ICHTHYOFAUNAL DIVERSITY AND SPECIES RICHNESS IN MYIT DAUNT GWAE IN (LAKE), MYINGYAN TOWNSHIP, MANDALAY REGION

Su Mon Kyaw[1], Naw Dolly Wilbur[2], Thin Thin Khaing[3]

Abstract

Diversity of fish fauna in Myit Daunt Gwae In (Lake) was studied from September 2017 to August 2018 in two sampling sites (western part of the In Site I and eastern part of the In Site II). In the present study, a total of 42 species confined to 29 genera, 17 families and eight orders were recorded. In Site I total number of 189254 individuals with 42 species and in Site II 149786 individuals with 42 species were recorded. Diversity of fish species was assessed by calculating the various diversity indices such as Shannon-Wiener's index (H'), Simpson's index (D), Margalef's index of species richness and Hill's diversity number (N_1), (N_2) and (E). Diversity indices varied among the two sampling sites according to the catch in terms of both the number of species and the number of individuals. The values of species richness and diversity indices were found to be higher in Site I than in Site II. On the seasonal basis, the highest value of diversity indices was observed in cold season at Site I and in rainy season at Site II. According to the number of fish species, individuals and diversity indices, the study area Myint Daunt Gwae In may be related to the suitable ecology of water body. So there is a need to continuous maintain the In (Lake) in order to protect and conserve the fish fauna to thrive in the In (Lake).

Keywords: Fish fauna, Diversity indices, Species richness, Myint Daunt Gwae In.

Introduction

Fishes are important elements in the economy of many nations as they have been a stable item in the diet of many people. They constitute slightly more than one-half of total number of approximately 54,711 recognized living vertebrate species; there are descriptions of an estimated 27,977 valid species of fishes (Nelson, 2006). According to Ehrlich and Wilson (1991) biodiversity is essential for stabilization of ecosystem, protection of overall environmental quality for understanding intrinsic worth of all species on the earth. Fish diversity 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.

Many fish species have become highly endangered particularly in rivers where heavy demand is placed on freshwater. However, the impact of the anthropogenic activities, habitat degradation, exotic species introduction, water diversions, pollution and global climate change are the main causative agents for the aquatic species rapid decline (Basavaraja *et al*., 2014). Species diversity of aquatic organisms in flood plains connected with large rivers is always large, because they can easily recognize the floodplain from the main river channels and other permanently aquatic habitats (Junk, 1996).

The floodplain environment also promotes species diversity due to its dynamic habitat structure (Junk, 1989). In the present study, the study area Myit Daunt Gwae In is also floodplain Lake of Ayeyawady River and plays a significant role in supplying fish as a source of protein and providing livelihood to the local people. The biodiversity and its conservation are regarded as one of the major issues of enabling sustainable use of natural resources and are essential for the Myit

[1] Lecturer, Zoology Department, University of Meiktila
[2] Dr, Professor (Retd), Zoology Department, University of Mandalay
[3] Dr, Associate Professor , Zoology Department, University of Myingyan

Daunt Gwae In . Thus, the present study was undertaken to evaluate and assess the species richness, diversity and evenness of fish fauna in Myit Daunt Gwae In.

Materials and Methods

Study Area

The study area Myit Daunt Gwae In is situated in Myingyan Township, Mandalay Region. It lies about 2 km away from Myingyan and is located between 21°24'56" to 21°25'12" N Latitudes and 95°19'53" to 95°21'48" E Longitudes. The study area was divided into two sampling sites. The Site I is western part of the In situated near the Kuwe Gyan Village and Site II is eastern part of the In situated near the Lin Gyi Village (Fig 1).

Study Period

The study period was conducted from September 2017 to August 2018.

Specimen Collection and Preservation

The specimen collection was carried out at two sampling sites on monthly basis throughout the study period. Fish specimens were collected with the help of local fishermen using different types of fishing gears. The physical appearance of fish was noted down and photographs taken immediately after capturing the fish. At least five specimens were collected and preserved in 5% or 10% formalin depending on the size of specimens.

Identification and Classification of Fish Specimens

Collected fish specimens were identified and classified according to Talwar and Jhingran (1991) and Jayaram (2013).

Data Analysis

To measure the species richness, diversity and evenness of fish species, four methods of diversity were applied: Margalef (1958), Simpson (1949), Shannon-Wiener (1948) and Hill (1973) as given in Ludwing and Reynolds (1988).

Species richness of fish species were determined by using the formula of Margalef's index (1958) as follows:

For Margalef's species richness index (1958),

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

Where, d = Margalef's species richness index

S = number of species

N = total number of individuals in the sample

This method incorporates the total number of individuals and it is the measure of the number of species present for a given number of individuals.

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

For Simpson's index (1949),

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

Where, D = Simpson's index

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

n = total number of individuals of all species

It ranges in value from 0 to 1. With this index, 0 represents infinite diversity and 1, no diversity. That is, the higher the value of D, the lower the diversity.

For Shannon-Wiener's index (1948),

$$H' = -\sum_{i=1}^{s} P_i(\mathrm{Ln}P_i)$$

Where, H' = Index of species diversity

S = number of species

P_i = the proportion of each species

ln = Natural Logarithm

$$P_i = \frac{n_i}{n}$$

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

n = total number of individuals of all species

A great number of species increase diversity, and a more even or equitable distribution among species will increase species diversity measured by Shannon- Wiener's function.

For Hill's diversity numbers (1973),

Number 0: N_0 = S

Where,

S = total number of species

N_0 = number of all species in the sample

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

Where,

H' = Shannon's index

N_1 = number of abundant species in the sample

Number 2: N_2 = $\frac{1}{D}$

Where,

D = Simpson's index

N_2 = number of very abundant species in the sample

Note that N_1 is always being intermediate between N_0 and N_2.

The effective number of fish species is a measure of the number of species in the sample where each species is weighed by its abundance.

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

$$E = \frac{\left(1/D\right)-1}{e^{H'-1}} = \frac{N_2 - 1}{N_1 - 1}$$

Where,

E	=	Hill's evenness index (which approaches zero)
D	=	Simpson's index
H'	=	Shannon's index
N_1	=	Number of abundant species in the sample
N_2	=	Number of very abundant species in the sample

Source: Google earth pro, 2018

Figure 1 Location map of study area

Results

Species Composition and Fish Species Recorded

In the present study, a total of 42 species confined to 29 genera distributed among 15 families and eight orders were recorded. Among eight orders, Osteoglossiformes, Beloniformes and Tetraodontiformes were each represented by a single species, genus and family. Clupeiformes was confined to two species, two genera and one family, while Cypriniformes was 15 species, ten genera and one family. Siluriformes was represented 12 species, seven genera and four families, whereas Perciformes was seven species, five genera and five families. The remaining order Synbranchiformes was three species, two genera and one family.

The percentage of fish species composition shown that order Cypriniformes was most dominant constituting 35.71% followed by order Siluriformes 28.57%, Perciformes 16.67%, Synbranchiformes 7.14%, Clupeiformes 4.76% and the remaining three orders namely, Osteoglossiformes, Beloniformes and Tetradontiformes were 2.38% each (Fig 2).

Species Richness, Diversity and Evenness of Fish Fauna

To get a better description of fish diversity, a measure of species richness and evenness of their distribution were undertaken during the study period. According to Margalef's species richness, in Site I the highest value of species richness (d = 3.735) was observed in November while the lowest value (d = 2.761) in April (Table 1, Fig 3). In Site II the highest value of species richness (d = 3.757) was recorded in October whereas the lowest value (d = 2.617) in April (Table 2, Fig 3).

During the study period, two diversity indices were calculated using Shannon-Wiener's diversity index (H′) and Simpson's diversity index (D). At Site I, the highest value of Simpson's index (D = 0.113) and Shannon Wiener's index (H′= 2.549) was found in December while the lowest value of (D = 0.278) and (H′= 1.899) was observed in May. In Hill's diversity number, the highest value of abundant species (N_1 = 12.807) and very abundant species (N_2 = 8.815) were observed in December whereas the lowest value of (N_1= 6.679) and (N_2 = 3.601) were recorded in May. The highest value of evenness (E = 0.664) was recorded in September and the lowest value (E = 0.444) in June (Table 1, Fig 3 and 4).

At Site II, the highest value of Simpson's index (D = 0.114) and Shannon Wiener's index (H′= 2.567) was observed in August whereas the lowest value of (D = 0.205) and (H′= 2.084) in April. The highest value of abundant species (N_1 = 13.024) and very abundant species (N_2 = 8.775) were observed in August while the lowest value of (N_1 = 8.034) and (N_2 = 4.868) were recorded in April. The highest value of evenness (E = 0.705) was recorded in January and the lowest value (E = 0.524) was observed in June (Table 2, Fig 3 and 4).

During the study period, the value of species richness, diversity and evenness was varied according to different season at both study sites. The highest value of Margalef's species richness (d = 3.869) and (d = 3.911) were observed in hot season while the lowest value (d = 3.543) and (d = 3.513) were found in rainy season at both study sites. At Site I, the highest value of (D = 0.114) was observed in cold season and (D = 0.119) was recorded in rainy season at Site II. The lowest value of (D = 0.161) and (D = 0.159) were recorded in hot season at both study sites. The highest value of (H′= 2.576) was found in cold season at Site I and (H′= 2.565) was observed in rainy season at Site II. At both study sites the lowest values of (H′= 2.286) and (H′= 2.304) were recorded in hot season (Table 3 and 4, Fig 5 and 6).

Hill's diversity number, (N_1 = 13.150), (N_2 = 8.770) and (E = 0.639) were found to be highest in cold season at Site I while (N_1= 12.996) and (N_2 = 8.362) were to be highest in rainy season and (E = 0.619) in cold season at Site II. At Site I, the lowest value of (N_1= 9.833) and (N_2 = 6.221) and (E = 0.591) was observed in hot season and the lowest value of (N_1= 10.016), (N_2 = 6.286) and (E = 0.586) were also recorded in hot season at Site II (Table 3 and 4, Fig 5 and 6).

Table 1 Monthly diversity indices evaluated on the number of fish species and individuals recorded in Site I during September 2017 to August 2018

Diversity indices	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Total number of species	36	40	40	38	35	34	33	24	29	28	28	34
Total number of individuals	38522	38232	34282	20246	12322	9102	7109	4145	3487	1671	1484	18652
d	3.315	3.696	3.735	3.731	3.609	3.619	3.608	2.761	3.433	3.638	3.697	3.356
D	0.122	0.117	0.117	0.113	0.129	0.139	0.163	0.192	0.278	0.224	0.154	0.116
H'	2.469	2.522	2.541	2.549	2.472	2.347	2.246	2.117	1.899	2.173	2.467	2.531
N_1	11.814	12.449	12.692	12.807	11.84	10.456	9.446	8.304	6.679	8.781	11.787	12.565
N_2	8.175	8.542	8.565	8.815	7.769	7.158	6.135	5.215	3.601	4.454	6.473	8.624
E	0.664	0.659	0.647	0.662	0.624	0.651	0.608	0.577	0.458	0.444	0.507	0.659

Table 2 Monthly diversity indices evaluated on the number of fish species and individuals recorded in Site II during September 2017 to August 2018

Diversity indices	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Total number of species	35	40	37	36	31	30	29	22	29	25	27	34
Total number of individuals	30562	32212	27404	15985	7776	6342	4840	3053	2311	1181	1280	16835
d	3.292	3.757	3.523	3.615	3.349	3.312	3.300	2.617	3.615	3.393	3.634	3.391
D	0.128	0.119	0.126	0.126	0.137	0.155	0.164	0.205	0.159	0.189	0.131	0.114
H'	2.451	2.509	2.499	2.505	2.299	2.269	2.239	2.084	2.323	2.214	2.516	2.567
N_1	11.593	12.296	12.174	12.244	9.966	9.665	9.385	8.034	10.209	9.149	12.378	13.024
N_2	7.826	8.349	7.968	7.948	7.319	6.468	6.111	4.868	6.251	5.273	7.654	8.775
E	0.644	0.651	0.624	0.618	0.705	0.631	0.609	0.549	0.570	0.524	0.585	0.647

Table 3 Seasonal diversity indices of fish species recorded in Site I from Myit Daunt Gwae In (Lake) during September 2017 to August 2018

Diversity indices	**Margalef's species richness**	**Simpson's diversity index (D)**	**Shannon-Wiener's diversity index (H')**	**Hill's diversity index (N_1)**	**Hill's diversity index (N_2)**	**Hill's evenness index (E)**
Hot Season	3.869	0.161	2.286	9.833	6.221	0.591
Rainy Season	3.543	0.117	2.572	13.092	8.516	0.623
Cold Season	3.546	0.114	2.576	13.150	8.770	0.639

Table 4 Seasonal diversity indices of fish species recorded in Site II from Myit Daunt Gwae In (Lake) during September 2017 to August 2018

Diversity indices	Margalef's species richness	Simpson's diversity index (D)	Shannon-Wiener's diversity index (H')	Hill's diversity index (N_1)	Hill's diversity index (N_2)	Hill's evenness index (E)
Hot Season	3.911	0.159	2.304	10.016	6.286	0.586
Rainy Season	3.513	0.119	2.565	12.996	8.362	0.614
Cold Season	3.618	0.121	2.546	12.759	8.273	0.619

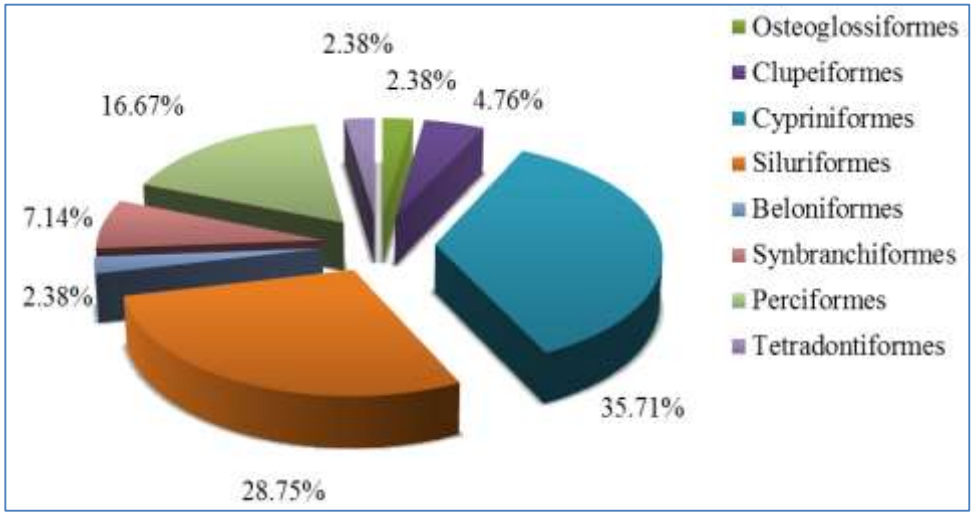

Figure 2 Percent composition of fish species in different orders in Myit Daunt Gwae In (Lake) during September 2017 to August 2018

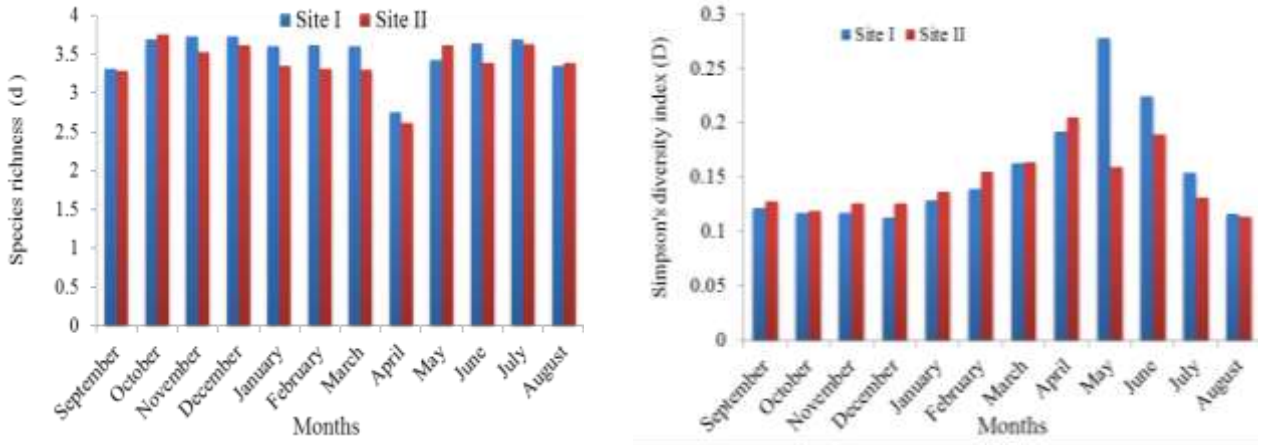

Figure 3 Comparison of the Margalef's species richness (d) and the Simpson's diversity index (D) between the two study sites during September 2017 to August 2018

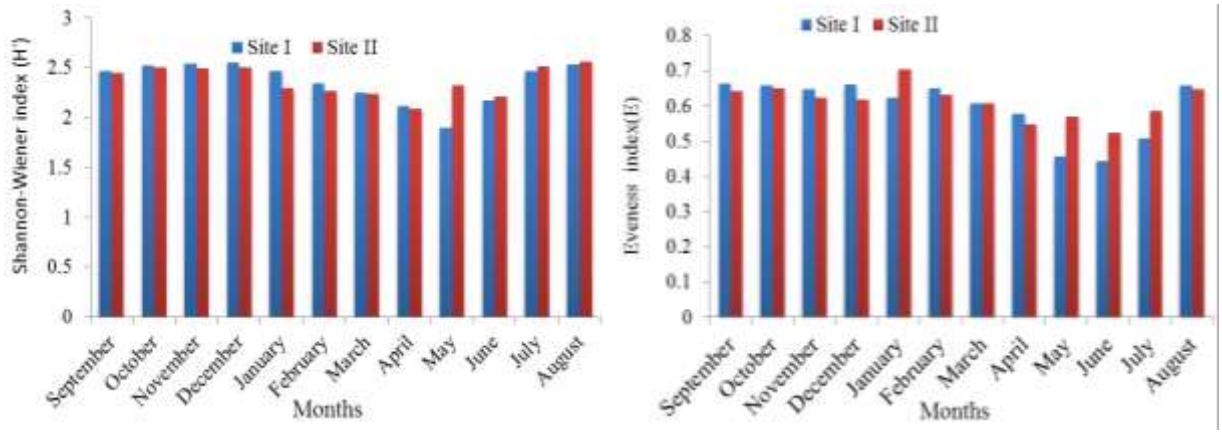

Figure 4 Comparison of the Shannon-Wiener's diversity index (H') and Hill's evenness index (E) between the two study sites during September 2017 to August 2018

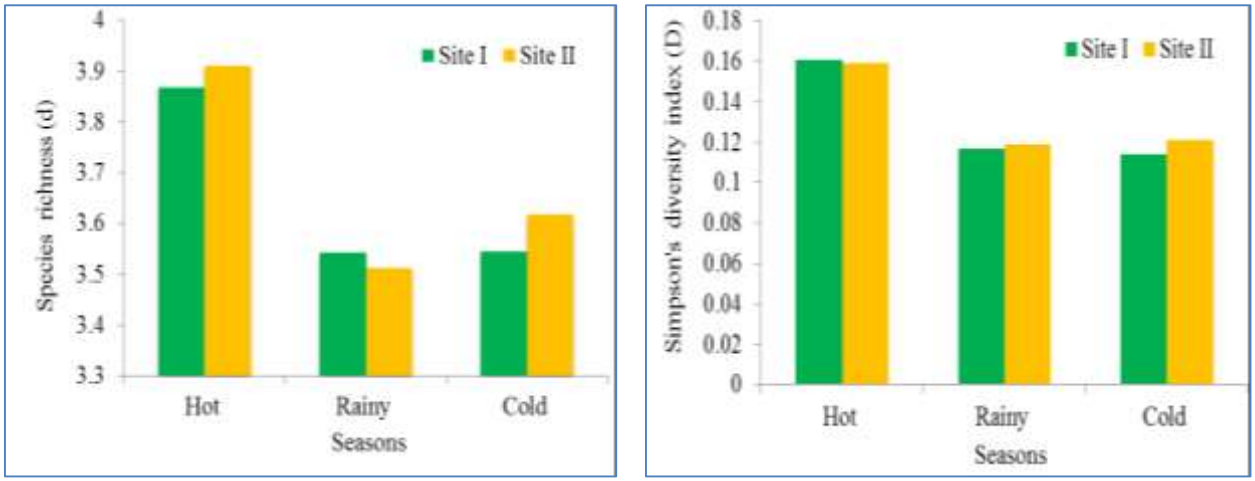

Figure 5 Seasonal comparison on Margalef's species richness (d) and Simpson's diversity index (D) of fish fauna in Myit Daunt Gwae In (Lake) during September 2017 to August 2018

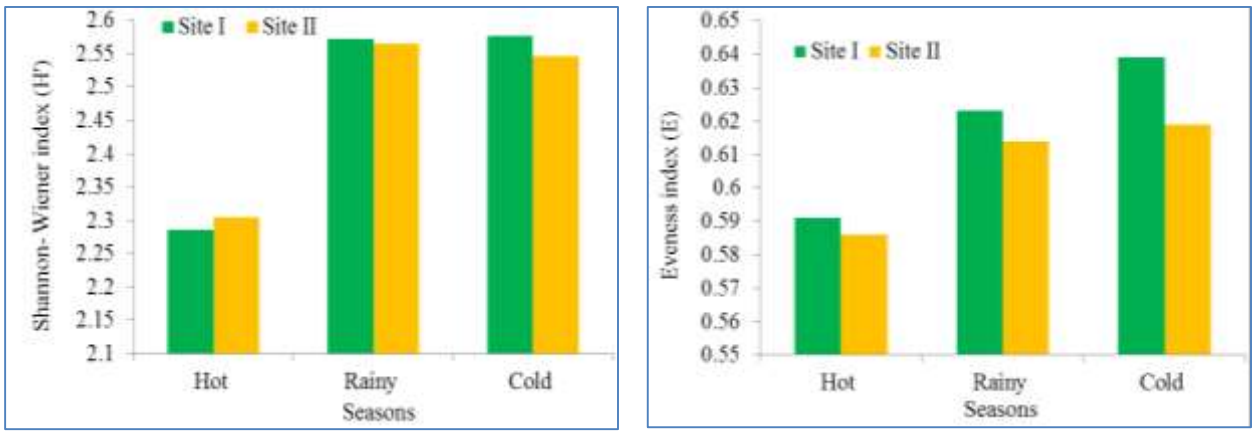

Figure 6 Seasonal comparison on Shannon-Wiener's index (H') and Hill's evenness index (E) of fish fauna in Myit Daunt Gwae In (Lake) during September 2017 to August 2018

Discussion

Biodiversity represents trophic status of an aquatic system. It is very essential to have a sufficient knowledge about fish faunal diversity and their present status because fish comprises the half of the total number of vertebrates in the world and they are the nutritional food source mainly the protein (Nath and Patra, 2017).

In the present study, a total of 42 species confined to 29 genera distributed among, 15 families and eight orders were recorded. In Site I total number of 189254 individuals with 42 species and in Site II 149786 individuals with 42 species were observed.

Magurran (2004) stated that biological diversity into two components; species richness and species evenness. Species richness measure that focus on the component of diversity. During the study period, Margalef's species richness (d) showed that it was highest in November at Site I and in October at Site II while lowest index was found in April at both study sites. A total of 40 species was observed in November and October at Site I and in October at Site II. The species richness was observed to be highest in November and October at Site I and Site II. It is assumed that this may be due to favorable condition such as sufficient water and ample food resources in these months for fish survival and aggregated in the In (Lake).

In the present study, species diversity was calculated by using two formulae indices, viz; Simpson's diversity index (D) and Shannon Wiener's index (H'). The highest value of (D), (H'), (N_1) and (N_2) were observed in December at Site I and in August at Site II. However, the lowest value of (D), (H'), (N_1) and (N_2) were recorded in May at Site I and in April at Site II. The highest value of (E) was observed in September at Site I and in January at Site II while the lowest in June at both study sites. When compare on the two sampling sites, species diversity was found to be higher in Site I than that of in Site II. This may be due to temporal variation and difference in their habitat types in the In (Lake).

According to Simpson's diversity index, the values range between 0 and 1 with this index 0 represents infinite diversity and 1, no diversity. This is the bigger the value of D, the lower the diversity. Hill's (1973) proposed a unification of several diversity measures in a single statistic while (N_1) is equivalent of Shannon diversity, (N_2) the reciprocal of Simpson's diversity. The value of Hill's evenness index (E) varied between 1 and 0. The closer to 1 the more even the population of fish that from the community.

In Myanmar, a clear defined hot season is from February to May, rainy season from June to September and cold season from October to January. On the seasonal basis, in the present study except Margalef's species richness (d), the values of (D), (H'), (N_1), (N_2) and (E) were observed to be highest in cold season at Site I. It may be due to healthy environment, water temperature, stable water environment and food available is optimal in this season for fish fauna. At Site II except Margalef's species richness (d), and Hill's evenness (E), the remaining diversity indices were found to be highest in rainy season. It is assumed that this may be due to during the rainy season, flood water of Ayeyawady River causes the entry of water with new stock of fish species from narrow channel near the Naung Bin village into the In where they utilize this habitat for their spawning and survival of larvae to adult. Thus the diversity of fish species may increase during the rainy season.

In the work of Htay Htay Sein (2010), described that the diversity was highest in rainy season in Lay- Eain- Su- Let- Kyar- In (Lake). Ni Ni Aye (2013) stated that diversity index was highest in cold season in the Synye In (Lake). Galib (2013), diversity and richness indices showed that diversity of fish fauna was higher in the winter months than other months. The maximum number of fish species was also recorded during this time. This is because, may be water depth

reduced to minimum due to lack of sufficient rainfall this time allowing fishermen to employ their fishing gears more effectively.

According to Nath and Patra (2017), determination of biodiversity has become very essential aspect to understand and express the condition of an ecosystem. In the present study, the results revealed that the number of fish species, individuals, fish faunal diversity and their production in Myit Daunt Gwae In may be related to the suitable ecology of water body. In order to maintain the species diversity it is essential to preserve the habitat in which the living assets thrive.

Acknowledgements

We express our thanks to Dr Ba Han, Rector and Dr Tin Tun Aung, Pro Rector, Meiktila University for their encouragements. Thanks are also due to Dr Thet Thet Tun, Professor and Head, Department of Zoology, and Dr Khin Aye Aye Htun, Professor, Department of Zoology, Meiktila University for their suggestions in preparing this paper.

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