

# Biodiversity of Mothronwala Swamp, Doon Valley, Uttarakhand

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**Abstract:** India is a hub of biodiversity, encompassing a wide spectrum of habitats from tropical rain forests to alpine vegetation and from temperate forests to coastal wetlands. Among the 25 hotspots, India is considered as eighth hottest of hotspots extending from Western ghats on one side and Eastern Himalayas on the other. India contributes significantly to this latitudinal biodiversity trend with mere 2.4% of the world's area. Wetlands are transitional zones between the terrestrial and aquatic environment. These habitats perform major ecological role in the biosphere. Many of the fossil fuels are known to be produced and preserved by the swampy environment of the carboniferous period. These are source, sinks and transformers of a multitude of chemicals, biological and genetic materials. These produce a rich collection of plants, many of which are potential for one, or more economic use these provide food, timbers, fuel, fodder and forage etc. India has a rich variety of wetlands habitats. Tropical swamp forests once formed an important part of vegetation and extended all along the base of Himalayas from Assam to Peshawar. The International Biological Program (IBP) states that: "A wetland is an area dominated by specific herbaceous macrophytes, the production of which takes place predominantly in the aerial environment above the water level while the plants are supplied with amounts of water that would be excessive for most other higher plants bearing aerial shoots". Doon valley is known for its swamps. There was a time when low lying areas of the valley were having a chain of swamps but human interference once started in the name of "Malaria Climate" still persists. The trees were cut at that time and the openings created resulted in the extinction of most of the swamps. Wetlands are one of the most productive ecosystems and thus subjected to human greed which is yet another reason for their extinction. The Mothronwala swamp is a "Hot Spot" of biodiversity due to its topographic and edaphic variations. Unfortunately these habitats have not been explored from ecological point of view. The fresh water swamp of Mothronwala is under threat due to human interference and other anthropogenic activities. The present work was carried out to explore the biodiversity of the swamp and suggest conservation and management strategies. [Life Science Journal. 2006;3(2):73 - 78] (ISSN: 1097 - 8135).

**Keywords:** wetlands; swamps; biodiversity; Mothronwala; conservation

## 1 Introduction

Diversity is a concept about range of variation or differences among entities. The term biodiversity is a contracted form of biological diversity. Biodiversity is the degree of variety in nature and nature itself and also is the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part. It includes diversity within species, between species and ecosystems. It is the most significant national asset and constitutes an enduring source for supporting the continued existence of human societies.

Wetlands are neither aquatic nor terrestrial, but are transitional zones. Swamps lie in the palustrine system of wetland. Swamps are marshy areas with typical habitats where water oozes out in perennial streams at constant level through out the year. They support characteristic vegetation on account of specialized edaphic conditions, as influ-

enced by free water accumulation. Unfortunately these habitats have not been explored sufficiently from ecological point of view.

The Mothronwala swamp is a "Hot Spot" of biodiversity due to topographic and edaphic variations. The only authentic record of the area available is in the old settlement documents preserved in the office of the District Collector, Dehradun. The earliest document available is one - dated 1862, and on a map the site is indicated as "Land under water" and lies close to the Bindal River. A later record dates 1902 reveals that the river has changed its course and there is a wide gap between the present course of the river and the forest. Local enquires made of the village elders have elicited the information that in the past, the swamp was much deeper and more inaccessible than at present. The villagers dreaded approaching the swampy zone. In a report on the Dehradun forests prepared by Dr. G. King and published in 1871, a reference was made to these areas and it was recommended that

the forest department should drain the swampy places, which would incidentally improve the health of the eastern part of Doon but nothing appears to have been done in this regard.

The swampy zones are located in between the ridges and are composed of innumerable pools with characteristics bubbling and small intercommunicating streams. The northern portion, however, is drier than the southern, which is slushier and consists of loose soil. Besides the pools and streamlets mentioned above there are two large streams with a swampy base, which originate from the extreme north of the forest and flow from the north to south. 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 swamps. Vegetation and soil texture of Mothronwala have been studied by Dakshini (1960a, 1960b, 1965, 1970, 1974). 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. However, study relating to the biodiversity of Mothronwala swamp has been left untouched, so the present study aimed to explore the biodiversity and give its conservation and management strategies.

## 2 Materials and Methods

### 2.1 Study area

Mothronwala, Dulhani-1 (new reserve) and Navada 10 - 14 (old reserve) of Lachiwala range about 5 km from main city of Dehradun, at an elevation of 600 m above sea level. It occupies an area of approximately 22 acres. The swamp lies at 30° 15' 40" and 30° 16' 45" N latitude and 78° 1' and 78° 2' 15" E longitude and lies to the South-East of Dehradun near the military township of Clement Town. On the East is the village of Mothronwala from which the swamp derives its name. On the north lies Banjarwala Tea Estate. On the West lies the Sushwa river, stream coming out of the swampy zone drains into the river that ultimately discharges into the Ganga through Rispana River. On the South is the Clement Town water works.

The swampy area of Mothronwala is humid and fairly green. The maximum rainfall ranges between 600 - 800 mm during the months of July - August and minimum is recorded during April - May. The maximum temperature reaches up to 40 °C during the months of May and June whereas minimum of 2 - 30 °C during December - January.

The ridge of Mothronwala swamp is about 10 - 11 m above the surrounding level. The slope along the ridge is approximately 20° - 30°. The northern part of the ridge is drier than the southern area, which is slushy. Inside the swampy area, the subsoil water level is quite high and remains so through out the year. The slush in marshy place is knee deep. During rains the water infiltrate through the gravelly soil extending over a very large area of the terrain oozes out here in a series of deep but narrow ravines giving rise to a number of streams which unites into a few main channels pour into the Suswa river.

### 2.2 Collection of aquatic flora and fauna

Clusters of algal filaments were collected from the swamp for the study of diatoms and algae present in them. Insects attached to stones were collected by a fine forceps. Insects inhabiting the shallow areas of the streams below stones were collected by enclosing 1 m<sup>2</sup> of the substratum with fine square-mesh netting cloth and sweeping the area completely. The insects were collected in cloth and picked up. The collected material was preserved in 4% formalin and identified.

### 2.3 Collection of terrestrial flora and macrophytes

Parts of different types of vegetation having flower, bud, node etc. were collected and then pressed in newspapers and dried for identification. The herbaria were identified at Botanical Survey of India (BSI), Dehradun.

## 3 Results

### 3.1 Plant diversity

Mothronwala swamp possesses peculiar vegetation due to topographic and edaphic variations. It has diverse and dense vegetation ranging from climbers and small herbs to tall trees. Indiscriminate human interference has led to the degradation of the swamp forest to a great extent leading a very small green cover. The original forest vegetation had dwindled to a larger extent and only two tree species namely *Shorea robusta* and *Dalbergia sisso* are left in the region. Other tree species like *Bischofia javanica*, *Celtris australis*, *Litsaea monopetala*, *Quercus leutrichophora*, *Toddalia asiatica* etc., could also be seen on the few places. Exorbitant growth of *Lantana camara* and other exotic weeds have replaced the larger part of the vegetation. The shallow streambeds often extending over vast area of the swamp are covered with original hydrophytic and amphibious communities *Calamus tenuis* is the most dominant species. Shrubs in the swamp reach to a maximum height of

2 – 3 m. A pure community of *Ipomoea fistulosa* dominates upper portion of the swamp and bank of channel. The villagers collect *Rorripa nasturtium aquaticum*, observed as patches along the stream for vegetable. The herbaceous vegetation of the ridge is very sparse. The dominating ground vegetation is *Parthenium hysterophorus* and the grass *Cynodon dactylon*. On the ridges small tree communities like *Ficus palmata* and *Pyrus pashia* were common. *Mallotus philippensis*, *Indigofera tinctoria*, were found at few places. Invasive weed *Lantana camara* occupies most of the area. The dominant vegetation was *Parthenium hysterophorus* and few grasses like *Cynodon dactylon*. Small trees like *Desmodium*, *Indigofera tinctoria*, *Ficus palmata* could be seen on the slopes. The surface of the slope is almost covered with large number of herbs like *Ageratum conyzoides* (Table 1).

**Table 1.** Plant diversity of Mothronwala swamp

Species	Name	
Trees	<i>Shorea robusta</i>	
	<i>Dalbergia sissoo</i>	
	<i>Celtris australis</i>	
	<i>Ficus palmate</i>	
	<i>Sapium sebiferum</i>	
	<i>Solanum torvum</i>	
	<i>Indigofera tinctoria</i>	
	<i>Ficus religiosa</i>	
	<i>Caryopteris wallichiana</i>	
	<i>Pyrus pashia</i>	
	Shrubs	<i>Ardisia solanacea</i>
		<i>Mallotus philippensis</i>
		<i>Carrisa opaca</i>
<i>Zizyphus mauritiana</i>		
<i>Murraya koenigii</i>		
<i>Smilax glaucophylla</i>		
<i>Plectranthes japonicus</i>		
<i>Rubus niveus</i>		
<i>Polygonum chinense</i>		
Weeds	<i>Lantana camara</i>	
	<i>Parthenium hysterophorus</i>	
	<i>Eupatorium adenophorum</i>	
Herbs	<i>Argemone mexicana</i>	
	<i>Solanum nigrum</i>	
	<i>Chenopodium album</i>	
	<i>Rungia pectinata</i>	
Grasses	<i>Ageratum conyzoides</i>	
	<i>Cynodon dactylon</i>	
	<i>Cyperus kyllingia</i>	
	<i>Eleusine indica</i>	

In the swampy zone, the plant diversity varies according to the habitat, in pools and numerous streams usually macrophytes are found. Among shrubs *Ipomea fistuosa*, *Lantana camara* etc., are commonly found. *Polygonum barbatum*, *Oenanthe javanica*, *Desmodium trifolium* are seen along the streams and present on well-drained soils.

The ground flora covers species like *Acorus calamus*, *Parthenium hysterophorus* etc., the live-stock grazes the palatable species during the summer season, while the fern *Diplazium esculentum* locally known as lingora is collected for the vegetable in the region. *Calamus tenuis* is the most dominant at shallow streambeds and *Ipomoea fistuosa* is dominant in the upper portion of the swamp (Table 2).

**Table 2.** List of aquatic macrophytes of the swamp

Taxonomical name	Family
<i>Ranunculus sceleratus</i>	Ranunculaceae
<i>Rorripa nasturtium aquaticum</i>	Brassicaceae
<i>Sida acuta</i>	Malvaceae
<i>Sida cordata</i>	Malvaceae
<i>Ventilago denticulate</i>	Rhamnaceae
<i>Acer oblongum</i>	Acoraceae
<i>Acer pennata</i>	Acoraceae
<i>Pyrus pashia</i>	Rosaceae
<i>Carallia integerrima</i>	Rhizophoraceae
<i>Oenanthe javanica</i>	Apiaceae
<i>Oldenlandia corymbosa</i>	Rubiaceae
<i>Inula cappa</i>	Arteraceae
<i>Enhydra fluctuans</i>	Arteraceae
<i>Ipomoea carnea</i>	Convolvulaceae
<i>Ipomoea fistulosa</i>	Convolvulaceae
<i>Bacopa monnieri</i>	Scropulariaceae
<i>Lantana camara</i>	Verbenaceae
<i>Allmania nodiflora</i>	Amranthaceae
<i>Polygonum barbatum</i>	Polygonaceae
<i>Commelina berghalensis</i>	Commelinaceae
<i>Narengaporphyrosum</i>	Poaceae
<i>Imperata cylindrica</i>	Poaceae
<i>Coix lachrymal jobi</i>	Poaceae
<i>Acorus calamus</i>	Araceae
<i>Calanus tenuis</i>	Araceae
<i>Pouzolzia pertendra</i>	Urticaceae
<i>Canna indica</i>	Cannaceae
<i>Cyperus iria</i>	Cyperaceae
<i>Cyperus globosus</i>	Cyperaceae
<i>Scirpus eractus</i>	Cyperaceae
<i>Justicia quinqueargularis</i>	Acanthaceae

A total of 19 genera of algae belonging to three orders were found in the stagnant water of the swamp. 16 species belonging to Bacillariophyceae, 2 species of Chlorophyceae and 1 species of Myxophyceae were found. *Tabellaria* of Bacillariophyceae was found to be abundant. Amongst the Chlorophyceae *Spirogyra* was found to be abundant (Table 3).

**Table 3.** Abundance of Algal components

Name	Abundance
<b>Bacillariophyceae</b>	
<i>Cymbella</i>	++
<i>Symedra</i>	++
<i>Pinnularia</i>	++
<i>Meridion</i>	++
<i>Diatoma</i>	+
<i>Achnathes</i>	+
<i>Gomphonema</i>	++
<i>Cocconeis</i>	++
<i>Melosira</i>	+
<i>Pinnularia</i>	+
<i>Nitzschia</i>	+
<i>Tabellaria</i>	+++
<i>Stauroneis</i>	+
<i>Flagilaria</i>	+
<i>Naviculla</i>	++
<i>Licmophora</i>	+
<b>Chlorophyceae</b>	
<i>Spirogyra</i>	+++
<i>Chlorella</i>	+
<b>Myxophyceae</b>	
<i>Oscillatoria</i>	++

+++ Abundant, ++ Common, + Rare

### 3.2 Animal diversity

Biodiversity is key factor for natural development of global ecosystem. The concern for biodiversity has emerged as a result of quantification of consumers and consumables. Among the animals *Lepus nigricollis* (Indian Hare) and *Sus scrofa cristatus* (wild boar) were known to be dominant. *Rana tigrina* the only amphibian was found abundant. Four species of fishes also represented the animal diversity (Table 4). Leeches are found in large number during the rains. Water snakes were common in the streams. Among the macro-zoobenthos 13 species belonging to 5 orders were identified. Amongst the 13 species of macroinvertebrate present 5 species represented genera Trichoptera, 2 species of Ephemeroptera, 2 species of Odonata, 2 species of Coleoptera and 2 species of Hemiptera.

Three species of Molluscs also represented the animal diversity of the swamp. Amongst the Trichoptera, *Planaria* was found to be abundant whereas *Hydropsyche* was found to be rare. *Ephemerall* of Ephemeroptera and *Gerris* of the order Hemiptera were also found abundantly (Table 5).

**Table 4.** List of fishes found in the stream flowing in the swamp

Vernacular name	Scientific name
Kali Machi	<i>Barbus chilinoides</i>
Baan	<i>Mastacembalus</i>
Sewal	<i>Vphicephalus punctatus</i>
Potto	<i>Barbus ticto</i>

**Table 5.** Abundance of Macroinvertebrates

Name	Abundance
<b>Trichoptera</b>	
Molanna	++
Hydropsyche	+++
Plannaria	+
Economus	+
Hydroptila	+
<b>Coleoptera</b>	
Amphizoa lecontes	++
Anchycetus	+
<b>Molluscs</b>	
Gyraulus	+++
Cerithidea	+++
Lymnaea	+++
<b>Hemiptera</b>	
Gerris	++
Hespercorixa	+++
<b>Ephemeroptera</b>	
Heptagenia	++
Ephemerella	+++
<b>Odonata</b>	
Enallagma	++
Agrion	+

+++ Abundant, ++ Common, + Rare

## 4 Discussion

The threats to wetlands may be divided into two broad categories: natural threats and anthropogenic threats, which may be direct or indirect. Natural threats include eutrophication, erosion, storm damage, drought or biotic interference other than by man, which may lead to destruction of wetlands. The human intervention by drainage and reclamation for agriculture and urban construction

stop them to play their usual ecological roles. Ecological degradation of wetlands together with pollution has resulted in the loss of flora and fauna.

The fresh water swamp of Mothronwala is under great environmental stress and has been degraded to a great extent during the last few decades. The major portion of the swamp has been encroached upon by the human settlements, agriculture, cultivation and related developmental activities. Forests felling are common on the ridges. The villagers have occupied the peripheral area of cultivation of various fodder species. As the cantonment is in the close vicinity of the swamp, the area is being exploited to meet out the various needs of the military persons. A water pump has been installed inside the swamp to pull out the water to be used for drinking, bathing and other domestic purposes.

Lopping of trees by people from neighboring village results in the deformity of some of the trees with the consequent effect on the ground floor vegetation. Invasion of exotic weeds like *Lantana camara*, *Parthenium hysterophorum*, *Ageratum conyzoides*, *Ipomoea* has drastically changed the vegetation of the swamp. Plant species like *Shorea robusta*, *Bombax ceiba*, *Grewia oppositifolia*, *Toona ciliata* are used for fodder, fuel and timber by villagers.

Cattle trampling is another big biotic factor responsible for reduced vegetal cover of the region. Grazing is also a factor to be considered particularly on the slope and the ridges. Leasing out of medicinal plants like *Centella asiatica*, *Bacopa monnieri*, *Berchemia floribunda*, *Desmodium triangulare*, *Cassia pumila*, *Acorus calamus* etc., have caused the depletion of these species from the swamp area. At Mothronwala swamp, the ecological succession is resulting into conversion of aquatic region to terrestrial is also contributing to the shrinkage of waterbed area. Erosion of the exposed slopes is responsible for the alteration in vegetational cover from season to season. Higher deforestation rate results in the loss of topsoil, which is drained off with rainwater and settles down in the stream. This result in rise of soil level in swamps making them much shallower with reduced water spread area.

Wetlands are the sources sinks and transformers of chemical, biological and genetic materials. They play a significant role in environment by providing a unique habitat for a wide variety of flora and fauna. However, over a period of time these natural heritages are continuously disturbed by human interference and over exploitation of biological resources available in them or in nearby locations. Since last few decades efforts have been made at na-

tional and international level to assess the status, management and conservation of wetlands with growing awareness the importance of these fragile ecosystems have been realized throughout the globe (Chatrath, 1992).

The long-term solution to the problem of protecting wetlands lies in educating the masses. Unless people realize the need to safeguards wetland ecosystem and are made aware of how they can contribute to this effort, there is little hope for the survival of these ecologically valuable and vulnerable habitats. The fresh water swamp of Mothronwala is under threat due to human interference and other anthropogenic activities. As a consequence, some measures are of utmost importance to check their further deterioration like the knowledge of the physical dimensions of these fresh water swamps by way of field surveys and other appropriate techniques like remote sensing etc. should be gained.

Inventory of both flora and fauna in these swamps should be made and rare, endangered and economically important species should be given top priority for their protection. Since deforestation in the catchment area due to human interference, has adversely affected these swamps. It is necessary to go for large scale afforestation in these areas.

Sincere efforts should be made to check the soil erosion from slopes, which lead to siltation in these swamps. It can be done by constructing check dams in high reaches, at different places and initiating afforestation in these areas. There should be a regular testing and monitoring of the water quality of these swamps. The water samples need to be taken from the disturbed areas along the stream at regular intervals to judge the adverse effects of human activities. State Pollution Control Board situated locally should be entrusted with such responsibility.

There should be a complete ban on all construction activities up to a specified distance, say about 100 m or more from the swamp. This can be ensured by making a clearance mandatory from the state environment department before undertaking any construction activity in the vicinity of the swamp. Efforts should be initiated by the State Forest Department to protect these swamp forests from further destruction by enforcing strict laws and warding heavy penalties on defaulters who are harming these ecologically sensitive zones by over exploitation of resources, cutting and lopping, diversion of water for irrigation and agriculture and urban land use.

To make people aware of the importance and threats to wetlands and their conservation, various government institutions, NGOs and media (both

print and audiovisual) should take the lead and make it a mass movement. Local communities should be involved to ensure sustainability of conservation effort under taken by the government agencies. For this they can be involved in decision-making processes required for management and conservation of wetlands.

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