea robusta*, *Diospyros malabarica*, *Pterospermum acerifolium*, *Trewia nudiflora*, *Mallotus philippense*, *Syzygium cumini* in tree layer. The undergrowth consists of *Clerodendron viscosum*, *Adathoda zeylanica*, *Calamus tenuis*, *Urena lobata*, *Murraya koenigii*, *Pogostemon benghalensis* and *Coffea benghalensis*, the herb layer consists of *Oplismenus compositus*, *Oxalis corniculata*, *Stellaria media*, *Curculigo orchoides*, *Zingiber roseum* and *Cyperus kyllingia* while *Smilax zeylanica*, *Vallisneria spiralis*, *Ichinocarpus frutescens* and *Climatis gouriana* are the prominent climbers. *Adiantum incisum*, *Adiantum philippense*, *Theylepteris dentata*, *Lygodium flexosum*, *Diplazium esculentum* and *Amplopteris prolifera* are the prominent pteridophytes.

#### Species diversity, richness and evenness at Golatappar

Species diversity, richness and evenness were calculated separately for trees, herbs and shrubs (Table 1). Shannon diversity index for trees was 2.25, for shrubs were recorded 2.98 and for herbs was recorded as 3.29.

**Table 1: Richness, evenness, and diversity indices at Golatappar**

Habit	Richness (R)	Evenness (E)	Shannon diversity (H')
Trees	32	0.65	2.25
Shrubs	48	0.78	2.98
Herbs	65	0.79	3.29

The richness of herb species (65) was higher than the trees (32) and shrubs (48) denote the high disturbance at Golatappar. Evenness of trees was recorded 0.65 and of herbs was recorded 0.79 which was almost same as shrubs which was recorded 0.78 and indicates the even distribution of herbs and shrubs than trees.

#### Vegetation structure and plant community composition

The phyto-sociological attributes of dominant tree species at Golatappar swamp forest is shown in Table 2. The dominant species was *Diospyros malabarica* with highest IVI value (83.21) followed by *Shorea robusta* (46.91), *Pterospermum acerifolium* (42.04), *Trewia nudiflora* (30.84) and *Syzygium cumini* (27.34). The total tree density and basal area was 975 ind. ha<sup>-1</sup> and 90.94 m<sup>2</sup> ha<sup>-1</sup> respectively. *Diospyros malabarica* had highest density (326 ind. ha<sup>-1</sup>) followed by *Shorea robusta* (149 ind. ha<sup>-1</sup>), *Pterospermum acerifolium* (134 ind. ha<sup>-1</sup>), *Trewia nudiflora* (95 ind. ha<sup>-1</sup>) and *Syzygium cumini* (82 ind. ha<sup>-1</sup>). However, the maximum basal area was observed for *Diospyros malabarica* (25.01m<sup>2</sup>ha<sup>-1</sup>) followed by *Shorea robusta* (19.93 m<sup>2</sup>ha<sup>-1</sup>). The phyto-sociological attributes of dominant shrub species at Golatappar is shown in Table 3. The dominant species was *Clerodendron viscosum* with highest IVI (50.2) followed by *Lantana camara* (20.95 IVI), *Calamus tenuis* (19.71 IVI), *Ardisia solanacea* (19.49 IVI) and *Adathoda zeylanica* (17.34 IVI).

**Table 2: Phyto-sociological attributes of dominant trees at Golatappar swamp forest.**

Species	Density (ind/ha)	IVI
<i>Diospyros malabaricum</i>	326	83.21
<i>Shorea robusta</i>	149	46.91
<i>Pterospermum acerifolium</i>	134	42.04
<i>Trewia nudiflora</i>	95	30.84
<i>Syzygium cumini</i>	82	27.34

The total shrub density and basal area was 18778 ind. ha<sup>-1</sup>. *Clerodendron viscosum* had highest density (5044 ind. ha<sup>-1</sup>) followed by *Urena lobata* (1456 ind. ha<sup>-1</sup>), *Smilax zeylanica* (1144 ind. ha<sup>-1</sup>), *Adathoda zeylanica* (1033 ind. ha<sup>-1</sup>) and *Lantana camara* (867 ind. ha<sup>-1</sup>). However, the maximum basal area was observed for *Calamus tenuis* (0.27m<sup>2</sup>ha<sup>-1</sup>) followed by *Clerodendron viscosum* (0.25 m<sup>2</sup>ha<sup>-1</sup>), *Lantana camara* (0.24 m<sup>2</sup>ha<sup>-1</sup>), and *Ardisia solanacea* (0.21 m<sup>2</sup>ha<sup>-1</sup>).

**Table 3: Phyto-sociological attributes of dominant shrubs at Golatappar swamp forest.**

Species	Density (ind/ha)	IVI
<i>Clerodendron viscosum</i>	5044	50.20
<i>Lantana camara</i>	867	20.95
<i>Calamus tenuis</i>	511	19.71
<i>Ardisia solanacea</i>	789	19.49
<i>Adathoda zeylanica</i>	1033	17.34

The phyto-sociological attributes of dominant herbs at Golatappar is shown in Table 4. The dominant species was *Oplismenus compositus* with highest IVI (22.6) followed by *Ageratum conyzoides* (16.6 IVI), *Cyrtococcum accrescens* (15.7 IVI), *Oxalis corniculata* (13.1 IVI) and *Curculigo orchiodes* (10.7 IVI).

**Table 4: Phyto-sociological attributes of dominant herbs at Golatappar swamp forest.**

Species	Density (ind/ha)	IVI
<i>Oplismenus compositus</i>	45800	22.6
<i>Ageratum conyzoides</i>	35500	16.0
<i>Cyrtococcum accrescens</i>	33800	15.7
<i>Oxalis corniculata</i>	26400	13.1
<i>Curculigo orchiodes</i>	12100	10.7

The total herb density was 339800 ind. ha<sup>-1</sup>. *Oplismenus compositus* had highest density (45800 ind. ha<sup>-1</sup>) followed by *Ageratum conyzoides* (35500 ind. ha<sup>-1</sup>), *Cyrtococcum accrescens* (33800 ind. ha<sup>-1</sup>), and *Oxalis corniculata* (26400 ind. ha<sup>-1</sup>). Doon valley was famous for its tropical valley fresh water swamps and once had a chain of swamps, however now there are few swamp forests are left. The floristic diversity of swamp forest have declined remarkably over the period when compared with studies of past on other swamp forests of Doon Valley [7, 2, 8, 19]. Som Deva and Srivastava, 1978 [20] also reported the more or less same result for dominant trees. The high IVI of *D. malabaricum* and *T. nudiflora*, indicates loss of other species or greater growth of these two species. The values of vegetation parameters in the present study fall within a comparable range of values reported for western Himalaya [21]. The findings of the study reveal that the presence of some opportunistic species such as *Mallotus philippensis*, *Holarrhena antidysenterica*, *Adathoda zeylanica*, *Urena lobata*, *L. camara*, and *Murraya koenigii* in forests are taking advantage of canopy opening changing the environmental conditions from moist to xeric. In general, the species diversity (H') of tropical forests is high, ranging between 5.06 and 5.40 [22], but in Indian forests it ranges between 0.00 and 4.21 [10, 24]. The diversity index values for all habits showed a close similarity with the values reported by Gautam et al. (2008) for sal forests from other locations of Doon Valley. The species diversity, and evenness values of the shrub species in the present study site closely matched the values reported by Kukreti and Negi 2004 [25]. The study further reveal the spread of *L. camara*, *A. conyzoides*, *Oxalis*

*corniculata* and many other invasive species throughout the edges of the forests because of their competitive ability relative to other species.

#### 4. CONCLUSIONS

Due to its unique topography Doon Valley have number of fresh water swamp forests, however due to expanding urbanization and agriculture fields these swamp forests are experiencing great stress in terms of their biodiversity. Increased richness, diversity and dominance of herbaceous and invasive species such as *A. conyzoides*, *A. zeylanica*, and *L. camara* shows high degree of degradation which in turn is altering the structure and composition of the forest and reversing the process of succession. There is the need of hour to conserve these precious swamp forests of Doon valley and its adjoining areas so that we can stop the further degradation of these forests.

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