Diversity of Fish Species in the Segment of Myittha River between Pyinthar Village and Kyigone Village, Kalay Township

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Abstract

Diversity of fish species in the Segment of Myittha River between Pyinthar Village and Kyigone Village was investigated during January 2019 to December 2019. A total of 31246 individuals of fishes representing 55 species, under 39 genera and 21 families distributed among nine orders were recorded. According to the diversity index, Margalef's species richness index (6.962) was the highest at Site I, (7.082) at Site II and (7.048) at Site III. Simpson's diversity (0.028) at Site I in February and in October, (0.027) at Site II in October,(0.028) at Site III in February. In Shannon-Wiener's index (3.646, 3.674, 3.639) were revealed as the highest values at Site I, II and III respectively in October. According to Hill's diversity index, the highest abundant value N1 was (38.735) at Site I in February, (39.416) at Site II and (38.070) at Site III in October. The highest very abundant value N2 was (35.436) at Site I in February, (37.166) at Site II in October and (35.390) at Site III in February. The highest evenness value E was (0.949) at Site I in May, (0.956) at Site II in December and (0.958) at Site III in May. According to the present data, Myittha River segment was still in good environmental condition for the habitats and breeding sites for native species in Myanmar.

Keywords: Fish, diversity, Segment of Myittha River

Introduction

Myanmar is rich in freshwater resources like large rivers, small rivers, streams, creeks, lakes and wetlands and flood plain around the rivers. The most distinguished rivers of Myanmar are the Ayeyarwady, Thanlwin, Chindwin and Sittaung rivers (Thanda Tun, 2004). Among them, Chindwin is one of the largest rivers in Myanmar. Most of the streams take their sources from Chin Hills. Myittha River flows from south to northwards through Pyinthar and Kyigone villages and finally drains into the Chindwin River in Kalay wa Township. These inland water systems together with the annual heavy rainfalls provide a vast amount of water resources for the country and more than 820 species were known to occur in Myanmar (Welcomme, 1985).

Diversity is the quantity, variety and distribution across biological scale ranging through genetic and life forms of population, species communities and ecosystem (Mace *et al*., 2005). Although diversity present at all levels of organisms most commonly measured by ecologist and biogeographists as species richness, or the number of species found at particular point in space or time (Femandez *et al.,* 2007). Biodiversity is found in natural and semi-natural ecosystems but tends to decline with increased human activity as a result of environmental stress due to pollution and disturbance. The capacity of our natural heritage to sustain the pressure of modern human activities may be limited and needed for sustainable development of natural resources (Kirkwood and Longley, 1995).

Fish biodiversity of river essentially represents the fish faunal diversity and their abundance. River conserves a rich variety of fish species which support to the commercial fisheries (Pallavi and Ajay, 2013). The simplest way to measure species diversity is to count the number of species present in a designated area. This number of species richness is the

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oldest, most fundamental, and perhaps the least ambiguous of the diversity measurements (Peet, 1974).

Species diversity has two basic components: richness or number of species in a given area, and evenness or how relative abundance or biomass is distributed among species. These components are combined in diversity indices (e.g., Shannon's and Simpson's diversity) (Magurran, 2004). Shannon and Weiner index (H') is based on randomly sampling individuals from an independently large population. Additionally, it also assumes that all the species are represented in the sample. Logarithm base 2 is normally used to estimate the index H', nevertheless, any log base can be used. Shannon-Weiner index is a very widely used index for comparing diversity between various habitats (Clarke and Warwick, 2001). Evenness indices standardize abundance and range from near 0 when most individuals belong to a few species, to close to 1, when species are nearly equally abundant (Smith and Wilson, 1996).

Fish are the most important food for human beings as delicious and variable value. Thus, this title was selected for research work to investigate the species richness and diversity of the fishes in Myittha River segment.

Materials and Methods

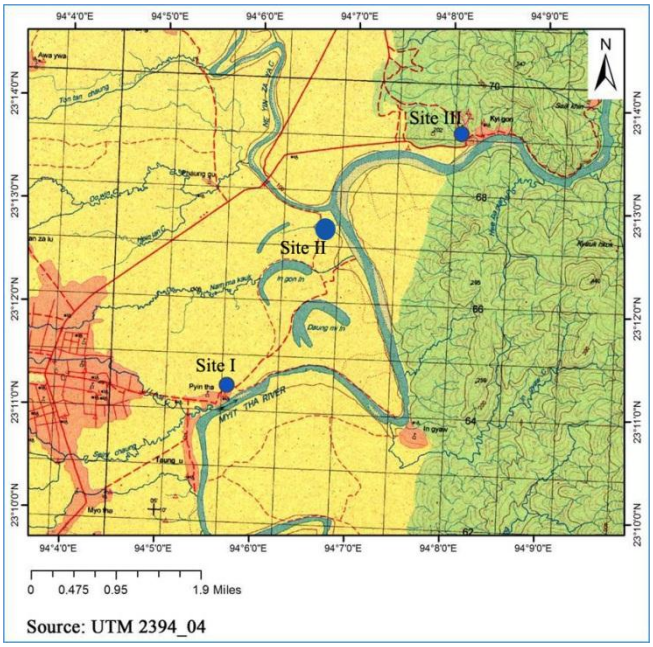

Fig.1 Location map of study area

Study Area and Study Sites

Kalay Township is situated in the southwestern part of Sagaing Region of Myanmar. It lies between 23°11' and 23°14' N and 94° 5' and 94°9'E. Myittha River flows south to northwards through the eastern part of Kalaymyo. Fish specimens for the study were collected from three study sites between Pyinthar and Kyigone villages. Site I is located in Pyinthar

Village, Site II is in Phaunggu Village and Site III is near Kyigone Village (Fig. 1). The present study was conducted from January 2019 to December 2019.

Data collection

Collection of the specimens was made once in each site within a month from the local fishermen. The fishes were caught by small cast net (Let-pyit-kun), drift gill net (Hmyaw-paik), Shallow water Seine-net (Lin-bat) and portable hand lift net (Dyne-kwin) employed by the local fishermen were taken into consideration. During the study period, five specimens of each species were collected and photographs were taken soon after catching the fish. Local names of the fishes were provided by local fishermen. The external characters and measurements were recorded. The numbers of individuals in each species were recorded in each site. All specimens were preserved in 10% formalin but larger specimens were injected with 10% formalin into the abdomen. Identification of fish specimens were made according to Day (1878), Jayaram (1981), Talwar and Jhingran (1991) and Ferraris (1997). The classification and nomination of fishes was followed after Talwar and Jhingran (1991) and Jayaram (2013).

Data Analysis

Dominant index, Shannon index, Simpson index, and itgs eveness were used to assess species diversity of fishes (Krebs, 2001, and Tiling, 1999).

Species Richness Index

Margalef's species Richness Index (1963),

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

Diversity Index

Species diversity was determined by using two formulae of Simpson's index of diversity "D" and Shannon-Wiener's information theory index, H′.

$$D = \sum_{i=1}^{s} \frac{n_i\,(n_i - 1)}{n(n-1)}$$

For Shannon-Wiener Index (1948)

The Shannon index was developed by Shannon and Weiner in 1948.

$$H' = -\sum_{i=1}^{s} \left[\frac{n_i}{n}\right] \mathrm{Ln} \left[\frac{n_i}{n}\right]$$

Evenness Index

The actual diversity value and the maximum possible diversity can be compared by a measurement the evenness value. Evenness usually ranges between 0 and 1.0.

For Hill's diversity number (1973),

Number 0: N_0 = S

Number 1: N_1 = $e^{H'}$

Number 2: N_2 = 1/D

The measure of bird species evenness or equitability (or relative species abundance) was determined by using the evenness index of modified Hill's ratio (1973).

$$E = \frac{\left[\frac{1}{D}\right]-1}{eH'-1} = \frac{N_2-1}{N_1-1} = \frac{N_2}{N_1}$$

Results

A total of 55 fish species belonging to 39 genera, 21 families and nine orders were recorded from Myinttha River segment during January to December 2019.

Species Diversity of Fishes

During the study period, a total of 31246 individuals were recorded from three study sites in Myittha River segment. While 10327 individuals belonging to 55 fish species were recorded from Site I, 10895 individuals and 10024 individuals belonging to 55 fish species were observed from Site II and Site III. According to the data recorded, 55 fish were occurred in all these three study sites (Table 2-4).

With respect to the most number of species and individuals collected per month from three study sites, the highest number of 48 species amounting to 855 individuals at Site I in September, 50 species with 1011 individuals at Site II in September and 49 species comprising 907 individuals at Site III were recorded in October. While the lowest 29 species with 737 individuals at Site I and 33 species representing 719 individuals at Site II in June and 28 species with 669 individuals at Site III in June were also observed (Table 2-4).

In this study, Simpson's index (D), and Shannon-Wiener's index (H') were calculated as diversity indices, which incorporated Hill's index, Margalef's were used to calculate the numbers of individual (N_1, N_2), evenness index (E) and species richness (d). Comparison of species richness, abundance, evenness and diversity of fish communities in three study sites for the whole study period were shown in (Table 5-9 and Fig 2-7)

At study Site I, the highest value for species richness (6.962) was recorded in September and the lowest value (4.241) was observed in May. The highest value for Simpson's index (0.028) was observed in February and in October while the lowest (0.044) was observed in June. The highest value for Shannon-Wiener's index (3.646) in October and the lowest value (3.197) were observed in June. The highest number of species (N1) was 38.735 in February and the lowest abundant value (N_1) was (24.463) in June. The highest very abundant value **(**N_2**)** was (35.436) in February. The lowest very abundant value (N_2) was 22.939 in June. The highest value for evenness value (0.949) in May and the lowest (0.909) was recorded in January (Table 5 and Fig. 2-7).

At study Site II, the highest value for Margalef's species richness index (7.082) was recorded in September and the lowest value (4.806) was observed in July. The highest value

for Simpson's index (0.027) was observed in October and the lowest (0.042) was observed in June. The highest value for Shannon-Wiener's index (3.674) in October and the lowest value (3.235) in June were recorded. The highest number of species (N1) was 39.416 in October and the lowest abundant value (N1) was (25.415) in June. The highest very abundant value **(**N_2**)** was (37.166) in October. The lowest very abundant value (N_2) was 23.790 in June. The highest value for evenness value (0.956) in December and the lowest (0.884) was recorded in January (Table 6 and Fig. 2-7).

At study Site III, the highest value for Margalef's species richness index (7.048) was recorded in September and the lowest value (4.150) was observed in June. The highest value for Simpson's index (0.045) was observed in June and the lowest (0.028) was observed in February. The highest value for Shannon-Wiener's index (3.639) in October and the lowest value (3.154) in June were recorded. The highest number of species (N1) was (38.070) in October and the lowest abundant value (N1) was (24.725) in May. The highest very abundant value **(**N2**)** was (35.390) in February. The lowest very abundant value (N2) was (22.466) in June. The highest value for evenness value (0.958) in May and the lowest (0.894) was recorded in January (Table 7 and Fig. 2-7).

Table 5 Monthly species richness, diversity and evenness of fish species in Site I

Month / Index	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total no. of species	43	47	42	30	29	30	33	37	48	47	43	38
Total no. of individuals	1111	1023	860	717	737	699	696	797	855	961	1014	857
d	5.989	6.637	6.068	4.411	4.241	4.428	4.889	5.389	6.962	6.698	6.068	5.479
D	0.034	0.028	0.033	0.041	0.042	0.044	0.040	0.034	0.029	0.028	0.030	0.034
H'	3.476	3.578	3.493	3.236	3.209	3.197	3.284	3.434	3.621	3.646	3.563	3.463
N1	32.345	38.735	32.876	25.426	24.742	24.463	26.686	31.001	37.379	38.310	35.277	31.919
N2	29.479	35.436	30.289	24.122	23.539	22.939	24.720	29.184	34.426	35.385	32.977	29.717
E	0.909	0.913	0.919	0.947	0.949	0.935	0.923	0.939	0.919	0.922	0.933	0.929

Table 6 Monthly species richness, diversity and evenness of fish species in Site II

Month / Index	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total no. of species	41	47	44	34	34	33	33	42	50	48	43	40
Total no. of individuals	956	1003	935	781	742	719	779	904	1011	1009	1033	1023
d	5.829	6.656	6.286	4.955	4.993	4.865	4.806	6.023	7.082	6.795	6.052	5.627
D	0.036	0.029	0.031	0.039	0.041	0.042	0.039	0.033	0.028	0.027	0.028	0.031
H'	3.432	3.625	3.548	3.297	3.265	3.235	3.296	3.497	3.646	3.674	3.607	3.533
N1	30.951	37.541	34.733	27.029	26.171	25.415	27.003	33.006	38.328	39.416	36.871	34.210
N2	27.476	34.298	32.313	25.444	24.585	23.790	25.446	30.432	35.591	37.166	35.116	32.754
E	0.884	0.911	0.928	0.939	0.937	0.933	0.940	0.920	0.927	0.941	0.951	0.956

Table 7 Monthly species richness, diversity and evenness of fish species in Site III

Month / Index	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total no. of species	44	45	46	37	30	28	32	42	46	49	43	38
Total no. of individuals	1149	975	905	729	697	669	691	766	867	907	879	790
d	6.102	6.393	6.610	5.461	4.430	4.150	4.741	6.174	6.652	7.048	6.196	5.546
D	0.032	0.028	0.030	0.038	0.042	0.045	0.041	0.033	0.030	0.029	0.030	0.034
H'	3.535	3.638	3.603	3.331	3.208	3.154	3.266	3.487	3.572	3.639	3.574	3.463
N1	34.310	38.000	36.713	27.979	24.725	23.441	26.205	32.675	35.573	38.070	35.653	31.909
N2	30.790	35.390	33.720	26.296	23.726	22.466	24.684	30.256	32.867	34.920	33.552	29.681
E	0.894	0.929	0.916	0.938	0.958	0.957	0.940	0.924	0.922	0.915	0.939	0.928

Table 8 Species richness, diversity and evenness of fish species in combined sites

Month / Index	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total no. of species	44	47	49	41	35	55	33	45	52	52	46	54
Total no. of individuals	3216	3001	2700	2227	2176	2087	2166	2467	2733	2877	2926	2670
d	5.324	5.745	6.075	5.189	4.424	7.065	4.166	5.633	6.445	6.403	5.638	6.718
D	1.000	0.942	0.907	2.146	33.292	61.438	91.651	0.957	0.823	0.857	0.978	1.000
H'	3.513	3.435	3.247	3.325	3.256	3.231	3.472	3.378	3.007	3.132	3.515	3.521
N1	33.543	31.033	25.716	27.799	25.946	25.302	32.200	29.314	20.230	22.912	33.608	33.821
N2	1.000	1.061	1.103	0.466	0.030	0.016	0.011	1.045	1.215	1.167	1.022	1.000
E	0.000	0.034	0.043	0.017	0.001	0.001	0.000	0.036	0.060	0.051	0.030	0.030

Table 9 Species richness, diversity and evenness of fish species in three study sites

Month / Index	Site I	Site II	Site III
Total no. of species	55	55	55
Total no. of individuals	10327	10895	10024
d	5.8426	5.8089	5.8614
D	0.0309	0.0305	0.0312
H'	3.6437	3.6422	3.6296
N1	38.2330	38.1757	37.6977
N2	32.3861	32.8019	32.0467
E	0.8430	0.8554	0.8460

Discussion

In the present study, a total of 55 fish species belonging to under 39 genera and 21 families distributed among nine orders was recorded in Myittha River segment during the study period from January 2019 to December 2019. The total number of fishes collected was 31246 individuals. Among the total number of species, Cypriniformes was dominant with Cypriniformes was the dominant Order with 22 species (40%), followed by 18 species of Siluriformes (32.73%), 8 species of Perciformes (14.54%), 2 species of Synbranchiformes (3.63%), while the Osteoglossiformes, Anguilliformes, Mugiliformes, Beloniformes and Tetraodontiformes were represented by one species (1.82%) only.

The highest number of 55 species amounting to 10327 individuals was recorded from Site I, 10895 individuals representing 55 species from Site II and 10024 individuals of 55 species from Site III. During the study period, the highest number of 48 fish species was recorded in Site I during September whereas the lowest number of 29 fish species in May. The highest number of 50 fish species was recorded in Site II during September whereas the lowest number of each 33 fish species in June and July. The highest number of 49 fish species was recorded in Site III during October whereas the lowest number of 28 fish species in June.

According to the diversity index, Margalef's index (5.8614) was the highest at Site III, followed by (5.8426) at Site I and (5.8089) at Site II. Simpson's diversity index (0.0305) was the highest at Site II, followed by (0.0309) at Site I and (0.0312) at Site III. In Shannon-Wiener's index (3.6437, 3.6422, 3.6296) was the highest at Site I, followed by (3.6422) at Site II and (3.6296) at Site III.

In this study, Simpson's diversity index (D) and Shannon-Weiner index (H') were applied to estimate fish species diversity. According to Simpson's diversity index, the value ranges 0 and 1. With this index 0 represents infinite diversity and 1, represents no diversity. That is, the bigger the value of (D), the lower the diversity.

Shannon-Weiner index (H') called Hetero geneity test, it was suggested that it combines the concept of number of species and relative abundance into a single concept of species heterogeneity, which is higher in a community when the species are equally abundant diversity (Ludwing and Reynolds, 1988).

According to Hill's diversity number, the highest abundant value N_1 (38.2330) was recorded in Site I, follow by (38.1757) and (37.6977) were in Site II and III. The highest very

abundant value N_2 (32.8019) was recorded in Site II followed by (32.3861) and (32.0467) was in Site II and III.

Alatolo (1981) reported that it is measured with a standardized index of species abundance (evenness or equitability) that is typically on a scale ranging from dominance to 1, which indicates equal abundance of all species or maximum evenness.

Mon Htwe Lwin (2010) also described that the total number of species, the total number of individuals and Margalef's index (d) of species richness were the highest in November and the lowest in May in Kaung Hmu Daw Lake, Sagaing Township during both of the study period. Margalef's index of species richness showed a seasonal pattern of variation, decreasing from February to May that may be a consequence of local factors, unfavourable environmental conditions and low level of water. In the present study, these findings agree with the present results of Site I.

Krabs (1978) stated that a greater number of species increase species diversity, and a more even or equitable distribution among species will also increase species diversity measured by the Shannon-Wiener's function. Dash (1993) also reported that the higher the value of H', the greater diversity. The maximum value of H' can be more than 1.

Nandar Lin (2016) described when three study periods were compared, total number of individuals and Margalef's index (d), Shannon-Wiener's index (H') and Hill's diversity number (N_1) in the third year are greater than in the first and second years but in the first year, Simpson's index (D), Hill's diversity number (N_2) and Hill's evenness index (E) are greater than in the second and third years. Therefore the first and third years are more diverse than the second year. This may be due to flooding in the second year although total numbers of species and individuals are higher than in the first year.

Freshwater fishes are much more diverse in tropical rivers and lakes (Krebs, 1978). Myittha River has the most diverse fish faunas in Myanmar. Therefore, they should be taken in protection of natural habitats and resources.

Acknowledgements

I am greatly indebted to Professor Dr Thant Zin, Head of Zoology Department, University of Mandalay, for his suggestion and permission to work on the present topic and for allowing to access the necessary facilities in the department. I also thanks to Professor Dr San San Myint and Professor Dr Moe Kyi Han, Department of Zoology, University of Mandalay, for their advice and encouragement.

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