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RESEARCH ARTICLE

**Phyto-Sociological studies on *Pistia stratiotes* L. var. *cuneata* Engl. (Araceae) in Purba Medinipur District, West Bengal, India**

**\*Babulal Sasmal and Amal Kumar. Mondal**

Plant Taxonomy and Biosystematic Laboratory, Department of Botany and Forestry,  
Vidyasagar University, Midnapore – 721 102, West Bengal, India

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**ABSTRACT**

*Pistia stratiotes* L. var. *cuneata* Engl. is an aquatic, floating, stemless, stoloniferous and huge herb found growing in different parts of the tropical as well as subtropical regions of India. It has immense diverse economic potentialities. Phyto-sociologically it is very much related with six constant associates like *Ipomoea aquatica*, *Eichhornia crassipes*, *Lemna perpusilla*, *Enhydra fluctuans*, *Typha elephantina*, *Marsilea quadrifolia* and 31 other plants like *Alternanthera sessilis*, *Cyperus rotundus*, *Monochoria hastata*, etc. which are known as flexible associates. Maximum association was noted with *Lemna* and *Eichhornia* and minimum with *Alisma* and *Nymphaea* during our present studies. Relative Density (RD), Relative Frequency (RF) as well as Importance Value Index (IVI) of the said species are also discussed in this paper.

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**INTRODUCTION**

The genus *Pistia* L is widely distributed in tropical and subtropical regions of India. One species of *Pistia* has been reported from India, viz. *Pistia stratiotes* L. var. *cuneata* Engl. *Pistia stratiotes* L. gregariously floating on the stagnant water, village pond, jheels, paddy fields or roadside ditches and completely covers the surface water on a large area in Purba Medinipur district of West Bengal. It is aquatic, small, floating stemless, 0.2 cm – 3.5cm long, stoloniferous herb. Leaves sessile, obovate-cuneate together forming an erect cup. Spathe small, shortly peduncled, tubular below, open above. Spadix adnate to the back of the tube of the spathe, free above. Fruits membranous, few seeded. Seeds oblong or obovoid albuminous, embryo minute. This aquatic weed frequently clogging the water surface hampers the inland fish culture, but it possesses adequate antiseptic, antidysenteric, antitubercular and insecticidal properties. Leaves are used in piles, asthma and cough and also as a fodder for ducks and pigs. This taxon shows intergeneric as well as interspecific phytosociological relationships in different natural habitats. The present study deals with phytosociological status of *Pistia stratiotes* L. var. *cuneata* Engl.

**MATERIALS AND METHODS**

**Study area**

The district Purba Medinipur is an important political and administrative segment of the Indian Union. It lies in between 88°12'40" E to 86°33'50" E longitude and 22°57'10" N to 21°36'35" N latitude in West Bengal. It is situated in southern part of West Bengal. Its area is about 4061 sq. km. (according to the census, 2001). The district is bounded by Hooghly and Rupnarayan rivers, Howrah district and South 24-parganas district in the east; Paschim Medinipur in the west; Hooghly in the north and the Bay of Bengal in the south.

Corresponding author: babulalmbotvu@yahoo.com

The climate of Midnapore is monsoonal type. The annual range of temperature varies from 9 °c to 35 °c. Average annual rainfall is 1800 m.m. The District has three groups of soil: a) Younger alluvial b) Coastal alluvial, and c) Saline and saline alkali. The Younger alluvial is predominant in northern and eastern parts of the district, being mainly characterized by flood plane of Silabati, Rupnarayan and Haldi rivers. The coastal alluvial is mainly observed at southern part of the district. The extreme southern margin is covered with saline and saline alkali soil of coastal origin. In the present study, the survey was carried out in the townships of Purba Medinipur district such as Mecheda, Tamluk, Contai, Haldia and Digha (Fig. 1)

The herbarium specimens of *Pistia stratiotes* L. var. *cuneata* Engl. and its associates were collected between February to October, 2008 from different localities in Purba Medinipur district (Mecheda, Tamluk, Contai, Haldia and Digha etc.) of West Bengal. The specimens were properly identified at Central National Herbarium (Cal.). Most of the habitats were mostly covered with herbs. Therefore, quadrats of 2 x 2 m were selected for phytosociological studies. Quadrats were marked permanently with wooden pegs and were studied in different seasons in a year. At each locality, 20 quadrats and totally 100 quadrats were randomly placed during our study in different parts of the district. Relative Density (RD), Relative Frequency (RF) and Index Value Index (IVI) of the recorded species were calculated following Philips (1959), Malhotra (1973), Samanta and Das (1996), Bhattacharya and Mukherjee (1998), Bhattacharya and Palit (2000), Chakraborty and Hazra (2003), Das and Samanta (2006), Chaudhuri (1965), Das and Lahiri (1997), Majumdar (1965), Mitra et al. (1971), Mondal et al. (1998), Safui et al. (1979) and Saha (2003). The collected herbarium specimens are deposited in the herbarium of the Vidyasagar University.

**OBSERVATIONS AND DISCUSSIONS**

In the present investigation, thirty eight taxa have been investigated as associated members of *Pistia stratiotes* L. var. *cuneata* Engl. Thirty

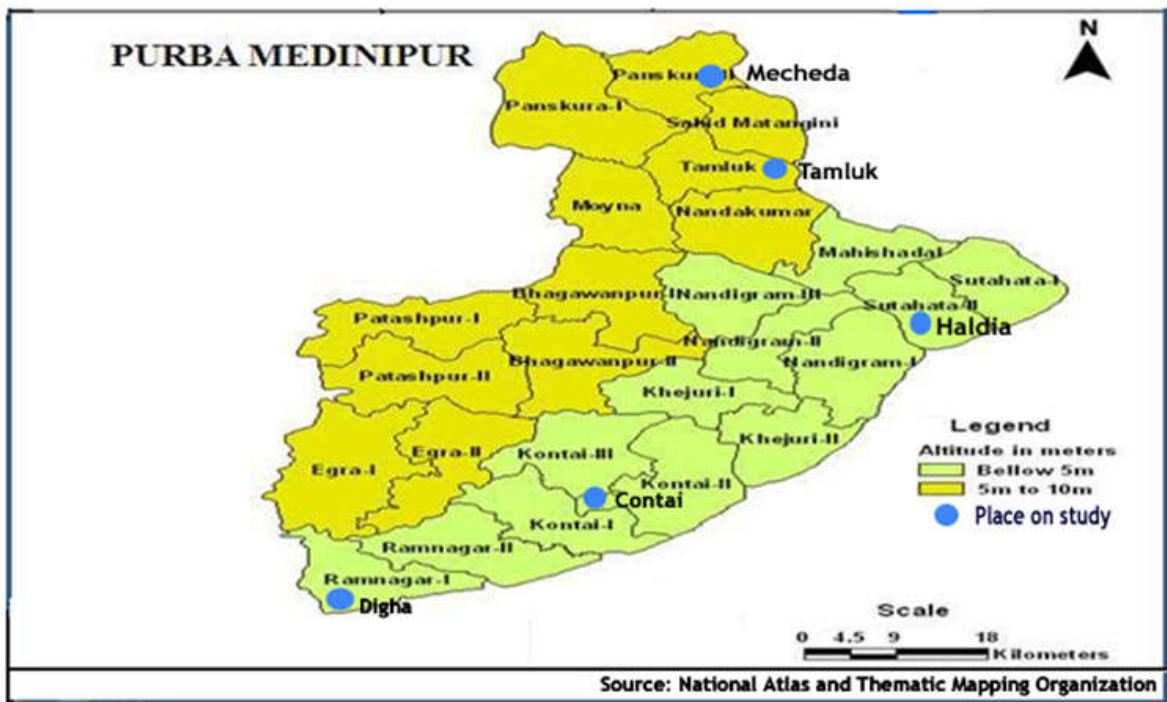


Figure – 1



Figure : 2A



Figure : 2B



Figure : 2C



Figure : 2D



Figure : 2E



Figure : 2F



Figure : 2G

Figure 2A. *Pistia stratiotes*, 2B: *Eichhornia crassipes*, 2C: *Typha elephantina*, 2D: *Marsilea quadrifolia*, 2E: *Lemna perpusilla*, 2F: *Ipomoea aquatic* and 2G: *Enhydra fluctuans*.

one of them are infrequent in some quadrats and rest seven (*Eichhornia*, *Enhydra*, *Ipomoea*, *Lemna*, *Marsilea*, *Typha* and *Pistia*) are constantly associated. The only Pteridophyte *Marsilea* shows the lowest frequency of association with *Pistia stratiotes* L. var. *cuneata* Engl. than any other angiospermic taxa. All the associated members are aquatic herbs and among them *Ipomoea* members are creepers or climbers. The phytosociological status of *Pistia stratiotes* L. var. *cuneata* Engl. is tabulated in Table - 1. The locality wise observations are shown as following.

#### Locality – Mecheda

In this zone only thirty four associates have been found to occur. *Ipomoea* are stem twiners twisting around the leaves of *Pistia stratiotes* L. var. *cuneata* Engl. by their stem. The free-floating members viz. *Azolla*, *Eichhornia*, *Lemna* and *Salvinia* preferably float surrounding the *Pistia stratiotes* L. var. *cuneata* Engl. Among rooted herbs, *Alternanthera*, *Cyperus*, *Enhydra*, *Marsilea*, *Monochoria*, *Nymphaea*, *Polygonum*, *Sagittaria*, *Ipomoea* and *Ludwigia* are more common. The RD, RF and IVI values of *Azolla* and *Pistia* are 34.82 (RD), 5.28 (RF) and 40.10 (IVI) and 7.38 (RD), 6.91 (RF) and 14.29 (IVI) respectively, representing high degree of association. The lowest RD, RF and IVI values of *Nymphaea stellata* and *Enhydra* are 0.03 (RD), 0.41 (RF) and 0.44 (IVI) and 0.41 (RD), 0.24 (RF) and 0.65 (IVI) respectively indicating very low degree of association.

#### Locality – Tamluk

In this zone only twenty five associates have been found to occur. *Ipomoea* are stem twiners twisting around the leaves of *Pistia stratiotes* L. var. *cuneata* Engl. by their stem.

The free-floating members viz. *Eichhornia*, *Lemna* and *Salvinia* preferably float surrounding the *Pistia stratiotes* L. var. *cuneata* Engl. Among rooted herbs, *Alternanthera*, *Cyperus*, *Enhydra*, *Marsilea*, *Monochoria*, *Nymphaea*, *Polygonum*, *Sagittaria* and *Ipomoea* are more common. The RD, RF and IVI values of *Lemna perpusilla* and *Commelina* are 38.40 (RD), 2.00 (RF) and 40.40 (IVI) and 0.27 (RD), 10.67 (RF) and 10.94 (IVI) respectively, representing high degree of association. The lowest RD, RF and IVI values of *Nymphaea pubescens* and *Salvinia* are 0.04 (RD), 1.33 (RF) and 1.37 (IVI) and 0.20 (RD), 0.67 (RF) and 0.87 (IVI) respectively indicating very low degree of association.

#### Locality – Contai

In this zone only twenty eight associates have been found to occur. *Ipomoea* are stem twiners twisting around the leaves of *Pistia stratiotes* L. var. *cuneata* Engl. by their stem. The free-floating members viz. *Azolla*, *Eichhornia*, *Lemna* and *Salvinia* preferably float surrounding the *Pistia stratiotes* L. var. *cuneata* Engl. Among rooted herbs, *Alternanthera*, *Cyperus*, *Enhydra*, *Marsilea*, *Monochoria*, *Nymphaea*, *Polygonum*, *Sagittaria* and *Ipomoea* are more common. The RD, RF and IVI values of *Lemna perpusilla* and *Eichhornia* are 35.63 (RD), 5.26 (RF) and 40.89 (IVI) and 0.43 (RD), 7.37 (RF) and 7.80 (IVI) respectively representing high degree of association. The lowest RD, RF and IVI values of *Spirodela* 0.03 (RD), 0.53 (RF) and 0.56 (IVI) indicate very low degree of association.

#### Locality – Haldia

In this zone only twenty six associates have been found to occur. *Ipomoea* are stem twiners twisting around the leaves of *Pistia stratiotes* L. var. *cuneata* Engl. by their stem. The free-floating members viz. *Azolla*, *Eichhornia*, *Lemna* and *Salvinia* preferably float surrounding the *Pistia stratiotes* L. var. *cuneata* Engl. Among rooted herbs, *Alternanthera*, *Cyperus*, *Enhydra*, *Marsilea*, *Nymphaea*, *Ipomoea* and *Ludwigia* are more common. The RD, RF and IVI values of *Lemna perpusilla* and *Eichhornia* are 33.00 (RD), 4.28 (RF) and 37.28 (IVI) and 0.06 (RD), 8.56 (RF) and 8.62 (IVI) respectively representing high degree of association. The lowest RD, RF and IVI values of *Nymphaea pubescens* and *Nymphaea nouchali* are 0.03 (RD), 1.60 (RF) and 1.63 (IVI) and 0.06 (RD), 1.07 (RF) and 1.13 (IVI) indicating very low degree of association.

#### Locality – Digha

In this zone only twenty nine associates have been found to occur. *Ipomoea* are stem twiners twisting around the leaves of *Pistia stratiotes* L. var. *cuneata* Engl. by their stem. The free-floating members viz. *Azolla*, *Eichhornia*, *Lemna* and *Salvinia* preferably float surrounding the *Pistia stratiotes* L. var. *cuneata* Engl. Among rooted herbs, *Alternanthera*, *Cyperus*, *Enhydra*, *Marsilea*, *Monochoria*,

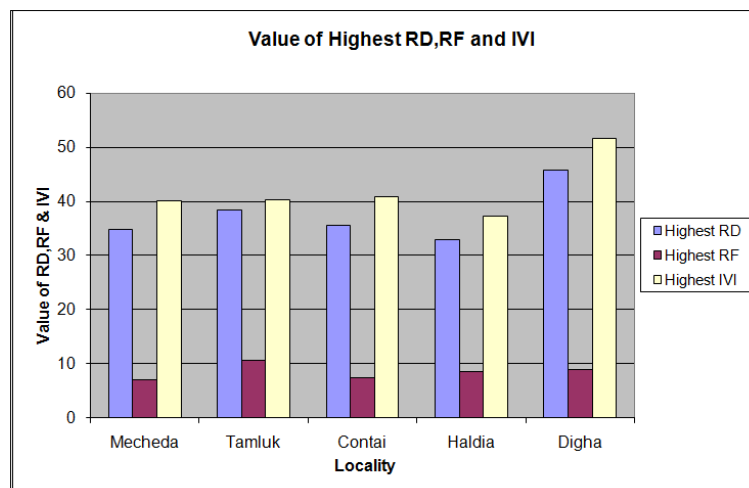


Figure 3.

Table 1. Computation of Phytosociological data of *Pistia stratiotes* L.var. *cuneata* Engl. in different localities

NAMES OF TAXA (FAMILY)	MECHEDA					TAMLUK					CONTAI					HALDIA					DIGHA					
	TN/QA	TC	RD	RF	IVI	TN/QA	TC	RD	RF	IVI	TN/QA	TC	RD	RF	IVI	TN/QA	TC	RD	RF	IVI	TN/QA	TC	RD	RF	IVI	
<i>Aeschynomene aspera</i> L (Fabaceae)	03/20	11	0.10	1.22	1.32	-----	-----	-----	-----	-----	11/20	43	0.20	5.79	5.99	08/20	34	0.21	4.28	4.49	05/20	21	0.20	3.20	3.40	
<i>Alisma plantago-aquatica</i> L (Alismataceae)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	05/20	09	0.04	2.63	2.07	-----	-----	-----	-----	-----	07/20	12	0.11	4.49	4.60	
<i>Alocasia fornicata</i> (Roxb.) Schott. (Araceae)	07/20	22	0.20	2.84	3.04	04/20	14	0.11	2.67	2.78	10/20	23	1.09	5.26	6.35	08/20	28	0.17	4.28	4.45	-----	-----	-----	-----	-----	
<i>Alternanthera sessilis</i> (L.) R. Br. ex. Dc.(Amaranthaceae)	13/20	123	1.10	5.28	6.38	15/20	172	1.36	10.00	11.36	11/20	128	0.60	5.79	6.39	09/20	35	0.22	4.81	5.03	-----	-----	-----	-----	-----	
<i>Ammannia salicifolia</i> Monti (Lythraceae)	02/20	12	0.11	0.81	0.92	-----	-----	-----	-----	-----	04/20	18	0.08	2.10	2.18	-----	-----	-----	-----	-----	05/20	17	0.16	3.20	3.36	
<i>Arundo donax</i> L.(Poaceae)	16/20	61	0.55	6.50	7.05	06/20	17	0.13	4.00	4.13	03/20	08	0.04	1.58	1.62	08/20	21	0.13	4.28	4.40	-----	-----	-----	-----	-----	
<i>Azolla pinnata</i> R. Brown sub sp. <i>Asiatica</i> , R.M.K. Saunders & K. Fowler (Azollaceae)	13/20	3887	34.82	5.28	40.10	-----	-----	-----	-----	-----	05/20	1628	7.70	2.63	10.33	09/20	2477	15.55	4.81	20.36	07/20	1839	17.72	4249	22.20	
<i>Commelina benghalensis</i> L. (Commelinaceae)	11/20	48	0.43	4.47	4.90	16/20	34	0.27	10.67	10.94	03/20	13	0.06	1.58	1.64	-----	-----	-----	-----	-----	06/20	22	0.21	3.85	4.70	
<i>Cyperus rotundus</i> L. (Cyperaceae)	10/20	36	0.32	4.06	4.38	11/20	46	0.36	4.47	4.83	-----	-----	-----	-----	-----	13/20	76	0.48	6.95	7.43	14/20	82	0.79	8.97	9.76	
<i>Eichhornia crassipes</i> (Mart.) Solms (Pontederiaceae)	13/20	140	1.25	5.28	6.53	09/20	84	0.66	6.00	6.66	14/20	92	0.43	7.37	7.80	16/20	109	0.06	8.56	8.62	07/20	57	0.55	4.49	5.04	
<i>Enhydra fluctuans</i> Lour. (Asteraceae)	06/20	46	0.41	0.24	0.65	11/20	41	0.32	7.33	7.65	09/20	32	0.15	4.74	4.89	11/20	49	0.31	5.88	6.19	08/20	53	0.51	5.13	5.64	
<i>Hydrilla verticillata</i> (L.f.) Royle (Hydrocharitaceae)	09/20	97	0.87	3.66	4.53	-----	-----	-----	-----	-----	12/20	52	0.25	6.31	6.56	10/20	77	0.48	5.35	5.83	03/20	61	0.59	1.92	2.51	
<i>Hygrophila auriculata</i> (K. Schum.)Heine(Acanthaceae)	07/20	58	0.52	2.84	3.36	05/20	66	0.52	3.33	3.85	11/20	156	0.74	5.79	6.53	-----	-----	-----	-----	-----	06/20	85	0.82	3.85	4.67	
<i>Ipomoea aquatica</i> Forsk. (Convolvulaceae)	08/20	23	0.21	3.25	3.46	05/20	32	0.25	3.33	3.58	12/20	46	0.28	6.31	6.59	10/20	27	0.17	5.35	5.52	07/20	30	0.29	4.49	4.78	
<i>Lemna minor</i> L. (Lemnaceae)	04/20	1821	16.31	1.63	17.94	06/20	1508	11.92	4.00	15.92	04/20	3267	15.46	2.10	17.56	09/20	4010	25.18	4.81	30.00	-----	-----	-----	-----	-----	
<i>Lemna perpusilla</i> Torrey. e. (Lemnaceae)	06/20	2335	20.92	2.44	23.36	03/20	4860	38.40	2.00	40.40	10/20	7530	35.63	5.26	40.89	08/20	5255	33.00	4.28	37.28	09/20	4758	45.85	5.77	51.62	
NAMES OF TAXA (FAMILY)	MECHEDA					TAMLUK					CONTAI					HALDIA					DIGHA					
	TN/QA	TC	RD	RF	IVI	TN/QA	TC	RD	RF	IVI	TN/QA	TC	RD	RF	IVI	TN/QA	TC	RD	RF	IVI	TN/QA	TC	RD	RF	IVI	
<i>Limnophila heterophylla</i> (Roxb.) Benth. (Scrophulariaceae)	05/20	47	0.42	2.03	2.45	02/20	31	0.24	1.33	1.57	-----	-----	-----	-----	-----	03/20	42	0.26	1.60	1.86	06/20	52	0.50	3.85	4.35	
<i>Ludwigia adscendens</i> (L.) Hara (Onagraceae)	07/20	32	0.29	2.84	3.13	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	04/20	58	0.36	2.14	2.50	02/20	15	0.14	1.28	1.42	
<i>Marsilea quadrifolia</i> L. (Marsileaceae)	04/20	26	0.23	1.63	1.86	07/20	32	0.25	4.67	4.92	03/20	25	0.12	1.58	1.72	09/20	53	0.33	4.81	5.14	11/20	47	0.45	7.05	7.50	
<i>Monochoria hastata</i> (L.) Solms (Pontederiaceae)	06/20	38	0.34	2.44	2.78	02/20	13	0.10	1.33	1.43	05/20	18	0.08	2.63	2.71	-----	-----	-----	-----	-----	03/20	15	0.14	1.92	2.06	
<i>Najas indica</i> Cham. (Najadaceae)	03/20	29	0.26	1.22	1.48	-----	-----	-----	-----	-----	02/20	33	0.16	1.05	1.21	06/20	54	0.34	3.21	3.55	02/20	17	0.16	1.28	1.44	
<i>Nelumbo nucifera</i> Gaertn. (Nelumbonaceae)	04/20	10	0.09	1.63	1.72	02/20	07	0.05	1.33	1.38	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
<i>Nymphaea nouchali</i> Burm.f. (Nymphaeaceae)	04/20	09	0.08	1.63	1.71	-----	-----	-----	-----	-----	05/20	11	0.05	2.63	2.68	02/20	09	0.06	1.07	1.13	06/20	14	0.13	3.85	3.98	

NAMES OF TAXA (FAMILY)	MECHEDA					TAMLUK					CONTAI					HALDIA					DIGHA				
	TN/QA	TC	RD	RF	IVI	TN/QA	TC	RD	RF	IVI	TN/QA	TC	RD	RF	IVI	TN/QA	TC	RD	RF	IVI	TN/QA	TC	RD	RF	IVI
<i>Nymphaea pubescens</i> Willd. (Nymphaeaceae)	02/20	03	0.03	0.81	0.84	02/20	05	0.04	1.33	1.37	03/20	05	0.03	1.60	1.63	01/20	02	0.02	0.64	0.66					
<i>Nymphaea stellata</i> Willd. (Nymphaeaceae)	01/20	03	0.03	0.41	0.44	04/20	06	0.05	2.70	2.75	03/20	07	0.03	1.58	1.61	03/20	05	0.05	1.92	1.97					
<i>Oryza sativa</i> L. (Poaceae)	05/20	17	0.15	2.03	2.18	02/20	14	0.11	1.33	1.44	06/20	15	0.07	3.16	3.23	03/20	06	0.06	1.92	1.98					
<i>Ottelia alismoides</i> (L.) Pres. (Hydrocharitaceae)	04/20	28	0.25	1.63	1.88						06/20	62	0.39	3.21	3.60	03/20	42	0.40	1.92	2.32					
<i>Pistia stratiotes</i> L. var. <i>cuneata</i> Engl. (Araceae)	17/20	824	7.38	6.91	14.29	11/20	1215	9.60	7.33	16.93	05/20	2130	10.08	2.63	12.71	07/20	565	3.55	3.74	7.29	02/20	280	2.70	1.28	3.98
<i>Polygonum barbatum</i> (Polygonaceae)	03/20	35	0.31	1.22	1.53	05/20	72	0.57	3.33	3.90	02/20	27	0.13	1.05	1.18										
<i>Sagittaria sagittifolia</i> L. (Alismataceae)	05/20	55	0.49	2.03	2.52	03/20	36	0.28	2.00	2.28	07/20	85	0.40	3.68	4.08	04/20	40	0.38	2.56	2.94					
<i>Salvinia molesta</i> Mitchell (Salviniaceae)	06/20	720	6.45	2.44	8.89	01/20	26	0.20	0.67	0.87	05/20	700	4.40	2.67	7.07	07/20	1100	10.60	4.49	15.09					
<i>Scirpus articulatus</i> L. (Cyperaceae)	11/20	125	1.12	4.47	5.59						06/20	22	0.10	3.16	3.26	08/20	88	0.55	4.28	4.82	05/20	120	0.96	3.20	4.16
<i>Scirpus corymbosus</i> Heyne ex. Roth. (Cyperaceae)	03/20	22	0.20	1.22	1.42																				
<i>Spirodela polyrrhiza</i> Sch. (Lemnaceae)						02/20	15	0.12	1.33	1.45	01/20	07	0.03	0.53	0.56	04/20	18	0.11	2.14	2.25	06/20	36	0.35	3.85	4.20
<i>Typha elephantina</i> Roxb. (Typhaceae)	16/20	315	2.82	6.50	9.32	04/20	68	0.54	2.67	3.21	05/20	35	0.16	2.63	2.79	03/20	28	0.17	1.60	1.77	02/20	08	0.08	1.28	1.36
<i>Utricularia reticulata</i> Smith. (Lentibulariaceae)	05/20	80	0.72	2.03	2.75						02/20	56	0.35	1.07	1.42	04/20	30	0.29	2.56	2.85					
<i>Vallisneria spiralis</i> L. (Hydrocharitaceae)	07/20	24	0.21	2.84	3.05	03/20	16	0.13	2.00	2.13	05/20	22	0.10	2.63	2.73	03/20	20	0.12	1.60	1.72					
<i>Wolffia arrhiza</i> Winn. (Lemnaceae)						09/20	4225	33.39	6.00	39.39	11/20	5650	26.74	5.79	32.53	03/20	1970	12.37	1.60	13.97	02/20	1540	14.84	1.28	16.12
Total Count (TC)		11162					12655					21132					15926					10376			

Symbols: TN – Total number of quadrates where a particular species is present out of 20 quadrates.

QA – Total number of quadrates studied in a particular area.

TC – Total number of individuals of a species out of 20 quadrates.

$$RD = \frac{\text{Total number of individuals of a species} \times 100}{\text{Total number of individuals of all species within 20 quadrates}}$$

$$RF = \frac{\text{Frequency of a species} \times 100}{\text{Sum total of the frequencies for all species}}$$

$$IVI = RD + RF$$

*Nymphaea*, *Polygonum*, *Sagittaria*, *Ipomoea* and *Ludwigia* are more common. The RD, RF and IVI values of *Lemna perpusilla* and *Cyperus rotundus* are 45.85 (RD), 5.77 (RF) and 51.62 (IVI) and 0.79 (RD), 8.97 (RF) and 9.76 (IVI) respectively, representing high degree of association. The lowest RD, RF and IVI values of *Nymphaea pubescens* 0.02 (RD), 0.64 (RF) and 0.66(IVI) indicate very low degree of association.

### Conclusion

Details observation and discussion it may be concluded that of five localities, at Mecheda RD value of *Azolla* is highest among the species, at Tamluk RD value of *Lemna* is highest among the species, at Contai RD value of *Lemna* is highest among the species and at Digha RD value of *Lemna* is highest among the species. Again, of different RD values of *Lemna* at different localities, RD value is highest Digha. Further, of RD values of different species at different localities, RD value of *Lemna* is highest which is at Digha. Of five localities, at Mecheda RF value of *Pistia* is highest among the species, at Tamluk RF value of *Commelina* is highest among the species, at Contai RF value of *Eichhornia* is highest among the species, at Haldia RF value of *Eichhornia* is highest among the species and at Digha RF value of *Cyperus* is highest among the species. Again, of different RF values of *Commelina* at different localities, RF value is highest at Tamluk. Further, of RF values of different species at different localities, RF value of *Commelina* is highest which is at Tamluk. Of five localities, at Mecheda IVI value of *Azolla* is highest among the species, at Tamluk IVI value of *Lemna* is highest among the species, at Contai IVI value of *Lemna* is highest among the species, at Haldia IVI value of *Lemna* is highest among the species and at Digha IVI value of *Lemna* is highest among the species. Again, of different IVI values of *Lemna* at different localities, IVI value is highest Digha. Further, of IVI values of different species at different localities, IVI value of *Lemna* is highest which is at Digha. The above results reflect the maximum association with *Lemna* and *Azolla* and minimum association with *Nymphaea*, *Spirodela* and *Salvinia*. The rare occurrence of *Scirpus corymbosus* and *Nelumbo nucifera* is also a notable information. The range of species variation in phytosociological associations remains in between 16 and 23 in which 6 species remain constant. Further investigations will help to understand and draw the conclusion about the range of phytosociological relationship of *Pistia*.

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