

Seasonal Variation in Plant Species in the Vicinities of Chimdi Lake in Sunsari, Nepal

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Abstract

The plant species composition of the Chimdi lake area showed seasonal variation. Altogether 54 plant species under 21 families, 41 plant species under 19 families and 29 plants species under 14 families have been recorded in summer, rainy and winter seasons respectively. Dominant families were Poaceae 22.2%, Cyperaceae 24.4% and again Poaceae 31% in the above respective seasons. The dicot and monocot members were maximum in the summer and minimum in the winter.

Key words: Seasonal variation, plant species composition, Chimdi lake, Nepal

Introduction

Wetlands are the sites characterized by the presence of water and occupy the place between the land and deep water habitats. These sites have unique soils which differ from adjacent uplands and supports vegetation adapted to waterlogged and submerged aquatic conditions. Aquatic environment may be classified into three types on the basis of variation in salt concentration of water. They include marine (concentration of salt- 35.0 g/l), estuarine (concentration of salt is 5.0 g/l) and freshwater environment (concentration of salt is 1-3.5 g/l). In Nepal, wetlands are only of freshwater type and are broadly classified into two categories, natural and man made. The natural wetlands include lakes, ponds, riverine flood plains, swamps and marshes, while man made wetlands include water storage area and deep-water agricultural land (IUCN, 1996). Wetlands of the Terai

region substantially support the endangered species of wildlife. In Terai, out of 163 wetland sites highest number of wetland site is represented by lakes and ponds (78), followed by riverine flood plains (53) of the total wetland sites in Nepal. The least number is represented by swamps (5) and reservoir (6).

Wetlands are the most productive ecosystem and are thus important natural resources for economic and sustainable development. They play a very important role in maintaining biodiversity, bio-productivity and ecological productivity. Their significance in terms of ecological, biological, economical, sociological, cultural, religious, recreational and aesthetic values has always been appreciated. Wetlands support to provide tremendous socio- economic benefits to mankind through agricultural production,

aquaculture, wood and timber production.

Numerous works have been done in the past on different aspects of limnology outside Nepal. But, there is very little work done on the wetland vegetation in Nepal, even though it is rich in having a wide range of aquatic vegetation, riverine forest, marshlands and grasslands. Some information on aquatic and wetland plants found in seasonally inundated flood plains of Nepal was mentioned in earlier works of Stainton (1972).

Jones *et al.* (1989) studied fifty lakes during their limnological work in Nepal. They studied ionic concentration, nitrogen and suspended solids. The lake productivity was limited by nitrogen, however, nutrients ratio varies seasonally, so the limiting nutrients could change to phosphorus. Mc Eachern (1993) studied physico-chemical characteristics of water in six sites in Chitawan district. He observed pH 7.2-7.5 and dissolved oxygen ranging from 0.5-4.3 mg/l in Devital. In biodiversity assessment of terai wetlands done under BPP (1996) different macrophytes in various wetland sites have been reported. In Ghodaghodi tal, plant species such as *Azolla*, *Lemna*, *Wolffia* etc., were free floating species, *Hydrilla*, *Chara*, *Potamogeton* the submerged species, *Ludwigia adscendens*, *Potamogeton natans*, *Nymphoides* as the rooted floating species, *Limnophylla* as the emergent species. There is a rich growth of *Salix tetrasperma* scrubs in open water of the lake. Bhandari (1996), in his study "An inventory of Nepal's Terai Wetlands" presented 163 wetlands of Terai with their location and characteristic features. He also generated the primary data on physical, biological, limnological, hydrological and socio-economic information. About 172 species of the major wetland plants were

listed by IUCN, Nepal (1996). Bhatta *et al.* (1999) studied physico-chemical characteristics and phytoplanktons of Taudaha lake, Kathmandu and reported that lake water exhibited richness in nitrogen and orthophosphate which favored the growth of phytoplankton.

At present, the Chimdi lake is at the process of restoration. Some of the area of lake (19 ha) has been impounded in 2001. Since then restoration process is going on in the impoundment area of the lake. An aquatic habitat has been redeveloped which comprises different forms of macrophytes and their location in the lake. The present study has been carried out to enumerate the plant species found in the vicinities of impounded area of Chimdi lake in different seasons.

The study site, Chimdi lake is located at Chimdi Village Development Committee (VDC), which lies in south eastern part of Sunsari district in eastern Nepal. Chimdi VDC is situated between 87°9'-87°13'E and 26°28'-26°31'N. The climate of Chimdi lake area is tropical monsoon type. The year is divisible into three distinct seasons: dry and warm summer season (March to May), wet and warm rainy season (May to October) and dry and cool winter season (Mid-November to February). Based on climate data for 1994-2003, average annual mean monthly minimum temperature ranged from 8.34°C (January) to 25.9°C (August) and mean monthly maximum temperature ranged from 22.2°C (January) to 32.9°C (June). Climatological records show that average annual rainfall is 1829.8 mm of which 79% occurred from June to September (rainy season).

Materials and methods

The plants were collected in summer, rainy and winter season around the vicinities of lake. They were identified with the help of herbarium specimens and available literatures at Tribhuvan University Herbarium, Department of Botany, Post Graduate Campus, Biratnagar. The valid names of the species concerned are adopted after Press *et al.* (2000).

Results

Altogether 54 plant species belonging to 21 families were collected in summer season. (Tab. 1). On the basis of number of species, Poaceae was the largest family contributing 22.2% of total strength of families. Four larger families were in the following order: Poaceae > Cyperaceae > Asteraceae > Acanthaceae.

Similarly, 41 plant species belonging to 19 families were collected in rainy season (Tab. 2). Out of 41 species only a few like *Ceratopteris thalictroides* (L.) Brong, *Ludwigia adscendens* (L.) Hara, *Marsilea crenata* Presl., *Eleocharis acutangula* (Roxb.) Schutt, *Ipomoea aquatica* Forssk., *Sacciolepis interrupta* (R.Br.) and *Sagittaria sagittifolia* Auct. hon. L., Hook. f. were aquatic species. On the basis of number of species, Cyperaceae was the largest family contributing 24.4% of total strength of families. Four larger families were in the following order: Cyperaceae > Poaceae > Fabaceae > Acanthaceae.

Twenty eight plant species belonging to 14 families were collected in winter season (Tab. 3). On the basis of number of species, Poaceae was the largest family with 9 species contributing 31% of total strength of families. Four larger families were in the following order: Poaceae > Asteraceae > Euphorbiaceae > Acanthaceae.

Distinct seasonal variation was observed in species richness and family diversity of the plant species found in the vicinities of Chimdi lake. Species richness and diversity of families were maximum in summer season (Tab. 4). These parameters showed decreasing trend towards rainy to winter and were minimum (species richness 28 and family diversity 14) in the winter season. In the winter season most of the Cyperaceae members disappeared which were abundant in the rainy season. So, in the winter season dominance is shifted to Poaceae, while members of Asteraceae become second dominant.

Similarly, the seasonality was also observed in the availability of dicot, monocot and other members in the lake area (Tab. 5). The dicot and monocot members were maximum in the summer and minimum in the winter. Moreover, the dicot members were higher in all the seasons than monocot.

Discussion

On the basis of number of species, family distribution revealed that Poaceae was found as the dominant family in the summer season and Cyperaceae was represented as second dominant family in that season. Cyperaceae was dominant family in the rainy season while Poaceae was second dominant. Similarly, Poaceae was largest dominant family in winter season and Asteraceae was second. In the winter season most of the Cyperaceae members disappeared which were once abundant in the rainy season. So, in the winter season dominance is shifted to Poaceae and Asteraceae become the second dominant family.

Distinct seasonal variation was

Table 1. Enumeration of plant species in summer season in the vicinities of Chimdi lake, Sunsari, Nepal.

SN	Plant species	Local name	Family
1	<i>Alternanthera sessilis</i> (L.) R.Br. ex DC.	Saraunchi	Amaranthaceae
2	<i>Amaranthus</i> sp.	Latte sag	Amaranthaceae
3	<i>Axonopus compressus</i> (SW) P. Beauv	Hade dubo	Poaceae
4	<i>Blumea</i> sp.	Gandhe jhar	Asteraceae
5	<i>Cyperus compactus</i> Retz.	-	Cyperaceae
6	<i>Caesulia axillaris</i> Roxb.	-	Asteraceae
7	<i>Centella asiatica</i> (L.) Urb.	Ghodtapre	Apiaceae
8	<i>Chara</i> sp.	-	Characeae
9	<i>Chrysopogon aciculatus</i> L.	-	Poaceae
10	<i>Cyperus compressus</i> L (Chota-della)	-	Cyperaceae
11	<i>Commelina benghalensis</i> L.	Kane jhar	Commelinaceae
12	<i>Cynodon dactylon</i> (L.) Pers.	Dubo	Poaceae
13	<i>Cyperus diformis</i> L.	Mothe	Cyperaceae
14	<i>Cyperus iria</i> L.	Mothe	Cyperaceae
15	<i>Cyperus pilosus</i> Vahl	Thulomotho	Cyperaceae
16	<i>Cyperus rotundus</i> L.	Mothe	Cyperaceae
17	<i>Cyperus exalatus</i> Retz.	-	Cyperaceae
18	<i>Desmodium triflorum</i> (L.) DC.	Tinpate	Fabaceae
19	<i>Digittaria setigera</i> Roth ex R. & S.	Banso	Poaceae
20	<i>Dryopteris cochleata</i> (D. Don) P. Beauv	Ghiu niguro	Polypodiaceae
21	<i>Echinochloa colonum</i> L.	Jhiro	Poaceae
22	<i>Echinochloa crus-galli</i> (L.) P. Beauv	Chirchiro	Poaceae
23	<i>Eclipta prostrata</i> (L.) L. Mant.	Bhringaraj	Asteraceae
24	<i>Eichhornia crassipes</i> (Mart) Solms	Jalkumbhi	Pontederiaceae
25	<i>Eleocharis acutangula</i> (Roxb.) Schutt.	-	Cyperaceae
26	<i>Eleusine indica</i> (L.)	Kode jhar	Poaceae
27	<i>Eragrostis uniloides</i> (Retz.) Nees ex Steud.	-	Poaceae
28	<i>Evolvulus alsinoides</i> L.	-	Convolvulaceae
29	<i>Gnaphalium pensylvanicum</i> Wild.	Bhui buki	Asteraceae
30	<i>Hedyotis</i> sp.	-	Rubiaceae
31	<i>Hemarthria compressa</i> (L.f.) R.Br.	Ghode dubo	Poaceae
32	<i>Hemigraphis hirta</i> (Bihl.) T. Anders.	-	Acanthaceae
33	<i>Hygrophilla auriculata</i> (Schum.) Heine	-	Acanthaceae
34	<i>Hygrophilla polysperma</i> (Roxb.) T. Anders.	-	Acanthaceae
35	<i>Imperata cylindrica</i> (L.) Raeurch	Siru	Poaceae
36	<i>Ipomoea aquatica</i> Forssk.	Kaami sag	Convolvulaceae
37	<i>Kyllinga brevifolia</i> Rottb.	-	Cyperaceae
38	<i>Lidernia parviflora</i> (Roxb.) Haines	-	Scrophulariaceae
39	<i>Ludwigia adscendens</i> (L.) Hara	-	Onagraceae
40	<i>Ludwigia octovalis</i> (Jacq.) Raven	-	Onagraceae
41	<i>Marsilea crenata</i> Presl.	Charpate	Marsiliaceae
42	<i>Mecardonia procumbens</i> (Mill.) Small	-	Scrophulariaceae
43	<i>Mimosa pudica</i> L.	Lajawati	Fabaceae
44	<i>Paspalum distichum</i> L.	-	Poaceae
45	<i>Phyllanthus</i> sp.	-	Euphorbiaceae
46	<i>Polygonum barbatum</i> L.	Pirre jhar	Polygonaceae
47	<i>Polygonum plebium</i> R.Br.	Pirre jhar	Polygonaceae
48	<i>Ranunculus scleratus</i> L.	-	Ranunculaceae
49	<i>Rungia pectinata</i> (L.) Nees	-	Acanthaceae
50	<i>Sacciolepis interrupta</i> (R.Br.) A.Camus	Pani ghas	Poaceae

51	<i>Sagittaria sagittifolia</i> Auct. hon.L.,hook.f. Laph	-	Alismataceae
52	<i>Schoenoplectus mucronatus</i> (L.) Palla	-	Cyperaceae
53	<i>Sida rhombifolia</i> L.	Khareto	Malvaceae
54	<i>Sphaeranthus indicus</i> L.	-	Khareto

Table 2. Enumeration of plant species in rainy season in the vicinities of Chimdi lake, Sunsari, Nepal.

SN	Plant species	Local name	Family
1	<i>Alternanthera sessilis</i> (L.) R.Br. ex DC.	Saraunchi	Amaranthaceae
2	<i>Anagalis</i> sp.	-	Primulaceae
3	<i>Blumea</i> sp.	Gandhe jhar	Asteraceae
4	<i>Centella asiatica</i> (L.) Urb.	Ghodtapre	Apiaceae
5	<i>Ceraptopteris thalictroides</i> (L.) Brong.	-	Parkeriaceae
6	<i>Chrysopogon aciculatus</i> L.	-	Poaceae
7	<i>Commelina benghalensis</i> L.	Kane jhar	Commelinaceae
8	<i>Cynodon dactylon</i> (L.) Pers.	Dubo	Poaceae
9	<i>Cyperus compactus</i> Retz.	-	Cyperaceae
10	<i>Cyperus compresus</i> L (Chota-della)	-	Cyperaceae
11	<i>Cyperus diformis</i> L.	Mothe	Cyperaceae
12	<i>Cyperus exalatus</i> Retz.	-	Cyperaceae
13	<i>Cyperus iria</i> L.	Mothe	Cyperaceae
14	<i>Cyperus pilosus</i> Vahl.	Thulomothe	Cyperaceae
15	<i>Cyperus rotundus</i> L.	Mothe	Cyperaceae
16	<i>Desmodium triflorum</i> (L.) DC.	Tinpate	Fabaceae
17	<i>Eclipta prostrata</i> (L.) L. Mant.	Bhringaraj	Asteraceae
18	<i>Eleocharis acutangula</i> (Roxb.) Schutt.	-	Cyperaceae
19	<i>Eleusine indica</i> (L.)	Kode jhar	Poaceae
20	<i>Eriocaulon</i> sp.	-	Eriocaulaceae
21	<i>Evolvulus alsinoides</i> L.	-	Convolvulaceae
22	<i>Fimbristylis dichotoma</i> (L.) Vahl.	Badami jhar	Cyperaceae
23	<i>Hedyotis</i> sp.	-	Rubiaceae
24	<i>Hemarthria compressa</i> (L.f.) R.Br.	Ghode dubo	Poaceae
25	<i>Hemigraphis hirta</i> (Bihl.) T. Anders.	-	Acanthaceae
26	<i>Hygrophilla auriculata</i> (Schum.) Heine	-	Acanthaceae
27	<i>Hygrophilla polysperma</i> (Roxb.) T. Anders.	-	Acanthaceae
28	<i>Imperata cylindrica</i> (L.) Raeurch	Siru	Poaceae
29	<i>Ipomoea aquatica</i> Forssk.	Kamisag	Convolvulaceae
30	<i>Kyllinga brevifolia</i> Rottb.	-	Cyperaceae
31	<i>Ludwigia adscendens</i> (L.) Hara	-	Onagraceae
32	<i>Ludwigia octovalis</i> (Jacq.) Raven	-	Onagraceae
33	<i>Marsilea crenata</i> Presl.	Charpate	Marsiliaceae
34	<i>Mecardonia procumbens</i> (Mill.) Small	-	Scrophulariaceae
35	<i>Mimosa pudica</i> L.	Lajawati	Fabaceae
36	<i>Paspalum distichum</i> L.	-	Poaceae
37	<i>Phyllanthus</i> sp.	-	Euphorbiaceae
38	<i>Polygonum barbatum</i> L.	Pirre jhar	Polygonaceae
39	<i>Sacciolepis interrupta</i> (R.Br.) A. Camus	Pani ghans	Poaceae
40	<i>Sagittaria sagittifolia</i> Auct. hon.L., hook.f.Laph	-	Alismataceae
41	<i>Sesbania aculeata</i> (Wild.) Pers.	Dhaincha	Fabaceae

Table 3. Enumeration of plant species in winter season in the vicinities of Chimdi lake, Sunsari, Nepal.

SN	Plant species	Local name	Family
1	<i>Alternanthera sessilis</i> (L.) R.Br. ex DC.	Saraunchi	Amaranthaceae
2	<i>Axonopus compressus</i> (Sw) P. Beauv	Hade dubo	Poaceae
3	<i>Blumea</i> sp.	Gandhe jhar	Asteraceae
4	<i>Caesulia axillaris</i> Roxb.	-	Asteraceae
5	<i>Centella asiatica</i> (L.) Urb.	Ghodtapre	Apiaceae
6	<i>Chrysopogon aciculatus</i> L.	-	Poaceae
7	<i>Commelina benghalensis</i> L.	Kane jhar	Commelinaceae
8	<i>Croton bonplandianum</i> Baill	Khursanejhar	Commelinaceae
9	<i>Cynodon dactylon</i> (L.) Pers.	Dubo	Poaceae
10	<i>Desmodium triflorum</i> (L.) DC.	Tinpate	Fabaceae
11	<i>Digittaria setigera</i> Roth ex R.& S.	Banso	Poaceae
12	<i>Eclipta prostrata</i> (L.) L. Mant.	Bhringaraj	Asteraceae
13	<i>Eragrostis uniloides</i>	-	Poaceae
14	<i>Evolvulus alsinoides</i> L.	-	Convolvulaceae
15	<i>Fimbristylis dichotoma</i> (L.) Vahl.	Badami jhar	Cyperaceae
16	<i>Gnaphalium pensylvanicum</i> Wild.	Bhuibuki	Asteraceae
17	<i>Hemarthria compressa</i> (L.f.) R.Br.	Ghode dubo	Poaceae
18	<i>Imperata cylindrica</i> (L.) Raeurch	Siru	Poaceae
19	<i>Leucas indica</i> (L.) R. Br. ex Vatke	Dulphi	Lamiaceae
20	<i>Mecardonia procumbens</i> (Mill.) Small	-	Scrophulariaceae
21	<i>Paspalum distichum</i> L.	-	Poaceae
22	<i>Phyllanthus</i> sp.	-	Euphorbiaceae
23	<i>Polygonum barbatum</i> L.	Pirre jhar	Polygonaceae
24	<i>Rungea pectinata</i> (L.) Nees	-	Acanthaceae
25	<i>Saccharum spontaneum</i> L.	Kans	Poaceae
26	<i>Sida rhombifolia</i> L.	Khareto	Malvaceae
27	<i>Sonchus asper</i> (L.) Hill	-	Asteraceae
28	<i>Sphaeranthus indicus</i> L.	-	Asteraceae

Table 4. Seasonal variation in species richness and family diversity of the plant species found in the vicinities of Chimdi lake, eastern Nepal.

Season	Species richness	Family diversity
Summer	54	21
Rainy	41	19
Winter	28	14

Table 5. Seasonal variation in the dicot, monocot and other members in the vicinities of Chimdi lake, eastern Nepal.

Season	Dicot	Monocot	Dicot:Monocot	Others	Total
Summer	29	22	1.3	3	54
Rainy	22	17	1.3	2	41
Winter	19	9	2.1	-	28

observed in species richness and family diversity of the plant species. After winter, many plant species grow in the summer. So, species richness and family diversity are higher in summer and lower in winter. The number of dicot species was higher than monocots in all seasons. Especially in the winter most of the monocots are disappeared. So, the ratio of dicots and monocots is distinctly higher in the winter.

The Chimdi lake shows seasonal variation in the wetland communities. During summer season drying of standing water in the eastern part of lake exposes the substrate and allows the germination of emergent species. Many species of *Cyperus* and other dicot plants eg. *Eclipta*, *Polygonum*, *Ludwigia* and *Sesbania* appeared in the dry marsh area. After rainfall, standing water returns and then submerged species quickly reappear as their seeds readily germinate in standing water.

Based upon different factors like presence and absence and quantity of water, water depth and seasonal changes in water area, wetlands may be classified into permanent and seasonal wetlands. Permanent wetlands develop where shallow moving or stagnant water remains perennial. Seasonal wetlands are restricted to areas which are only periodically inundated. Chimdi lake can be placed under seasonal wetland where water area and water depth changed seasonally. During rainy season

most of the grassland area is filled with water. The water depth in the impoundment area also increases. But due to shallow nature, most of the plant of the lake dries during summer season which stimulate the generation of emergent species leading to terrestrial communities.

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