Diversity of Fish Species in Nat Min Chaung In, Singu Township

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Abstract

The study was carried out in Nat Min Chaung In from July, 2015 to January 2016 to evaluate the species richness and diversity of fish fauna related to water physiochemical parameters. Collection of data was performed bimonthly. Data were analyzed by Margalef (1958), Simpson (1949), Shannon-Wiener (1949) and Hill (1973). A total of 39 species belonging to 27 genera, 16 families and eight orders were recorded in the study area. The order Cypriniformes (38.46%) was found to be the highest inspecies composition. Among the species recorded, *Corica soborna* was dominant species. The value of Marglef's richness index, d (3.8165) was the highest in August. The values of Simposon's index D (0.0815), Shannon-Weiner's index H' (2.7879), Hill diversity indices N_1 (16.0995), N_2 (12.2727) were recorded during November. The highest evenness value E (0.8046) was found in January. According to the value of physiochemical parameter of water in the study area, the maximum depth of water 13.5 m in July and the minimum 4.5 m in January were found. The highest value of water temperature (32.5°C) was observed in July and the lowest value of water temperature (21.4°C) was recorded in December. pH ranged from 7.4 in August to 8.2 in November. Dissolved oxygen ranged from 3.8 mg/L in September to 6.8 mg/L in November. The monthly variation of physiochemical parameters of water quality in the study area directly influenced on the composition, richness and diversity of fish fauna. Based on the result of study, it may be concluded that the richness of fish fauna and species diversity is useful for implementing conservation strategies in order to maintain the sustainability of fisheries in Nat Min Chaung In.

Keywords: Nat Min Chaung In, fish, species,diversity indicies, physiochemical parameters

Introduction

Biodiversity is also essential for stabilization of ecosystems, protection of overall environmental quality, for understanding intrinsic worth of all species on the earth. Species diversity is a property at the population level while the functional diversity concept is more strongly related to ecosystem stability and stress, physical and chemical factors for determining population dynamics in the lentic ecosystem. Fish constitutes almost half of the total number of vertebrates in the world. They live in almost all conceivable aquatic habitats. They exhibit enormous diversity of size, shape and biology, and in the habitats they occupy (IUCN, 2009).

The fish diversity is correlated with biological and various physiochemical parameters that regulate the productivity and distribution of different species of the fishes. The fish population is abundant and majority of fishes are exploited for human consumption (Bakawale and Kanhere, 2013).The rich diversity of fish (25000 species) is due to the diversity of aquatics and the range of water quality in which they live. It also results from immerse isolation in time and space. Fish diversity has been reduced by habitat loss, siltation, water pollution, dams, mining, and human development (Helfrich and Neves, 2009).

Macro habitat assessment indicated that high habitat diversity was associated with high species diversity and that habitat volume was a major determining factor for species diversity and abundance (Arunachalam, 2000).

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Habitat destruction and the introduction of exotic species are causing the extinction of many native species (Sax and Gaines, 2003).

Species diversity indices are influenced by both the species number, or "richness", and the species "evenness", or relative number of individuals of a species in a given habitat (Koenig *et al.*, 1976). Species diversity of aquatic organisms in flood plains connected with large river is always large, because they can easily recolonize the flood plain from the main river channel and other permanently aquatic habitats (Kar *et al*., 2006).

Nat Min ChaungIn is the most popular In due to richness in fishes fauna. It is also situated near Taung In village at the southern part of SinguTownsahip. The In lies on the east of the Ayeyarwady River. It is connected by Zeikchaung creek which joins the Ayeyarwady River. It is a long narrow channel about 4.83 km in length, 6.1 - 9.1 m in wide and 4.6 - 12.2 m depth, between Saw Lu In, and Myaung Katku In. Although Nat Min Chaung In is a seasonal flood plain leasable fishery, the In has no basic biological information of fish species. Therefore, the present study was conducted to evaluate the fish diversity in relation to physiochemical parameter of water quality of Nat Min Chaung In and to contribute a better knowledge for conservation management of aquatic environments.

Materials and Methods

Study Site

The stud ysite was selected in Nat Min Chaung In near Taung In village that is situated in the southern part of Singu Township, 22° 29' 29.95" N and 96°01' 03.78"E.

Study Period

The present study was conducted from July 2015 to January 2016.

Fig.1 Location map of study area (Source: Google Map)

Collection of Specimens

Specimen was collected bimonthly from the study site with the help of local fishermen and In owner. The morphological characters and measurements of each species were noted down and taken the photo immediately before the body color disappeared. The local name was also noted down. The collected specimens were preserved in 10% formalin. The water sample was sent tothe Laboratory of Water and Sanitation Department, Mandalay City Development Committee (MCDC) for determination of physiochemical factors.

Species Identification

Identification of fishes species were made according to Day (1878), Jayaram (1981), Talwar and Jhingran (1991).

Data Analysis

Species richness, diversity and evenness of fish species were analyzed by Margalef (1958), Simpson (1949), Shannon-Wiener (1948), Hill (1973),and Ludwing (1988).

Species Richness (Margalef, 1958)

$$d = \frac{S-1}{Ln(N)}$$

Where, d = Margalef's species richness index

S = Number of species

N = Total number of individuals

Simpson's Diversity Indice (1949)

$$D = \sum_{i=1}^{S} \frac{n_i(n_i - 1)}{n(n-1)} \text{ (Simpson, 1949)}$$

Where, Σ = sum

D = Simpson's index of diversity

S = number of species

n_i = number of individuals in the i^{th} species

n = total number of individuals of all species

Shannon-Wiener's Index (1948)

$$H' = \sum_{i=1}^{s} \left(\frac{n_i}{n}\right) Ln \left(\frac{n_i}{n}\right) \text{ (Shannon – Wiener, 1949)}$$

Where, H' = index of species diversity

S = number of species

ni = number of individuals in the i^{th} species in the sample

n = total number individuals of all species in the sample

For Hill's diversity number (1973)

Number1: $N_1 = e^{H'}$

Where, H' = Shannon's index

N_1 = number of abundant species in the sample

Number 2: $N_2 = 1/D$

Where, D = Simpson's index

N_2 = number of very abundant species in the sample

Evenness

Hill's ratio (1973).

$$E = \frac{(1/D) - 1}{e^{H'} - 1} = \frac{N_2 - 1}{N_1 - 1} \text{ (Hill, 1973)}$$

Results

A total of 69803 individuals and 39 species confined to 27 genera, 16 families and eight orders were recorded from Nat Min Chaung In during the study period of July 2015 to January 2016 (Table 1).

Table 1. List fish species recorded from Nat Min Chaung In from July, 2015 to January , 2016

No	Order	Family	Scientific Name	Common Name	Vernacular Name
1	Osteoglossiformes	Notopteridae	*Notopterusnotopterus* (Pallas, 1769)	Grey featherback	Nga -phe, Nga-pya
2	Clupeiformes	Clupeidae	*Coricasoborna* Ham., &Buch., 1882	Ganga-river-spart	Nga-pan-thay
			Gudusiavariegata (Day,1869)	Burmese-river-shad	Nga-la-pi-bay-kyar
3	Cypriniformes	Cypinidae	*Salmophasiasardinella* (Valenciennes, 1844)	Sardinellarozorbelly minnow	Yin-baung-zar
			Amblypharyngodonatkinsonii (Blyth,1861)	Burmese carplet	Nga-byet
			Osteobramabelangeri (Valenciennes, 1844)	Manlpurosteobrama	Nag-phant-ma
			Osteobramacunma (Day,1888)	Cunmaosteobrama	Nga-lay-daung
			Puntiuschola (Ham., & Buch.,1822)	Chola barb	Nga-hkone-ma-myi-ni
			Puntiusgonionotus (Bleeker,1850)	Sliver barb	Thai-nga-hkone-ma
			Puntiussarana (Ham., &Buch., 1822)	Olive barb	Nga-hkone-ma-toke
			Cirrhinusmrigala (Ham., &Buch., 1822)	Mrigal	Nga-gyin-phyu
			Catlacatla (Ham., &Buch., 1822)	Catla	Nga-thaing-gaung-bwa
			Labeoangra(Ham., &Buch., 1822)	Angralabeo	Nga-lu-myee-net
			Labeoboga(Ham., &Buch., 1822)	Bogalabeo	Nga-loo-phyu
			Labeocalbasu(Ham., &Buch., 1822)	Black rohu	Nga-net-pyar
			Labeorohita (Ham., &Buch., 1822)	Rohu	Nga-myint-chin
		Cobitidae	*Lepidocephalichthysberdmorei* (Blthy, 1860)	Burmese loach	Nga-the-le-doh
			Acantopsischoirorhynchos(Bleeker, 1854)	Spotted horseface loach	Nga-paw-myint
4	Siluriformes	Bagridae	*Mystusbleekeri* (Day, 1877)	Day's mystus	Nga-zin-yaing-ket-chay
			Mystuscavasius (Ham., &Buch., 1822)	Gangeticmystus	Nga-zin-yaing-phyu
			Mystuspulcher (Chaudhuri, 1911)	Pulchermystus	Nga-zin-yaing-ket-chay
		Siluridae	*Ompokbimaculatus*(Bloch, 1797)	Indian butter cat fish	Nga-nu-than
			Wallagoattu (Schneider, 1801)	Boal freshwater shark	Nga-butt
		Schilbeidae	*Netropiusacutirostris* (Day, 1869)	Butter cat fish	Nga-za-kar
			Clupisomagarua (Ham., &Buch., 1822)	Garuabachcha	Nga-myin-oak-phar
5	Beloniformes	Belonidae	*Xenentodoncancila* (Ham., &Buch., 1822)	Fresh water garfish	Nga-phaung-yoe
6	Synbranchiformes	Mastacembelidae	*Macrognathusaral*(Bloch and Schneider, 1801)	One stripe spiny eel	Nga-mway-ni
			Macrognathuszebrinus (Blyth, 1859)	Burmese spiny eel	Nga-mway-doh-kyan-sit
			Mastacembelusarmatus (Lacepede, 1800)	Tire-track spiny eel	Nga-mway-nagar
7	Perciformes	Ambassidae	*Parambassisranga* (Ham., &Buch., 1822)	Indian glassy fish	Nga-zin-zat
		Cichlidae	*Orechromis* sp. (Peters, 1852)	Tilapia	Salapia
		Gobiidae	*Glossogobiusgiuris* (Ham., &Buch., 1822)	Tank goby	Nylon-nga or ka-tha-boe
		Anabantidae	*Anabas testudineus* (Bloch, 1795)	Climbing perch	Nga-byay-ma
		Belontidae	*Colisalabiosus* (Day, 1877)	Thick lipped gourami	Nga-phyin-tha-let
			Trichogasterpectoralis (Regan, 1909)	Snakeskin gourami	Nga-hpee-ma
		Channidae	*Channaorientalis* (Ham., &Buch., 1822)	Asiatic snake head	Nga-yant-gaung-to
			Channapunctatus (Bloch, 1793)	Spotted snake head	Nga-yant-pa-naw
			Channastriata(Bloch, 1793)	Striped snake head	Nga-yant-auk
8	Tetraodontiformes	Tetradontidae	*Tetraodoncutcutia* Han., &Buch., 1822	Ocellated puffer	Nga-pu-tin

In the present study order Cypriniformes was represented with the highest number of species (38.46%), followed by Perciformes (23.08%), Siluriformes (17.95%), Synbranchiformes (7.69%), Clupeiformes (5.13%), and (2.56%) in each of the remaining three orders, Osteoglossiformes, Clupeiformesand Tetraodontiformes (Table 2, Fig. 2).

Table 2. Species composition of different orders of fish fauna in Nat Min Chaung In from July, 2015 to January, 2016

No.	Orders	No. of family	No. of genus	No. of species	Composition (%)
1	Osteoglossiformes	1	1	1	2.56
2	Clupeiformes	1	2	2	5.13
3	Cypriniformes	2	9	15	38.46
4	Siluriformes	3	5	7	17.95
5	Beloniformes	1	1	1	2.56
6	Synbranchiformes	1	1	3	7.69
7	Perciformes	6	7	9	23.08
8	Tetraodontiformes	1	1	1	2.56
	Total	16	27	39	

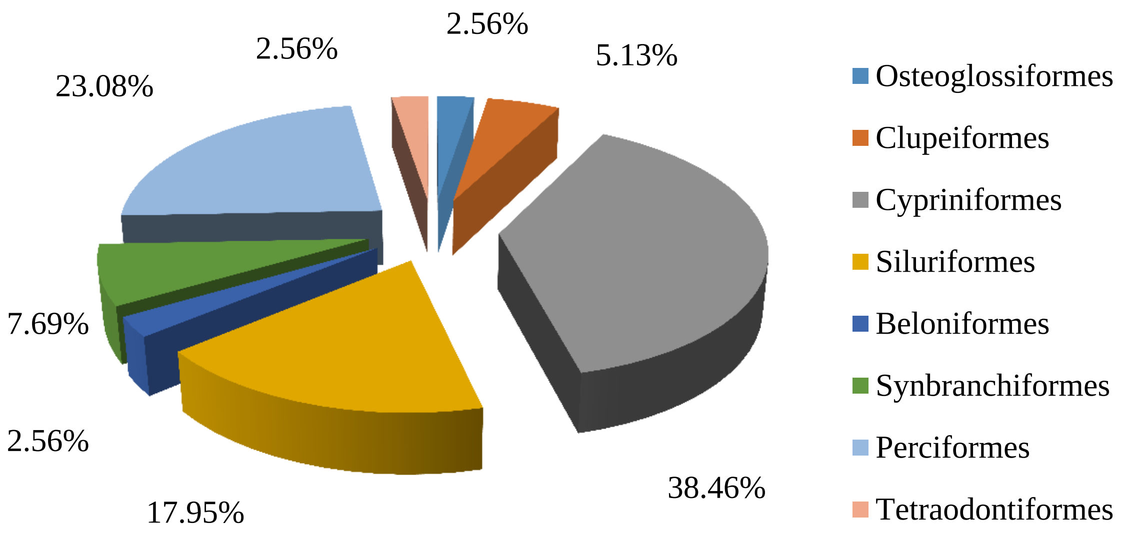

Fig.2 Species composition in different orders of fish in Nat Min Chaung In

According to monthly data, the highest number of 36 species was recorded in September. The highest individuals 13946 were recorded in December. The lowest number of 29 species was recorded in July. The lowest individuals of 7396 were recorded in August (Table 3, Fig.3 and 4)

Table 3. Monthly recorded fish species from Nat Min Chaung In from July , 2015 to January , 2016

No.	Scientific name	July, 2015	Aug., 2015	Sep., 2015	Oct.,2015	Nov.,2015	Dec., 2015	Jan., 2016	Total	Percentage (%)
1	*Notopterusnotopterus*	10	28	35	32	55	20	73	253	0.36
2	*Coricasoborna*	2885	1676	2310	1870	1093	1442	923	12199	17.48
3	*Gudusiavariegata*	235	392	332	274	107	98	64	1502	2.15
4	*Salmophasiasardinella*	570	285	152	170	76	35	44	1332	1.91
5	*Amblypharyngodonatkinsonii*	360	240	581	1589	1130	3710	203	7813	11.19
6	*Osteobramabelangeri*	96	173	368	972	520	498	690	3317	4.75
7	*Osteobramacunma*	92	105	37	57	80	210	63	644	0.92
8	*Puntiuschola*	470	503	575	846	1645	2350	2544	8933	12.80
9	*Puntiusgonionotus*	180	225	68	135	90	72	170	940	1.35
10	*Puntiussarana*	90	185	458	315	247	585	992	2872	4.11
11	*Cirrhinusmrigala*	0	7	3	0	18	21	9	58	0.08
12	*Catlacatla*	32	360	413	320	765	450	730	3070	4.40
13	*Labeoangra*	0	32	88	97	132	223	413	985	1.41
14	*Labeoboga*	0	5	3	0	2	1	0	11	0.02
15	*Labeocalbasu*	33	82	620	368	532	170	53	1858	2.66
16	*Labeorohita*	88	105	371	575	875	920	812	3746	5.37
17	*Lepidocephalichthysberdmorei*	171	541	840	280	364	680	220	3096	4.44
18	*Acantopsischoirorhynchos*	0	0	1	0	0	1	0	2	0.00
19	*Mystusbleekeri*	74	51	84	115	85	69	35	513	0.74
20	*Mystuscavasius*	40	280	365	340	102	72	43	1242	1.78
21	*Mystuspulcher*	345	690	805	920	810	645	651	4866	6.97
22	*Ompokbimaculatus*	40	28	36	32	80	72	38	326	0.47
23	*Wallagoattu*	192	105	232	63	77	140	106	915	1.31
24	*Neotropiusacutirostris*	12	28	20	33	40	21	31	185	0.27
25	*Clupisomagarua*	80	65	58	63	75	52	32	425	0.61
26	*Xenentodoncancila*	21	8	17	13	5	6	0	70	0.10
27	*Macrognathusaral*	72	36	320	213	320	80	43	1084	1.55
28	*Macrognathuszebrinus*	5	21	9	0	0	0	0	35	0.05
29	*Mastacembelusarmatus*	0	12	4	20	0	0	5	41	0.06
30	*Parambassisranga*	960	192	240	235	520	352	124	2623	3.76
31	*Oreochromis sp.*	110	65	15	23	143	264	382	1002	1.44
32	*Glossogobiusgiuris*	673	825	495	330	165	660	520	3668	5.26
33	*Anabas testudineus*	0	7	4	0	2	0	0	13	0.02
34	*Colisalabiosus*	0	5	1	0	0	0	2	8	0.01
35	*Trichogasterpectoralis*	18	33	7	23	14	11	7	113	0.16
36	*Channaorientalis*	2	0	2	1	0	10	4	19	0.03
37	*Channapunctatus*	0	0	0	3	1	2	5	11	0.02
38	*Channastriata*	0	0	0	0	2	2	3	7	0.01
39	*Tetraodoncutcutia*	0	1	0	0	1	2	2	6	0.01
	Total no. of individuals	7956	7396	9969	10327	10173	13946	10036	69803	
	Total no. of species	29	35	36	31	34	35	34	39	

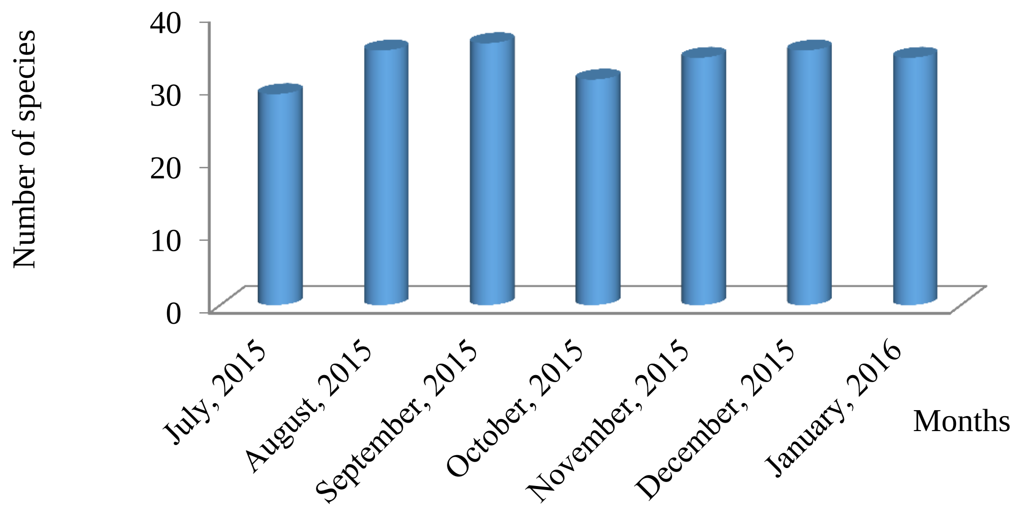

Fig.3 Monthly occurrence of fish species in Nat Min Chaung In from July , 2015 to January , 2016

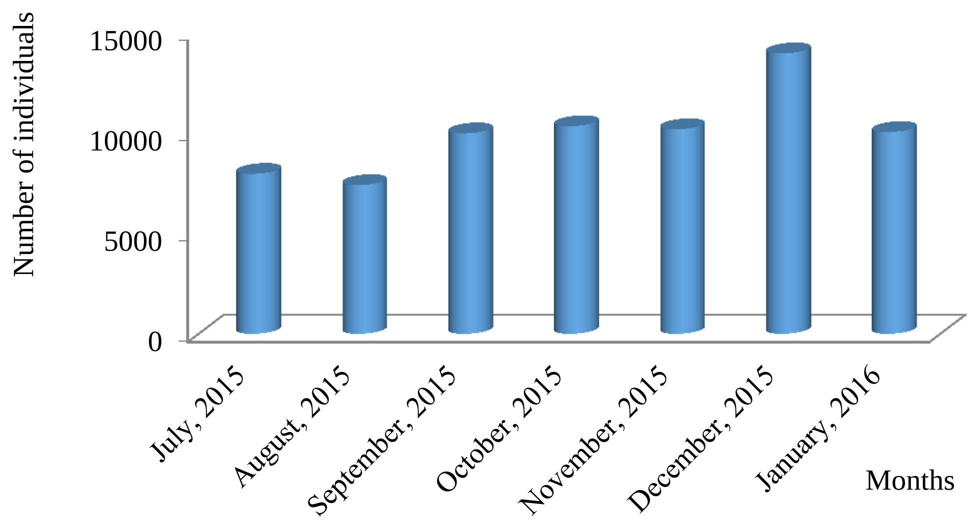

Fig.4 Monthly occurrence of fish individuals in Nat Min Chaung In from July, 2015 to January, 2016

On the monthly basis, during the study period, the highest species richness d (3.8165) was in August, Simpson's index diversity D (0.0815), Shannon-Weiner's diversity H' (2.7879) and Hill diversity indices N_1 (16.0995), N_2(12.2727) were recorded during November. The highest evenness value 0.8046 was found in January. The lowest species richness d (3.1175), Simpson's index diversity D (0.1692), Shannon-Wiener's diversity H' (2.3757), Hill diversity indices N_1 (10.7584), N_2 (5.9111) and Evenness value E (0.5033) were recorded in July (Table 4).

Table 4. Diversity indices of species in Nat Min Chaung In from July, 2015 to January, 2016

Diversity indices	July, 2015	Aug., 2015	Sep., 2015	Oct., 2015	Nov., 2015	Dec., 2015	Jan., 2016
Total no. of species	29	35	36	31	34	35	34
Total no. of individuals	7956	7396	9969	10327	10173	13946	10036
d	3.1175	3.8165	3.8014	3.2459	3.5763	3.5628	3.5815
D	0.1692	0.0953	0.0920	0.0914	0.0815	0.1269	0.1107
H'	2.3757	2.7654	2.7721	2.7309	2.7879	2.5166	2.4414
N_1	10.7584	15.8856	15.9928	15.3471	16.0995	12.3864	10.9847
N_2	5.9111	10.4907	10.8734	10.9367	12.2727	7.8790	9.0334
E	0.5033	0.6376	0.6585	0.6926	0.7466	0.6041	0.8046

The seasonal average values of water physiochemical parameters of the study area are depicted in the Table 5. The relationship between monthly occurrence of fish species and individuals with physiochemical parameters are described (Fig. 5 and 6).

Table.5 Monthly water physiochemical parameters of Nat Min Chaung In from July, 2015 to January, 2016

Parameters	July	Aug	Sep	Oct	Nov	Dec	Jan
Water depth (m)	13.5	12.5	13	10	8.2	6.5	4.5
Temperature (°C)	32.5	31.05	30	29.05	24	21.4	22.05
pH value	7.5	7.4	7.6	7.5	8.2	8.1	7.8
DO (mg/L)	6.1	5.8	3.8	4.1	6.8	6.2	5.9

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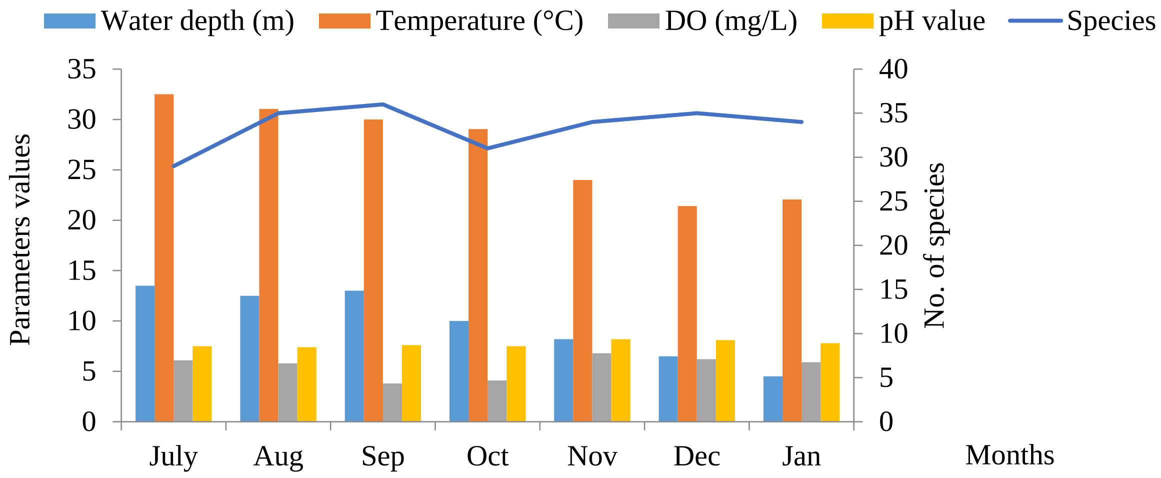

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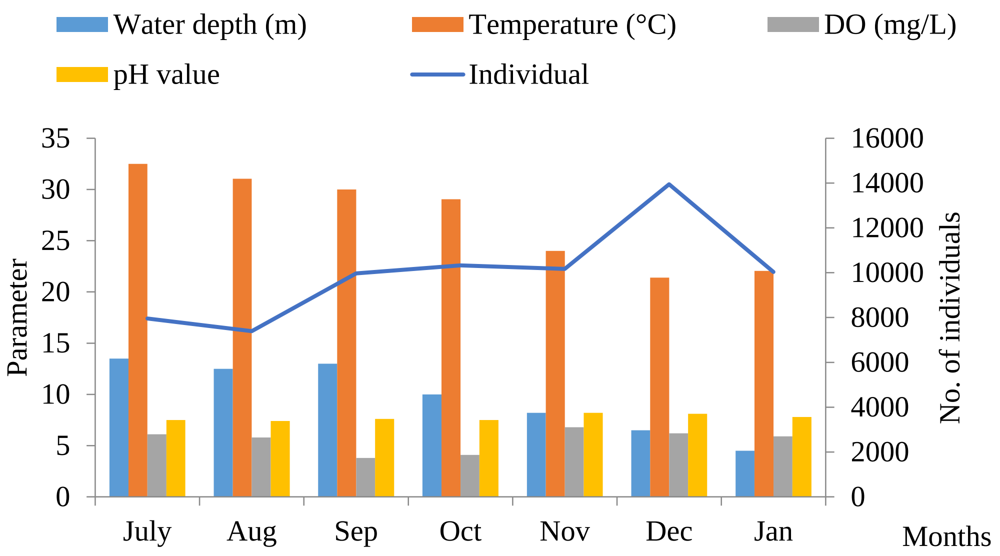

Fig. 6 Relationship between monthly occurrences of individuals and physiochemical parameter at Nat Min Chaung In from July, 2015 to January, 2016

Discussion

In the present study, 39 species of fish with 69803 individuals confined to 27 genera, 16 families and eight orders were recorded. Based on the result of species composition , the Cypriniformes fishes (38.46%) was found to be the most dominant group during the study period. The present result agrees with Vijiaylaxmi and Vijaykumar(2011) who reported that family Cyprinidae was most dominant family in Karala River and Mullameri River respectively in India.

Mi Mi Lay (1993) recorded 57 species from Nat Min Chaung In. In her study, the family Cypriniformes is the most dominant. There is similar result in the present study. According to the present number of recorded species, the fish species are becoming reduced. It may be assumed that the result is due to illegal fishing activities, over exploitation, and degradation of aquatic environment caused by agriculture land and water use.

According to monthly data of present study, the highest value of species richness (d) was found in August. The highest value of Simpson's index diversity (D), Shannon-Wiener's index (H') and Hill number value N_1, N_2 were found in November in the study period. The highest value of evenness index (E) was recorded in January. Similar result was also reported by Galib*et al.* (2013) who have recorded the value of diversity and richness indices of fish fauna that was higher in the winter months (November to February) than other months in Bangladesh.

Nath and Deka (2012) reported that the richest fish diversity is in winter. The lowest number of species was recorded in the month of June, this is due to heavy rain during this time which makes fishing very difficult as water level reached its maximum in Chandubi Tectonic Lake, India. In the present study, the lowest diversity indices were found in July. This is because water level reached its maximum on an account of heavy rain in this time and some species may be dispersed to other sites with the water current.

With respect to diversity indices, the number of each species per sample is a measure of richness. Simpson's diversity index is a measure of diversity. It takes into account the number of species present, as well as the abundance of each species. It is expressed as 1-D or 1/D. The value which is standing for the dominance index is used in pollution monitoring studies, as D increases. That way it is effectively used in environmental impact assessment to identify perturbation (Khan, 2006).

Namin and Spurny (2004) reported that Shannon-Wiener index (H') is the value that combines species diversity and evenness where > 3.99 is considered as no impacted; 3.00-3.99, slightly impacted; 2.00-2.99, moderately impacted and < 2.00, severely impacted. Based on this scale, the present study of (H') is categorized as moderately impacted in study area because H' value is within the range of 2.00-2.99.

The physiochemical characteristics of water have an important role in supporting fish diversity in freshwater ecosystems (Basavaraja*et al.*, 2014).Sweke*et al.* (2013) recorded that the human activities may influence fish diversity but its variations also could be because of the differences in food availability, habitat preference of fish, breeding sites, depth, topography and physiochemical properties of water.

Temperature in the range 20°C to 32°C is ideal for majority of freshwater fishes (Boyd, 1990). Kundanagar*et al.* (1996) reported that the natural bodies of water may exhibit a seasonal and during variation and is closely related with the change in atmospheric temperature.

In the present study, the lowest water temperature was 21.4°C in December and the highest water temperature was 32.5°C in July. This result showed that the temperature value range influences fish species for richness, abundance and survival.

The pH of an aquatic ecosystem is important because it is closely linked to biological productively (UNEP, 2006). According to FAO/NACA, 2003, the range of pH value, 7.0 to 8.5 is considered to support a rich biota and fish. In the study period, the pH values varied between 7.4 and 8.2. Thus, this optimal pH value is ideal for fish species in the study area.

According to Santosh and Shrihari (2008), dissolved oxygen (DO) is a primary and comprehensis indicator of water quality in surface water. The decline of DO level has serious implication for the heath of aquatic system. The optimum value for good water quality is 4 mg/L to 6 mg/L of DO, which ensures healthy aquatic, live in a water body. DO> 5 mg/L is stressful to most aquatic organisms, which DO < 2 mg/L does not support fish life (EPA, 2003).

In the present study, the recorded DO value range from 3.8 mg/L to 6.8 mg/L which is a safe level to support fish life. According to relationship monthly number of individuals fish and physiochemical parameter, the maximum number of individuals were found in December. Therefore, the present study may be assumed that there is a good relationship between monthly occurrence of fish species and individuals with physiochemical parameters. So, water depth, dissolved oxygen and pH were found to be the most important variables in shaping fish assemblage. The present study indicates that the water body of Nat Min Chaung In is rich in diversified fish fauna due to the optimal water quality for fish survival.

Conclusion

Nat Min Chaung In is a seasonal flood plain leasable fishery which supports the people inhabitants of the surrounding area for their livelihoods. The present study focused on fish species richness and diversity of Nat Min Chaung In. These results show that the biodiversity measure may be appropriate indicator for monitoring sustainability in fisheries. Understanding the physiochemical factors that influence fish community structure is important not only for accumulating basic information but also to predict the effects of environmental change on the Nat Min Chaung In will help in implementing the future conservation activities and maintaining of fish species in that area.

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