



A study on the biomass variation of the macrophytes in Poiroupat Lake, Manipur, northeast India

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Biomass assessment of the macrophytic plant species were carried out at Poiroupat lake located in Imphal East district of Manipur. The present study reveals the presence of 30 aquatic macrophytes. The recorded aquatic macrophytes of the lake have been classified into four categories, viz. submerged (10%), rooted with floating leaves (16.7%), free floating (20%) and emergent (53.3%). In all the study sites, *Ceratophyllum demersum* recorded the maximum total biomass with values ranging from 24.52 (Site I) to 241.45 gm⁻² (Site III). This was followed by *Alternanthera philoxeroides* with values ranging from 25.74 (Site II) to 139.77 gm⁻² (Site II). This was successively followed by *Utricularia flexuosa* (14.12 to 110.45 gm⁻²), *Ludwigia adscendens* (14.09 to 89.32 gm⁻²), *Nymphaea stellata* (29.66 to 84.32 gm⁻²), *Nelumbo nucifera* (15.03 to 67.41 gm⁻²), *Hydrilla verticillata* (16.09 to 67.00 gm⁻²), *Hygroryza aristata* (30.95 to 62.52 gm⁻²), *Ipomoea aquatica* (4.54 to 58.31 gm⁻²), *Nymphoides indicum* (4.41 to 47.95 gm⁻²). *Eichhornia crassipes* recorded peak value of 26.54 gm⁻². During the entire study period, the total biomass of all species (combined) ranged from 130.07 to 512.28 gm⁻². The maximum biomass values were recorded during rainy season.

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Introduction

Biomass is usually expressed as living weight, dry weight, ash-free dry weight or carbon weight or calories or any other convenient unit for comparative purposes and is also expressed as the 'organism mass' in unit area.¹ Biomass is the total amount of Organic matter present at a given time per unit area of the earth's surface.² The biomass is an expression of the standing crop which is referred to as the

amount of living materials in a trophic level or component population. Biomass determination is one of the most important tools for evaluation of the primary productivity. Species which accumulate more biomass and having higher production rates are found dominant in the community and hence they usually influence the overall physiognomy of the vegetation.³

Studies on the variation of biomass of the macrophytes of freshwater ecosystems in India and abroad were undertaken various researchers viz., Gopal et al.,⁴ Billore & Vyas,⁵ Yadava et

al.,⁶ Shardendu & Ambasht,⁷ Devi,⁸⁻¹⁴ Zotina,¹⁵ Singh *et. al.*,¹⁶ Devi,¹⁷⁻¹⁸ Singh & Sharma,¹⁹ Maqbool & Khan,²⁰ Tamire & Mengistou,²¹ etc. The present study has been undertaken to determine the biomass variation of the aquatic macrophytes found in the lake under study. This study would supplement the existing database on variation in the biomass of the aquatic macrophytes in freshwater ecosystems of the state.

Materials and Methods

Poiroupat is situated in the Imphal East district of Manipur at a distance of 15km from the Imphal city. It lies between 24°40' 6.24" N to 24°40' 6.71" N latitude and 93°58' 9.82" E to 93°58' 10.25" longitude. The lake is about 881m above mean sea level with an area of 0.16 sq. km. It is a much aged, and eutrophic and it is one of the endangered lakes of Manipur. Rain and ground water are the only source of water to this lake. At present, the lake is threatened to extinction due to artificial eutrophication which is attributed to encroachment and pisciculture.

For the present study, the lake was divided into four sites representing as site I, II, III and IV which were named as Sabam, Kabui Panung, Thambou Kom and Thaba Konjin respectively (Fig. 1). Site I – Sabam: This site has an area of 0.02 sq km and water depth ranged from 82.4 to 186.0 cm during the whole study period. 18 macrophytes were recorded in this site in the different seasons. Site II – Kabui Panung: This site is just adjacent to site I with an area of 0.06 sq km. The depth of the water ranged from 85.4 to 190.0 cm. In this site 17 macrophytes were found during the study period. Site III – Thambou Kom: This is the largest site with an area of 0.07 sq. km and depth of water ranged from 82.5 to 192.0 cm during the whole study period. Maximum number of macrophytes (21 species) was recorded in this site in the different seasons. Site IV – Thaba konjin: This is the smallest site of the lake. It has an area of 0.01 sq. km. The depth of the water during the whole study period ranged from 79.0 to 172.3 cm. Here 17 macrophytes were recorded during the study period.

The macrophytic plant samples were collected from each site on monthly basis during

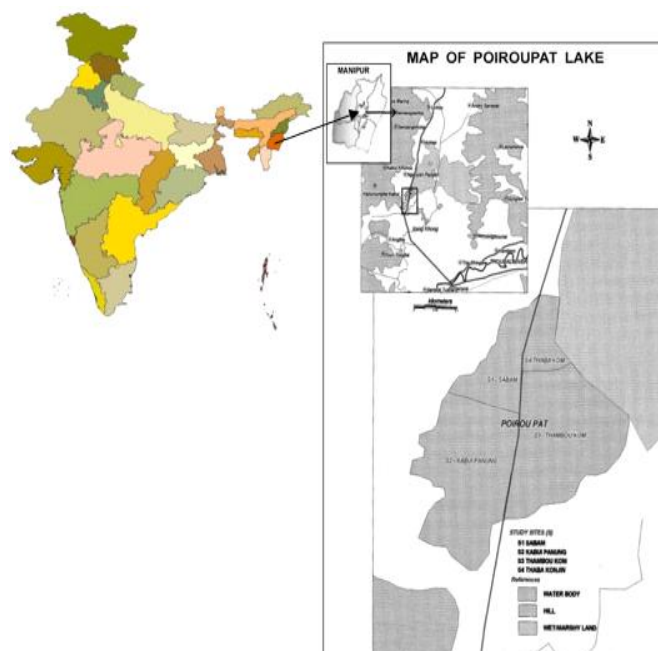


Figure 1 | Location map of the study site.

June 2010 to May 2012. Standing crop biomass was estimated by Harvest method²². Macrophytic plants were sampled on monthly basis during the study. Plant samples were collected using quadrats of 25 x 25 cm in dimension from the vertical core sampling sites and the cumulative data were analyzed. However, for the sampling of some submerged species methods described by Ekman Dredge²³ were used. After collection each sample was kept in polythene bags marked with wax pencil and brought to the laboratory. Plant materials were washed to remove the adhering silt, soil, mud, other plants and animal debris etc. Then the plants were sorted out as dominant species and remaining as 'other species'. Excess of water was drained using blotting papers. Fresh weights of the different species were taken by differentiating into shoot and root portions. The root portions of the submerged species are generally found to be insignificant and as such the same may be neglected²⁴. After taking the fresh weights, each labeled sample packed in paper bags was dried in the oven at 80°C for 48 hours. Later, dry weights of the shoot and root portions were taken separately. Thus, biomass of the macrophytes were calculated on dry weight basis and expressed in grams per square metre (gm⁻²).

Results

The present study revealed the presence of 30 aquatic macrophytes. Generally, the vegetation of Poiroupat Lake has been classified into four classes viz. (i) Submerged (10%) (ii) Rooted with floating leaves (16.7%) (iii) Free floating (20%) and (iv) Emergent (53.3%). The ranges and mean biomass value in the different study sites of Poiroupat lake, Manipur are furnished in Table 1, 2 and 3. The higher ranges of biomass are recorded in *Alternanthera philoxeroides*, *Ceratophyllum demersum*, *Hydrilla verticillata*, *Ludwigia adscendens*, *Nymphaea stellata*, *Utricularia flexuosa* etc. Among the dominant species *Ceratophyllum demersum* recorded peak value of biomass values in Sites II & III.

The biomass values of *C. demersum* varied from 29.01 to 218.30 gm⁻² in the first year and 24.52 to 241.45 gm⁻² in the second year (Fig. 2 & 3). *C. demersum* recorded a mean biomass value of 112.82 ± 47.72 gm⁻². The biomass value of *A. philoxeroides* ranged from 25.74 to 139.77 gm⁻² in the first year and 38.13 to 120.84 gm⁻² in the second year with a mean biomass value of 69.86 ± 20.08 gm⁻² during the entire study period. *U. flexuosa* recorded biomass values of 14.12 to 110.45 gm⁻² and 24.25 to 94.25 gm⁻² in the first

Table 1 | Ranges and mean biomass values (gm⁻²) in different sites of Poiroupat Lake during the first year of study.

Name of Species	Range (entire lake)	Site-I	Site-II	Site-III	Site-IV	Mean ± SD
<i>Alternanthera philoxeroides</i>	25.74 - 139.77	104.96	50.96	60.43	66.44	70.70 ± 23.72
<i>Ceratophyllum demersum</i>	29.01- 218.0	57.73	158.15	147.76	92.27	113.98 ± 47.36
<i>Eichhornia crassipes</i>	6.90 – 26.54	10.53	16.72	7.52	11.86	11.66 ± 3.83
<i>Hydrilla verticillata</i>	16.09 – 55.44	35.76	41.97	49.37	23.72	37.71 ± 10.86
<i>Hygroryza aristata</i>	32.23– 60.52	46.36	25.03	18.26	19.52	27.29 ± 13.05
<i>Ipomoea aquatica</i>	4.54 – 48.37	12.98	15.85	17.6	33.84	20.07 ± 9.38
<i>Ludwigia adscendens</i>	14.05 – 68.77	53.10	23.58	36.27	12.52	31.37 ± 17.44
<i>Nelumbo nucifera</i>	15.03 – 59.41	40.56	25.53	56.39	44.63	41.78 ± 12.74
<i>Nymphoides indicum</i>	8.79 – 40.68	25.78	24.73	14.23	25.14	22.47 ± 5.51
<i>Nymphaea stellata</i>	29.66 - 75.12	44.52	20.05	52.39	24.82	35.45 ± 15.49
<i>Salvinia cucullata</i>	16.02 – 30.93	18.74	23.47	19.56	20.89	20.67 ± 2.07
<i>Utricularia flexuosa</i>	14.12 – 110.45	35.86	49.64	53.46	70.39	52.34 ± 14.21
Other Species	8.48 – 31.28	22.87	16.99	14.90	20.73	18.88 ± 3.60
All Species (Combined)	154.55 – 512.03	307.39	308.29	340.19	328.22	321.03 ± 15.99

Table 2 | Ranges and mean biomass values (gm^{-2}) in different sites of Poiroupat Lake during the second year of study.

Name of Species	Range (entire lake)	Site-I	Site-II	Site-III	Site -IV	Mean \pm SD
<i>Alternanthera philoxeroides</i>	38.13 – 120.84	92.58	55.43	60.57	67.51	69.02 \pm 16.47
<i>Ceratophyllum demersum</i>	24.52 - 241.45	81.66	151.20	159.38	54.39	111.66 \pm 51.71
<i>Eichhornia crassipes</i>	8.16 – 22.75	9.52	15.45	18.21	12.65	13.96 \pm 3.73
<i>Hydrilla verticillata</i>	22.33 – 67.00	35.82	46.73	37.52	52.37	43.11 \pm 7.81
<i>Hygroryza aristata</i>	30.95 – 62.52	46.73	39.52	29.87	35.75	37.97 \pm 7.07
<i>Ipomoea aquatica</i>	28.54 – 58.31	42.85	38.12	43.42	39.20	40.90 \pm 2.63
<i>Ludwigia adscendens</i>	37.11 – 89.32	65.04	43.38	61.76	26.94	49.28 \pm 17.68
<i>Nelumbo nucifera</i>	15.33 – 67.41	39.43	36.65	29.65	49.82	38.89 \pm 8.37
<i>Nymphoides indicum</i>	4.41 – 47.95	23.65	32.45	20.54	18.76	23.85 \pm 6.08
<i>Nymphaea stellata</i>	37.37 – 84.32	52.63	50.64	60.84	44.6	52.18 \pm 6.71
<i>Salvinia cucullata</i>	14.36 – 34.12	21.54	24.24	20.65	19.36	21.45 \pm 2.07
<i>Utricularia flexuosa</i>	24.25 – 94.25	58.61	65.23	78.73	52.83	63.85 \pm 11.14
Other Species	8.79 – 48.23	18.87	23.36	23.41	28.51	23.54 \pm 3.94
All Species (Combined)	130.07 – 512.28	319.71	330.56	343.95	324.81	333.64 \pm 13.33

Table 3 | Ranges and mean biomass values (gm^{-2}) in different sites of Poiroupat Lake during the entire study.

Name of Species	Site-I	Site-II	Site-III	Site-IV	Mean \pm SD
<i>Alternanthera philoxeroides</i>	98.77	53.20	60.50	66.98	69.86 \pm 20.08
<i>Ceratophyllum demersum</i>	69.70	154.68	153.57	73.33	112.82 \pm 47.72
<i>Eichhornia crassipes</i>	10.03	16.09	12.87	12.26	12.81 \pm 2.50
<i>Hydrilla verticillata</i>	35.79	44.35	43.45	38.05	40.41 \pm 4.15
<i>Hygroryza aristata</i>	46.55	32.28	24.07	27.64	32.63 \pm 9.87
<i>Ipomoea aquatica</i>	27.92	26.99	30.51	36.53	30.48 \pm 4.29
<i>Ludwigia adscendens</i>	59.07	33.48	49.02	19.73	40.32 \pm 17.30
<i>Nelumbo nucifera</i>	40.00	31.10	43.02	47.23	40.33 \pm 6.84
<i>Nymphoides indicum</i>	24.72	28.60	17.39	21.95	23.16 \pm 4.72
<i>Nymphaea stellata</i>	48.58	35.35	56.62	34.71	43.81 \pm 10.66
<i>Salvinia cucullata</i>	20.14	23.86	20.11	20.13	21.06 \pm 1.87
<i>Utricularia flexuosa</i>	47.24	57.44	66.10	61.61	58.10 \pm 8.06
Other Species	20.87	20.18	19.16	24.62	21.21 \pm 2.38
All Species (Combined)	313.55	319.43	342.08	326.52	325.39 \pm 12.32

and second year of the study period. The maximum value was reported from study Site IV. The mean value for *U. flexuosa* during the study period is $58.10 \pm 8.06 \text{ gm}^{-2}$. *L. adscendens* had biomass values ranging from 14.09 to 68.77 gm^{-2} in the first year and 37.11 to 89.32 gm^{-2} in the second year with mean value of $40.32 \pm 17.30 \text{ gm}^{-2}$. The biomass value of *N. stellata* ranged from 29.66 to 75.12 gm^{-2} in the first year and 37.37 to 84.32 gm^{-2} in the second year. The biomass values of *Nelumbo nucifera* varied from 15.03 to 59.41

gm^{-2} in the first year and 15.33 to 67.41 gm^{-2} in the second year with mean value of $40.33 \pm 6.84 \text{ gm}^{-2}$. The peak biomass values were recorded during rainy season (July and August) while the lowest values were observed during winter season (December) in the consecutive years of study period.

H. verticillata had biomass values ranging from 16.09 to 55.44 gm^{-2} in the first year and 22.33 to 67.00 gm^{-2} in the second year. *H. verticillata* recorded mean biomass value of 40.10 ± 4.15

Table 4 | Comparison of biomass values of the aquatic macrophytes in different freshwater ecosystems.

Ecosystem	Biomass (gm ⁻²)	Authors
Poiroupat lake, Manipur	154.55-512.03 (1 st Year) 130.07-512.28 (2 nd Year)	Present Study
Osby lake, Sweden	520.00	Forsberg ⁴⁰
Freshwater ponds, Varanasi	1,250.00	Ambasht ³¹
Wetlands, Malaysia	370.00 – 520.00	Wassink ³⁶
Opinicon lake, Canada	1154.00	Crowder <i>et al.</i> , ³²
Manasbal and Anchar lake, Kashmir	970.00 and 1010.00	Kaul ³³
Ramgarh Reservoir	92.90 – 564.50	Gopal <i>et al.</i> , ⁴
Pichhola lake, Udaipur	10.00 – 35.80	Billore & Vyas ³⁷
Lakes of Udaipur	537.60 – 1884.09	Vyas <i>et al.</i> ³⁵
Eutrophic ponds, Michigan	196.00 – 260.00	Spencer & King ³⁸ ; Freeman ³⁹
Waikaremona lake, New Zealand	1106.00	Howard-Williams <i>et al.</i> ³⁴
Shallow ponds, Varanasi	778.00	Misra ³
Loktak lake, Manipur	363.21 – 782.63	Devi ⁸
Waithou lake, Manipur	422.97 – 1305.70	Devi ²⁹
Utrapat lake, Manipur	139.18 – 579.85	Devi ⁹
Freshwater Ecosystems, Canchipur, Manipur	55.13 – 408.40	Devi ¹⁰
Deux Montagnes lake, Canada	112.20	Hudon <i>et al.</i> ⁴³
Sanapat lake, Manipur	33.19 – 229.53	Devi ¹¹
Ikop lake, Manipur	16.81 – 295.62	Devi & Sharma ⁴⁴
Awangsoipat lake, Manipur	164.45 – 841.00	Devi ¹³
Oksoipat lake, Manipur	150.87 – 588.05	Devi & Sharma ²⁷
Kharungpat lake, Manipur	304.01 – 989.95	Singh <i>et al.</i> ¹⁶
Hidenkompat lake, Manipur	292.67-855.78	Devi ¹⁸
Yenapat lake, Manipur	198.80-866.40	Devi ¹⁷

gm⁻². *Hygroryza aristata* had biomass values ranging from 32.23 to 60.52 gm⁻² in the first year and 30.95 to 62.52 gm⁻² in the second year. During the whole study period the biomass value of *Ipomoea aquatica* varied from 4.54 to 48.37 gm⁻² in the first year and 28.54 to 58.31 gm⁻² in the second year. The biomass values of *Nymphaeoides indicum* varied from 8.79 to 40.68 gm⁻² in the first year and 4.41 to 47.95 gm⁻² in the second year and that of *Eichhornia crassipes* from 6.90 to 26.54 gm⁻² and 8.16 to 22.75 gm⁻² in the first year and second year respectively.

The biomass values of *Salvinia cucullata* ranged from 16.02 to 30.93 gm⁻² in the first year and 14.36 to 34.12 gm⁻² in the second year. The biomass values of other species ranged from 8.48 to 31.28 gm⁻² in the first year and 8.79 to 48.23 gm⁻² in the second year. During the whole study period, the total biomass of all species (combined) in the different study sites ranged

from 154.55 to 512.03 gm⁻² and 130.07 to 512.28 gm⁻² in the first year and second year respectively (Fig. 4). The mean biomass values of all species (combined) during the entire study period is 325.39 ± 12.32 gm⁻².

Discussion

In the present study the recorded biomass values of *Ceratophyllum demersum* are slightly higher when compared with those reported by Sahai & Sinha²⁵ from Gorakhpur (161.00 gm⁻²), Shah & Abbas²⁶ in Bhagalpur (90.60 to 135.60 gm⁻²) and Singh *et al.*¹⁶ in Kharungpat lake, Manipur with values varying from 34.65 to 128.22 gm⁻² in the first year and 42.54 to 155.82 gm⁻² in the second year. Devi¹³ in Awangsoipat Lake, Manipur reported biomass values ranging from 20.14 to 163.56 gm⁻² in the first year and 39.56 to 175.32 gm⁻² in the second year which are lower when

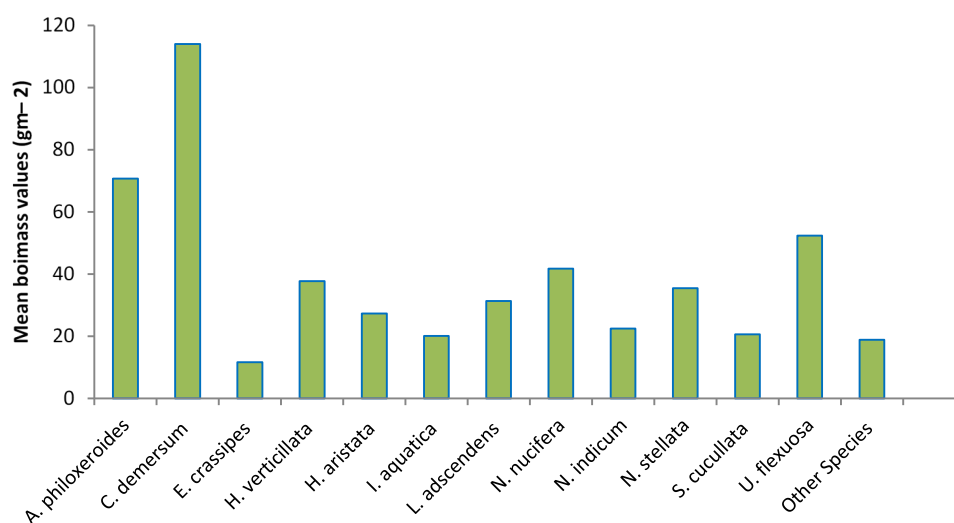


Figure 2 | Biomass variation of aquatic macrophytes in first year of study period.

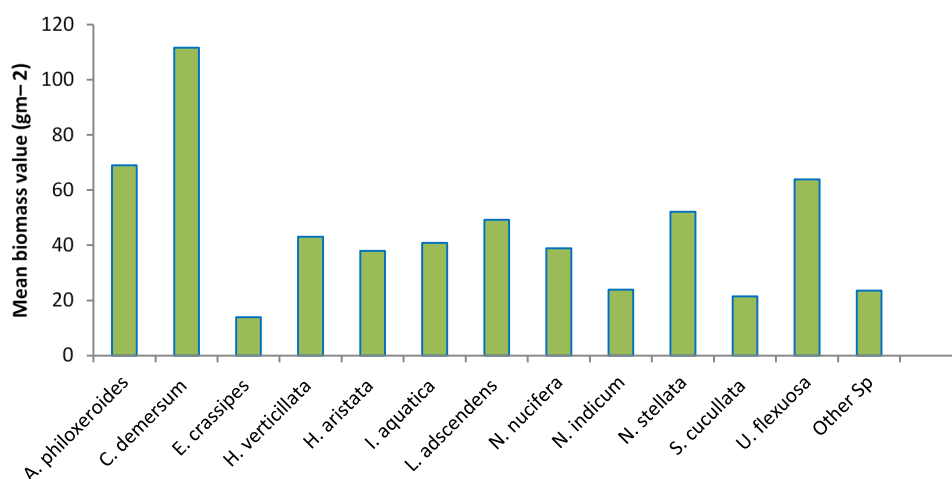


Figure 3 | Biomass variation of aquatic macrophytes in second year of study period.

compared with the present findings. Devi & Sharma²⁷ in Oksoipat Lake, Manipur also reported lower values varying from 46.88 to 155.63 gm⁻² in the first year and 30.53 to 168.96 gm⁻² in the second year. Devi¹⁸ recorded lower values in Hidenkompat lake, Manipur (22.80 to 164.90 gm⁻²), Sharma & Devi²⁸ in Loktak lake, Manipur reported comparable values of biomass (9.23 to 214.01 gm⁻²).

The biomass values of *Alternanthera philoxer-*

oides observed in the present study are comparatively higher than those reported by various authors viz., Devi²⁹ in Waithou lake, Manipur (53.70 gm⁻² in the first year and 50.30 gm⁻² in the second year), Devi in Utrapat⁹ lake, Manipur (57.12 to 93.01 gm⁻²) and Devi¹⁷ in Yenapat lake, Manipur (73.30 gm⁻²). Biomass values comparable to the present study were reported by Devi in Awangsoipat lake⁴³, Manipur (32.55 to 124.35 gm⁻² in the first year and 22.50 to 153.06 gm⁻² in the

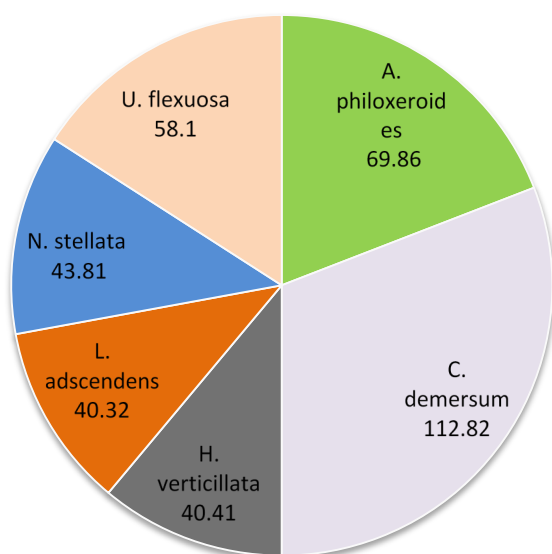


Figure 4 | Biomass values of the dominant aquatic macrophytes during the entire study period (gm⁻²).

second year) and Devi & Sharma²⁷ in Oksoipat lake, Manipur (19.94 to 139.41 gm⁻² in the first year and 21.44 to 135.79 gm⁻² in the second year of study). However, the findings are found to be lower when compared with those reported by Singh *et al.*¹⁶ in Kharungpat lake, Manipur where the biomass value of *A. philoxeroides* ranged from 56.41 to 183.48 gm⁻² in the first year and 53.97 to 201.45 gm⁻² in the second year.

The biomass values of *L. adscendens* of the present study are found to be in close conformity when compared with the ones reported by Devi¹³ in Awangsoipat lake, Manipur with values ranging from 18.03 to 66.86 gm⁻² and 10.04 to 52.80 gm⁻² in the two consecutive years of study. However, the present values of biomass for *L. adscendens* are found to be lower when compared with those reported in Hidenkompat lake, Manipur (12.52 to 122.86 gm⁻²).¹⁸ In the present study, the peak biomass values of *H. verticillata* for the two consecutive years were reported during rainy season (July). In consonance with the present findings, peak biomass value for *H. verticillata* (443.08 gm⁻²) were also recorded during rainy season (July) from Loktak lake, Manipur.⁸ Similarly, Mishra & Tripathi³⁰ also observed peak

biomass values during rainy seasons.

The present findings of biomass values for *H. aristata* are comparable with those in Oksoipat lake, Manipur with biomass values ranging 17.44 to 64.26 gm⁻² in the second year.²⁷ The biomass value of *Ipomoea aquatica* are found to be slightly higher when compared with those reported in Sanapat lake¹¹, Manipur with values in the range of 4.87 to 26.93 gm⁻² and in Awangsoipat lake¹³, Manipur with values of 1.33 to 19.69 gm⁻². The biomass values of *Eichhornia crassipes* are found to be lower when compared with the one reported in Kharungpat lake¹⁶, Manipur with biomass values ranging from 13.08 to 72.21 gm⁻² in the first year and 15.83 to 94.25 gm⁻² in the second year and in Oksoipat lake²⁷, Manipur with biomass values ranging from 17.87 to 64.96 gm⁻² in the first year and 17.76 to 69.02 gm⁻² in the second year. The present findings of biomass values for *Salvinia cucullata* are found to be lower with those reported in Oksoipat lake²⁷, Manipur with biomass values varying from 9.17 to 47.46 gm⁻² in the first year and 14.99 to 67.52 gm⁻² in the second year as well as in Kharungpat lake¹⁶, Manipur with values ranging from 9.06 to 52.20 gm⁻² in the first year and 13.37 to 49.73 gm⁻² in the second year.

A comparative account of the biomass variation of the macrophytes in different Freshwater Ecosystems is presented in Table 4. The present findings for the total biomass of all species (combined) in the different study sites of the lake are found to be lower than those reported by earlier workers viz., Forsberg⁴⁰ in Osby Lake, Sweden (620 gm⁻²); Ambasht³¹ in Freshwater ponds, Varanasi (1250 gm⁻²); Crowder *et al.*³² in Lake Opinicon, Canada (1154.00 gm⁻²); Kaul³³ in Manasbal and Anchar lake, Kashmir observing 970 gm⁻² and 1010 gm⁻² respectively; Howard-Williams *et al.*³⁴ in Waikaremona lake, New Zealand (1106 gm⁻²); Vyas *et al.*³⁵ in five major lakes of Udaipur (537.6 to 1884.09 gm⁻²) and Devi²⁹ in Waithou lake, Manipur (422.97 to 1173.01). Devi¹³ in Awangsoipat lake, Manipur (164.45 to 841.00 gm⁻²); Devi⁸ in Loktak lake, Manipur (363.21 to 782.63 gm⁻²). Singh *et al.*¹⁶ in Kharungpat lake, Manipur (304.01 to 989.95 gm⁻²), Devi¹⁷ in Yenapat lake, Manipur (198.80 to 866.40 gm⁻²), Devi¹⁸

in Hidenkompat lake, Manipur (292.67 to 855.78 gm^{-2}).

The present findings are found to be in close conformity with the those reported by Wassink³⁶ in some wetlands in Malaysia (where the biomass ranges from 370.0 to 520.0 gm^{-2}); Devi⁹ in Utrapat lake, Manipur (139.18 to 579.85 gm^{-2}); Devi¹⁰ in Freshwater Ecosystems of Canchipur, Manipur (36.09 to 408.40 gm^{-2}); Devi & Sharma²⁷ in Oksoipat lake, Manipur (150.87 to 588.05 gm^{-2}). Lower biomass values are reported by Billore & Vyas²⁷ in Pichhola lake, Udaipur (10.0 to 35.80 gm^{-2}); Spencer & King³⁸ and Freeman³⁹ in Eutrophic ponds, Michigan (196 to 260 gm^{-2}); Devi¹² in Ikop lake, Manipur (16.81 to 295.62 gm^{-2}). The present lake falls within the average global biomass values for the lakes and streams⁴¹ of the world which varied from 0.02 to 0.1 kgm^{-2} . Biomass data for lakes in different parts of the world has also been given by Sculthrope⁴² in which the biomass values ranged from 0.07 to 680 gm^{-2} in temperate lakes, 50 to 1000 gm^{-2} in lakes of New Zealand and 630 to 4640 gm^{-2} in reed swamps of Minnesota (U.S.A).

Conclusion

The variations in the biomass for the dominant aquatic macrophytes of Poiroupat lake varied considerably during the entire study period. The biomass values were found to be comparable to other lakes of Manipur, as well as other wetlands of India and abroad. The higher values of biomass observed in the different study sites are indicative of the eutrophic status of the lake. There has been constant exploitation of the lake by the people living in the vicinity of the lake. So, it is high time to take up preventive and corrective steps to control the lake from degradation.

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